Study on the Current Issues and Needs for

Water Supply and Wastewater Management in Malaysia

Volume 2

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Volume 2

AKADEMI SAINS MALAYSIA

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List of Abbreviations

AKSB	*Air Kelantan Sdn. Bhd.*
ASM	Academy of Sciences Malaysia
DMA	District Metering Areas
DMZ	District Watering Zone
DOE	Department of Environment
FOMCA	Federation of Malaysian Consumers Association
ICWE	Conference on Water and the Environment
IST	Individual Septic Tanks
IWA	International Water Association
IWK	Indah Water Konsortium
IWRM	Integrated Water Resources Management
JANS	*Jabatan Air Negeri Sabah*
JBA	*Jabatan Bekalan Air*
KeTTHA	Ministry of Energy, Green Technology and Water
KWB	Kuching Water Board
LAKU	*Lembaga Air Kawasan Utara*
LAP	*Lembaga Air Perak*
MLD	Million Litres per Day
MOH	Ministry of Health
MWA	Malaysian Water Association
MWIG	Malaysia Water Industry Guide
NRW	Non-revenue Water
NWRS	National Water Resources Study
OPEX	Operating Expense
PAAB	*Pengurusan Aset Air Berhad*
PAIP	*Pengurusan Air Pahang Berhad*
PBAPP	*Perbadanan Bekalan Air Pulau Pinang Sdn. Bhd.*
PWSA	Penang Water Services Academy
R&D	Research and Development
SADA	*Syarikat Air Darul Aman Sdn. Bhd.*
SAINS	*Syarikat Air Negeri Sembilan*
SAJ	*Syarikat Air Johor*
SAMB	*Syarikat Air Melaka Berhad*
SAP	*Syarikat Air Perlis*

List of Abbreviations

SATU	*Syarikat Air Terengganu Sdn. Bhd.*
SPAN	*Suruhanjaya Perkhidmatan Air Negara*
SSD	Sewerage Services Department
STI	Science, Technology and Innovation
STP	Sewerage Treatment Plant
SW	Scheduled Waste
SWB	Sibu Water Board
SYABAS	*Syarikat Bekalan Air Selangor Sdn. Bhd.*
TTLC	Total Threshold Limit Concentration
WDM	Water Demand Management
WHO	World Health Organisation
WSIA	Water Services Industry Act
WSP	Water Safety Plans

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Chapter One : Introduction

1.1 General

Malaysia is committed to implementing **Integrated Water Resources Management (IWRM)** for the sustainable management of the country's water resources since the late 1990s. The National Water Resources Policy formally launched in March 2012, further reaffirms the adoption of IWRM which calls for balanced development and management of "water as a resource" and "water for livelihood". The implementation of the IWRM agenda involves the integration of both natural and human systems set within an overall framework that provides the enabling environment with effective institutional arrangements supported by necessary management instruments. Implementation of IWRM across all sub-sectors and levels of hierarchy is guided by the internationally endorsed 1992 ICWE Dublin Principles as shown below:

The Dublin principles on Water (ICWE 1992)

Principle No. 1 – Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.

Principle No. 2 – Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.

Principle No. 3 – Women play a central part in the provision, management and safeguarding of water.

Principle No. 4 – Water has an economic value in all its competing uses and should be recognised as an economic good.

The Academy of Sciences Malaysia (ASM), an independent think-tank providing strategic advice to Government on STI matters, has since 2008 been undertaking studies pertaining to the water sector, considered strategic for the country's economic development. The studies have been overseen by a dedicated ASM Water Committee. Adopting IWRM as the central thrust and noting that IWRM per se is a rather abstract concept, the Committee has for practical application in the Malaysian context, broken down IWRM into discrete sub-sets or sub-themes. Each of these sub-sets or sub-themes is then subjected to in-depth studies culminating in the preparation of a strategy plan or advisory report for consideration and adoption by the relevant authority or agency responsible for their implementation. The studies also undergo a process of strategic consultations with relevant institutional, community and private sector stakeholders.

One of the studies undertaken by the Academy is this study on "Current Issues and Needs for Water Supply and Wastewater Management in Malaysia". Water and the wastewater industry have been undergoing several changes in its form and structure with the objective of making the industry sustainable and self-sufficient. The introduction of the Water Services Industry Act **(WSIA)** in 2006 was an important milestone in the transformation of the industry.

Since enactment, **WSIA** together with Suruhanjaya Perkhidmatan Air Negara (SPAN) Act are supposed to drastically change water and wastewater from a segmented industry to a holistic and standard form. However the fundamental problem of non-uniform standards and practices between the states, is still

prevailing. The next step of integrating water and wastewater is considered another major leap to become a successful industry.

Water safety and security is another aspect that is required to be looked at from time to time. With continuous development in the country, demand for water increases proportionately to meet needs depending on the type of development that the country has adopted. Being located in the rainfall blessed region, it is unwarranted for Malaysia to be faced with water shortage in the years to come. Proper strategy needs to be put in place to ensure water safety and security.

The **true value for water** is not being fully appreciated by the people in the country. This might be closely related to its abundance and cheap price. The low tariff of treated water has in many ways hindered the measures towards conservation of water. Water operators have questioned the worthiness of reducing water losses when the effort to save them is more expensive than the cost of the water itself. Hence the economics of water loss must be given emphasis. This is based on the comparison of repairing works against the operations cost. Comparing the true value of water would make a difference.

There has been much development in many countries where **wastewater** had been considered as having the potential for the creation of wealth. Wastewater treatment plants are constructed to treat effluent and place quality water back into the water cycle. However there have been some occasions where the operations have been interrupted by several issues including human capital and financial constraints. Since the number of wastewater treatment plants is increasing, there is an urgent need to asses the performance of wastewater treatment plant operations. The future of individual septic tanks also need to be addressed.

There have been concerns on the **competency of personnel** in the water industry. Since the privatisation of IKRAM in 1990s, training of water industry personnel have been very much neglected. Similarly training in wastewater has been limited to the capabilities of several institutions and organisations that conduct training programme on a piecemeal basis.

Upon the successful conclusion of the 2nd IWA International Development Congress in Kuala Lumpur in 2011, Malaysia is seen as the **prospective leader and mentor** for the development of water and wastewater in developing nations. The selection was based on the appropriateness of its technology in developing water and wastewater coverage which when viewed by others would contribute to the successful implementation of Millennium Development Goals for the developing nations.

1.2 The Role of the Academy of Sciences Malaysia

The **ASM WEHABE Committee on Water** (preceded earlier by the ASM Water Committee since 2008) initiated the Sustainable Water Management Programme for the 9th Malaysia Plan with an overall goal "to manage water resources (both surface and ground water) in a sustainable manner and in accordance with IWRM principles and practices". The Programme was also consistent with and complements work done by others towards achieving the goals and objectives of the

National Water Resources Policy (2012) and ensuring the successful implementation of **Water Services Industry Act 2006.**

Implementation of the programme according to the above shall be executed by Task Forces (TF) appointed by the Committee. This **Task Force on Water and Wastewater Management**, currently co-chaired by ASM Fellows, Dato' Seri Dr Zaini Ujang FASc and Prof Dr Zulkifli Yusop FASc., is specifically mandated to address the issues towards achieving the Committee's objectives.

1.3 Concerns of the Water Industry

There are several issues surrounding the water services industry that need the attention of policy makers and stakeholders in order to ensure the success of restructuring the water industry and achieving the goal of a sustainable water services industry in the country.

From Strategic Consultations, there were strong recommendations that tariff or water pricing needs a closer look to change the landscape of the water services industry. It was well concurred that the current water tariff in the country was low and efforts to remain efficient including pushing the NRW level lower and implementing green technology had not been rewarding. That had only resulted in the status quo where activities were concentrated to traditional breakdown and corrective maintenance rather than preventive maintenance. All these had caused interruption to water supply and inconvenience to consumers.

Another important issue that was raised was the lack of capacity building facilities after the privatisation of Institute Kerja Raya Malaysia (IKRAM) in 1990s. Though Malaysian Water Academy (MyWA) and several other state water training centres were in existence, the real needs of training for the water industry were not adequate. The need for proper coordination of water industry capacity building was becoming more important with new water acts being put in place and another new act on Safe Drinking Water to be tabled very soon in Parliament.

Another aspect that was discussed in depth especially in the SC3, was the need for sensitive water decisions to be detached from political manoeuvring and intervention. It was suggested that the regulator (SPAN) reports to Parliament and not the Minister so that it becomes more independent in making decisions. On the same note, it was also suggested that a new single Ministry be formed to take charge of water services, wastewater and water resources.

The safety and security of supply is the essence of a good and sustainable water services industry and will enable proper management of water supply to be done. Several organisations and water entities had worked on developing water safety plans (WSP) in several water treatment plants. However a lot more needed to be done. Another concern of the industry was the categorisation of aluminium residual as scheduled waste which is anticipated to burden heavily on the operational cost of water treatment plants.

Chapter Two:
Background of Study

2.1 Introduction

This chapter introduces the establishment of the study team followed by a listing of its objectives. Then it introduces the members of the study team. It also looks at the terms of reference and its deliverables.

A study team was established to carry out a study on the current issues and needs for water supply and wastewater management in Malaysia. The study was mainly about gathering current information from relevant bodies of both prospective industries and stakeholders for evaluation and to give a view, advice and possible solutions to the Government on how far these industries have developed.

This scope of study covered evaluation of the planning, implementation of policies, regulatory, facility/asset management, water security & safety, and operation of water & wastewater industries. However due to its vast scope, prioritisation was made in the strategic consultations to ensure correct emphasis was given.

This study team reported to the Task Force on Water and Wastewater Management, currently co-chaired by ASM Fellows, Dato' Seri Dr Zaini Ujang FASc. and Prof Dr Zulkifli Yusop FASc.

2.2 Objectives of the Study

Consistent with the Terms of Reference mandated to the Task Force on Water and Wastewater Management Committee, the main objectives of the study were determined as follows:

i. Provide advice to Government on strategic water and water-related policies, issues and programme;

ii. Setting and facilitating establishment of best practices using local and international benchmarking of the water and wastewater industry;

iii. Raising awareness and advocacy of the true value of water;

iv. Enhancing capacity building; and

v. Promoting international networking, collaboration and technology transfer.

2.3 Terms of Reference for the Study

The Terms of Reference and Scope of the Study were as follows:

i. A compilation of on-going policies and strategies decided by the Government related to the water and wastewater industry;

ii. Undertake evaluation of the results of the policies and strategies, review and making necessary recommendations for improvement;

iii. Undertake study on the countrywide water safety and security with reference to previous studies such as NWRS;

iv. Recommended practical solutions for sustainability of industry on issues related to water operations and wastewater facilities;

v. To ensure comprehensiveness, all data and information compiled under items (i) – (iv) above should be obtained through desk studies, from responses to suitably framed questionnaires and through interviews with responsible personnel of relevant public and private stakeholder agencies and organisations. Prior to their adoption, all information must be duly validated with their respective sources; and

vi. To submit a report to ASM addressing items (i) – (v) above.

2.4 The Study Team

The study team was headed by Ir Mohmad Asari Daud. The team comprised six experienced professionals and experts in water related fields as follows:

Table 1 : Study Team Members

	Name	Field of expertise	Working experience
1	Ir Mohmad Asari Daud	Water Management (Study Leader)	28 years
2	Ir Wan Mohd Zamri	Water Resources and Management	29 years
3	Prof Dr Mohd Razman Salim	Wastewater	28 years
4	Dr Aznah Nur Anuar	Wastewater	13 years
5	Khairi Yeob	Wastewater Treatment	28 years
6	Mansor Abdul Ghani	Water management	31 years

2.5 Deliverables

Based on the TOR, the following shall be provided by the study team:

i. Compilation of policies and strategies decided by the Government relating to the water and wastewater industry;

ii. Compilation of the results of the policies and strategies,

iii. Proposal of recommendations for improvement;

iv. Evaluation of water safety and security with reference to the previous NWRS;

v. Proposal of recommended practical solutions to water operations and wastewater facilities; and

vi. Position paper on the above.

Chapter Three: Methodology and Approach

3.1 Introduction

This chapter looks at the approach of the study. It starts with the study strategy, followed by the preliminary assessment and then the strategic consultations.

3.2 Study Strategy

The study approach looked at the identification of the core area and to be followed by prioritisation of issues. At the initial level before the Strategic Consultation (SC) 1, the scope of study was divided into six core areas to enable further research in depth on areas related to each area.

SC1 was a forum to gain institutional support and insights on the current status of the water industry. Upon completion of SC1, the scope of discussion was focused to the more specific areas, anticipated to have more concern to the water and wastewater sectors. The five sectors (including the 11 issues proposed in the Task Force Meeting) were then presented and discussed in SC2 with the stakeholders, finally coming up with 13 major issues wherefrom several recommendations were given.

The SC2 was the forum where prioritisation of issues was carried out by stakeholders in a workshop format consultation. In prioritising the issues, the Logical Framework Approach (LFA) analysis was used as the tool where the stakeholders discussed issues and challenges, current status, gaps in knowledge, future needs, recommendations as well as action plan and strategies.

The outcomes and findings of SC2 were further analysed and discussed to assess the recommendations. Finally the recommendations were presented in SC3 where further refinements were suggested and included in the Final Report.

3.2.1 Identification of core areas

The six core areas identified were:

- Water planning and policies;
- Wastewater planning and policies;
- Water technology, operations and regulatory;
- Wastewater technology, operations and regulatory;
- Capacity building, security and safety; and
- Assets and facility management.

3.2.2 Issues

Issues identified in the initial discussion were as follows:

- Progress of **WSIA** implementation;
- Integrated environment as in IWRM;
- Implementation of the NWRP;
- Achievement of green initiatives;
- Sustainability of water and wastewater industry - looking at real issues faced by water deficient states and states with concessionaires;
- Demand management – loss reduction and reduction of wastage;
- Asset management - develop comprehensive decision support tools for management, operations and planning use;
- Reaching the people for the states of

Kelantan, Sabah, Sarawak and the 'orang' Asli villages;
- Outlook to achieve developed nation's status in 2020;
- Water and wastewater tariffs;
- Mechanism of pricing;
- Sludge from water and wastewater;
- Politics versus policies in water management;
- Regional commitment;
  - International positioning of water industry
  - Malaysia to lead the developing nations in improving water supply as discussed in the 2nd IWA Development Congress in Kuala Lumpur
- Organisational strengthening and Non-Govermental Organisation (NGO) involvement in development;
- Free water policies;
- Coordination of research and development - towards commercialisation;
- Water safety;
- Protection of water source;
- Competency requirements as stipulated in **WSIA;**
- Capacity building in the water industry;
- Optimisation of sewerage treatment facilities;
- Alternative source for future – groundwater potential;
- Vision: Drinking water directly from the tap;
- Water for the environment;
- High per capita consumption; and
- Public perception of the industry.

These issues have different impact on the industry and the significance of each issue need to be further studied. As such, the SC2 gave the option to the stakeholders to decide on which issues should be of higher priority and needed the attention of the Government.

3.3 Preliminary Assessment

The study reviewed various water and wastewater management issues and their related information as listed in key documents. The aim was to gather sufficient information to be used as basis for deliberation with relevant stakeholders. This was done to include references to the previous study reports, conference/workshop proceedings, summary transcripts of interviews with relevant institutional and community stakeholders from which the major findings and recommendations could be extracted and compiled, leading to a synthesised set of summary conclusions and recommendations to be presented in a consolidated report to the ASM.

3.3.1 Key documents to be used

The study team had obtained a number of reports for review from various sources. These reports included the followings:
- National Water Resource Policy (2012);
- WSIA and SPAN Acts;
- NWRS;
- MWA previous work; and
- Regional and global forums.

3.3.2 Study flow charts

- **Previous study report**

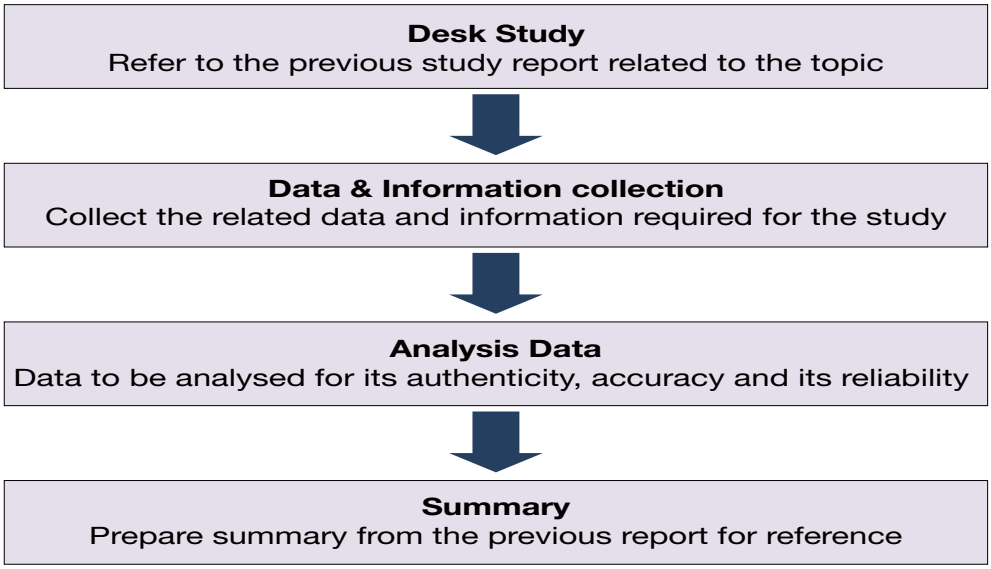


Figure 1: Flow chart for previous study report

- **Journal, technical paper and conference/workshop**

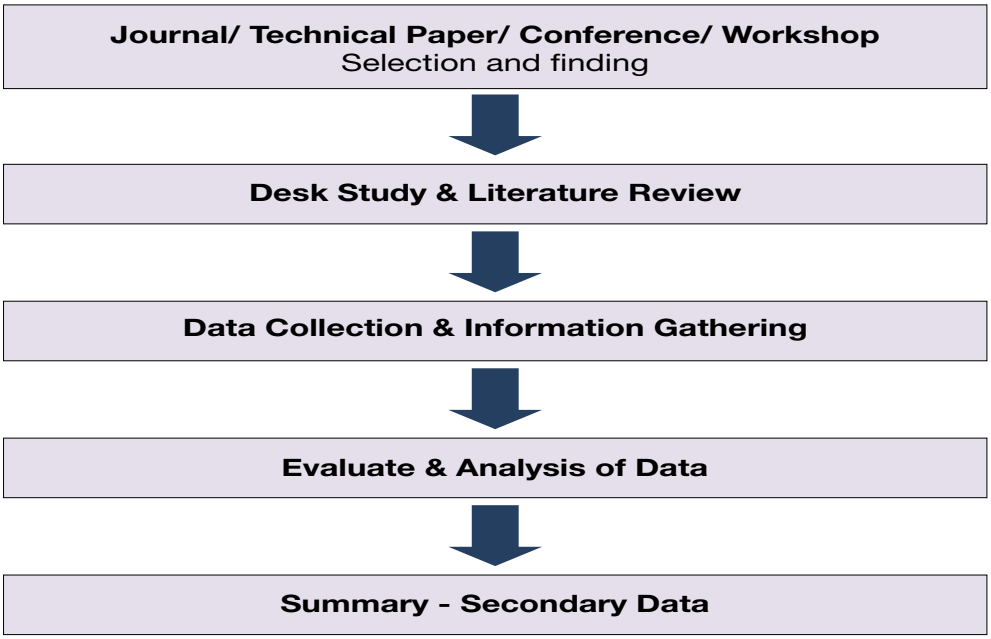


Figure 2: Flow chart for journal, technical paper and conference/workshop

3.3.3 Strategic Consultations (SC):

There were three sessions of Strategic Consultation (SC) for the study, as follows:

1. SC1 was conducted at the early stage which was to obtain agreement on the scope of the study with relevant stakeholders (**Forum Format**);
2. SC2 was organised based on the information gathered from SC1 which would need further elaboration in SC2 (**Workshop Format**); and
3. SC3 discussed the outcome of the study and incorporation of comments from various stakeholders before submission to ASM (**Dialogue Format**).

• Stakeholders

The study required the involvement of several Government and Non-Government agencies in their cooperation to provide information and suggestions to enable assessment on the current situation and improvements there on.

The key agencies included were:

- Ministry of Energy, Green Technology and Water (KeTTHA)
- National Water Services Commission
- Water Supply Department
- Department of Sewerage
- Department of Environment
- Department of Irrigation and Drainage
- Sabah Water Department
- Perak Water Board
- Sibu Water Board
- Kuching Water Board
- LAKU
- JKR Perlis
- JKR Sarawak
- Water Operators, (SYABAS, SAMB, PBAPP, SADA, SAINS, SAJ, PAIP, SATU, AKSB etc.)
- Consultants
- WTP concessionaires
- Indah Water Konsortium
- Non-governmental organisations
- Universities

• Strategic Consultation 1

On 12 June 2013, the Strategic Consultation 1 was conducted successfully at Putrajaya International Conventional Centre (PICC). The consultation session was attended by the panellist and stakeholders from government departments, agencies and the private sector as follows:

- *Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA;*
- *Suruhanjaya Perkhidmatan Air Negara (SPAN);*
- *Indah Water Konsortium (IWK);*
- *Syarikat Air Melaka (SAMB);*
- *Jabatan Perkhidmatan Pembentungan (JPP);*
- *Jabatan Bekalan Air (JBA); and*
- *Air Kelantan Sdn. Bhd.*

The strategic consultation was conducted to achieve the following objectives:

i) To highlight the current issues relating to water management in Malaysia, so as to identify anomalies and provide the possible enablers and providers to the solution of the identified problems.

ii) To promote best practices in water-related technologies and taking steps to optimise the operations of water assets.

iii) To review the effectiveness of the current regulatory framework in improving water management and identify the issues currently hindering the states from migrating to asset light regimes.

The meeting was also attended by Tan Sri Syed Muhammad, a Fellow of ASM who shared his NGO experiences in the Malaysian Water Association (MWA) and Malaysian Water Partnership (MyWP). The SC1 was conducted as a round table discussion chaired by Prof Dr Zulkifli Yusof, Water and Wastewater Management Task Group Chairman together with members of the Study Team and officials from Academy of Sciences Malaysia, regarding the issues related to water and wastewater industry in Malaysia. Much of the discussion was based on the questions prepared earlier and all the attendees gave excellent cooperation to the study team.

The following questions were raised and responded by the panellists:

1. What is the present status of water restructuring in the country?
2. What are the obstacles, issues and challenges in applying the National Water Resources policy in Malaysia at all levels?
3. What is the state of our water services in Malaysia now, in the aspects of water resources, treatment works, network assets and customer services?
4. For asset and facility management, is the current operator/worker able to use or handle the existing assets properly, effectively and rightfully?
5. Do the workers/operators know how to handle the machinery and equipment correctly? Are they being exposed to the new technologies of treatment plants?
6. Are all the workers, either in water and waste water industries, undergoing regular operator training in every level for competency? What are the current worker/operator competency levels? Are they competent enough to handle the operation and system?
7. Are the current issues regarding the poor operations and maintenance due to the lack of knowledge and competence by the worker/operators? What are the stakeholders views on this and the target in overcome this issue?
8. In Water Services Industry Act, **WSIA**, there is a clause on competency in handling the water facilities. What is the industry's response to this Act? What are the obstacles in applying this Act and what steps can be taken to implement this policy efficiently?
9. Are the waste water industries in Malaysia open to explore a new technology in sewerage treatment which can save cost, time, operating space and be more efficient compared to conventional systems?
10. How well does the water operator implement good engineering practices and adapt new appropriate technologies in water supply operations? Any optimisation measures taken to produce water at efficient costs and energy-saving operations?
11. Have the water operators embraced 'green technology' and become 'eco-friendly' in their corporate statement in the development of new water treatment works? Are they using value management tools to select options in constructing water treatment plants, in particular to energy-saving and cost-saving selections?

• Strategic Consultation 2

SC2 convened at the new offices of the Academy of Sciences Malaysia on 3 October 2013. The SC2 was conducted in three parts:

1. Paper presentations
2. Break-out sessions; and
3. Plenary discussion.

The topics that were selected for discussion were as follows:

- Policy on Water and Wastewater
- Technology for Water and Wastewater
- Management
- Capacity Building; and
- Water And Wastewater Safety Plan.

There were **issues** raised in the Task Force meeting which were presented in SC2 as follows:

Table 2: Topics and suggested issues to discuss in SC2

No.	Topics to cover	Issues of Task Force concern
1	Policy	Tariff mechanism Appreciation of the true value of water Confidentiality and disclosure National Policy for Sewerage Mechanism for integrating the industry
2	Technology	Ageing infrastructure Decentralised vs centralised system Outstanding aluminium residual as scheduled waste issue
3	Management	NRW
4	Capacity Building	Lack of capacity building
5	WSP	Asset and facilities reliability

Maintaining the 5 topics, the 11 issues were discussed and expanded in the break-out sessions. The break-out sessions re-examined the 11 main concerns and discussed further on the concerns according to the groups' topics.

The break-out sessions focused on coming up with action plans and the strategy to overcome all the issues discussed including placing them on levels of priority. These will be conducted in the workshop using the logical framework analysis (LFA).

The participants discussed on the possible solutions and came up with the strategic solution, action plan and the implementation program. The study team acted as moderators assisting the break-out groups in the workshop discussions.

Prior to the workshop, selected papers were presented to refresh the participants and initiate interest in the discussions. The following papers were presented:

1. Policy issues in the water and waste water industry (Ir Wan Zamri, AKSB)
2. The way forward for the sewerage industry (Dr Aznah, UTM)
3. NRW experience in Australia (Martin Shaw, Waterloss and PM Pte Ltd)
4. Capacity building in Malaysia: An overview (Jaffaran Suhaimi, PNMC)
5. Asset management (Ir Mohd Sofi Ibrahim, Hatimuda Sdn Bhd)

As mentioned, there were five topics for discussion, as such there were also five break-out sessions.

The participants come from all water and wastewater operators, concessionaires, state and Federal authorities and regulators, local Government and NGOs.

Invited participants:

1. MWA
2. AWER, FOMCA, *Forum Air*, CAP
3. Water Watch Penang
4. ASM
5. KeTTHA
6. SPAN
7. JBA Malaysia, WP Labuan, Sabah
8. JKR Perlis (Air), JKR Sarawak (Air)
9. JKR Malaysia (Bahagian Jalan)
10. Water Operators in Malaysia (in all states)
11. Water concessionaires
12. JMG, JMG
13. LUAS, LUAK
14. IWK
15. Local Governments
16. DOE (Dept of Environment)
17. State regulators / SUK
18. JHEOA (Orang Asli)
19. UTM, UM, UPM etc.

• Strategic Consultation 3

SC3 convened at the Academy of Sciences Malaysia office on **14 March 2014**. The SC3 was intended to get the endorsement of the stakeholders on the findings made by the study team based on the draft final reports.

The format of the SC3 was a dialogue where the Team Leader, Ir Mohmad Asari led the discussion by presenting the findings of the SC2 and highlighting the recommendations of the SC2. There was active participations from the stakeholders representing many fractions of the water industry – from Ministries to individuals.

The subjects discussed were focused on policy issues as most of the participants were involved in policy making at different institutions. However, technology, management, capacity building and water safety plans were also discussed.

There were several comments given by the participants which had been already covered in the earlier strategic consultations. However, there were also a few new issues which were raised and accepted to be included in the Final Report.

Chapter Four: Reviews and Outcomes

4.1 Introduction

This chapter discusses the literature reviews including those on the existing policies and strategies being put in place in the industry. It begins with looking at the current scenario and issues related to policies in water and wastewater sectors. It then looks at the sustainability of water and technology. Finally it discusses the capacity building and safety plans for the water and wastewater sectors.

4.2 Current Scenario

Treated water in Malaysia is supplied to more than 95% of the population. Water tariffs are among the cheapest in the world where the poor are not denied access. Water is supplied for 24 hours per day. (Chan 2009)

In Malaysia, water is a state matter, thus the role of the Federal Government is limited. The shortcomings in the provision for safe and affordable water supply services has led the federal government to seek solutions in sharing the responsibility with the state governments in reforming the water services to be self-sustainable.

In the year 2005, the Federal Constitution was amended to allow for joint responsibility in water services between the state states in Peninsular Malaysia and Labuan, the Federal Government. Malaysia currently has no single agency in the country entrusted with the overall responsibility for holistic planning and management of water services, wastewater and water resources. However, it has many agencies with overlapping responsibilities at the state and federal levels.

Table 3: Statistics of Water Supply and Wastewater Coverage in Malaysia

States	No of accounts (all categories)		% Population served/connected		
	Water	Sewerage	Urban	Rural	State total
	2012		2012		
Johor	990,783	287,635	100.0	99.5	99.8
Kedah	519,493	120,695	100.0	96.3	98.2
Kelantan	208,187	4,128	57.9	60.8	59.9
Labuan	15,677	5,973	100.0	100.0	100.0
Malacca	258,022	112,847	100.0	100.0	100.0
N. Sembilan	365,138	178,954	100.0	99.8	99.9
Penang	533,916	384,138	100.0	99.7	99.9
Pahang	369,741	66,031	98.0	96.0	98.0
Perak	692,865	271,250	100.0	99.2	99.6
Perlis	65,415	6,015	100.0	99.0	99.5

Table 3: Statistics of Water Supply and Wastewater Coverage in Malaysia (cont.)

States	No of accounts (all categories)		% Population served/connected		
	Water	Sewerage	Urban	Rural	State total
	2012		2012		
Perak	692,865	271,250	100.0	99.2	99.6
Perlis	65,415	6,015	100.0	99.0	99.5
Sabah	262,525		99.8	64.2	82.0
Sarawak*	457,893		99.6	63.5	93.5
Selangor**	1,841,162	1,713,726	100.0	99.5	99.8
Terengganu	252,095	22,664	99.1	92.9	96.0
National average	**Total**	**Total**	**96.9**	**90.7**	**94.7**
	6,832,912	**3,174,056**			

Notes :

*Whole of Sarawak State including LAKU, Kuching and Sibu

**Includes WP. Kuala Lumpur and WP. Putrajaya

SOURCE: MWIG 2013

4.3 Policies

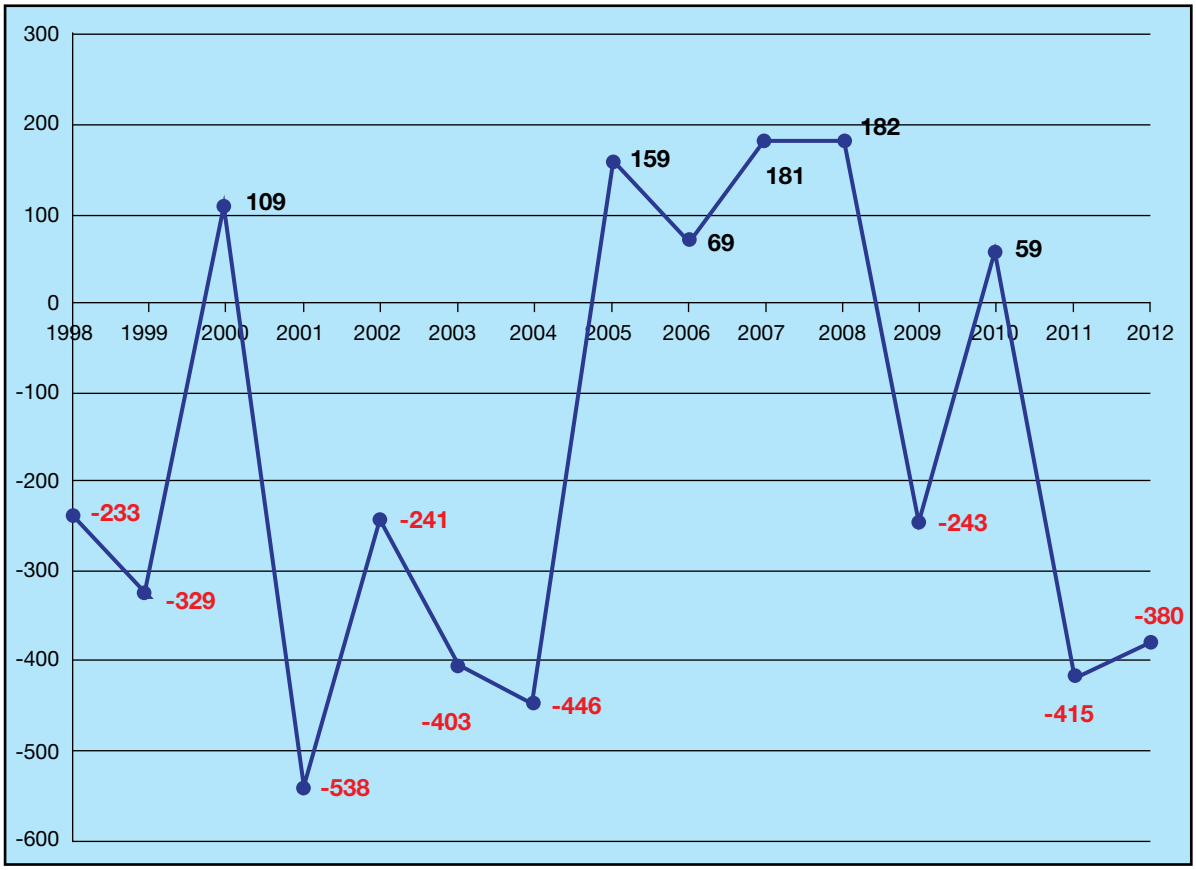
4.3.1 Water Supply

• Migration of state water entities

In tandem with WSIA, the Goverment has formulated a policy on migration to asset-light regime. However, the migration exercise has not yet achieved the target of having all the states to migrate to the new funding regime. This is not only affecting the long term targets but has also slowed down the economic activities in the industry. Funds are limited by the statutory constraints due to the prolonged transitional periods of the migration.

• Pricing

There is still a wide range of water tariff pricing between the states in Malaysia. It is evident that some of the water supply entities are not profitable in their operations. Although this study did not assess the audited reports of the entities, the main reference made to assess the health of the water entities is the annual MWIG published by the MWA in conjunction with KeTTHA and SPAN.

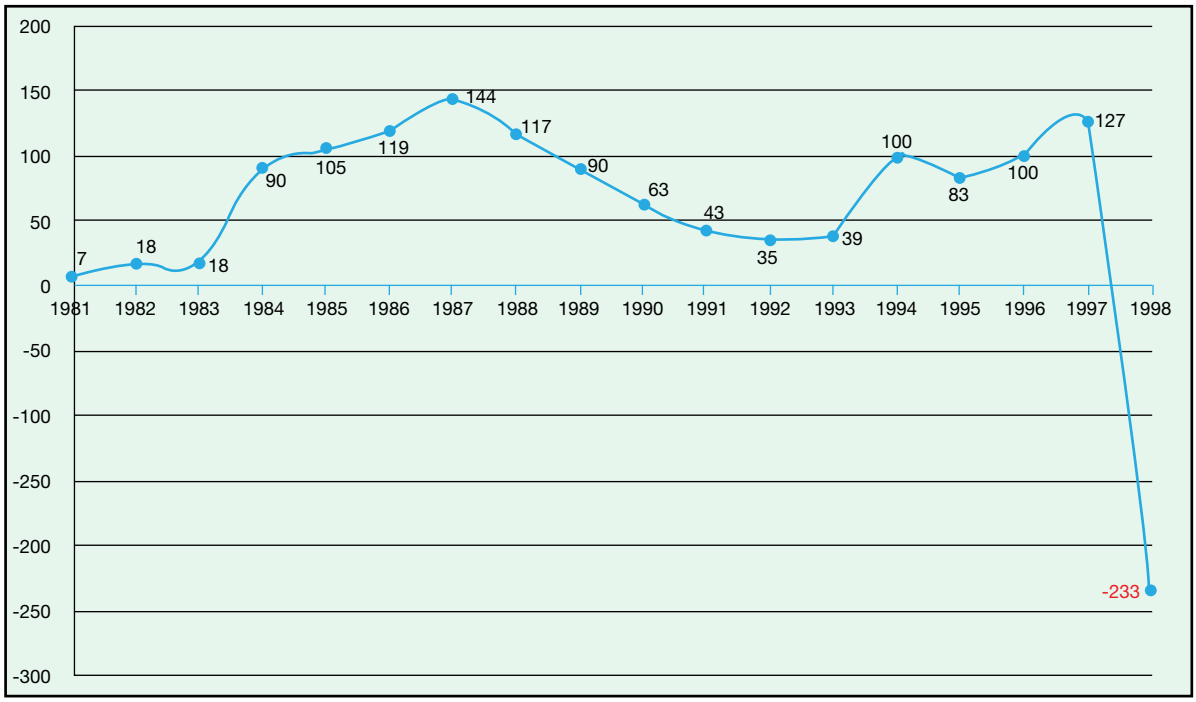


Negative figure shows deficit in operational turnover
(Source : MWIG 2013)

Figure 3: Revenue – Expenditure 1998 - 2012

From figure 3, it is evident that the water supply industry suffered deficits in revenue. The exact numbers could not be extracted as there was no in-depth auditing of the financial reports of each water entity. However, the trend is quite clear of the difficulties of water entities to be profitable.

Comparing these figures against previous trend as in figure 4, it shows a big difference in terms of surplus. It is therefore obvious that there is a change of trend from surplus to deficit of turnover in water supply industry.



Negative figure shows deficit in operational expenditures
(Source : MWIG 1998/99)

Figure 4: Revenue – Expenditure 1981 - 1998

- **Categorisation of WTP residue as scheduled waste (SW)**

A study conducted together by MWA and UiTM in 2007/2008, showed that most residue samples had very low chemical concentrations, often below their detection limits. There are no specified limits for potable water treatment plant residue in the developed countries such as USA (USEPA 2000), UK (Northumbrian Water 2008), Australia (Hamann & McMurrich 2004), Canada (INAC 2008) and South Africa (Titshall & Hughes 2005). However, the study by MWA had used the Total Threshold Limit Concentration (TTLC) as specified in the Guidelines for the Application of Special Management by DOE, to compare with the elements present in the residue. As most of the plants used alum, polyaluminium chloride or other aluminium-based coagulants, aluminium concentrations are expected to be high in the residue. Table 4 shows that the values of aluminium concentrations ranged from 1,100 mg/l to 79,200 mg/l with an average of 29,677 mg/l. However, it is interesting to note that there are no aluminium threshold limits specified in the TTLC.

Table 4: Chemical Analysis of Residues - Statistics

Parameters/site	Unit	LOR	TTLC	MEAN	MAX	MIN
Antimony	mg/kg	10.0	500	ND	ND	ND
Arsenic	mg/kg	5.0	500	53.50	91.00	16.00
Barium	mg/kg	5.0	10000	49.50	115.00	2.00
Beryllium	mg/kg	1.0	75	2.22	6.00	1.00
Cadmium	mg/kg	1.0	100	2.00	2.00	2.00
Chromium	mg/kg	1.0	2500	14.21	23.00	2.00
Chromium IV	mg/kg	10.0	500	3.00	3.00	3.00
Cobalt	mg/kg	1.0	8000	4.33	7.00	2.00
Copper	mg/kg	1.0	2500	10.29	33.00	2.00
Lead	mg/kg	1.0	1000	23.54	42.00	6.00
Mercury	mg/kg	1.0	20	ND	ND	ND
Molybdenum	mg/kg	1.0	3500	2.00	2.00	2.00
Nickel	mg/kg	1.0	2000	3.50	6.00	1.00
Selenium	mg/kg	10.0	100	ND	ND	ND
Silver	mg/kg	1.0	500	ND	ND	ND
Thallium	mg/kg	1.0	700	7.33	9.00	5.00
Vanadium	mg/kg	1.0	2400	30.93	79.00	9.00
Zinc	mg/kg	1.0	5000	38.60	95.00	2.00
Aluminium	mg/kg	1.0	N/A	29,677	79200	1,110
Pentachlorophenol	mg/kg	1.0	17	ND	ND	ND
2,4-Dichloropenoxy Acetic Acid	mg/kg	1.0	100	ND	ND	ND
2,4,5-Trichloropenxy propionic Acid (silvex)	mg/kg	1.0	10	ND	ND	ND
Trichloroethylene	mg/kg	0.5	2040	ND	ND	ND
Aldrin	mg/kg	0.5	1.4	ND	ND	ND
Chlordane	mg/kg	0.5	2.5	ND	ND	ND
DDT, DDE, DDD	mg/kg	0.5	1	ND	ND	ND
Deldrin	mg/kg	0.5	8	ND	ND	ND
Endrin	mg/kg	0.1	0.2	ND	ND	ND
Heptechlor	mg/kg	0.5	4.7	ND	ND	ND
Kepone	mg/kg	0.5	21	ND	ND	ND
Lindane	mg/kg	0.5	4	ND	ND	ND
Methoxychlor	mg/kg	0.5	100	ND	ND	ND
Mirex	mg/kg	0.5	21	ND	ND	ND
PCBs	mg/kg	0.5	50	ND	ND	ND
Toxaphene	mg/kg	0.5	5	ND	ND	ND

NOTE:

TTLC: Total Threshold Limit Concentrations as specified in Department of Environment, Malaysia Guidelines for the Application of Special Management regarding Scheduled Waste.
LOR: Lowest Detectable Limit
ND: Not present or below detection limits

From the Table 4, aluminium though present in the residue, does not have any threshold limits specified. Based on the comparison against the TTLC levels, the residues do not exhibit any scheduled waste characteristics.

The issue of categorising aluminium residual as Scheduled Waste is a major concern of the industry since a new water treatment plant would have to be more costly to provide for treatment of residue. The problem does not end merely with the realisation that having more comprehensive treatment of residue is not necessarily a wise move towards better management of water treatment plant residue. The classification of aluminium as scheduled waste requires the treated sludge to be transported to designated landfills which could be more costly as compared to the current water tariffs. It is estimated that the cost of the disposal of aluminium residue at municipal landfills and *Kualiti Alam* was RM0.06 and RM1.58 respectively per cubic meter of water produced. Hence, the annual cost for the whole country might exceed RM10 billion if all the residue were to be handled in drums and sent to *Kualiti Alam*. This is double the annual revenue of the water supply industry which is about RM5 billion.

The study by MWA recommends adoption of similar approach as practised in USA and UK. The residue should not be considered as scheduled waste, but rather as ordinary waste which is subjected to other existing regulations, such as effluent standards for direct discharge or with threshold limits for landfill and land applications. Specific exemption is recommended for the potable water treatment residue, based on the practice in other countries, where the residue is not considered hazardous waste.

Looking at history, EQA Regulations 1989 had only categorised sludge from wastewater as scheduled waste. However the EQA Regulations 2005 had included metals such as **chromium, nickel, zinc, lead, cadmium, aluminium, tin, vanadium dan beryllium** as scheduled waste SW204. There was a suggestion made earlier to DOE that the sludge from aluminium is given similar treatment as **spent activated carbon excluding carbon from potable water and processes of the food and vitamin production (SW411).**

Another possible solution to the aluminium residual problem is to opt for alternative coagulants that are non-aluminium based. Possible coagulants are ferric-based or organic coagulants which are available in the market but not widely tested.

4.3.2 Wastewater

There are several issues that remain unsolved despite the establishment of SPAN on 1st February 2007 via the enforcement of SPAN Act (Act 654), followed by Water Services Industry Act (Act 655) a year later. The legislation of WSIA supercedes provisions of the Sewerage Services Ac, 1993.

- **National sewerage policy**

There has not been any clear policy moves pertaining to sewerage services to guide the

industry although Section 15(a) of SPAN Act mentions about national policy objectives for the sewerage industry. The establishment of a fair and efficient tariff mechanism as mentioned in Section 15(e) would be an important catalyst for the industry.

The national policy objectives pertaining to sewerage services must be well-defined to ensure that the sewerage industry would progress in the right track in line with the national policy. The national policy should provide solutions through a national sewerage development plan focussing on issues related to sewerage catchment and local sewerage plans, facilities and infrastructure together with the operation and management of the industry.

The draft copy of the National Sewerage Policy was obtained from Indah Water Konsortium. However, it is still in the draft stage and need to be quickly revised and endorsed by the relevant authorities for implementation.

• Environmental Quality Act, 1974

EQA, 1974 is a legislation that is related to the prevention, abatement, control of pollution and enhancement of the environment in Malaysia. The Act restricts the discharge of wastes into the environment in contravention of the acceptable conditions. To date, 38 sets of Regulations and Orders have been introduced and enforced. The Director General of Environment has been appointed by the Minister to administer this Act and any regulations and orders made thereunder.

Under the Environmental Quality Act (EQA), 1974 and the Regulations thereunder, any industrial activity is required to obtain the following approvals from the Director General of Environmental Quality prior to project implementation:

a) **Environmental Impact Assessment reports** - under Section 34A of the EQA, 1974 (for prescribed activities);

b) **Site suitability evaluation** (for non-prescribed activities);

c) **Written permission to construct** - under Section 19 of the EQA, 1974 (for prescribed premises scheduled wastes treatment and disposal facilities, crude palm oil mills and raw natural rubber processing mills);

d) **Written approval for installation of incinerator, fuel burning equipment and chimney** – under Environmental Quality (Clean Air) Regulation, 1978, EQA, 1974; and

e) **License to use and occupy prescribed premises and prescribed conveyances** - under Section 18 of the EQA, 1974.

• Integration of water and sewerage services

There has been a lot of discussion on this subject but there has not been much progress. The issue needs to be addressed in a holistic manner taking recognition of the difficulty of collecting revenue for sewerage if it continues to be in isolation. Water companies are not keen to share their profit and taking sewerage as part of their responsibilities without seeing to the profitability of sewerage services. Hence, integration efforts should also look at the tariffs in the sewerage services.

Some views given were to relook at the combined billing for water supply and sewerage services. Earlier efforts were made but did not succeed. If integration of billing is difficult to be carried out, it is envisaged that integration of the two services would be even more difficult.

• Management of pollution from STP

There are nearly 6,000 public sewerage treatment plants and nearly 2,400 private plants. The national coverage policies should also address issues pertaining to the operations and management of all the private and public STP as poor management could result in uncontrolled pollution.

Some of the methods to control pollution that could be incorporated in the national policy objectives are:

- All sources of sewerage discharge must be identified and quantified;
- The concept of Integrated River Basin Management needs to be implemented, which includes the issue of storm water and industrial discharges to be made part of the sewerage services; and
- Provision of interceptor sewers as implemented for Sungai Malacca rehabilitation programme.

Best practices from foreign experiences in controlling pollution could be adopted.

• Sewerage services coverage

Currently, sewerage related issues are dealt with by different authorities namely:

- Ministry of Health in the rural areas; and
- Local governments for internal sanitary plumbing.

The management of all aspects of sewerage services and other related issues should be under the purview of **SPAN** as the regulator. **SPAN** should regulate all types of sewerage system including the primitive pit toilets, pour flush, direct discharge and upgrading of conventional and decentralised sewerage systems. About a third of the sewerage systems are still individual septic tank (IST) and pour flush systems.

An integrated management system should also chart out the national development goals of the sewerage services to ensure that all sewerage related issues are well-addressed with uniformity. The integration would be able to look at all stakeholders' interest both in the rural and developed regions while protecting the environment for long term sustainability.

• Pricing

Current tariff rates are generally inadequate for sustainability of the sewerage services industry. Operating at an annual loss of more than RM75 million while accounting only for operation expenses has proved that the current tariff is not sufficient for full-cost recovery. Comparing the size of the industry with other utilities, sewerage is just 10% of the water supply industry. It is even much smaller when compared to the power and telecommunication sectors individually which is nearly 80-fold in terms of revenue.

- **Reuse and recycle**

There is no clear directions on reuse and recycling of the sewerage water. As the quality of treated STP effluent increased, there is a need to look at how the effluent could be re-used for other purposes if potable use is considered too early for Malaysia. The possible reuse and recycling circle might be ventured for the non-potable usage since industrial usage could be relieved from the current water demand burden. With the increased demand for limited water resource anticipated in future, recycling and reuse is the best way out to endeavour with.

- **Sullage**

Sullage is not currently considered part of domestic waste. It is allowed to flow into the drain but then it pollutes the river. Although the management of sullage is under the prerogative of local Governments, it is viewed that this arrangement is not working well. It would be best that sullage be made part of the sewerage and to be treated in the existing STPs. However, the preliminary treatment before entering into the sewerage system should be provided for and monitored.

4.3.3 Outcome of Strategic Consultation

- **Changing public perception on tariff**

Tariff seems to be a sensitive issue. Currently, the tariff system is not sustainable and there is a need to review the tariff based on full cost recovery (FCR). That should reflect the additional investment for operation and maintenance costs. Apart from domestic water consumption, water usage by industries is also high. Hence, the need for the new tariff setting to include all hidden costs. Proper long-term strategy is necessary, particularly on the financial aspects of water use. Benchmarking with neighbouring countries could provide some indication on the way forward on tariff evaluation.

However, the implementation of tariff ratings should not be insensitive to the multi-socioeconomic groups in existence in Malaysia. Subsidy should be targeted to those eligible and needy. The need for public engagement through opinion polls would gauge the readiness of the consumers to pay more for their water bill. The acceptance of the public would reflect between affordability and willingness to pay. The reluctance is probably due to poor water services and occasional water quality violation.

It is important to achieve the buy-in from consumers on a reasonable price of water. This is to ensure **"quality water at tap"** all the time. The current practice of testing water at regular intervals is not uncovering the poor quality water received by consumers. Consumers should be allowed to make random tests by third parties should they feel unsatisfied with the quality of tap water.

"Quality water at tap" should also aim at enabling the consumer to drink water right from the tap. There must be reasons for the reluctance on drinking directly from the tap. How can it be overcome? Many cities in Europe and Asia have overcome this barrier since water companies are confident of their water quality at all times. These cities can

afford to do it by doing proper work at every stage of a project implementation operations. Do it right first time, all the time.

• Assessing the true value of water

The consumers are not really concerned about a hike in water tariff as they perceive that the current rates are cheap or reasonably priced. Their concern is more on water supply and services which need to be more reliable. The quality of water too, is of great significance, particularly on issue of safe and palatable drinking water.

The tariff setting should be transparent and attuned to the true value of water. That information should be communicated to the public through active engagement. It is pertinent to educate the public on the true value of water. It could be communicated through multimedia as well, so as to create a close link between the water industry and the consumers. The enactment of policies and regulations pertaining to water management needs to be declared to the public.

As seen from the tariff mechanism, disclosure of utility data is of utmost importance since the willingness to pay by the public is based on the transparency of water operations.

Transparency helps in building public confidence, as the cost of production and historical data are accessible to the public. Hence, from the discussions it could be seen that, in order to achieve long-term sustainability, the water industry has to work towards a full-cost recovery regime.

Full-cost recovery does not mean for the recovery cost of an inefficient operation or a blown out costing made for an operation. What is essential for the regulator is to make a jump-start in taking the water services industry en route to efficiency and effectiveness.

As for the public, particularly the consumers, they have an important responsibility which is to change their mindset and be aware of the several reformative activities that are being implemented towards full-cost recovery. Hence the shift for more public participation is as vital as transparency.

• National sewerage policy

The wastewater sector has raised their concern on the lacking of a policy for sewerage services, with specific reference to deal with outstanding issues on integration of water and wastewater, handing over of wastewater treatment facilities, land development on WTP reserves and so forth.

Looking at it from another angle, the Government should look into the risks of poorly maintained STP that could pollute water resources. Those issues have resulted in the growing problems of water resource security and sustainability. Stringent enforcement for protecting the water catchment areas against pollution from sewerage and industrial effluent have to take place. There is also a need for continuous awareness and educational programme for the public in order to increase their confidence.

Fragmentation exists between the water and wastewater sectors. There is a need for

integration, hence the policy should be revised for further improvement. The needs are more pertinent for addressing the grey areas, such as in the management of wastewater treatment plants.

There are also regions which are not well covered, such as the rural areas. Even the need to manage grey water including sullage should be catered for. Both the state and federal authorities have to collaborate and discuss the issues. SPAN should play the leading role to facilitate the discussions and initiate the decision making.

4.4 Sustainability in Water Services

The challenges that influenced sustainability in water services need to be fully understood and properly addressed amongst water operators, as underlined below.

4.4.1 Water scarcity and stressed areas

Water-stressed areas in some parts of Malaysia experience difficulty in obtaining water for potable use because of depleting resources and raw water scarcity. Sometimes this can create a water crisis, a situation where the availability of potable water within a region is less than that region's demand especially during dry spells.

4.4.2 Climate change

Changing precipitation patterns, unpredictable rainfall intensities, increasing runoff, rising sea levels and greater saltwater intrusion would likely need significant adaptation efforts to maintain water resources and infrastructure services.

4.4.3 Increasing population

There is an ever increased demand for water and wastewater facilities to be built to meet the rise in water usage. If the population doubles normally the demand on public supply systems would be more than tripled. The fast increasing demand is a nightmare for the affected water operators.

4.4.4 Energy uncertainty

The resources used for conventional fuel and traditional power sources have become increasingly more expensive. The costs are driving up fuel prices, destabilising the economy and causing global shortages and uncertainty for utility operating budgets.

4.4.5 Ageing infrastructure

Repairing, replacing, upgrading ageing and building new infrastructure facilities to meet the expected demand would cost billions of Ringgit over the next 20 years. These include WTPs and distribution or transmission networks.

4.4.6 Increasing Non-Revenue Water

Non-Revenue Water (NRW) still remains as an alarming issue in Malaysia despite substantial amount of funds being allocated for NRW, as illustrated in the table below. From past record, for RM1 billion Federal allocation, the reduction of NRW for the whole country was a mere 1.33%.

Table 5: NRW Level 2005 – 2012 (Source: MWIG 2006 – 2013)

Negeri	2005	2006	2007	2008	2009	2010	2011	2012	9MP Budget	Reduction 2005 - 2010	Reduction 2010 - 2012
Johor	35.5	32.46	31.2	31.3	31.95	29.85	29.2	27.8	0	5.65	2.05
Kedah	43.8	45	41.7	44.9	44.97	42.99	47.8	50.6	51.6	0 .81	(7.61)
Kelantan	40	44.4	48.4	49.3	48.32	52.41	55.6	53.9	130	(12.41)	(1.49)
Malacca	28.8	27	29.8	30	29.71	26.03	25.1	23.8	74	2.77	2.23
N. Sembilan	53	60.1	53.8	50.51	49.16	43.41	44.6	40.4	168	9.59	3.01
Pahang	49.7	46.4	53.6	52.8	59.9	55.29	56.2	54.2	145	(5.59)	1.09
Perak	30.6	30.7	30.1	31.1	30.68	29.44	30.4	30.1	80	1.16	(0.66)
Perlis	36.3	35.54	34.1	41.66	44.67	51.3	59.8	66.4	20	(15.00)	(15.10)
Penang	19.4	18.6	16.8	16.9	19.08	18.22	18.4	17.6	50	1.18	0.62
Selangor	38.4	36.6	34.7	33.9	32.49	32.45	32.3	33.1	100	5.95	(0.65)
Terengganu	34.7	31.5	38.5	38	37.85	39.39	37.0	36.8	45.7	(4.69)	2.59
Sabah	57.2	57	56.3	55.73	49.41	57.35	50.9	49.9	90.8	(0.15)	7.45
Sarawak	24.7	32	30.5	29.4	29.52	31.38	30.5	29.4	50	(6.68)	1.98
Labuan	24	36	35.9	33.1	25.85	24.91	21.9	20.4	1.5	(0.91)	4.51
NATIONAL	37.7	37.7	37.1	37	36.63	36.37	36.7	36.4	1,004.60	1.33	(0.03)

• The WLA Conference 2010

The Water Loss Asia Conference 2010 held on the 4 November 2010, unveiled the fact that Malaysia had still not achieved much in reduction of NRW despite the various efforts that had been taken in the past two Malaysia Five-Year Plans. This was taken as a shock and thus some re-appraisal of the measures undertaken in the past is needed. Tables above illustrates the NRW performance of each state for the period 2005 until 2012.

It is generally accepted that a holistic approach in reducing NRW is still the way forward. Due to the difference in the levels of NRW and differing management policies, each state's achievement in the past few years varies. In brief, the holistic approach is simplified as follows:

i) Prompt repair of visible leaks;
ii) Ensure accurate production meters;
iii) Establish district metering zones;
iv) Undertake pressure management; and
v) Implement selective pipe replacement.

- **Prompt repair of visible leaks**

This is important since it gives the right message to everyone including the consumers that NRW reduction is a serious matter and the water operators are determined to clear all backlogs in public complaints. A specific response time must be strictly adhered to by water operators. Naturally, the public would be more willing to report leaks without the necessity for the operators to look for them.

The promptness could be improved in several ways such as:

a) Increase resources in repair works;
b) Improve monitoring and control of works done;
c) Incentives for high productivity;
d) Penalties for delay and non-conformance; and
e) Proper information and reports.

It was suggested that a centralised customer service centre be established at all states. The centre should be able to function independently to provide some form of check and balance to the other services provided including repair works. The Puspel, a customer centre in Selangor can be benchmarked by others.

To support the existence of a centralised customer centre, a strong defect repair team is required at the district level. The team has to be adequately trained to emphasise quality and speed in doing repair works. Shoddy repair work and the use of inferior replacement parts are common problems that resulted in repeated occurrence of leaks and defects. To overcome these, it might be necessary to control the procurement of parts by centralising it at depots where strict quality assurance could be done. The provision of additional repair teams would be a short term measure to overcome backlog in complaints. It is envisaged that a period of two to three years would be a reasonable duration to put the situation back on track.

The low tariff on treated water has in many ways hindered the measures towards conservation of water. Water operators questioned the worthiness of reducing water loss when the effort to save it is more expensive than the cost of water to save. Hence, the economics of water loss has to be given emphasis. That is based on the comparison of repairing works against the operational cost. On average, the cost of repairing a leak would be from RM100 to RM1000 depending on the difficulty of the work. A burst pipe would be more than RM600. The amount of water saved from leaks is on average 3-7 m^3/day. That means the return on investment could be as long as 456 days (based on national average production cost of 73 sen/m^3) or 314 days (based on national average water price). However, comparing the true value of water which is much higher would make a difference.

Every state has already created a basic customer service centre. Thus, there is only a need to enhance the operation of the customer service centre, including using appropriate software and hardware for an on-line computerised complaint system. The effectiveness of the service centre would depend on management involvement in monitoring the action taken on every complaint.

- **Accurate production meters**

Most water treatment plants (WTP) have production meters. Production meters of privatised WTP are usually electromagnetic flowmeters and these are calibrated (verified) regularly. Other WTP have several types of flowmeter namely:

- Electromagnetic
- Ultrasonic
- Dall tube
- Venturi tube
- Turbine meter
- Venturi flume
- Weir

Accurate measurement of production is essential to ensure the integrity of data, vis-à-vis water balance. Some meters are not working, whilst some are sadly inaccurate. Very highly accurate, electromagnetic flow meters are now available at competitive prices.

Calibration of the existing flow meters are required to determine their reliability. Nevertheless, it is anticipated that a number of meters need to be changed since the accuracy of the meters is questionable. It is anticipated that many meters at the older plants need to be changed or recalibrated periodically, every 6 months or annually.

- **Establishment of district metering zones (DMZ) and pressure management**

District meter zoning is the best policy to be adopted in managing NRW within a distribution system. It is based on recorded flow passing through an inlet point into a designated distribution area. Each zone is usually approximately 500 – 2000 households. The continuous flow recording using data loggers could be monitored on-line or by periodic uploading of data logging.

Most states have established a number of DMZ. In Johor, Selangor and Labuan, all DMZ have been identified and mostly completed. Kelantan, Terengganu, Kedah, Perak, Malacca, Negeri Sembilan and Sabah have established DMZ by districts. Pahang and Perlis need to rehabilitate existing DMZ or establish new ones. Sarawak and Penang are also continuously establishing DMZ to manage NRW.

To ensure the continuity of DMZ policy, the states must ensure that adequate supporting teams are trained to take over the continuous monitoring of the DMZ. In a recent workshop, it was highlighted that the problems of DMZ being decommissioned due to the opening of boundary valves. There are also cases where the level of leakage returned to the original level within a month after the DMZ was left unattended after being established.

Thus, DMZ management has to be a continuous effort. It should not be perceived as a project but a process. The establishment of DMZ is part of the process where infrastructure to undertake DMZ management is built. Once built, the monitoring, analysis and remedial works have to be continuous. Short-term maintenance before handing-over has to be provided to enable sufficient training and technology transfer.

DMZ can not be the solution to all problems in a distribution system. There are cases where the DMZ was completed but

could not be commissioned due to inadequate water pressure and flow. Therefore, the development of DMZ has to be decided with prudence.

Pressure management can be implemented either inside a DMZ or outside it. Usually, it is installed together within a DMZ, since it can be placed in the same chamber as the district meter. Furthermore, information of the distribution system in a DMZ is very comprehensive, thus the pressure management can be done effectively. Pressure management can reduce NRW significantly especially if the existing pressure in the pipe is high.

The DMZ chamber can also house the data logger with a transmitter to enable the data logger to send data periodically to a server. The data sent can then be analysed using software that can produce reports from time to time.

The establishment of DMZ has to be expanded to new areas. The establishment usually involves mapping, zone proving, determination of bulk meter location, establishing baseline NRW and repair works. Once completed, it would be monitored continuously thereafter.

- **Selective pipe change and network improvement**

It is a known fact that Malaysia has a high percentage of asbestos cement (AC) pipes. The AC pipes are expected to have a life span of 25 years, but the pipes might fail earlier due to the corrosive environment that the pipes have to endure thus reducing the serviceable life of the pipes. In most cases, the AC pipes have exceeded the life span which were installed until 1980s. There are proposals that 5% of AC pipes be changed every year which takes 20 more years to complete. That is probably supported by the fact that the AC pipes could be replaced before they become catastrophic. However, this situation is actually happening in states with high NRW level.

Some pipes have been softened and are merely held in position by the firm ground. Once the ground moves or is disturbed, the pipes will start to leak or break. The breakage will propagate along the area and cause failures at nearby stretches. Records on the location of pipe breaks and leaks should be kept to justify pipe replacement.

Replacing pipes at random or for pressure and flow improvement does not impact NRW reduction but it can improve the service level. It must also be ascertained that the old pipes that are supposed to be replaced are put out of operation. All connections have to be transferred to the new pipe and all new communication pipes have to be changed using quality material and workmanship. Keeping old pipes in service would aggravate the NRW level.

Pipe replacement is best done in metered areas so that the savings achieved can be measured. Some form of temporary measurements can be done using insertion flow meters outside DMZ or District Metering Area (DMA).

Johor, Malacca, Penang and Perak have matured in implementing several NRW policies and approaches. Penang has reached a level that was considered as optimum NRW level whereby the cost of further reduction is not economically viable.

These states should continue to undertake NRW reduction works to counter the natural rise in the rate of leakage in the system.

Network improvement or selected pipe replacement can be implemented to overcome the problem of pipe deterioration besides the continuation of all other NRW policies that have been set and continuously executed. However, pipe replacement requires high capital investment with a long payback period and the current tariff structure.

Selective pipe replacement should be implemented on stretches with clear evidence of recurring pipe leakage and breakage. Determination of NRW is preferred before and after pipe replacement. Some reduction can be achieved from pipe replacement.

Since previous pipe replacement works were not properly recorded, it is difficult to estimate the NRW reduction achieved. For medium density housing, it is estimated that the NRW reduction is 0.1Mld per km of pipe replaced (based on Selangor's experience).

- **Outcomes of Strategic Consultations**

Concerns were raised in the SC that the current tariff in most states in Malaysia is not adequate even to cover the operations cost. Hence, it is quite difficult for water operators to be innovative and aggressive in the NRW works as calculations might prove that efforts to reduce NRW are not compensated by the saving, even on long-term basis. The operations deficit status are as follows:

Table 6: Financial status of states deficit on operating expenditure (MWIG, 2013)

State	2012		
	Total revenue	Total operating cost	Deficit
Sabah	RM271.3 million	RM420.2 million	RM148.9 million
Pahang	RM127.5 million	RM150.0 million	RM22.5 million
Labuan	RM16.4 million	RM25.3 million	RM8.9 million
Terengganu	RM117.1 million	RM119.3 million	RM2.2 million

The impact of deficit operations is limiting the implemention of NRW works. Hence NRW reduction has always been left out until separate funding is obtained from Federal agencies or financial institutions. That practice reflects severe misunderstanding of NRW reduction being considered as a project rather than an operations issue or a programme.

The real issue behind that predicament is inadequacy of the tariff to fund NRW reduction as part of facilities operations and maintenance. Hence, it is preferred at the moment to accept NRW reduction as capital expenditure rather than operations expenditure on the basis of the prevailing low tariff.

If further analysis is made on the capital expenditure, the situation would show that there is no operator in Malaysia that has fully recovered the total costs. That proves that the current tariff in Malaysia is too low compared to the operations and capital costs that have to be incurred by the operator.

The soft financing which is made available by Pengurusan Aset Air Berhad (PAAB) should consider NRW expenses as capital expenses until the tariff is properly rationalised. Without such provisions the situation would be a "non-starter".

It was also recommended that all water operators conduct a proper study on economic level of leakage which has been highlighted by the speaker on the practices in Australia. Looking from another perspective, the question that should be asked of water operators is "what is the water tariff that will give NRW a level of 25% in 2020 as economically viable or financially balanced?"

SPAN has set the following as target NRW for states:

Table 7: Target NRW (2013 – 2020)

STATE	NRW Projections (%)							
	2013	2014	2015	2016	2017	2018	2019	2020
Johor	28.9	28.7	28.6	28.4	28.3	28.1	28.0	26.9
Kedah	44.1	42.1	40.1	38.1	36.1	34.0	32.0	30.0
Kelantan	43.0	36.9	30.7	24.6	18.4	18.4	18.4	18.4
Labuan	20.4	20.3	20.2	20.1	20.0	19.9	19.8	19.7
Malacca	23.6	22.8	22.0	21.2	20.4	19.6	18.8	18.0
N. Sembilan	36.0	34.0	32.0	31.0	29.0	28.0	26.0	25.0
Penang	17.2	16.8	16.4	16.0	15.6	15.2	14.8	14.4
Pahang	48.3	44.9	41.6	38.3	35.0	31.6	28.3	25.0
Perak	28.1	26.9	25.8	24.6	23.5	22.3	21.2	20.0
Perlis	54.6	51.6	48.6	45.6	42.6	39.6	36.6	33.6
Selangor	31.1	29.5	28.1	25.9	24.2	22.6	21.7	20.8
Terengganu	33.0	31.5	30.0	28."	27.5	26.5	25.5	24.5
NATIONAL	34.0	32.2	30.3	28.5	26.7	25.5	24.3	23.0

Another important element to appreciate is, NRW reduction is time consuming, labour intensive and hard work but it is not "rocket science". Expertise can be made available locally and international input is probably only needed for benchmarking.

The current restructuring has seen some operators partially moving into the full cost recovery regime although they are not fully covered as some aspects of the water supply chain are still under different entities.

Taking into account only the operating expenditure, depreciation, amortisation, fixed monthly payment, finance cost and current capital expenditure, it is possible to see some operations having a surplus after expenditure.

The states that are still having a deficit on total expenditure are as follows:

Table 8: Financial status of states deficit on total expenditure (MWIG, 2013)

State	2012		
	Total revenue	Total expenditure	Deficit
Selangor	RM1808.9 million	RM2338.9 million	RM530.0 million
Sabah	RM271.3 million	RM420.2 million	RM148.9 million
Pahang	RM127.5 million	RM151.3 million	RM23.8 million
Labuan	RM16.4 million	RM25.3 million	RM8.9 million
Terengganu	RM117.1 million	RM120.5 million	RM3.4 million
Kelantan	RM81.1 million	RM81.7 million	RM0.6 million

The last water tariff review is already long overdue for some states such as:

Table 9: States with last tariff review before 2000 (MWIG, 2013)

State	Last tariff review	Ranking for first 30 m^3 domestic (from lowest)	Ranking for first 80 m^3 commercial (from lowest)
Sabah	1982	12 (0.90/m^3)	1 (0.90/m^3)
Labuan	1982	12 (0.90/m^3)	1 (0.90/m^3)
Pahang	1983	4 (0.54/m^3)	9 (1.45/m^3)
Sarawak (JKR areas)	1984	5 (0.55/m^3)	4 (1.15/m^3)
Sarawak (LAKU/Kuching) except Bintulu	1992	7 (0.61/m^3)	3 (1.04/m^3)
Sarawak (Bintulu)	1995	7 (0.61/m^3)	5 (1.21/m^3)
Perlis	1996	5 (0.55/m^3)	7 (1.30/m^3)
Terengganu	1997	4 (0.54/m^3)	4 (1.15/m^3)

It is evident that Sabah has been suffering low commercial rates and that it has affected its financial capabilities seriously. While **WSIA** coverage has been limited to Peninsular Malaysia, the future of the water industry in Sabah and Sarawak needs to be given special attention and not left to suffer the fate of such a low tariff.

Another point that was raised in the SC2 was the reluctance of policy makers (mostly at state levels) to implement tariff reviews. It has already been brought to the attention of the policy makers on the increase needed to cover operations cost but it was usually turned down due to matters related to politics. At the Federal level, access to media such as radio and television channels has to be strategically used to support the approved tariff and not otherwise. In the current situation where some states are governed by different political parties than the Federal level, similar assistance and encouragement should be given.

Another important point raised in the SC2 was the quality of equipment supplied to water companies. In the past, the water industry only purchased two brands of meter but today more meter brands are in the market. So it is important that more attention be given to ensure that meters are of good quality and put into service only for the reliable period when their accuracy is within a reasonable range. Information was also received that unapproved meters in one state are still usable in other states. There were also suggestion that meters should be subjected to certification of accuracy under the Weights and Measures Act 1972. However, that would only be additional cost to operations. Hence, the mechanism of implementation has to be looked in totality so that there is no unnecessary cost incurred.

Another very important issue in NRW is data integrity. It is evitable that SPAN or other regulators have not yet enforced formal reporting by third parties on the performance of water companies. There is a need that the performance of water operators to be audited similar to the financial auditing carried out by certified accountants. Similarly, there is a need that operations performance of water operators be done by independent third party technical auditors who would then submit reports to SPAN to assess and make public that information as it is of public interest.

Such practice has been adopted by the regulator in UK, the OFWAT, which appoints auditors to produce reports of the performance of water companies. In that way the integrity of data and reporting are protected and would be useful for planning and policy determination. It is quite evident that false data lead to wrong decisions.

- **Gaps in knowledge**
  - **Difference in levels of stakeholders acceptance**
    The major gap is the differences in the stakeholders' awareness on the importance of NRW problems. Different states have different level of buy-in among the stakeholders and even the staff working in the water entities.
  - **NRW awareness among staff**
    It is quite glaring that staff in efficient water companies in other countries such as Korea and Japan are very much concerned and involved in NRW management. It has become a culture in them to be knowledgeable, concerned and work hand in hand

with peers to reduce NRW in the company. That has not yet been achieved in the NRW programme in Malaysia. Probably the focus in Malaysia is the physical and infrastructural needs with little emphasis on people and culture.

- **NRW implementation approach**
  We have had states where NRW programme was performed on project basis and once the project was over, there were cases as reported by the Auditor General that the situation returned to what was before within six months.

- **Future needs**

  - **Political will**
    The Government should be able to push for both funding for NRW reduction and the right value for water. That would push down the NRW faster as public and policy makers would both be pushing for the performance and supporting the efforts of water operators to achieve them.

    The open opportunity for funding lays with PAAB as the custodian of assets and "banker" to the water industry. The debate whether NRW works are CAPEX or OPEX is not supposed to prolong as the final analysis would show that the cost needed to reduce NRW to what was targeted (25% in 2010) is almost unbearable even if the tariffs were to increase gradually.

  - **Evaluation of pipe condition**
    The two major challenges in NRW reduction, particularly the physical losses, is the high percentage of asbestos cement pipe (AC) and leaking communication pipes.

    The quantity of AC pipes, though decreasing, is still daunting as indicated below, together with the number of connections in the country.

    The 43,890 kilometres of AC pipe shown in Table 10 comprised about a third of the national distribution network system and are supposed to be replaced gradually as it reached its serviceability life span which is 25 years, depending on the working environment and pipe condition. Some AC pipe are even 50 years old and performing just fine. However, most should be in less favourable condition.

Table 10: Statistics of AC pipe 2005-2012

Year	Total length of pipe	Total lengths of AC pipe	% AC
2005	96,976	42,091	43.4%
2006	100,513	42,242	42.0%
2007	113,085	42,867	37.9%
2008	118,580	42,999	36.3%
2009	126,421	44,282	35.0%
2010	127,994	43,874	34.3%
2011	130,543	44,050	33.7%
2012	134,495	43,890	32.6%

Table 11: Statistics of AC pipe 1997-2004

Year	Total length of pipe	Total lengths of AC pipe	% AC
1997	67,743	42,933	63.38%
1998	74,826	46,386	61.99%
1999	81,908	49,838	60.85%
2000	86,990	48,132	55.33%
2001	88,786	46,426	52.29%
2002	91,247	45,746	50.13%
2003	92,283	43,673	47.33%
2004	94,668	43,439	45.89%

Note: Derived as discrepancies anticipated in the data available

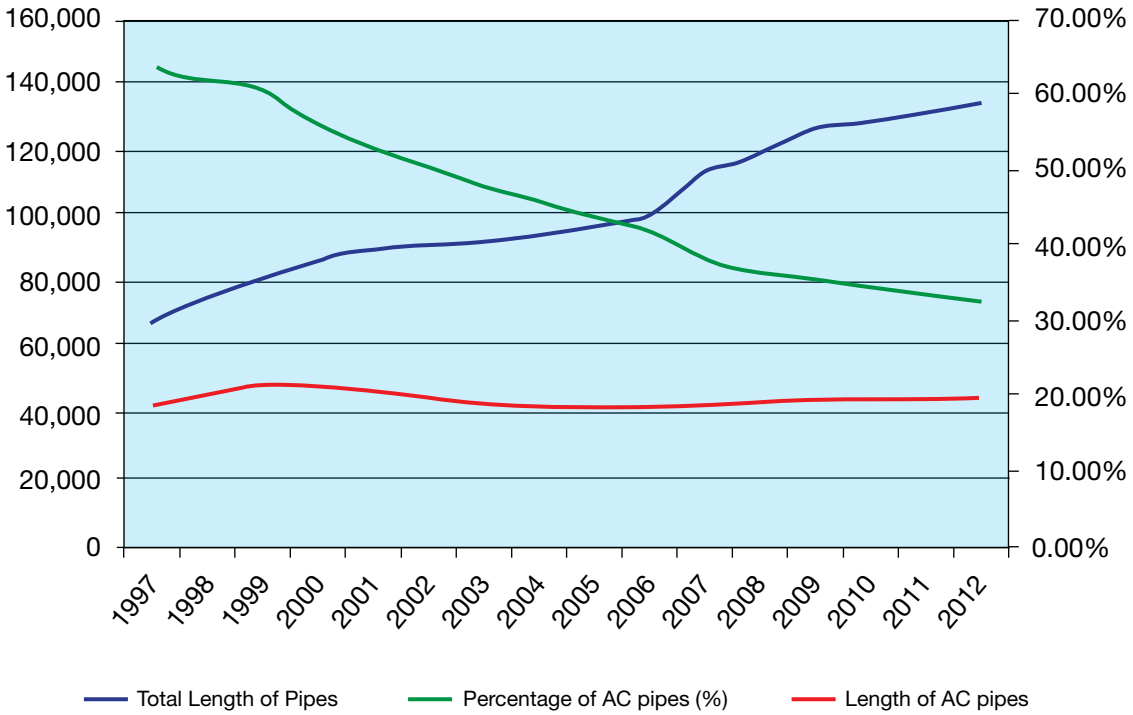


Figure 5: Statistics of AC pipe 2005-2012

Over time, AC pipes undergo gradual degradation in the form of corrosion (i.e., internal calcium leaching due to low alkalinity in conveyed water and/or external leaching due to groundwater). Such leaching led to reduction in effective cross-section, which resulted in pipe softening and loss of mechanical strength. Accordingly, as the water distribution system aged, the number of AC pipe failures increased with time.

In light of these risks, an AC pipe condition assessment is essential to determine the remaining useful service life and develop a suitable, proactive replacement plan for the distribution system. Exponent engineers and scientists can assist water operators in the development of strategic and cost-effective AC pipe replacement plans, customised to the individual challenges of the distribution system.

There are several types of data that need to be collected from sites to undertake the proactive and effective replacement methods. It is not simply replacing them based on convenience. The data might look elaborative but based on the amount of funds needed to undertake the exercise, it is worthwhile to make a proper evaluation of the pipes. The data that should be collected are:

- Identification of prevalent AC pipe failure mechanisms;
- Analysis of historical AC pipe leak records with respect to geographic location in the distribution system, incorporating geographic information system (GIS); and
- Identification of factors affecting AC pipe failure propensity, which might include:

- Pipe age
- Pipe diameter
- Pipe class
- Pipe manufacturer
- Internal/external water chemistry
- Internal water pressure
- Soil physical and chemical properties
- Groundwater table elevation
- Overburden
- Environment

There are several laboratory testings that can be carried out to determine the condition and strength of the pipes such as:

- **Residual strength testing**

  i. Crushing strength test (ASTM C 500)
  ii. Hydrostatic pressure test (ASTM C 500)
  iii. Flexural strength test (ASTM C 500)
  iv. Splitting tensile strength (ASTM C 496)

- **Degradation depth evaluation**

  i. Determination of calcium leaching depth
  ii. Scanning electron microscopy
  iii. Energy dispersive X-ray spectroscopy
  iv. Petrographic examination (ASTM C 856)
  v. Matrix hardness test

- **Assessment of o-ring condition**

  i. Compression set test (ASTM D 395)
  ii. Hardness test (ASTM D 1415)
  iii. Fourier transform infrared spectroscopy (FTIR)

Depending on the quality of historical leak records, size of the distribution system and the number of samples collected for laboratory testing, the following types of service life prediction models can be developed:

a. Historical leak rate based model:
   - Leak rate model based on influential factors (identified in Item 1)
   - Remaining service life determined by acceptable leak rate threshold
b. Pipe degradation/residual strength model
c. Model predicting rate of pipe degradation and/or strength loss based on laboratory testing, pipe attributes, and operational environment characteristics
d. Failure threshold degradation depth/ residual strength obtained from failed pipe samples
e. Remaining service life based on projection of degradation rate/strength loss to failure threshold

The final one is the development of a pipe replacement master plan. That can replace the ad-hoc system of pipe replacement which has been practised. That master plan would be:

a. Based on a system-wide remaining service life prediction model; and
b. Incorporate hydraulic, operational and financial considerations, critical customers, risk, optimal feasible replacement length and other factors.

According to Teik (1992), AC pipe laying had a history back to the late 1940's and some of the pipes have already reached the end of their life span and more will follow. Malaysia's main manufacturer of AC pipes is UAC which has started producing local pipes in mid-1967. It will be 50 years old in next year (2017). Hence, the pipe replacement is something that

needs assessment and proactive planning for the medium term.

- **Inventorisation**

  Asset management has to be properly mapped and tagged. Not all the states have Geographical Information System (GIS) and hence, not all assets are mapped.Unless a lot of information is gathered about the assets, little can be done to manage them well. The asset management system too would have to tie up well with the Water Safety Plan (WSP) to ensure reliable water supply at all times.

  The SC2 also highlighted the lack of exposure to Economic Level of Leakage (ELL) which is a prerequisite in decison on how much should be spent to manage NRW by the water operator. A model of ELL was presented in the SC2 and it was agreed that similar approaches be made in the implementation of NRW programmes.

  Finally, there was a suggestion that water awareness should be incorporated in the education system. Water education has been all along driven solely by NGOs and Government organisations. The idea was well accepted by everyone but needed another driver to push it in the Education Ministry.

4.5 Technology Issues

4.5.1 Water

Reviewing the past and present technologies installed in water service facilities such as with the *JICA Water Treatment Plant Optimisation Exercise Report 1985*, displays that there are only limited innovations and inventions in the water industry. The conventional treatment systems are still popular. That is acceptable but it should not be restricted to only such practices, particularly if conventional treatment systems are proven to be not adequate to treat raw water.

The problems of coloured water, algal blossom, high iron and manganese, high ammonia and peat water are still happening in several conventional water treatment plants.

Technology on NRW reduction was looked into in the Non-revenue Water Control Study and Development for Malaysia 1989 and generally touched on in the Review of the National Water Resources Study 2010. The performance of NRW reduction did not commensurate with the expenses incurred in NRW programmes.

4.5.2 Wastewater

- **The evolution of sewerage treatment technology**

In the early days, sanitation problem was never a concern to society. During those times, nature took care of the problem due to the small population in the world. However, due to progression in human civilisation and the outgrowing number of people, the need for proper sanitation management has become an issue to society.

During the era of the Middle Ages, the evolution of sewerage systems began with direct discharge to the streets, where the street became the sewerage disposal area. However,

the improper sanitation method caused the outbreak of bubonic plague which then raised the concern of society on the need for an improved and better sanitation system. In the 19th century, development in sewerage systems introduced the use of pour flush and sewers discharging straight into rivers. Later, sewerage farms were used to treat the sewage instead of rivers due to the increased level of pollution in rivers. These were later developed into proper sewerage treatment plants.

Before the country's independence in 1957, there were no proper sewage systems in Malaysia. In fact, the need for proper sewerage treatment never was a concern to the people during that time due to the low population density and also the very limited urbanised developments. Sewage treatment was mainly by primitive methods such as pit and bucket latrines and over-hanging latrines beside direct discharge into rivers or seas. This was recognised as the most successful model by the World Health Organisation, with a minimum of 90% coverage in 1995 (compared to 2.6% in 1970) (*Sewerage Services Department 1998*).

However, for the urban areas, the usage of conventional sewerage approaches had been adopted. The method of treatment during that time could only provide basic primary treatment through the method of sedimentation and digestion.

As the world advanced in technology, innovation on the treatment systems and increased involvement from the Government by establishment of Sewerage Service Act 1993, the sewerage systems in Malaysia were gradually improved and developed as shown in Figure 6.

Figure 6: Evolution of Sewerage system in Malaysia (Courtesy of IWK)

During 1960s, sewerage treatment systems in the form of individual septic tanks (ISTs) and pour flush systems were introduced in the town areas. That method helped to reduce the direct discharge of sewage pollution to the environment.

As more towns were established, the use of communal septic tanks (CSTs) was introduced to provide for community-based sanitation. These CSTs gave similar performance to ISTs but by way of a series of pipes connecting to a row of tanks.

CST was quite commonly used and currently made up 53% of all treatment plants in Malaysia. CST is clarified as a primary treatment and consisted of two chambers. The effluent enters into the first chamber where solids settle and partially clarified effluent overflows into the second chamber. The sludge then accumulates in the first chamber and requires regular desludging. Additional settlement occurs in the second chamber before the effluent is discharged to the drain.

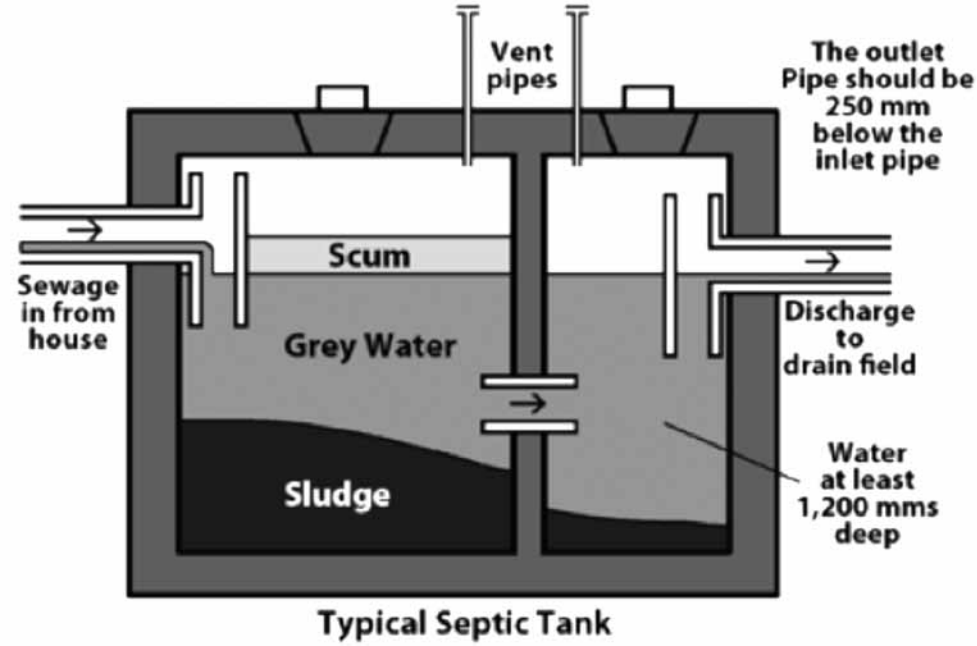


Figure 7: Typical plant layout of Communal Septic Tanks

Besides that, another improved version of primary treatment system, that is Imhoff Tanks were later used for treatment as community sewerage systems. Imhoff tanks constitute 24% or 800 numbers of all sewerage treatment plants in Malaysia and are the second most common form of treatment plant.

Imhoff tanks are normally used to service small communities up to a population equivalent of 1,000. They are relatively cheap to install, operate and maintain. However, the Imhoff tanks only partially treat sewage. The effluent from the tank does not meet the environmental requirements of the Department of Environment.

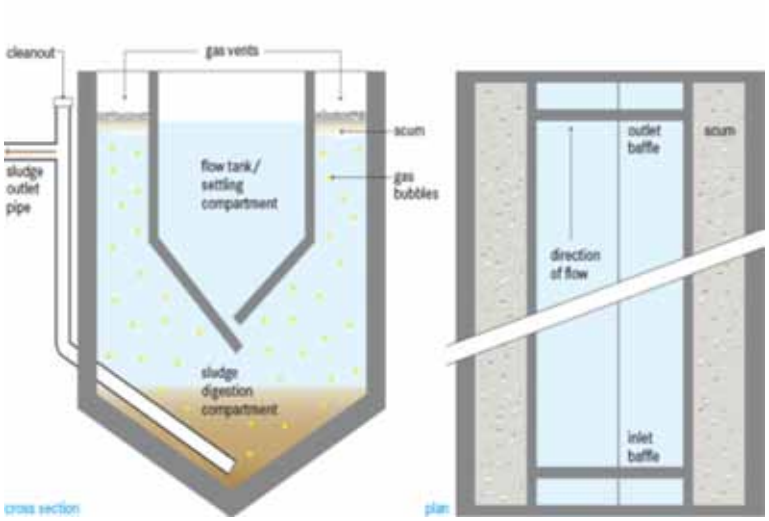


Figure 8: Typical plant layout of Imhoff Tank

In the 1970s, the sewerage technology in Malaysia evolved to more expanded treatment in the form of biological oxidation pond systems. That was to cater for the development of more towns into cities and increased environmental concern which then led to the enactment of the Environmental Quality Act in 1974. The treatment proved to reduce BOD from 200-400 mg/l to 20-100 mg/l.

Normally, oxidation ponds consist of at least two constructed ponds. The first pond is used to reduce the organic material using aerobic digestion while the second pond filters the effluent and reduces the pathogens present. Oxidation ponds require large land areas. The degree of treatment was weather dependent thus causing them to be incapable of achieving a good standard of effluent consistently.

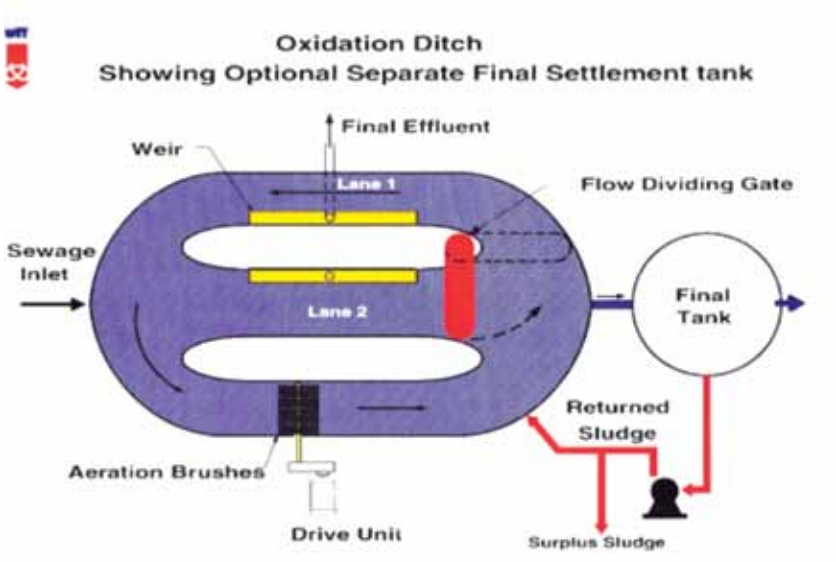


Figure 9: Typical plant layout of Oxidation Pond

The increased population then caused the introduction of aerated lagoons in the late 1970s in order to serve a larger population within a limited land area reserved for oxidation ponds. The technological advancement allowes for enhancement of oxidation pond capacities up to more than five times the original capacities as illustrated in Figure 10 below.

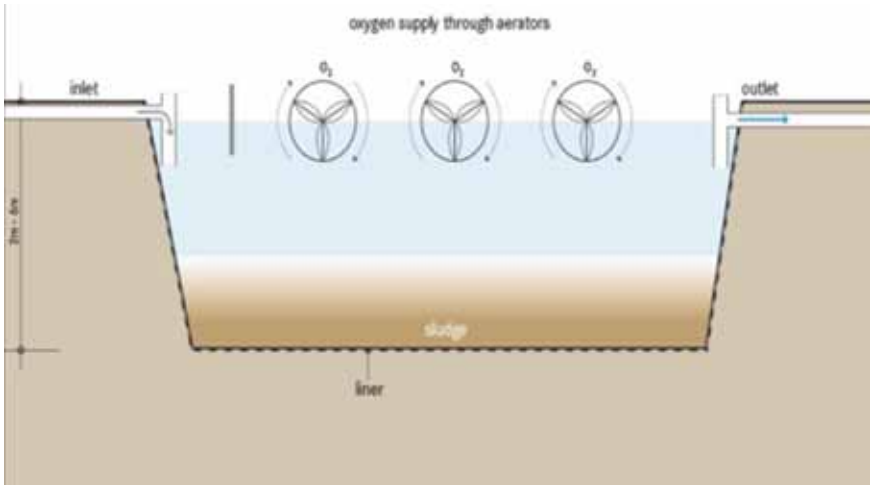


Figure 10: Typical plant layout of Aerated Lagoon

The late 1980s and the 1990s saw the accelerated development of fully mechanised systems in the form of biological filters and activated sludge systems due to enactment of Environmental Quality Regulations,1979.

The use of trickling filters and bio filter ponds proved that the biological treatment is able to remove 65% to 85% of Biological Oxygen Demand (BOD) and Suspended Solids (SS).

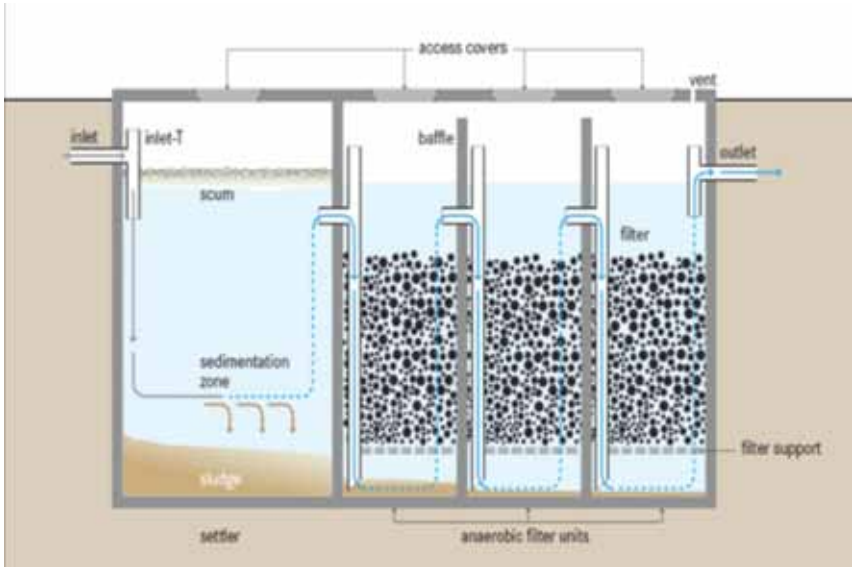


Figure 11: Typical plant layout of Biofilter

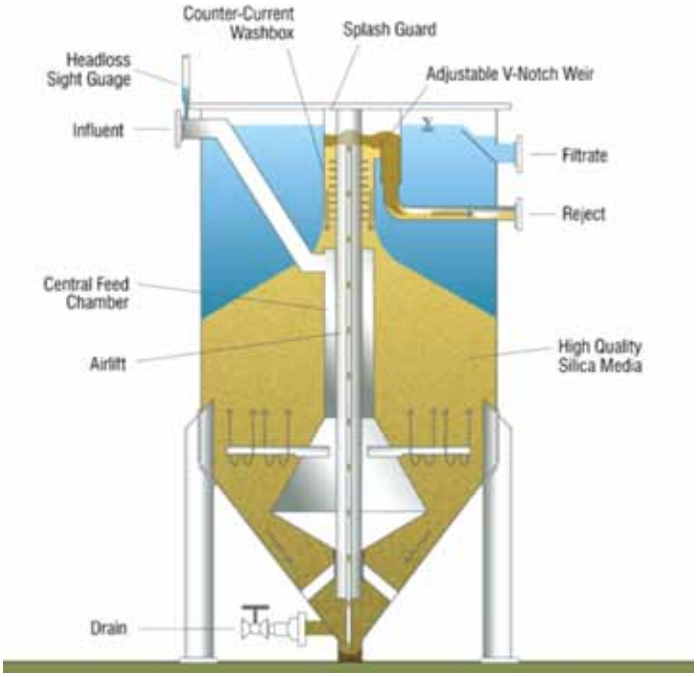


Figure 12: Typical plant layout of Trickling Filter

The advanced technologies in sewage treatment has enabled Malaysia to adopt more mechanical sewage plants. Mechanised sewage treatment plants are more capable in providing more efficient secondary treatment compared to other methods. That has improved the level of sanitation treatment in Malaysia.

Besides that, the use of more advanced pumps and aerator technology has also helped to improve the efficiency of oxygen transfers in the treatment pond. The use of PLC and SCADA further improves sewage treatment technology in Malaysia and provides better and efficient control of waste treatment.

• Recent sludge management

The management of sludge from wastewater treatment facilities is one of the most critical environmental issues in Malaysia, due to the very fast increase in sludge production as a result of sewerage extensions, new installations and upgrading of existing facilities (Zaini and Salmiati, 2011). The sludge accumulated in a wastewater treatment process has to be treated and disposed of in a safe and effective manner. Thus it is necessary to develop a comprehensive plan for the treatment and disposal of sludge.

The purpose of digestion is to reduce the amount of organic matter and the number of disease-causing microorganisms present in the solids. The most common treatment options include anaerobic digestion, aerobic digestion, and composting. Prior to the privatisation of sewerage services, there was no proper programme to handle, treat and dispose of sludge safely back to the environment. Currently, there are about 7,500 public sewerage treatment plants which generate sludge as by-products. That does not include

the massive number of individual septic tanks which also generate sludge.

Sludge management policy in Malaysia is centralised and governed by SPAN which aims to:

i) Reduce the amount of sludge production;
ii) Produce a safe and hygienic material; and
iii) Apply to reuse options instead of disposal.

Landfilling has been a simple route for sludge disposal, especially when recycling is not of primary importance. In any case, landfilling is necessary to support all the other systems to dispose of materials that can not be reused and for maintenance or emergencies during shutdown periods. Only well-dewatered sludge is suitable for landfilling, where a good level of biological stability is also necessary to avoid possible emission of bad odour.

Utilisation in agriculture as composting material and forestry for soil enhancement are likely to remain major options for sludge management, especially for sludge with limited contamination by bacterial pathogen and toxic compounds. Besides that, the concept of recovering energy from sludge has had emerged with growing technologies and currently the Department of Environment (DOE) is working on regulations and standards for energy recovery from sludge management.

Most of the sludge treated is still disposed of in landfills, forestry and composting while the agricultural applications of sludge are being studied and gaining acceptance. The amount of sludge produced and treatment options are shown in Table 12.

Table 12: Amount of sludge produced, and treatment options in Malaysia

Sludge	**Generation rate (million m^3)**	**Treatment options (million m^3)**	
		Centralised facilities*	**Non-centralised facilities**
Sewage sludge	7.40	5.30	2.10
Industrial sludge	9.90	6.40	3.50

* Bio-Soil (BS), Biofilter (BF), Rotating Biological Filter (RBC), Sewage Aeration Treatment System (SATS), Hi-Kleen (HK), Fine Bubble Activated Sludge (FBAS)

Continuous efforts in research and development especially by public universities are being implemented to develop more innovative, cost-saving and environmentally friendly means to upgrade the management of sludge. Figure 13 shows the sludge reuse options in Malaysia (IWK 2008).

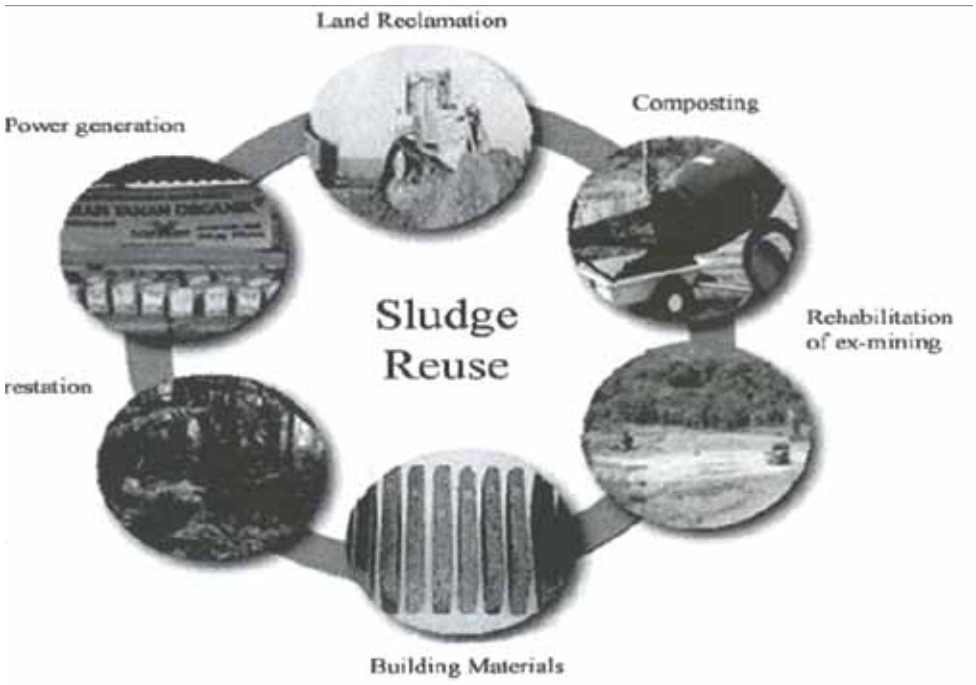


Figure 13: Sludge reuse options in Malaysia

Sludge disposal management experts are currently focusing on the possibilities of producing gas or oil from sludge, that subject has now become an interesting study especially in universities of Malaysia. On-going research for methods to produce fuel from biomass is currently a highlight. Sludge as soil improvement seems to have become the ultimate solution for sludge management as it is useful for reconditioning sandy and degraded soils for agricultural and forestry development.

However, sufficient knowledge about the characteristics of the types of sludge produced is required to assess the long term impact of its utilisation. Besides that, sludge of good quality should find use in agricultural applications as it contains nutrients and minerals that can help in plant growth, proving to be beneficial to the agricultural industry.

In all cases, the future development of sludge management would be strongly influenced by the new Malaysian directive on sewerage sludge. In areas where disposal in landfills is still common practice, that could later lead to better recycling of valuable compounds from sludge. In other areas, the directive would not influence the current situation much, especially where agricultural application is the common means of sludge disposal.

- **Future strategic plans for green and eco-friendly services**

The future strategy plan of IWK towards greener technology and eco-friendly services applies the 3R concept of reduce, reuse and recycle of treated sludge by the plant. That is in accordance with the seven concepts of future treatment plants which are to:

i) Protect receiving water
ii) Be economical
iii) Be a good neighbour
iv) Be sustainable
v) Reuse effluent
vi) Recover energy
vii) Recover nutrients

That strategy maximises the usage of sludge so that the plant can achieve near zero waste production and develops better management of the sludge.

- **Water**

The water accumulated from the thickening and dewatering process of sludge management can be used for irrigation. That can help provide much more water for human consumption besides saving more fresh water. However the potential has not yet been seriously explored or utilised. Although Malaysia is blessed with about 3,000 mm of annual rainfall, many parts of the country have suffered periodic water shortage which might be due to the imbalance of water demand with the availability of rainfall. The situation is expected to worsen in future due to the impact of climate change and global warming.

National Water Resources Study (2000-2050) forecasts that water stress will be experienced in the states of Penang, Malacca, Selangor and Negeri Sembilan. The new paradigm is to look at the potential of using treated wastewater from sewage treatment plants for non-potable use, probably also having the advantage of demand being within the supply area. That would significantly reduce the demand of potable water for non-potable use such as for factories, gardening, car washing etc. The amount of "treated wastewater" (which is the STP discharge – in Singapore it is called "recycled water") is estimated to be approximately 4,500 Mld. That is about double the volume of the available water in the existing Pahang-Selangor interstate water transfer project. That puts "treated wastewater" as a reliable potential water source for future usage.

- **Sludge**

The sludge generated from the treatment can be reused as non-chemical fertiliser which is safer to use compared to conventional chemical fertilisers. Other than that, the treated sludge can be used for landscaping and it is also more beneficial to the plant as the soil will contain more minerals and nutrients.

- **Gas**

The methane gas produced during the treatment can be used as a source of renewable energy. The treatment of sludge produces nearly 70% of methane gas. Thus it can be utilised for generating energy rather than simply being disposed. This energy source can be used to run the plant itself or be sold to the community to help increase self-sustainability. Collaboration with other parties such as local universities is encouraged to help turn the sludge into more useful resource for beneficial purposes.

Besides that, IWK is now focusing on trying to reduce the volume of sludge by

doing more research on sewage treatment using enzymes. Research on sludge that could be used to produce energy was also being conducted to make potential use of renewable energy. This includes exploring energy generation such as the usage of micro turbine that can be used to generate energy for the plant, thus help in reducing the cost of purchased energy.

Other purposes of sludge such as conversion into coal or brick are also being studied to find more sophisticated and efficient ways of using treated sludge. Currently, IWK and Universiti Teknologi Nasional (UNITEN) are jointly undertaking a pilot project that is being funded by KeTTHA to harness renewable energy of 500 kilowatt from biogas and 50 kilowatt micro-hydro power plant. It is being conducted at the Kuala Lumpur STP. The project is expected to benefit in cost savings and increased revenue of the plant for better sustainable management.

- **Operation**

- **Current achievements on wastewater**

To improve operation and maintenance, IWK has gradually taken over sewerage systems of various sizes and types. From 1994 to 2008, more than 8,800 systems have become public systems under IWK's control while more than 3,000 systems still remain under the direct management of the owners and thus, are classified as private systems. IWK does not own the public facilities but only operates and maintains them, which has the right to collect sewerage charges. On average, IWK takes over 300 treatment facilities and 1,000 km of sewer network yearly. However, in areas where large-scale sewerage systems are not provided, private developers continue to construct small-scale sewerage systems.

In 2006, the Malaysian Parliament passed the Water Service Industry Act (**WSIA**), which replaced the Sewerage Service Act. The latter provides the regulatory framework for sewerage management, and requires the owners and occupants who have septic tanks to take the responsibility of operating and maintaining them appropriately. Under the previous legal arrangement, IWK had no right to oblige the users to pay desludging costs and sewerage charges, or to impose a fine on them. The new act also features the integration of drinking water and sewerage services. The holistic approach to water management has enabled enforcement and termination of water supply on users who do not pay sewerage charges. The framework also reinforces SSD's roles and provided by law a new regulator, SPAN (*Suruhanjaya Perkhidmatan Air Negara* or National Water Services Commission).

One of the Malaysian sanitation characteristics is that sewerage systems and septic tanks are equally considered to contribute to the improvement of sanitation regardless of whether they are constructed by the public or private sector. Based on this concept, both systems' regulation, operation and maintenance are provided by the same organisations.

The ratio of connected houses to the sewerage system was 5 per cent in 1993, but it drastically increased to about 70% in 2010. Furthermore, the number of wastewater treatment plants that conform to the standards for discharged effluent have increased yearly. In 2006, 69% of wastewater treatment plants met the BOD standard and 88% of them complied with the SS standard. Table 13 shows the classification of public and private wastewater systems that treat grey and black water through proper treatment facilities or septic tanks.

Table 13: Classification of wastewater treatment facilities in the Malay Peninsula (Country Sanitation Assessment in Malaysia, JSC 2011)

Wastewater treatment facilities	Quantity/Length	Population equivalent (PE)
Regional STPs (Public)	74	5,600,000
Multipoint STPs (Public)	5,148	12,300,000
Pumping Stations (PS)	668	3,600,000
Private STPs	3,415*	2,000,000*
Communal Septic Tanks (CST)	3,635	434,000
Individual Septic Tanks (IST)	1,100,000	5,500,000
Pour flush (PF)	761,000	3,800,000
Sludge Treatment Facilities (STF)	40	-
Sewer Networks (km)	14,000	-

In moving forward to the reconstruction, expansion and new implementation of wastewater treatment facilities, in accordance with the Sewerage Catchment Strategy, it can be estimated that the activated sludge process, or similar processes that can be easily modified to achieve advanced treatment, would prevail. By doing so, septic tanks are expected to gradually decrease in urban areas.

IWK operates and maintains about 5,800 wastewater treatment facilities all over the country, which covers a population equivalent (PE) of 19,500,000 people (2010). In the past, a communal septic tank used for an apartment was regarded as a wastewater treatment plant, but it now fell under the same category as an individual household septic tank. IWK reported the characteristics of raw wastewater as follows : 200 mg/l < BOD < 400 mg/l and 200 mg/l < SS <350 mg/l. Table 14 below shows the quality of wastewater treated by different treatment processes.

Table 14: Relationship between treatment processes and the quality of treated wastewater (Country Sanitation Assessment in Malaysia, JSC 2011)

Treatment process		Effluent quality	
		BOD (mg/l)	SS (mg/l)
Activated sludge process or similar treatment process		10-30	15-40
Aerated lagoon		20-80	40-100
Stabilization pond process		20-100	30-150
Imhoff tank		50-150	30-150
Individual household septic tank		150-200	50-100
Reference Discharged effluent quality standards	Standard A	20	50
	Standard B	50	100

- **Current major problems faced by IWK**

The major problem faced by IWK is customer non-payment for wastewater services which commonly occurs in Malaysia. Society pays little interest to the service provided by IWK and take them for granted as if it is a free service. Society still lacks knowledge of the importance of proper sanitisation methods which causes them to be unwilling to pay for the services provided by IWK unless they face a problem regarding the sewerage tank at their residential house.

Educating the future generation of students on the importance of sewerage treatment as a public health and environmental concern would be beneficial in helping to educate society to maintain a clean environment. Society needs to be educated on the importance of a proper sewerage system to ensure that there are no water-borne diseases in the country and that will help to attract tourists. It then can be beneficial to the country's economy and reputation as well gain awareness among the members of society to be more cooperative in matters regarding wastewater services.

Besides that, IWK is also facing problems in the funding of its operations. Although the transfer of all sewerage assets to IWK for management and development has resulted in drastically increasing its sewerage coverage, ineffective cost recovery due to the low tariffs and insufficient collection has caused IWK to be dependent on additional subsidies from the Federal Government.

IWK is also frequently facing mechanical problems reported by its customers in form of spills or blockage of the manhole. These problems need to be resolved by IWK in a short duration of time to ensure that there is no inconvenience faced by the public. The complaints that are usually reported :

- **Spills/Overflowing manhole**

  Occasionally, the flow of wastewater in the underground public sewer is blocked by

rubbish or solid waste/objects. When that happens, the wastewater will overflow from the public manholes. IWK is responsible for clearing the blockage in the sewer through the manholes using special equipment within 24 hours from the time of notification.

- **Missing manhole cover**

Public manholes are covered with a round metal cover made of cast iron and are embossed with "JPP" (Jabatan Perkhidmatan Pembetungan), "Indah Water" or Local Authority's logo. There have been many cases of the cover being stolen by unscrupulous individuals.

The new manhole covers come with a hinge and lock to prevent theft. IWK will replace the missing cover within 12 hours from the time of notification.

- **Blockage within a premise**

The blockage in the sanitary plumbing within a premise or between a premise to the nearest public manhole can cause the toilet to overflow or spill. That is usually caused by solid waste/object blocking the passage in the pipeline. Clearing of the blockage can be performed through the drainage pipe in the inspection chamber or the internal sewerage pipeline within the premise.

The inspection chamber can be identified from the single rectangular metal cover, which is usually located outside the premise either in front, at the back or by the side. The service is rendered within 48 hours from the time of notification.

- **Blockage at public sewer**

IWK is responsible for maintaining the public sewer network for areas which have a sewerage system that are connected to is public STP. The most common problem encountered is blockage caused by rubbish/solid waste, grease, rubbles, grit, and occasionally damaged pipes.

IWK will rectify the problem within 24 hours depending on the type of objects blocking the passage, using high pressured water jet, high powered vacuum and/or mechanical rudders. If there are broken pipes, IWK will replace the pipe and ensure minimal inconvenience to customers.

- **Future investment plan to improve facilities**

For the future, the government plans to have 85% of the urban population to be connected to the sewer network while the remaining 15% will be using septic tanks. For the rural areas, the government plans to have 70% of the population with septic tanks and the rest will be using non-standard facilities. Besides that, regional plants will be established to integrate all developers' smaller plants into a more efficient system.

IWK has conducted a number of sewerage studies in order to assess demand and capacity for a 30-year planning horizon and has designed a 3-phase strategy. The phases are (1) locating and upgrading the old wastewater treatment plants as well as increasing the septage collection capacity, (2) using all available oxidation ponds as a temporary measure for septage treatment

and constructing trench treatment facilities in accordance with the guidelines provided by the Department of Environment, and (3) building centralised and mechanised treatment facilities in areas with high population density. In addition, IWK has developed a database of the houses connected to a septic tank and started scheduled desludging by geographic area.

Besides that, IWK has also made efforts for the residents to understand the importance of sanitation, raise awareness on good practices, the acceptance of desludging, and sewerage charge payment.

- **Regulations**

- **WSIA Act 2006**

In 2006, the Parliament approved WSIA 2006 as a new law and the establishment of SPAN as a regulatory body for the water supply and sewerage sector. In 2008, the WSIA came into effect and the Commission started operations. For sewerage, SSD transfered its regulatory function to SPAN. SSD as a project implementation agency (managing funding for facility construction/ renewal), SPAN regulates and IWK manages the public sewerage facilities. The national policy objectives for the water supply and sewerage services industry were developed. The outline is as follows:

i. To establish a transparent and integrated structure for water supply and sewerage services that delivers effective and efficient services to consumers;
ii. To ensure long-term availability and sustainability of water supply including the conservation of water;
iii. To contribute to the sustainability of water courses and water catchments;
iv. To facilitate the development of competition to promote economy and efficiency in the water services industry;
v. To establish a regulatory environment which facilitates financial self-sustainability amongst the operators in water services industry in the long term;
vi. To regulate for the long-term benefit of the consumers;
vii. To regulate tariff and ensure the provision of affordable water services on an equitable basis;
viii. To improve the quality of life and environment through effective and efficient management of water services;
ix. To establish an effective system accountability and governance between operators in water services industry; and
x. To regulate the safety and security of water service systems.

- **Environmental Quality Act, 1974**

EQA, 1974 is the legislation that is related to the prevention, abatement, control of pollution and enhancement of the environment in Malaysia. The Act restricts the discharge of waste into the environment in contravention of the acceptable conditions. To date, 38 sets of Regulations and Orders have been introduced and enforced. The Director General of Environment has been appointed by the Minister to administer this Act and any regulations and orders made there under.

Under the Environmental Quality Act (EQA), 1974 and the Regulations there under, industrial activities are required to obtain the following approvals from the Director General of Environmental Quality prior to project implementation:

i. **Environmental Impact Assessment reports** - under Section 34A of the EQA, 1974 (for prescribed activities);
ii. **Site suitability evaluation** (for non-prescribed activities);
iii. **Written permission to construct** — under Section 19 of the EQA, 1974 (for prescribed premises-scheduled wastes treatment and disposal facilities, crude palm oil mills and raw natural rubber processing mills);
iv. **Written approval for installation of incinerator, fuel burning equipment and chimney** — under Environmental Quality (Clean Air) Regulation, 1978, EQA, 1974; and
v. **License to use and occupy prescribed premises and prescribed conveyances** —under Section 18 of the EQA, 1974.

- **Acts listed regarding sewerage treatment**

i) Notification for a new source of sewerage, industrial effluents and leachate discharge or release (starting from October 2009)

*(a) No person shall, without prior written notification to the Director General, discharge or release or permit the discharge or release of **sewerage** onto or into any soil, or any inland waters or Malaysian waters. The written notification to the Director General shall be in the form as specified in the First Schedule of the Environmental Quality (Sewerage) Regulations, 2009 [P.U.(A) 432/2009].*

*(b) No person shall, without prior written notification to the Director General, carry out any work on any solid waste transfer station or landfill, or construct on any land any facility or building that may result in a new source of **leachate** discharge or release. The written notification to the Director General shall be accompanied by the information as specified in the First Schedule of the Environmental Quality [Control of Pollution From Solid Waste Transfer Station And Landfill) Regulations, 2009 [P.U.(A) 433/2009].*

(c) No person shall, without prior written notification to the Director General:

- *Carry out any work on any premises that may result in a new source of discharge of industrial effluent or mixed effluent;*
- *Construct on any land, building or facility designed or used for a purpose that may cause the land or building or facility to result in a new source of discharge of industrial effluent or mixed effluent;*
- *Make or cause or permit to be made any change of, to, or in any plant, machine, or equipment used or installed at the premises that causes a material change in the quantity or quality of the discharge or release from an existing source; or*
- *Carry out upgrading work of an existing industrial effluent treatment*

system that may result in a material change in the quantity and quality of the discharge or release.

The written notification to carry out any work, construction, or upgrading, or to make any change shall be submitted to the Director General in the form as specified in the Second Schedule of the (Industrial Effluent) Regulations, 2009 [P.U.(A) 434/2009].

ii) Sewerage, industrial effluent and leachate discharge

Industries discharging sewerage, industrial effluent and leachate are required to comply with the following relevant discharge limits as stipulated in their respective regulations:-

- Sewerage discharge standards. **(Appendix K1)**
- Industrial effluent discharge limits. (**Appendix K2)**
- Leachate discharge standards

• Outcomes of Strategic Consultations

- **Centralised versus decentralised system**

To meet the standards set forth by the Clean Water Act, centralised treatment plants capitalised on economies of scale in treating large quantities of wastewater. With public opinion in the 20th century favouring centralised systems, funding from federal construction grants, and later subsidised loans, connected municipal technologies became the conventional option (Burian et al. 2000).

Over the years, Onsite Waste Water Treatment Systems (OWTSs) has evolved from primitive pits to installations capable of producing a disinfected effluent that is fit for human use and consumption. In the modern era, the typical onsite system consists primarily of a septic tank and a soil absorption field, also known as a subsurface wastewater infiltration system (SWIS). These are known as conventional onsite systems. While these conventional systems have traditionally consisted of subsurface soil treatment, many alternatives today involve advanced chemical treatments that enable high quality effluent, comparable to centralised municipal systems (U.S. EPA 2002).

Decentralised wastewater technologies differ from conventional centralised systems in that they “treat and reuse or dispose of wastewater at or near its source of generation” (Magliaro & Lovins 2004).

In contrast to centralised wastewater treatment systems, which are characterised by a sewerage network draining to a wastewater treatment plant (WWTP) for the whole catchment, decentralised wastewater management involved dividing the catchment into sub-catchments; each with their own wastewater treatment plant. The smallest possible decentralised system consists of an on-site system serving an individual household (usually a septic tank). However, the terms “centralised” and “decentralised” do not necessarily correspond to the terms “large” and “small”, but to “larger” and “smaller”, as illustrated in Figure 14 (Markus *et al.* 2012).

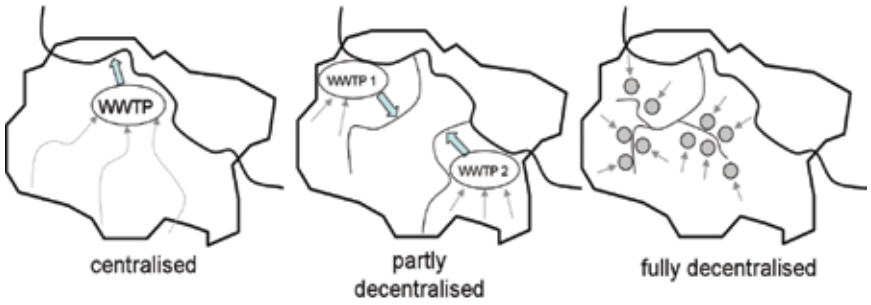


Figure 14: Centralised vs. Decentralised System

Haniffa *et al*., (2008) defines that a centralised sewerage system is a sewerage collection and treatment system containing collection sewers and a centralised treatment facility. Centralised sewerage systems are used to collect and treat large volumes of sewerage from a catchment specified as per the Sewerage Catchment Strategy for the area. The collection system typically requires large-diameter deep pipes and major excavation.

At the treatment facility, the wastewater is treated to standards required for discharge to a surface water body. Currently, the total number of centralised systems in Peninsular Malaysia is 80 (as of December 2013).

The **advantages** of a centralised sewerage system are:

- Improved reliability;
- Reduced impact on environment;
- Greater buffer distance;
- Greater operational efficiency;
- Opportunity for rationalisation of small inefficient STPs and on site Systems; and
- O&M cost is focused on core activities rather than logistics and travel.

The **disadvantages** of a centralised sewerage system are:

- Requires large land area;
- High construction costs; and
- Longer time spent on construction.

Meanwhile, the concept of decentralised sewerage system refers to sewage treatment and disposal systems from the individual on-site treatment system (commonly known as the septic tanks) to small community collection and treatment systems.

The **advantages** of a decentralised sewerage system are:

- Easy installation (package plant);
- Best solution for slow-paced development area;
- Initial construction cost cheaper; and
- Fast implementation.

The **disadvantages** of a decentralised sewerage treatment plant are:

- High cost of visitation and operations;
- Plants are located in close proximity to communities, and that raised many social and environmental concerns;
- Longer time spent on construction; and
- Types of plants and equipment vary according to developer.

Comprehensive comparison

This section summarises statements reporting their pros and cons mainly referring to the essential information that, according to Libralato *et al.* 2012 should be provided : life span of system elements, estimated capital and operating costs, periodic maintenance and operation costs, energy use, residuals, water and nutrient budgets and water reuse potential. Some general statements highlighted from various researchers on centralisation and decentralisation are described in Table 15:

Table 15 : Statements from various researchers on centralisation and decentralisation (Libralato *et al.* 2012)

Centralisation	Decentralisation
• The wastewater treatment unit cost was still competitive to decentralisation where the wastewater collection system already exists.	• It might respond to suburban areas and rural centers, industrial, commercial and residential areas (re) development, as well as to population growth in rural areas and developing countries.
• About 80%-90% of the capital cost was related to the collection system with the potential economies of scale associated to densely populated areas.	• It might contribute in the planning of isolated communities development.
• It is predicted that the whole collection system or part of it had to be renewed every 50-60 years , besides the required periodic maintenance , potentially generating disruptions to traffic and other public utilities.	• It supported treated wastewater recovery and reuse.
• Potential eutrophication phenomena might occur in the receiving water body due to large volumes of treated wastewater discharged.	• It reduced or excluded the inconvenience related to discharges collection, with much smaller and shorter pipes compared to centralisation.
• Diluted wastewater required more expensive treatment approaches.	• It was applicable to various levels from individual to community.
• Heavy rainfall events or contamination by industrial wastewater might generate overflow phenomena.	• Small WWTPs (SWWTP) were eligible for easy remote controlled facilitating their management.
• Natural disasters such as earthquakes and terroristic attacks might cause disruptions to the system generating strong pollution phenomena in the receiving water body.	• SWWTPs were considered as viable if an efficient, robust, easy to maintain and manage medium-high technological level was implemented.
• Diseconomies of scale were possible where long distances had to be covered or as a consequence of rainwater infiltration.	• SWWTPs might assure a greater environmental sustainability by supporting the potential reuse of treated wastewater as well as nutrients recovery.
• There was a strong dependency on electrical energy supply that might not be adequate due to an economic or political crisis.	• SWWTPs allowed urine source separation and reduced/removed micro-pollutants such as metals and other emerging compounds.
	• SWWTPs allowed the separation of domestic wastewater and rainwater, avoiding dilution phenomena.

Table 15 : Statements from various researchers on centralisation and decentralisation (Libralato *et al.* 2012) (cont.)

Centralisation	Decentralisation
• Huge volumes of potable water were required to keep the sewerage system clean.	• Possible separation of contaminants at source, eased their treatment and potential reuse and increased treatment efficiency and saving energy. • Possible in situ reuse of treated wastewater. • Small WWTPs were generally compact, with highly flexible operating conditions and reduced aesthetic impact.

4.6 Capacity Building

The water supply and wastewater industries are in dire need of an established institutional platform to train the thousands of staff in the two sectors. There are several important stakeholders that require continuous training - the state water entities, the national sewerage operator Indah Water Consortium (IWK), the consultants, the contractors, and private water supply and wastewater operators.

The failure in the continuation of water supply training programme initially conducted by Institut Kerja Raya Malaysia (IKRAM) when it was privatised in the 90s has set back the water industry by 20 years. Subsequent to that, ad hoc water supply training programme initiated by individual state water operators did not help much in developing skilled workers and even competent supervisors as there was no centralised institution to manage the training needs. As for the sewerage industry which is part of the wastewater sector, training was mostly done in-house by IWK.

The other wastewater components such as industrial wastewater, partially (>50 m^3/ day) comes under the purview of the Department of Environment. Sullage comes under the local authority and septage is actually under SPAN jurisdiction as in **WSIA** Section 63~67.

The birth of SPAN and **WSIA** in 2006 has somewhat given a light at the end of the tunnel. There are provisions in **WSIA** that require competent personnel to operate the water and sewerage systems.

Subsequent to that, the Malaysian Water Association (MWA) has initiated the formation of the Malaysian Water Academy (MyWA) in April 2010. MyWA was appointed as a training facilitator institution which collaborated with the existing training providers. With no financial support from the government, the implementation of its programme was at a slow pace. SPAN so far has only issued an administrative letter to encourage participation in competency programme by the water operators instead of enforcing the requirement.

Knowledge-based programme has been established through collaborative partnership with the existing training providers such as Penang Water Services Academy (PWSA), SAJ

Holdings, IWK and UTM but poor response from the industries has hampered the human resource development of the industry's technical staff. However, PWSA has been successful even in enrolling participants from neighbouring countries to attend their training and certification courses.

Efforts have been made to obtain the government's assistance to subsidise the cost of module development and purchase of training equipment with facilities. However, it is very necessary that SPAN enforces the requirement for technical staff to be trained and made competent through MyWA.

4.6.1 MyWA Competency Programme

As MyWA has been given the task to conduct the Competency Programme, MyWA has taken the lead by running two competency programmes which were supposed to be taken up by the large number of water treatment plant operators that have not acquired any Competency Certification.

However, the statistics in Table 16 shows the lack of motivation among the water supply operators in sending their staff for the water treatment plant competency programme. The numbers do not jive with the actual staff involved who need training in the area. There was only a very small number of participants for the competency programme.

Table 16: Competency programme attendance

	Competency programme	Est. no. of participants	No. of sessions	No. of session conducted	No. of attendees	% Attended
1	Water Treatment Plant – Operator (Level 1)	2,000	100	1	14	0.7%
2	Water Treatment Plant – Technician (Level 2)	140	7	2	30	21%

Table 17 shows that there are 15 competency programme that were planned to be implemented by MyWA involving more than 7,000 personnel. As mentioned earlier, only the first 2 programmes i.e. Water Treatment Plant Operator and Technician Competency Certification (WTP-OCC and WTP-TCC) have actually been launched.

Table 17: Planned water competency programme

	Program	# Trainee
1	WTP-OCC (Operator-Level 1)	2,000
2	WTP-TCC (Technician-Level 2)	140
3	NRW-ICC (Inspector-Level 1)	200
4	NRW-TCC (Technician-Level 2)	100
5	DOM -FCC (Distribution O&M Fitter-Level 1)	400
6	DOM -TCC (Distribution O&M Technician-Level 2)	350
7	ML-FCC (Mains Laying Fitter-Level 1)	450
8	ML-TCC (Mains Laying Technician-Level 2)	100
9	DS-POCC (Distribution System Pump Operator-Level	400
10	MRCC (Meter Reader-Level 1)	1,719
11	SM RCC (Senior M eter Reader-Level 2)	200
12	CC-ACC (Call Centre Agent-Level 2)	450
13	CS-CECC (Cust Service Counter Executive-Level 2)	250
14	CS-CCC (Cust Service Cashier-Level 2)	200
15	ERP-TDCC (Emergency Tanker Driver-Level 1)	200
	Total	7,159

4.6.2 Outcomes of Strategic Consultations

- **Lack of capacity building infrastructure**
- **Current status**

It was realised that the water industry (particularly the water supply sector) is deprived of formal conventional knowledge-based training for nearly **two decades** since the privatisation of IKRAM in 1996 which put many training programme in the water sector on hold at central level. There is no real replacement to IKRAM but the Malaysian Water Academy (MyWA) which is owned by the Malaysian Water Association has played the role of central entity, to organise the range of training offered by water operators, training institutions and companies in the country. This is in a way a difficult task as there would be differences in many aspects of training and sending trainees to different places would bear different results.

It is worthwhile to reflect on the history of IKRAM. It was set-up in the Klang Valley in 1973 when JKR purchased 100 acres of land in Bangi and started building its Training Centre in 1980. In 1988, a few JKR Laboratories joined the JKR Training Centre and the complex was amalgamated to form the JKR Training and Research Centre (Institut Latihan dan Penyelidikan JKR). Later in 1991 it was renamed Institut Kerja Raya Malaysia (IKRAM), then it was promoted five years later and is currently known as

the Kuala Lumpur Infrastructure University College (KLIUC) and focuses more on tertiary education rather than knowledge-based on-job training.

However, the sewerage sector might not be as much affected since it did not go along the same history. MyWA has been conducting several training courses for the sewerage industry jointly with Indah Water Konsortium for some time.

The re-structuring of the industry and the enforcement of **WSIA** is an important push factor for the establishment of a proper capacity building. MyWA has not been setup as a training centre but more as a training certifier and auditor, probably an agent for the regulator, SPAN or for the Government.

- **Gaps**

It was agreed that there has been a lot of changes in the industry. Technology has changed in several areas, organisational structure too has changed and is more varied nowadays. Are the workers having the right knowledge, attitude and skills in carrying out their task? As senior staff are leaving the organisation due to their retirement age, the new ones are making up the majority in the staff lists. Without formal centralised training in institutions like IKRAM, the staff are dependent on in-house training which is very limited and much depending on the management style of each entity. Hence, it is more important now than before that Malaysia to establish a centralised training centre to ensure uniformity in practices throughout the nation while regulated by SPAN.

- **Future needs**

Attendance to training alone would not be adequate. There must be a mechanism of evaluating the trainees and certifying them. The training must provide the required knowledge, skills and attitude for personnel in the water industry to work competently in their respective areas.

It was anticipated that substantial competency skills would be required to operate the entire water industry. The 15 areas for the water supply sector mentioned earlier would be a good start before developing further into more specific competency areas.

Training institutions at regional, state or district level could be credited by a certifying body which the Ministry (or SPAN) or their agents could accredit. It would be vital to formalise an accreditation body similar to Engineering Accreditation Council (EAC) Malaysia which accredits engineering courses in universities for the Board of Engineers (BEM).

There are several training facilities available in Malaysia, some are active and some are conducting programmeon an ad-hoc basis.

1. Penang — Penang Water Services Academy
2. Johor — SAJ Training centre in Sungai Layang
3. Malacca — Training centre in Merlimau

There are also old water training centres which are not very active but sometimes conducted in-house activities related to capacity building such as:

1. Selangor — Sungai Tengi
2. Negeri Sembilan — Sungai Linggi
3. Terengganu — Bukit Bauk

Water treatment plants are suitable locations for hands-on training as they have the equipment and sites for training and skills development. Pahang has adopted in-house plant training coupled with troubleshooting from one plant to another which provides a better understanding for plant operators in performing their work.

- **Action plan suggested**

Two suggestions were put forward:

a. Recognition of existing training providers; and
b. Establish centralised training institution.

- **Strategy**

It was recommended that centralised competency certification and accreditation be undertaken by institutions such as Malaysian Water Academy. However, the competency examinations could be held at regional levels to ease logistics and travelling of staff. Decentralised knowledge-based training conducted at regional, state and district levels should be certified and regulated.

- **Lack of enforcement**

- **Current status**

The enforcement needs qualified personnel to operate water supply or sewerage systems as mentioned in Section 49(1) **WSIA**, whilst the Commission (SPAN) is required to set the standards for minimum qualifications for such personnel in Section 180(a)(iii) of the same Act. Currently the regulations are not being enforced since proper regulations on personnel competency have not yet been formulated.

However, there should not be a stop on providing knowledge-based training programme to the industry as it is vital to ensure that the system is operated correctly and does not cause any danger and risk to the workers, equipment and people at large. There is also no clear career path to workers should they strive to acquire competency at any appropriate entry point.

- **Gaps**

It was highlighted that there would be several difficulties for operators to adhere to WSIA as it involved a large number of staff. The current number of staff for state water operators (excluding concessionaires) is as follows:

Table 18: Manpower statistics for water supply and wastewater

	Management	Executive	Non-executive	Meter readers	Total for water ops	Sewerage only
Johor	117	226	1713	230	2286	217
Kedah	27	175	875	158	1235	208
Kelantan	25	57	513	69	664	31
Labuan	8	11	163	11	193	27
Malacca	23	26	595	69	713	170
N. Sembilan	24	61	922	88	1095	183
Penang	22	53	1052	73	1200	316
Pahang	25	33	1231	111	1400	130
Perak	54	61	894	179	1188	308
Perlis	3	5	128	22	158	14
Sabah	44	38	994	115	1191	-
Sarawak	24	53	1957	296	2330	-
Selangor/ KL	294	1021	3143	313	4771	1366
Terengganu	23	15	379	83	500	112
MALAYSIA	713	1835	14559	1817	18924	3082

- *Number excluding personnel employed at concessionaire companies (for water supply)*
- *For sewerage, numbers are only from IWK organisation*

Another issue that needs to be addressed is the variation in the status of the water operators, which represented in Table 19:

Table 19: Status of state water operators

	Treatment	Distribution	Migration to new regime
Johor	SAJH	SAJH	Yes
Kedah	Air Utara, Taliworks	SADA	No
Kelantan	AKSB	AKSB	No
Labuan	Jab. Bek. Air	Jab. Bek. Air	Not required
Malacca	SAMB	SAMB	Yes
N. Sembilan	SAINS	SAINS	Yes
Penang	PBAPP SB	PBAPP SB	Yes
Pahang	PAIP	PAIP	No
Perak	MUC	Lembaga Air Perak	Yes
Perlis	Bhg. Bek. Air, JKR	Bhg. Bek. Air, JKR	Yes
Sabah	Timatch, LDWS, Jetama	Jab Air Sabah	Not required
Sarawak	JKR, LAKU, LAK, LAS	JKR, LAKU, LAK, LAS	Not required
Selangor/ KL	PNSB, Splash, ABASS, KASB	SYABAS	No
Terengganu	SATU	SATU	No

The main concerns are the following:

1. The migrated states performance over the non-migrated must be assessed;
2. The non-migrated states are required to keep to time frame migration; and
3. **WSIA** should also be adopted by East Malaysia.

- **Future needs**

It was envisaged that enforcement is still preferred rather than voluntary compliance to WSIA. However, measures to encourage water operators to send their staff for proper training should remain as an important requirement of the organisation while waiting for enforcement by the regulator.

As for the personnel, the organisation should provide clear career paths for staff acquiring competency or successfully attending certified training. Some form of reward and penalty would give an impact to push training and other capacity building activities. It is the recognition that would boost human resource advancement in the industry.

- **Action plans suggested**

  It was suggested that SPAN:
  1. Expedite regulations on capacity building and subsequent enforcement; and
  2. Ensure proper entry requirements for new staff.

- **Strategies**

  It was agreed that the legal framework would give the external push to enhance capacity building. Hence, there is immediate need for formulation of competency regulation and implementation within specific timeline.

- **Budget**

- **Current status**

  As of the date for strategic consultancy, the industry is still awaiting financial assistance to conduct training at affordable prices. The water operators have not been giving priority to allocate adequate funds for capacity building. That is further aggravated by the huge number of staff who need to undergo training once competency becomes compulsory to everyone.

- **Gap**

  The main gap is low priority among stakeholders and no clear direction. The cost of sending staff for training is still high, hence some financial assistance from the Government or other sources would boost the number attending training.

  The current on-going training fee conducted by MyWA per person is as follows:

Table 20: On-going training fee conducted by MyWA per person

No	Programme	Days	Fee
1	Confined Space Authorised Entrance	2	550
2	Confined Space (Refresher)	1	435
3	Basic M&E Application in Sewerage Treatment Plant (STP)	-	1052
4	Certified Environmental Professional in STP Operation	5	3900
5	Examination for CEPSTPO (for re-sit)	2	400
6	Introduction to Sewerage Treatment	2	750
7	Best practices on Sewerage System Maintenance	2	800
8	Health and Safety for STP	1	700

Table 20: On-going training fee conducted by MyWA per person (cont.)

No	Programme	Days	Fee
9	Maintenance of Sewers	1	700
10	Water Treatment Plant Operator Competency: Level 1	3	1500
11	Water Treatment Plant Technician Competency: Level 2	5	2400
12	WTP Technician Competency: Level 2 (Refresher)	2	1000
13	Drinking Water Quality Analysis	2	1200
14	Dam Management	3	1300
15	Technical talks	0.5	-

- **Future needs**

  The following has been identified as the future needs:
  - Clear direction should be given by the central agencies and regulator in line with the objective of re-structuring the water industry.
  - Stakeholders should consider the benefits of training for improving efficiency in the delivery system and indirect cost reduction in operations.

- **Action plans suggested**

  1. Water companies should allocate a certain percentage of expenditure as part of the organisation's KPI which should apply to all staff. It should be proportionate to the money spent on the salaries or amount spent for other benefits of each category of staff. In this way, more lower ranked staff would have the opportunity to attend training.
  2. An annual allocation should be provided by the Federal Government to reflect the importance of capacity building in the water industry.

- **Strategies**

  Incorporation in Business Plan – it implies that the budget for training is carefully accounted for in the operations cost and impact the tariff. It might be considered as investment as the return would be realised in improvement of delivery system and higher efficiency.

4.7 Water and Wastewater Safety Plan

The quality of potable water produced by the water supply operators in Malaysia is generally guided by the Ministry of Health while the Water Services Industry Act 2006 (WSIA) regulates the quantity and quality of potable water except for Sabah and Sarawak. However, it has been reported from time to time that water treatment plants in the country has to be shut down due to pollution of raw water, or treated water quality violation. The elements of quality mentioned in the Water Safety Plan

(WSP) Manual by WHO-IWA published in 2009 are as follows:

i) The source(s) of water including the runoff and/or recharge processes, and if applicable, alternative sources in case of incident
ii) Identify all hazards and hazardous events in the water supply being, or becoming contaminated, compromised or interrupted
iii) Flooding, run-off, sufficiency; and
iv) Hazard, physical, failure of pumps.

In order to minimise the incidents stated above from recurring, an effective means of consistently ensuring the safety of a potable water supply system via comprehensive risk assessment and risk management approach from catchment to consumers is required. The approach is defined as a Water Safety Plan.

A typical water supply system consists of four basic elements is as shown in figure 15:

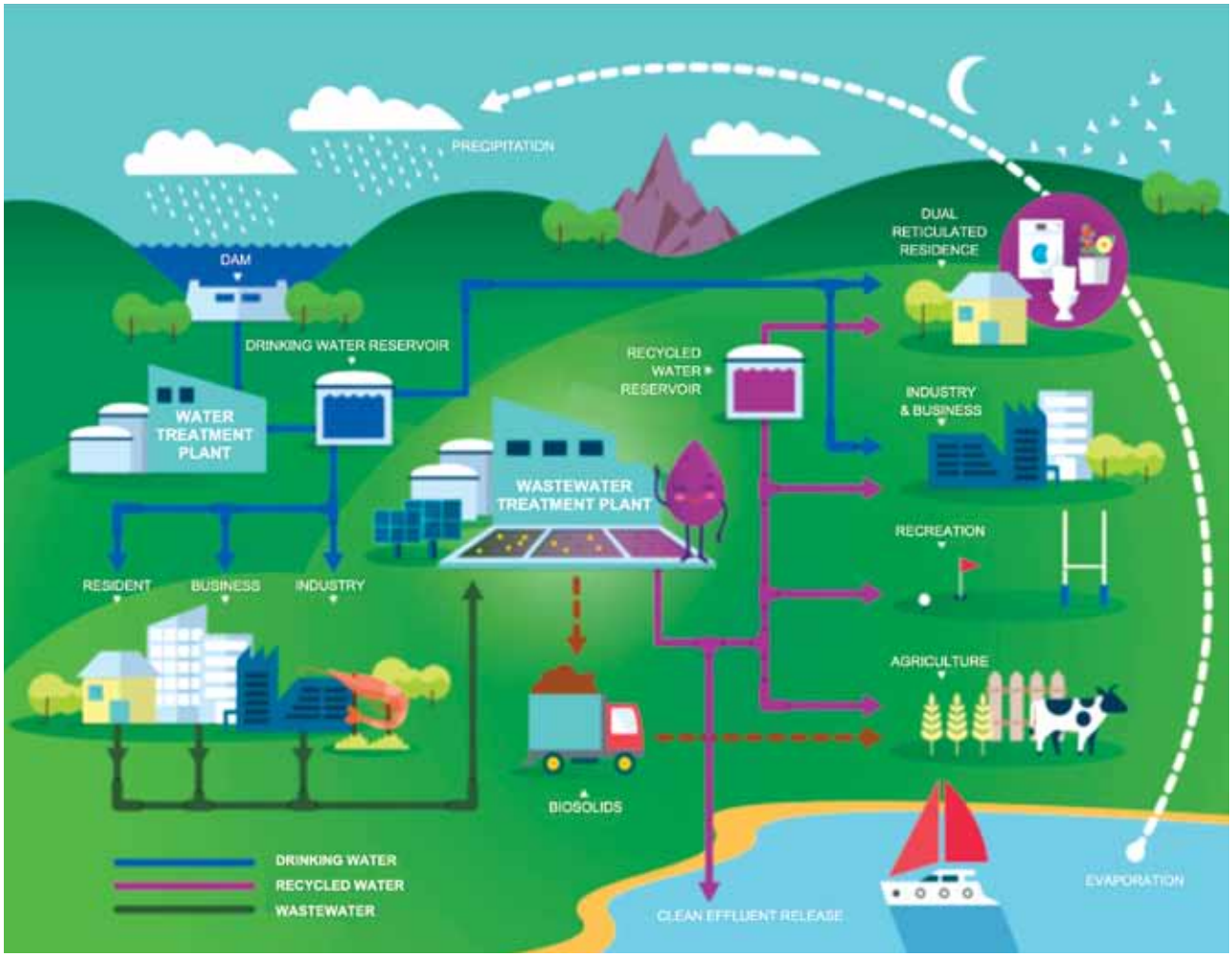


Figure 15: Basic Elements of WSP (Catchment, Treatment, Distribution, Consumer)

The semi-quantitative approach demonstrates how each risk is graded as very *high, high, medium or low risk*. Risk value is the product of Severity/Consequence and Likelihood/ Frequency. Subsequent action plans involving control measures will be implemented to lower high risk hazards.

4.7.1 Current status

Through WHO, consultancy work for MOH Malaysia on WSP was planned to support the development of a national strategic plan for WSP implementation in Malaysia in April and July 2012. During the first consultancy gathering on 9-10 April 2012, a coordination meeting was held with the relevant stakeholders and water utilities to seek clarifications on current national policies and the drinking water regulatory framework as described in the MOH Malaysia documents:

i. Water Safety Plan in Malaysia; and
ii. Strategic Action Plan for the Development and Implementation of WSP in Malaysia.

An action framework for the national strategic plan was presented at the consultation workshop in July 2012 to generate buy-in of the draft strategic plan before finalising of the documents.

4.7.2 Conventions and resolutions

i. WSP IWA-WHO Global Water Safety Conference, 2-4 November 2010.
ii. MOH Co-ordination Meeting on WSP, 9-10 April 2012.
iii. MOH Consultation Meeting on WSP, 3 July 2012, JPS Ampang.

4.7.3 Outcomes of Strategic Consultations

The workshop team comprised of representatives from various sectors of the water industry namely water NGO, universities, state water resource regulatory agency, water operators and government agencies. Although wastewater or the sewerage safety plan was supposed to be part of the study, the absence of representatives from the sewerage industry in the workshop made it difficult to dwell into the potential issues. Therefore, only WSP issues were discussed in the workshop. Those were:

- WSP authority;
- Insufficient WSP development; and
- Implementation constraints.

• WSP authority issues

Currently WSP is mentioned in the Water Services Industry Act 2006 (**WSIA**) and it is enforceable by SPAN. However, the requirements for WSP development and its implementation has not yet been made compulsory by SPAN. In the meanwhile, the Ministry of Health (MOH) is championing the WSP development nationwide through several buy-in programmes and workshops. MOH has also included WSP in the proposed Safe Drinking Water Act.

However, the focus on WSP that is being championed by MOH only covers water quality. As discussed in the WSP Manual published by WHO-IWA, the risk assessment on water supply infrastructure components needs to be conducted to ensure continuity of supply. In that context, SPAN has an important role to play in ensuring that those components are assessed in terms of physical conditions and their performance.

From the current scenario, there seems to be a gap in coordination and integration even at the WSP development stage between the two agencies. It is understandable that MOH is championing WSP as it is the traditional contact agency with WHO. However, in the Malaysian water industry set-up, we already have a regulatory body which also deals with business plans submitted by the state water operators. The business plans should include all the high risks found in each water supply system and the budgetary proposals put forward to reduce those risks.

To bridge the gaps, effective cooperation between SPAN and MOH needs to be established. Since SPAN has been entrusted to enforce **WSIA**, it is necessary that SPAN takes the lead in WSP development and implementation with support from MOH. WSP should become a management tool to determine the required capital works (CAPEX) to overcome all of the system constraints identified through the risk assessment. WSP should also be used to improve among others, operational standard operating procedures (SOP), record keeping, competency, training and stakeholders' awareness. The involvement of SPAN will give the **emphasis of quantity of water** which has been the main cause of the **1998 water crisis** as well as the impending crisis anticipated in the dry months of 2014 with the possibility of El-Nino phenomenon as has happened in 1998.

The proposed action plan includes strengthening the collaboration among water supply regulatory agencies at both federal and state levels, including water resource matters. The roles of each regulatory agency should be clearly defined.

It is important that the "acceptance" would be made by SPAN to enforce WSP development and implementation while MOH continues to support and promote the WSP programme. Between the two regulatory bodies, there should be division of roles and responsibilities so as not to overlap functions with each other. That could easily be done through a workshop session or coordination meeting.

• Insufficient WSP development

There are 458 water supply systems under the jurisdiction of state water operators and privatised concessions for the public in the country. As of October 2013, only 14 WSPs has been developed since the first WSP pilot project for Sri Gading water supply system presented by SAJH in AsiaWater Conference 2010. There are three WSPs for water treatment plants alone, developed by the respective concessionaires which is considered incomplete as far as the whole water system is concerned. There are around 18 WSPs being developed, mainly under the MOH pilot program, one for each state. Statistically, only 1.5% of the total water supply systems has a developed WSP. A recent enquiry revealed that SAJH has developed another seven WSPs and LAP has developed another six WSPs. This brings the total to 27 WSPs already developed.

The group found that the slow WSP development is due to several reasons as listed below:

1. Lack of training and trainers
2. Lack of enforcement
3. Lack of resources
4. Reluctance due to increase in work load

For the programme to be successful, a strong commitment from the top management of all the state water operators and SPAN must be made. Training should be included as part of the state water operators' KPIs. Sufficient number of facilitators should be developed to assist WSP development through a series of workshops. WSP audit is also required to check WSP conformity to the guidelines and conduct field audits to verify the hazards and risk scores as listed.

- **Implementation constraints**

It has been noted that there was implementation constraints on WSP development and utilisation. The implementation programme is ad-hoc, without proper planning by most of the state water operators. There is no proper scheduling on how many WSPs was to be developed in a given time frame.

Even when WSPs were being developed, there was very limited engagement with the major stakeholders within the water supply system, especially in the catchment areas where pollution is a major concern. In fact, by not engaging with the stakeholders, the stakeholders were not aware of their roles in contributing to water safety. Without the engagement, it also impossible to get their commitment to play their role in mitigating existing and potential hazards to the water resource.

Chapter Five:
Findings and Analysis

5.1 Introduction

This chapter discusses the findings and analyses. It discusses on the eight major issues pertaining to policies, technology and management. The study comes up with 23 recommendations to be brought to relevant authorities.

5.2 Issues

5.2.1 Policies

• First Issue: Failure of states to migrate

In realising the involvement of the federal government in the state's water services, by means of a holistic manner of migration of all state's water operators to light asset regime in tandem with WSIA, only half of the peninsular state's water operators have migrated which had been affecting the progress of restructuring the industry.

There are several states that have been privatised/corporatised such as Kedah (SADA), Penang (PBAPP Sdn.Bhd.), Selangor (SYABAS), Negeri Sembilan (SAINS), Malacca (SAMB), Pahang (PAIP), Terengganu (SATU), Kelantan (AKSB) and Johor (SAJ).

The enforcement of the two new acts, Act 654 pertaining to the establishment of SPAN and Act 655 pertaining to water services industry, marked an important milestone in the history of water industry in Malaysia. The water reform initiated by KeTTHA required all states in Malaysia except Sabah and Sarawak to migrate to a new regime with light assets. However, existing concessions might continue until their terms expired but new concession agreements are not permitted.

To date, six states have migrated to the new regime after more than five years of the WSIA enactment vis-à-vis:

- Syarikat Air Negeri Sembilan (SAINS)
- Syarikat Air Melaka Berhad (SAMB)
- Syarikat Air Johor (SAJ)
- PBAPP Sdn. Bhd. (PBAPP) – Penang
- Lembaga Air Perak (LAP)
- Syarikat Air Perlis (SAP)

However, there are still six water operators that have not migrated to the new regime and they have jeopardised the overall objectives of standardising practices in all the water entities in Malaysia. With the latest move agreed between Selangor and Federal Government, the impact of Selangor migrating to the new regime will be an interesting progress to see since its share of the business is substantial.

To promote the migration of water operators in the remaining states that have not yet migrated to the new regime, efforts has to be made in facilitating the states to migrate, such as by providing grants and financial support to the water operators, especially for development of new water sources and the conversion of loans to grants.

Recommendations:

1. The Federal Government should facilitate deficit water entities by providing grants until the tariffs could help to recover operational expenses.

2. The Federal Government should have more leniency in the restructuring of debt by taking into account the high cost of providing infrastructure in rural areas.

3. A new target date must be set.

• Second Issue: Pricing not sustainable

Water operators could not implement proper water supply management due to low revenue from the low tariff scheme and could not generate good business practices because of small earnings out of poor business outlook in water services. Full-cost recovery strategy should be targeted for sustainability of the water supply industry. Hence the current water tariff setting mechanism must incorporate the objectives.

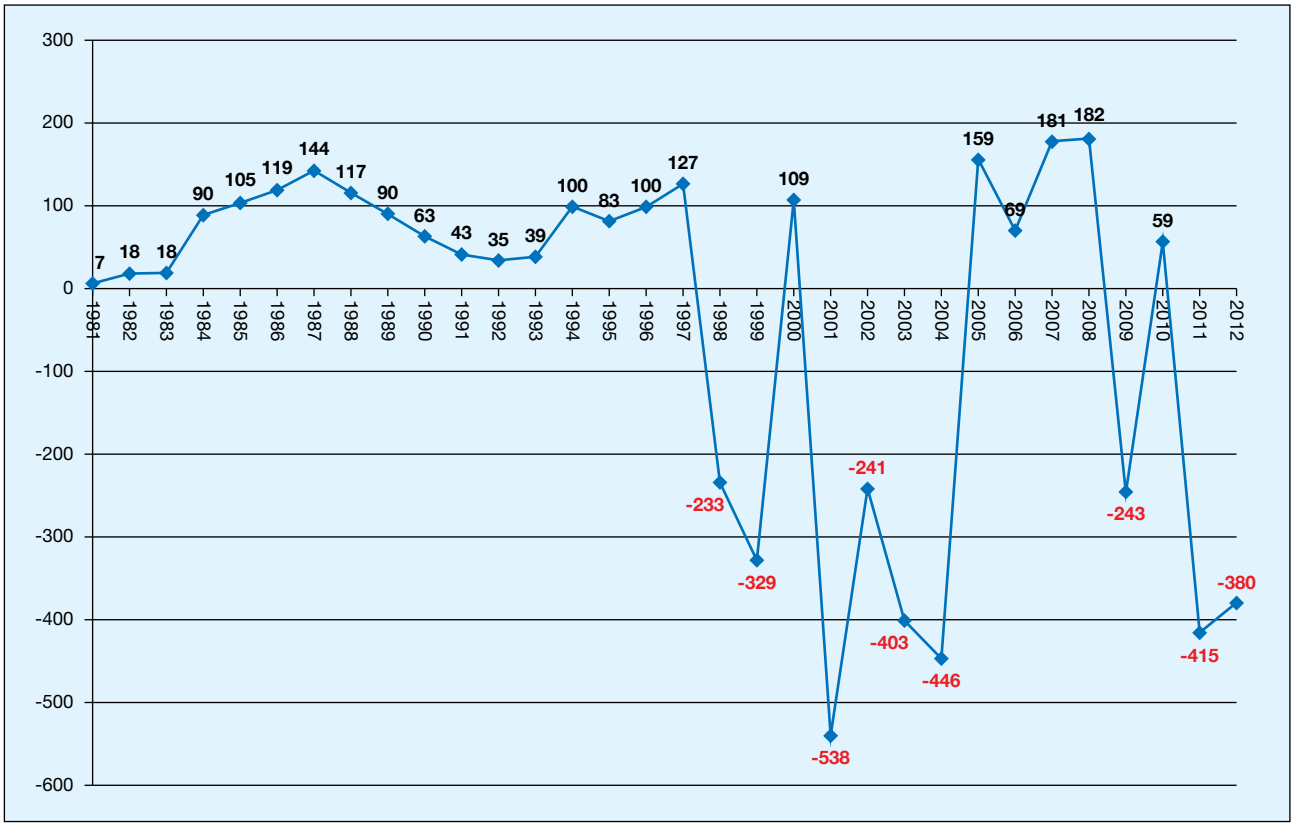
In the wastewater sector, the current tariff rates are generally inadequate for sustainability of the sewerage services industry. Operating at annual losses of more than RM75 million while accounting only for operation expenses, has proven that the tariff mechanism does not make it possible for the operators to recover their full costs. Comparing the size of the industry to others, sewerage is just 10% of the water industry and 1% of the energy sector.

The current practice of tariff review is seen as not being adequately facilitated. It was raised in the SC3 that there was an incident of tariff review approved by SPAN and it was not able to be implemented, due to political fear of losing popularity. It was further aggravated when the opposing political parties took the opportunity to discredit the state that had made the announcement. This sort of political scenario will make any water issues to be seldom exposed and politicised, thus, will be counter-productive in the long run.

There are concerns that the current tariff is too low. The findings are:

1. National average monthly consumption per household is estimated at RM27.00 (state figures ranging from RM14.00 – RM47.00) which is less than 1% of the monthly Malaysian household income.

2. The low tariff has resulted in deficit in the revenue to cover expenditure as indicated in table 16. This situation is not sustainable and will result in poor services and system inefficiency.



Negative figure shows deficit in operational turnover
(Source : MWIG 1998/1999 & MWIG 2013)

Figure 16: Revenue-Expenditure (RM million) 1981-2012

3. The trend of losses is evident from 1998 which could be **due to the high burden of paying for water production concessions in a few states**. Hence the effort for restructuring and regulating the water industry in a holistic manner is inevitable. Based on the observation, the development of restructuring the water industry is backed by the Federal Government in line with the spirit of WSIA.

4. Some states had their tariffs reviewed quite some time, back in the 1980's. In the past, that was due to the lack of political determination to declare tariff hikes in the states. The political unwillingness was expected due to the fear of losing the political support in future elections. Although that might not be totally true, the views from SC suggested that political figures should be disengaged from the decision making process. An independent party, probably SPAN should take the responsibility of deciding tariff.

5. It is more costly to repair leak pipes compared to losses incurred by letting the pipes to leak.

6. Initiatives to use alternative sources such as rainwater harvesting or efforts to recycle, reuse and reduce water are not feasible yet since the savings anticipated from these initiatives does not commensurate in the present circumstances.

- **Role of *Forum Air***

Forum Air Malaysia, a water forum was formed under Section 69 and 70 of the Water Supply Industry Act and entrusted to assist National Water Services Commission (*Suruhanjaya Perkhidmatan Air Negara* - SPAN). It was to carry out the duties as water forum under the Water Services Industry Act 2006 amongst which include the following duties and responsibilities:

i. Give feedback and recommendations to SPAN on matters pertaining to consumer interests in water supply services and sewerage services;
ii. Represent consumer interest in water supply services and sewerage services;
iii. Promote consumer's interest in relation to the tariffs, standards and water supply services;
iv. Identify and study all related matters that represent consumer interest and ensure that all water services licensees realise, and are responsive of the issues related to services rendered; and
v. Publicise the existence, functions and work of the water forum in protecting the interests of the consumers.

However, there has not been much interaction between *Forum Air* and the industry. Industry players should also be involved in *Forum Air*. That is particularly important since *Forum Air* does not only address consumerism issues but also acts as conveyor of information pertaining to services and works which are available within the industry players.

The role of the water forum to understand the tariff situation in the country has be further explored with more dissemination and discussion made. It must be reiterated here that state water operators are still having problems in revising tariffs and making public the review due to political reasons. It might be necessary that tariff revisions be revisited to find means to make their process less politicised.

'In Australia, it was stated by the Australian Water Association (AWA) that tariff review was not handled by politicians or elected policy makers but rather by an independent evaluation agency … "independent" of politics.' SPAN in its current stature had the outlook of the said arrangement and could be given the authority to decide on the tariff structure, free of political intervention. There were views to enhance the function of SPAN which was currently limited to advising the Minister on the tariff mechanism, and fair treatment to licensees and consumers. A stronger role and increased power to SPAN would ensure that business sustainability and regulations were well synchronised. It was also suggested that SPAN reported to Parliament and not the Minister. That would give more freedom for SPAN to act for the benefit of the industry.

There were also suggestions that water, wastewater and water resource be put under one Ministry, the Ministry of Water. That suggestion could be best looked into by the present Ministry itself, since it had merits and demerits. The present study will not elaborate on the suggestions but agree to address it to higher authorities.

Recommendations:

1. **The tariff is to be reviewed at regular intervals until it reaches full cost recovery by 2030. Increase in electricity tariff should automatically revise water tariff.**

2. **SPAN to be answerable to the Parliament and not the Minister.**

3. **Determination of tariff is to be done in a transparent and holistic manner and subsequent announcement on tariff reviews is to be conducted by SPAN.**

4. ***Forum Air* should be strengthened by getting the involvement of industry players and not merely consumer enthusiasts.**

5. **Establishment of Water Ministry in the Malaysian Cabinet.**

- **Third Issue: Aluminium sludge as scheduled waste**

EQA Regulations 2005 had included metals such as *chromium, nickel, zinc, lead, cadmium, aluminium, tin, vanadium dan beryllium* as scheduled waste SW204. As most of the plants used alum, PACl or other aluminium-based coagulants, aluminium concentrations were expected to be high. A study in 2007/2008 showed that the values of Aluminium concentrations ranged from 1,100 mg/l to 79,200 mg/l with an average of 29,677 mg/l. However, it was interesting to note that there were no aluminium threshold limits specified in the DOE Malaysian Guidelines for the Application of Special Management regarding schedule waste.

There was a suggestion made earlier to DOE that the sludge from aluminium be given similar treatment as *spent activated carbon excluding carbon from potable water and processes of the food and vitamin production (SW411)*. This was not agreed by DOE and the status of aluminium as schedule waste remain unchanged.

The classification of aluminium waste as scheduled waste required the treated sludge to be transported only to designated landfills, the charges could be hefty as compared to the current water tariffs. It was estimated that the cost of disposal of aluminium sludge at municipal landfills and *Kualiti Alam* could be RM0.06 and RM1.58 respectively per cubic meter of water produced. Hence the annual cost for the whole country might exceed RM10 billion a year if all sludge needed to be handled in drums and sent to *Kualiti Alam*, double the annual revenue which was currently about RM5 billion.

The study by MWA has recommended that the residue should not be considered as scheduled waste, but as ordinary waste which is subjected to other existing regulations, such as effluent standards for direct discharge or threshold limits for landfill and land applications. Specific exemption is recommended for the potable water treatment

sludge residue, based on findings on the characteristics and also on practices in other countries, where these residue were not considered hazardous waste.

Recommendations:

1. **Aluminium residue from WTP should not be categorised as schedule waste element under SW204.**
2. **Academy of Sciences Malaysia to assist in propagating research on the hazard of aluminium residual from WTP, looking at potential for beneficial purposes and finding a more acceptable coagulant for water treatment (probably a non-aluminium base or organic).**

- **Fourth Issue: Need for national water services policy**

During earlier discussions, there was concern on the need of a National Sewerage Policy (NSP). Upon discussion with IWK, it was found that the NSP was drafted in 2010 but had not been endorsed or implemented.

There were no clear policy directives pertaining to sewerage services to guide the industry, although Section 15(a) of the SPAN Act mentioned about national policy objectives for the sewerage industry. The establishment of a fair and efficient tariff mechanism, as mentioned in Section 15(e), would be an important catalyst for the industry.

The national policy objectives pertaining to sewerage services must be well defined to ensure that the sewerage industry would progress in the right track in line with the national policy. The national policy should provide for solutions, through a national sewerage development plan focussing on issues related to sewerage catchment and local sewerage plans, facilities and infrastructure together with the operations and management of the industry.

The draft copy of the National Sewerage Policy was obtained from Indah Water Konsortium. However, it is still in draft form and needed to be quickly revised and endorsed by relevant authorities for implementation. The water sector also reckoned the existence of a draft National Water Policy (NWP) drafted by JBA, as being mentioned by the Director of Water Supply at Malaysia Water Resources Management Forum in 2012.

- **Integration of water and wastewater**

There also had been a lot of discussion on the subject of *integration of water and wastewater services* but there had not been much progress. The issue needed to be addressed in a holistic manner taking recognition of the difficulties of collecting revenue for sewerage, if it continues to be in isolation. Water companies were not keen to share their profit and take sewerage as part of their responsibilities without seeing to the profitability of sewerage services. Hence integration efforts should look at the tariffs in the sewerage services. Some views given were to rework on combined billing for water and wastewater. That had been done before but it did not succeed. If integration of the billing was difficult to be carried out, it was envisaged that integration of the two services would be even more difficult.

- **Reduce, reuse, recycle**

  Another important area that needed clear direction and strategic action was pertaining to reuse and recycling of treated wastewater. Water from large consumers was not lucrative to be recycled as the price of water was still relatively cheap. Similarly in the wastewater sector, as the quality of STP effluent increased, there is a need to look at how the recycled effluent could be re-used for other purposes, if potable use was considered too early for Malaysia. The possible reuse and recycling might be ventured to in the non-potable usage sector since industrial use could be relieved from the current water demand burden. With the limited supply of raw water anticipated in future, recycling and reusing was the best way out to endeavour in. That would contribute significantly to reinforce the green initiative of the Government.

- **Sewerage services coverage**

  Currently sewerage related issues are dealt with by different authorities namely:

  i. Ministry of Health in the rural areas; and
  ii. Local governments for internal sanitary plumbing.

  Sullage is not currently part of domestic waste and allowed to flow into the drain and later pollute the river which is the main source of raw water for drinking purposes. Although the management of sullage would be under the prerogative of local Governments, it is viewed that it would not work well. It is best that sullage be made part of the sewerage to be treated in the existing STPs. However the preliminary treatment before entering into the sewerage system should be provided and monitored.

  The management of all aspects of sewerage services and other related issues should be under the purview of WSIA as the regulator. WSIA should regulate all types of sewerage systems including the primitive pit toilet, pour flush, direct discharge and upgrading of conventional and decentralised sewerage systems. About a third of the sewerage systems were still individual septic tank (IST) and pour flush systems.

  An integrated management system should also chart the national development goals of the sewerage services, to ensure that all sewerage related issues were well addressed with uniformity. The integration would be able to cater for every party's interests both in the rural and developed regions and protect the environment for long term sustainability.

- **Management of pollution from STP**

  There were nearly 6,000 public sewerage treatment plants and 2,400 private plants. The national coverage policies should also address issues pertaining to the operations and management of all the private and public STP as poor management would result in pollution. Some of the methods to control pollution that could be incorporated in the national policy objectives are:

  i. All sources of sewerage discharge should be identified and quantified;
  ii. The concept of River Basin Management should be implemented which included the

issue of storm water and industrial discharges to be made part of the sewerage services, as then it could be best dealt with; and

iii. Possibility of provision of interceptor sewers as was being done for Sungai Melaka rehabilitation programme.

Since both water and wastewater sectors were in need of a national policy, it was agreed in the SC3 that a National Water Services Policy (NWSP) be established. The NWSP would compliment the NWRP which was developed in 2000 and the National Green Technology Policy launched in 2009.

Recommendations:

1. **The Federal Government should prepare a National Water Resources Policy that would guide the industry including the initiatives towards amalgamation of water and wastewater sectors.**

2. **The standards of STP effluent to be improved to enable reuse (alternative source) while reducing pollution loading to rivers.**

- **Fifth Issue: Water safety and security**

- **Water Safety Plan**

WHO-IWA had been promoting it for many years since 2005 but it had not been well taken up by the water operators in the country despite the **WSIA** requirement. The Ministry of Health Malaysia is currently championing the development of WSP and planned to include WSP in the proposed Safe Drinking Water Act. At the national level, an action plan was being implemented to initiate the development of WSP. Each water operator had been assigned to develop a pilot project.

- Statistics on WSP

The statistics in Table 21, indicate the minimal interest among the water supply operators in developing WSP. Currently there are only 7 developed WSPs (1.5%), as compared to 458 water systems. Therefore, implementation of WSP needs to be focused and further explored.

Table 21: Progress of WSP Development in Malaysia

No.	State	Operator/ Concessionaire	WSPs developed	WSP being developed (KKM)	Water systems
1	Johor	SAJH, SWC	1	1	42
2	Kedah	SADA, AUI, Taliworks	0	1	33
3	Kelantan	AKSB	0	1	32
4	Labuan	JBAL	0	1	3
5	Malacca	SAMB	0	1	8
6	N. Sembilan	SAINS	0	1	22
7	Penang	PBAPP	0	1	10
8	Pahang	PAIP	0	1	76
9	Perak	LAP, MUC	6 + 1 (Gunung Semanggol WTP)	2	46
10	Perlis	SAP	0	1	4
11	Sabah	JANS	0	1	51
12	Sarawak	JKR, KWB, SWB, LAKU	0	4	84
13	Selangor	SYABAS, PNSB, SPLASH, ABASS	1 (Semenyih WTP)	1	33
14	Terengganu	SATU, VEOLIA	1 (Petronas Dungun WTP)	1	14
		Total	7 + 3 WTPs	18	458

The current constraints on WSP facing the water and sewerage industry are as follows:

i. No incentive for water operators to provide good quality potable water;
ii. Low priority by regulator to enforce the development of WSP;
iii. Lack of facilitators to assist operators in WSP development;
iv. Insufficient funding to develop WSP;
v. Legislative and jurisdictional uncertainties on catchment pollution especially on non-point source pollution, sullage and septage; and
vi. Very poor awareness and response to WSP development.

- **Provision in WSIA 2006**

Factors that could possibly affect water quality were duly addressed in the Water Services Industry Act 2006 (Act 655), and they were as follows:

i. Section 34 – Security, integrity and safety of water supply and sewerage system;
ii. Section 35 – Duty of facilities licensee in respect of water supply and sewerage system;
iii. Section 41 – Water quality;
iv. Section 61 – Prohibited effluent or noxious matter not to be discharged into public sewer, etc;
v. Section 121 – Offence of contamination of water; and
vi. Section 122 – Wrongful acts.

The following clause are related to the development of WSP:

Clause180. The Commission may make such rules for all or any of the following matters:
(k) All matters relating to the safety and security of water supply and sewerage systems
(l) All matters relating to the formulation and implementation of a water and sewerage safety plan.

- **Water scarcity and stress areas**

  Water stress areas in some parts of Malaysia, experience difficulty in obtaining sources of fresh water for potable use, because of depleting resources and raw water scarcity. It sometimes created a water crisis when the need for potable water was less than supply.

- **Climate change**

  Changing precipitation patterns, unpredictable rainfall intensities, increasing runoff, rising sea levels and greater saltwater intrusion would likely result in significant adaptation efforts to maintain water resource and infrastructure services.

- **Increasing demand**

  Demand for water and wastewater facilities were always increasing, with the national annual increase averaging at 4%. The increase in demand might also be contributed to industrialisation, as well as losses in systems due to leakages and overflows.

- **Energy uncertainty**

  For conventional fuel and traditional power sources, resources have had been getting expensive, driving up fuel prices, destabilising the economy and causing global shortages and uncertainty for utility operating budgets.

- **Ageing infrastructure:**

  Repairing, replacing, upgrading ageing and building new infrastructure facilities would cost billions of ringgit to suffice demand over the next 20 years, which included WTPs and distribution or transmission networks. The reticulation systems in Malaysia were mostly built more than 30 years ago and some of the pipes were reaching the end of their service lives.

- **Pollution from sewerage sector**

  The sewerage sector also needed to be elevated to be sustainable and perform excellently to supply the recycled good quality water effluent. With a significant number of sewerage plants being operated by small scale management contractors, it was very challenging to ensure the retention of good quality effluent from entering the rivers or lakes, where it polluted the waters and was utilised downstream of the plant.

- **Managing demand**

  Many water managers only want to look at solving the supply side by developing more new water sources and new WTP's, without planning and promoting the demand side of water supply. Promoting a Water Demand Management (WDM) policy was the way

forward in managing water for the future, but the matter was taken lightly by many quarters.

There was also a concern on the practice of giving free water and cross-subsidy as they might discourage savings in the consumption of water. Although this assumption was not possible to be proven unless detailed surveys were conducted, it is best to take every effort to encourage conservation. For the record, the domestic per capita consumption of water in Selangor did not increase dramatically but fluctuated after the implementation of the 20m^3 free water in Selangor since 2008 as indicated and compared in the Table 22:

Table 22: Per capita daily domestic consumption 2007-2012 (MWIG)

Year	Per capita daily domestic consumption		
	Selangor	Johor	Penang
2007	232	206	281
2008	234	207	285
2009	235	205 / 213 *	286
2010	239	214	291
2011	230	216	285
2012	235	221	285

Note: * Different figures reported in MWIG 2010 (p. 34) / MWIG 2011(p. 31)

However, the tariff structure should consider measures to encourage conservation. Alongside, water entities should promote installation of water saving devices which were not aggressive for the same reason – the water is cheap.

Moving forward, the state water operators should take the initiative to collaborate with regulatory stakeholders such as *Jabatan Alam Sekitar*, State Water Resource Regulators such as LUAS and PBT for pollution control. In addition, other technical stakeholders such as JPS and JKR should be included.

At the same time, important stakeholders which are potential polluters such as IWK, palm oil mills, plantation companies, land developers, TNB hydroelectric power plants and food court under PBT need to be engaged through forums or even seminars and workshops.

As part of the action plan, it is recommended that SPAN should enforce WSP development and implementation. The need for minimum yearly reviews of WSPs should also be made. The following target could be set to be achieved by the industry:

i. Enforcing the development of WSP for all water and sewerage systems;
ii. Utilising WSP in improving operation and maintenance;

iii. Utilising WSP in the national budget for improvement works to reduce risk and enhance reliability with efficiency; and
iv. All water operators to adopt WSP which covered from source to tap.

It is suggested that, at the national level water NGOs such as the Malaysian Water Association play a role in promoting WSP, so that water agencies such as Jabatan Bekalan Air (JBA) Malaysia and SPAN which were under the Ministry's jurisdiction could join in.

Recommendations

1. **To highlight to the Government the importance of WSP so that adequate funding could be provided to water operators to develop and implement WSP.**

2. **To form a national steering committee on WSP to deal with legislative and judicial uncertainties, and implementation of a proper program.**

3. **To enact rules under WSIA for WSP implementation and greater involvement of SPAN.**

5.2.2 Technology - Matching appropriate technology (Sixth Issue)

• STI and R&D in water services

To become a high income and developed economy, Malaysia as a country had to intensify knowledge generating capacity by investing in R&D and strategic studies. Poorly, the low budget in R&D did not reflect the norm usually associated with countries having a developed economy and advancement in Science, Technology and Innovation (STI). Similarly, in the water services sector, the expenditure in R&D is still far from reaching the target for producing excellent water services in the country.

It is the normal scenario for the R&D unit or department in any organisation to be dormant and facilities are not being used fully to produce innovative products. To make things worse, even exploring the possibility of using new technology in water services could be a hoax and it was a thing to avoid when faced with the probability of the technology failing to work as planned. It is a human problem that did not dare to take up challenges in the new technological frontiers toward advancement.

• Optimisation of operations

Another aspect that was discussed was the importance of optimisation in operations. The practice of adopting a standard design had restricted water engineers from adopting new technology where systems could operate more efficiently.

Some of the options and alternatives that had been well implemented at several places are as follows:

- River bank infiltration – cost saving in construction as well as operations. Reference project is the Jeli WTP, Kelantan
- The use of ozone for water treatment – current developments in science and technology had reduced very much the carbon footprint of ozone plants and their energy utilisation

- Hybrid systems to treat **brackish water** in Labuan (Kinabenua) and Sarawak (Daro) – it is a two stage process where the initial stage removed suspended and colloidal particles where else the second stage removed the salinity in water using membranes
- The use of a streaming current for optimising floc formation – the water quality is consistently good and chemical consumption is optimum (no wastage)
- The use of other forms of chlorine to improve its optimum working pH and reduce the danger of chlorine gas leakages – brine (Malacca), chlorine dioxide (Perak)
- The expansion of reservoir capability by raising dam heights
- Exploring extensive ways of optimising **groundwater, storm water and STP effluent water.**

- **Ageing (malfunction and failure) infrastructure**

"Infrastructure" refers to the pipes, treatment plants, pumps, valves, water storage tanks, hydrants and other critical components that delivered safe drinking water to our taps, supported fire and emergency services, removed wastewater from our homes and other buildings and carried away storm water from our streets. The infrastructure helps to protect the public health, the environment and economic activity; contributes to a good quality of life and likely represent the community's largest capital investment.

Infrastructure malfunction and failure could disrupt any and all water services, and problems are more likely to occur as the equipment aged. One of the biggest problem is water loss from leaks or breaks in the drinking water distribution system, the underground pipes that carries water from the treatment plant to the user. Water loss equals money loss, because the water had already been treated.

Furthermore, public health is at risk if harmful organisms entered the pipes and flowed to the tap. Broken or blocked wastewater pipes could cause systems to overflow during major rainstorms or heavy snowmelt and discharge raw (untreated) sewerage into local waterways. That, along with storm water discharges, especially during heavy rainfall, could pollute beaches and waterways making them unsafe for swimming, fishing, and boating.

Providing clean, safe, and affordable water to Malaysian's citizens is one of the greatest public health achievements of the last century. Local governments have been at the forefront, serving as the public entity responsible for providing water, and storm water inclusive of sewer services to generations of families in local communities. However, maintaining and sustaining those critical services were crucial.

Below are the elaborations of all key strategies and action plans for proper asset management:

- **Learn about the condition of water infrastructure**

  An important initial step is to discuss with water and sewer plant operators/ managers, the condition of the systems. Visit the drinking water system wells or surface water intakes, treatment plants, points along the distribution system and storage tanks. Take a look

at the wastewater treatment plants and processes, pump stations and other key points along the collection systems, inspect the manhole covers and storm drains, as well as the discharge points where treated water or storm water is released into the environment. Get to know how the system operated; find out if there was a maintenance plan, what equipment worked and what did not, and what could happen as a result. That small investment in time up front, could yield better decisions and, save time and money in the long run.

- **Implement an asset management plan**

According to the U.S. Environmental Protection Agency (EPA), asset management is a "planning process that ensures that you get the most value from each of your assets and have the financial resources to rehabilitate and replace them when necessary." Assets to consider managing typically include any infrastructure component that has a useful life of more than one year. Asset management involves gathering key information to determine:

i. What is available;
ii. Where it is;
iii. What condition it is in; and
iv. How long it is expected to last.

You could then use the information to make timely maintenance, repair, rehabilitation, replacement, capital improvement, rate-setting, financial planning and other decisions. A utility's existing plans, such as the strategic, long-range, operations and maintenance, or capital improvement plan could be integrated or aligned with the asset management plan.

Any sized system could benefit from asset management planning. For example, the asset management plan might indicate that it is more cost-effective to replace a piece of equipment now, rather than spend money maintaining it for several more years.

It could also help identify the cost to replace and maintain all equipment over the next 10 or 20 years, and help calculate how much money to set aside in reserve each year to cover these future expenses. In the long run, asset management could help to move out of the crisis management mode, extend the service life of equipment, reduce system down-time, identify repair and replacement costs, give more time to plan and research cost-effective solutions for replacing and rehabilitating assets, improve ability to comply with regulations, show the public and investors that the money was being used effectively and efficiently, enhance opportunity for obtaining financing, and enable system personnel to use their limited time and resources most efficiently.

- **Educate the public**

When it is time to repair, rehabilitate, or replace the water infrastructure, it is important for the public to understand and support the stated goals because taxpayers and ratepayers might be affected. Public education is a proactive way to inform the public about the value of the infrastructure, its condition and

needs, and what is required to keep water services up and running. Research has suggested that people prefer to learn about water issues by reading printed fact sheets, bulletins, and brochures or reading a newspaper article, or watching television coverage. It could even be visiting a website.

- **Centralised versus decentralised wastewater treatment systems**

Millions of gallons of domestic wastewater is generated every day through sinks, showers and toilets. The wastewater contains pathogens that could be dangerous to human health and thus properly treating and managing it is crucial for human safety.

Properly managing wastewater is an issue of increasing importance in sustainable development and design due to growing population numbers and the increasing scarcity of freshwater resources. In urban areas, wastewater has traditionally been collected and transported to a centralised municipal treatment facility where it is treated and discharged into a water body. In rural areas, septic systems that collect and treat wastewater onsite had been the conventional method. However, large centralised systems are expensive to maintain and often faced funding shortages.

Additionally, because centralised plants treat water that had been transported to single sites, the recycled water from those plants is not normally used in the location from which it had been collected. Septic systems also face challenges, such as improper operation and maintenance, which could cause contamination of surface and groundwater. To fill this void, innovative onsite technologies could provide state-of-the-art treatment and avoid pumping water for long distances, all the while offering significant savings in water and energy. Additionally, by treating water onsite, decentralised systems take the strain off from ageing centralised treatment plants and their infrastructure. The treated water might be reused for landscape irrigation or toilet-flushing in order to maximise water savings. Furthermore, innovative decentralised systems are more effective than traditional septic systems in their ability to reduce the nutrient load in treated effluent.

Many factors need to be considered when choosing and installing a wastewater treatment system. These includes the type of system to install; wastewater characteristics and extent of treatment; human health considerations; level of management and oversight that would be required; and the standards that had to be met. Additionally, there is an on-going discussion regarding centralised and decentralised systems, touching upon the potential benefits and shortcomings from both options.

From strategic consultation, the service provider is looking forward to implement a new decentralised system integrated with a sustainability concept (resource recovery, utilisation of natural plants, wastewater recycling) to improve Malaysia's sewerage management. In the current practice, wastewater has traditionally been managed through large centralised treatment facilities in urban areas and septic tanks in rural areas. However, at present, there is an array of innovative decentralised wastewater systems that could collect and treat domestic wastewater onsite. These systems sometimes offer more increased benefits compared to the

conventional treatment because they reduced the need for energy and large infrastructure, provided recycled water for use onsite, and could be expanded to meet increasing demand.

To get further understanding about innovative decentralised systems, a comprehensive literature research has been conducted. The outcomes are elaborated in the following paragraphs

- **Definition and criteria**

In this section, background information on comparison between centralised and decentralised system is provided. The following definitions have been adopted:

➢ **Centralised wastewater treatment system:** A managed system that consists of collection sewers and a single treatment plant, which is used to collect and treat wastewater from an entire service area. Traditionally, these systems are referred to as publicly owned treatment works (U.S. EPA Water 2012), although not all of these systems would be publicly owned.

➢ **Decentralised wastewater treatment system:** A wastewater treatment system for collection, treatment, and dispersal or reuse of wastewater from individual homes, clusters of homes, or isolated communities at or near the point of generation (National Decentralised Water Resources Capacity Development Project 2012)

Under certain conditions, decentralised technologies might offer benefits over centralised technologies, but an array of different factors need to be considered. The following section outline and compare these two options, and also provide considerations regarding wastewater treatment infrastructure and planning options.

Meanwhile, Table 23 further articulates the distinction between decentralised and centralised systems using the specific categories (Magliaro & Lovins 2004):

Table 23: Decentralised vs. centralised system

Category	Centralised WWTP	Decentralised WWTP
Volume	Treat relatively big volumes of water	Treat relatively small volumes of water
Sewer Type	Use conventional gravity sewers	Use alternatives, small-diameter pressurised pipes, small-diameter gravity and vacuum sewers
Treatment Type	Usually use activated sludge process	Use alternatives, constructed wetlands, sand filters, trickling filters, etc.
Discharge Method	Discharge to a surface water body	Discharge by infiltration into water soil
Ownership	Publicly owned	Owned by developer, homeowner's association, another private entity
Relative scale	Serve entire communities or substantial area	Serve only a portion of community

Innovative systems might be desired for several purposes, including cost-reduction, flexibility in site constraints, and lowered environmental impact. Those systems might also appeal to their users for aesthetic reasons, a sense of environmentalism, or specific required treatment. These potential benefits are explained in further detail below.

- **Water reuse potential**

The potentials for lowered water consumption and also water reuse are particularly appealing features of innovative decentralised systems. The U.S. EPA defines water recycling as "reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, and replenishing a ground water basin (refers to as ground water recharge)" (U.S. EPA 2011). The use of recycled water on site lessens demand for energy (to pump water), total water demand on a centralised system, and the need for water storage.

- **Capital costs and running costs**

As a result of their smaller size, decentralised systems have lower capital costs, minimising reliance on risky loans for systems that were highly dependent on speculations of increased population and treatment demand. Those savings could be realised instantly through the reduction of conveyance and piping costs.

Moreover, costs associated with system failure are minimised in smaller decentralised technologies when compared to large centralised systems. Due to the smaller nature of decentralised systems, the water flows are lower in relation to central treatment plants, required less sewer piping, and were typically designed to reuse water onsite. These localised systems minimised reliance on leaky pipes, joints, exchanges, and pumps, and could capture additional savings both immediately and continually.

Reduced size and increased efficiency could translate into a less energy intensive option, as wastewater does not have to be pumped over large distances, gradients, and between multiple points, thus reducing the embedded energy requirements (Cohen *et al.*, 2004). If the existing nexus between energy and water was considered, a decentralised system might be appealing not only at the local or regional scale, but also at the state and national level.

- **Need for infrastructure replacement**

Since treatment capacities either remains constant or increased, wastewater systems have to respond to that demand. Rather than replace heavy and corroding iron pipes, municipalities and communities might find opportunities through a just-in-time approach; that is, customise treatment capacity as it arose rather than over-build a large treatment capacity. Furthermore, in many cases, decentralised systems could increase local water reuse and decrease impact on natural hydrologic integrity. That could create direct environmental benefits while offering economic and social opportunities (Magliaro & Lovins 2004). If managed properly, both on the technical and the regulatory sides, decentralised wastewater systems offered a potentially sustainable alternative.

- **Social component**

An additional awareness to natural water cycles and environmental systems had been observed in cases where decentralised technologies was adopted for onsite wastewater treatment. The Rocky Mountain Institute (2004) had highlighted potential educational and social benefits associated with decentralised systems, such as habitat creation, aesthetic appeal, and educational opportunities.

The social and aesthetic appeal of alternative onsite systems such as constructed wetlands, aquatic ecological systems, and even prefabricated systems offered an element of community connection to the filtration and treatment process (Leverenz et al. 2002). The localised nature of decentralised infrastructure encouraged public awareness and participation. With appropriate management, that could offer awareness to consumption rates, which was increasingly important as states seek to conserve water consumption.

Recommendations:

1. **To explore alternative sources, adopt appropriate technology, understand and develop R&D parallel to industry problems and needs.**

2. **Proper capacity building to ensure appropriate application of technology.**

5.2.3 Management

• Seventh Issue: High non-revenue water

It was observed that the performance of each state is not directly proportional to the amount of money allocated. It was evident that the approach of managing NRW had to be holistic in nature and continuous.

Generic process of a holistic approach:

- Accurate measure of water balance components;
- Attend all complaints on visible leaks;
- Metering of production;
- DMA and pressure management; and
- Selective pipe change.

The process should be addressed in the order of priority as closely as possible. There were operators who opted for pipe changes as their initial step for reducing NRW. It was quite difficult to assess the effectiveness of the NRW approach since there was no means to measure the baseline NRW for the area where the pipe was changed.

- **Establishment of water balance**

Water Balance was the tool developed by the International Water Association (IWA). It enabled the evaluation of the magnitude of each component of NRW as shown in table 24.

Table 24: Water balance

SYSTEM INPUT VOLUME	**Authorised Consumption**	**Billed Authorised Consumption**	**Billed Matered Consumption**	**REVENUE WATER**
			Billed Non Matered Consumption	
		Unbilled Authorised Consumption	**Unbilled Matered Consumption**	**NON-REVENUE WATER**
			Unbilled Non-Matered Consumption	
	Water Losses	**Apparent Losses**	**Unauthorised Consumption**	
			Metering Inaccuracies	
		Real Losses	**Leakage on Transmission/ Distribution**	
			Leakage/Overflows at Tanks	
			Leakage on Service Connection	

It is necessary that the application of Water Balance as an NRW management tool be actively adhered to. Accurate and reliable data is essential to obtain a useful Water Balance. In doing so, the following fundamentals needs to be addressed:

- Standardisation of terms and measurements; and
- Specific approach according to NRW situation.

- **Standardisation of terms and measurements**

The definition has to be standardised throughout the nation and the person responsible for the collection and analysis of the data needed to have the same understanding of the terms used. Even though IWA has developed the formula for every component of the Water Balance, the methods of measurement and data collection has to be standardised, i.e.:

- Formula;
- Forms;
- Type of equipment;
- Data collection frequency; and
- Reporting frequency.

SPAN would be the best agency to regulate the water companies in West Malaysia and the respective state regulatories in Sabah and Sarawak. In Labuan, KeTTHA would be directly in charge of regulating the operators.

It is essential that data and records submitted to SPAN be gathered correctly since the information would be used in decision making including determining tariff rates.

The aspects lacking in the NRW implementation are:

- Training; and
- Auditing.

Some states such as Selangor, Johor, Malacca, Perak and Penang have already established their own standard operation procedures in producing Water Balance, thus that could be emulated by other states after standardisation was achieved at national level.

- **Specific approach according to NRW situation**

As mentioned earlier, there are several approaches in addressing NRW. The NRW Leadership Workshop agreed to that in adopting a holistic approach in NRW management, the solution for each state is different and it needs to suit their respective problems.

In brief, the approach could be simplified as follows:

i. Prompt repair of visible leaks;
ii. Ensure accurate production meters;
iii. Establish district metering zones;
iv. Undertake pressure management; and
v. Implement selective pipe replacement.

The approaches could be opted to in the priority as listed above but there is no restriction to implement them all together, varying in emphasis according to each state's NRW situation.

NRW has to be given serious attention as it has not been given much change from the WLA Conference 2010 except for the formation of the NRW Task Force at SPAN. However, the focus has been on technical issues where else inadequate funds to undertake NRW programme had been the **main barrier** to the holistic approach.

The role of PAAB was indeed crucial to sort out the high NRW in most states. Success in Malacca and Penang were very much attributed to the high level of management commitment in reducing NRW. Hence NRW reduction should be an important component of the business plan that PAAB had looked at, to assist the water operators.

Another good practice that PAAB could adopt is to tie up conventional project loans to NRW projects. This has been done in the past when international donor banks such as the World Bank and Asia Development Bank put a condition that borrowers appoint consultants and carry out proper auditing, policy evaluation or/and implementation of the NRW programme planned by the operators.

Putting clear policy and direction coupled with proper planning would be important to ensure NRW was always top priority for the management. It must be realised that putting NRW programme on hold and waiting for funds would waste much of the improvement efforts that had previously been done. Continuity of NRW implementation is a must and in the dire situation of limited funds, PAAB role is much needed.

- **Tariff reviews to reflect actual cost**

Right value for water should be an important driver to make NRW reduction a success. It would even facilitate green initiatives

to be incorporated since improvements would be easily quantified in real savings, translated to financial gains. The common remark of "it is cheaper to let the leak flow rather than stopping it" must be put to a stop. Tariff mechanisms are already in place as SPAN had already done reviews several times for the states previously. What is properly lacking is the will to implement the approved tariff. Another issue raised was the automatic tariff review. Some of the revised tariff rates already had been established in the water company business model but the implementation does not seem to be automatic.

It is recommended that automatic but regulated water tariff be implemented so that water companies could plan their asset improvement and NRW reduction ahead and make the necessary obligations with the confidence that the tariff proposed was approved together with the entire 3-year business plan.

- **Develop comprehensive asset management plan**

The asset management plan is part of the NRW reduction program. Funding is required for the implementation of NRW reduction and sustaining it.

A rough estimate of RM250 per metre of pipe replacement would sum up to RM10.97 billion to change the entire stretch of AC pipe and communication pipes. Based on the 2012 AC pipe length concerned, the funds needed for pipe change in total is estimated as shown in Table 25:

Table 25: Statistics of AC pipes and NRW 2012 according to states

	Total length (km)	AC length (km)	AC %	NRW %	Estimated cost of AC pipe replacement (RM million)
Johor	20308	7550	37.2%	29.2%	1,887.50
Kedah	10722	6359	59.3%	47.8%	1,589.75
Selangor	26656	6316	23.7%	32.5%	1,579.00
N. Sembilan	7984	3952	49.5%	44.6%	988.00
Pahang	10637	3945	37.1%	56.2%	986.25
Kelantan	6354	3675	57.8%	55.7%	918.75
Perak	11143	2233	20.0%	30.4%	558.25
Sarawak	10309	2130	20.7%	30.5%	532.50
Sabah	10396	1820	17.5%	50.9%	455.00
Terengganu	8811	1772	20.1%	37.0%	443.00
Malacca	4715	1715	36.4%	25.1%	428.75
Penang	4118	1321	32.1%	18.4%	330.25
Perlis	1849	935	50.6%	59.8%	233.75
Labuan	493	169	34.3%	22.0%	42.25
Total					10,973

The programme could spread up in 20 years, making the annual budget that should be allocated for the country to be about **RM550 million**. That would be different from the funds needed for the NRW programme.

- **Strategies**
  - **Tariff review strategies**
    a. Revision should allowed for inflation, increase in fuel and power costs;
    b. Revision should be gradual and implemented on a yearly basis; and
    c. Effective role to be played by *Forum Air* together with regulators.
  - **Asset management strategies**
    a. Asset tagging and mapping;
    b. Proactive pipe replacement system;
    c. GIS for distribution system; and
    d. DMZ establishment.
  - **Public engagement strategies**
    a. Media and public support for awareness on true value of water and NRW reduction;
    b. Continuous campaign on the important and true/right value of water;
    c. Reward and appreciation platform to consumers; and
    d. Indicate actual cost of water in bills.
- **SPAN Procurement Recommendation (for Performance based Contract)**
    i. Accurate baseline data;
    ii. Baseline prepared by separate vendor from the NRW works contractor;
    iii. Baseline cannot be changed during contract commencement;
    iv. Determining the target level for each component;
    v. Realistic targets; and
    vi. Proper specification and project management.

Recommendations:

1. **NRW must be implemented in a holistic manner and follow the recommendations of NRW Task Force of SPAN.**
2. **Federal Government should provide funds to states based on the financial health of the entity and the physical conditions of the assets.**
3. **NRW is a programme not a project, continuity is essential.**

• Eighth Issue: Inadequate capacity building

In 2010, MyWA was established to consolidate and standardise the various training programme, especially in competency. The current obstacles facing the water and sewerage industries on capacity building are as follows:

- The regulator had yet to enforce the competency requirement on the state operators in operating the water systems;
- Lack of financial support to engage module developers for the development of water competency modules as well as in acquiring training equipment facilities;
- No government funding to support the capacity building programme for the water and sewerage industry which

the state water operators had financial difficulties to participate in; and
- Very poor response from the state water operators to take up the competency assessment and knowledge-based training programme provided under MyWA.

- **Legislation and policies**

The competency requirements to operate the water and sewerage systems were duly addressed in the Water Services Industry Act 2006 (Act 655), Section 49:

Qualifications to operate, etc., water supply system and sewerage system

49. (1) No part of any water supply system or sewerage system shall be worked, managed or operated or caused to be worked, managed or operated except by and under the control of persons possessing such qualifications and holding such certificates as may be provided in this Act or as may be prescribed.

(2) A person who contravenes subsection (1) commits an offence and shall, on conviction, be liable to a fine not exceeding fifty thousand ringgit.

- **Current status**

Three competency programme for the sewerage sector were fairly well established with major participation, such as the contractors and private-run STPs, from the private sector. Those was due to the fact that DOE had enforced the requirement.

The refresher course for Confined Space with the 3-year cycle has also attracted a large number of participants as it is compulsory for their license renewal. Recently, there was an issue of the high fee charged for the STP competency programme and that had slowed down the number of programme conducted. However, other competency and knowledge-based programme had not really taken off well. It is also to be noted that IWK, even though being the largest sewerage operator had not been enforced to have its staff to undergo the same programme as had imposed on to the other parties.

For the water sector, MWA is currently pursuing KeTTHA to obtain grants to assist MyWA in developing competency modules and to acquire lab equipment and other facilities for competency training and practical examinations.

An action plan for the national strategic plan was presented at the consultation workshop in July 2012 to generate buy-in of the draft strategic plan before finalising of the documents.

- **Conventions and resolutions**

i. *Workshop on Training Programme for the Water Supply Industry*, 10 October 2010, MWA Kuala Lumpur organised by MWA; and
ii. *Workshop on Competency Training Programme for Water Supply Industry*, 30 November 2011, Kota Kinabalu, Sabah in conjuction with JTJAD Annual Conference.

- **Targets**

    i. Development of competency modules through funding by the government;
    ii. Procurement of training equipment and facilities;
    iii. Enforcing the participation of all water and sewerage operators in competency programme over an agreed period by the industry players;
    iv. Enforcing Section 49 **WSIA** to ensure water supply and sewerage systems are handled by competent staff; and
    v. Enforcing all staff in both industries to attend knowledge-based courses for a designated number of days annually.

Recommendations:

1. **The Government needs to establish a centralised Training Centre for water and wastewater services.**

2. **The Government shall provide funding for conducting competency and knowledge based programme.**

3. **All water operators must enrol into competency and training programme carried out by training centres and institutions endorsed by SPAN.**

Chapter Six: Conclusion

6.1 Introduction

The study lists out the appropriate actions to be implemented by several agencies including formulation of new institutions should it be necessary. In eventuality of long lead time for implementation, there has to be alternative methods to initiate actions.

The actions suggested are in coherence with several policies already established in the **National Water Policy** and fits well into the **Integrated Water Resources Management (IWRM) Principles.** At the same time, the actions would pave greater steps into implementation of the **Water Services Industry Act (WSIA)** which is seen to be lagging.

6.2 Contribution to the Industry

Providing clean, safe, and affordable water to Malaysian's citizens are one of the greatest public health achievements of the last century. Water operators have been at the forefront, serving as the public entity responsible for providing sewer, water, and storm water management services to generations of families in local communities. However, maintaining and sustaining these critical services are crucial.

In this study, strategies, such as implementing an asset management plan and educating the public to support the nation's goals, have been suggested to overcome ageing (malfunction and failure) infrastructure issues.

In the light of growing population, ageing infrastructure and higher demand for clean water, an increased focus has been placed on advanced decentralised wastewater treatment options as an alternative or supplement to centralised facilities. In Malaysia's current practices, wastewater has traditionally been managed through large centralised treatment facilities in urban areas and individual septic tanks in rural areas.

However, today there is an array of innovative decentralised wastewater systems that could collect and treat domestic wastewater onsite. Those systems sometimes offer increased benefits over conventional treatments because they reduce the need for energy and large infrastructure, provided recycled water for use onsite, and could expand to meet increasing demand. Therefore, this study has recommended that further research is needed to determine potential/ appropriate decentralised wastewater treatment technologies.

Life cycle assessment of wastewater treatment systems could be used as a tool to gather valuable information and to identify the barriers preventing the adoption of decentralised systems, as well as to understand critical aspects of selecting, permitting, and installing decentralised systems from field experts.

Treated wastewater should be utilised as a potential source of water. The treated wastewater has high potential as sewerage treatment plants are producing good quality reusable water which could be used to replace the "non-potable use" water currently supplied from water companies with potable quality water. The initiative would be in line with

Thrust No. 3 of the National Water Policy vis-a-vis "Alternative Water Resources and Sources".

NRW management could play an important forward role. However, the push factor would be in funding and tariff rationalisation. Asset management should enable proper NRW programme be implemented. Engaging competent personnel to manage NRW is imperative for a sustainable NRW programme. Public participation should be encouraged to help in creating awareness of water and appreciation of the right value of water. This would be in line with **IWRM Principle No. 2,** which suggests that water development and management should be based on a participatory approach involving users, planners and policy-makers at all levels.

The current status would be the basis to evaluate progress related to water reform of the states involved and outstanding issues such as NRW, water security and safety. **IWRM Principle No. 4** mentions that *"Water has an economic value in all of its competing uses and should be recognised as an economic asset".*

Capacity building should be given a greater emphasis through regulatory framework or special funding initiatives. Incorporation of adequate funds into business plans is also an option. To ensure standard practice throughout the country, centralised training or coordinated decentralised training should be implemented.

However, certification of personnel should be done by the certifying bodies or their agents. A centralised training centre has to be revitalised to replace IKRAM where MyWA should have a pivotal role. That initiative would be in line with **Thrust No. 9 of the National Water Policy i.e. "Capacity Building and Awareness".**

Water Safety Plan efforts have been progressing well in some states while some are just having only one WSP, developed initially by the Ministry of Health. There must be greater attention given to the development of WSP in all systems encompassing both aspects of quality and quantity of potable water. Those efforts are in-line with **IWRM Principle No. 1** which states that fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.

Reasonable targets and a time frame should be given. In line with the security of supply, the National Water Policy stressed on water resource security and sustainability in its 28th Strategy which is ***"strengthening existing awareness programme and campaigns to suit goals for water resources security and sustainability"***.

6.3 Summary of Recommendations

The twenty three recommendations put forward from this study were discussed in detail in Chapter 5 and could be categorised as follows:

6.3.1 Federal Government

1. *The Federal Government should facilitate deficit water entities by providing grants until the tariffs could recover operational expenses.*
2. *The Federal Government should have more leniency in the restructuring of debt by taking into account the high cost of providing infrastructure in rural areas.*

3. *SPAN should be answerable to Parliament and not the Minister.*
4. *There should be an establishment of a Water Ministry in the Malaysian Cabinet.*
5. *The Federal Government should prepare a National Water Services Policy that would guide the industry including initiatives towards amalgamation of water and wastewater sectors.*
6. *The Federal Government should provide funds to states based on the financial health of the entity and the physical conditions of the assets.*
7. *The Federal Government should establish a centralised Training Centre for water and wastewater services.*
8. *The Federal Government should provide funding for conducting competency and knowledge based programmes.*

6.3.2 Academy of Sciences Malaysia

1. *The Academy of Sciences Malaysia should assist in propagating research on the hazards of residual aluminium from WTP, looking at the potential of beneficial purposes and finding a more acceptable coagulant for water treatment (probably a non-aluminium or organic base).*

6.3.3 SPAN/relevant stakeholders

1. *Tariffs are to be reviewed at regular intervals until it reaches full cost recovery by 2030. Increase in electricity tariff should automatically revise water tariff.*
2. *Determination of tariff is to be done in a transparent and holistic manner and subsequent announcement on tariff reviews are to be conducted by SPAN.*
3. *Aluminium residues from WTP should not be categorised as schedule waste element under SW204.*
4. *A new target date should be set for migration.*
5. *Forum Air should be strengthened by getting the involvement of industry players and not merely enthusiastic consumers.*
6. *The standards of STP effluent are to be raised to enable reuse (alternative source) while reducing pollution loading to rivers.*
7. *To highlight to the Government the importance of WSP and the need for adequate funding to be provided to water operators to develop and implement WSP.*
8. *A national steering committee on WSP has to be formed to deal with legislative and judicial uncertainties, and an implementation programme.*
9. *Rules has to be enacted under WSIA for WSP implementation and greater involvement of SPAN.*
10. *Appropriate technology has to be used through understanding and developing R&D parallel to industry problems and needs.*
11. *There must be proper capacity building to ensure appropriate application of technology.*
12. *NRW should be implemented in a holistic manner and follow the recommendations of NRW Task Force of SPAN.*
13. *NRW should be a programme not a project, continuity is of essence.*
14. *All water operators have to enrol into competency and training programme currently carried out by training centres and institutions endorsed by SPAN.*

6.4 Acknowledgement

Sincere thanks to the Academy of Sciences Malaysia for having the trust in the team to conduct the study and all the support and guidance throughout the endeavour. Our gratitude also goes to all the stakeholders and water enthusiasts to whom we owe so much for their cooperation and contributions towards completion of this study. Last but not least, *terima kasih* to all team members who had sacrificed their time and effort for this study.

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APPENDIX 1

a. Attendance list for SC1 (12 June 2013)

i. Ir Dorai Narayan (IWK)
ii. Ir Noor Azahari (JBA)
iii. Mohd Ridhuan Ismail (SPAN)
iv. Zainal Abidin (SAMB)
v. Syafiqah Mohd Yusop (SAMB)
vi. Mohd Sobri Zakaria (*Pengarah Bahagian Kawal Selia Air SPAN*)
vii. Khairul Ashraf Rosli (*TP Bahagian Kawal Selia Air SPAN*)

b. Attendance list for SC2

1) POLICY

i. G. Lalchand
ii. Wong Chee Ching
iii. Tham Yee Kiong
iv. Mohd Fauzi Omar
v. Chong Meng Choon
vi. Dorai Narayana
vii. Marzuki Mohammad
viii. Rogayah Kadari
ix. Mohd Hanafee A Rahman
x. Basar Ishaz
xi. Wan Zamri
xii. Mohd Razman Salim

2) TECHNOLOGY

i. Syazrin Syima Sharifuddin (Nahrim)
ii. Goh Yee Chai (Nahrim)
iii. Tan Yong Nee (Sirim)
iv. Lim P. B. (IWK)
v. Mohd Hakimi Abd Rahman (Malaysian Remote Sensing Agency)
vi. Wan Zakaria Mohd Tahir (Agensi Nuklear Malaysia)
vii. Bavinder Singh (Salcon Engineering Berhad)
viii. Gordon Fernandez (Syabas)
ix. Norhasim Baron (SPAN)
x. Mohd Nafis Isnin (ABASS)
xi. Junainah Ahmad (ABASS)

3) NON-REVENUE WATER, NRW

i. Dato' Wan Ngah bin Ali
ii. Ir Sofi Ibrahim
iii. Martin Shaw
iv. Mohmad Asari Daud

4) CAPACITY BUILDING

i. Razahidi Abdul Hayet (KeTTHA)
ii. Prof Fatimah bt Md Yusoff (UPM)
iii. Jaffarran Suhaimi (PMNC S/B)
iv. Roowina Merican (Syabas)
v. Khairy Yeob (TF)
vi. Nurul Ashikeen Bt Kamaruzaman (SPAN)
vii. Shaharis Saad

5) WATER SAFETY PLAN, WSP

i) Mansor A. Ghani (MWA)
ii) Marlinda A. Malek (UNITEN)
iii) Haslina Amer (LUAS)
iv) Ahmad Haziq at Jusoh (Stds. M'sia.)
v) Rohasliney Hashim (UPM)
vi) Humairah Yeoh Yee Voon (ABASS)
vii) Shahirwan Aman Shah (SAMB)
viii) Noreen Juliana Bt Ismail (Syabas)

APPENDIX 2

1. Quality standards for wastewater discharged from new treatment plant

APPENDIX K1

Extracted from Environmental quality (Sewage) regulations 2009 (PU(A)432)

SECOND SCHEDULE

(Regulation 7)

ACCEPTABLE CONDITIONS OF SEWAGE DISCHARGE OF STANDARDS A AND B

i) New sewage treatment system

	Parameter	Unit	Standard	
			A	B
	(1)	(2)	(3)	(4)
(a)	Temperature	°C	40	40
(b)	pH Value	-	6.0-9.0	5.5-9.0
(c)	BOD5 at 20°C	mg/l	20	50
(d)	COD	mg/l	120	200
(e)	Suspended Solids	mg/l	50	100
(f)	Oil and Grease	mg/l	5.0	10.0
(g)	Ammonical Nitrogen (enclosed water body)	mg/l	5.0	5.0
(h)	Ammonical Nitrogen (river)	mg/l	10.0	20.0
(i)	Nitrate – Nitrogen (river)	mg/l	20.0	50.0
(j)	Nitrate – Nitrogen (enclosed water body)	mg/l	10.0	10.0
(k)	Phosphorus (enclosed water Body)	mg/l	5.0	10.0

Note:
Standard A is applicable to discharges into any inland waters within catchment areas listed in the Third Schedule, while Standard B is applicable to any other inland waters or Malaysian waters.

2. Quality standards for wastewater discharged from treatment facilities approved before January 1999

(ii) Existing sewage treatment system (approved before January 1999)

This category refers to all sewerage treatment systems which were approved before the Guidelines for Developers : Sewerage Treatment Vol. IV, 2nd edition and were enforced by the Department os Sewerage Servive , Ministry of Housing and Local Government, beginning January 1999. Below are the acceptable conditions for sewerage discharge according to type of sewerage discharge according to type of sewage discharge treatment systems:

			Type of Sewage Treatment System									
			Communal Septic Tank		Imhoff Tank		Aerated Lagoon				Oxidation Pond		Mechanical System	
	Parameter	Unit	A	B	A	B	A	B	A	B	A	B
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(a)	BOD_5 at 20°C	mg/l	200	200	175	175	100	100	120	120	60	60
(b)	COD	mg/l	-	-	-	-	300	300	360	360	180	240
(c)	Suspended Solids	mg/l	18	18	150	150	120	120	150	150	100	120
(d)	Oil and Grease	mg/l	-	-	-	-	-	-	-	-	20	20
(e)	Ammoniacal Nitrogen	mg/l	-	-	100	100	80	80	70	70	60	60

Note:

1. Standard A is applicable to discharge into any inland waters within catchment areas listed in the Third Schedule, while Standard B is applicable to any other inland water or Malaysian waters.
2. These standards are applicable to the sewerage treatment systems that may have been constructed prior to 1999 based upon approval given by other agency, other than the Department of Sewerage Services, Ministry of Housing and Local Government.

3. Quality standards for wastewater discharged from treatment facilities approved after January 1999

(ii) Existing sewage treatment system (approved before January 1999)

All sewerage treatment systems which were approved after the Guidelines for Developers: Sewerage Treatment Vol. IV , 2nd edition and were enforced by the Department of Sewerage Service, Ministry of Housing and Local Government, Beginning January 1999 and up to date of coming into operation of these regulations.

	Parameter	Unit	Standard A	Standard B
(a)	BOD_5 at 20°C	mg/l	20	50
(b)	COD	mg/l	120	200
(c)	Suspended Solids	mg/l	50	100
(d)	Oil and Grease	mg/l	20	20
(e)	Ammoniacal Nitrogen	mg/l	50	50

Note :
Standard A is applicable to discharge into any inland waters within catchment areas listed in the Third Schedule, while Standard B is applicable to any other inland waters or Malaysian waters.

1. List of parameters for discharged wastewater according to Standard A&B

Extracted from Enviromental Quality (Industrial Effluents) Regulations 2009 (PU (A) 434)

APPENDIX K2

FIFTH SCHEDULE
[Paragraph 11 (1) (a)]

ACCEPTABLE CONDITIONS FOR DISCHARGE OF INDUSTRIAL EFFLUENT FOR MIXED EFFLUENT OF STANDARDS A AND B

	Parameter	Unit	Standard	
			A	B
	(1)	(2)	(3)	(4)
(i)	Temperature	°C	40	40
(ii)	pH Value	-	6.0-9.0	5.5-9.0
(iii)	BOD_5 at 20°C	mg/l	20	40
(iv)	Suspended Solids	mg/l	50	100
(v)	Mercury	mg/l	0.005	0.05
(vi)	Cadmium	mg/l	0.01	0.02
(vii)	Chromium, Hexavalent	mg/l	0.05	0.05
(viii)	Chromium, Trivalent	mg/l	0.20	1.0
(ix)	Arsenic	mg/l	0.05	0.10
(x)	Cyanide	mg/l	0.05	0.10
(xi)	Lead	mg/l	0.10	0.5
(xii)	Copper	mg/l	0.20	1.0
(xiii)	Manganese	mg/l	0.20	1.0
(xiv)	Nickel	mg/l	0.20	1.0
(xv)	Tin	mg/l	0.20	1.0
(xvi)	Zinc	mg/l	2.0	2.0
(xvii)	Boron	mg/l	1.0	4.0
(xviii)	Iron (Fe)	mg/l	1.0	5.0
(xix)	Silver	mg/l	0.1	1.0
(xx)	Aluminium	mg/l	10	15
(xxi)	Selenium	mg/l	0.02	0.5
(xxii)	Barium	mg/l	1.0	2.0
(xxiii)	Flouride	mg/l	2.0	5.0
(xxiv)	Formaldehyde	mg/l	1.0	2.0
(xxv)	Phenol	mg/l	0.001	1.0
(xxvi)	Free Chlorine	mg/l	1.0	2.0
(xxvii)	Sulphide	mg/l	0.50	0.50
(xxviii)	Oil and Grease	mg/l	1.0	10
(xxix)	Ammoniacal Nitrogen	mg/l	10	20
(xxx)	Colour	ADMI*	100	200

ADMI- American Dye Manufactures Institute

2. List of acceptable conditions for discharge of industrial effluent

Extracted from Enviromental Quality (Industrial Effluents) Regulations 2009 (PU (A) 434)

SEVENTH SCHEDULE
(Regulation 12)

ACCEPTABLE CONDITIONS FOR DISCHARGE OF INDUSTRIAL EFFLUENT FOR INDUSTRIAL EFFLUENT CONTAINING CHEMICAL OXYGEN DEMAND (COD) FOR SPECIFIC TRADE OR INDUSTRY SECTOR

(1)	(2)	(3)	(4)
Trade/ Industry	**Unit**	**Standard**	**Standard**
(a) Pulp and paper industry			
(i) Pulp mill	mg/l	80	350
(ii) Paper mill (recycled)	mg/l	80	250
(iii) Pulp and paper mill	mg/l	80	350
(b) Textile industry	mg/l	80	250
(c) Fermentation and distillery industry	mg/l	400	400
(d) Other industries	mg/l	80	200

EIGTH SCHEDULE

(Regulation 13)

ACCEPTABLE CONDITIONS FOR DISCHARGE OF MIXED EFFLUENT CONTAINING CHEMICAL OXYGEN DEMAND (COD)

(1)	(2)	(3)
Unit	**Standard**	**Standard**
	A	**B**
mg/l	80	200

3. List of parameters for discharge of effluent listed in Ninth Schedule

NINTH SCHEDULE
(Regulation 14)
ACCEPTABLE CONDITIONS FOR DISCHARGE OF EFFLUENT OR MIXED EFFLUENT WHICH BEST MANAGEMENT PRACTICE TO BE ADOPTED

(i) Nitrate Nitrogen
(ii) Sulphate
(iii) Chloride
(iv) Cobalt
(v) Detergent, Anionic
(vi) Molybdenum
(vii) Phosphate (as P)
(viii) Polychlorinated Biphenyls
(ix) Beryllium
(x) Vanadium
(xi) Pesticides, fungicides, herbicides, rodenticides, fumigants or any other biocides or any other chlorinated hydrocarbons
(xii) Any substance that either by itself or in combination or by reaction with other waste may give rise to any gas, fume or odour or substance which causes or is likely to cause pollution
(xiii) Total organic carbon
(xiv) Whole Effluent Toxicity (WET)
(xv) Dioxin
(xvi) Endocrine disruptors

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