CHAPTER 4

REVISION OF GUIDELINES VOL.1 PARTS B & C

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4.1 Discrepancies in the Current Catchment Strategy Reports

The following discrepancies were identified for correction upon revision of the existing catchment strategy reports.

(1) Outline of Catchment Study Report

This issue relates to the format of a catchment study report. While the current catchment reports contain a summary checklist of the catchment strategy reports, it does not include basic information such as catchment name and present connection PE.

(2) No Link between Sewerage Development Effects and Catchment Strategies

This issue relates to the content of the report. Current reports focus on the location of new STP sites, routes of new sewers, and the development of the sewerage system, but the effects of sewerage development on effluent-receiving rivers are neither mentioned nor examined. Therefore, the objectives for the sewerage system and its implementation are unclear.

(3) Current Analytical Approach for Catchment Strategies

This issue relates to the analytical approach of catchment plans. The current Guidelines show the general procedural scheme for developing sewerage catchment plans, but this scheme combines or blends what to do and what to consider. Since different developers use different approaches for catchment plans, comparing and evaluating these catchment strategies becomes complex.

(4) No Consideration for Local Water Conservation

This issue relates to constraints in identifying catchment strategies. The concept of local water conservation does not exist in the current Guidelines.

(5) No Quantitative Analysis on Sludge Management

This issue relates to financial analysis. Current catchment reports do not perform quantitative analysis on sludge management. Therefore, the evaluation of sludge management with the selected catchment strategy has no quantitative basis.

(6) Revenue is not considered in the NPV calculation, and O&M costs are calculated using a percentage of capital costs

These issues relate to financial analysis. Developers are currently requested (based on the Guidelines) to calculate NPVs of options only for capital and O&M costs. O&M costs are

often set as a certain % of capital costs. Therefore, in the event that an option is prioritised based on NPV, the option with the lowest capital costs tends to be assigned a higher priority. This is a reason for construction of more smaller-sized STPs in the catchment area.

4.2 Revisions Introduced into Guidelines Vol. 1

The following items have been proposed to address current discrepancies.

(1) Outline of Catchment Study Report

Inclusion of a summary sheet containing the outline of the study report in Part B *Section 3 The Structure of a Catchment Strategy Report* is recommended. Anticipated content is as follows:

- Catchment name
- Catchment area
- Water use conditions
- Population
- Number of water borne disease cases
- PE projection
- Connected PE
- No of water intake points
- Number of STPs without project and with project
- First STP commission year
- Number of upstream STP without project and with project
- Discharge pollution load per unit of area without project and with project
- Quality of received water without project and with project
- Reduced pollution load without project and with project
- Capital cost
- Total O&M cost
- Project net present value
- B/C value

In the summary sheet, results with the projects or without the projects are presented in order to compare the effect of sewerage catchment strategies.

Since this summary sheet is used not only for the catchment report but also for prioritisation of the catchment's projects, a re-evaluation of content will be conducted to reconcile the required data with the prioritisation after trial application of the manual for prioritisation.

(2) Link the Effect of Sewerage Development to Catchment Strategies

Use of BOD_5 pollution load as a major factor in considering sewerage development is

proposed. In formulating catchment strategies, current and future discharged BOD_5 pollution loads are calculated to show the effects of sewerage development. **Figure 4.2.1** shows an example usage of BOD_5 pollution load. The effect of sewerage development is expressed as a decrease in the BOD_5 pollution load.

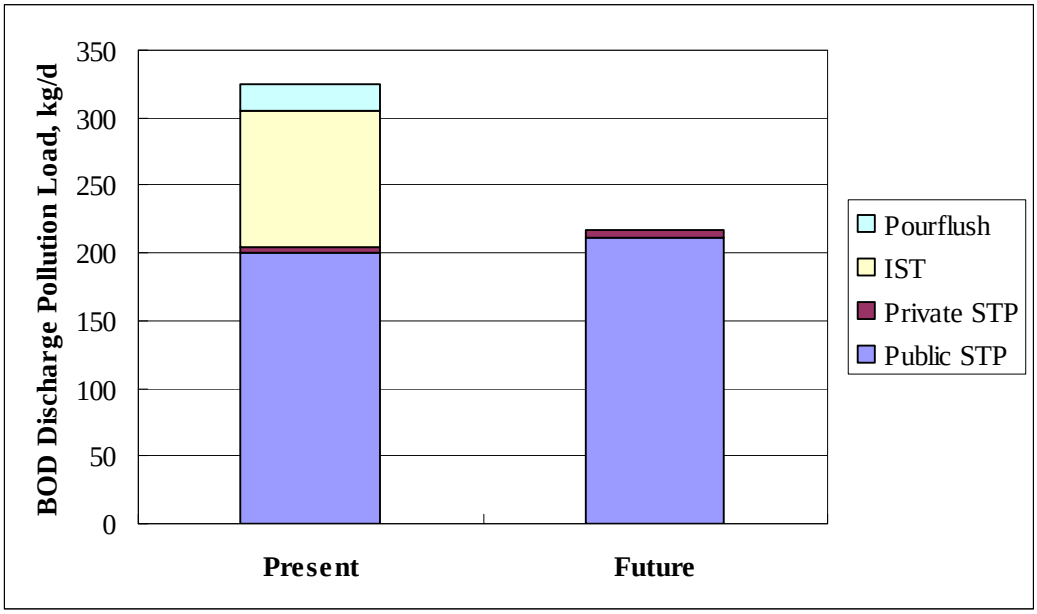


Figure 4.2.1 Example Usage of Pollution Load

The alternatives are evaluated by utilizing metrics measuring modified pollution load, such as pollution production load per unit of area, reduction of pollution load per unit of area, and cost per unit of reduced load. **Table 4.2.1** shows the example of alternatives described in **Appendix E**.

Table 4.2.1 Example Evaluation of Sewerage Alternatives

Zone	Pollution production load Kg as BOD_5/ha	Reduction in pollution load Kg as BOD_5/ha	Reduction cost RM/kg as BOD_5	Alternative
A	High	High	High	Decentralization
B	High	Low	Medium - Low	Decentralization or connection to another STP
C	Low	Low	High	On-site
D	High	High	Low	Connection to another STP
E	Low	Low	Low	Connection to another STP

(3) Analytical Approach for Catchment Strategies

The following scheme or steps are proposed to better analyse catchment strategies. See **Figure 4.2.2**.

- Identify planning area
- Define catchment boundaries
- Identify land use and development profiles
- PE forecasts
- Identify alternative sewerage strategies
- Technical, financial, and environmental evaluation
- Select and optimize sewerage system
- Staged implementation scheme

The first four steps are involved in collecting (and calculating) background information on the catchment study area. Alternative sewerage strategies are then formulated in this step by using background information. In the next two steps, technical, financial and environmental evaluations of each strategy (option) are conducted. Finally, the preferred option is implemented in phases.

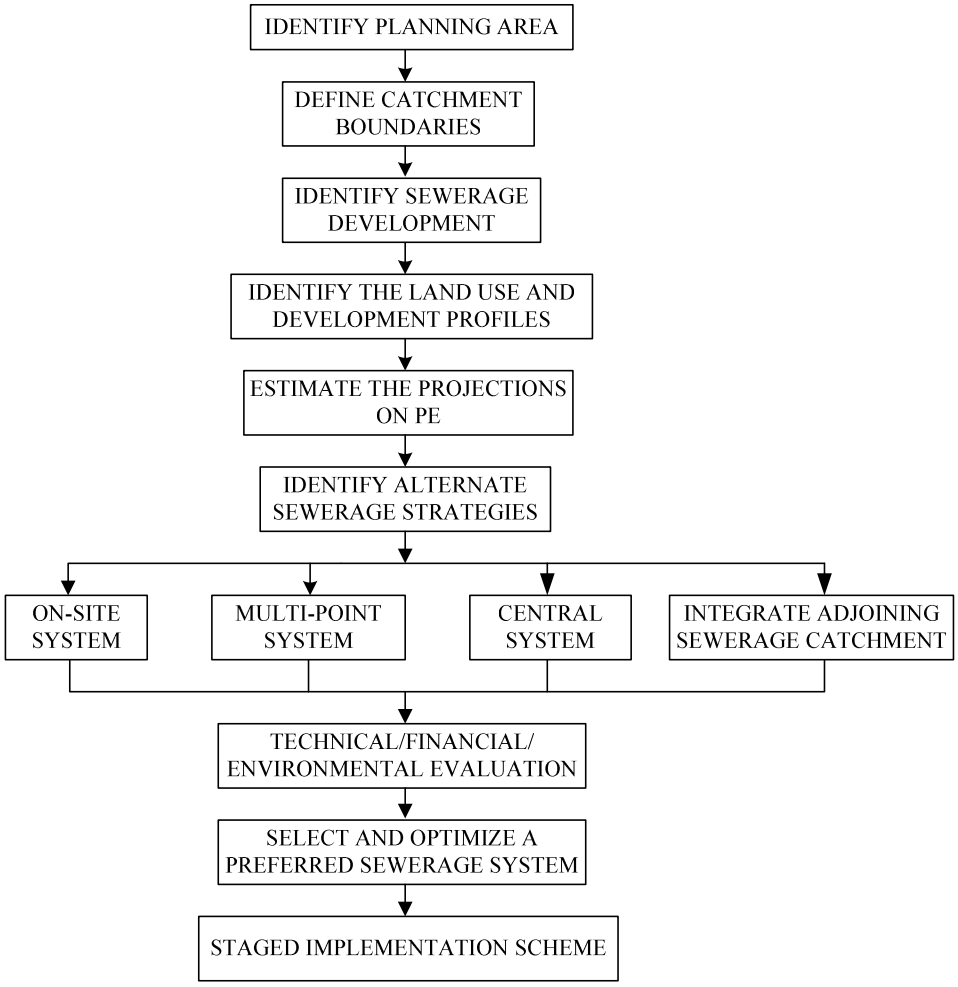


Figure 4.2.2 Analytical Approach for Identification of Appropriate Sewerage and Sludge Management Schemes

(4) Local Water Conservation

When river flow is low, the risk of river dry-out exists due to the change in the discharge point after sewage is collected at a single large STP. Therefore, introducing local water conservation efforts is recommended to prevent dry-out of the river due to the change in the discharge point of treated water in Section 6 Issues and Constraints. **Figure 4.2.3** shows an example of local water conservation.

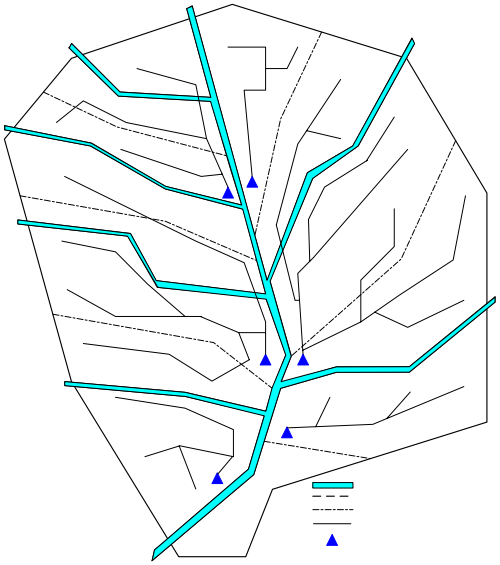
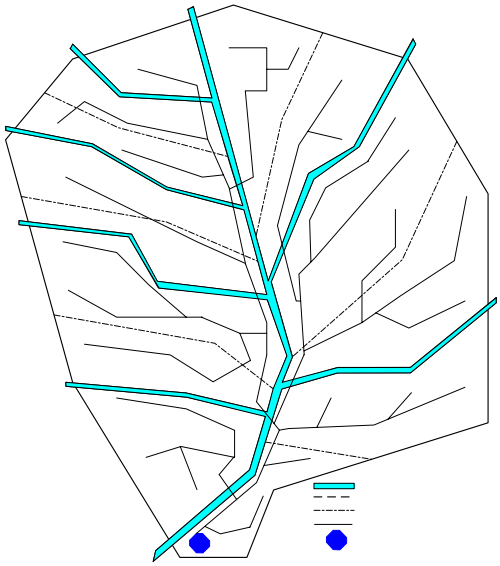
Multi-Point Discharge System	Centralized Discharge System
A multi-point discharge system favors a river with flow mostly composed of domestic sewage effluent.	A centralized discharge system favors a river with flow that does not rely primarily on domestic sewage effluent.
	

Figure 4.2.3 Example of Local Water Conservation

(5) Sludge Management

For purposes of quantitative analysis of sludge management, typical sludge production data and an example of sludge management alternatives are presented.

Sludge production is calculated based on the sludge generation rate as shown in Guidelines Vol. 4. **Table 4.2.2** presents the typical sludge production for mechanized plants included in Section 5.6 Sewage Sludge Quantification.

An example of sludge management alternatives is presented in Section 7 Identification and Assessment of Optional Sewerage Management Strategies to show how to analyse the sludge management. Onsite and centralized strategies are explained using schematic diagrams and financial considerations are presented (**Figure 4.2.4**).

Table 4.2.2 Typical Sludge Production for Mechanized Plant

PE	Produced sludge (m^3/day)	Dewatered sludge (m^3/day)
2,000	8.1	0.41
2,500	10.1	0.51
3,000	12.2	0.61
3,500	14.2	0.71
4,000	16.2	0.81
4,500	18.2	0.91
5,000	20.3	1.01
5,500	22.3	1.11
6,000	24.3	1.22
6,500	26.3	1.32
7,000	28.4	1.42
7,500	30.4	1.52
8,000	32.4	1.62
9,000	36.5	1.82
9,500	38.5	1.92
10,000	40.5	2.03
11,000	44.6	2.23
12,000	48.6	2.43
13,000	52.7	2.63
14,000	56.7	2.84
15,000	60.8	3.04
16,000	64.8	3.24
17,000	68.9	3.44
18,000	72.9	3.65
19,000	77.0	3.85
20,000	81.0	4.05
21,000	85.1	4.25
22,000	89.1	4.46
23,000	93.2	4.66
24,000	97.2	4.86
25,000	101.3	5.06
26,000	105.3	5.27
27,000	109.4	5.47
28,000	113.4	5.67
29,000	117.5	5.87
30,000	121.5	6.08

PE	Produced sludge (m^3/day)	Dewatered sludge (m^3/day)
31,000	125.6	6.28
32,000	129.6	6.48
33,000	133.7	6.68
34,000	137.7	6.89
35,000	141.8	7.09
36,000	145.8	7.29
37,000	149.9	7.49
38,000	153.9	7.70
39,000	158.0	7.90
40,000	162.0	8.10
41,000	166.1	8.30
42,000	170.1	8.51
43,000	174.2	8.71
44,000	178.2	8.91
45,000	182.3	9.11
46,000	186.3	9.32
47,000	190.4	9.52
48,000	194.4	9.72
49,000	198.5	9.92
50,000	202.5	10.13

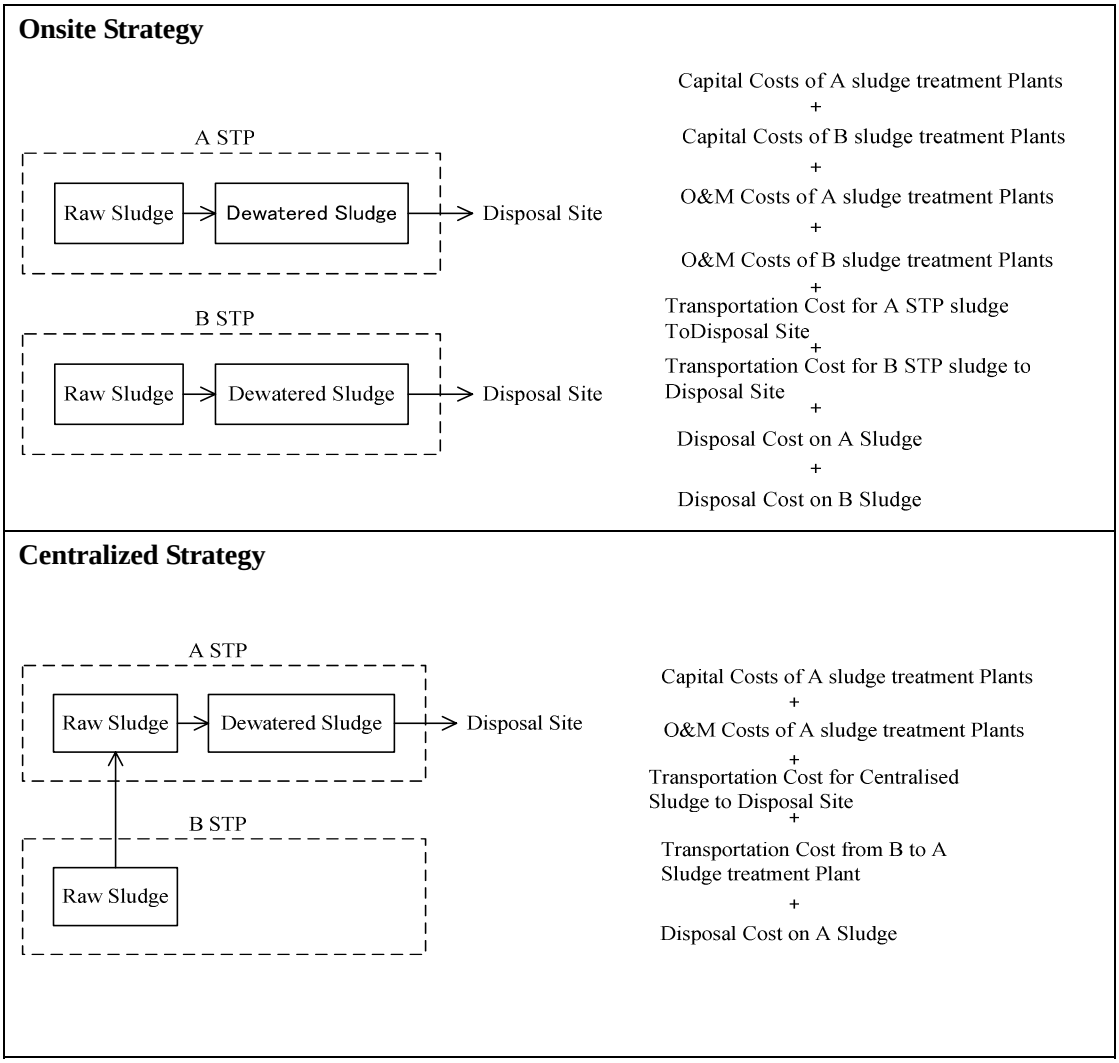


Figure 4.2.4 Example of Sludge Management Alternatives

(6) Financial Analysis

To improve financial analysis, the following tactics are recommended:

1) Introduction of tariff revenue in addition to costs for financial analysis
2) Proper setting of O&M costs for each treatment system

By introducing revenue and by estimating the O&M costs properly, the option of a larger STP may have a greater chance of selection as a priority project. Due to the STP's centralized and rationalised operations, there is a high probability that tariff revenue will increase in direct proportion to the capacity of the STP.

While O&M costs may also increase as STP capacity increases, they do so at a lower rate. These two approaches contribute to minimizing net loss over the lifecycle of the sewerage project.

Table 4.2.3 shows a comparison of two evaluation methods (with two option): the current financial analysis approach and the new method, which introduces revenue. In Option A, the developer plans to construct an STP in the catchment area; but in Option B, the plan is to connect to an existing STP outside the area (**Figure 4.2.5**). Under the present financial analysis, O&M costs are a percentage of capital costs. As a result, Option A, which has a smaller NPV, is selected as the priority project. Under the new financial analysis, the O&M costs of option B are lower than those of option A because it utilizes the existing STP. Revenue is the same for both options as they serve the same PE. However, option B, which has a larger NPV, is selected as priority project. This new financial analysis method is anticipated to contribute to the rationalisation of existing sewerage systems.

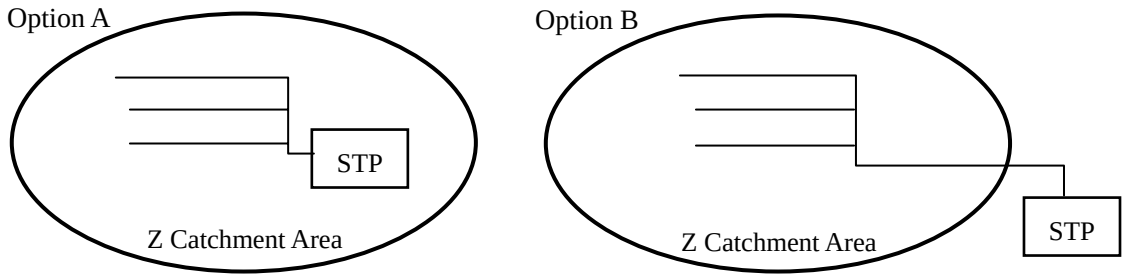


Figure 4.2.5 Options A and B for Comparison of Current and New Financial Analysis Approaches

Table 4.2.3 Expected Revenue and Expenditures

	Current Financial Analysis Approach			New Financial Analysis Approach			
	Capital cost	O&M cost	NPV	Capital cost	O&M cost	Revenue	NPV
Option A	100	10	**206.1**	100	15	10	-158.6
Option B	120	12	247.3	120	8	10	**-96.7**

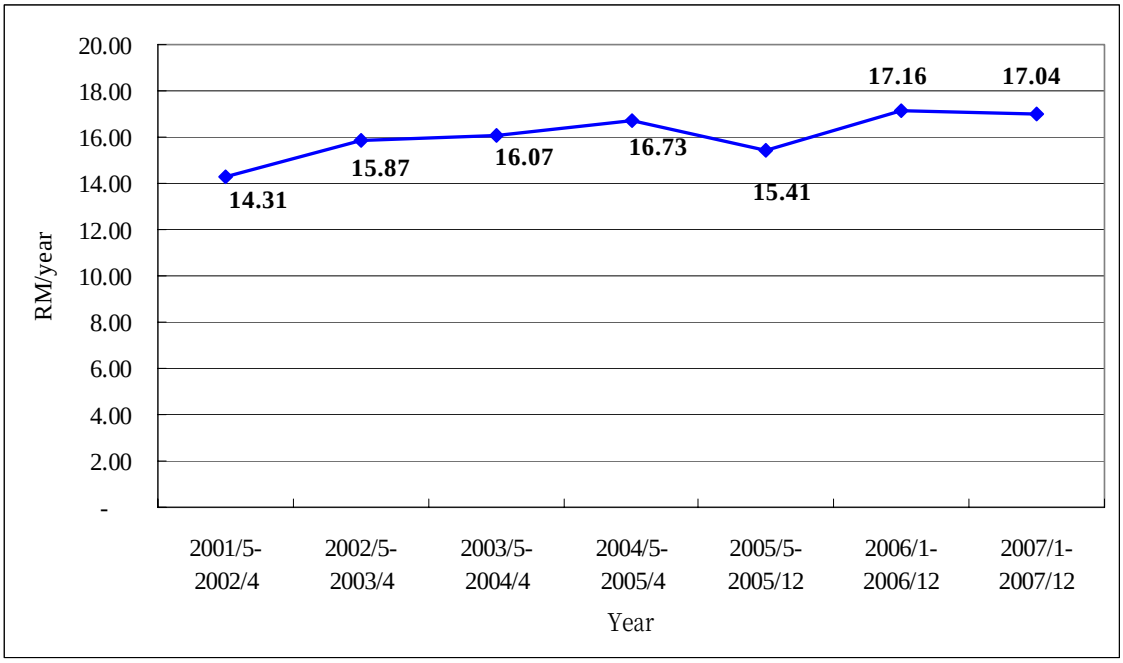
Notes: Figures are illustrative.
Under the new financial analysis approach, the option with higher NPV is given higher priority, since NPV is the present value of revenue minus cost. In other words, the new NPV approach is the required external budget input for the selected option.

In order to include revenue when performing financial analysis of the options, standardized unit tariff revenues are calculated and are described in the Guidelines as follows:

Figure 4.2.6 shows the average tariff revenue per PE unit based on the billed amount data for all types of customer and the total Population Equivalent for the period May 2001 to December 2007. This figure is presented in the Guidelines to calculate the tariff revenues of the options. Collection efficiency must also be considered to calculate revenue, since it is based on billed amounts.

Estimates of revenue and expenditures are put into the Revenue and Expenditure Stream in **Table 4.2.4**. The NPV of the difference between revenues and expenditures of each year is

calculated. B/C is also computed for reference. Financial evaluation is conducted by comparing the NPVs of all options.



Source: JICA Study Team, based on data provided by IWK

Figure 4.2.6 Average Sewage Tariff Revenue per PE Unit for the Last Seven Years

Table 4.2.4 Revenue and Expenditures Stream of Sewerage Catchment Strategy Option X

(Unit: RM in million)

Year		Expenditures				Revenue	Balance
		Construction	O&M	Replacement	Total	Total	
-2	2008						
-1	2009						
0	2010						
1	2011						
2	2012						
3	2013						
4	2014						
5	2015						
6	2016						
7	2017						
8	2018						
9	2019						
10	2020						
:	:						
30	2040						

Note: In this table, the construction period is assumed to be three years from 2008 to 2010, corresponding to years -2 to 0. The 30-year project period starts from 2011 when initiation of services is planned.

(7) Feedback on Trial Applications of Guidelines to Ipoh and Kota Kinabalu

Through trial applications of the Guidelines to Ipoh and Kota Kinabalu CSR preparation, the following findings and opportunities for revision emerged:

1) For tariff revenue calculation, it is almost impossible to calculate revenue by estimating the number of customers in each group and multiplying the results by the average tariff of each customer group (domestic, industrial, commercial, and governmental).

2) Therefore, it is not necessary to include the average tariff of each customer group in the Guidelines, and the table "Average Sewerage Tariff per Customer" was deleted from the draft Guidelines.

3) Also, to avoid confusion, "Revenue and Expenditure Stream" in the Guidelines should be revised to combine the two columns in "Revenue" (Domestic and Non-domestic) into a single "Total" column. (See **Table 4.2.4** illustrating reflection of the change.)

4) The draft Guidelines the described alternative tools of financial analysis to NPV analysis, rate of return on capital investments and average incremental cost. Nevertheless, these two methods were not utilized in past CSRs. Almost all of the CSRs utilized NPV analysis for financial evaluation. Considering the uniformity of analytical methods among CSRs, which would be compared for prioritisation purposes using the the Manual, these two methods were removed from the draft Guidelines.

5) It is very difficult for consultants to comply with requests to include the future sewerage capital contribution of the catchment in the revenue. This is due to the difficulty of estimating land area to be developed and future property values, including land values for which the SCC will be charged. Furthermore, the abilities of consultants are not sufficient to estimate the relevant property value at the time of CSR preparation. On the other hand, the SCC collected in the catchment is not currently utilized for the rehabilitation of the facilities in that catchment. It is not necessary to include SCC in revenue for financial analysis of the options.

Generally speaking, the introduction of the new approach to financial analysis can be made with few problems or difficulties. However, minor calculation mistakes were observed in financial analysis in steps to develop the final report. Important calculations should be reviewed upon receipt of the CSR by the certifying agency.

4.3 Examination of Revision Items Based on Results of Trial Application

This section explains the results of revisions proposed during the trial application of revised the Guidelines last year.

(1) Outline of Catchment Study Report

The summary sheet that was prepared for the trial study of Ipoh is shown in **Figure 4.3.1**. This sheet provides summarised data collated and included within a catchment report. It was found to be an effective means for understanding the outline of a catchment report and as a preliminary checklist for data availability.

However, information collected in a summary sheet is based on catchment-level information, which does not provide sufficient details on STPs, such as capacity and other data The summary sheet needs to be modified or further refined to include more detailed information, such as sub-catchment-level data.

Some information, such as complaints from the public, was found not to provide sufficient description or identification of the related STP or asset. In addition, details of waterborne disease were not readily available as they are seldom recorded and, moreover, may not be suitable for describing water pollution status because waterborne disease is no longer a threat in Malaysia due to improved hygienic conditions.

SUMMARY SHEET FOR SEWERAGE STRATEGY

(1) Catchment Name : Ipoh , Perak
(2) Catchment Area, km^2 : 407.42
(3) Water Pollution Status : Class II and Class III
(4) Water Use Situation

	Water Use, m^3/d
Drinking Water	155,896
Factory	81,364
Agriculture	99,998
Total	337,257

(5) Population :

2008	2010	2015	2020	2025	2030	2035
620,037	644,856	710,819	783,727	864,329	953,456	1,052,034

(6) Incident Situation of Waterborne disease, no :
(7) PE Projection :

2008	2010	2015	2020	2025	2030	2035
1,146,712	1,195,853	1,326,952	1,472,731	1,634,862	1,815,212	2,015,861

(8) Connected PE :

	Connected PE
Present (Year 2008)	134,872
Future (Year 2035)	2,015,861
without Strategy	269,744

(9) No. of Water Intake Points : 2
(10) No. of Complaints from the Public : No Information

Figure 4.3.1 Summary Sheet of Ipoh Sewerage Catchment Strategy Prepared in a Trial Application

SUMMARY SHEET FOR SEWERAGE STRATEGY

(11) Number of STP

	Public STP	Private STP	IST / CST	Pour Flush	Total
Present (Year 2008)	365	72	41,523	7,076	49,036
Future (Year 2035)	3	0	4,000	1,000	5,003
without Strategy	500	72	41,523	7,076	49,171

(12) First Works for Sewerage Provision : Yes

(13) Land Acquisition Status : 3 Regional Sites Acquired
(Reliability of Project Implements)

(14) No. of STP constructed before 1991 (Condition of Existing STP) :

	CST	IT	OP	AL	Standard A	Standard B
Present						

* Most STPs are not in compliance with effluent limit

(15) No. of Upstream STP :None

	Public STP	Private STP	IST/CST	Pour Flush	Total
Present (Year 2008)					
Future (Year 2035)					
without Strategy					

(16) Pollution Production :

	Public STP
Present (Year 2008)	60,616
Future (Year 2035)	112,888

(17) Discharge Pollution Load, kg/d :

	Public STP	Private STP	IST/CST	Total
Present (Year 2008)	11793.2	604.72	12016.1	24414
Future (Year 2035)	9031.57	0	0	9031.57
without Strategy	11053.9	604.72	12016.1	23674.75

Figure 4.3.1 Summary Sheet of Ipoh Sewerage Catchment Strategy Prepared in a Trial application (Cont'd)

SUMMARY SHEET FOR SEWERAGE STRATEGY

(18) Discharge Pollution Load per Area :

	Pollution Load/Area, kg as BOD/day/km^2
Present (Year 2008)	60.13
Future (Year 2035)	22.17
without Strategy	58.11

(19) Received Water Quality :

	Water Quality, mg as BOD/L
Present (Year 2008)	5.00
Future (Year 2035)	2.99
without Strategy	7.85

(20) Reduced Pollution Load

	Reduced Pollution Load, kg as BOD/day
Present (Year 2008)	36,651
Future (Year 2035)	103,857
without Strategy	89,213

(21) Promotion of Sludge Treatment :Yes

(22) Capital Cost

	Capital Cost, RM (million)
1st Stage	1,000
Total	3,694

(23) Total O&M Cost, RM (million) per year : 1,302.41

(24) Project Net Present Value, RM : -1,630.41

(25) B/C Value : 0.11

(26) Consideration for National Projects : Yes

Figure 4.3.1 Summary Sheet of Ipoh Sewerage Catchment Strategy Prepared in a Trial Application (Cont'd)

Based on the trial application, the following content was ultimately proposed in a summary sheet. **Figure 4.3.2** shows the modified summary sheet filled out for an Ipoh catchment study.

- Title of sewerage catchment strategy
- Details of STPs planned
- Number of STP
- Effluent discharge standard applied to planned STP
- Receiving water pollution status
- Population
- PE projection
- Connected PE
- Number of water intake points
- First-time work for sewerage provision
- Land status of STP
- Downstream water use condition (current)
- Number of complaints from the public on STP
- Production BOD_5 pollution load
- Inclusion of sludge treatment
- Cost
- Project net present value
- Special considerations

Summary Sheet for Sewerage Strategy (1/4)

(1) **Title of Sewerage Catchment Strategy**

Catchment Name	Ipoh, Perak
Title	The study on sewerage catchment strategy for Ipoh, Perak under the JICA study
Date of the report prepared	August, 2008

(2) **Details of STPs planned**

Name of STP	Ultimate Capacity, PE	Sub-Catchment Name	Sub-Catchment Area, Km^2
Papan	1,730,000	Ipoh	29.28
		Menglembu	100.59
		Gunung Rapat	65.20
		Bercham	91.14
Meru Raya	150,000	Chemor C1,4,5,7-13	62.35
Tanah Hitam	120,000	Chemor C2,3,6,14,15	58.83
Total	2,000,000		407.39

(3) **Number of STP**

Catchment		Public STP	Private STP	IST (PE)	Pourflush (PE)
Ipoh	Present	36	122	87,450	8,373
	Future	0	0	0	0
	w/o Strategy	36	122	87,450	8,373
Menglembu	Present	84	58	55,528	8,503
	Future	1	0	0	0
	w/o Strategy	84	58	55,528	8,503
Gunung Rapat	Present	100	0	32,794	4,700
	Future	0	0	0	0
	w/o Strategy	100	0	32,794	4,700
Bercham	Present	107	2	49,190	6,882
	Future	0	0	0	0
	w/o Strategy	107	2	49,190	6,882
Chemor	Present	38	6	40,992	6,922
	Future	2	0	0	0
	w/o Strategy	38	6	40,992	6,922
Total	Present	365	188	265,954	35,380
	Future	3	0	0	0
	w/o Strategy	365	188	265,954	35,380

Units of STP : Number

(4) **Effluent Discharge Standard applied to STP planned**

Name of STP	Name of receiving rver or stagnant water Bodies	Discharge Standard Applied	
Papan	Kinding River	River or Stagnant water bodies	Standard A or B
Meru Raya	Pari River	River or Stagnant water bodies	Standard A or B
Tanah Hitam	Kinta River	River or Stagnant water bodies	Standard A or B

Figure 4.3.2 Modified Summary Sheet of Ipoh Sewerage Catchment Strategy

Summary Sheet for Sewerage Strategy (2/4)

(5) **Receiving Water Pollution Status**

Name of STP	Concentration, mg/L		Pollution Status		Calculation
Papan	BOD_5	3	BOD_5 SI	87	BOD_5 SI
	NH_3-N	0.01	NH_3-N SI	99	for $BOD_5 \leq 5$, BOD_5 SI = 100.4 - 4.23xBOD_5
			WQI		for $BOD_5 > 5$, BOD_5 SI = 108*exp(-0.055X)-0.1xBOD_5
Meru Raya	BOD_5	8	BOD_5 SI	68	
	NH_3-N	0.01	NH_3-N SI	99	NH_3-N SI
			WQI		for NH_3-N ≤ 0.3, NH_3-N SI = 100.5-105xNH_3-N
Tanah Hitam	BOD_5	5	BOD_5 SI	81	for 0.3<NH_3-N<4, NH_3-N SI = 94*exp(-0.573X)-5*|NH_3-N-2|
	NH_3-N	0.01	NH_3-N SI	99	for NH_3-N≥4, NH_3-N SI = 0
			WQI		

(6) **Population**

Present and Future (every 5 year)

Name of Sub-Catchment	2007 (Exisiting)	2010	2015	2020	2025	2030	2035
Ipoh	225,364	236,182	255,076	275,482	297,521	321,322	347,028
Menglembu	162,542	173,758	193,740	216,020	240,862	268,561	299,446
Gunung Rapat	132,132	140,853	156,347	173,545	192,635	213,824	237,345
Bercham	59,311	63,582	71,211	79,757	89,328	100,047	112,053
Chemor	28,277	30,483	34,445	38,923	43,983	49,701	56,162
Total	607,626	644,858	710,819	783,727	864,329	953,455	1,052,034

(7) **PE Projection**

Name of Sub-Catchment	2007 (Exisiting)	2010	2015	2020	2025	2030	2035
Ipoh	230,708	241,782	261,125	282,015	304,576	328,942	355,257
Menglembu	256,629	274,336	305,885	341,062	380,284	424,017	472,779
Gunung Rapat	266,844	284,456	315,746	350,478	389,030	431,824	479,324
Bercham	230,320	246,903	276,531	309,715	346,881	388,507	435,128
Chemor	137,640	148,376	167,665	189,461	214,091	241,923	273,373
Total	1,122,141	1,195,853	1,326,952	1,472,731	1,634,862	1,815,213	2,015,861

(8) **Connected PE**

Name of Sub-Catchment	Present PE	Future PE (Ultimate PE)	PE w/o Strategy
Ipoh	101,353	355,257	101,353
Menglembu	178,722	472,779	178,722
Gunung Rapat	229,350	479,324	229,350
Bercham	173,248	435,128	173,248
Chemor	85,814	273,373	85,814
Total	768,487	2,015,861	768,487

(9) **Number of Water Intake Points**

Name of STP	No. of Upstream Water Intake	No. of Downstream Water Intake
Papan	1	0
Meru Raya	0	0
Tanah Hitam	1	0

(10) **First Works for Sewerage Provision**

Please mark Yes or No.

Name of STP	Existing of Sewerage Project in each Treatment Catchment	
Papan	(Yes)	No
Meru Raya	(Yes)	No
Tanah Hitam	(Yes)	No

Figure 4.3.2 Modified Summary Sheet of Ipoh Sewerage Catchment Strategy (Cont'd)

Summary Sheet for Sewerage Strategy (3/4)

(11) **Land Status on STP**

Please mark the status.

Name of STP	Status
Papan	Acquired (Y) / N) Gazetted (At present, Public or Private) (No Resettlement or Resettlement) Land Area: km^2 Land Lot No: Estimated Cost:
Meru Raya	Acquired (Y) / N) Gazetted (At present, Public or Private) (No Resettlement or Resettlement) Land Area: km^2 Land Lot No: Estimated Cost:
Tanah Hitam	Acquired (Y) / N) Gazetted (At present, Public or Private) (No Resettlement or Resettlement) Land Area: km^2 Land Lot No: Estimated Cost:

(12) **Downstream Water Use Situation (Present)**

Name of Water Intake or Irrigation Gate	Upstream Sub-Catchment Name	Name of River or Water Bodies	Volume of Intaking or Irrigation, m^3/d	Intake Water Closure Time, hrs/year
Intake Ulu Kinta	Bercham	Sg. Kinta	Not Available in This Time	Not Available
Intake sg.Tapah	Menglembu	Sg. Tapah	Not Available in This Time	Not Available

(13) **Number of Complaints from Public on Sewerage**

Last 3 years

Name of Sub-Catchment	STP related											
	Problematic or Critical Plants			Plants with O&G			Direct Discharge			Others		
	2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008
Ipoh	Not Available											
Menglembu	Not Available											
Gunung Rapat	Not Available											
Bercham	Not Available											
Chemor	Not Available											
Total												

Name of Sub-Catchment	Network									Others		
	Blockage			Collapse			Others					
	2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008
Ipoh	Not Available											
Menglembu	Not Available											
Gunung Rapat	Not Available											
Bercham	Not Available											
Chemor	Not Available											
Total												

(14) **BOD Pollution Load**

Name of STP	Production BOD Pollution, kg/d			Discharged Pollution, kg/d		
	Present	Future		Present	Future	w/o Strategy
Papan	55,132	97,579		13,231	7,806	20,338
Meru Raya	5,418	8,895		1,300	711	1,605
Tanah Hitam	2,289	6,413		549	513	1,157

(15) **Inclusion of Sludge treatment**

Please mark Yes or No.

Name of STP	Sludge Treatment Facilitie		Final Capacity m^3/day	(If no, Please write down the name of Sludge treatment plant)
Papan	(Yes)	No		
Meru Raya	(Yes)	No		
Tanah Hitam	(Yes)	No		

Existing Sludge treatment Facility

Name of STF	Present Capacity:m^3	Present Handling Volume:m^3	Treated Sludge Type
			wet or dry
			wet or dry
			wet or dry

Figure 4.3.2 Modified Summary Sheet of Ipoh Sewerage Catchment Strategy (Cont'd)

Summary Sheet for Sewerage Strategy (4/4)

(16) **Cost**

Name of STP	Capital	O&M	Total
Papan	2,953	1307.7	
Meru Raya	675	95.04	5,157
Tanah Hitam	66	60.08	

Unit:Million RM

(17) **Project Net Present Value**

Name of STP	NPV
Papan	
Meru Raya	-1,630
Tanah Hitam	

Unit:Million RM

(18) **Special Conditions**

Please describe any special considerations that need to be taken into account for immediate implementation of sewerage projects or that should be considered in devicing a strategy
For example, the closure of water intate happened frequently due to river water pollution or national sanctuary exists in a planning area.

Nothing

Figure 4.3.2 Modified Summary Sheet of Ipoh Sewerage Catchment Strategy (Cont'd)

(2) Linking the Effects of Sewerage Development to Catchment Strategies

The use of BOD_5 pollution load is proposed as a major factor in the consideration of sewerage development. The parameters for using BOD_5 load in a trial catchment strategy are shown in **Table 4.3.1**.

By using BOD_5 load, each option is evaluated quantitatively, which appears to be an effective means of using BOD_5 load as an evaluation parameter in sewerage catchment strategy.

Table 4.3.1 Comparison of Pollution Load for the Three Options (Prepared in a Trial Study of Ipoh)

Year 2035	Option-1	Option-2	Option-3
Incoming pollution load/ area (kg as BOD_5/d/km^2)	277.08	277.08	277.08
Discharged pollution load/ area (kg as BOD_5/d/km^2)	44.08	22.17	22.17
Reduced pollution load/ capital cost (kg as BOD_5/d/RM)	25.392	28.112	27.757

However, there could be issues in which scoring of some evaluation criteria, such as the importance of city/area or national projects involved, may generate the same results as options that are based within the same catchment area (**Table 4.3.2**).

Table 4.3.2 Evaluation Table of Ipoh Sewerage Catchment Strategy Prepared in a Trial Application

Evaluation Content	Weight	Option 1		Option 2		Option 3	
		Mark	Score	Mark	Score	Mark	Score
Importance of city/Area	15	80	12.0	80	12.0	80	12.0
Pollution load reduction	15	60	9.0	80	12.0	80	12.0
Water pollution status	10	70	7.0	70	7.0	70	7.0
Complaints from the public	10	50	5.0	85	8.5	90	9.0
River water use	10	50	5.0	50	5.0	50	5.0
Rationalisation benefit	10	60	6.0	100	10.0	100	10.0
First-time work for sewerage facilities	5	80	4.0	80	4.0	80	4.0
Cost	15	35	5.3	50	7.5	40	6.0
Inclusion of sludge treatment	5	60	3.0	90	4.5	90	4.5
National projects involved	5	30	1.5	30	1.5	30	1.5
Total	100	-	57.8	-	72.0	-	71.0

To resolve the above issue and to generate a useful score, use of the following parameters, which tend to differ for each option, are recommended for evaluations (**Table 4.3.3**).

- Total capital cost
- NPV
- Pollution load reduction
- Rationalisation benefit
- Inclusion of bio-solid treatment
- Flexibility of option
- Land status

(3) Analytical Approach for Catchment Strategies

An analytical approach using a standardized method for identification of appropriate sewerage and sludge management schemes is recommended to maintain the quality of and monitor the progress of sewerage catchment strategies. The analytical approach (**Figure 4.3.3**) has been modified based on the latest feedback. By following these schemes, the content of sewerage catchment strategies for different areas (i.e., Ipoh and Kota Kinabalu) in the trial could be kept largely consistent (**Table 4.3.4**). This approach seems to be an effective means of maintaining and monitoring the contents of a sewerage catchment strategy.

Table 4.3.3 Modified Evaluation Table of Ipoh Sewerage Catchment Strategy Prepared in a Trial Application

Evaluation Content	Weight	Option 1		Option 2		Option 3	
		Mark	Score	Mark	Score	Mark	Score
Total capital cost	30	9	27.0	9	27.0	9	27.0
NPV	20	5	1.0	9	18.0	7	14.0
Pollution load reduction	20	5	1.0	9	18.0	7	14.0
Rationalisation benefit	10	5	5.0	7	7.0	9	9.0
Inclusion of bio-solid treatment	10	5	5.0	7	7.0	9	9.0
Flexibility of option	5	9	4.5	9	4.5	5	2.5
Land status	5	9	4.5	9	4.5	9	4.5
Total	100	-	66.0	-	86.0	-	80.0

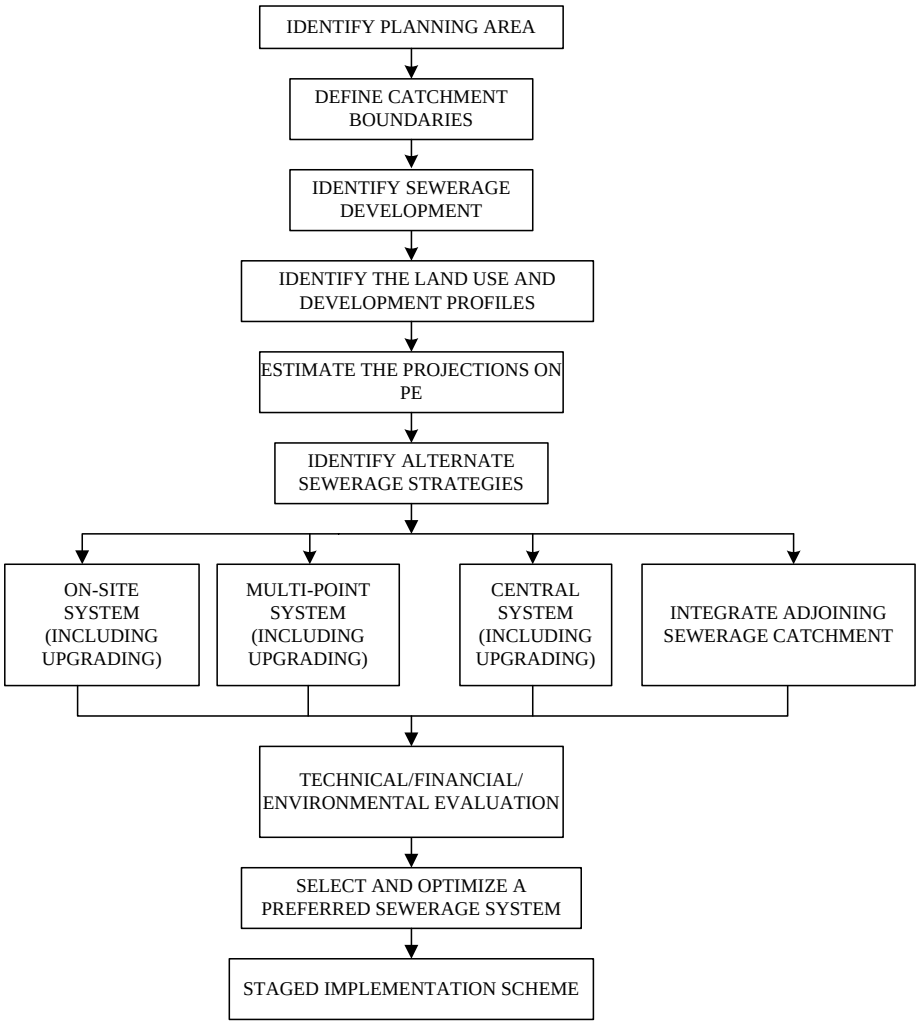


Figure 4.3.3 Analytical Approach for Identification of Appropriate Sewerage and Sludge Management Schemes

Table 4.3.4 Comparison of Ipoh and Kota Kinabalu Tables of Contents

Ipoh	Kota Kinabalu
CHAPTER 1: INTRODUCTION ・Background of the Study ・Study Area ・Demarcation of Study Boundary ・Study Objectives ・Review of Previous Sewerage Studies	**CHAPTER 1: INTRODUCTION** ・Background ・Study Area ・Study Objectives ・Review of the Investigation Report for the Kota Kinabalu Structure Plan ・ Review of the Kota Kinabalu Sewerage Masterplan and Feasibility Study by Engineering-Science, Inc. ・Review of the Inception Report by Perunding Era Daya Sdn. Bhd. ・Structure of the Study
CHAPTER 2: PHYSICAL DESCRIPTION OF THE PROJECT STUDY AREA ・Location of the Study Area ・Topography ・Geology ・Soil ・Drainage ・Water Catchment Areas and Water Intakes ・River Water Quality (2007) ・River Water Quality Monitoring Undertaken in this Study ・Potential Causes of River Pollution Load Improvement Measures Necessary	**CHAPTER 2: DESCRIPTION OF THE STUDY AREA** ・Location and Boundary of the Study Area ・Topography ・Drainage ・Environmentally Sensitive Areas ・General Geology and Soil Profile ・Influence of Water Intake Points ・Water Quality Monitoring Locations
CHAPTER 3: EXISTING SEWERAGE INFRASTRUCTURE ・Existing Sewerage Management Facilities ・Ipoh City Centre Catchment ・Menglembu Catchment ・Gunung Rapat Catchment ・Bercham Catchment ・Chemor Catchment ・Status of Existing Public Sewage Treatment Facilities ・Private Plants ・Public Sewer Networks ・Problematic Sewers ・Effluent from sources other than toilets ・Existing Regional STP Sites	**CHAPTER 3: SEWERAGE PROVISIONS** ・Introduction ・Description of Sewerage Catchments and Sub-catchments ・Existing Sewage Treatment Facilities in Kota Kinabalu City ・Existing Sewerage Provisions within the Study Area ・Assessment of STP Performance ・Problematic Public Plants ・Refurbishment of Public Plants ・Assessment of Sewer Network
CHAPTER 4: LAND USE PROFILES ・Existing Land Use ・Landscape and Recreational Areas ・Future Land Use ・Major Developments Proposed in Study Area ・Summary of Structure Plan Report for Ipoh ・Summary of Draft Local Plan Report for Ipoh	**CHAPTER 4: LAND USE AND DEVELOPMENT PROFILES** ・Introduction ・Land Use Profiles
CHAPTER 5: POPULATION LEVELS AND P.E. PROJECTIONS ・Preamble ・Basic for Population Levels and PE Projections ・Population Projections ・Population Equivalent Projection	**CHAPTER 5: POPULATION LEVELS AND P.E. PROJECTIONS** ・Preamble ・Population Projection Based on National Population Census ・P.E. Projection ・Selected Method of P.E. Projection

Ipoh	Kota Kinabalu
CHAPTER 6: SEWAGE FLOW PROJECTIONS ・Introduction ・Average Sewage Flow Projections ・Peak Sewage Flow Projections	**CHAPTER 6: SEWAGE FLOW PROJECTIONS** ・Introduction ・Average Sewage Flow Projection ・Peak Flow Sewage Projection
CHAPTER 7: SEWERAGE MANAGEMENT STRATEGY ・Introduction ・Categorization of Sub-Catchments ・Sewerage Catchment Strategies ・Pollution Load Computations ・Capital Cost for Sewerage Strategy Options ・Net Present Value Analysis ・Multiple criteria Evaluation Methodology ・Evaluation of Options and Selection of Preferred Option ・Implementation Programme ・Recommended Option – Option 2 ・Sewage Treatment Process Evaluation Basis ・Odour Control ・Project Benefits and Impact ・Environmental Impact on Existing Rivers for Recommended Option	**CHAPTER 7: SEWERAGE MANAGEMENT STRATEGY** ・Introduction ・Categorization of Catchments ・Sewerage Catchment Strategies ・Pollution Load Computations ・Capital Costs for Sewerage Strategy Options ・Net Present Value Analysis ・Evaluation of Options ・Selection of Preferred Option ・Recommendation ・Implementation Programme ・Proposed Work under the Project ・Recommended Sewage Treatment Process ・Project Benefits and Impact
CHAPTER 8: SLUDGE MANAGEMENT STRATEGY ・Introduction ・Sludge Management ・Source of Sludge ・Sludge Treatment Processes ・Overview of Existing Sludge Management Situation ・Existing and Projected Quantities of Sludge ・Projected Quantities of Transported Sludge ・Proposed Sludge Management Strategy ・Final Sludge Disposal ・Recommendation	**CHAPTER 8: SLUDGE MANAGEMENT STRATEGY** ・Introduction ・Sludge Management ・Sources of Sludge ・Sludge Treatment Process ・Overview of Existing Sludge Management Situation ・Existing and Projected Quantities of Sludge ・Projected Quantities of Transported Sludge ・Proposed Sludge Management Strategy ・Sludge Final Disposal ・Recommendation

(4) Local Water Conservation

Local water conservation is recommended to prevent drying out of the river due to the change in the discharge point of treated water. Only flow in the main stream, irrigational, and water intake points are measured. However, others in tributaries and small rivers are not measured. At present, the introduction of local water conservation measures into a sewerage catchment strategy appears to be difficult due to lack of river flow data. This concept should be applied in the future.

(5) Sludge Management

To allow quantitative analysis of sludge management, sludge production data and an example of sludge management alternatives were proposed.

Based on trial studies, sludge management alternatives are an effective way of evaluating quantitatively and of implementing wise sludge management taking into account sludge

transport (**Table 4.3.5**).

Table 4.3.5 Example of Staged Implementation of Sludge Management in Ipoh Trial Study (Transport of Sludge from Sub-catchment to CSTP in the Immediate Term)

Sub-catchments	Sludge treatment facility	Quantity of transported sludge
1. Chemor	Papan CSTF Tanah Hitam CSTF (Total capacity 560m^3/d, 14 hours of operation/day)	530m^3/ day
2. Bercham		
3. Ipoh City Centre		
4. Menglembu		
5. Gunung Rapat		

Sludge production is calculated based on the sludge generation rate, as shown in Guidelines Vol. 4 under revision. These production rates, which are based on mass balance, are the same as utilized in the United States and Japan. However, these differ from present production described in the current Guidelines (**Table 4.3.6**). It is necessary to address this difference in the staged facility capacity implementation, although the final sludge production in the target year is estimated by the revised new production rate for acquisition of sludge treatment sites.

Table 4.3.6 Comparison of Sludge Production

Treatment system	Sludge production under revision	Sludge production in the current Guidelines
Conventional sctivated Sludge	1.13 m^3/year/PE (=(250-20)×0.9/10^6×225/10^3/ 0.015 ×365)	0.500 m^3/year/PE
Extended seration or oxidation ditch	0.630 m^3/year/PE (=(250-20)×0.5/10^6×225/10^3/ 0.015 ×365)	0.400 m^3/year/PE
RBC	1.00 m^3/year/PE (=(250-20)×0.8/10^6×225/10^3/ 0.015 ×365)	0.510 m^3/year/PE

With respect to sludge disposal, reuse and incineration to reduce volume should be considered in the future because of recent disposal site problems, such as shortages of land and leachate issues. Nevertheless, the Guidelines must provide some solutions for the immediate and short term need.

In consideration of actual conditions of sludge disposal in Malaysia, two methods of disposal are recommended depending on health and safety factors and the disposal characteristics of sludge (dry or wet).. **Figure 4.3.4** shows final disposal methods.

Disposal methods are basically determined according to the moisture content of sludge.

Stable and well dewatered sludge (dry bio-solid) can either be utilized as a resource, for example, as soil cover after composting, or be disposed at a landfill after mechanical dewatering or trenching treatment. Wet sludge should be safely disposed at a landfill, which includes leachate monitoring and treatment.

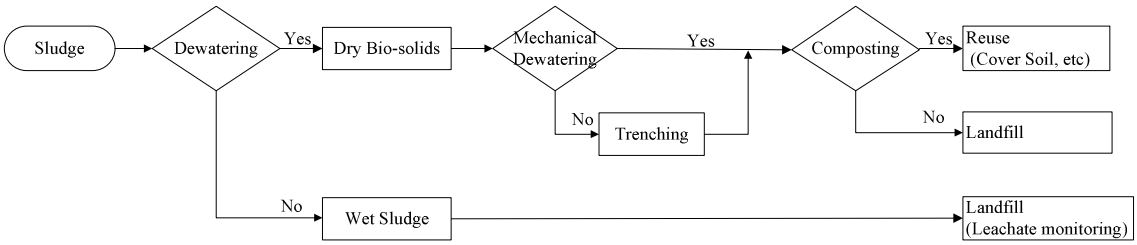


Figure 4.3.4 Final Disposal Methods

CHAPTER 5

REVISION OF GUIDELINES VOL.4

CONCERNING SLUDGE TREATMENT AND DISPOSAL

CHAPTER 5
REVISION OF GUIDELINES VOL. 4 CONCERNING SLUDGE TREATMENT AND DISPOSAL

The current version of Guidelines Vol. 4 has been reviewed with a special focus on sludge treatment and disposal. The draft of the revised Guidelines, as shown in **Appendix 5,** has been prepared in accordance with the viewpoints and ideas described below.

5.1 Unit Processes and the Combination of Unit Processes

Sewage sludge treatment is conducted to reduce sludge volume (moisture content reduction), decrease solid content and stabilize the sludge to reduce pathogens, eliminate offensive odours, and control the potential for putrefaction. The alternative unit processes corresponding to these treatment objectives are as follows:

Treatment objectives	Alternative unit processes
Reduce sludge volume	Thickening, dewatering and drying
Reduce solid content	Digestion and incineration
Stabilization	Digestion, composting and incineration

Sewage sludge treatment is a system of combined unit processes, and methods of selecting and combining unit processes is crucial to planning. The current Guidelines lack such consideration in selecting sludge treatment processes.

The typical sludge treatment flow relation to sludge disposal and reuse is shown in **Figure 5.1.1**.

Process 1 is considered when dewatered sludge is used for greenfields and farmland or used in reclamation projects. In this case, the process to reuse sludge for greenfields and farmland is inexpensive and simple with respect to final disposal, but poses safety risks from a bacteriological perspective. Stabilizing the sludge prior to disposal using digestion is recommended. There are also considerations to be made for odour and conveyance, which should be carefully studied with respect to impact on the surrounding environment. Risks and impacts must be mitigated or carefully managed, especially when natural dewatering systems are selected.

Process 2 should be considered when dewatered sludge is used as fertilizer after further processing for greenfields and farmland. The processed sludge is more favorable for greenfield and farmland application, since it can be converted into dry sludge, which is safer and easier to handle, through composting or mechanical drying.

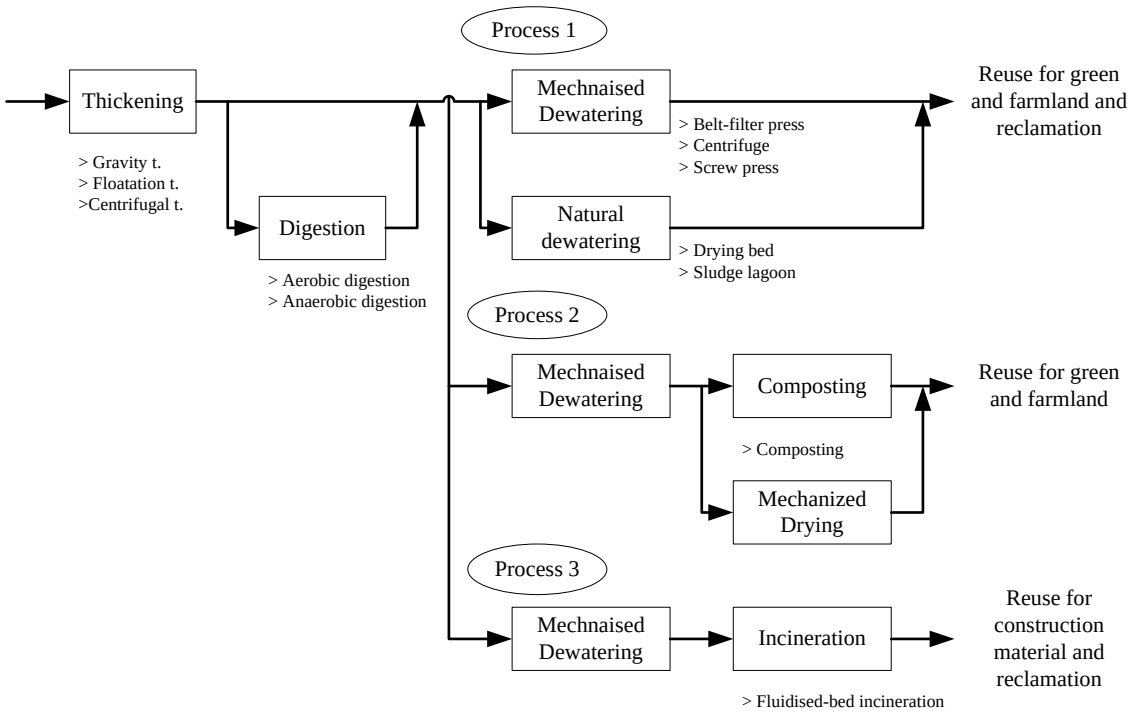


Figure 5.1.1 Typical Sludge Treatment Flow Related to Sludge Disposal and Reuse

Process 3 is considered when sludge is used in construction materials in ash or slug form or when dewatered sludge is incinerated for use for reclamation purposes. In particular, sludge has been reused as construction material, raw material for cement, soil improvement agent, road-base material, light aggregate, brick, tile, permeable concrete block, concrete aggregate, and clay pipe, among others. Sludge can also be used for reclamation for both marine and inland applications.

5.2 Unit Processes Included in the Guideline

Figure 5.1.1 also shows the unit processes described in the draft Guidelines, which are internationally-accepted and commonly-used throughout the world, although there are many unit processes other than described here. Some processes, such as sludge incineration, have not yet been adopted in Malaysia, but are included here with the anticipation that they will be required in the near future, taking into account the present situation of sludge treatment and disposal.

5.3 Methods for Determining Quantity and Dimensions of Facilities and Equipment

The purpose of this revision in the Guidelines is to provide information on how to determine the

quantity and dimensions of facilities/equipment required for the preparation of a layout plan, cost estimates and land requirement estimates. The current Guidelines are not clear on this matter.

The design criteria are given for sludge thickening, digestion, dewatering, drying, incineration and composting facilities and the layout examples of sewage treatment plants with sludge treatment facilities selected from the JBIC project are shown for reference.

5.4 Emerging Sludge Treatment Technologies

The following new technologies are introduced in the Guidelines, anticipating that they will require sewage sludge treatment and disposal in Malaysia will encounter in future. Naturally, the adoption of any new applications should be based factor in the quantity and quality of sewage sludge to be collected, construction and O&M costs, economy, ease of O&M, safety, the surrounding environment, and other factors.

(1) Pipeline Conveyance System for Sewage Sludge

Although sludge is generally transported by a tanker, this method will place a heavy burden on operations and maintenance due to increasing sludge volume, traffic,(especially in urban centres), and manpower requirements, among others. Pipeline systems are also considered to be effective means of conveying sewage sludge.

(2) Mobile Sludge Dewatering Vehicles

In Malaysia, one practice is to transport sewage sludge by tanker for desludging at widely dispersed sewage treatment facilities. An alternative to centralized treatment of sewage sludge is decentralized sewage sludge treatment using a mobile sludge dewatering vehicle.

(3) Composting

There are various forms of treated sewage sludge that can be disposed in greenfields and farmland: raw sludge, compost, dried sludge, dewatered sludge, and incineration ash, among others. However, composted sewage sludge is preferable in terms of fertile matter content, handling and hygienic aspects,.

(4) Sludge Incineration

Sludge volume can be substantially reduced through combustion of the organic matter in dewatered sludge and evaporation of water content, with ash or inorganic matter remaining as a combustion byproduct. Sludge incinerators may be classified as fluidized bed incinerators, multiple-hearth incinerators, step grate stoker furnaces and rotary kilns based on structure. Fluidized bed incinerators have been adopted in most recent projects.

CHAPTER 6

RECOMMENDATIONS FOR IMPROVEMENT OF PLANNING CAPABILITY IN THE SEWERAGE SECTOR

CHAPTER 6 RECOMMENDATIONS FOR IMPROVEMENT OF PLANNING CAPABILITY IN THE SEWERAGE SECTOR

In this report, planning capability improvement is viewed as a process by which individuals, organisations, institutions and societies develop abilities to perform functions, solve problems and set and achieve objectives.

This definition brings to the forefront two important features of capability improvement:

1) First, capability improvement is not a one-time event, but rather a continuous process in which prevailing capacity needs should be identified and training and educational activities developed and implemented to address these needs.

2) Second, capability improvement involves a concerted effort at multiple levels. Capability improvement or development is not just a question of training and educating professionals in the sector, but also requires activities to be undertaken in the institutional environment in which an organisation operates and in the organisation itself.

(1) Revised Guidelines and Manual for Prioritisation

The draft Manual and revised Guidelines were prepared, and the former was applied to the sewerage catchments collected from the existing CSRs and LSPs as well as the report for Upper Langat Basin, while the latter was applied to the formulation of CSRs for Ipoh and Kota Kinabalu. In the course of such trial applications, the draft Manual and revised Guidelines were improved, but various problems were also identified in the existing CSRs and LSPs. The solutions to these problems are anticipated to contribute to the strengthening of sewerage planning capability and further improvement of the draft Manual and revised Guidelines. Therefore, it is recommended that the Malaysian side implement these solutions.

1) The data in catchment strategy reports must be indicated on a sewerage planning unit basis. In the report, catchments/sub-catchments are first set based on topography, administrative boundaries, river-basins, and other factors, but attention should be paid to the fact that such division may not necessarily correspond to the sewerage system that is finally adopted. Some of them may be integrated into one CSTP system or further divided into sewerage planning units that are covered by the respective STP systems. For integrated sewerage systems, design population, area to be sewered, information on existing STPs/ISTs involved, construction costs, and other factors must be clarified on as an independent system as well as the sub-divided systems in the latter. Otherwise, the Manual for prioritising sewerage catchments/projects will not be applicable.

2) DOE's water quality monitoring stations, WIPs, intake points for irrigational use and sewage effluent discharge points must be indicated on the same map during the the catchment strategy study in order to clarify their physical relationship as shown in **Figure 6.1**. After submission of the catchment strategy report, it is difficult for third parties to identify such physical relationship. The best approach to this issue may be to have the planner request that the office holding the relevant maps required for the study plot the locations of these project features.

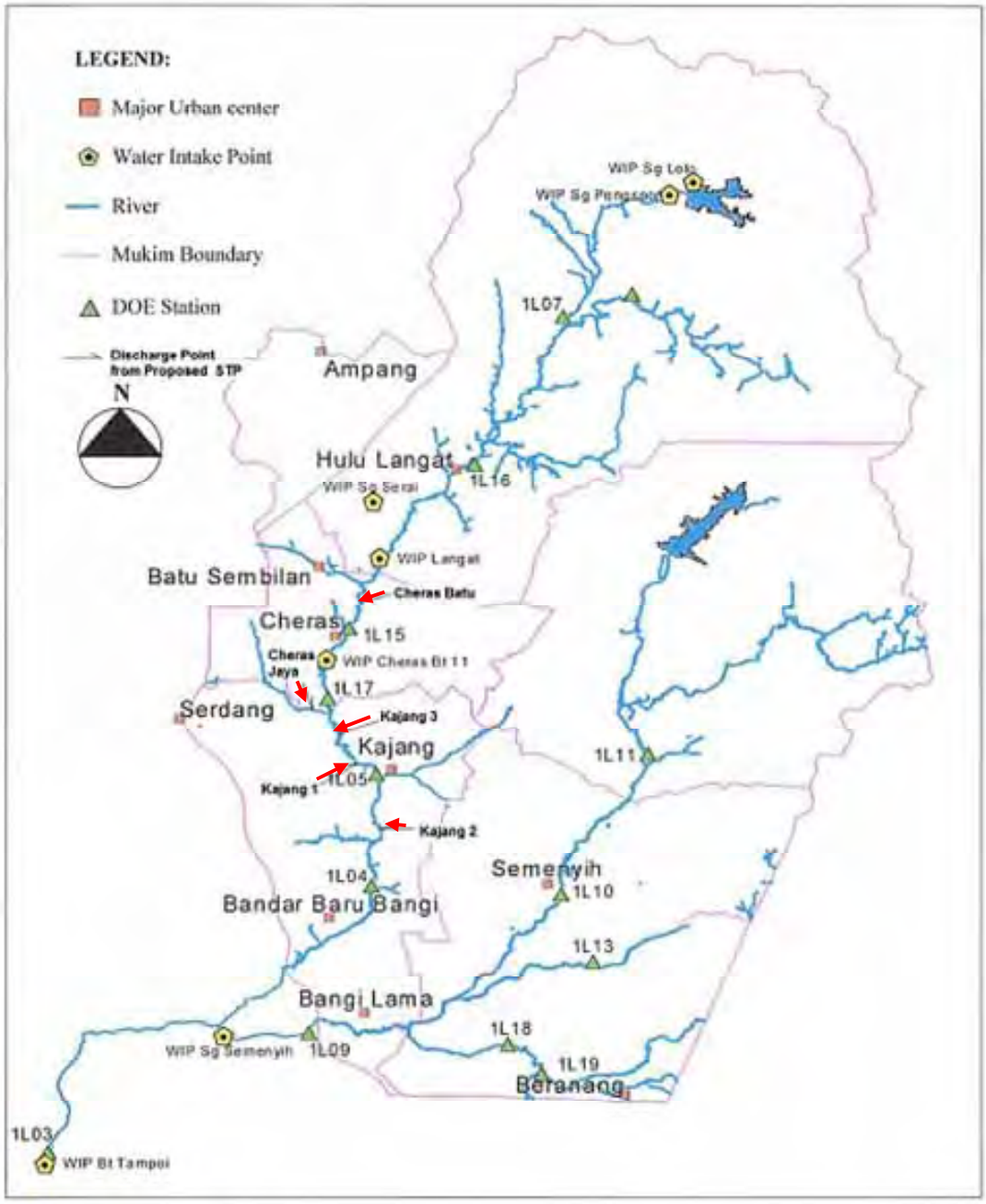


Figure 6.1 Example Map Showing Locations of DOE Monitoring Stations, WIPs for Water Supply and Discharge Points for Sewage Effluent from Proposed CSTPs

3) In most existing catchment strategy reports, the target year is 2020, and, moreover, most of reports do not reflect the results of the 2000 census population. In contrast, most recent reports have a target year of 2035, making it difficult to make comparisons among the reports. In a few years, 2020 will no longer be a suitable target year. Review of existing catchment strategy reports, especially by local authorities in areas anticipating a rapid increase in population, is strongly recommended.

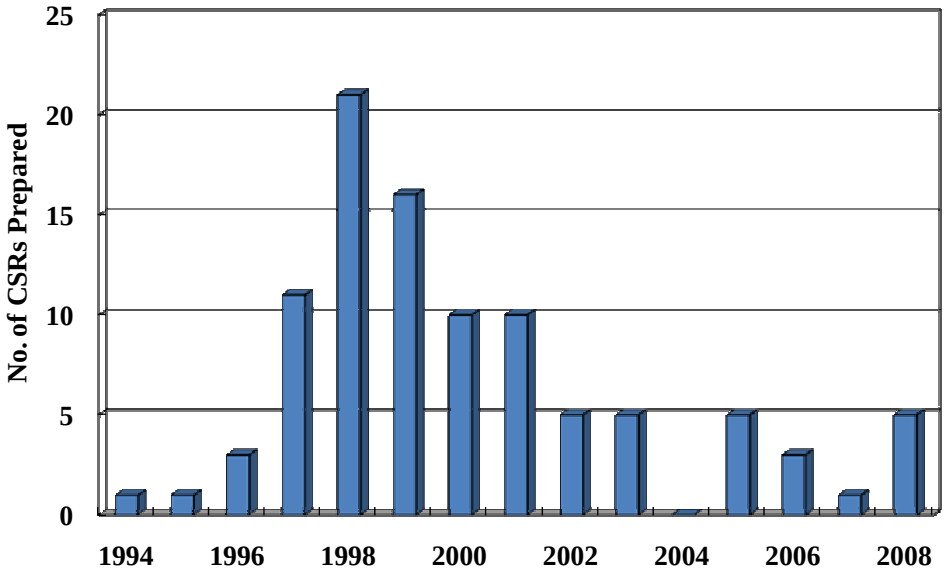


Figure 6.2 Catchment Strategy Reports Prepared

Note: Based on CSRs maintained in the Planning Division of SSD. This is not a definitive record, but reflects only an approximate level of report preparation.

4) The population projection section of existing catchment strategy reports, contain only design PE projections and do not include any description of design population. Design population must be clarified at the catchment/sub-catchment level with a firm projection, since it is used to verify the reasonableness of the projected design PE. Since design PEs are always shown in the report, the growth rate of design PE may be an option to evaluate the importance of an area, but it is not recommended due to a tendency to overestimate design PE.

5) The data pertaining to an area to be sewered is relatively disregarded in Malaysia and currently not available in many catchment strategy reports. The population and area data should always be considered together in sewerage planning to allow the development of new indicators. Attention should not be limited to area data, but should also paid to data that might be required in the future.

6) When a catchment strategy is endorsed among the relevant agencies, it is recommended that IWK begin to arrange the existing data on the sewerage planning unit basis as well

as the registration of new STPs, including complaints related to existing STPs. It is helpful to collect the relevant data upon prioritisation of the sewerage projects.

7) It is not clear what methods the consultants or planners used to estimate the construction costs in the reports, reducing the reliability of the data. Although the revised Guidelines recommend the collection and arrangement of construction cost, it is important to elevate the reliability of the planning content. Currently, the use of the increased weighting on investment efficiency for prioritisation may not be suitable for sewerage catchments. In prioritising sewerage projects at the implementation size, the application of increased weighting on investment efficiency is considered to be significant since it is expected that the construction costs would be estimated under certain rules.

8) The action plan shown in **Figure 6.3** has been proposed to solve the problems mentioned above. Until now, approximately 100 CSRs have been prepared, but there is no information that summarizes the content. Data collection and arrangement was done by the JICA study data for the CSRs for 24 areas in ascending order from the latest reports in addition to those for Upper Langat and Iskandar. It is recommended that IWK, which competently maintains past reports, will assume these tasks so as to provide complete coverage of all reports and develop a database. Centralizing report management with IWK will lead to further identification of problems in the existing CSRs while the database will be a useful tool for selecting CSRs to be reviewed. As many existing reports set the target year in 2020, they should be intensively reviewed every five years.

   As it is better to prepare the location map showing DOE monitoring stations, WIPs for water supply and irrigational use and discharge points of sewage effluent from the proposed CSTP in the course of the study for catchment strategy, this work should be added to the Terms of Reference (TOR) for the study, as well as the preparation of a summary sheet in the earliest time. Another option would be for SPAN, the regulating agency for water supply operators, to request that DOE, DID and other relevant authorities submit materials, rather than making this request of third parties.

   The revised Guidelines are expected to be published by SPAN in the middle of 2009. The review or formulation of the CSRs using the new Guidelines as ordered by SSD will be jointly checked by SSD, SPAN and IWK, and the CSRs to be submitted by private developers will be instructed by IWK or the certifying agency.

   IWK has a database of existing sewerage facilities and relevant data. It is recommended that such data be classified and arranged in line with the sewerage systems proposed in

the CSRs, when it will be endorsed by the stakeholders.

Results from the 2010 census will likely be available two years later. By comparing the population projection in the CSRs with the census data of 2000 and 2010, insights may be obtained to improve the accuracy of population projection. Furthermore, since much of the data will be collected through the review and formulation of catchment strategies, it will be a good opportunity to develop new evaluation indicators. The effectiveness of the new indicators will be verified and then be used to replace or supplement existing indicators in order to improve the Manual. IWK will play a key role in these studies.

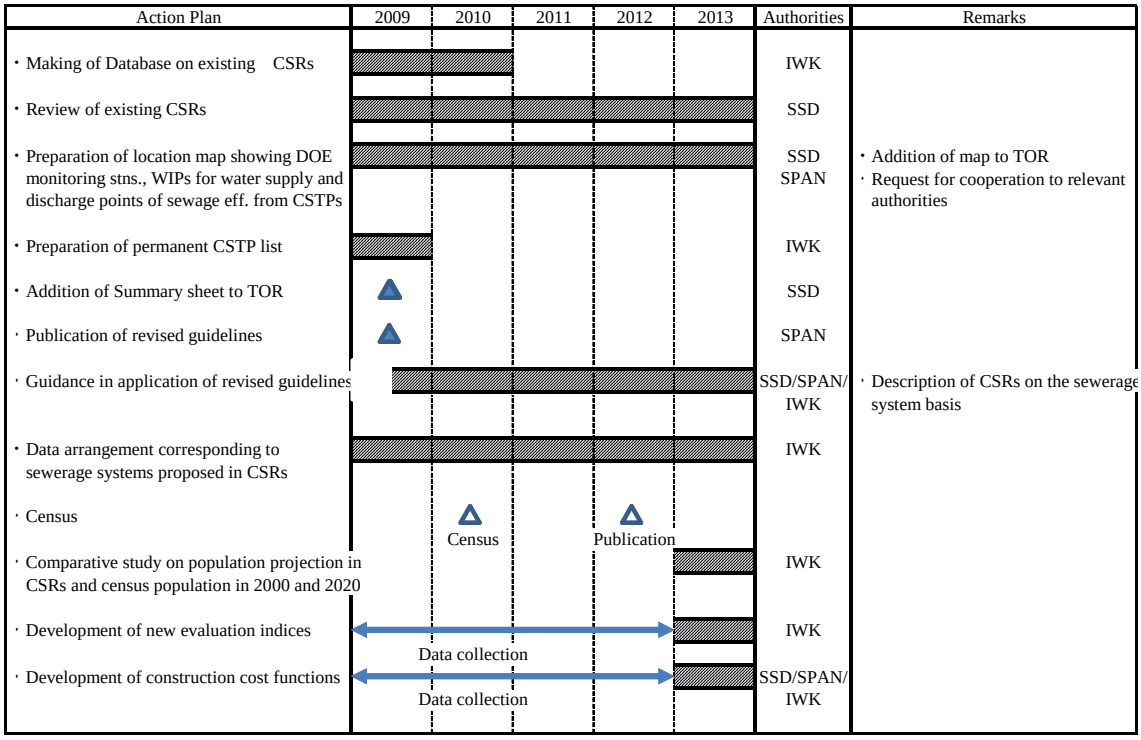


Figure 6.3 Action Plan for Improvement of Planning Capability

(2) Building Institutional Capability

For initiatives to build institutional capability, it is recommended that MEWC and relevant authorities or agencies strengthen the water sector-related organisations and develop postgraduate education, professional training and research facilities with partner institutions.

Counterpart organisations should include universities, research centres, and centres within ministries and other government institutions. After a thorough analysis of the relevant organisations, including needs assessments for staff and other resources, activities such as staff development, curriculum design, research and development (R&D) support, facilities

upgrading, educational training, and enhancing managerial systems and skills, should be implemented.

The above initiative concerns a detailed capacity needs assessment for the sewerage sector. The initiative should analyse not only technical but also management, legal and socio-economic knowledge gaps of agencies or institutions in the field of integrated water management. This initiative could represent a first step towards a comprehensive capacity building strategy in the Malaysian water sector.

This initiative builds capabilities of staff, in particular existing and new employees mostly from the Ministry of Energy, Water and Communications and other authorities such as SPAN, SSD and others, after reforms and new legislation have been introduced in the Malaysian water sector. The focus is specifically on the human resources and the degree to which the Malaysian sewerage sector has the required capacity to address the challenges facing the sewerage sector.

The initiative should, amongst others, successfully:

1) analyse new responsibilities and tasks of various water sector organisations as a result of the recent reforms;
2) identify and analyse existing capacity (in terms of human resources) and required short term as well as medium term capacity;
3) identify and analyse existing training and education activities in Malaysia that can address these capacity gaps; and
4) identify additional capacity building possibilities (short-term capacity building activities as well as activities of a longer duration), needed to acquire the required capacity.

There was a substantial demand for qualified wastewater engineers in particular, especially with respect to water shortages, pollution at water sources and deficiencies in the existing facilities within the service areas. As part of the institutional and human resources capability building efforts, postgraduate courses will also be needed to familiarize engineers from the local government and private sector in Malaysia with integrated planning, design and management of water resources, water supply and sewerage facilities.

(3) National Sewerage Development Plan and Supplementary National Sludge Management Plan

To facilitate the sewerage industry's future planning direction, it is recommended that a National Sewerage Development Plan (NSDP) that clearly defines and advocates timely "practical implementation" be developed. This document is expected to include and highlight area defined; immediate, mid- and long-term plans to meet stipulated targets and indicators.

Targets and indicators within the plan should be quantifiable and achievable and, most importantly, must set the direction towards the realization of a sustainable sewerage industry. To supplement the NSDP, a National Sludge Management Plan (NSMP) should also be produced.

As critical as setting the direction of the industry, the methodology for final sludge disposal is related to the NSMP and need to be urgently addressed. This iissue is expected to escalate further when all construction of national sewerage projects comes to an end and begin to generate sludge. This would lead to a greater volume of sludge requiring disposal. As of this report, a feasible method for final disposal of sludge has yet to be developed.

While IWK, as the agency in charge of O&M, has done as much as possible to manage this issue and carry out the necessary R&D activities to identify a feasible solution, the support of a clearly defined policy and a procedural direction for successful implementation of possible measure remains absent.

Various options—incineration, composting, waste-to-energy conversion, and others—exist, but the practicality of implementation and acceptance within the local communities still cannot be determined. For addressing immediate and medium-term needs, the conventional method of final disposal to land is still the most desired method, but it is also plagued by the issue of suitable land availability.

It is recommended that SPAN, with the assistance of MEWC, initiates a discussion with the Housing Ministry regarding the potential allocation of a portion of all future sanitary landfill area for sludge disposal. This will certainly require a collaborative effort between ministries at the federal level to address the issue of suitable land availability. Using designated sanitary landfill areas as part of this solution might facilitate acceptance and mitigate environmental issues, since they are generally less sensitive to public resistance. Though Housing Ministry approval is required to allocate or acquire additional land area for sludge disposal, this initiative could be appreciated as an effective dual solution for both domestic solid waste and sludge.

(4) National Sewerage Information System

A national sewerage information system is a vital asset for efficient and effective sewerage planning and decision making. Improvement of planning and other capabilities can only be achieved if the relevant quantitative and qualitative information pertaining to the wastewater situation is available in a timely manner.

As highlighted in **Chapter 2**, there are wide variations in the quality and content of sewerage plans. The quality, consistency, and timeliness of sewerage plans needs to be improved based

on updated information. Many existing catchment strategy reports have failed to include updated population estimates and service demands.

The necessity to update these plans has also been highlighted in the process of compiling the study on sewerage catchment strategy for Kota Kinabalu (Northern Catchment).

It is recommended that this national sewerage information system include population projections, mapped data showing water resource availability, the assimilative capacity of receiving waters, and problem area inventories, among others.

(5) The Green Approach

Eco-construction comes at a crucial moment for the Asian Economy and especially for Malaysia.[1] Environmental concerns and technological advances will be required in the Malaysian sewerage industries and the green approach—an indication of promising efforts to ensure procurement of ecological materials and methods to work together for a sustainable recycling-based society—will also be highlighted in future sewerage system plans.

Materials and methods to be procured should be evaluated using of life-cycle analysis from raw material acquisition to disposal. However, it will take time to identify comprehensive evaluation methods for life cycle analysis in sewerage industries.

By formulating a comprehensive evaluation method, it is recommended that sewerage system plans with a view to ensuring the effects of environmental preservation be carried out at the present time to allow the early establishment of a sustainable recycling-based society. Furthermore it is important to measure and monitor environmental management efficiency through quantitative assessment parameters.

Item	Object	Content	Assessment Parameters
Resource recycling	Discharge control of disposal	Sewage sludge compost	Composted sludge volume
		Sewage sludge reuse	Reused sludge volume
		Soil recycling at construction sites	Recycled soil volume
Global environment preservation	CO_2 emission control	Adoption of energy-saving treatment methods	CO_2 emission volume
Prevention of public nuisance	Environmental load control	Adoption of public nuisance control construction methods & equipment	NOx & SOx emission volume Number of public nuisance cases

(6) Improvement of Planning Capability in Each Organisation

[1] The Conference on Sustainable Building in Southeast Asia was held in Kuala Lumpur in November 2007 hosted by MEWC and featured the vision of Green Building Mission Malaysia.

Required capabilities differ from organisation to organisation due to what roles are required for each organisation.

With respect to current planning capability of the planning sewerage system within relevant authorities, the SSD Planning and Development Division has recently declared its intention to implement sewerage strategies and plans, the SPAN Catchment Planning & Control Division is still in the set up process, and the IWK Planning Service Section alone possesses a relatively high ability to implement sewerage catchment strategies/plans. These conditions indicate that the way in which IWK's planning capability is shared with SSD and SPAN will be a critical driver in restructuring new Malaysian water industries, especially sewerage industries, so that it is successful and sustainable over the long term.

1) Planning Section in the SSD Planning and Development Division

Until recently this Division was in charge of the planning and development of the sewerage infrastructure and is now also responsible for reviewing catchment strategies/plans that have been implemented by the Planning Service Section of IWK.

However, the planning capability of the Division is not sufficient to properly shoulder all responsibilities due to the fact that it is still quite new. As motioned in the sector analysis, some problems of this division are as follows:

(a) There are no specific planning manuals in the Division.
(b) There are no dedicated capacity development programmes for the planning staff.
(c) The Division lacks a knowledge bank related to sewerage system planning.
(d) The Planning Division has limited manpower.

In contrast, IWK has enough capability and experience that, with the exception of manpower, the above are not issues. The following are IWK internal programmes:

Specialized Sewerage Technical Courses

- Module 1

1)	M1P1	Planning of Sewerage Systems
2)	M1P5	Sewerage Policies and Procedures
3)	M1P3	EIA for Sewerage Systems
4)	M1P4	HAZOPs(Hazard and Operability) of Sewerage Systems
5)	M1P2	Plant Integration and Planning

- Module 2

6)	M2P1	Basic Hydraulics
7)	M2P2	Hydraulic Energy and Flow Resistance in Sewer Design
8)	M2P3	Sewer Design
9)	M2P4	Pumps and Pumping Systems
10)	M2P5	Design of Pump Stations
11)	M2P6	Flow Measurement Systems & Applications
12)	M2P7	Construction of Sewers

13)	M2P8	Sewer Rehabilitation and Property Connection

- Module 3

14)	M3P1	Introduction to Sewage Treatment
15)	M3P2	Design of Septic Tanks
16)	M3P3	Preliminary & Primary Treatment
17)	M3P4	Activated Sludge Systems
18)	M3P5	Fixed Film Systems
19)	M3P6	Tertiary Process in Sewerage Systems
20)	M3P7	Introduction to Sludge Treatment & Disposal
21)	M3P8	Sludge Thickening and Stabilization
22)	M3P9	Sludge Dewatering and Disposal
23)	M3P10	Basic Hydraulics of STP
24)	M3P11	Hydraulics of Unit Processes
25)	M3P12	Introduction to M&E Design for Sewerage Systems
26)	M3P13	Construction of STPs
27	M3P14	Testing and Commission of Sewerage Systems
28)	M3P15	Introduction to Operations and Maintenance of Sewerage Systems

Module 1 courses would be especially useful in cultivating planning capability needed by SSD.

Recommendation 1

- Appointment of SSD officers and staff to participate in IWK internal programmes

Career training helps acclimatize individuals to the actual working environment and provides necessary skills. Currently, the responsibilities of the Planning and Engineering Department and Planning Service Section of IWK are nearly the same as those of the Planning and Development Division of SSD.

Recommendation 2

- Temporary transfer of SSD staff to the Planning and Engineering Department of IWK for at least three years

Planning capability is not increased through training alone. It is also important that staff accrue actual planning experience in research, data collection and analysis, various projection methods, establishment and comparative study of planning options, cost estimation, development of implementation programmes, and preparation of reports with discussions. Experience in different planning work can foster diversity of approach, viewpoints and ideas. As in Malaysia, it takes about one year to complete the development of one catchment strategy, and a minimum of three year of actual practice is necessary.

2) Catchment Planning & Control Division, Sewerage Regulatory Department, SPAN

SPAN is still in set-up stages, and detailed activities and responsibilities are still being discussed in the MEWC.[2]

The required key role of the Catchment Planning & Control Division is summarized as follows:

- To formulate and implement a plan so that all reasonable demands for sewerage services are satisfied, and, through consultation with the relevant authorities, to prepare a sewerage catchment plan formulating the policy and general proposals related to the development of any new sewerage and measures for improvement of any existing sewerage system[3].

SPAN has already appointed and recruited officers and staff to prepare for these responsibilities, and the key line managers are from the Planning and Engineering Department of IWK. Other officers and staff have backgrounds as contractors, consultants, and IT engineers, among others. The aim of this staffing arrangement is to enable one-on-one on-the-job training of staff by line managers.

Recommendation 1

- The current personnel arrangement is reasonable and appropriate. Henceforth it will be very important to monitor the individual need for capacity building to meet the progress of on-the –job-training in the field.

Recommendation 2

- External training programmes in addition to in-house on-the-job training will be required to meet SPAN's detailed responsibilities, which are now being discussed in the MEWC. An intra-committee should be established with other SPAN's Divisions to discuss ways of evolving programmes for capacity improvement. [4]

3) IWK

Since IWK was selected as the concessionaire company of sewerage services in 1993, it plays a leading role in the sewerage planning in Malaysia. For this reason, IWK has been blessed with experience and sufficient staffing. The existing catchment strategy reports have not always been created with a consistent level of quality, a tendency that has often been observed among less-experienced consultants. However, this may also demonstrate that the significance of catchment strategies has been recognized even within IWK.

[2] The Government of Malaysia has commissioned KPMG to conduct a study to provide a framework for the development of the water industry in light of the integration of water supply and sewerage industries.
[3] http://www.span.gov.my/abt_function.html: Functions of the Commission
[4] The committee should be established after the KPMG Report identified detailed responsibilities and activities for each authority. In November, 2008 the Draft Final Report was submitted.

Recommendation

- IWK should hold regular meetings with staff in charge of sewerage planning from all regional offices in attendance and use actual catchment strategy reports to demonstrate the minimum requirement to consultants.

APPENDIX

APPENDIX 3

MANUAL FOR REVIEWING/EVALUATION/PRIORITISING OF SEWERAGE CATCHMENTS/PROJECTS

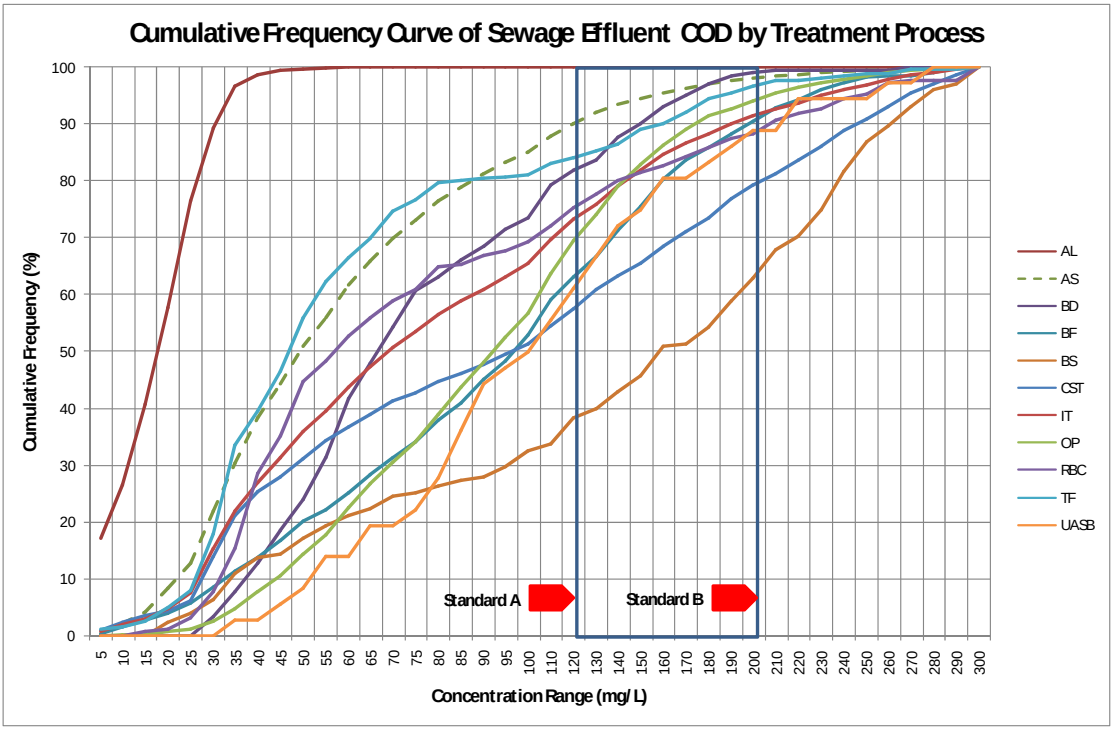
APPENDIX 3-A HOTEL GUESTS BY LOCALITY (2007)

HOTEL GUESTS BY LOCALITY 2007

BY LOCALITY	DOMESTIC			FOREIGNER			TOTAL		
	2006	2007	2007/2006	2006	2007	2007/2006	2006	2007	2007/2006
KUALA LUMPUR	**6,999,802**	**7,963,280**	**13.76**	**8,012,219**	**8,632,466**	**7.74**	**15,012,021**	**16,595,746**	**10.55**
PUTRAJAYA	**42,778**	**81,793**	**91.20**	**45,575**	**88,535**	**94.26**	**88,352**	**170,328**	**92.78**
SELANGOR	**1,626,445**	**2,021,491**	**24.29**	**1,505,614**	**1,783,343**	**18.45**	**3,132,059**	**3,804,834**	**21.48**
Petaling Jaya	428,617	550,615	28.46	672,039	782,133	16.38	1,100,656	1,332,748	21.09
Subang	181,726	230,332	26.75	151,362	184,107	21.63	333,088	414,439	24.42
Shah Alam	191,683	216,647	13.02	137,984	113,152	(18.00)	329,667	329,799	0.04
Sepang	134,832	256,509	90.24	302,264	397,196	31.41	437,096	653,705	49.56
Others Selangor	689,587	767,388	11.28	241,965	306,755	26.78	931,552	1,074,143	15.31
PENANG	**2,562,978**	**2,787,260**	**8.75**	**2,125,526**	**2,399,351**	**12.88**	**4,688,504**	**5,186,611**	**10.62**
Georgetown	1,870,861	2,009,090	7.39	1,252,013	1,432,082	14.38	3,122,874	3,441,172	10.19
Batu Feringghi	206,867	253,860	22.72	531,628	549,755	3.41	738,495	803,615	8.82
Tg Bungah	201,194	226,146	12.40	167,947	225,465	34.25	369,141	451,611	22.34
Others Penang	284,055	298,164	4.97	173,938	192,049	10.41	457,994	490,213	7.03
PERAK	**1,551,336**	**1,769,095**	**14.04**	**608,752**	**663,859**	**9.05**	**2,160,088**	**2,432,954**	**12.63**
Ipoh	689,650	756,940	9.76	150,758	168,785	11.96	840,408	925,725	10.15
Pulau Pangkor	378,006	454,493	20.23	314,544	334,009	6.19	692,550	788,502	13.85
Lumut	203,054	230,890	13.71	114,441	121,522	6.19	317,496	352,412	11.00
Others Perak	280,627	326,772	16.44	29,009	39,543	36.32	309,635	366,315	18.31
KEDAH	**2,563,814**	**2,648,636**	**3.31**	**1,502,248**	**1,879,809**	**25.13**	**4,066,062**	**4,528,445**	**11.37**
Alor Setar	534,106	449,416	(15.86)	33,352	60,431	81.19	567,457	509,847	(10.15)
Sungai Petani	331,954	300,038	(9.61)	68,243	109,684	60.73	400,197	409,722	2.38
Langkawi	1,637,457	1,812,002	10.66	1,344,188	1,614,424	20.10	2,981,646	3,426,426	14.92
Others Kedah	60,297	87,180	44.58	56,465	95,270	68.72	116,762	182,450	56.26
PERLIS	**83,934**	**90,972**	**8.39**	**14,469**	**15,166**	**4.82**	**98,402**	**106,138**	**7.86**
N. SEMBILAN	**1,218,661**	**1,220,277**	**0.13**	**327,676**	**405,803**	**23.84**	**1,546,337**	**1,626,080**	**5.16**
Seremban	175,770	171,272	(2.56)	70,352	107,070	52.19	246,122	278,342	13.09
Port Dickson	984,420	996,647	1.24	242,883	268,249	10.44	1,227,304	1,264,896	3.06
Others NS	58,471	52,358	(10.45)	14,441	30,484	111.09	72,912	82,842	13.62
MELAKA	**1,532,580**	**1,764,465**	**15.13**	**1,311,057**	**1,512,941**	**15.40**	**2,843,637**	**3,277,406**	**15.25**
Bandar Melaka	1,327,757	1,532,017	15.38	1,090,338	1,254,840	15.09	2,418,095	2,786,857	15.25
Ayer Keroh	158,757	164,081	3.35	165,187	185,181	12.10	323,944	349,262	7.82
Others Melaka	46,066	68,367	48.41	55,532	72,920	31.31	101,598	141,287	39.06
JOHOR	**2,036,812**	**2,566,144**	**25.99**	**962,862**	**1,206,842**	**25.34**	**2,999,674**	**3,772,986**	**25.78**
Johor Bahru	1,518,899	1,734,075	14.17	743,891	911,443	22.52	2,262,790	2,645,518	16.91
Kota Tinggi	176,105	152,426	(13.45)	83,358	103,979	24.74	259,463	256,405	(1.18)
Mersing	111,898	118,323	5.74	96,025	93,369	(2.77)	207,923	211,692	1.81
Others Johor	229,910	561,320	144.15	39,589	98,051	147.67	269,499	659,371	144.67
PAHANG	**3,607,340**	**4,461,258**	**23.67**	**2,521,562**	**2,904,680**	**15.19**	**6,128,902**	**7,365,938**	**20.18**
Kuantan	1,371,381	1,467,373	7.00	297,362	337,569	13.52	1,668,743	1,804,942	8.16
Genting Highlands	1,480,587	2,164,704	46.21	1,987,476	2,227,093	12.06	3,468,063	4,391,797	26.64
Cameron Highlands	419,000	444,092	5.99	118,100	178,733	51.34	537,100	622,825	15.96
Fraser Hills	54,691	47,893	(12.43)	15,651	14,553	(7.02)	70,342	62,446	(11.23)
Jerantut	31,030	36,676	18.19	18,014	31,423	74.44	49,044	68,099	38.85
Kuala Lipis	49,527	58,552	18.22	7,933	14,375	81.22	57,459	72,927	26.92
Others Pahang	201,124	241,968	20.31	77,026	100,934	31.04	278,150	342,902	23.28
TERENGGANU	**1,028,265**	**1,018,426**	**(0.96)**	**139,422**	**150,325**	**7.82**	**1,167,687**	**1,168,751**	**0.09**
Kuala Terengganu	696,843	639,950	(8.16)	84,526	87,404	3.40	781,369	727,354	(6.91)
Kemaman	69,114	81,963	18.59	21,877	23,333	6.66	90,991	105,296	15.72
Others Terengganu	262,307	296,513	13.04	33,019	39,588	19.89	295,326	336,101	13.81
KELANTAN	**690,178**	**766,326**	**11.03**	**79,886**	**84,611**	**5.91**	**770,065**	**850,937**	**10.50**
Kota Bharu	598,199	667,394	11.57	76,093	79,904	5.01	674,292	747,298	10.83
Others Kelantan	91,979	98,932	7.56	3,794	4,707	24.07	95,773	103,639	8.21
PENINSULA MALAYSIA	**25,544,923**	**29,159,423**	**238.73**	**19,156,868**	**21,727,731**	**265.83**	**44,701,790**	**50,887,154**	**244.25**
SABAH	**3,032,389**	**3,506,933**	**15.65**	**2,357,487**	**2,662,056**	**12.92**	**5,389,876**	**6,168,989**	**14.46**
Kota Kinabalu	2,050,336	2,467,661	20.35	2,159,887	2,449,852	13.42	4,210,223	4,917,513	16.80
Sandakan	288,346	323,648	12.24	52,474	60,595	15.48	340,820	384,243	12.74
Others Sabah	693,707	715,624	3.16	145,126	151,609	4.47	838,833	867,233	3.39
LABUAN F.T	**212,711**	**251,493**	**18.23**	**68,169**	**88,117**	**29.26**	**280,880**	**339,610**	**20.91**
SARAWAK	**3,110,467**	**3,335,740**	**7.24**	**874,808**	**916,708**	**4.79**	**3,985,275**	**4,252,448**	**6.70**
Kuching	1,134,394	1,236,048	8.96	504,458	511,351	1.37	1,638,851	1,747,399	6.62
Miri	1,132,937	1,222,615	7.92	245,855	265,402	7.95	1,378,792	1,488,017	7.92
Others Sarawak	843,136	877,077	4.03	124,495	139,955	12.42	967,631	1,017,032	5.11
GRAND TOTAL	**31,900,490**	**36,253,589**	**279.85**	**22,457,332**	**25,394,612**	**312.80**	**54,357,821**	**61,648,201**	**286.32**

APPENDIX 3-B CUMULATIVE FREQUENCY CURVE OF SEWAGE EFFLUENT BY TREATMENT PROCESS

COD



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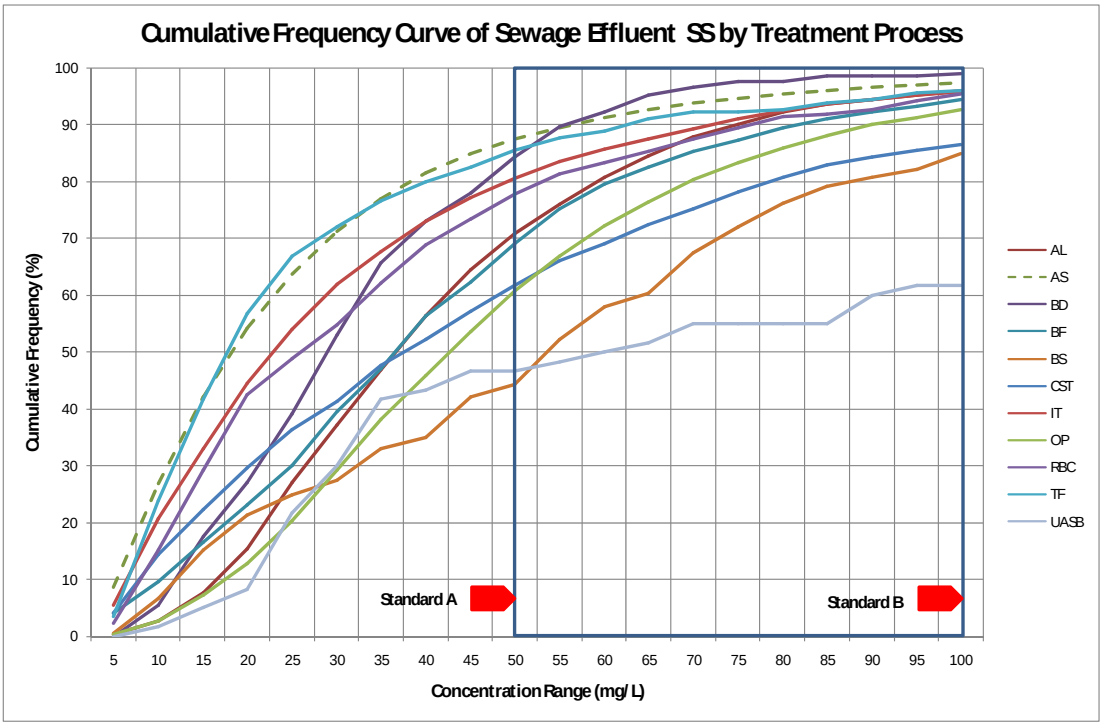
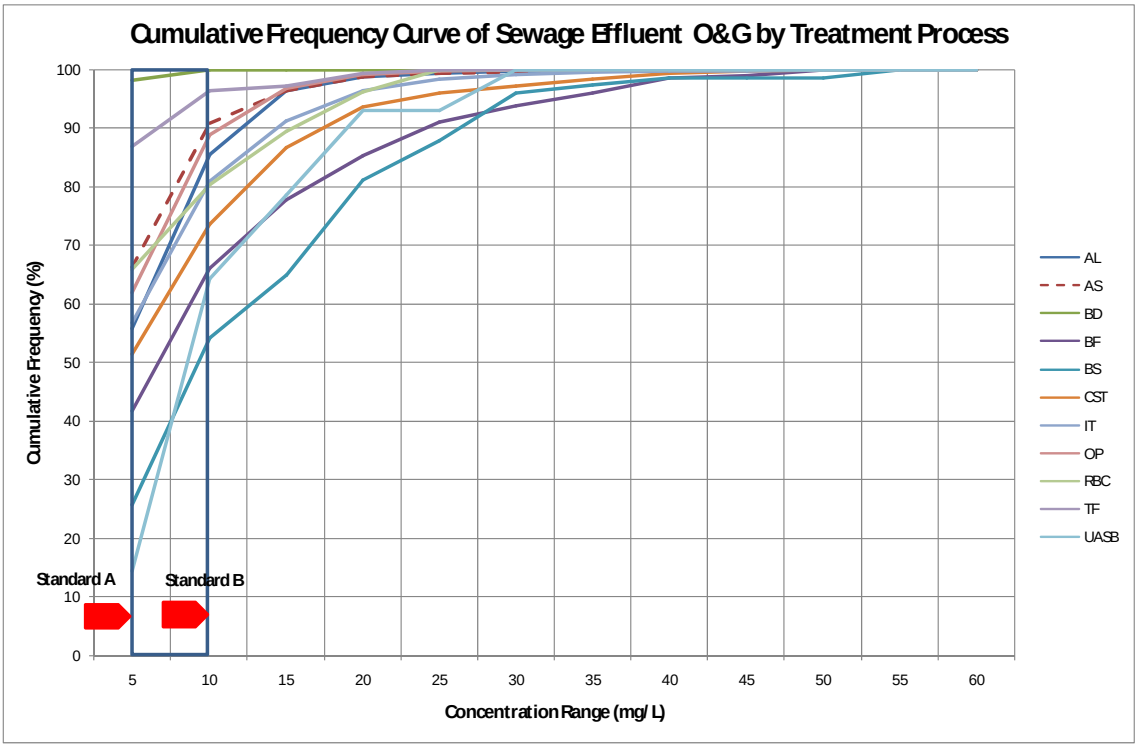


Oil & Grease (O&G)



APPENDIX 3-C INCIDENCE OF NOTIFIABLE COMMUNICABLE DISEASES IN MALAYSIA (1990-2005)

Diseases/Year	1990		1991		1992		1993		1994		1995		1996		1997		1998		1999		2000		2001		2002		2003		2004		2005	
	Case	Dealh	Case	Death	Case	Death	Case	Death	Case	Death	Case	Death	Case	Death	Case	Dealh	Case	Death	Case	Death	Case	Dealh	Case	Death	Case	Death	Case	Death	Case	Death	Case	Death
HIV Infection (All Form)	778	10	1794	19	2512	46	2507	55	3393	80	4198	165	4597	271	3924	473	4624	689	4692	874	5107	882	5938	975	6978	881	3060	537	3926	732	2825	152
Cholera	2071	37	504	5	699	13	995	13	523	0	2209	27	1466	2	380	5	1304	19	536	9	124	1	557	11	365	7	84	0	89	0	196	0
Dengue Fever	4235	0	5888	0	4828	0	5060	0	2877	0	6156	0	13723	2	18642	49	26240	18	9602	6	6690	4	15446	3	14694	2	21281	5	26619	11	24949	9
Dengue Haemorrhagic Fever	645	21	740	36	645	24	555	23	256	13	387	28	532	30	787	1	1141	64	544	31	413	41	922	47	799	64	905	24	1452	30	1508	33
Diptheria	9	1	12	2	4	1	4	0	0	0	1	0	0	0	2	0	5	1	6	1	1	1	4	4	7	0	11	1	4	1	5	0
Dysentery (All types)	548	1	434	0	379	1	261	0	151	0	152	0	121	0	132	0	246	0	429	0	447	0	348	0	292	0	282	0	356	0	505	0
Ebola	-		-		-		-		-				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Food Poisioning	1251	1	1094	0	960	2	1638	1	1229	3	1438	3	3236	0	6734	0	6976	3	8640	3	8129	2	7137	3	7023	0	5975	0	5957	1	4129	4
Chancroid	92	0	114	0	58	0	24	0	23	0	5	0	6	0	4	0	18	0	9	0	7	0	6	0	2	0	1	0	0	0	0	0
Gonococcal Infection (All forms)	4277	0	4008	0	3937	0	3614	0	2977	0	2157	0	1772	0	1393	0	1307	0	2232	0	1336	0	1294	0	964	0	750	0	751	0	479	0
Syphilis (All Forms)	1855	1	2027	0	2093	0	2256	0	1804	0	1941	0	1562	0	1317	0	2460	0	2150	0	1705	1	1435	0	1070	0	953	0	953	0	723	2
Leprosy	296	0	315	0	293	0	336	0	333	0	311	0	273	0	277	0	236	0	224	0	217	0	195	0	179	0	177	1	185	1	112	0
Malaria	54831	43	43545	47	36853	25	39890	23	58956	27	59208	35	51921	40	26649	25	13491	27	11106	21	12705	35	12780	46	11016	39	4469	9	5161	21	1565	3
Measles	563	0	275	0	363	0	517	3	346	1	654	6	460	4	585	0	483	0	2608	10	6187	7	2207	4	899	0	632	1	5689	0	1430	2
HFMD/Myocarditis	-		-		-		-		-		-		-		5999	42	922	0	434	1	3027	7	1531	6	2595	0	2799	4	623	0	5856	1
Plague	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polomylitis, Acute	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rabies	1	1	0	0	1	0	0	0	0	0	0	0	5	0	7	3	1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Relapsing Fever	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Tetanus Neonatorum	11	3	13	0	26	8	20	0	9	5	27	4	23	3	15	1	13	4	10	2	20	0	8	3	11	0	8	0	14	0	2	0
Tetanus Adult	19	2	18	1	14	1	25	1	8	0	12	2	9	1	13	2	6	0	16	0	20	0	20	2	24	0	10	0	19	0	9	0
Tuberculosis(All Forms)	10873	741	11059	750	11420	743	12075	901	11078	524	11778	844	12661	915	13539	978	14115	1059	14908	1191	15057	1295	14830	1326	14389	1290	13144	249	13942	310	9456	135
Typhoid & Paratyphoid	2223	9	1999	26	1764	5	1442	9	1031	9	906	8	953	9	701	3	782	3	811	2	765	4	695	2	853	2	714	1	484	0	2756	5
Typhus & Other Rickettsioses	119	0	234	0	186	0	333	0	102	0	186	0	108	0	83	0	58		68		36	0	86	0	60	0	27	0	38	0	26	0
Viral Encephalitis	39	2	24	0	15	0	13	0	12	2	7	0	18	3	12	1	64	14	301	101	90	3	83	3	65	2	71	0	103	2	107	9
Viral Hepatitis (All Forms)	2444	0	2580	0	2450	0	1580	0	765	0	1076	0	1581	1	714	0	5410	3	6014	1	4067	2	4067	2	3601	1	3080	1	2904	3	2150	34
Hepatitis A	1265	0	1666	0	1571	0	915	0	402	0	419	0	849	0	341	0	240	0	319	0	497	0	453	0	295	0	206	0	107	0	53	0
Hepatitis B	942	0	724	0	723	0	576	0	335	0	551	0	627	1	307	0	5010	3	5295	1	2863	2	2926	3	2706	1	2313	1	1964	2	1166	16
Hepatitis C	-		-		-		-		-		48	0	33	0	43	0	136	0	257	0	550	0	549	0	435	0	479	0	728	1	876	22
Hepatitis Other (Unclass.)	237	0	190	0	156	0	89	0	28	0	60	0	72	0	23	0	24	0	143	0	157	0	109	0	165	0	82	0	80	0	64	1
Whooping Cough	24	0	20	0	21	0	18	0	12	0	6	0	7	0	3	0	6	0	17	0	42	0	26	0	27	0	28	0	42	4	65	1
Yellow Fever	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Nota

Data tahun 2005 belum disahkan

Tankh:15 Februari 2006

Sumber: 1.epid 203 pind. 2000

2.CDCIS201

APPENDIX 3-D WATER QUALITY INDEX (WQI)

A Water Quality Index is a method of combining numerous water quality parameters into one concise and objective value representing the state of the water quality trends. In the Environmental Quality Report prepared by the Department of Environment, the DOE-WQI (Water Quality Indices) is used.

The DOE-WQI is an opinion-poll formula - a panel of experts is consulted on the choice of parameters and on the weightage to be assigned to each parameter. The parameters which have been chosen are:

DO (Dissolved oxygen)	BOD_5 (Biochemical oxygen demand)
COD (Chemical oxygen demand)	NH_3-N (Ammoniacal nitrogen)
SS (Suspended solids)	pH (pH value)

Calculations are performed not on the parameters themselves but on their subindices whose values are obtained from a series of equations shown below. These are best-fit equations obtained from rating curves. The subindices for the chosen parameters are named SIDO, SIBOD, SICOD, SIAN, SISS and SIPH, and the formula used in the calculation is:

$$WQI = 0.22 \times SIDO + 0.19 \times SIBOD + 0.16\times SICOD + 0.15 \times SINH_3\text{-}N + 0.16 \times SISS + 0.12 \times SIpH$$

where the multipliers are the weightages for the corresponding parameters with a total value of 1.

(1) Subindex for DO (in % saturation):

DO is converted to DO saturation degree using the following equation.

$$\text{DO saturation degree (\%)} = DO \times 12.657$$

DO	$X \leq 8$ (%)	$8 < x < 92$ (%)	$X \geq 92$ (%)
SIDO	0	$-0.395 + 0.030\ x^2 - 0.00020\ x^3$	100

(2) Subindex for BOD_5

BOD	$X \leq 5$ (mg/L)	$x > 5$ (mg/L)
SIBOD	$100.4 - 4.23\ x$	$108\ e^{-0.055\ x} - 0.1\ x$

(3) Subindex for COD

COD	$X \leq 20$ (mg/L)	$x > 20$ (mg/L)
SICOD	$-1.33\ x + 99.1$	$103\ e^{-0.0157\ x} - 0.4\ x$

(4) Subindex for NH_3-N

AN	$X \leq 0.3$ (mg/L)	$0.3 < x < 4$ (mg/L)	$X \geq 4$ (mg/L)
SIAN	$100.5 - 105\ x$	$94\ e^{-0.573\ x} - 5\ (x - 2)$	0

(5) Subindex for SS

SS	$X \leq 100$ (mg/L)	$100 < x < 1000$ (mg/L)	$X \geq 1000$ (mg/L)
SISS	$97.5\ e^{-0.00676\ x} + 0.05\ x$	$71\ e^{-0.0016\ x} - 0.015\ x$	0

(6) Subindex for pH

PH	$X < 5.5$	$5.5 \leq x < 7$	$7 \leq x < 8.75$	$X \geq 8.75$
SIPH	$17.2 - 17.2\ x + 5.02\ x^2$	$-242 + 95.5\ x - 6.67\ x^2$	$-181 + 82.4\ x - 6.05\ x^2$	$536 - 77.0\ x + 2.76\ x^2$

APPENDIX 3-E REDUCTION IN O&M MANPOWER REQUIREMENTS FOR STPS (1/2)

Staff Req.	3	3	3	3			3	3	3	3	9	17	3	3	3	3	3	3	
STP/NPS	80	40	40	20			20	10	4	1	1	1	20	10	10	3.34	3.34	2	
Type of STP	CST	CST	CST	CST	CST	CST	IT, OP, STP	IT, OP, STP	IT, OP, STP	IT, OP, STP	IT, OP, STP	IT, OP, STP	NPS	NPS	NPS	NPS	NPS	NPS	TOTAL
PE Size	0-500	500-2000	2000-10000	10000-20000	20000-50000	50000-	0-500	500-2000	2000-10000	10000-20000	20000-50000	50000-	0-500	500-2000	2000-10000	10000-20000	20000-50000	50000-	
MD KOTA TINGGI	0.53						0.45	1.80		3.00				0.60	0.30				6.68
MD LABIS	1.24						0.15	1.20											2.59
MD MERSING	2.18							0.90											3.08
MD PONTIAN	0.53						1.05	3.30	3.75										8.63
MD SEGAMAT	0.38						1.35	6.30	1.50	3.00			0.15	0.30					12.98
MD SIMPANG RENGGAM	0.90						0.30	3.00	1.50										5.70
MD TANGKAK	0.04						0.75	4.20	1.50				0.15	0.30					6.94
MD YONG PENG	0.30						0.15	0.60	0.75					0.30					2.10
MP BATU PAHAT	1.13						0.45	3.60	3.75										8.93
MP JOHOR BAHRU TENGAH	2.48						1.80	11.40	33.75	51.00	36.00		0.45	6.60	8.70	0.90			153.08
MP KLUANG	5.89						2.40	7.80	13.50				0.15	0.60					30.34
MP KULAI	0.49						0.45	7.20	9.75	9.00	18.00		0.15	3.00	1.20				49.24
MP MUAR	3.30						5.40	8.40	3.00										20.10
MB ALOR STAR	1.24	0.08	0.08				7.65	13.20	8.25	3.00			0.15		0.30				33.95
MD BALING	0.64						0.90	0.90	1.50					0.30					4.24
MD BANDAR BAHARU	0.45						0.45	1.20											2.10
MD KUBANG PASU	1.43						1.50	6.00	5.25										14.18
MD PADANG TERAP	0.53						0.15												0.68
MD PENDANG	0.41						0.15	0.30											0.86
MD SIK	0.11																		0.11
MD YAN	0.11																		0.11
MP KULIM	0.86	0.08					2.70	10.80	15.00	6.00			0.45	1.80	0.30				37.99
MP LBP	0.08						0.45	1.50	2.25					0.90	0.60				5.78
MP SUNGAI PETANI	8.89						3.15	10.80	18.00	3.00	9.00			2.10		0.90			55.84
MB MELAKA BERSEJARAH	5.70	0.08					17.40	37.20	40.50	6.00			0.45	1.80	0.60				109.73
MD JASIN	2.59						2.40	8.70	5.25										18.94
MP ALOR GAJAH	3.19						2.25	12.00	9.75				0.15						27.34
MD JELEBU	0.75							0.90											1.65
MD JEMPOL	2.06						1.65	5.10	2.25										11.06
MP KULIM	1.69	0.08					2.10	3.60					0.15						7.62
MD REMBAU	2.29						1.05	2.10	2.25				0.15		0.30				8.14
MD TAMPIN	3.00						1.05	6.00	1.50										11.55
MP NILAI	1.95						3.30	7.50	23.25	15.00	18.00		0.75	1.80	2.10	0.90			74.55
MP PORT DICKSON	1.24	0.08					2.85	9.00	12.75	3.00			0.45	1.50					30.87
MP SEREMBAN	3.38	0.08					8.70	20.40	33.00			17.00	1.50	3.90	2.70				90.66
MD BERA	0.08						1.05	1.80						0.30					3.23
MD CAMERON HIGHLANDS	0.86						0.90	2.70	3.00										7.46
MD JERANTUT	0.08						0.75	2.70											3.53
MD LIPIS	0.08						1.50	0.60											2.18
MD MARAN	0.26						1.35	1.50	0.75										3.86
MD PEKAN							0.30	0.30											0.60
MD RAUB	0.45	0.08					0.75	0.30											1.58

APPENDIX 3-E REDUCTION IN O&M MANPOWER REQUIREMENTS FOR STPS (2/2)

Staff Req.	3	3	3	3			3	3	3	3	9	17	3	3	3	3	3	3	
STP/NPS	80	40	40	20			20	10	4	1	1	1	20	10	10	3.34	3.34	2	
Type of STP	CST	CST	CST	CST	CST	CST	IT, OP, STP	IT, OP, STP	IT, OP, STP	IT, OP, STP	IT, OP, STP	IT, OP, STP	NPS	NPS	NPS	NPS	NPS	NPS	TOTAL
PE Size	0-500	500-2000	2000-10000	10000-20000	20000-50000	50000-	0-500	500-2000	2000-10000	10000-20000	20000-50000	50000-	0-500	500-2000	2000-10000	10000-20000	20000-50000	50000-	
MD ROMPIN							0.30												0.30
MP BENTONG	0.60						2.85	5.40	2.25										11.10
MP KUANTAN	3.00						11.55	11.40	10.50	6.00	9.00		0.75	1.20					53.40
MP TEMERLOH	0.83						4.35	4.50	5.25										14.93
MB IPOH	1.35						6.30	42.30	84.00	30.00			1.05	7.80	3.00				175.80
MD GRIK	0.38						0.45	0.90											1.73
MD KERIAN	1.31						2.40	3.90	3.00	3.00									13.61
MD KINTA BARAT	1.43						2.85	9.90	4.50				0.15						18.83
MD KINTA SELATAN	1.50	0.23					1.05	4.80	4.50		9.00			0.60	0.30				21.98
MD LENGGONG	0.26							0.30											0.56
MD PENGKALAN HULU	0.49						0.15												0.64
MD PERAK TENGAH	1.16						0.60	0.90	1.50					0.30					4.46
MD SELAMA	0.60	0.15					0.45	1.20											2.40
MD TANJUNG MALIM	0.90						2.55	1.80	1.50										6.75
MD TAPAH	0.98						0.60	2.10											3.68
MP KUALA KANGSAR	3.56	0.08					1.80	5.40	4.50				0.15	0.30					15.79
MP MANJUNG	0.79						4.95	11.10	6.00	6.00			0.15	1.50	0.90				31.39
MP TAIPING	1.69	0.15					6.00	20.10	15.00				0.45	1.80	0.30				45.49
MP TELUK INTAN	2.48						3.45	3.00	2.25										11.18
MP KANGAR	0.56	0.08					1.05	3.90											5.59
MP PULAU PINANG	1.61	0.23					8.70	12.90	22.50	3.00	9.00	34.00	0.45	0.30		0.90	5.39	4.50	103.48
MP SEBERANG PERAI	0.83						19.65	55.80	61.50	18.00	27.00	51.00	0.15	2.10	2.70	1.80	3.59		244.12
MB PETALING JAYA	4.43	0.08					7.35	21.60	32.25	45.00	9.00	51.00	0.45	4.20	1.20	3.59	2.69	1.50	184.34
MB SHAH ALAM	0.38						4.20	11.10	30.00	24.00	27.00	34.00	0.30	3.60	2.70	1.80	1.80		140.88
MD HULU SELANGOR	3.49						1.50	3.00	9.75	6.00	54.00		0.30	0.60	1.50	0.90			81.04
MD KUALA LANGAT	4.20	0.08					6.60	5.40	6.00						0.30				22.58
MD KUALA SELANGOR	4.46						3.90	7.20	5.25	6.00	9.00			0.30					36.11
MD SABAK BERNAM	2.25						3.00	0.90											6.15
MD SEPANG	1.54						3.15	3.60	9.75	3.00	9.00			0.90	2.10		0.90		33.94
MP AMPANG JAYA	0.04	0.08	0.08				1.50	9.60	41.25	48.00	45.00		0.30	5.40	1.80				153.05
MP KAJANG	0.04						5.25	29.70	74.25	36.00	36.00	17.00	1.05	4.80	3.90	0.90			208.89
MP KLANG	10.88						19.65	31.20	43.50	24.00	27.00		0.45	3.00	3.90	0.90			164.48
MP SELAYANG	2.21						0.90	13.80	48.75	18.00	18.00		0.75	1.80	1.80				106.01
MP SUBANG JAYA		0.08					0.90	6.90	41.25	54.00	81.00	34.00	0.45	3.30	4.50	2.69			229.07
MD BESUT	1.09						0.15												1.24
MD DUNGUN	0.64						0.30	0.60	1.50				0.15	0.60					3.79
MD HULU TERENGGANU	0.15						0.30												0.45
MD MARANG	0.23						0.45	0.30											0.98
MD SETIU	0.19						0.30												0.49
MP KEMAMAN	0.98						1.05	2.70	1.50				0.15	0.60					6.98
MP KUALA TERENGGANU	2.14						2.85	5.40	3.75				0.15	0.30	0.30				14.89
DB KUALA LUMPUR	0.49	0.08	0.15				8.25	21.30	51.00	48.00	54.00	119.00	0.60	12.00	3.30	0.90		4.50	323.57
PERBADANAN PUTRAJAYA	0.19						1.35	2.40	1.50		9.00	17.00	0.45	1.80	0.90	1.80		1.50	37.89
Total	130.12	1.88	0.31	0.00	0.00	0.00	236.10	605.10	887.25	480.00	513.00	374.00	14.10	85.20	52.50	18.88	14.37	12.00	3424.81

APPENDIX 3-F TREATMENT EFFICIENCY OF EXISTING STPS UNDER IWK O&M BY LOCAL AUTHORITY

(1) Number of Sewage Treatment Plants by Treatment Process

	AS	AB	EA	HK	IDEA	OD	SATS	SBR	TF	AL	BD	OP	RBC	IT	BF	CST	BS	UASB	Total	NPS
JOHOR																				
KOTA_TINGGI	0	0	7	1	0	0	0	0	0	0	0	2	0	0	0	14	0	0	24	3
LABIS	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	33	0	0	38	0
MERSING	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	58	0	0	61	0
PONTIAN	0	0	14	0	0	4	0	2	0	0	0	2	0	1	0	14	0	0	37	0
SEGAMAT	0	0	26	0	0	0	0	1	0	0	0	4	0	1	0	11	0	0	43	2
SIMPANG_RENGGAM	0	0	10	0	0	1	0	0	0	0	0	3	0	0	0	24	0	0	38	0
TANGKAK	0	0	20	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	22	2
YONG_PENG	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	12	1
BARU_PAHAT	0	0	13	0	0	0	0	0	0	0	0	7	0	0	0	30	0	0	50	0
JOHOR_BAHRU_TENGAH	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	33	0	0	38	0
KULUANG	0	0	25	1	0	0	0	2	0	1	0	19	0	12	0	157	0	0	217	3
KLAI	0	0	23	1	0	6	0	5	1	0	0	5	0	1	3	13	0	0	58	15
MUAR	0	4	45	2	0	0	1	0	0	0	0	9	0	6	0	89	0	0	156	0
	0	4	198	7	0	11	1	10	1	1	0	52	0	21	3	485	0	0	794	26
KEDAH																				
ALOR_STAR	0	2	57	7	0	0	3	0	0	0	0	13	0	15	0	43	0	0	140	2
BALING	0	0	6	0	0	0	1	0	0	0	0	0	0	1	0	20	0	0	28	1
BANDAR_BAHARU	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	19	0
KUBANG_PASU	0	0	26	2	0	0	1	1	0	0	0	3	0	0	0	40	0	0	73	2
PADANG_TERAP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	14	0
PEDANG	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	13	0
SIK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	0
YAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	0
LBP	0	0	8	2	0	0	0	0	0	0	0	0	0	0	0	3	0	0	13	7
KULIM	0	0	51	7	0	1	0	1	1	2	0	7	0	2	1	26	0	0	99	11
SUNGAI_PETANI	0	1	54	2	1	10	0	1	0	0	0	6	1	6	0	237	0	0	319	8
	0	3	211	20	1	11	5	3	1	2	0	29	1	24	1	412	0	0	724	31
MELAKA																				
MELAKA_BERSEJARAH	29	16	136	47	1	1	9	3	2	1	0	10	1	25	10	154	2	0	447	11
JASIN	0	0	38	4	0	0	0	1	0	0	0	2	0	5	0	70	0	1	121	0
ALOR_GAJAH	1	2	49	8	1	0	0	0	0	0	0	3	0	4	0	86	0	0	154	1
	30	18	223	59	2	1	9	4	2	1	0	15	1	34	10	310	2	1	722	12
NEGERI SEMBILAN																				
JELEBU	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	20	0	0	23	0
JEMPOL	1	0	12	2	0	0	0	0	0	0	0	10	0	5	1	55	0	0	86	0
KUALA_PILAH	1	0	12	2	0	0	0	0	0	0	0	3	0	6	0	46	0	0	70	1
REMBAU	0	0	12	1	0	0	0	0	0	0	0	3	0	1	0	61	0	0	78	2
TAMPIN	0	0	10	3	0	0	0	0	0	0	0	14	0	2	0	80	0	0	109	0
NILAI	1	4	38	8	2	13	0	3	0	1	0	8	0	7	0	52	0	0	137	19
PORT_DICKSON	1	2	33	4	0	1	0	3	2	2	0	4	1	9	4	34	0	0	100	8
SEREMBAN	1	2	65	6	3	1	1	2	1	5	0	29	0	53	2	91	0	0	262	32
	5	8	183	26	5	15	1	8	3	8	0	73	1	83	7	439	0	0	865	62

(1) Number of Sewage Treatment Plants by Treatment Process

	AS	AB	EA	HK	IDEA	OD	SATS	SBR	TF	AL	BD	OP	RBC	IT	BF	CST	BS	UASB	Total	NPS
PAHANG																				
BERA	0	0	7	0	0	0	0	0	0	0	0	3	0	2	0	2	0	0	14	1
CAMERON_HIGHLANDS	0	1	11	1	0	0	0	0	0	0	0	0	0	5	0	24	0	0	42	0
JERANTUT	0	0	8	0	0	0	0	0	0	0	0	1	0	1	0	2	0	0	12	0
LIPIS	0	0	3	1	0	0	0	0	0	0	0	0	0	8	0	2	0	0	14	0
MARAN	0	0	6	2	0	0	2	0	0	0	0	2	0	0	0	10	0	0	22	0
PEKAN	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
RAUB	0	0	5	1	0	0	0	0	0	0	0	0	0	0	0	13	0	0	19	0
ROMPIN	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
BENTONG	1	1	26	1	0	0	0	0	0	0	0	4	0	7	0	16	0	0	56	0
KUANTAN	3	3	71	6	0	2	1	2	2	0	0	6	2	11	1	82	0	0	192	11
TEMERLOH	0	0	28	2	0	0	0	0	0	2	0	7	0	5	0	24	0	0	68	0
	5	5	168	14	0	2	3	2	2	2	0	23	2	39	1	175	0	0	443	12
PERAK																				
IPOH	50	4	73	13	1	7	0	9	5	27	0	55	3	15	1	75	0	0	338	43
GRIK	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	11	0	0	16	0
KERIAN	1	1	22	0	0	0	0	2	0	0	0	3	0	2	0	38	0	0	69	0
KINTA_BARAT	4	2	32	3	0	0	0	3	0	1	0	7	0	5	0	38	0	0	95	1
KINTA_SELATAN	2	0	17	1	0	0	0	0	0	1	0	4	0	4	0	43	0	0	72	3
LENGGONG	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	7	0	0	8	0
PENGKALAN_HULU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	14	0
PERAK_TENGAH	0	0	6	1	0	0	0	0	0	0	0	1	0	0	0	31	0	0	39	1
SELAMA	0	1	3	0	0	0	0	0	0	0	0	1	0	2	0	18	0	0	25	0
TANJUNG_MALIM	0	0	8	2	0	2	0	0	0	0	0	0	0	1	0	33	0	0	46	0
TAPAH	0	0	8	0	0	0	0	0	0	0	0	1	0	2	0	26	0	0	37	0
KUALA_KANGSAR	1	1	16	4	0	0	0	0	0	1	0	6	0	4	0	96	0	0	129	2
MANJUNG	4	2	38	3	0	0	0	2	0	3	0	3	0	21	1	24	0	0	101	9
TAIPING	7	3	34	4	0	0	0	2	0	2	0	16	0	42	0	61	0	0	171	10
TELUK_INTAN	0	0	16	0	0	0	0	0	0	0	0	5	0	12	0	66	0	0	99	0
	69	14	277	32	1	9	0	18	5	35	0	103	3	110	2	581	0	0	1,259	69
PERLIS																				
KANGAR	0	1	11	2	0	0	2	0	0	0	0	0	0	1	0	16	0	0	33	0
	0	1	11	2	0	0	2	0	0	0	0	0	0	1	0	16	0	0	33	0
PINANG																				
PULAU_PINANG	39	1	47	2	0	1	0	1	13	0	0	0	0	1	3	67	0	0	175	14
SEBERABG_PERAI	3	4	126	5	0	26	1	5	12	8	25	12	15	131	28	23	2	0	426	23
	42	5	173	7	0	27	1	6	25	8	25	12	15	132	31	90	2	0	601	37
																			0	
SELANGOR																			0	
PETALING_JAYA	0	1	36	5	1	5	0	11	0	2	0	6	3	106	5	119	2	0	302	29
SHAH_ALAM	4	1	69	9	0	11	0	5	0	5	0	8	1	2	3	10	0	0	128	27
HULU_SELANGOR	1	0	18	0	1	6	6	1	0	1	0	6	0	1	0	93	0	0	134	10
KUALA_LANGAT	0	4	60	1	0	0	0	0	0	0	0	2	0	1	0	113	0	0	181	1
KUALA_SELANGOR	1	4	29	3	1	0	0	3	0	1	0	5	0	12	1	119	0	0	179	1
SABAK_BERMAN	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	72	0	0	82	0
SEPANG	0	1	37	0	1	1	0	1	0	1	0	1	0	5	0	41	0	0	89	11
AMPANG_JAYA	0	2	31	1	2	2	0	1	0	12	0	21	2	23	12	5	7	0	121	26
KAJANG	0	8	141	10	12	7	1	10	0	8	0	18	2	15	14	1	3	0	250	37
KLANG	0	17	237	2	4	3	0	1	0	8	0	12	0	6	4	290	10	0	594	27
SELAYANG	0	1	51	0	4	19	0	7	2	7	0	17	0	11	6	59	0	0	184	17
SUBAN_JAPA	0	0	46	1	2	23	0	7	0	12	0	7	0	2	11	1	2	0	114	33
	6	39	765	32	28	77	7	47	2	57	0	103	8	184	56	923	24	0	2,358	219

(1) Number of Sewage Treatment Plants by Treatment Process

	AS	AB	EA	HK	IDEA	OD	SATS	SBR	TF	AL	BD	OP	RBC	IT	BF	CST	BS	UASB	Total	NPS
TERENGGANU																				
BESUT	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	29	0	0	30	0
DUNGUN	0	0	3	2	0	0	0	0	0	0	0	0	0	1	0	17	0	0	23	3
HULU_TERENGGANU	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	4	0	0	6	0
MARANG	0	0	1	1	0	0	0	0	0	0	0	1	0	1	0	6	0	0	10	0
SETIU	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	6	0	0	7	0
KEMAMAN	0	0	6	0	0	1	0	1	0	0	0	3	0	4	0	29	0	0	44	3
KUALA_TERENGGANU	1	0	14	8	0	0	3	0	0	0	0	0	0	14	1	57	0	0	98	3
	1	1	24	12	0	1	4	1	0	0	0	4	0	21	1	148	0	0	218	9
KUALA LUMPUR																				
KUALA_LUMPUR	2	5	49	12	3	6	0	8	0	17	0	24	2	88	4	16	3	0	239	61
	2	5	49	12	3	6	0	8	0	17	0	24	2	88	4	16	3	0	239	61
LABUAN																				
LABUAN	0	1	6	6	0	0	0	1	0	1	0	1	1	3	0	5	0	0	25	15
	0	1	6	6	0	0	0	1	0	1	0	1	1	3	0	5	0	0	25	15
PUTRAJAYA																				
PUTRAJAYA	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8
	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	8
Total	160	104	2,288	229	40	160	33	108	41	132	25	439	34	740	116	3,600	31	1	8,281	553

(2) Total Connected Population Equivalent (PE) to Existing Sewage Treatment Plants by Treatment Process

	AS	AB	EA	HK	IDEA	OD	SATS	SBR	TF	AL	BD	OP	RBC	IT	BF	CST	BS	UASB	Total	NPS
PAHANG																				
BERA	0	0	4,832	0	0	0	0	0	0	0	0	3,630	0	480	0	410	0	0	9,352	1,500
CAMERON_HIGHLANDS	0	650	21,190	1,350	0	0	0	0	0	0	0	0	0	1,558	0	2,818	0	0	27,566	0
JERANTUT	0	0	5,457	0	0	0	0	0	0	0	0	1,465	0	220	0	160	0	0	7,302	0
LIPIS	0	0	1,363	425	0	0	0	0	0	0	0	0	0	3,245	0	410	0	0	5,443	0
MARAN	0	0	3,880	835	0	0	310	0	0	0	0	2,785	0	0	0	690	0	0	8,500	0
PEKAN	750	0	650	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,400	0
RAUB	0	0	1,898	345	0	0	0	0	0	0	0	0	0	0	0	2,640	0	0	4,883	0
ROMPIN	0	0	225	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	225	0
BENTONG	658	635	21,916	450	0	0	0	0	0	0	0	5,455	0	2,100	0	1,485	0	0	32,699	0
KUANTAN	1,067	887	53,750	3,947	0	9,704	273	14,737	17,110	0	0	46,424	2,210	5,076	1,244	2,727	0	0	159,156	4,642
TEMERLOH	0	0	16,496	1,210	0	0	0	0	0	7,115	0	15,660	0	1,015	0	2,460	0	0	43,956	0
	2,475	2,172	131,657	8,562	0	9,704	583	14,737	17,110	7,115	0	75,419	2,210	13,694	1,244	13,800	0	0	300,482	6,142
PERAK																				
IPOH	140,054	5,894	136,747	9,363	2,030	24,347	0	38,523	11,347	107,745	0	153,820	29,231	11,109	6,186	59,524	0	0	735,920	70,149
GRIK	0	0	2,705	600	0	0	0	0	0	0	0	0	0	0	0	1,245	0	0	4,550	0
KERIAN	2,677	335	28,842	0	0	0	0	2,126	0	0	0	5,336	0	530	0	4,302	0	0	44,148	0
KINTA_BARAT	2,360	980	31,246	1,546	0	0	0	8,009	0	3,720	0	5,927	0	3,392	0	4,310	0	0	61,490	205
KINTA_SELATAN	24,649	0	22,557	650	0	0	0	0	0	3,372	0	6,210	0	2,664	0	6,105	0	0	66,207	4,726
LENGGONG	0	0	0	0	0	0	0	0	0	0	0	860	0	0	0	1,075	0	0	1,935	0
PENGKALAN_HULU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,590	0	0	1,590	0
PERAK_TENGAH	0	0	15,483	550	0	0	0	0	0	0	0	913	0	0	0	3,865	0	0	20,811	1,730
SELAMA	0	280	2,206	0	0	0	0	0	0	0	0	960	0	1,075	0	1,965	0	0	6,486	0
TANJUNG_MALIM	0	0	8	2	0	2	0	0	0	0	0	0	0	1	0	33	0	0	46	0
TAPAH	0	0	7,500	0	0	0	0	0	0	0	0	1,045	0	395	0	2,010	0	0	10,950	0
KUALA_KANGSAR	1,346	626	18,747	1,819	0	0	0	0	0	1,231	0	8,938	0	6,189	0	9,560	0	0	48,456	2,068
MANJUNG	13,369	808	33,193	1,100	0	0	0	2,315	0	22,449	0	4,761	0	11,448	1,509	4,978	0	0	95,930	20,234
TAIPING	12,881	1,911	28,801	2,039	0	0	0	3,344	0	12,095	0	38,933	0	38,201	0	13,980	0	0	152,185	9,041
TELUK_INTAN	0	0	10,105	0	0	0	0	0	0	0	0	7,478	0	7,135	0	4,650	0	0	29,368	0
	197,336	10,834	338,140	17,669	2,030	24,349	0	54,317	11,347	150,612	0	235,181	29,231	82,139	7,695	119,192	0	0	1,280,072	108,153
PERLIS																				
KANGAR	0	450	8,335	750	0	0	400	0	0	0	0	0	0	725	0	2,665	0	0	13,325	0
	0	450	8,335	750	0	0	400	0	0	0	0	0	0	725	0	2,665	0	0	13,325	0
PINANG																				
PULAU_PINANG	100,649	165	85,184	1,080	0	263,049	0	1,215	8,506	0	0	0	0	555	10,883	18,237	0	0	489,523	857,490
SEBERABG_PERAI	2,480	1,225	236,333	6,163	0	57,348	180	19,352	61,769	71,770	53,317	310,368	46,230	79,675	51,366	2,553	1,210	0	1,001,339	206,329
	103,129	1,390	321,517	7,243	0	320,397	180	20,567	70,275	71,770	53,317	310,368	46,230	80,230	62,249	20,790	1,210	0	1,490,862	1,063,819
SELANGOR																				
PETALING_JAYA	0	375	299,372	3,035	3,075	34,725	0	159,819	0	26,760	0	39,628	15,585	112,206	37,478	10,221	5,200	0	747,479	29
SHAH_ALAM	429,410	225	247,032	11,690	0	65,785	0	33,847	0	50,180	0	45,664	650	800	9,325	1,310	0	0	895,918	27
HULU_SELANGOR	653	0	212,377	0	12,975	39,730	455	3,608	0	3,025	0	10,840	0	1,500	0	4,680	0	0	289,843	10
KUALA_LANGAT	0	1,530	63,715	250	0	0	0	0	0	0	0	2,596	0	385	0	9,495	0	0	77,971	1
KUALA_SELANGOR	3,370	1,196	30,319	1,450	16,521	0	0	37,215	0	2,850	0	11,625	0	4,360	740	11,625	0	0	121,271	1
SABAK_BERMAN	0	0	6,522	0	0	0	0	0	0	0	0	0	0	0	0	7,185	0	0	13,707	0
SEPANG	0	225	58,301	0	9,714	28,435	0	10,695	0	2,560	0	503	0	1,611	0	3,810	0	0	115,854	11
AMPANG_JAYA	0	1,780	135,887	315	5,425	36,390	0	4,005	0	90,172	0	121,458	4,685	45,557	94,273	6,660	89,227	0	635,834	26
KAJANG	0	5,138	482,702	6,974	127,031	29,372	350	82,308	0	108,447	0	45,315	2,871	12,800	30,363	260	4,861	0	938,792	37
KLANG	0	8,810	335,405	774	48,752	37,500	0	1,290	0	62,990	0	33,435	0	6,015	8,555	24,819	23,100	0	591,445	27
SELAYANG	0	3,750	163,636	0	16,498	140,212	0	36,443	10,395	46,151	0	72,860	0	12,840	11,690	4,040	0	0	518,515	17
SUBAN_JAPA	0	0	209,878	3,572	9,960	396,295	0	104,390	0	165,345	0	43,160	0	1,400	68,612	600	20,700	0	1,023,912	33
	433,433	23,029	2,245,146	28,060	249,951	808,444	805	473,620	10,395	558,480	0	427,084	23,791	199,474	261,036	84,705	143,088	0	5,970,541	219

(2) Total Connected Population Equivalent (PE) to Existing Sewage Treatment Plants by Treatment Process

	AS	AB	EA	HK	IDEA	OD	SATS	SBR	TF	AL	BD	OP	RBC	IT	BF	CST	BS	UASB	Total	NPS
JOHOR																				
KOTA_TINGGI	0	0	18,457	175	0	0	0	0	0	0	0	1,846	0	0	0	1,210	0	0	21,688	5,045
LABIS	0	0	3,871	0	0	0	0	0	0	0	0	0	0	0	0	2,975	0	0	6,846	0
MERSING	0	0	1,205	1,335	0	0	0	0	0	0	0	550	0	0	0	3,275	0	0	6,365	0
PONTIAN	0	0	16,120	0	0	6,915	0	7,515	0	0	0	3,115	0	965	0	1,510	0	0	36,140	0
SEGAMAT	0	0	31,037	0	0	0	0	1,205	0	0	0	13,092	0	760	0	1,890	0	0	47,984	1,140
SIMPANG_RENGGAM	0	0	13,202	0	0	1,300	0	0	0	0	0	2,200	0	0	0	2,230	0	0	18,932	0
TANGKAK	0	0	21,635	780	0	0	0	0	0	0	0	0	0	0	0	160	0	0	22,575	1,150
YONG_PENG	0	0	3,529	0	0	0	0	0	0	0	0	0	0	0	0	520	0	0	4,049	775
BARU_PAHAT	0	0	22,504	0	0	0	0	0	0	0	0	13,916	0	0	0	3,020	0	0	39,440	0
JOHOR_BAHRU_TENGAH	6,295	485	188,802	0	0	99,913	0	92,084	7,690	46,635	0	180,719	0	23,059	0	5,450	0	6,992	658,124	158,048
KULUANG	0	0	23,394	625	0	0	0	15,410	0	8,900	0	55,677	0	6,109	0	13,540	0	0	123,655	3,090
KULAI	0	0	64,520	670	0	35,061	0	48,627	2,238	0	0	14,895	0	755	6,735	1,115	0	0	174,616	32,541
MUAR	0	2,355	30,744	742	0	0	180	0	0	0	0	11,065	0	2,755	0	7,755	0	0	55,596	0
	6,295	2,840	439,020	4,327	0	143,189	180	164,841	9,928	55,535	0	297,075	0	34,403	6,735	44,650	0	6,992	1,216,010	201,789
KEDAH																				
ALOR_STAR	0	1,063	44,805	6,074	0	0	937	0	0	0	0	42,748	0	7,152	0	10,758	0	0	113,537	3,669
BALING	0	0	9,947	0	0	0	150	0	0	0	0	0	0	200	0	2,372	0	0	12,669	995
BANDAR_BAHARU	0	0	5,544	0	0	0	0	0	0	0	0	0	0	0	0	1,205	0	0	6,749	0
KUBANG_PASU	0	0	34,429	1,780	0	0	85	1,305	0	0	0	7,235	0	0	0	5,561	0	0	50,395	0
PADANG_TERAP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	884	0	0	884	0
PENDANG	0	0	975	0	0	0	0	0	0	0	0	0	0	0	0	1,235	0	0	2,210	0
SIK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	305	0	0	305	0
YAN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	710	0	0	710	0
LBP	0	0	15,837	835	0	0	0	0	0	0	0	0	0	0	0	400	0	0	17,072	10,490
KULIM	0	0	94,893	12,955	0	760	0	3,950	1,650	7,587	0	25,638	0	1,050	2,600	3,730	0	0	154,813	9,733
SUNGAI_PETANI	0	200	79,986	1,894	8,709	59,272	0	9,120	0	0	0	14,025	160	9,472	0	16,980	0	0	199,818	21,603
	0	1,263	286,416	23,538	8,709	60,032	1,172	14,375	1,650	7,587	0	89,646	160	17,874	2,600	44,140	0	0	559,162	46,490
MELAKA																				
MELAKA_BERSEJARAH	50,492	14,620	208,426	34,453	4,385	2,175	1,590	9,118	7,190	1,600	0	43,853	240	15,831	17,405	15,845	1,939	0	429,162	16,665
JASIN	0	0	44,362	1,400	0	0	0	2,673	0	0	0	2,545	0	3,255	0	7,945	0	320	62,500	0
ALOR_GAJAH	805	2,190	65,999	3,603	3,166	0	0	0	0	0	0	5,671	0	1,890	0	7,565	0	0	90,889	230
	51,297	16,810	318,787	39,456	7,551	2,175	1,590	11,791	7,190	1,600	0	52,069	240	20,976	17,405	31,355	1,939	320	582,551	16,895
NEGERI SEMBILAN																				
JELEBU	0	0	935	0	0	0	0	0	0	0	0	2,390	0	0	0	3,000	0	0	6,325	0
JEMPOL	255	0	11,834	935	0	0	0	0	0	0	0	15,300	0	2,820	4,155	3,745	0	0	39,044	0
KUALA_PILAH	315	0	9,239	605	0	0	0	0	0	0	0	2,980	0	2,060	0	5,840	0	0	21,039	330
REMBAU	0	0	14,451	2,600	0	0	0	0	0	0	0	1,735	0	460	0	5,010	0	0	24,256	2,425
TAMPIN	0	0	10	3	0	0	0	0	0	0	0	14	0	2	0	80	0	0	109	0
NILAI	20,000	2,050	92,752	11,135	19,518	113,232	0	13,988	0	9,845	0	23,757	0	2,590	0	4,725	0	0	313,592	48,090
PORT_DICKSON	412	840	62,449	3,795	0	2,738	0	11,342	3,477	2,760	0	3,605	2,191	5,085	10,135	4,230	0	0	113,059	5,275
SEREMBAN	2,300	1,130	95,558	5,040	5,135	6,930	375	9,430	870	20,255	0	198,091	0	29,909	4,210	6,200	0	0	385,433	47,714
	23,282	4,020	287,228	24,113	24,653	122,900	375	34,760	4,347	32,860	0	247,872	2,191	42,926	18,500	32,830	0	0	902,857	103,834

(2) Total Connected Population Equivalent (PE) to Existing Sewage Treatment Plants by Treatment Process

	AS	AB	EA	HK	IDEA	OD	SATS	SBR	TF	AL	BD	OP	RBC	IT	BF	CST	BS	UASB	Total	NPS
TERENGGANU																				
BESUT	0	360	0	0	0	0	0	0	0	0	0	0	0	0	0	2,740	0	0	3,100	0
DUNGUN	0	0	4,589	4,345	0	0	0	0	0	0	0	0	0	450	0	1,815	0	0	11,199	2,785
HULU_TERENGGANU	0	0	0	460	0	0	0	0	0	0	0	0	0	220	0	385	0	0	1,065	0
MARANG	0	0	323	206	0	0	0	0	0	0	0	63	0	696	0	765	0	0	2,053	0
SETIU	0	0	0	0	0	0	171	0	0	0	0	0	0	0	0	400	0	0	571	0
KEMAMAN	0	0	7,970	0	0	0	0	3,200	0	0	0	3,315	0	305	0	100	0	0	14,890	1,830
KUALA_TERENGGANU	1,050	0	15,581	12,220	0	0	760	0	0	0	0	0	0	4,460	1,275	6,448	0	0	41,794	3,255
	1,050	360	28,463	17,231	0	0	931	3,200	0	0	0	3,378	0	6,131	1,275	12,653	0	0	74,672	7,870
KUALA LUMPUR																				
KUALA_LUMPUR	158,500	5,343	267,469	33,282	9,800	58,017	0	158,453	0	1,640,984	0	135,789	7,610	61,691	15,555	11,610	18,470	0	2,582,573	595,583
	158,500	5,343	267,469	33,282	9,800	58,017	0	158,453	0	1,640,984	0	135,789	7,610	61,691	15,555	11,610	18,470	0	2,582,573	595,583
LABUAN																				
LABUAN	0	1,010	79,347	1,833	0	0	0	2,885	0	20,701	0	3,750	640	1,960	0	790	0	0	112,916	121,327
	0	1,010	79,347	1,833	0	0	0	2,885	0	20,701	0	3,750	640	1,960	0	790	0	0	112,916	121,327
PUTRAJAYA																				
PUTRAJAYA	0	0	73,801	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73,801	103,086
	0	0	73,801	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73,801	103,086
Total	976,797	69,521	4,751,525	206,064	302,694	1,549,207	6,216	953,546	132,242	2,547,244	53,317	1,877,631	112,303	562,223	394,294	419,180	164,707	7,312	15,086,023	2,272,121

(3) Treatment Efficiency by Existing STPs

Estimated Effluent BOD5 (mg/L)	20	20	20	20	20	20	20	20	30	30	30	30	40	40	50	70	80	100			55 (g / capita / day)	
	Effluent Load (ton / day)																			NPS	Influent Load	Treatment Eff.
Treatment Process	AS	AB	EA	HK	IDEA	OD	SATS	SBR	TF	AL	BD	OP	RBC	IT	BF	CST	BS	UASB	Total		(ton / day)	(%)
PAHANG																						
BERA			0.022									0.025		0.004		0.006			0.057	0.000	0.514	88.9
CAMERON_HIGHLANDS		0.003	0.095	0.006										0.014		0.044			0.162		1.516	89.3
JERANTUT			0.025									0.010		0.002		0.003			0.040		0.402	90.0
LIPIS			0.006	0.002										0.029		0.006			0.043		0.299	85.6
MARAN			0.017	0.004			0.001					0.019				0.011			0.052		0.468	88.9
PEKAN	0.003		0.003																0.006		0.077	92.2
RAUB			0.009	0.002												0.042			0.053		0.269	80.3
ROMPIN			0.001																0.001		0.012	91.7
BENTONG	0.003	0.003	0.099	0.002								0.037		0.019		0.023			0.186		1.798	89.7
KUANTAN	0.005	0.004	0.242	0.018		0.044	0.001	0.066	0.115			0.313	0.020	0.046	0.014	0.043			0.931	0.000	8.754	89.4
TEMERLOH			0.074	0.005						0.048		0.106		0.009		0.039			0.281		2.418	88.4
	0.011	0.010	0.592	0.039		0.044	0.003	0.066	0.115	0.048		0.509	0.020	0.123	0.014	0.217			1.811	0.000	16.527	89.0
PERAK																						
IPOH	0.630	0.027	0.615	0.042	0.009	0.110		0.173	0.077	0.727		1.038	0.263	0.100	0.070	0.938			4.819	0.000	40.476	88.1
GRIK			0.012	0.003												0.020			0.035		0.250	86.0
KERIAN	0.012	0.002	0.130					0.010				0.036		0.005		0.068			0.263		2.428	89.2
KINTA_BARAT	0.011	0.004	0.141	0.007				0.036		0.025		0.040		0.031		0.068			0.363	0.000	3.382	89.3
KINTA_SELATAN	0.111		0.102	0.003						0.023		0.042		0.024		0.096			0.401	0.000	3.641	89.0
LENGGONG												0.006				0.017			0.023		0.106	78.3
PENGKALAN_HULU																0.025			0.025		0.087	71.3
PERAK_TENGAH			0.070	0.002								0.006				0.061			0.139	0.000	1.145	87.9
SELAMA		0.001	0.010									0.006		0.010		0.031			0.058		0.357	83.8
TANJUNG_MALIM			0.000	0.000		0.000								0.000		0.001			0.001		0.003	66.7
TAPAH			0.034									0.007		0.004		0.032			0.077		0.602	87.2
KUALA_KANGSAR	0.006	0.003	0.084	0.008						0.008		0.060		0.056		0.151			0.376	0.000	2.665	85.9
MANJUNG	0.060	0.004	0.149	0.005				0.010		0.152		0.032		0.103	0.017	0.078			0.610	0.000	5.276	88.4
TAIPING	0.058	0.009	0.130	0.009				0.015		0.082		0.263		0.344		0.220			1.130	0.000	8.370	86.5
TELUK_INTAN			0.045									0.050		0.064		0.073			0.232		1.615	85.6
	0.888	0.049	1.522	0.080	0.009	0.110		0.244	0.077	1.017		1.587	0.263	0.739	0.087	1.877			8.549	0.000	70.404	87.9
PERLIS																						
KANGAR		0.002	0.038	0.003			0.002							0.007		0.042			0.094		0.733	87.2
		0.002	0.038	0.003			0.002							0.007		0.042			0.094		0.733	87.2
PINANG																						
PULAU_PINANG	0.453	0.001	0.383	0.005		1.184		0.005	0.057					0.005	0.122	0.287			2.502	0.000	26.924	90.7
SEBERABG_PERAI	0.011	0.006	1.063	0.028		0.258	0.001	0.087	0.417	0.484	0.360	2.095	0.416	0.717	0.578	0.040	0.022		6.583	0.000	55.074	88.0
	0.464	0.006	1.447	0.033		1.442	0.001	0.093	0.474	0.484	0.360	2.095	0.416	0.722	0.700	0.327	0.022		9.086	0.000	81.997	88.9
SELANGOR																						
PETALING_JAYA		0.002	1.347	0.014	0.014	0.156		0.719		0.181		0.267	0.140	1.010	0.422	0.161	0.094		4.527	0.000	41.111	89.0
SHAH_ALAM	1.932	0.001	1.112	0.053		0.296		0.152		0.339		0.308	0.006	0.007	0.105	0.021			4.332	0.000	49.275	91.2
HULU_SELANGOR	0.003		0.956		0.058	0.179	0.002	0.016		0.020		0.073		0.014		0.074			1.395	0.000	15.941	91.2
KUALA_LANGAT		0.007	0.287	0.001								0.018		0.003		0.150			0.466	0.000	4.288	89.1
KUALA_SELANGOR	0.015	0.005	0.136	0.007	0.074			0.167		0.019		0.078		0.039	0.008	0.183			0.731	0.000	6.670	89.0
SABAK_BERMAN			0.029													0.113			0.142		0.754	81.2
SEPANG		0.001	0.262		0.044	0.128		0.048		0.017		0.003		0.014		0.060			0.577	0.000	6.372	90.9
AMPANG_JAYA		0.008	0.611	0.001	0.024	0.164		0.018		0.609		0.820	0.042	0.410	1.061	0.105	1.606		5.479	0.000	34.971	84.3
KAJANG		0.023	2.172	0.031	0.572	0.132	0.002	0.370		0.732		0.306	0.026	0.115	0.342	0.004	0.087		4.914	0.000	51.634	90.5
KLANG		0.040	1.509	0.003	0.219	0.169		0.006		0.425		0.226		0.054	0.096	0.391	0.416		3.554	0.000	32.529	89.1
SELAYANG		0.017	0.736		0.074	0.631		0.164	0.070	0.312		0.492		0.116	0.132	0.064			2.808	0.000	28.518	90.2
SUBAN_JAPA			0.944	0.016	0.045	1.783		0.470		1.116		0.291		0.013	0.772	0.009	0.373		5.832	0.000	56.315	89.6
	1.950	0.104	10.103	0.126	1.125	3.638	0.004	2.131	0.070	3.770		2.883	0.214	1.795	2.937	1.334	2.576		34.760	0.000	328.380	89.4

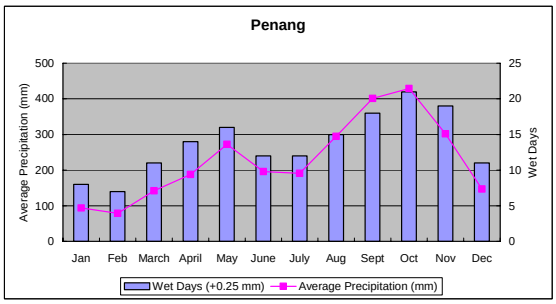
(3) Treatment Efficiency by Existing STPs

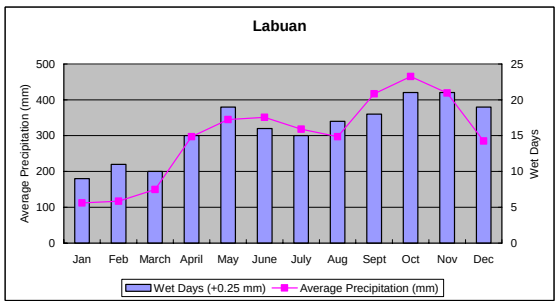
Estimated Effluent BOD5 (mg/L)	20	20	20	20	20	20	20	20	30	30	30	30	40	40	50	70	80	100			55 (g / capita / day)	
	Effluent Load (ton / day)																			NPS	Influent Load	Treatment Eff.
Treatment Process	AS	AB	EA	HK	IDEA	OD	SATS	SBR	TF	AL	BD	OP	RBC	IT	BF	CST	BS	UASB	Total		(ton / day)	(%)
JOHOR																						
KOTA_TINGGI			0.083	0.001								0.012				0.019			0.115	0.000	1.193	90.4
LABIS			0.017													0.047			0.064		0.377	83.0
MERSING			0.005	0.006								0.004				0.052			0.067		0.350	80.9
PONTIAN			0.073			0.031		0.034				0.021		0.009		0.024			0.192		1.988	90.3
SEGAMAT			0.140					0.005				0.088		0.007		0.030			0.270	0.000	2.639	89.8
SIMPANG_RENGGAM			0.059			0.006						0.015				0.035			0.115		1.041	89.0
TANGKAK			0.097	0.004												0.003			0.104	0.000	1.242	91.6
YONG_PENG			0.016													0.008			0.024	0.000	0.223	89.2
BARU_PAHAT			0.101									0.094				0.048			0.243		2.169	88.8
JOHOR_BAHRU_TENGAH	0.028	0.002	0.850			0.450		0.414	0.052	0.315		1.220		0.208		0.086		0.157	3.782	0.000	36.197	89.6
KULUANG			0.105	0.003				0.069		0.060		0.376		0.055		0.213			0.881	0.000	6.801	87.0
KULAI			0.290	0.003		0.158		0.219	0.015			0.101		0.007	0.076	0.018			0.887	0.000	9.604	90.8
MUAR		0.011	0.138	0.003			0.001					0.075		0.025		0.122			0.375		3.058	87.7
	0.028	0.013	1.976	0.019		0.644	0.001	0.742	0.067	0.375		2.005		0.310	0.076	0.703		0.157	7.116	0.000	66.881	89.4
KEDAH																						
ALOR_STAR		0.005	0.202	0.027			0.004					0.289		0.064		0.169			0.760	0.000	6.245	87.8
BALING			0.045				0.001							0.002		0.037			0.085	0.000	0.697	87.8
BANDAR_BAHARU			0.025													0.019			0.044		0.371	88.1
KUBANG_PASU			0.155	0.008			0.000	0.006				0.049				0.088			0.306		2.772	89.0
PADANG_TERAP																0.014			0.014		0.049	71.4
PENDANG			0.004													0.019			0.023		0.122	81.1
SIK																0.005			0.005		0.017	70.6
YAN																0.011			0.011		0.039	71.8
LBP			0.071	0.004												0.006			0.081	0.000	0.939	91.4
KULIM			0.427	0.058		0.003		0.018	0.011	0.051		0.173		0.009	0.029	0.059			0.838	0.000	8.515	90.2
SUNGAI_PETANI		0.001	0.360	0.009	0.039	0.267		0.041				0.095	0.001	0.085		0.267			1.165	0.000	10.990	89.4
		0.006	1.289	0.106	0.039	0.270	0.005	0.065	0.011	0.051		0.605	0.001	0.161	0.029	0.695			3.333	0.000	30.754	89.2
MELAKA																						
MELAKA_BERSEJARAH	0.227	0.066	0.938	0.155	0.020	0.010	0.007	0.041	0.049	0.011		0.296	0.002	0.142	0.196	0.250	0.035		2.445	0.000	23.604	89.6
JASIN			0.200	0.006				0.012				0.017		0.029		0.125		0.007	0.396		3.438	88.5
ALOR_GAJAH	0.004	0.010	0.297	0.016	0.014							0.038		0.017		0.119			0.515	0.000	4.999	89.7
	0.231	0.076	1.435	0.178	0.034	0.010	0.007	0.053	0.049	0.011		0.351	0.002	0.189	0.196	0.494	0.035	0.007	3.358	0.000	32.040	89.5
NEGERI SEMBILAN																						
JELEBU			0.004									0.016				0.047			0.067		0.348	80.7
JEMPOL	0.001		0.053	0.004								0.103		0.025	0.047	0.059			0.292		2.147	86.4
KUALA_PILAH	0.001		0.042	0.003								0.020		0.019		0.092			0.177	0.000	1.157	84.7
REMBAU			0.065	0.012								0.012		0.004		0.079			0.172	0.000	1.334	87.1
TAMPIN			0.000	0.000								0.000		0.000		0.001			0.001		0.006	83.3
NILAI	0.090	0.009	0.417	0.050	0.088	0.510		0.063		0.066		0.160		0.023		0.074			1.550	0.000	17.248	91.0
PORT_DICKSON	0.002	0.004	0.281	0.017		0.012		0.051	0.023	0.019		0.024	0.020	0.046	0.114	0.067			0.680	0.000	6.218	89.1
SEREMBAN	0.010	0.005	0.430	0.023	0.023	0.031	0.002	0.042	0.006	0.137		1.337		0.269	0.047	0.098			2.460	0.000	21.199	88.4
	0.105	0.018	1.293	0.109	0.111	0.553	0.002	0.156	0.029	0.222		1.673	0.020	0.386	0.208	0.517			5.402	0.000	49.657	89.1

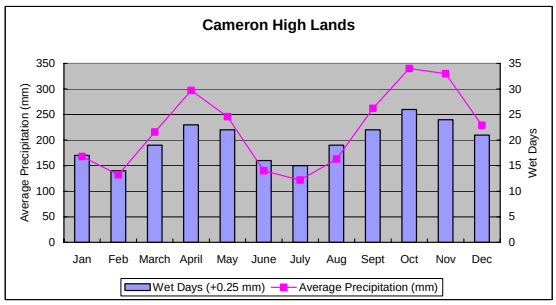
(3) Treatment Efficiency by Existing STPs

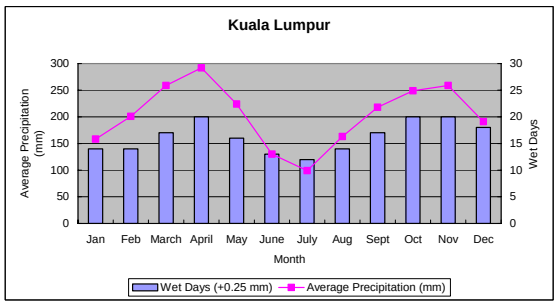
Estimated Effluent BOD5 (mg/L)	20	20	20	20	20	20	20	20	30	30	30	30	40	40	50	70	80	100			55 (g / capita / day)	
Treatment Process	Effluent Load (ton / day)																			NPS	Influent Load (ton / day)	Treatment Eff. (%)
	AS	AB	EA	HK	IDEA	OD	SATS	SBR	TF	AL	BD	OP	RBC	IT	BF	CST	BS	UASB	Total			
TERENGGANU																						
BESUT		0.002														0.043			0.045		0.171	73.7
DUNGUN			0.021	0.020										0.004		0.029			0.074	0.000	0.616	88.0
HULU_TERENGGANU				0.002										0.002		0.006			0.010		0.059	83.1
MARANG			0.001	0.001								0.000		0.006		0.012			0.020		0.113	82.3
SETIU							0.001									0.006			0.007		0.031	77.4
KEMAMAN			0.036					0.014				0.022		0.003		0.002			0.077	0.000	0.819	90.6
KUALA_TERENGGANU	0.005		0.070	0.055			0.003							0.040	0.014	0.102			0.289	0.000	2.299	87.4
	0.005	0.002	0.128	0.078			0.004	0.014				0.023		0.055	0.014	0.199			0.522	0.000	4.107	87.3
KUALA LUMPUR																						
KUALA_LUMPUR	0.713	0.024	1.204	0.150	0.044	0.261		0.713		11.077		0.917	0.068	0.555	0.175	0.183	0.332		16.416	0.000	142.042	88.4
	0.713	0.024	1.204	0.150	0.044	0.261		0.713		11.077		0.917	0.068	0.555	0.175	0.183	0.332		16.416	0.000	142.042	88.4
LABUAN																						
LABUAN		0.005	0.357	0.008				0.013		0.140		0.025	0.006	0.018		0.012			0.584	0.000	6.210	90.6
		0.005	0.357	0.008				0.013		0.140		0.025	0.006	0.018		0.012			0.584	0.000	6.210	90.6
PUTRAJAYA																						
PUTRAJAYA			0.332																0.332	0.000	4.059	91.8
			0.332																0.332	0.000	4.059	91.8
Total	4.396	0.313	21.382	0.927	1.362	6.971	0.028	4.291	0.893	17.194	0.360	12.674	1.011	5.060	4.436	6.602	2.965	0.165	91.030	0.000	829.731	89.0

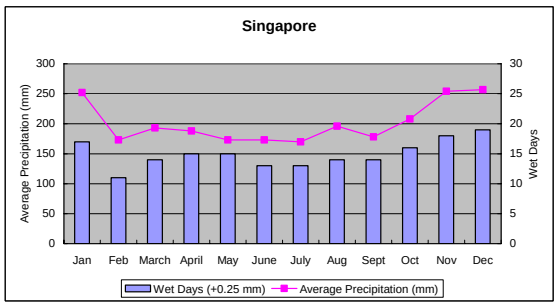
APPENDIX 3-G RAINFALL AND WET DAYS OF MAJOR CITIES IN MALAYSIA

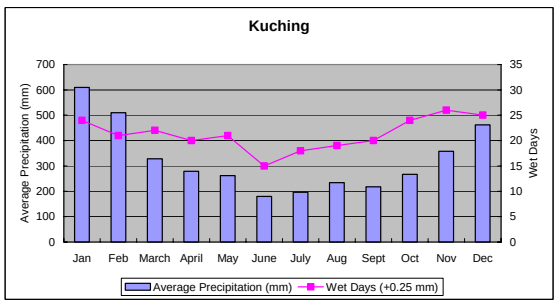












APPENDIX 3-H REFERENCE

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APPENDIX 3-I TREATMENT EFFICIENCY BY EXISTING STPS AND ISTS (1/2)

	STP						IST						STP + IST				Score
	No. of STPs (nos.)	Total PE (PE)	Eff. Load (ton / day)	Inf. Load (ton / day)	Efficiency (%)	O&M Red.	No. of ISTs (nos.)	Total PE (PE)	Eff. Load (ton / day)	Inf. Load (ton / day)	Efficiency (%)	O&M Red.	Eff. Load (ton / day)	Inf. Load (ton / day)	Efficiency (%)	O&M Red.	
MP SELAYANG	184	518,515	2.808	28.518	90.2	106.01	16,646	83,230	1.311	4.578	71.36	7.62	4.119	33.096	87.55	113.630	4
MD HULU SELANGOR	134	289,843	1.395	15.941	91.2	81.04	9,926	49,630	0.782	2.730	71.36	4.54	2.177	18.671	88.34	85.580	3
MP SUBANG JAYA	114	1,023,912	5.832	56.315	89.6	229.07	6,038	30,190	0.475	1.660	71.39	2.76	6.307	57.975	89.12	231.830	3
MB PETALING JAYA	302	747,479	4.527	41.111	89.0	183.34	11,802	59,010	0.929	3.246	71.38	5.40	5.456	44.357	87.70	188.740	4
MB SHAH ALAM	128	895,918	4.332	49.275	91.2	140.88	1,808	9,040	0.142	0.497	71.43	0.83	4.474	49.772	91.01	141.710	3
MD SEPANG	89	115,854	0.577	6.372	90.9	33.94	5,751	28,755	0.453	1.582	71.37	2.63	1.030	7.954	87.05	36.570	1
MP KAJANG	250	938,792	4.914	51.634	90.5	208.89	16,401	82,005	1.292	4.510	71.35	7.51	6.206	56.144	88.95	216.400	4
MP AMPANG JAYA	121	635,834	5.479	34.971	84.3	153.05	12,231	61,155	0.963	3.364	71.37	5.60	6.442	38.335	83.20	158.650	4
MP KLANG	594	591,445	3.554	32.529	89.1	164.48	36,425	182,125	2.868	10.017	71.37	16.68	6.422	42.546	84.91	181.160	4
MD SABAK BERNAM	82	13,707	0.142	0.754	81.2	6.15	5,726	28,630	0.451	1.575	71.37	2.62	0.593	2.329	74.54	8.770	1
MD KUALA SELANGOR	179	121,271	0.731	6.670	89.0	36.11	7,869	39,345	0.620	2.164	71.35	3.60	1.351	8.834	84.71	39.710	1
MD KUALA LANGAT	181	77,971	0.466	4.288	89.1	22.58	12,743	63,715	1.004	3.504	71.35	5.83	1.470	7.792	81.13	28.410	2
DB KUALA LUMPUR	239	2,582,573	16.416	142.042	88.4	323.57	57,132	285,660	4.499	15.711	71.36	26.16	20.915	157.753	86.74	349.730	4
WP LABUAN	25	112,916	0.584	6.210	90.6	16.39	4,708	23,540	0.371	1.295	71.35	2.16	0.955	7.505	87.28	18.550	1
PERBADANAN PUTRAJAYA	1	73,801	0.332	4.059	91.8	21.50							0.332	4.059	91.82	21.500	1
MD KOTA TINGGI	24	21,688	0.115	1.193	90.4	6.68	10,529	52,645	0.829	2.895	71.36	4.82	0.944	4.088	76.91	11.500	1
MD MERSING	61	6,365	0.067	0.350	80.9	3.08	5,613	28,065	0.442	1.544	71.37	2.57	0.509	1.894	73.13	5.650	1
MP JOHOR BAHRU TENGAH	38	658,124	3.782	36.197	89.6	153.08	31,820	159,100	2.506	8.751	71.36	14.57	6.288	44.948	86.01	167.650	4
MP KULAI	58	174,616	0.887	9.604	90.8	49.24	16,330	81,650	1.286	4.491	71.36	7.48	2.173	14.095	84.58	56.720	2
MD PONTIAN	37	36,140	0.192	1.988	90.3	8.63	7,463	37,315	0.588	2.052	71.35	3.42	0.780	4.040	80.69	12.050	1
MD LABIS	38	6,846	0.064	0.377	83.0	2.59	8,662	43,310	0.682	2.382	71.37	3.97	0.746	2.759	72.96	6.560	1
MD SEGAMAT	43	47,984	0.270	2.639	89.8	12.98	16,827	84,135	1.325	4.627	71.36	7.70	1.595	7.266	78.05	20.680	2
MP BATU PAHAT	50	39,440	0.243	2.169	88.8	8.93	26,838	134,190	2.113	7.380	71.37	12.29	2.356	9.549	75.33	21.220	2
MD YONG PENG	12	4,049	0.024	0.223	89.2	2.10	8,103	40,515	0.638	2.228	71.36	3.71	0.662	2.451	72.99	5.810	1
MD SIMPANG RENGGAM	38	18,932	0.115	1.041	89.0	5.70	4,680	23,400	0.369	1.287	71.33	2.14	0.484	2.328	79.21	7.840	1
MP KLUANG	217	123,655	0.881	6.801	87.0	30.34	21,104	105,520	1.662	5.804	71.36	9.66	2.543	12.605	79.83	40.000	2
MP MUAR	156	55,596	0.375	3.058	87.7	20.10	16,741	83,705	1.318	4.604	71.37	7.67	1.693	7.662	77.90	27.770	2
MD TANGKAK	22	22,575	0.104	1.242	91.6	6.94	9,655	48,275	0.760	2.655	71.37	4.42	0.864	3.897	77.83	11.360	1
MP SEREMBAN	262	385,433	2.460	21.199	88.4	90.66	21,273	106,365	1.675	5.850	71.37	9.74	4.135	27.049	84.71	100.400	4
MP PORT DICKSON	100	113,059	0.680	6.218	89.1	30.87	8,150	40,750	0.642	2.241	71.35	3.73	1.322	8.459	84.37	34.600	1
MP NILAI	137	313,592	1.550	17.248	91.0	74.55	5,431	27,155	0.428	1.494	71.35	2.49	1.978	18.742	89.45	77.040	3
MD JELEBU	23	6,325	0.067	0.348	80.7	1.65	5,536	27,680	0.436	1.522	71.35	2.53	0.503	1.870	73.10	4.180	1
MD JEMPOL	86	39,044	0.292	2.147	86.4	11.06	5,571	27,855	0.439	1.532	71.34	2.55	0.731	3.679	80.13	13.610	1
MD KUALA PILAH	70	21,039	0.177	1.157	84.7	7.62	3,956	19,780	0.312	1.088	71.32	1.81	0.489	2.245	78.22	9.430	1
MD REMBAU	78	24,256	0.172	1.334	87.1	8.14	2,034	10,170	0.160	0.559	71.38	0.93	0.332	1.893	82.46	9.070	1
MD TAMPIN	109	109	0.001	0.006	83.3	11.55	6,493	32,465	0.511	1.786	71.39	2.97	0.512	1.792	71.43	14.520	1
MP ALOR GAJAH	154	90,889	0.515	4.999	89.7	27.34	8,347	41,735	0.657	2.295	71.37	3.82	1.172	7.294	83.93	31.160	1
MD JASIN	121	62,500	0.396	3.438	88.5	18.94	6,400	32,000	0.504	1.760	71.36	2.93	0.900	5.198	82.69	21.870	1
MP MELAKA BERSEJARAH	447	429,162	2.445	23.604	89.6	109.73	35,818	179,090	2.821	9.850	71.36	16.40	5.266	33.454	84.26	126.130	4
MP LBP	13	17,072	0.081	0.939	91.4	5.78	3,524	17,620	0.278	0.969	71.31	1.61	0.359	1.908	81.18	7.390	1
MB ALOR STAR	140	113,537	0.760	6.245	87.8	33.95	34,781	173,905	2.739	9.565	71.36	15.93	3.499	15.810	77.87	49.880	2
MD KUBANG PASU	73	50,395	0.306	2.772	89.0	14.18	9,912	49,560	0.781	2.726	71.35	4.54	1.087	5.498	80.23	18.720	1

Appendix 3-I Treatment efficiency by existing STPs and ISTs (2/2)

	STP						IST						STP + IST				Score
	No. of STPs (nos.)	Total PE (PE)	Eff. Load (ton / day)	Inf. Load (ton / day)	Efficiency (%)	O&M Red.	No. of ISTs (nos.)	Total PE (PE)	Eff. Load (ton / day)	Inf. Load (ton / day)	Efficiency (%)	O&M Red.	Eff. Load (ton / day)	Inf. Load (ton / day)	Efficiency (%)	O&M Red.	
MD PADANG TERAP	14	884	0.014	0.049	71.4	0.68	890	4,450	0.070	0.245	71.43	0.41	0.084	0.294	71.43	1.090	1
MD PENDANG	13	2,210	0.023	0.122	81.1	0.86	2,096	10,480	0.165	0.576	71.35	0.96	0.188	0.698	73.07	1.820	1
MD SIK	3	305	0.005	0.017	70.6	0.11	612	3,060	0.048	0.168	71.43	0.28	0.053	0.185	71.35	0.390	1
MD YAN	3	710	0.011	0.039	71.8	0.11	1,682	8,410	0.132	0.463	71.49	0.77	0.143	0.502	71.51	0.880	1
MP KULIM	99	154,813	0.838	8.515	90.2	37.99	26,149	130,745	2.059	7.191	71.37	11.97	2.897	15.706	81.55	49.960	2
MP SUNGAI PETANI	319	199,818	1.165	10.990	89.4	55.84	50,698	253,490	3.992	13.942	71.37	23.21	5.157	24.932	79.32	79.050	4
MD BANDAR BAHARU	19	6,749	0.044	0.371	88.1	2.10	2,108	10,540	0.166	0.580	71.38	0.97	0.210	0.951	77.92	3.070	1
MD BALING	28	12,669	0.085	0.697	87.8	4.24	4,321	21,605	0.340	1.188	71.38	1.98	0.425	1.885	77.45	6.220	1
MP KUANTAN	192	159,156	0.931	8.754	89.4	53.40	42,486	212,430	3.346	11.684	71.36	19.45	4.277	20.438	79.07	72.850	4
MP TEMERLOH	68	43,956	0.281	2.418	88.4	14.93	12,089	60,445	0.952	3.324	71.36	5.54	1.233	5.742	78.53	20.470	2
MD JERANTUT	12	7,302	0.040	0.402	90.0	3.53	8,129	40,645	0.640	2.235	71.36	3.72	0.680	2.637	74.21	7.250	1
MD PEKAN	3	1,400	0.006	0.077	92.2	0.60	5,570	27,850	0.439	1.532	71.34	2.55	0.445	1.609	72.34	3.150	1
MD MARAN	22	8,500	0.052	0.468	88.9	3.86	3,658	18,290	0.288	1.006	71.37	1.67	0.340	1.474	76.93	5.530	1
MD ROMPIN	1	225	0.001	0.012	91.7	0.30	2,956	14,780	0.233	0.813	71.34	1.35	0.234	0.825	71.64	1.650	1
MD BERA	14	9,352	0.057	0.514	88.9	3.23	5,050	25,250	0.398	1.389	71.35	2.31	0.455	1.903	76.09	5.540	1
MD LIPIS	14	5,443	0.043	0.299	85.6	2.18	4,584	22,920	0.361	1.261	71.37	2.10	0.404	1.560	74.10	4.280	1
MD RAUB	19	4,883	0.053	0.269	80.3	1.58	8,758	43,790	0.690	2.408	71.35	4.01	0.743	2.677	72.25	5.590	1
MD BENTONG	56	32,699	0.186	1.798	89.7	11.10	9,638	48,190	0.759	2.650	71.36	4.41	0.945	4.448	78.75	15.510	1
MD CAMERON HIGHLANDS	42	27,566	0.162	1.516	89.3	7.46	1,768	8,840	0.139	0.486	71.40	0.81	0.301	2.002	84.97	8.270	1
MP KANGAR	33	13,325	0.094	0.733	87.2	5.59	15,438	77,190	1.216	4.245	71.35	7.07	1.310	4.978	73.68	12.660	2
MB IPOH	338	735,920	4.819	40.476	88.1	175.80	41,626	208,130	3.278	11.447	71.36	19.06	8.097	51.923	84.41	194.860	4
MP TELUK INTAN	99	29,368	0.232	1.615	87.9	11.18	24,579	122,895	1.936	6.759	71.36	11.25	2.168	8.374	74.11	22.430	2
MD TANJUNG MALIM	46	46	0.001	0.003	87.2	6.75	9,130	45,650	0.719	2.511	71.37	4.18	0.720	2.514	71.36	10.930	1
MD TAPAH	37	10,950	0.077	0.602	85.9	3.68	10,778	53,890	0.849	2.964	71.36	4.93	0.926	3.566	74.03	8.610	1
MD PERAK TENGAH	39	20,811	0.139	1.145	87.9	4.46	2,450	12,250	0.193	0.674	71.36	1.12	0.332	1.819	81.75	5.580	1
MD KINTA BARAT	95	61,490	0.363	3.382	89.3	18.83	5,368	26,840	0.423	1.476	71.34	2.46	0.786	4.858	83.82	21.290	1
MD KINTA SELATAN	72	66,207	0.401	3.641	89.0	21.98	11,487	57,435	0.905	3.159	71.35	5.26	1.306	6.800	80.79	27.240	2
MP MANJUNG	101	95,930	0.610	5.276	86.5	31.39	18,797	93,985	1.480	5.169	71.37	8.61	2.090	10.445	79.99	40.000	2
MP TAIPING	171	152,185	1.130	8.370	85.6	45.49	16,377	81,885	1.290	4.504	71.36	7.50	2.420	12.874	81.20	52.990	2
MP KUALA KANGSAR	129	48,456	0.376	2.665	88.4	15.79	12,020	60,100	0.947	3.306	71.36	5.50	1.323	5.971	77.84	21.290	2
MD KERIAN	69	44,148	0.263	2.428	89.2	13.61	8,777	43,885	0.691	2.414	71.38	4.02	0.954	4.842	80.30	17.630	1
MD SELAMA	25	6,486	0.058	0.357	66.7	2.40	1,197	5,985	0.094	0.329	71.43	0.55	0.152	0.686	77.84	2.950	1
MD GRIK	16	4,550	0.035	0.250	86.0	1.73	2,672	13,360	0.210	0.735	71.43	1.22	0.245	0.985	75.13	2.950	1
MD PENGKALAN HULU	14	1,590	0.025	0.087	71.3	0.64	1,182	5,910	0.093	0.325	71.38	0.54	0.118	0.412	71.36	1.180	1
MD LENGGONG	8	1,935	0.023	0.106	78.3	0.56	1,467	7,335	0.116	0.403	71.22	0.67	0.139	0.509	72.69	1.230	1
MP PULAU PINANG	175	489,523	2.502	26.924	90.7	103.48	4,951	24,755	0.390	1.362	71.37	2.27	2.892	28.286	89.78	105.750	3
MP SEBERANG PERAI	426	1,001,339	6.583	55.074	88.0	244.12	4,682	23,410	0.369	1.288	71.35	2.14	6.952	56.362	87.67	246.260	3
MP KUALA TERENGGANU	98	41,794	0.289	2.299	87.4	14.89	18,052	90,260	1.422	4.964	71.35	8.27	1.711	7.263	76.44	23.160	2
MP KEMAMAN	44	14,890	0.077	0.819	90.6	6.98	14,822	74,110	1.167	4.076	71.37	6.79	1.244	4.895	74.59	13.770	2
MD DUNGUN	23	11,199	0.074	0.616	88.0	3.79	10,176	50,880	0.801	2.798	71.37	4.66	0.875	3.414	74.37	8.450	1
MD HULU TERENGGANU	6	1,065	0.010	0.059	83.1	0.45	3,179	15,895	0.250	0.874	71.40	1.46	0.260	0.933	72.13	1.910	1
MD BESUT	30	3,100	0.045	0.171	73.7	1.24	4,166	20,830	0.328	1.146	71.38	1.91	0.373	1.317	71.68	3.150	1
MD SETIU	7	571	0.007	0.031	77.4	0.49	1,865	9,325	0.147	0.513	71.35	0.85	0.154	0.544	71.69	1.340	1
MD MARANG	10	2,053	0.020	0.113	82.3	0.98	4,706	23,530	0.371	1.294	71.33	2.15	0.391	1.407	72.21	3.130	1
TOTAL	8,282	15,159,824	91.360	833.794	89.0	3,423.81	989,983	4,949,915	77.963	272.246	71.36	453.25	169.323	1,106	84.69	3,877	

Note:
Influent BOD_5 concentration to individual septic tanks is assumed to be 70 mg/L same as to that for communal septic tanks.

APPENDIX 4

GUIDELINES FOR DEVELOPERS VOLUME 1

PARTS B & C

Guidelines for Developers

VOLUME 1

Sewerage Policy for New Developments

PART B

Catchment Strategy Report

Table of Contents

SECTION 1

Overview

1.1 An Outline of this Guideline

This document provides guidance for planners on the preparation of Catchment strategy reports. The scope of this manual is for all areas in Malaysia, which come under the Sewerage Services Department.

The structure of this document provides a reminder for experienced planners of the issues involved in preparing Catchment strategy reports. A more detailed explanation is also provided for those with less experience in the preparation of catchment strategies and plans.

This document describes the major stages required to develop a Catchment strategy report, which are:

- Introduction
- Existing Conditions
- Future Conditions
- Options
- Recommended Strategy

Section 1 Provides an overview of the Manual.

Section 2 Provides a summarised checklist of the components of a Catchment Strategy Report (a summary).

Section 3 Describes the component parts of a Catchment Strategy Report.

Section 4 Presents some typical examples of tables from a Catchment Strategy Report, produced by a combination of desktop and field appraisal of available information.

Section 5 Describes the preparation and approval of a Catchment strategy report.

1.2 How to use this Guideline

This guideline is intended to be used primarily by consultants engaged in the planning of sewerage infrastructure for communities in Malaysia.

Users of this guideline may need access to the companion volume, the Sewerage Catchment Planning Manual Volume 1 Part C for a detailed catchment strategy analysis.

The use of the procedure described in this document ensures that the majority of relevant information, interpretations and assumptions are recorded in a consistent format. This will allow future planning to have access to the basis of current planning and the issues involved in developing recommended strategies.

This guideline is not intended to limit the content of a Catchment Strategy Report. It is intended to provide a format for recording the outputs of this phase of the planning process. Since each catchment may have some site specific issues, this document should be regarded as a guideline only.

SECTION 2

A Summary Checklist

2.1 Introduction

This section is intended to provide a quick access checklist for experienced planners. The checklist as a reminder of the contents, intent and interpretation of the components of the report. More detailed descriptions of the components are given in Section 3.

2.2 Format of Information

Catchment Description

- Local area description
- Boundaries
- Local government area(s)
- Topography overview
- Historical landuse summary
- Current landuse status
- Externalities
- Geology
- Drainage flow pattern
- Water Intake Points
- Surrounding neighboring catchment information

Catchment Details and Maps

- Topography
- Boundaries
- Natural subcatchment breakup
- Landuse zones

Issues

- A description of those issues that are the major causes for the need to upgrade system components or build new ones

Existing conditions

- Description of the existing sewerage system by subcatchment
- Table of sewage pump stations and sewage treatment plants with a capacity and condition report
- Table of sewage treatment plants not maintained by IWK -number and connected PE
- Table of IST and other systems -number and connected PE
- Map of sewerage system showing trunk main routes, sewage pump station and sewage treatment plant locations
- Sewage treatment plant description
- List data on system capability and comment on implications
- Note record of public complaints, if any
- Water Intake Points
- List of present domestic sewage loading for different treatment systems and pollution load per area for each sub-catchment
- Discharge points of the STP effluent

Future conditions

- General description of predicted situations
- History of sources of data used as a basis for predictions of future situations such as, changes to population or land use, etc.
- Develop a table (spreadsheet) or projected growth (or decline) in PE by subcatchment for at least 30 years
- Table to include flow and load change predictions
- Describe implications of changes in flow and load on system sewage treatment plant
- List all assumptions made in bullet point format
- Water Intake Points
- Table of different treatment systems - number and pollution load of each treatment system for each sub-catchment
- Future discharge points of the effluent for STPs

Options

- On the basis of an analysis of the above details, describe the available options. For each option include:

- Brief description and scope of option
- Map showing layout of option
- List of advantages and disadvantages in bullet point format
- Estimated cost
- Layout of each STP
- Reduction in number of localized STPs, ISTs and other systems
- Reduction of pollution load

Recommended Option

- Summary of reasons for selection of preferred options

Description of Recommended Strategy

- Layout of recommended strategy shown on a map superimposed onto a topographic layout of the catchment
- Description of the essential elements, components and functions, on a subcatchment basis in bullet point format
- Layout of STPs
- Schedule of activities table and graphical, including staging of works
- List of pollution load per area for each sub-catchment
- Schedule showing reduction of pollution load
- List comparing present and future number of STPs, ISTs and other systems and pollution load
- Reduction in number of localized STPs, ISTs and other systems
- Description of future sewerage status - with and without strategy
- NPV analysis, if applicable
- Projected Sewerage Capital Contributions
- Capital Works funding

SECTION 3

The Structure of a Catchment Strategy Report

3.1 Introduction

This section expands on the description of the components of the Strategy Report, which were listed in Section 2.

The descriptions in this section are not intended to be complete, but to act as an initial guide for those planners and support staff who need assistance.

The format described below is not assumed to be the only one viable for preparation of reports but is presented to allow consistency for record keeping and ease of future access by enhancing readability.

3.2 Catchment Strategy Report Components

3.2.1. Introduction and Catchment Description

This part of the report is intended to provide a brief background to enable future readers to understand what the extent of the catchment is at a strategic level. Therefore, the amount of detail for each of the subheadings should be kept to a minimum to provide a general understanding of the development history and current status (at the time of writing the report).

- Local area description
  - Should be only a travel guide type of overview
- Boundaries
  - These should be broadly described without the need to ensure that all detail is precise
- Local government areas
  - all instrumentalities with a relevant stake in the catchment, in regard to sewerage and related services, should be listed
- Topographic overview
  - This should be a summary description only. It should note any divergences in topography between subcatchments, if they exist. Drainage lines need to be shown.
- Historical landuse summary
  - The level of detail presented here should give the reader a feel for the trend in development that is occurring. Differences in subcatchments should be noted.

- Current landuse status
  - This should be a summary statement that follows from the previous historical description
- Past, Present and Future Population Equivalent
  - This should be a summary statement on present population equivalent and growth trends for the last ten years as well as growth projections for 30 years
- Externalities
  - Describe any issues that relate to adjacent catchments and that may have an impact on the study catchment. The construction of an airport, major development or transport link in the vicinity may have future impact on the sewerage infrastructure options described later in the report.

3.2.2 Catchment Details on Maps

This part of the report must provide the best detail available to the planner. This should be the basis for further calculations and decision making within the report. Specific details and descriptions of the following points must be included in a format that is easily read and interpreted. The details must include:

- Topography
  - Showing, in particular, main drainage lines and obstructions, such as, major roads, pipelines and railways
- Boundaries
  - Showing, in particular, major developments, backlog areas, rationalisation areas and local government boundaries
- Natural subcatchment breakup
  - If arbitrary choices are needed, these should be identified and comments on the rationale should be included
- Landuse zones
  - If these are derived from planning documents of others, the sources and level of certainty should be noted
- Present Population Equivalent
  - This should be a summary statement on present population equivalent
- Water Intake Points
  - Showing in particular if any existing and proposed future water intake points upstream or downstream of development

3.2.3 Issues

This part of the report should contain a description and discussion of the issues that are leading to or have led to the need to upgrade the capacity of (or ability to deliver higher quality) system components. This may incorporate discussion of previously raised issues and/or may be separate issues such as public complaints, government programme initiation or regulation change. Issues that are driving system improvements could include:

- Rezoning of land
- Changed government policy
- New government programme
- Public complaints
- Change to previous planning assumptions (for example, growth rates)
- Change to standards of service
- Specific developer requests

3.2.4 Existing Conditions

This part of the Catchment Strategy Report should provide a detailed description of the condition, capacity, capability, pollution loading and sludge production volume of the sewerage scheme at the time of writing.

The report should describe the existing conditions by subcatchment, and isolate various sections of trunk main or specific pump stations and the STP for separate description. This information should be presented in tabular (spreadsheet) form at supported by a system plan showing capacities. For small catchments, this will be a trivial task, but it ensures easy access for future readers.

All information noted in the spreadsheet will need an annotation indicating the latest update (revision) of the specific piece of information. If the data is old, with an unknown revision date, a note “unknown” should be affixed beside the data. If there is no field data, but an assumed or engineering estimate available, then the quality of the estimate should be noted.

Any relevant comments from other agencies regarding recent historical performance should be noted.

3.2.5 Future Conditions

This part of the report can be a key to the successful planning for the provision of sewerage services to the catchment.

This section should be written in a style which allows the reader to capture the essence of the planner's view about the future need of the catchment (with regard to sewerage services). Thus, a general description is required of the predicted changes in the catchment for at least 15 years. In special cases, mention may also be required of a longer time period, up to 30 years.

In catchments where industrial, commercial or residential growth is predicted as a major driver, it is essential to list the sources of information.

Any projections of growth should be presented in a Tabular form while ensuring that over simplifications is avoided. Consideration should be given to reductions in growth rate as saturation is approached. Also, the future pollution loading should be mentioned to highlight the necessity for a public sewerage system in the catchment.

If changes in government policy are likely which would alter the predicted flow or load per PE, then separate flow and load trends should be produced and included. This may be relevant for subcatchments dominated by industry where flow and load per factory area, or employee are used to generate future conditions.

All assumptions must be clearly stated.

3.2.6 Options

This part of the Catchment Strategy report is important because it must show all possible options, even those that are obviously not viable. Clearly, minor trivial variations should not be listed, for example, some minor route changes would not be classified as different options.

The do-nothing option is a valid option to include in a set of options. The purpose of this is simply to indicate to future planners or to other readers that the do-nothing approach has been considered, even if rejected. However, when the do-nothing option is trivial and obviously not viable (say because of new growth) then it can be safely ignored.

For each option, the report should show a map, a brief description of the option, the number of STPs, ISTs and other systems, the reduction of pollution load and a bullet point list of advantages and disadvantages.

If cost is a major factor in the selection of the recommended option then a table of cost estimates should be included. This cost estimation should include capital and O&M costs. This may only be necessary for 2 or 3 of the options when other possible options have been excluded on other grounds (access, topography, political, technical, etc).

Option comparison for some schemes may be sensitive to operating costs. If this is the case then an NPV comparison would be important for selecting option. On small catchments, where the type of sewage treatment plant is obvious (due to policy or land constraints, etc.) then an NPV analysis may not be important.

3.2.7 Recommended Option

This part of the report many readers will turn to immediately to find the answer or solution that is proposed. Thus this section should be written with some information repeated that had been previously. The description and map from Section 3.2.6. (Options), should be used first with a discussion following which explains the reasons for the selection of the recommended (preferred) option.

If there are any uncertainties or sensitivities in the assumptions that have lead to the recommendation they should be highlighted.

3.2.8 Description of the Recommended Strategy

This part of the Catchment Strategy Report will be read in conjunction with Section 3.2.7. The descriptions here should be of greater detail, with maps showing routes shown superimposed on topography and subcatchment boundaries with asset numbers shown. The map should be accompanied by a table indicating trunk main sections and all assets with all technical details, sizes, etc., shown in full and referenced back to the map.

The table should be clearly set out on a subcatchment basis. The descriptions should also include an activities table. The NPV of the recommended strategy should be included showing capital investment dates and operating costs. Projected contributions should also be included.

3.2.9 Summary of the Recommended Strategy

Summary of the Recommended Strategy should be attached as the first page of the Catchment Strategy Report. This summary not only describes the sewerage strategy concisely, but also provides information for the prioritisation of the sewerage projects. Example of Summary Sheet is presented in Table 3.2. To show the impact of the recommended strategy on water quality, the “no action” impacts on water quality is also presented on the summary sheet.

Nineteen items describing the outline of a sewerage catchment strategy are selected. Most of the data required for completing the summary sheet could be obtained from available recourses such as a sewerage catchment report, IWK, Department of Environment, Irrigation Department and etc. Some data should be reviewed before the selection of projects because it takes times after the preparation of a sewerage catchment preport.

Each item is defined as followed.

(1) Title of sewerage catchment strategy
The title of sewerage catchment strategy identifies the location of the area for which the catchment study was carried out for and also highlights the date of its completion.

(2) Details of STPs Planned
It is very important to highlight the number of STPs that are being planned within a sewerage catchment strategy as it could acknowledge its compliance to the rationalisation and centralisation needs of the planned area. The outlines of STPs proposed in a sewerage catchment strategy shows its planned treatment capability via capacity of PE treated, the area covered and intended for.

(3) Number of STPs and other facilities
The comparison of the number of STPs and other facilities are shown to the effect of rationalisation and centralisation induced by a sewerage catchment strategy based on its present and future scenarios. Scenario of number of plants due to none existence of a strategy is also shown in a without strategy column. Public STP is shown by the number of STP, and other facilities are shown by PE.

(4) Effluent Discharged Standard applied to STP planned
Consideration for compliance to the required effluent discharge standards is vital for the preparation of a sewerage catchment strategy. This information is the basis for the design of treatment facilities. These data should be reviewed at the time of selecting projects. These data should be reviewed at the time of selecting projects.

(5) Receiving Water Pollution Status
The condition of the receiving water environment is important to assess the need for a sewerage system and also to gauge possible alleviation of water quality. Pollution status is explained by BOD_5 and NH_3-N, sub index and water quality index (WQI) as prepared and monitored by DOE. The pollution status data comes from the Department of Environment.

(6) Population
The population data is one of the basic information that should be able to be obtained form a sewerage catchment strategy. The population data for each sub-catchment or catchment should be highlighted to show its present figure and its projected future population to its target year (which is to be highlighted in a 5 yearly interval)

(7) PE Projection
Present and future PE projection for each sub-catchment or catchment should be based on details provided by the structure plans and also the land use plan. The PE projection is to be highlighted with a 5 years interval within a span of 30 years.

(8) Connected PE
Connected PE is the number of PE connecting to a public sewerage system maintained by IWK. This data should be shown in numerical form for sub-catchment or catchment. These data should be reviewed at the time of selecting projects.

(9) Number of Water Intake Points

As the discharge water quality from STP is decided by whether there is a water intake point at the downstream of a STP or not, therefore it is perceived to be one of the vital information required for deciding the design parameters of treatment facilities. These data should be reviewed at the time of selecting projects.

(10) First Works for Sewerage Provision

First works for sewerage provision is a parameter to avoid the overlapping of government sewerage investment towards the same catchment. This parameter describes the past record of government investment to a catchment area. These data should be reviewed at the time of selecting projects.

(11) Land Acquisition Status of proposed STP

Land acquisition status of proposed STP is a parameter for determining the reliability of project implementation. When all STP sites had been acquired by the government, implementation of the proposed sewerage project can be promptly conducted without land issues. These data should be reviewed at the time of selecting projects.

(12) Downstream Water Use Situation

Water use situation explains the possible water utilization from a river to which treated sewerage is discharge. These data could be obtained from the Department of Environment and Drainage, Irrigation Department and water Company.

(13) Number of Complaints from Public on Sewerage

Number of complaints from the public is the parameter to find a potential need for the improvement of public sewerage system within a specific area. When this number is high, the residences seem to desire the improvement or the installation of new public sewerage system. The data on the number of complains are to be summarised and shown by year. These data should be reviewed at the time of selecting projects.

(14) BOD Pollution Load

BOD Pollution load shows the extent of pollution due to sewage. Production BOD Pollution load shows the pollution load produced in each sub-catchment area. This number describes the potential need for sewerage system at present and future. Discharged pollution load shows BOD discharge pollution load with or without a strategy. This parameter describes the effect of a strategy by comparing the discharged pollution load without a strategy. The data at the present condition should be reviewed at the time of selecting projects.

(15) Inclusion of Sludge Treatment

Inclusion of sludge treatment shows the existence of whether centralised or regionalised sludge treatment is planned within the implementation of a strategy.

(16) Cost

Capital Cost is the amount of investment required for the realisation of a planned sewerage project or scheme.

O&M cost is the basic operation and maintenance cost data of sewerage facilities in a strategy.

(17) Project NPV

Project net present value shows the financial data for priority analysis. These data describes the cost effectiveness of a strategy. Negative NPV indicates that external money must be put on the project other than tariff revenues. Sewerage project which has bigger NPV (close to zero, in case of negative number) shall be given higher priority from the financial viewpoint.

(18) Special Considerations

Special considerations highlights the need to consider unique situations planned or arising from a specific catchment or sub-catchment; such as those highlighted within national interest structural plans, national sanctuary and etc.

Table 3.2 Example of Summary Sheet

Summary Sheet for Sewerage Strategy (1/3)

(1) **Title of Sewerage Catchment Strategy**

Catchment Name	Ipoh, Perak
Title	The study on sewerage catchment strategy for Ipoh, Perak under the JICA study
Date of the report prepared	August, 2008

(2) **Details of STPs planned**

Name of STP	Ultimate Capacity, PE	Sub-Catchment Name	Sub-Catchment Area, Km^2
Papan	1,730,000	Ipoh	29.28
		Menglembu	100.59
		Gunung Rapat	65.20
		Bercham	91.14
Meru Raya	150,000	Chemor C1,4,5,7-13	62.35
Tanah Hitam	120,000	Chemor C2,3,6,14,15	58.83
Total	2,000,000		407.39

(3) **Number of STP**

Catchment		Public STP	Private STP	IST (PE)	Pourflush (PE)
Ipoh	Present	36	122	87,450	8,373
	Future	0	0	0	0
	w/o Strategy	36	122	87,450	8,373
Menglembu	Present	84	58	55,528	8,503
	Future	1	0	0	0
	w/o Strategy	84	58	55,528	8,503
Gunung Rapat	Present	100	0	32,794	4,700
	Future	0	0	0	0
	w/o Strategy	100	0	32,794	4,700
Bercham	Present	107	2	49,190	6,882
	Future	0	0	0	0
	w/o Strategy	107	2	49,190	6,882
Chemor	Present	38	6	40,992	6,922
	Future	2	0	0	0
	w/o Strategy	38	6	40,992	6,922
Total	Present	365	188	265,954	35,380
	Future	3	0	0	0
	w/o Strategy	365	188	265,954	35,380

Units of STP : Number

(4) **Effluent Discharge Standard applied to STP planned**

Name of STP	Name of receiving rver or stagnant water Bodies	Discharge Standard Applied	
Papan	Kinding River	(River) or Stagnant water bodies	Standard A or (B)
Meru Raya	Pari River	(River) or Stagnant water bodies	Standard A or (B)
Tanah Hitam	Kinta River	(River) or Stagnant water bodies	Standard A or (B)

Table 3.2 Example of Summary Sheet
(Cont'd)

Summary Sheet for Sewerage Strategy (2/3)

(5) **Receiving Water Pollution Status**

Name of STP	Concentration, mg/L		Pollution Status		Calculation
Papan	BOD_5	3	BOD_5 SI	87	BOD_5 SI
	NH_3-N	0.01	NH_3-N SI	99	for $X \leq 5$, BOD_5 SI = 100.4 - 4.23X
			WQI		for $X > 5$, BOD_5 SI = 108*exp(-0.055X)-0.1X
Meru Raya	BOD_5	8	BOD_5 SI	68	
	NH_3-N	0.01	NH_3-N SI	99	NH_3-N SI
			WQI		for $X \leq 0.3$, NH_3-N SI = 100.5-105X
Tanah Hitam	BOD_5	5	BOD_5 SI	81	for $0.3<X<4$, NH_3-N SI = 94*exp(-0.573X)-5*|X-2|
	NH_3-N	0.01	NH_3-N SI	99	for $X \geq 4$, NH_3-N SI = 0
			WQI		

(6) **Population**

Present and Future (every 5 year)

Name of Sub-Catchment	2007 (Exisiting)	2010	2015	2020	2025	2030	2035
Ipoh	225,364	236,182	255,076	275,482	297,521	321,322	347,028
Menglembu	162,542	173,758	193,740	216,020	240,862	268,561	299,446
Gunung Rapat	132,132	140,853	156,347	173,545	192,635	213,824	237,345
Bercham	59,311	63,582	71,211	79,757	89,328	100,047	112,053
Chemor	28,277	30,483	34,445	38,923	43,983	49,701	56,162
Total	607,626	644,858	710,819	783,727	864,329	953,455	1,052,034

(7) **PE Projection**

Name of Sub-Catchment	2007 (Exisiting)	2010	2015	2020	2025	2030	2035
Ipoh	230,708	241,782	261,125	282,015	304,576	328,942	355,257
Menglembu	256,629	274,336	305,885	341,062	380,284	424,017	472,779
Gunung Rapat	266,844	284,456	315,746	350,478	389,030	431,824	479,324
Bercham	230,320	246,903	276,531	309,715	346,881	388,507	435,128
Chemor	137,640	148,376	167,665	189,461	214,091	241,923	273,373
Total	1,122,141	1,195,853	1,326,952	1,472,731	1,634,862	1,815,213	2,015,861

(8) **Connected PE**

Name of Sub-Catchment	Present PE	Future PE (Ultimate PE)	PE w/o Strategy
Ipoh	101,353	355,257	101,353
Menglembu	178,722	472,779	178,722
Gunung Rapat	229,350	479,324	229,350
Bercham	173,248	435,128	173,248
Chemor	85,814	273,373	85,814
Total	768,487	2,015,861	768,487

(9) **Number of Water Intake Points**

Name of STP	No. of Upstream Water Intake	No. of Downstream Water Intake
Papan	1	0
Meru Raya	0	0
Tanah Hitam	1	0

(10) **First Works for Sewerage Provision**

Please mark Yes or No.

Name of STP	Existing of Sewerage Project in each Treatment Catchment	
Papan	(Yes)	No
Meru Raya	(Yes)	No
Tanah Hitam	(Yes)	No

Table 3.2 Example of Summary Sheet (Cont'd)

Summary Sheet for Sewerage Strategy (3/3)

(11) **Land Acquisition Status on STP**

Please mark the status.

Name of STP	Status
Papan	(Acquisition) Gazetted (At present, Public or Private (No Resettlement or Resettlement))
Meru Raya	(Acquisition) Gazetted (At present, Public or Private (No Resettlement or Resettlement))
Tanah Hitam	(Acquisition) Gazetted (At present, Public or Private (No Resettlement or Resettlement))

(12) **Downstream Water Use Situation (Present)**

Name of Water Intake or Irrigation Gate	Upstream Sub-Catchment Name	Name of River or Water Bodies	Volume of Intaking or Irrigation, m^3/d	Intake Water Closure Time, hrs/year
Intake Ulu Kinta	Bercham	Sg. Kinta	Not Available in This Time	Not Available
Intake sg.Tapah	Menglembu	Sg. Tapah	Not Available in This Time	Not Available

(13) **Number of Complaints from Public on Sewerage**

Last 3 years

Name of Sub-Catchments	2003	2006	2007
Ipoh	Not Available in this time		
Menglembu	Not Available in this time		
Gunung Rapat	Not Available in this time		
Bercham	Not Available in this time		
Chemor	Not Available in this time		
Total			

(14) **BOD Pollution Load**

Name of STP	Production BOD Pollution, kg/d			Discharged Pollution, kg/d		
	Present	Future		Present	Future	w/o Strategy
Papan	55,132	97,579		13,231	7,806	20,338
Meru Raya	5,418	8,895		1,300	711	1,605
Tanah Hitam	2,289	6,413		549	513	1,157

(15) **Inclusion of Sludge treatment**

Please mark Yes or No.

Name of STP	Sludge Treatment Facilities	(If no, Please write down the name of Sludge treatment plant)
Papan	(Yes) No	
Meru Raya	(Yes) No	
Tanah Hitam	(Yes) No	

(16) **Cost**

Name of STP	Capital	O&M	Total	
Papan	2,953	1307.7		
Meru Raya	675	95.04	5,157	
Tanah Hitam	66	60.08		Unit:Million RM

(17) **Project Net Present Value**

Name of STP	NPV	
Papan	-1,630	
Meru Raya		
Tanah Hitam		Unit:Million RM

(18) **Special Conditions**

Please describe any special considerations that need to be taken into account for immediate implementation of sewerage projects or that should be considered in devicing a strategy

For example, the closure of water intate happened frequently due to river water pollution or national sanctuary exists in a planning area.

Noting

SECTION 4

Typical Tables

4.1 Introduction

This part of the report presents some hypothetical tables, as an example layout of information, required for the development of the Catchment Strategy Report.

These tables should be used as a guide only. For larger catchments, it may be appropriate to present the network and pumps station data as separate tables.

The tables given below are examples and should only be used as a guideline in preparing tables for Catchment Strategy Reports. The amount of information given in the tables should be sufficient to give an understanding as to why a particular catchment strategy is recommended based upon a preferred option.

The extent of a catchment strategy study will depend upon the size of the catchment and the complexity of the existing development within the catchment.

4.2 Tables

4.2.1 Existing Conditions

The following tables should be included and supported by maps and plans.

Table 1: Sewerage Subcatchment

- Subcatchment number
- Land use
- Population growth trend for last ten years
- Population equivalent and composition
- Flow at outlet
- Load at outlet

Table 2: Sewage Pumping Stations

- Sewage pumping station number
- Sewage pumping station location
- Design capacity and population equivalent
- Sewage pumping station owner and operator
- Connected flow and population equivalent
- Condition

Table 3: Sewage Treatment Plant

- All Sewage treatment plant number including septic tank
- Sewage treatment plant location
- Sewage treatment plant type
- Sewage pumping station owner and operator
- Design capacity and population equivalent
- Connected flow and population equivalent
- Pollution load of each sewage treatment plant
- Condition

Table 4: Sludge Treatment Facility

- Sludge treatment facility number
- Sludge treatment facility location
- Sludge treatment facility type
- Sludge Volume of each sewage treatment plant
- Sludge treatment facility owner and operator
- Design capacity and population equivalent
- Connected usage and population equivalent

Table 5: Sewerage Areas

- Growth Areas
- Backlog areas
- Rationalisation areas
- New development areas
- Redevelopment areas
- Present Pollution load per area for sub-catchment

4.2.2 Future Condition

The following tables should be included and supported by maps and plans for the recommended options only.

Table 6: Growth Forecasts

- Over 30 year time horizon
- Annual increase in residential PE
- Annual increase in commercial PE
- Annual increase in industrial PE
- Annual increase in flow and pollution load
- Annual increase of pollution load and sludge volume for each sewage treatment plant
- Annual increase of pollution load per area for sub-catchment

Table 7: Capital Works

- Capital works project number
- Capital works project category
- Capital works project name
- Required land area for STP
- Reduced land space by centralization and rationalization of STP
- Capital works project location
- Capital works project estimate
- Capital works project description
- Capital works project staging
- Capital works project timing
- Capital works project cash flow
- Capital works project funding

4.2.3 Cash Flow

Cash flows are given annually from the present year for 15 years or 30 years for the recommended option only.

Table 7: Cash Flows

- Project capital costs listed for each project separately
- Operations and maintenance costs listed for each network, network pump station, sewage treatment plant and sludge treatment separately
- Present values calculated using discount rates of 8% and 12%

SECTION 5

Preparation and Approval

5.1 Presentation

Catchment Strategy Reports should be self-contained, bound documents of A4 size.

Maps and plans should preferably be A4 or A3 size and bound within the document. For larger catchments, A2 or A1 size maps or plans may be required. In these cases, the maps or plans may be included in the report or presented separately.

The front cover of the report should clearly identify the name of the Catchment Strategy Report, the names of the developers (if any), the names of the developments (if any), the name of the consultant whom prepared the Catchment Strategy Report and the date of the report.

The first page in the report shall contain an approvals page, as shown in Appendix A.

All text and tables are to be presented in clear, legible, typewritten format. Type face size used should be 11 point or larger.

5.2 Data

The developer, preparing a Catchment Strategy Report, is required to collect all relevant data to enable a Catchment Strategy Report to be evaluated and approved.

Sources of data include Local Authorities and State Government Planning Departments for land use and growth forecast data and Indah Water Konsortium for existing sewerage infrastructure.

Where necessary, field studies may need to be undertaken to substantiate population equivalents from which flows and loads are determined.

All existing and proposed sewerage infrastructure within a catchment must be included in a Catchment Strategy Report.

5.3 Consultation

Developers are advised to discuss their proposed Catchment Strategy Reports with the relevant Planning Departments and Indah Water Konsortium when it is still in a draft form. This will ensure all planned works have been considered and data properly assessed.

5.4 Approval

Catchment Strategy Reports are to be submitted to the Branch Offices of the Sewerage Services Department located in Kuala Lumpur, Kuala Trengganu, Penang and Melaka.

Four copies of the report must be submitted.

Developers shall be required to provide briefing of the catchment strategy, if required, before approval.

Developers should allow at least 22 working days to obtain approval for a Catchment Strategy Report.

One copy of an approved report will be returned to the developer for retention.