TRANSFORMING THE WATER SECTOR:

NATIONAL INTEGRATED WATER RESOURCES MANAGEMENT PLAN

STRATEGIES AND ROAD MAP

VOLUME 1 - MAIN REPORT

Transforming the Water Sector:

National Integrated Water Resources Management Plan

Strategies and Road Map

Volume 1 - Main Report

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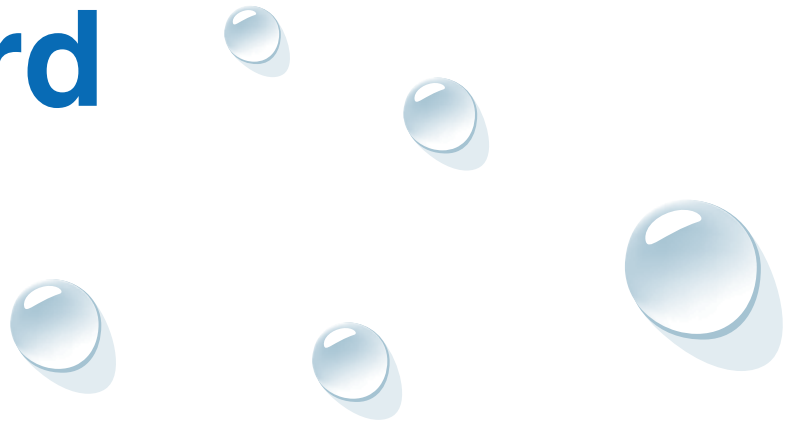
Foreword



The Academy of Sciences Malaysia (ASM), as a thought leader in science, technology, and innovation (STI), strives to address the needs of the nation by providing the best scientific advice and advocacy that is independent, credible, relevant, and timely. In fulfilling this mandate, the Academy engages a wide spectrum of expertise not only within the Academy but also its network and linkages with many prominent international and local partners.

The ASM Water Sector Studies provide comprehensive and strategic STI input to all stakeholders towards a better water future for Malaysia. The release of this Report, entitled *Transforming the Water Sector: National Integrated Water Resources Management Plan: Strategies and Road Map,* is a timely contribution by ASM to assist the government in meeting its commitment to the Sustainable Development Goals (SDGs) announced at the UNSD Summit in September 2015. Among the targets under SDG No. 6 to "Ensure availability and sustainable management of water and sanitation for all" is *Item 6.5* which states that "*By 2030, implement integrated water resources management at all levels, including through trans-boundary cooperation as appropriate*".

The Report also marks the culmination of work of the ASM Water Committee, begun in 2008, following a series of Integrated Water Resources Management (IWRM)-related thematic studies undertaken earlier by designated Task Forces. The outcome of the completed studies formed the central basis to the formulation of this National IWRM Plan (NIWRMP) aimed at bringing all water-related stakeholders nationwide onto a common platform and mission, that is, to ensure the sustainable management of the country's water resources. Business as usual following past fragmented lines must make way to IWRM in seeking integrated solutions to the multiplicity of issues and challenges faced by the water sector. Promoting participatory management and addressing trans-boundary issues through continuing dialogue are all important elements of this paradigm shift towards "making water everybody's business".

Despite the importance of the water sector to the national economy, ASM noted with concern that "water" was not included as a National Key Economic Area (NKEA) under the Economic Transformation Programme. In an attempt to fill the gap arising from the absence of a dedicated NKEA, ASM undertook an in-depth study in

2014 to justify a National Key Priority Area (NKPA) on water complete with a road map. The NKPA now forms an integral part of the "Investments in Water Infrastructure", a crucial element of the NIWRMP.

We are confident that the findings, strategies, and recommendations contained in this report would provide the government and the various Federal and State water authorities concerned with the necessary stimulus to ensure that the transformation of the water sector advances in tandem with other sectors of the economy.

Congratulations to the members of the ASM Water Committee and its various Task Forces for their continued efforts and outstanding contribution towards yet another timely publication of national importance.

Tan Sri Dr Ahmad Tajuddin Ali
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Preface

The Academy of Sciences Malaysia (ASM) has since 2008 paid special focus on the water sector, considered strategic for the country's economic development. A dedicated ASM Water Committee was formed to address the issues facing this sector. Since then a number of water-related thematic studies were undertaken, each led by a Task Force appointed by the Water Committee and led by a Fellow of the Academy with the support from a small team of experts selected from agencies considered relevant to each field of study. The outcome of these thematic studies led to the release of Strategy Plans or Advisory Reports which have since been published and submitted to relevant authorities in government for their consideration and implementation. Some of the reports have been subsequently tabled and endorsed by *Majlis Sumber Air Negara* for implementation by designated lead ministries and State Governments.

This Report, entitled *Transforming the Water Sector: National Integrated Water Resources Management Plan: Strategies and Road Map*, herein referred to as the National Integrated Water Resources Management Plan (NIWRMP), marks the culmination of the earlier efforts. The Report is a synthesis and consolidation of the strategies recommended in the thematic study reports to form an overall strategy plan targeted to assist the government in expediting the implementation of IWRM nationwide through the concerted efforts of all stakeholders involved in the water sector. IWRM is a declared national policy for the sustainable management of its water resources since the late 1990s.

The Report comprises an Executive Summary followed by seven chapters as follows:

Chapter 1 — Evolution of IWRM: The chapter focuses on the global evolution of the IWRM paradigm since the 1970s, its formal adoption at the *1992 Earth Summit* to current day reaffirmation at the *UNSD Summit* in September 2015 when the post-2015 Sustainable Development Goals were announced. The chapter also traces the progress achieved by Malaysia since formal adoption of IWRM at the turn of the century. It includes a listing of initiatives taken in chronological sequence.

***Chapter 2 — ASM and the IWRM Agenda**:* This chapter introduces ASM, its mission, and objectives, before proceeding to describe its special focus studies related to the national IWRM agenda and the processes adopted by the ASM Water Committee in undertaking these studies.

Chapter 3 — Summary Briefs of ASM Component Plan Studies: This chapter is dedicated to reporting on the in-depth studies undertaken by ASM-led Task Forces on ten IWRM-related thematic areas for which summary briefs are reported as appendices.

***Chapter 4 — Complementary Component Plan Studies: Summary Briefs and Expert Reviews**:* The chapter focuses on invited contributions of a further 14 IWRM-related thematic areas from related agencies and subject matter specialists commissioned to review selected topics. These contributions in the form of summary briefs or expert reviews are reported as appendices.

***Chapter 5 — State IWRM Plans - Case Study on Lembaga Urus Air Selangor (LUAS)**:* This chapter covers an overview of the status of IWRM implementation in the states. A summary brief of a case study on LUAS, Selangor is included as an appendix to showcase the progress made in institutionalising IWRM in the state since the formation of LUAS in the year 2000.

***Chapter 6 — National Integrated Water Resources Management Plan**:* This chapter is the centrepiece of the Report. It provides an overview of the Malaysian water scenario, highlighting the issues and challenges, followed by a synthesis of the strategies emerging out of the earlier chapters 3, 4 and 5, organised into a coherent National IWRM Plan following the IWRM General Framework format. The plan comes with a road map for implementation over a 15-year period until 2030.

***Chapter 7 — Conclusions and Recommendations**:* The first part of this chapter comprises a summary overview pertaining to the state of the country's waters. This is followed by a central recommendation for the adoption and implementation of the National IWRM Plan and Road Map. In addition, 24 specific recommendations have been highlighted to ensure that the enabling environment, the institutional framework, management instruments, and investments in water infrastructure are set in place together with a management structure to oversee the implementation of the plan.

A special Editorial Committee was appointed to prepare this consolidated Report comprising the following members:

1. Academician Tan Sri Ir. Shahrizaila Abdullah FASc — Founding Chairperson of the ASM Water Committee;
2. Academician Fateh Chand FASc — Second Chairperson of the ASM Water Committee;
3. Ir. Dr Salmah Zakaria FASc — Current Chairperson of the ASM Water Committee; and
4. P. Loganathan — ASM Research Fellow

The Editorial Committee was chaired by Academician Tan Sri Ir. Shahrizaila Abdullah. Apart from developing an appropriate report structure, the task entailed the compilation

of the outcomes from thematic studies undertaken earlier by the ASM-led Task Forces, contributions from other agencies, and expert reviews. Summary briefs and expert reviews included as appendices against relevant chapters of this Report have been duly accredited to the contributors. The opinions expressed are that of the reviewers and ASM may not fully agree with the views expressed. The focus of the Editorial Committee was mainly devoted to the development of the consolidated NIWRMP (Chapter 6) and the Conclusions and Recommendations (Chapter 7).

On behalf of the Editorial Committee, we take great pleasure in placing on record our deepest appreciation to all the Task Force Chairpersons and Expert Reviewers for their invaluable contributions to enable this publication to be possible. We thank the ASM Secretariat for the continuing administrative support provided at the many meeting sessions and for facilitating the compilation and printing of the Report.

Last but not least, we owe a debt of gratitude to all our members for coming on board and painstakingly working as a team to complete this Report on schedule.

This report is published in 2 volumes, volume 1 comprises the main report while volume 2 contains a set of appendices related to chapters 3, 4, 5 and 6.

Academician Tan Sri Ir. Shahrizaila Abdullah
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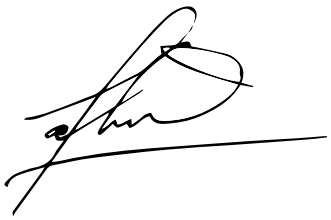

Ir. Dr Salmah Zakaria
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ACRONYMS

AACB	Awareness Raising, Advocacy And Capacity Building
ADB	Asian Development Bank
APWF	Asia Pacific Water Forum
AR5	Fifth Assessment Report
ARI	Average Recurrence Interval
ARSM	*Agensi Remote Sensing Malaysia* (Malaysian Remote Sensing Agency)
ASEAN	Association of Southeast Asian Nations
ASM	Academy of Sciences Malaysia
AWS	Agricultural Water Services
BCM	Billion Cubic Metres
BIMP-EAGA	Brunei Darussalam–Indonesia–Malaysia–The Philippines East Asean Growth Area
BKSA	*Badan Kawal Selia Air* (Water Regulatory Body)
BMP	Best Management Practices
BO	Business Opportunities
BOD	Biochemical Oxygen Demand
BPSP	*Bahagian Pengairan dan Saliran Pertanian* (Agricultural Drainage and Irrigation Division)
CBO	Community-based Organisation
CCIW	Climate Change Impacts on Water
CDD	Community Development Department (*Jabatan Kemajuan Masyarakat* – KEMAS)
CEB	Central Electricity Board
CGIAR	Consultative Group for International Agricultural Research
CSO	Civil Society Organisations
CTP	Community Transformation Programme
CWP	Country Water Partnerships Department of Irrigation and Drainage
DAN	*Dasar Agromakanan Negara* (National Agrofood Policy of Malaysia – NAPM)

DG	Director General
DID	Department of Irrigation and Drainage (*Jabatan Pengaliran dan Saliran* – JPS)
DMG	Department of Minerals and Geoscience
DOA	Department of Agriculture
DOE	Department of Environment
DOF	Department of Fisheries
DSAN	*Dasar Sumber Air Negara* (National Water Services Policy)
DSS	Decision Support Systems
EDC	Endocrine Disrupting Chemicals
EIA	Environmental Impact Assessments
EP	Entry Projects
EPP	Entry Point Project
EPU	Economic Planning Unit
EQA	Environmental Quality Act
ESC	Erosion and Sediment Control
ESCAP	Economic and Social Commission for Asia and The Pacific
ESCP	Erosion and Sediment Control Plan
ETP	Economic Transformation Programme
FAO	Food and Agriculture Organization
FGD	Focus Group Discussions
FOG	Fats, Oil and Grease
FSE	Food Services Establishments
GEC	Global Environment Centre
GNI	Gross National Income
GWA	Ground Water Assessment
GWP	Global Water Partnership
IADA	Integrated Agricultural Development Area
IAHR	International Association for Hydro-Environment Engineering And Research

IAP	Inter-Academy Panel
IASM	Integrated Aquifer System Management
ICID	International Commission on Irrigation and Drainage
ICM	Integrated Catchment Management
ICSU	International Council for Science
ICWE	International Conference on Water and the Environment
ICZM	Integrated Coastal Zone Management
IDM	Integrated Drought Management
IDNDR	International Decade for Natural Disaster Reduction
IFM	Integrated Flood Management
IHP	International Hydrological Programme
IHT	International Herald Tribune
IIGH	International Institute for Global Health
ILBM	Integrated Lake Basin Management
ILEC	International Lake Environment Committee
IMT-GT	Indonesia–Malaysia–Thailand Growth Triangle
INDCs	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
IRBM	Integrated River Basin Management
IUWM	Integrated Urban Water Management
IWA	International Water Association
IWK	Indah Water Konsortium
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
JBA	*Jabatan Bekalan Air* (Water Supply Department – WSD)
JKR	*Jabatan Kerja Raya* (Public Works Department – PWD)
JKT	*Jabatan Kerajaan Tempatan* (Local Government Department)

JMG	*Jabatan Mineral dan Geosains* (Department of Minerals and Geoscience – DMG)
JPBD	*Jabatan Perancangan Bandar dan Desa* (Town And Country Planning Department – TCPD)
KADA	Kemubu Agriculture Development Authorithy
KeTTHA	*Kementerian Tenaga, Teknologi Hijau dan Air* (Ministry of Energy, Green Technology and Water – MEGTW)
KKLW	*Kementerian Kemajuan Luar Bandar dan Wilayah* (Ministry of Rural and Regional Development – MRRD)
KPI	Key Performance Index
LBC	Lake Basin Committee
LESTARI	Institute for Environment and Development
LPP	*Lembaga Pertubuhan Peladang* (Farmers' Organisation Authority – FOA)
LSANK	*Lembaga Sumber Air Negeri Kedah* (Kedah State Water Resources Board)
LUAS	*Lembaga Urus Air Selangor* (Selangor Water Management Authority – SWMA)
MADA	Muda Agriculture Development Authority
MANCID	Malaysian National Committee on Irrigation and Drainage
MCM	Million Cubic Meters
MDKS	*Majlis Daerah Kuala Selangor* (Kuala Selangor District Council)
MENGO	Malaysian Environmental NGO
MET	Meteorological Department
MEWC	Ministry of Energy, Water and Communications
MFT	Malaysia Federal Territories
MHLG	Ministry of Housing and Local Government
MLD	Millions of Litres per Day
MOA	Ministry of Agriculture and Agro-based Industry
MOH	Ministry of Health
MOHE	Ministry of Higher Education

MOSTI	Ministry of Science, Technology and Innovation
MOT	Ministry of Transport
MPIC	Ministry of Primary Industry and Commodities
MPOB	Malaysian Palm Oil Board
MSAN	*Majlis Sumber Air Negara* (National Water Resources Council – NWRC)
MSANg	*Majlis Sumber Air Negeri* (State Water Resources Council – SWRC)
MSMA	*Manual Saliran Mesra Alam* (Urban Storm-water Management Manual)
MUWHLG	Ministry of Urban Wellbeing, Housing and Local Government
MWA	Malaysian Water Association
MWFCD	Ministry of Women Family and Community Development
MWIG	Malaysian Water Industry Guide
MyCapNet	Malaysian Capacity Building Network
MyCDNet	Malaysian Capacity Development Network
MyWP	Malaysian Water Partnership
NAHRIM	National Hydraulics Research Institute of Malaysia
NBOS	National Blue Ocean Strategy
NC2	Malaysia's National Communication No. 2
NEM	New Economic Model
NGO	Non-governmental Organisation
NIWR	National Integrated Water Research
NKEA	National Key Economic Area
NKPA	National Key Priority Area
NPP	National Physical Plan
NRE	Ministry of Natural Resources and Environment
NRLC	National Lake Resource Centre
NRW	Non-revenue Water
NSC	National Steering Committee
NTC	National Technical Committee

NTP	National Transformation Programme
NTS	Natural Treatment Systems
NWQS	National Water Quality Standards for Malaysia
NWRD	National Water Resources Department
NWRDC	National Water Resources Development Council
NWRP	National Water Resources Policy
NWRS	National Water Resources Study
O&M	Operations and Maintenance
OPEX	Operating Expenditure
OPP3	Third Outline Perspective Plan
PAAB	*Pengurusan Aset Air Berhad* (Water Asset Management Company – WAMCO)
PES	Payment for Ecosystem Services
PPCP	Pharmaceuticals and Personal Care Products
PPj	*Perbadanan Putrajaya* (Putrajaya Corporation)
PPP	Public-private Partnership
PWSA	Penang Water Services Academy
R&D	Research and Development
RBIMS	River Basins Information Management System
RBMC	River Basin Management Committees
RBMU	River Basin Management Unit
RNA	Research Needs Assessment
RoL	River of Life
RUU	Rang Undang-Undang
RWP	Regional Water Partnerships
SDG	Sustainable Development Goal
SME	Small- and Medium-enterprises
SOM	Service-oriented Management
SOP	Standard Operating Procedures

SPAN	*Suruhanjaya Perkhidmatan Air Negara* (National Water Services Industry Commission)
SSL	Self-sufficiency Levels
STI	Science, Technology and Innovation
STP	Social Transformation Programme
SWMA	Selangor Waters Management Authority
SWRA	State Water Resources Agencies
SWRE	Sabah Water Resources Enactment
SYABAS	Syarikat Bekalan Air Selangor Sdn Bhd
TMDL	Total Maximum Daily Load
TNB	Tenaga National Berhad
TOT	Training of Trainers
UKM	Universiti Kebangsaan Malaysia
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNCSD	United Nations Conference on Sustainable Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	UN Framework on Climate Change Convention
UNISDR	United Nations International Strategy for Disaster Reduction
UNSD	United Nations Statistics Division
UNU	UN University
VM	Value Management
VW	Virtual Water
WDM	Water Demand Management
WEF	Water, Energy, Food
WEM	Water Engineering and Management
WF	Water Footprint
WFD	Water Framework Directive

WFN	Water Footprint Network
WHO	World Health Organization
WMA	Water Management Authority
WMO	World Meteorological Organization
WQI	Water Quality Index
WRC	Water Research Consortium
WRD	Water Resource Department
WRDC	Water Research and Development Centre
WRM	Water Resources Management
WSIA	Water Services Industry Act
WSM	Water Supply Management
WSP	Water Safety Plans
WSSD	World Summit on Sustainable Development
WSWWM	Water Supply And Wastewater Management
WTP	Water Treatment Plant
WUGs	Water User Groups
WWC	World Water Council

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Executive Summary

Transforming the Water Sector:
National Integrated Water Resources Management Plan:
Strategies and Road Map

The water sector is of strategic importance and vital for the country's economic development. Subscribing to international water-related conventions, Malaysia has, since the turn of the century, formally adopted IWRM as its central paradigm and way forward to ensure the sustainable management of the country's water resources. It marked a clear shift away from past fragmented and sectoral management practices. IWRM is essentially about pursuing balanced development between "Water as a Resource" and "Water for Livelihoods". It is a concept that recognises the symbiotic relationship between land and water. It emphasises good water governance that addresses the six essential pillars of policy, institutions, participation, information, technology, and finance.

ASM and the IWRM Agenda

The Academy of Sciences Malaysia (ASM), the national S&T think tank, in reviewing the current status of the water sector, observed that despite the formal declaration and adoption of the IWRM policy, its implementation to date had yet to gain adequate traction on a national scale. Only minimal and sporadic successes have been reported to date. Fragmented management, a legacy from the past, still prevails at national level and the situation in the states is no better with few exceptions.

In line with its mandate to provide strategic advice on matters of national significance and interest, ASM embarked on this initiative to develop a National IWRM Plan (NIWRMP) for consideration and adoption by government for implementation nationwide. The initiative has become all the more relevant since the launch of the National Transformation Programme (NTP) under the 10th Malaysia Plan and also in view of Malaysia's commitment recently to the post-2015 Sustainable Development Goals (SDGs). The SDGs have targeted to "*implement integrated water resources management at all levels"* by 2030.

Preparing for the Plan

ASM adopted a multi-faceted approach, addressing the status of implementation of IWRM from three perspectives:

(i) *Component Plans by ASM:* ASM undertook critical reviews of some 10 thematic sub-sets or sub-sectors with

a view of infusing IWRM principles and practices into their planning and management operations. Each of these reviews involved extensive stakeholder consultations. The outcome of these component plan reviews led to the publication of strategy plans or advisory reports for submission to relevant authorities as applicable. Some of the reports have subsequently been endorsed by *Majlis Sumber Air Negara* (MSAN) for implementation by the relevant authorities. Below is a summary list of completed ASM component plan reports and their respective status.

Table 1: Completed Component Plan Reports by ASM

No.	Component Plan Report	Date of Completion by ASM	Submission to Lead Implementing Ministry	Endorsement by MSAN where relevant
1	*Integrated Lake Basin Management*	2009	NRE 2010	1 November 2012 (MSAN 07)
2	*Integrated Aquifer Systems Management*	2011	NRE 2012	NA
3	*Water Demand Management*	2016	EPU/NRE/ KeTTHA/ MOA 2016	NA
4	*Water Supply and Wastewater Management*	2016	KeTTHA 2016	NA
5	*National Agenda for Integrated Water Research*	2014	NRE/MOSTI 2015	15 October 2015 (MSAN 10)
6	*Climate Change and Water*	2014	NRE/MOSTI 2015	15 October 2015 (MSAN 10)
7	*Integrated River Basin Management*	2016	NRE	NA
8	*Water and Agriculture*	2016	MOA	NA
9	*NKPA on Water*	2015	NA	NA
10	*ASM Mega Science Study: Water Sector*	2011	Cabinet 2012	NA

NA: Not applicable.

(ii) *Complementary Component Plans Commissioned to Others:* Some 14 other summary briefs and expert reviews, referred to as Complementary Component Plan Reports, were commissioned to other agencies and subject matter specialists on IWRM-related themes and topics also considered relevant. The aim was to expand the synthesised knowledge base to ensure greater comprehensiveness when preparing the proposed NIWRMP.

Appended below is a table showing the list of complementary component plan reports:

Table 2: Complementary Component Plan Reports

No.	Complementary Component Plan Report	Relevance to IWRM	Lead Implementing Ministry/ Authority/Agency
1	*Integrated Flood Management*	Water as a Resource	NRE/State Governments
2	*Integrated Drought Management*	Water as a Resource	NRE/State Governments
3	*Water Quality Management*	Water as a Resource	NRE/State Governments
4	*Water and Land Use (National Physical Plan)*	Water as a Resource (*addressing trans-boundary issues*)	MUWHLG/ State Governments
5	*Water and Health*	Water as a Resource and for Livelihood	MOH/State Governments
6	*Water and Green Growth*	Water as a Resource and for Livelihood	KeTTHA/NRE/MOA/ State Governments
7	*Water and Gender*	Water as a Resource and for Livelihood	NRE/KeTTHA/MWFCD/ MOA/MPIC/MOSTI/ MUWHLG/MRRD/MOHE/ MOH/State Governments
8	*Virtual Water and Water Footprint*	Water as a Resource and for Livelihood	EPU/NRE/KeTTHA/ MOA/MPIC/FMM/ State Governments
9	*Water Financing*	Water as a Resource and for Livelihood	EPU/MOF/State Governments
10	*Water-Energy-Food Nexus*	Water as a Resource (*addressing trans-boundary issues*)	EPU/NRE/MOA/ KeTTHA/State Governments
11	*S&T Awareness, Advocacy and Capacity Building*	Water as a Resource and for Livelihood	NRE/KeTTHA/MOA/ MPIC/MOSTI/ MUWHLG/MRRD/ MOHE/State Governments
12	*International Networking and Collaboration*	Water as a Resource and for Livelihood	NRE/KeTTHA/MOA/MPIC/ MOSTI/MUWHLG/ MRRD/ MOHE/ State Governments
13	*Integrated Urban Water Management*	Water as a Resource and for Livelihood	MUWHLG/ State Governments
14	*NWRP Action Plan*	Water as a Resource and for Livelihood	NRE/State Governments

(iii) *State IWRM Plans:* A third important area of focus was an assessment of the extent to which the states have committed and progressed in implementing IWRM. Especially so, with regard to management of water resources since ownership of this resource, just like land, is vested with the State Governments as provided for under the Federal Constitution. The assessment showed great variance among the states.

Only three states (Sabah, Selangor, and Kedah) are currently equipped with the legal and institutional framework to enable the effective application of IWRM principles and practices, an essential prerequisite for the implementation of IRBM following MSAN's directive as far back as the year 2002. Selangor has taken great strides since the establishment of *Lembaga Urus Air Selangor* (LUAS) in the year 2000. It has been able to institutionalise IWRM in all its programmes and activities. ASM did not venture to make a detailed assessment of each state but instead did a case study on LUAS, highlighting the proactive actions taken to implement IWRM which included the development and implementation of an IWRM Strategy Plan for Selangor projected until the year 2030. A summary brief of this LUAS initiative is included under Chapter 5 of this Report to enable other states to use this case study to build on and develop similar State IWRM Plans for concurrent implementation.

National IWRM Plan: Strategies and Road Map

The Plan is a synthesis of the strategies recommended in each of the component and state plans described above. The Road Map is for implementation over a 15-year time frame spanning three Malaysia Plans until 2030, the target year set by UN for the realisation of the SDGs. The recommended strategies have been organised following the IWRM General Framework. They are attached as appendices under four discrete elements as follows:

i. Enabling environment (Appendix 1);
ii. Institutional framework (Appendix 2);
iii. Management instruments (Appendix 3); and
iv. Investments in water infrastructure (Appendix 4).

Recommendations

It is recommended that:

1) The transformation of the Malaysian water sector for a better future be anchored by the adoption and implementation of NIWRMP. The NIWRMP would provide the correct stimulus to ensure that the transformation of the sector advances in tandem with other sectors of the economy identified earlier as NKEAs under the ETP.

2) Component plans and programmes included in this report be implemented concurrently nationwide and led by the key ministries identified in the plan according to their entrusted responsibilities, be it under "water resource management" or "water utility provision".

Enabling Environment

3) An overarching National Integrated Natural Resources Policy (NINRP) be formulated by the NRE Ministry on a priority basis that ensures the integrity and symbiotic relations among water, land, forests, minerals and rock materials, inland fisheries and marine parks, wildlife and the environment are safeguarded at all hierarchical levels.

4) A common policy framework governing the water-energy-food nexus be formalised to ensure balanced development and progress in meeting water security, food security, and energy security targets.

5) The *Dasar Agromakanan Negara* (DAN) 2011–2020 be reviewed to stress the importance of water as a critical component for crop development and for attaining optimal yields through sound water management.

6) A National IRBM Policy to complement NWRP 2012 be promulgated to ensure sound water resource management at the river basin level that addresses equitable water allocation, trans-boundary issues, stakeholder consultation, priority setting, and conflict resolution.

7) A National Water Supply Services Policy to encompass both consumptive and non-consumptive water uses be formulated to complement the NWRP 2012.

8) The legislation of a common National Water Resources Act replacing the outdated Waters Act 1920, should be expedited to ensure uniformity in application by all states with the states enacting corresponding state enactments/ordinances. With the availability of the relevant state laws, this will facilitate water resource management since ownership of water is vested with the states.

Enabling Environment (Contd.)

9) A contemporary Agricultural Water Services (AWS) Act be legislated to replace the outdated Irrigation Areas Ordinance 1953 and the Drainage Works Ordinance 1954.

10) The Streets, Drainage, and Building Act 1974 be reviewed to incorporate IUWM principles and practices to ensure more holistic management of urban drainage.

11) In keeping with current norms, Federal finances be provided to fund programmes and activities such as water resources assessment; information management; river basin and coastal zone management planning; integrated water R&D; awareness raising, advocacy and capacity building; and mitigation of water-related hazards (such as floods, droughts, tsunamis, coastal erosion, and landslides). Water supply services for all uses are on the Concurrent List making them eligible for funding from both Federal and State resources.

12) Ecosystem rehabilitation and restoration measures be included in the list of Federal funded activities.

Institutional Framework

13) To complement MSAN, a second-tier leadership, the National Steering Committee (NSC) on IWRM, be established, jointly chaired by the KSU of NRE and KeTTHA with membership comprising KSUs of the other water-related ministries and State Secretaries. The NSC would oversee the coordinated implementation of the national IWRM agenda nationwide. The NSC shall be supported by a National Technical Committee, jointly chaired by the DG of DID and the CEO of SPAN with members comprising the DGs of other water-related departments and agencies.

11) State administrations establish urgently the legal and institutional framework in support of MSANg or its equivalent. They are also encouraged to develop State IWRM Plans on a priority basis for implementation concurrently with the NIWRMP.

15) The NSC jointly managed by KeTTHA, MOH, NRE, and MSANg be formed to oversee the development of a Water Safety Master plan and its implementation nationwide. This recommendation is in line with the World Health Organization requirements that Water Safety Plans addressing from “source to tap” be implemented to ensure safe drinking water.

Institutional Framework (Contd.)

16) Intra-ministerial integration be expedited, among which are:
   (i) The merger of surface water management (currently under DID) and groundwater management (currently under a division of JMG) to become a single agency under the NRE Ministry and designated as the Department of Water Resources;
   (ii) The integration of water supply and sewerage services at KeTTHA to ensure holistic management of water and wastewater; and
   (iii) The institutionalisation of demand management in all water-related institutions to trigger a cultural shift from hitherto water supply management to more water demand management.

17) With the passing of the proposed AWS Act, it would necessitate the reinstatement of a dedicated department for AWS under MOA with adequate capacity to deal with the challenges of a revitalised agricultural sector that is able to support agribusiness while permitting and regulating private sector involvement as AWS Providers or Operators.

Management Instruments

18) A centrally managed IWRM database be established at the NRE Ministry built around the 189 river basins as its platform for the collation and dissemination of all water-related data and information for open access. The central repository shall be appropriately linked with customised systems that are already in place for sectoral use. This is in line with MSAN 02 directive for adoption of IRBM nationwide.

19) Reinforced by effective legislation, the use of economic, financial and technical instruments be strategically applied to mitigate degradation of the water resource and to enhance accountability and efficiency in water use.

20) The findings and recommendations, as listed in the ASM Report entitled *Setting a National Agenda for Integrated Water Research in Malaysia*, completed in 2014 and endorsed by MSAN 10 for implementation by the NRE as the lead ministry, be implemented on a priority basis including a review of the governance structure based on the options proposed by the Report. The appropriation of adequate human and financial resources is equally vital.

Management Instruments (Contd.)

21) Green growth through the application of the 3Rs and the use of WDM instruments be pursued actively to ensure a cultural shift from WSM to WDM while also ensuring that WSM embraces green building codes and use green processes and products.

22) NRE, KeTTHA, MOA, and water operators pool their resources to establish and manage one-stop training centres at national level and in all states that offer integrated modules on awareness raising, advocacy, and capacity building to cater for all target groups, ranging from public, private and community stakeholders to political leaders who play an important advocacy role. Success of the national IWRM agenda over the long term requires a mindset change to ensure that "water is everybody's business".

Investments in Water Infrastructure

23) Investments in water infrastructure contained in Appendix 6.4 be urgently incepted to cater for the national water sector needs and to spur the transformation of the water sector. A summary list of the 15 programmes is shown in Table 3. A total of 95 EPPs have also been identified for implementation against these programmes.

Table 3: List of Programmes for Investments in Water Infrastructure

INVESTMENTS IN WATER INFRASTRUCTURE	
A. Cross-cutting Programmes (14 EPPs)	
1. Central Water Resources Database 2. Integrated Water Research 3. Climate Change Adaptation 4. Awareness Raising, Advocacy, Capacity Building 5. Meetings, Incentives, Conference, and Exhibition	
B. Programmes related to "Water as a Resource" (48 EPPs)	**C. Programmes related to "Water for Livelihood" (33 EPPs)**
1. Integrated River Basin Management and Integrated Aquifer Systems Management 2. Water-related Hazards 3. Ecosystem Services 4. Water Pollution Monitoring and Rehabilitation 5. Water-based Recreation and Tourism	1. Development of Alternative Water Sources 2. Water Supply and Wastewater Services Sector 3. Energy Sector 4. Agricultural Water Services 5. Commercial Water to Shipping

NIRWRM Plan Implementation Management Structure

24) A management structure for the implementation of the Plan be established as follows:

a) The Plan shall be managed nationally at the highest political level by MSAN which has the NRE and KeTTHA as its Joint Secretariat. Correspondingly, at respective state levels, it would be MSANg or its equivalent.

b) The NSC, comprising the KSUs of all water-related ministries and the State Secretaries, shall oversee the implementation of the Plan. KSUs of NRE and KeTTHA shall be the joint Chairpersons of the NSC. An independent advisory panel will assist the NSC in providing critical reviews of programmes & activities.

c) A dedicated IWRM Implementation Unit (IWRM-IU), headed by a senior executive well versed on IWRM, be established that would be responsible to ensure the timely and coordinated implementation of the Plan. The IWRM-IU would report to the NSC and serve as its Secretariat. It should also monitor on a regular basis the implementation programme at all hierarchical levels.

d) At the state level the MSANg or its equivalent would undertake the role of overseeing the implementation in the state, with its implementation arm being the Office of the Director WMA/Water Resources as applicable for each state.

e) A National Technical Committee (NTC) be formed reporting to NSC comprising the heads of water-related departments and agencies. They would meet frequently to resolve technical issues and assist in streamlining operational matters. It would be jointly chaired by the DG of DID and the CEO of SPAN.

Championing the National IWRM Agenda

25) The Hon. Ministers of NRE, KeTTHA, and MOA should take on the mantle in the true spirit of IWRM to jointly "champion" this "NIWRMP" initiative and the transformation process.

Appendix 1. Summary of NIWRM Strategy Plan and Implementation Road Map: Enabling Environment

Category	Water as a Resource				Water for Livelihood			
	Strategy	Lead Authority/ Collaborating Agencies	Target Completion	Remarks	Strategy	Lead Authority/ Collaborating Agencies	Target Completion	Remarks
POLICY	1. National Integrated Natural Resources Policy	NRE and all State Goverments	11MP	NR — Land, Water, Forests, Inland Fisheries, Marine Parks, Wildlife, Minerals, and Rock Materials. An overarching policy to address trans-boundary issues and linkages	1. Review *Dasar AgroMakanan Negara* (2011–2020)	MOA and line agencies	11MP	Review policy to emphasise the importance of water in agricultural development and optimum yield attainment
	2. WEF Nexus Policy Framework	EPU, MOA, NRE, KeTTHA, State Governments	11MP	Setting an optimal balance with regard to Water Security, Food Security, and Energy Security	2. National Integrated Water Supply Services Policy	KeTTHA, MOA, NRE, MOTAC, MOT, MHLG, MFT, MOH, State Governments, line agencies, and water operators	11MP	Policy to encompass both consumptive use (domestic and industrial, agriculture, ecosystem regulating services), and non-consumptive use (hydropower, recreation, tourism, and navigation)
	3. National Water Resources Policy	NRE and all State Governments	NIL	Launched in March 2012. Now awaiting adoption by states				
	4. Integrated River Basin Management Policy	NRE and all State Governments	11MP	Lentic and lotic systems management inclusive of ICM, IDM, IFM, ILBM, IASM, IUWM, and ICZM				

Appendix 1. Summary of NIWRM Strategy Plan and Implementation Road Map: Enabling Environment (continued)

Category	Water as a Resource				Water for Livelihood			
	Strategy	Lead Authority/ Collaborating Agencies	Target Completion	Remarks	Strategy	Lead Authority/ Collaborating Agencies	Target Completion	Remarks
LEGISLATION	1. National Water Resources Act	NRE, all State Governments, and MFT	11MP	To replace outdated Waters Act 1920	1. WSIA 2006 and SPAN 2006	KeTTHA, SPAN, line agencies, and water operators	11MP	Currently Peninsular Malaysia and Labuan. Consider extending legislation to Sabah and Sarawak
	2. State Water Resources Enactments	MSANg or equivalent and relevant state agencies	11MP	In states that have yet to pass new legislation	2. Promulgate Agricultural Water Services Act	MOA and line agencies	11MP	To replace out-dated Irrigation Areas Ordinance 1953 and the Drainage Works Ordinance 1954, Drainage and Irrigation Ordinance Sabah
	3. Review Streets, Drainage and Buildings Act 1974	MUWHLG and relevant local authorities	11MP	To incorporate Integrated Urban Water Management principles and practices. Consider also extending to Sabah and Sarawak	3. Safe Drinking Water Act	MOH and KeTTHA	11MP	Review the standards of drinking water
	4. Review EQA 1974	NRE, DOE, and respective Sabah and Sarawak agencies	11MP	To strengthen DOE's ability to take punitive actions against all polluters	4. AWS Enactment	All State Governments	11MP	Adoption of AWS Act and passing of enactment for state application repealing existing ordinances

Appendix 1. Summary of NIWRM Strategy Plan and Implementation Road Map: Enabling Environment (continued)

Category	Water as a Resource				Water for Livelihood			
	Strategy	**Lead Authority/ Collaborating Agencies**	**Target Completion**	**Remarks**	**Strategy**	**Lead Authority/ Collaborating Agencies**	**Target Completion**	**Remarks**
REGULATIONS	1. Rules for specific purpose management of: • Catchment Areas • Rivers and Lakes • Groundwater • Coastal Zone • Estuaries • Navigation	MSANg or equivalent authorities and state line agencies	11MP	Agencies responsible need to develop appropriate rules to govern/manage these areas	1. Rules for specific application pertaining to potable Water Supply and Sewerage Services	SPAN and water operators	11MP	Agencies responsible need to develop appropriate rules to govern/ manage these areas. Sewerage services to include sullage. Consider extending to Sabah and Sarawak
					2. Rules for specific application pertaining to AWS	MOA and line agencies	11MP	Agencies responsible need to develop appropriate rules to govern/ manage these areas

Appendix 1. Summary of NIWRM Strategy Plan and Implementation Road Map: Enabling Environment (continued)

Category	Water as a Resource				Water for Livelihood			
	Strategy	**Lead Authority/ Collaborating Agencies**	**Target Completion**	**Remarks**	**Strategy**	**Lead Authority/ Collaborating Agencies**	**Target Completion**	**Remarks**
FINANCE	1. Federal funding to continue on following activities: • Water resources assessment; • Information management; • River basin and coastal zone management planning; • Integrated water R&D; • Awareness raising, advocacy and capacity building; • Mitigation of water-related hazards (such as floods, droughts, tsunamis, coastal erosion and landslides); and • Ecosystem rehabilitation and restoration	NRE and all States Governments	11MP and beyond	Funding from yearly OPEX and allocation from 11MP and beyond	1. Federal funding to continue for those states that have migrated. Funding discussions need to be continued for those states that have yet to migrate	KeTTHA, SPAN, and water operators	11MP and beyond	Funding from yearly OPEX and allocation from 11MP and beyond
					2. Federal funding for AWS to continue in all agricultural areas	MOA and line agencies	11MP and beyond	Funding from yearly OPEX and allocation from 11MP and beyond

Appendix 2. Summary of NIWRM Strategy Plan and Implementation Road Map: Institutional Framework

Hierarchical Level	Water as a Resource				Hierarchical Level	Water for Livelihood			
	Strategy	Lead Authority/ Implementing Agencies	Target Completion	Remarks		Strategy	Lead Authority/ Implementing Agencies	Target Completion	Remarks
NATIONAL	1. *Majlis Sumber Air Negara*—(Existing)	NRE, KeTTHA, Water-related ministries, and all State Governments	Established 1998	Apex body on WR Management Chaired by DPM	NATIONAL	1. National Steering Committee on Water Safety	KeTTHA and MOH/ NRE, MSANg or equivalent	11MP	Jointly managed by KeTTHA, MOH, NRE and MSANg or equivalent
	2. National Steering Committee on IWRM—(New)	NRE, KeTTHA, Water-related ministries, and MSANg or equivalent	11MP	Oversee the coordinated implementation of the IWRM agenda nationwide.		2. Water Supply and Sewerage Services Department	KeTTHA, SPAN, water supply and sewerage operators	11MP	To ensure holistic management of water and wastewater under KeTTHA
	3. National Technical Committee—(New)	DID and SPAN/ line agencies	11MP	Resolve technical issues and assist in streamlining operational matters		3. Agricultural Water Services Department	MOA/ BPSP (MOA), KADA, MADA, and IADA	11MP	Dedicated department for AWS under MOA thereby replacing current BPSP
	4. Department of Water Resources—(Restructured)	NRE	11MP	Merger of current DID and Groundwater division under JMG		4. Water Demand Management Division in all Federal water supply service agencies	MOA, KeTTHA, NRE, line agencies, MSANg or equivalent	11MP	Consistent with WDM report recommendations, a division devoted to ensure water for environmental needs be incorporated
	5. National Water Research and Development Centre—(New)	NRE	11MP	Statutory body to act as clearing house and one-stop centre for all water R&D					
	6. National IWRM Training Centre—(New)	NRE, MOA, KeTTHA and water operators/line agencies	11MP and beyond	Inter-Ministry Consortium to set up One-stop Training Centres at national and state levels					

Appendix 2. Summary of NIWRM Strategy Plan and Implementation Road Map: Institutional Framework (continued)

Hierarchical Level	Water as a Resource				Hierarchical Level	Water for Livelihood			
	Strategy	Lead Authority/ Implementing Agencies	Target Completion	Remarks		Strategy	Lead Authority/ Implementing Agencies	Target Completion	Remarks
STATE	1. *Majlis Sumber Air Negeri*	MSANg or equivalent/ Implementing Arm	11MP	MSAN 08 directive. Exceptions—LUAS, Sabah SWRC, and LSANK already in existence. Ensure dedicated section to address water for environmental needs under its implementing agency	STATE	1. Agricultural Water Services Department (AWSD)	State Governments	11MP	Realignment of current State DID
						2. AWS divisions in IADAs	MOA	11MP	To be renamed AWS from Project Engineer's Office
						3. Water Demand Management Section in all State water supply service agencies and water operators	All State Governments	11MP	Institutionalising WDM
	2. State IWRM Technical Committee	State Governments and UPEN	11MP	Chaired by UPEN to oversee implementation of State IWRM programmes. Implemented in Selangor					
RIVER BASIN	1. River Basin Committees	MSANg or equivalent/ Implementing Arm	11MP and beyond	Individual RBC or for a cluster of RBs. Dedicated unit to address water for environmental needs to be incorporated	DISTRICT/ RESIDENCY	1. Agricultural Water Services Department	State Governments and State AWS	11MP	Realignment of current District DID
						2. Water Demand Management Units in water supply service agencies and water operators	State Governments, Water supply agencies, and Water operators	11MP	Institutionalising WDM
LOCAL	1. Local Action Community-based groups	MSANg or equivalent/ Implementing Arm	11MP and beyond	Facilitated by RBCs with support from NGOs to advance participatory management	LOCAL	1. Water User Groups	State Governments and line agencies	11MP	Consumers, Farmers, etc.

Appendix 3: Summary of NIWRM Strategy Plan and Implementation Road Map: Management Instruments

Category	Water as a Resource				Category	Water for Livelihood			
	Strategy	Lead Authority/ Implementing Agencies	Target Completion	Remarks		Strategy	Lead Authority/ Implementing Agencies	Target Completion	Remarks
1. Information Management	1. Central IWRM database	NRE/ Line agencies	11MP and beyond	Built around the 189 river basins as its platform. Linked with sectoral customised systems	1. Information Management	1. Decicated IMS for water supply and sewerage services	KeTTHA, Sabah and Sarawak State Governments/ Line agencies	11MP and beyond	To include real-time information on source pollution, breakdowns, interruption of supply, and leakage detected
	2. IWRM Tool Box	NRE/ Line agencies	11MP and beyond	Styled on similar lines as the GWP IWRM Tool Box					
	3. State of the Waters Annual Report	NRE/ Line agencies	11MP and beyond	Annually or at least triennially		2. Dedicated IMS for Agriculture Water Supply Services	MOA	11MP and beyond	To include real-time info during prolonged drought or floods causing crop damage
2. Planning	1. Foresight studies on IWRM and its sub-sets	NRE/ Line agencies	11MP and beyond	NRE to lead such studies nationwide	2. Planning	1. Develop alternative water supply sources of water supply	KeTTHA, MOA and NRE, Sabah and Sarawak State Goverments	11MP	Joint action to develop alternative sources of water supply for use singly or conjunctively with surface water
	2. Development of management guidelines	NRE/ Line agencies	11MP and beyond	NRE/DID to prepare management guidelines through stakeholder consultations					
	3. River Basin Studies and Management Plans	NRE/ Line agencies	11MP and beyond	NRE/DID to undertake such studies and prepare RB management Plans nationwide		2. Evaluate Centralised versus Decentralised Wastewater Treatment System	KeTTHA / Line agencies	11MP	Joint action on study nationwide in collaboration with agencies in Sabah and Sarawak.
						3. Review Scope and Coverage of Sewerage Services to ensure proper management of STP effluent	KeTTHA	11MP	Joint action on study nationwide in collaboration with agencies in Sabah and Sarawak

Appendix 3: Summary of NIWRM Strategy Plan and Implementation Road Map: Management Instruments (continued)

Category	Water as a Resource				Category	Water for Livelihood			
	Strategy	Lead Authority/ Implementing Agencies	Target Completion	Remarks		Strategy	Lead Authority/ Implementing Agencies	Target Completion	Remarks
3. Economic and Financial Instruments	1. Payment for ecosystem services	NRE/ MSANg or equivalent	11MP and beyond	NRE/State Water Authorities to develop PES Models and appropriate legislation for respective States	3. Economic and Financial Instruments	1. Incentive schemes to encourage the use of water saving devices or systems; and to encourage the use of alternate water resources	KeTTHA, MOA, Sabah and Sarawak State Governments/ Line agencies	11MP and beyond	Use of WDM instruments to reduce water usage
	2. Application of "polluter pays" principle	NRE/ MSANg or equivalent	11MP and beyond	NRE/State Water Authorities to develop appropriate legislation for respective States		2. Cost recovery of services with provisions for targeted subsidies	KeTTHA, MOA, Sabah and Sarawak State Governments/ Line agencies	11MP and beyond	Cost recovery in stages
	3. Uniform Pricing Model for Water Resources	MSAN and NRE	11MP and beyond	NRE/State Water Authorities to develop uniform Pricing Models and appropriate legislation		3. Equitable tariff setting	KeTTHA, MOA, Sabah and Sarawak State Governments	11MP and beyond	KeTTHA/ MOA, Sabah and Sarawak State Governments to seek uniformity in tariff setting

Appendix 3: Summary of NIWRM Strategy Plan and Implementation Road Map: Management Instruments (continued)

Category	Water as a Resource				Category	Water for Livelihood			
	Strategy	Lead Authority/ Implementing Agencies	Target Completion	Remarks		Strategy	Lead Authority/ Implementing Agencies	Target Completion	Remarks
4. Legal (Licenses and Penalties)	1. Enforcement of water-related laws and regulations	MSANg or equivalent/ Implementing Arm	11MP and beyond	NRE/Peninsular States/Sabah/ Sarawak authorities to ensure strict enforcement nationwide	4. Legal (Licenses and Penalties)	1. Enforcement of water supply and sewerage services related laws and regulations	KeTTHA/ Line agencies	11MP and beyond	SPAN to work with appropriate authorities in Sabah and Sarawak to ensure strict enforcement nationwide
						2. Gazetting of AWS areas and enforcement of associated legislation and regulations	MOA/ Line agencies	11MP and beyond	Proposed AWSD (MOA) to work with state AWSD and IADAs
5. Technical Instruments	1. Buffer zones around water bodies 2. Interceptor buffers along rivers 3. Artificial Wetlands 4. River Bank Filtration 5. Protection of groundwater recharge areas	MSANg or equivalent/ Implementing Arm	11MP and beyond	Gazette buffer and inceptor zones, protection of groundwater recharge areas, artificial Wetlands, and undertake River Bank Filtration studies	5. Technical Instruments	1. Water conservation measures	KeTTHA, MOA, MUWHLG, Sabah and Sarawak State Governments/ Line agencies	11MP and beyond	1. KeTTHA/MOA to incentivise measures such as water reuse, water recycling, use of water saving devices (including retrofitting), leakage control, and rainwater harvesting
						2. Modify agronomic practices	MOA	11MP and beyond	2. MOA continue to undertake and explore practices such as adjustment of cropping patterns; adoption of dry-seeding techniques in paddy planting; and choice of less thirsty crop varieties

Appendix 3: Summary of NIWRM Strategy Plan and Implementation Road Map: Management Instruments (continued)

Category	Water as a Resource				Category	Water for Livelihood			
	Strategy	**Lead Authority/ Implementing Agencies**	**Target Completion**	**Remarks**		**Strategy**	**Lead Authority/ Implementing Agencies**	**Target Completion**	**Remarks**
6. Operation and Maintenance	1. Periodic review of river basins to ensure equitable water allocation, accountability and regular audit	MSANg or equivalent/ Implementing Arm	11MP and beyond	To ensure the security, integrity, resilience and safety of water-related systems	**6. Operation and Maintenance**	1. Implementation of WSPs nationwide	KeTTHA, MOH, Sabah and Sarawak State Governments	11MP and beyond	KeTTHA/MOH, Sabah and Sarawak State Governments to implement WSPs based on WHO guidelines
						2. Development of SOPs for all process-related operations	KeTTHA, MOA, Sabah and Sarawak State Governments	11MP and beyond	KeTTHA/ SPAN/MOA in collaboration with Sabah and Sarawak State Governments to develop SOPs
						3. Reduction of water losses: a. NRW under potable water supply; and	KeTTHA, Sabah and Sarawak State Governments	11MP and beyond	KeTTHA/SPAN/ State Water Authorities to enhance efforts to reduce NRW nationwide
						b. Reticulation system losses in Agricultural Water Supply	MOA, Sabah and Sarawak State Governments	11MP and beyond	MOA to enhance efforts to reduce system losses nationwide
						4. Development of maintenance manuals for all operational systems	KeTTHA, MOA, Sabah and Sarawak State Governments	11MP and beyond	Develop appropriate manuals for distribution to all water supply and waste water operators

Appendix 3: Summary of NIWRM Strategy Plan and Implementation Road Map: Management Instruments (continued)

Category	Water as a Resource				Category	Water for Livelihood			
	Strategy	**Lead Authority/ Implementing Agencies**	**Target Completion**	**Remarks**		**Strategy**	**Lead Authority/ Implementing Agencies**	**Target Completion**	**Remarks**
					6. Operation and Maintenance	5. SOPs to address emergencies such as breakdown of water supply, pollution of water sources, floods, droughts, and water-borne diseases	KeTTHA, MOA, Sabah and Sarawak State Governments	11MP and beyond	KeTTHA/MOA/ NRE/MOH to jointly develop SOPs for nationwide application
7. Participatory Management	1. Community participation in lakes and rivers watch programmes	MSANg or equivalent/ Implementing Arm	11MP and beyond	Working with NGOs nationwide to develop such participatory management groups	**7. Participatory Management**	1. Engaging the consumers/ farmers and the public in Water Conservation Initiatives	KeTTHA/ MOA, Sabah and Sarawak State Governments	11MP and beyond	KeTTHA to further enhance role of *Forum Air* so that it is able to play its role effectively and efficiently. MOA to engage and involve farmers and farm operators in planning, and O&M activities
8. R&D	Integrated Water Research in line with ASM report *Setting a National Agenda for Integrated Water Research in Malaysia*	NRE/ NWRDC	11MP and beyond	NRE/ NAHRIM to initiate the establishment of the National Water Research and Development Centres; NAHRIM/ WRC in the interim	**8. R&D**	Integrated Water Research based on ASM report *Setting a National Agenda for Integrated Water Research in Malaysia*	KeTTHA/ MOA/ NWRDC	11MP and beyond	KeTTHA/MOA to hold discussions with NAHRIM/WRC in the interim

Appendix 3: Summary of NIWRM Strategy Plan and Implementation Road Map: Management Instruments (continued)

Category	Water as a Resource				Category	Water for Livelihood			
	Strategy	**Lead Authority/ Implementing Agencies**	**Target Completion**	**Remarks**		**Strategy**	**Lead Authority/ Implementing Agencies**	**Target Completion**	**Remarks**
9. Awareness, Advocacy and Capacity Building	1. Holistic training to O&M personnel comprising a blend of a common IWRM modules and specialised training pertaining to resource management 2. IWRM Awareness and participatory modules targeted at NGOs, and CBOs 3. Advocacy modules on IWRM tailored at political leaders	Inter-Ministerial Consortium/ National IWRM Training Centre	11MP and beyond	Inter-Ministerial Consortium and operators to undertake appropriate training courses for wide-ranging stakeholders nationwide	**9. Awareness, Advocacy and Capacity Building**	1. Holistic training to O&M personnel comprising a blend of a common IWRM modules and specialised training pertaining to respective utility service provision 2. WDM and participatory management modules targeted at NGOs, and CBOs 3. Advocacy modules on WDM for political leaders	Inter-Ministerial Consortium/ National IWRM Training Centre	11MP and beyond	Inter-Ministerial Consortium and operators to undertake appropriate training courses for wide-ranging stakeholders nationwide

Appendix 3: Summary of NIWRM Strategy Plan and Implementation Road Map: Management Instruments (continued)

Category	Water as a Resource				Category	Water for Livelihood			
	Strategy	Lead Authority/ Implementing Agencies	Target Completion	Remarks		Strategy	Lead Authority/ Implementing Agencies	Target Completion	Remarks
10. International Collaboration	1. Networking with regional and international institutions 2. Strategic alliances with renowned regional and international water research, and training centres 3. Regular participation in reputed water-related international water fora	NRE and State Governments/ Line agencies NWRDC/ IWRM Training Centre NRE and State Governments/ Line agencies	11MP and beyond	NRE and State Governments to enhance international networking and linkages on common subject matter focus areas	10. International Collaboration	1. Networking with regional and international institutions 2. Strategic alliances with renowned regional and international water research and training centres 3. Regular participation in reputed water-related international water fora	KeTTHA, MOA, State Governments KeTTHA, MOA, State Governments KeTTHA, MOA, State Governments	11MP and beyond	KeTTHA, MOA, and all State Governments to enhance international networking and linkages on common subject matter focus areas

Appendix 4. Summary of NIWRM Strategy Plan and Implementation Road Map: Investments in Water Infrastructure

Cross-cutting Programmes (14 EPPS)				
Item	**Water Infrastructure Development Programme**	**Lead Implementing Agency**	**Target Completion**	**Remarks**
1	Central Water Resources Database (1 EPP)	NRE	11MP and beyond	• All 189 river basin data to be deposited in the central database • To be populated based on a priority of river basins • Linked to all water-related Ministries
2	Integrated Water Research (3 EPPs)	NRE/NAHRIM	11MP and beyond	• Water Research Consortium is an interim measure comprising of NAHRIM, 20 IHLs and RIs until establishment of proposed NWRDC
3	Climate Change Adaptation (4 EPPs)	NRE	11MP and beyond	• All relevant ministries, agencies, and all State Governments
4	Awareness Raising, Advocacy, Capacity Building (3 EPPs)	NRE	11MP and beyond	• Inter-Ministerial Consortium
5	Meetings, Incentives, Conference, and Exhibition (3 EPPs)	NRE	11MP and beyond	--

Water as a Resource (48 EPPs)			
Item	**Water Infrastructure Development Programme**	**Lead Authority/ Implementing Agencies**	**Target Completion**
1	a. IRBM (4 EPPs) i. ICM (1 EPP) ii. ILBM (8 EPPs) iii. ICZM (6 EPPs) iv. IUWM (5 EPPs) b. IASM (3 EPPs)	NRE NRE NRE NRE MUWHLG NRE	11MP and beyond

Water for Livelihood (33 EPPs)			
Item	**Water Infrastructure Development Programme**	**Lead Implementing Agency**	**Target Completion**
1	Development of Alternative Water Sources a.Consumptive Use i. Groundwater (1 EPP) ii. Rainwater Harvesting (1 EPP) iii. Wastewater Reuse / Recycling (1 EPP) iv. Storage of unregulated flows (1 EPP) v. Desalination of Brackish/Saline Water (1 EPP) b. Non-consumptive Use i. Hydropower Development (1 EPP) ii. Fisheries (1 EPP) iii. Recreation and Tourism (1 EPP)	NRE, KeTTHA, MOA, MUWHLG, MOTAC, MOT	11MP and beyond

Appendix 4. Summary of NIWRM Strategy Plan and Implementation Road Map: Investments in Water Infrastructure (continued)

Water as a Resource (48 EPPs)				Water for Livelihood (33 EPPs)			
Item	**Water Infrastructure Development Programme**	**Lead Implementing Agency**	**Target Completion**	**Item**	**Water Infrastructure Development Programme**	**Lead Implementing Agency**	**Target Completion**
2	Water-related Hazards (1 EPP) a. Flood Mitigation (4 EPP) b. Drought Mitigation (1 EPP) c. Tsunami Readiness (1 EPP) d. Landslides and Sinkholes Mitigation (1 EPP)	NRE	11MP and beyond	2	Water Supply and Wastewater Services Sector (12 EPPs)	KeTTHA	11MP and beyond
3	Ecosystem Services (4 EPPs)	NRE	11MP and beyond	3	Energy Sector (2 EPPs)	KeTTHA	11MP and beyond
4	Water Pollution Monitoring and Rehabilitation (6 EPPs)	NRE	11MP and beyond	4	Agricultural Water Services (6 EPPs)	MOA	11MP and beyond
5	Water-based Recreation and Tourism (3 EPPs)	MUWHLG	11MP and beyond	5	Commercial Water to Shipping (4 EPPs)	MOT	11MP and beyond

Note : For the full list of Entry Point Projects (EPPs) please refer to Appendix 6.4 in Chapter 6. The cost of investments for the programmes mentioned above are to be estimated by the respective Ministries.

Chapter 1

Evolution of Integrated Water Resources Management

The holistic management of water resources to ensure long-term sustainability of the resource has been the subject of international discussion and dialogue since the late 1970s. It has now evolved into a globally endorsed concept called Integrated Water Resources Management (IWRM) since its formal adoption at both the Dublin ICWE 1992 and subsequent Rio Earth Summit 1992.

1.1 Global Evolution of IWRM

The significant events in chronological sequence pertaining to the global evolution of IWRM to date are as highlighted hereunder:

***International Water Conference in Mar del Plata (1977)*:** The need for coordination within the water sector was advocated at this international meeting but largely seen then as a task for national governments. Recommendation No. 2 of the Mar del Plata Action Plan States that *"Institutional arrangements adopted by each country should ensure that the development and management takes place in the context of national planning and that there is real coordination among all bodies responsible for the investigation, development and management of water resources"*.

- ***Brundtland Commission Report of 1987*** entitled *Our Common Future* launched the concept of "*Sustainable development, which seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future".*

- ***United Nations Conference on Environment and Development (UNCED)* in June 1992 at Rio de Janeiro:** Also dubbed as the Rio Earth Summit, UNCED was held in response to the call from the United Nations General Assembly in December 1989 for all nations to meet to confront the twin problems of environmental destruction and the necessity for sustainable development.

To prepare for UNCED, the water sector organised the *International Conference on Water and the Environment (ICWE) held in Dublin, Ireland in January 1992.*

The main outcome from ICWE 1992 was the landmark ***Dublin Statement containing the Guiding Principles on Water*** (Box 1.1).

Dublin Principles (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 recognized as an economic good.

Box 1.1: Dublin Principles (ICWE 1992)

The Dublin Statement was endorsed by the subsequent Rio Summit. The main substantive outcome of the Rio Summit was Agenda 21, a comprehensive blueprint for global action into the 21st century. Chapter 18 of Agenda 21 focused on the *"Protection of the Quality and Supply of Freshwater Resources: Application of Integrated Approaches to the Development, Management and Use of Water Resources".* Relevant sections of Chapter 18 related to IWRM are reproduced as follows:

"18.8. Integrated water resources management is based on the perception of water as an integral part of the ecosystem, a natural resource and a social and economic good, whose quantity and quality determine the nature of its utilization. To this end, water resources have to be protected, taking into account the functioning of aquatic ecosystems and the perenniality of the resource, in order to satisfy and reconcile needs for water in human activities. In developing and using water resources, priority has to be given to the satisfaction of basic needs and the safeguarding of ecosystems. Beyond these requirements, however, water users should be charged appropriately.

18.9. Integrated water resources management, including the integration of land-and water-related aspects, should be carried out at the level of the catchment basin or sub-basin. Four principal objectives should be pursued, as follows:

a. To promote a dynamic, interactive, iterative and multi-sectoral approach to water resources management, including the identification and protection of potential sources of freshwater supply, that integrates technological, socio-economic, environmental and human health considerations;

b. To plan for the sustainable and rational utilization, protection, conservation and management of water resources based on community needs and priorities within the framework of national economic development policy;

c. To design, implement and evaluate projects and programmes that are both economically efficient and

socially appropriate within clearly defined strategies, based on an approach of full public participation, including that of women, youth, indigenous people and local communities in water management policy-making and decision-making; and

d. To identify and strengthen or develop, as required, in particular in developing countries, the appropriate institutional, legal and financial mechanisms to ensure that water policy and its implementation are a catalyst for sustainable social progress and economic growth."

- ***Second World Water Forum*, March 2000, The Hague:** The international water sector led mainly by the World Water Council and the Global Water Partnership (GWP), both of which were established in the year 1996, released the World Water Vision for the 21st Century report at The Hague, Netherlands on the occasion of the Second World Water Forum in March 2000. The report carrying the tagline "Making Water Everybody's Business" was formulated over a period of two years by a 21-member World Water Commission. In adopting IWRM as its central philosophy the report was aimed "not just to speed up the implementation of the Dublin Principles but also to propose a set of practical principles for implementation". The GWP also released the first authoritative definition of IWRM as follows: ***"A process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems".***

- **The *2002 World Summit on Sustainable Development* in Johannesburg (WSSD 2002)** (also referred to as the Rio+10 Summit) reiterated that "improved development and management of water resources, based on a true and inclusive stakeholder involvement, provides a direct link to the *Millennium Development Goals (MDGs)* addressing poverty, hunger, gender equality, health, education and environmental degradation". In recognition of this link, an important short-term target was agreed upon at this WSSD 2002 and included in the Johannesburg Plan of Implementation: ***"To develop integrated water resources management and water efficiency plans by 2005, with support to developing countries", or in short the "IWRM Target"***. (Appendix 1.1 for full text of Para 26). This target was intended to highlight the vital role of improving water management through IWRM as a means towards the achievement of the MDGs.

- **The *2012 United Nations Conference on Sustainable Development* (UNCSD 2012)** (also referred to as Rio+20), held in Rio de Janeiro in June 2012, saw the release of the document *The Future We Want*. One of the main outcomes of this summit was the agreement by Member States to launch an inclusive process to develop a set of Sustainable Development Goals (SDGs) that would address in a balanced way all three dimensions of sustainable development—economic, social and environment—and be coherent with and integrated into the UN development agenda beyond 2015.

- **The *United Nations Sustainable Development Summit (2015)*** met in New York from 25–27 September 2015 to adopt the post-2015 development document entitled *Transforming Our World: the 2030 Agenda for Sustainable Development* and the announcement of the *SDGs* which sets out a "supremely ambitious and transformational vision" that envisages among many aspirations, "a world free of poverty, hunger, disease and want, where all life can thrive. A world free of fear and violence. A world with universal literacy. A world with equitable and universal access to quality education at all levels, to health care and social protection, where physical, mental and social, well-being are assured***. A world where we reaffirm our commitments regarding the human right to safe drinking water and sanitation and where there is improved hygiene;*** and where food is sufficient, safe, affordable and nutritious. A world where human habitats are safe, resilient and sustainable and where there is universal access to affordable, reliable and sustainable energy".

This new agenda comprise "17 Sustainable Goals with 169 associated targets which are integrated and indivisible" (Appendix 1.2).The new Goals and targets will come into effect on 1 January 2016 and will guide the decisions over the next 15 years.

Sustainable Development Goal No. 6 relates specifically to water and the associated targets are as listed in Box 1.2:

Sustainable Development Goal 6: **Ensure availability and sustainable management of water and sanitation for all**	
6.1.	By 2030, achieve universal and equitable access to safe and affordable drinking water for all
6.2.	By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
6.3.	By 2030, improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
6.4.	By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
6.5.	By 2030, implement integrated water resources management at all levels, including through trans-boundary cooperation as appropriate
6.6.	By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
6. a.	By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
6. b.	Support and strengthen the participation of local communities in improving water and sanitation management

Box 1.2: List of Targets under Sustainable Development Goal 6

1.2 Evolution of IWRM in Malaysia

Overview

Since the colonial era and into the first half of the 20th century, the provision of water infrastructure, and services were essentially for potable water supply to urban centres; for irrigation and drainage serving agricultural production of food crops (mainly rice) and plantation crops (mainly rubber and coconut) located largely in the coastal areas of Kedah, Penang, Perak, Selangor, Kelantan, and Johor; and for hydro-power generation to support the tin-mining industry in Perak. They were administered by single-purpose utility agencies created for each particular use, namely PWD for water supply, DID for drainage and irrigation, and CEB for energy. Sewerage services available in towns under the jurisdiction of town councils were still primitive with sewage collected manually. Water resources management was regulated conforming to the Waters Act of 1920 which served as a template for adoption by respective State Governments of then Federation of Malaya in administering this function. The legislated state enactments and accompanying rules were largely for the regulation and control of water sources (waterways and water bodies) from abuse, and to ensure legality of water use through proper licensing arrangements and approvals.

Fragmented management of the water sector both at the Federal and State levels, a legacy from the past, continued to remain as the institutional norm after the country achieved independence from British rule in 1957. The rapid pace of economic development subsequent to independence, the outcome from the successful implementation of consecutive five-year national development plans (two five-year rural development plans followed by 10 Malaysia Plans to date) has enabled the transformation of Malaysia from a developing country to a middle-income economy currently and is now on course to achieve its vision of attaining developed country status by the year 2020. Needless to say, such unprecedented economic progress would not have been possible without substantial investments in infrastructural development to support the growth especially of the agricultural, industrial, housing, transport, tourism, and service sectors. Investments in water infrastructure that focused on “water for livelihoods” was largely for potable water supply and wastewater management services to the fast growing rural and urban population nationwide; water supply for industrial use; agricultural water supply and water management services for both food and plantation crops; flood mitigation and urban drainage works; hydro-power generation to meet energy needs; and for the maintenance of waterways and water bodies for navigational and recreational purposes.

Understandably, the fast pace of economic progress and especially extensive land development (both controlled and uncontrolled) has had its negative impacts on “water as a resource” much to the detriment of the environment and ecosystem function services. This has manifested over time in the increased incidence of water-related hazards (floods, droughts, landslides, and mudslides) and increase in pollution of the natural waterways and water bodies limiting the use of its waters and consequential threats to aquatic life. River basins located in the main growth regions especially in Kedah, Perlis, Penang, Selangor, and Malacca have had water demands exceeding their respective carrying capacities requiring inter-basin water transfers. There are also growing conflicts of use and abuse of waters in many river basins including trans-boundary issues, thereby rendering “business as usual” based on past fragmented or sectoral approaches to water resources management ineffective and the need for more holistic

management models to ensure greater water security and sustainability.

Since the turn of the 21st century and in keeping with commitment to global trends and conventions, Malaysia has formally adopted Integrated Water Resources Management (IWRM) as the way forward to sustainably manage its water resources. This is reflected in policy statements contained in the Third Outline Perspective Plan (OPP3:2001–2010) and subsequent Eight (2001–2005) and Ninth (2006–2010) Malaysia Plan documents. The National Water Resources Policy formally launched in March 2012 reaffirms the adoption of IWRM marking a clear shift away from past fragmented and sectoral management practices. IWRM is a concept that recognises the symbiotic relationship between land and water. It emphasises good water governance that should address the six essential pillars of policy, institutions, participation, information, technology, and finance.

Despite the formal declaration and adoption of the IWRM policy, its implementation to date has yet to gain adequate traction on a national scale. This is largely related to governance issues due to the lack of concerted efforts at the national level and the absence of effective mechanisms for inter-ministry dialogue and for greater Federal-State cooperation, considering that relevant provisions under the Federal Constitution vests 'ownership' of water as a resource with the respective states.

Current Status

Notwithstanding, there have been some notable successes achieved to date in moving the IWRM agenda forward. IWRM is not entirely a new paradigm to the country. The agricultural sector has successfully institutionalised such practices as far back as in the 1970s (Box 1.3).

Integrated Agriculture Development Areas

Recognising the symbiotic relation between water, land, and farm management, integrated agriculture management under MOA has been practiced since the 1970s. All the relevant implementing agencies are placed under one roof to administer the "granary areas" and the larger agricultural drainage areas in an integrated manner. The forerunners were MADA and KADA, followed by IADAs spread over various states across Malaysia.

Box 1.3: Integrated Agriculture Development Areas

Since 1992, (i.e. the year when IWRM based on the ICWE 1992 Dublin Principles was endorsed globally for adoption at the first *Rio Earth Summit 1992*), some of the significant milestones reached are highlighted below based on chronological sequence and categorised according to the IWRM General Framework format:

(i) Enabling Environment

a) Malaysia is a signatory to Earth Summits (Rio 1992, Johannesburg 2002, and Rio+20, 2012); and Ministerial Declarations at World Water Forums (Marrakech 1997, The Hague 2000, Kyoto 2003, Mexico City 2006, Istanbul 2009, Marseille 2012, and Daegu Gyeongbuk, 2015). The country is hence committed to implementing IWRM following 1992 Dublin Principles which continues to be the central thrust to sustainable water resources management at these international fora. This stand has been reiterated at the recent

September *2015 UNSD Summit* where the SDGs unveiled include a call for IWRM to be implemented at all levels by 2030.

b) Policy Statements under OPP3 (2001–2010), the 8MP (2001–2005), and the 9MP (2006–2010) have all stressed the adoption of IWRM and IRBM; the need for a National Water Resources Policy (NWRP); and urging all states to set up water management bodies to facilitate IRBM similar to LUAS (Appendix 1.3).

c) The National Water Services Industry Commission Bill and Water Services Industry Act (WSIA) of 2006 permitted the control of all water services (formerly under state jurisdiction in 13 States of Malaysia) to be given to the Federal Government. The rationale for introducing these laws is to ensure quality and reliability where water supplies and sewerage services are concerned. Another apex body, *Suruhanjaya Perkhidmatan Air Negara* (SPAN), has been established under the provision of Water Services Commission Act which would serve as the central regulating body and employ the WSIA as regulatory tools to regulate water services industry in term of licensing, supervision, and monitoring.

d) Contemporary Water Legislation has been enacted to date by three states to enable the holistic management of water resources within the respective state boundaries. The laws passed to date by the respective State Legislature are as follows:

- Sabah Water Resources Enactment 1998
- Selangor Waters Management Authority Enactment 1999
- Kedah Water Resources Enactment 2008

Pursuant to the passing of the National Water Services Industry Commission Bill and WSIA of 2006, some states like Pahang, Johor, Negeri Sembilan, Melaka, Pulau Pinang, and Perlis have legislated complementary water resources enactments to enable the execution of regulatory functions related to managing water resources and water supply services. The state of Perak has amended the existing water enactment for similar purposes. These enactments and amendments made have essentially only included elements of control in water catchment areas, provision for the post of State Director of Water Resources, drought orders, licensing arrangements for raw water withdrawal and imposition of charges, listing of offences, and penalties for breach of orders.

The Sarawak Water Ordinance of 1994 provides for the establishment of a *Majlis Sumber Air Negeri* (MSANg) to oversee both water resources management and water supply services. The MSANg also has links with the Natural Resources and Environment Board established under the Sarawak Natural Resources and Environment Ordinance of 1993. Water resources management

under the Water Ordinance is limited to the protection and development of water resources focusing mainly on catchment management and the control and licensing of all water abstraction. Coverage on the management and administration of water supply services is more extensive dealing with the whole range of management services from the establishment of an overseeing State Water Authority that is responsible for approval of licenses, provisions for a Water Board as a body corporate, powers to appoint a statutory water company, water supply infrastructural services, to dealing with offences and penalties.

However, except for the first three state laws mentioned above (Sabah, Selangor, and Kedah), the other state legislations fall short of meeting the requirements of IWRM principles and practices for the sustainable management of water resources.

e) The NWR Policy 2012 was formally launched in March 2012. The Policy is based on the three essential principles of water resources security, water resources sustainability and collaborative governance, as elaborated briefly below:

- Water Resource Security: Water security, similar to food and energy securities in the country, is to ensure that water is readily available to meet all demands of society and the environment. It has an intrinsic as well as a financial cost value that could be much higher than those of other economic sectors.
- Water Resource Sustainability: Water is a catalyst for national development and for societal and environmental well-being. It should be sustained for present and future uses. This opens up vast opportunities to develop the water industry and to explore the use of alternative water sources through science, technology and investments.
- Collaborative Governance: Inclusiveness and collaboration are essential elements towards ensuring the security and sustainability of water resources as well as achieving the common goals of addressing multiple resource use, governance, and priorities.

(ii) Institutional Framework

a) The *Majlis Sumber Air Negara* (MSAN) was established in 1998 as an apex body to provide a forum for a holistic approach in the planning and management of water resources. It is currently chaired by the Deputy Prime Minister with the Chief Ministers of all States and water-related Federal Ministers as members.

b) Following a Cabinet reshuffle early in the year 2004, the NRE Ministry was formed where all natural resources (namely, land, forests, minerals, water, wildlife, and inland fisheries) were located under one ministry to enable greater integration. In the case of water,

it also marked the separation of "water as a resource" and "water as a utility", a desirable prerequisite for the sound implementation of IWRM. Based on its functional responsibility and by virtue of being the Joint Secretariat to the MSAN, the NRE Ministry is the designated lead agency to deal with water resources management matters nationwide. As a consequence, the Department of Irrigation and Drainage, which was under the Ministry of Agriculture, was moved to the new NRE Ministry with a greater focus on "water as a resource", while maintaining only a Division of Irrigation and Agricultural Drainage under the renamed Ministry of Agriculture and Agro-based Industries to deal with water for agriculture.

c) The 2004 Cabinet reshuffle also saw potable water services under the Ministry of Works moved together with energy and communications to a separate Ministry of Energy, Water and Communications (MEWC or KeTAK).

d) A 2009 Cabinet reshuffle saw the MEWC restructured, to include Green Technology and renamed Ministry of Energy, Green Technology and Water (MEGTW or KeTTHA). In the same process, Communications moved to the Ministry of Information, Communication and Culture (since renamed in 2013 as Ministry of Communications and Multimedia). Sewerage Services under the Ministry of Local Government and Housing was also moved to come under the purview of KeTTHA.

e) Establishment of *Majlis Sumber Air Negeri* (MSANg): To date, three states have created State Water Resources bodies as provided by laws enacted mentioned in *Section 1.2 (i) (d)* namely:

- Selangor Water Management Authority (LUAS) established in 2000 chaired by the MB
- Sabah Water Resources Council established in 2006 chaired by the CM
- Kedah Water Resources Board formed in 2008 chaired by the MB

Some states like Pahang, Johor, Pulau Pinang, Negeri Sembilan, Melaka, Perak, and Perlis who have enacted separate water resources enactments or have made amendments to existing water enactments have, in addition to creating MSANg following the directive from MSAN, established State Water Regulatory Bodies (*Badan Kawal Selia Air* (BKSA) *Negeri*) with BKSA units placed under the State Secretary's Office, led by a designated Director. In the case of Sarawak, the State Water Authority appointed under the provisions of the Sarawak Water Ordinance performs this regulatory role.

(iii) Management Instruments

a) National River Register (2001) and IRBM Plan Studies on selected Basins

DID completed a study in 2001 to develop a Register of Rivers in Malaysia, together with a recommended list of River Basin

Management Units (RBMU) which defines the river basin boundaries for management purposes. MSAN 02 had on 29 July 2003 stated that river basin master plans shall be the basis for the development within a river basin and had agreed to the preparation of IRBM plans for all 189 RBMU in the country.

Some 12 river basin management plans have been completed to date, namely, Sg. Selangor (2002), Sg. Muar Basin (2003), Sg. Kelang (2003), Sg. Langat (2005), Sg. Bernam (2007), Sg. Kedah/Sg. Anak Bukit, Kedah (2007), Sg. Kerian/Sg. Kurau, Perak (2008), Sg. Pahang, Sg. Perlis, Sg. Perak, Sg. Melaka, and Sg. Terengganu.

As part of DID's IRBM Blueprint Study in 2010 detailed reviews of key completed river basin studies for Sg. Langat, Sg. Kerian, Sg. Muar, and Sg. Linggi, have also been carried out. DID Malaysia has also developed a set of IRBM Blueprint Guidelines which gives the framework and methodology for the development of an IRBM plan and also a model TOR for IRBM planning.

b) *Urban Storm Water Management Manual (MSMA 2001)*

Manual Saliran Mesra Alam Malaysia (MSMA) or the Urban Storm Water Management Manual for Malaysia is a drainage design guideline published by DID Malaysia. The document was officially enforced by the Malaysian Government in 2001. It is required by law in Malaysia for all to design drainage works to comply with the requirements of MSMA. The application of MSMA guidelines is targeted at professional groups, developers, contractors, land owners, and development regulating agencies (such as Local Authorities, JKR, DID, and DOE).

The main concept of MSMA is about controlling the quantity and quality of runoff from a development site via a "control-at-source" approach as opposed to the "rapid-disposal" approach adopted earlier. The quantity and quality of discharges going out from the site must not exceed those before the development. To achieve the above, structural and hydraulic components such as site storage facilities, control structures, and underground infiltration modules must be designed and installed within the site. The ultimate objective is to ensure zero development impact on both quantity and quality of runoff from a development site.

c) *"One State, One River" Plan 2002*

The "One State One River" plan is a programme to improve urban rivers environment through restoration and other improvement works. The programme which started in 2004 is for specified river stretches and placed high priority for water quality improvement which may include removal of sediment and sludge, the construction or upgrading of treatment ponds, grease traps or solid waste screens, and

beautification and landscaping elements.

As the scope for river water quality and river environment improvement is the responsibility of many agencies, the management of this programme is coordinated with the support of the designated state EXCO. Over the last 10 years since its inception most of the rivers that were selected under this programme attained an average improvement of moving up by one level based on river classification index (e.g. from Class III to Class II).

d) National Study for the Effective Implementation of IWRM in Malaysia 2005

The Study carried out in 2005 principally focused on awareness and advocacy, capacity building, best management practices and information architecture framework. The completed study report which comes in five volumes comprises a comprehensive set of guidelines, written for technical and professional levels covering various resource management-related topics, to assist in the implementation of IWRM in Malaysia.

e) Implementation of IWRM Best Management Practices (BMPs) 2009

The implementation of IWRM BMPs was carried out subsequent to the *National Study for the Effective Implementation of IWRM in Malaysia*. It included the implementation of eight mini-projects spread over different states with the view of demonstrating BMPs in IWRM, each mini project focusing on a specific IWRM topic designed to promote awareness, capacity building, and public participation at the local level. The topics selected ranged from water enactment enforcement (Sg. Liwagu, Sabah), flood management (flood regulating pond in Taman Matahari Heights, Negeri Sembilan), water demand management (N-Park Condominium, Penang), public/community participation (Sg. Miri River Basin, Miri, Sarawak), river corridor management (Sg. Melaka, Alor Gajah, Melaka), water-borne disease management (Sg. Langat, Selangor), lake management (Tasik Chini, Pahang), and groundwater management (Kota Bharu Aquifer, Kelantan).

f) National Water Resources (NWR) Study 2011

Towards the end of the 9th Malaysia Plan, DID Malaysia under the NRE Ministry undertook this timely study entitled *Review of the National Water Resources Study* (2000–2050) and *Formulation of National Water Resources Policy*. The Study commenced in October 2009 and was completed in the year 2011 after a period of 16 months. The comprehensive study had, apart from reviewing and updating data and information from an earlier study confined to Peninsular Malaysia, expanded its scope to include Sabah and Sarawak.

Aspects of water resources governance, including setting priorities at the Federal and State levels on water resources management and development, were also addressed. An important outcome from the Study was the formulation of a unified and comprehensive NWR Policy and a model NWR Law to ensure security and sustainability of water resources for all (including nature and the environment). The Study marked an important milestone and a vital source of reference for the sound management of the country's water resources and development in the years ahead.

g) *Klang River RoL Project 2012*

The River of Life (RoL) is an Entry Point Project identified in the Greater Kuala Lumpur/ Klang Valley NKEA under the ETP. RoL that started in July 2012 was aimed to transform the Klang River into a vibrant and liveable water front with high economic value by 2020.

The project, costing an estimated RM4 billion, was divided into three parts, namely, (i) River Cleaning, (ii) River Master Planning and Beautification; and (iii) River Development. River cleaning involved a 110 km stretch along the Klang river. Beautification along a 10.7 km stretch by the Klang and Gombak river corridor included pedestrian walkways and corridor development.

h) *National Workshops and Fora on IWRM and IWRM Sub-themes*

As part of the efforts at advocacy, creating greater awareness, and capacity building on IWRM and related sub-themes, many colloquia, workshops, and seminars have been held. Some of the major ones held, and for some of which proceedings have been published, include:

- *National Conference on Sustainable River Basin Management in Malaysia (13 – 14 November 2000, Kuala Lumpur, Malaysia)*

  The Conference reiterated that rivers have always played a prominent role in Malaysia's development, being the source of water for people and food production, a means of transportation, providing energy for power generation, and as a receptacle for wastewater. Rivers have also an important role in maintaining the ecological balance and as habitats for flora and fauna. The recent rapid pace of development has brought degradation to many of the river systems. The forum recommended the need to review and strengthen legislation, to improve enforcement efforts, to establish river basin authorities to implement curative measures and preventive measures, to improve the planning

mechanism, to promote public participation, and to secure adequate finance for all the above activities.

- *Regional Forum on Capacity Building for Integrated Resource Management in Southeast Asia (December 2002, Kuala Lumpur, Malaysia)*

  This Forum was specifically targeted towards all stakeholders in the country, especially those working in the water sector. The main objective was to create awareness and promote cross-sectoral and sub-sectoral thinking on integrated water resource management systems in river basins. The main thrust would be towards the capacity building with a focus on education and training, networking with organisations and institutions, which have similar objectives, to create the IWRM knowledge base and to exchange information on IWRM, and development of relevant materials and tools for training.

  One of the main recommendations of the Forum was to introduce a dedicated IWRM academic programme, which could lead towards the awards of diploma and/or post-graduate degrees on IWRM. The first successful initiative towards this end was a joint curriculum development for a Master's degree programme in IWRM. It was a collaborative effort of experts from all Malaysian universities and various government agencies.

- *National Dialogue on Effective Water Governance in Malaysia (6–7 October 2003), Kuala Lumpur, Malaysia*

  The theme of this Dialogue held in conjunction with the Malaysian World Habitat Day was on "Water and Sanitation for Cities". The main objective of the Dialogue was to bring various groups including policy-makers involved in the management of water, land and the environment, to generate common grounds on measures necessary to improve water governance in line with the sustainable urbanisation of human settlements with social, economic development policies and programmes in the country.

- *Malaysian Water Forum (8–10 June 2004, Kuala Lumpur, Malaysia)*

  The Forum brought to the attention the issues and challenges in managing water resources and river basins. These issues are complex, multifarious, multidisciplinary, cross-boundary and cross-sectoral in nature.

Categorically, all these issues could be classified into legal, institutional, technical, economic, social, and environmental, and the Forum emphasised the need for political will and intervention to ensure integration from the present fragmented approach in managing resources in the country.

- *National Dialogue on Water Financing (February 2005, Kuala Lumpur)*

  Privatisation had resulted in the participation of private sector financing in the water industry. In the early stages, privatisation was concentrated in the area of water treatment. This did not address the problems of other areas of the water operations namely distribution (non-revenue water) and billing. Due to the fragmented management and accountability arising from different parties managing different parts of the operation chain, issues of water resources availability, water quality, the reliability of supply and accountability remained a major concern. The Forum discussed these issues in the context of the roles and responsibilities of the Federal and State Governments vis-à-vis the water industry and sustainability of water resources in the country. Underlying the issues is water financing and the economics of water by investors.

- *Institutional Assessment Workshop for IWRM 2005 (20 June 2006, Putrajaya, Malaysia*

  With assistance from UNEP, this Workshop hosted jointly by NRE and the Malaysian Water Partnership (MyWP) brought together institutional stakeholders to discuss efforts in streamlining the development of a National IWRM Strategic Plan aimed at achieving the targets of the MDGs.

- *TOT on Legislation and Institutional Arrangements in IWRM 2007 (10 – 14 July 2007, Putrajaya, Malaysia*

  This Training of Trainers (TOT) programme brought together water managers and water experts from ASEAN and Denmark to deliberate on the institutional arrangements most apt for IWRM implementation. As one expert indicated, “it is not so much to train, but to educate” the stakeholders on the need for appropriate institutional arrangements based on the country’s environment. As such, a wide range of topics was highlighted that included legislations and institutional set up for environmental management, integrated water and wastewater pollution control systems, and protection of aquatic ecosystems. It

tried to orientate thinking towards water ecosystems as development assets that must be mainstreamed into the national and local development policies as guides for control agencies and authorities.

- *The third Southeast Asia Water Forum (22–27 October 2007), PWTC Kuala Lumpur—Consolidating Actions Towards Effective Implementation of Integrated Water Resources Management*

  This regional Forum highlighted the targets of the MDGs looking at water as a production and developmental catalyst in the ASEAN countries. It introduced the dimension of climate change together with concepts of sustainability and vulnerability of fragile ecosystems that could collapse causing more poverty and water-related diseases.

  At the national level, it was reported that the legislations are often used to govern rather than protect the water resources. River flows are inadequate to meet growing demands during the drier seasons, which seemed to last longer because of weather fluctuations caused by climate change. One of the solutions put forward was a water plan of "one river, one plan, one management system" to integrate the natural and human systems. This would involve modes of operations and who should bear the cost although it was generally accepted that more investments in the water sector would bring greater benefits such as better water infrastructure, quicker decision-making and higher returns on investments as it reduced risks if water were allocated strategically from the water resources sector.

- *Malaysia Water Resources Management Forum 2012 (26–27 November 2012), Putrajaya, Malaysia — Time for Solutions*

  As a follow-up to the 6th World Water Forum which was held in March 2012 in France, the MyWP and DID Malaysia jointly organised the above mentioned inaugural Forum over two days carrying the same theme entitled "Time for Solutions". The Forum provided a national platform for all water-related stakeholders to identify and discuss the key water resources management issues and challenges in the country, and to propose holistic strategies to address them. Some 23 presentations were made over two plenary sessions and six thematic sessions, namely, Water Resources Management, Flood Hazards, Water

Resources Hazards, Water Governance, Research and Innovation, and Water and Civil Society.

i) Public Awareness Campaigns

Public awareness campaigns have been held from time to time to deal with issues related to both "water as a resource" and "water for livelihoods". Significant among them is the award-winning year-long nationwide "Love your River" campaign overseen by DID Malaysia held over 10 years in the 1990s. KeTTHA has held "Save Water" campaigns from time to time as part of its water demand management measures. Similar parallel efforts have also been taken by some of the state water supply authorities. Malaysian Environmental NGOs run similar on-site campaigns or on-line campaign banners, such as GEC's "Stop the Drip—Save the Drop". During prolonged drought periods, water conservation campaigns are more intensified resorting also to the use of both print and electronic media.

j) IWRM Capacity Building Initiatives and Programmes

Since the adoption of the IWRM concepts, it was found that the level of awareness was low amongst the general public and persons implementing the projects under the IWRM concepts. As the implementation of IWRM involved every sector of society and moving towards a relatively new mode to address river basin planning in an integrated manner, public sector institutions and NGOs like the MyWP, undertook from to time effective capacity building and training programmes that included provisions of modules and packages on various aspects of IWRM for dissemination to suit different target groups of stakeholders to improve their understanding of IWRM.

Furthermore, outreach and advocacy programmes on IWRM were enhanced through workshops, training of trainers, seminars either formally and informally. In the formal educational sector, the syllabus was written to ensure that all tertiary educational institutions start to have courses on IWRM. Today IWRM is entrenched as an important subject in water management up to the post-graduate level in nearly all institutions of higher learning.

k) NWRP Action Plans (2013–2020)

The NWRP was formally launched in March 2012. As a follow-up, the NRE Ministry has, beginning in 2013, initiated a NWRP Action Plan for implementation nationwide. To undertake this process, two national level committees comprising a NWRP Monitoring and Coordination Committee headed by the KSU of NRE, and a NWRP Implementation Working Group headed by the DG of DID, have been formed. In addition, five Working Groups have been constituted, respectively to deal with matters related to Governance, Water Resources Information, R&D,

Standards and Quality, and Capacity Building and Awareness. In addition, NRE is also actively pursuing the legislation of a new, more contemporary Water Resources Act to replace the current Waters Act which dates back to 1920.

Appendix 1.1: World Summit on Sustainable Development (WSSD) 2002

Para 26 of WSSD Plan of Implementation, issued in Johannesburg in September 2002

Para 26: Develop integrated water resources management and water efficiency plans by 2005, with support to developing countries, through actions at all levels to:

a) Develop and implement national/regional strategies, plans and programmes with regard to integrated river basin, watershed and groundwater management and introduce measures to improve the efficiency of water infrastructure to reduce losses and increase recycling of water;
b) Employ the full range of policy instruments, including regulation, monitoring, voluntary measures, market and information-based tools, land-use management and cost recovery of water services, without cost recovery objectives becoming a barrier to access to safe water by poor people, and adopt an integrated water basin approach;
c) Improve the efficient use of water resources and promote their allocation among competing uses in a way that gives priority to the satisfaction of basic human needs and balances the requirement of preserving or restoring ecosystems and their functions, in particular in fragile environments, with human domestic, industrial and agriculture needs, including safeguarding drinking water quality;
d) Develop programmes for mitigating the effects of extreme water-related events;
e) Support the diffusion of technology and capacity-building for nonconventional water resources and conservation technologies, to developing countries and regions facing water scarcity conditions or subject to drought and desertification, through technical and financial support and capacity-building;
f) Support, where appropriate, efforts and programmes for energy-efficient, sustainable and cost-effective desalination of seawater, water recycling and water harvesting from coastal fogs in developing countries through such measures as technological, technical and financial assistance and other modalities; and
g) Facilitate the establishment of public-private partnerships and other forms of partnership that give priority to the needs of the poor, within stable and transparent national regulatory frameworks provided by governments, while respecting local conditions, involving all concerned stakeholders, and monitoring the performance and improving accountability of public institutions and private companies.

Appendix 1.2: Sustainable Development Goals

Goal 1. End poverty in all its forms everywhere.
Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
Goal 3. Ensure healthy lives and promote well-being for all at all ages.
Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
Goal 5. Achieve gender equality and empower all women and girls.
Goal 6. Ensure availability and sustainable management of water and sanitation for all.
Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all.
Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
Goal 10. Reduce inequality within and among countries.
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable.
Goal 12. Ensure sustainable consumption and production patterns.
Goal 13*. Take urgent action to combat climate change and its impacts.
Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
Goal 17. Strengthen the means of implementation and revitalise the Global Partnership for Sustainable Development.

* *Acknowledging that the United Nations Framework Convention on Climate Change is the primary international, intergovernmental forum for negotiating the global response to climate change.*

Appendix 1.3: Policy Statements on Water Resources Management

- **Chapter 7 of the Third Outline Perspective Plan (OPP3)** on Sectoral Strategies and Practices regarding the Environment highlighted the need for a National Water Policy which would be formulated in the 8MP to provide a framework for water conservation and management to ensure adequate and safe water supply for the nation. The focus of the policy will be on the integrated river-basin approach; the protection of catchment areas and reservoirs; and addressing the issues of inter-state and inter-basin water transfers.

- **Chapter 19 of the Eighth Malaysia Plan (8MP)** on "Environment and Sustainable Resource Management" emphasised that:
  - The Government formed a National Water Resources Council in 1998 to provide a forum for a holistic approach to the planning and management of water resources.
  - The river-basin approach to water management in Malaysia was initiated with the establishment of LUAS in 1999. State Governments were urged to set-up similar water management bodies to integrate planning, monitoring, enforcement and management of water resources on a river-basin basis.
  - Water quality would be protected through an Integrated River Basin Management system while a National Water Policy would be formulated under the Plan to provide the framework for water conservation and management.
  - Issues of inter-state and inter-basin water transfers will be addressed
  - Demand management of water to include improvement of efficiency of supply and use, reducing water leakage and wastage, recycling of water, rainwater harvesting, and the use of market-based instruments.
  - Awareness campaigns and public education programmes will stress the critical importance of water and the need for conservation.

- **Chapter 22 of the Ninth Malaysia Plan (9MP)** on "Promoting Environmental Stewardship under section 22 on *Water Quality* states:
  - The utilization of the integrated river basin management (IRBM) approach will be intensified to improve river and groundwater quality.
  - Efforts will be targeted towards reducing the number of polluted rivers.
  - Public sewerage systems will be upgraded and additional centralised sewerage treatment plants will be constructed to reduce the discharge of inadequately treated wastewater into river systems.
  - Gross pollution traps and sedimentation ponds will be installed at critical locations in river basins to reduce the outflow of nonpoint source pollutants.
  - Siltation and erosion control will be addressed through the amendment of existing laws.
  - Enforcement will be intensified to ensure that effluent discharge complies with environmental standards in order to maintain environmental health.

Chapter 2

ASM and the IWRM Agenda

2.1 ASM Vision, Mission, and Objectives

The Academy of Sciences Malaysia is currently in its 21st year since its establishment on 1 February 1995 under the Academy of Sciences Malaysia Act 1994. It has set its vision to be the thought leader for advancing science for Malaysia and to become a contributor to science. Its mission is to pursue, encourage, and enhance excellence in science, engineering, and technology for the development of the nation and benefit of mankind. Its thrust areas are:

(i) Development for Science
- Accelerating STI for knowledge generation, new discoveries, and creating new value-added opportunities for future development.

(ii) Science for Development
- Utilisation of science for development, wealth creation, and societal well-being.

The objectives or focus areas are as follows:

(i) Advice to government;
(ii) Science excellence programme;
(iii) Upgrading technological capability in Malaysian industry;
(iv) Promoting public awareness and understanding of the importance of STI;
(v) International networking and collaboration; and
(vi) Scientific publications.

2.2 ASM Water Committee

At the end of the year 2008, the ASM Council, recognising that the water sector is of strategic importance and vital for the country's economic development, took the initiative to establish a dedicated ASM Water Committee to address the many issues and challenges faced by this sector with the view of offering strategic advice from time to time to the government and the appropriate authorities. The TOR of the ASM Water Committee are as follows:

(i) Provide advice to the government on strategic water-related policies, issues, and programmes;
(ii) Setting and facilitating R&D and capacity building agenda based on S&T needs for the water sector;
(iii) Raising STI awareness, advocacy, and capacity building; and
(iv) Promote international networking and collaboration.

Upon its formation, the ASM Committee whose membership comprises Fellows of the Academy who possess the necessary expertise and experience relevant to the water sector, decided at the first meeting in early 2009 to adopt Integrated Water Resources Management as the central philosophy and thrust for its work. This internationally endorsed paradigm, based on the 1992 Dublin Principles, provides the required set of guiding principles and practices for sustainable management of the country's water resources, noting also that water resources management in Malaysia has hitherto been largely sectoral in nature.

The Committee observed further that Malaysia as a signatory to the Rio+10 Summit had committed to the Johannesburg Plan of Implementation which required nations to meet the "IWRM Target" by developing IWRM and water efficiency plans by 2005. While attempts to work on this target were taken by others some time in 2006, nothing concrete had materialised. The Committee decided then to take on this task of developing a National IWRM Strategy Plan for consideration and adoption by Government for implementation nationwide. With the benefit of hindsight, the decision taken then has indeed proven to be appropriate, since the recent UNSD Summit held in New York in September 2015 has under SDG No. 6 not only reiterated the adoption of IWRM but went a step further to target by 2030 to "*implement integrated water resources management at all levels, including through trans-boundary cooperation as appropriate".*

2.3 IWRM Agenda and Sub-themes

The IWRM concept *per se* is rather abstract. Hence, for practical implementation of IWRM, the ASM Water Committee deemed it necessary that this central philosophy be broken down and applied to discrete subsets, each involving and engaging a different set of stakeholders. Some of the topical issues or focus areas initially identified by the Committee, all of which would be regarded as components or sub-themes under a common overarching IWRM agenda, were as follows:

- Integrated River Basin Management
- Integrated Lake Basin Management
- Integrated Aquifer System Management
- Water Demand Management
- Water Supply and Wastewater Management
- Integrated R&D Agenda for Water
- Climate Change and Water
- Integrated Urban Water Management
- Integrated Flood Management
- Integrated Drought Management
- Water Quality Management
- Water and Health
- Water and Agriculture
- Water and Land Use (National Physical Plan)
- Water, Energy, Food Nexus
- Virtual Water and Water Footprint
- Water and Green Growth
- Water Financing
- Water as a Business
- Water and Gender
- S&T Awareness, Advocacy, and Capacity Building
- International Networking and Collaboration

The outputs and outcomes from completed component or sub-theme studies would then form the basis for the subsequent development of a comprehensive IWRM Strategy Plan which would have considered the views and recommendations from a much broader spectrum of stakeholders to ensure its relevance and buy-in for effective implementation nationwide.

2.4 Scope and Process of Component Plan Studies

In developing strategy plans or advisory reports for each of the above-mentioned sub-themes,

the approach was multi-disciplinary and consultative with the engagement of all relevant stakeholders from the public, private, and NGO sectors. Each sub-theme was led by a Task Force, chaired normally by an ASM Fellow with members comprising subject matter specialists co-opted from the public/private sector and the academia.

The scope of reviews by each Task Force included (but not necessarily limited) to the following aspects:

- Governance
  - o Policy
  - o Legislation
  - o Institutions
- R&D
- Capacity Building
- Synthesised Knowledge
- Food/Water/Energy Nexus
- Information Management
- Green Technology/Growth/Economy
- Business Development
- Advocacy and Public Awareness
- Networking and International Cooperation
- Financing

The process adopted to develop strategy plans or advisory reports for each of the components or sub-themes is briefly as follows:

- **Stage 1:** The first stage comprised a status review or a position paper on the topic under focus. It entailed a research document that provided a comprehensive overview of the current status supported by relevant data and information. The commissioned study normally included an appraisal of global trends and strategies currently in vogue based on a literature review and recommended options in the Malaysian context.

- **Stage 2:** The position paper from Stage 1 and a draft conceptual framework of a strategy plan was then tabled for strategic consultations before a multi-stakeholder audience comprising public/private/NGO/Community sector stakeholders, subject matter specialists, and researchers both to validate and gather feedback and for identification of gaps that need to be further addressed. Appropriate management tools, facilitators, and rapporteurs as required were utilised for this exercise.

- **Stage 3:** This is the final stage where a synthesis of all the outputs of the earlier stages was undertaken which formed the basis to draft a succinct strategy plan, the task commissioned to a resource person engaged by ASM. The draft was then presented for discussion and adoption by the Task Force. The Chair of the Task Force subsequently tabled the strategy plan document to the ASM Water Committee for discussion and approval before submission to the ASM Council for endorsement prior to formal submission to the relevant authorities concerned.

2.5 Mega Science Framework Study for Sustained National Development (2011–2050)

The above flagship study undertaken by ASM, which began in the year 2010 and aimed at a longer time horizon until the year 2050, had its initial focus under Phase 1 on WEHAB, namely water, energy, health, agriculture, and biodiversity. The study completed in 2011 was essential to establish the framework or roadmap and identify the type and impact of STI and the areas of development on which STI will be applied to generate maximum sustained economic growth and prosperity for the country.

The Mega Science Study on Water noted that 10 Economic Sectors influenced by water are Agriculture, Forestry, Fisheries, Industry, Tourism, Ecosystem Services, Urban/Domestic, Health, Education, and Water Management.

STI opportunities were found in two discrete areas, namely in 'Sustaining the Resource' and in 'Wealth Creation'. The Study went on to identify some 70 STIs which were then subject to a Return-Risk Analysis from which 11 promising STIs emerged under the first category while another 10 STIs fell under the second. A listing of the 21 STIs under seven themes are as follows:

(i) Water Supplies
  a. Urban runoff
  b. Rainfall
  c. Groundwater
  d. Conjunctive use
(ii) Waste Management
  a. Zero waste
  b. Point and non-point source pollution
  c. Advanced Wastewater Treatment
(iii) Water Management
  a. Tourism
  b. Urban
  c. Coastal
  d. High-value ecosystem
(iv) Agriculture
  a. Sustainable Aquaculture
  b. Irrigation Flow
(v) Support Exports
  a. Bottled Water
  b. Water Purification Unit
(vi) Knowledge Product
  a. Tourism
  b. Urban
  c. Coastal
  d. High-value ecosystem
(vii) Knowledge/ Education
  a. Research centre
  b. Value ecosystem services
  c. Reform education

The findings and recommendations from this Mega Science Study were considered and incorporated as relevant in both the Component Strategy Plans and in the overall National IWRM Strategy Plan.

2.6 Completed Strategy Plans/Advisory Reports

The completed studies and component (sub-theme) strategy plans/advisory reports by ASM have been listed in the table below according to their relevance to IWRM.

Table 2.1: ASM Studies and the IWRM Agenda

No.	Component Plan	Relevance to IWRM	Lead Implementing Ministry/ Authority/Agency
1.	*Integrated Lake Basin Management*	Water as a Resource	NRE/State Governments
2.	*Integrated Aquifer Systems Management*	Water as a Resource	NRE/State Governments
3.	*Water Demand Management*	Water as a Resource and for Livelihood	EPU/NRE/KeTTHA/MOA/ MUWHLG/MOH/MPIC/MRRD/ State Governments
4.	*Water Supply and Wastewater Management*	Water for Livelihood	KeTTHA/State Governments

5.	*National Agenda for Integrated Water Research*	Water as a Resource and for Livelihood *(Harnessing STI)*	NRE/MOHE/NAHRIM/IHLs/ State Governments
6.	*Climate Change and Water*	Water as a Resource and for Livelihood *(Preparing for impending threats)*	NRE/KeTTHA/MOSTI/MOA/ State Governments
7.	*Integrated River Basin Management*	Water as a Resource	NRE/State Governments
8.	*Water and Agriculture*	Water for Livelihood	MOA/MPIC/State Governments
9.	*NKPA on Water*	Water as a Resource and for Livelihood (*Investing in water infrastructure*)	EPU/NRE/KeTTHA/MOA/State Governments
10.	*ASM Mega Science Framework Study on Water*	Water as a Resource and for Livelihood (*Long-term horizon until 2050*)	EPU

The strategies and recommendations from both the Mega Science and IWRM sub-theme studies, the information and views gathered at the many strategic consultations held with diverse and multi-stakeholder groups, and the expert inputs furnished by the many local and foreign subject matter specialists provides a sound basis for the development and formulation of a holistic and inclusive National IWRM Strategy Plan for the short, medium, and long term.

Chapter 3

Component Plan (IWRM Sub-Theme) Studies by ASM: Summary Briefs

Chapter 2 of this Report has elaborated in detail the scope and methodology adopted by ASM in undertaking studies on IWRM Sub-themes that were identified as important for the formulation of a National IWRM Plan. In addition, ASM had in 2010 included the water sector as one of the priority focus areas under Phase 1 of the Mega Science Study aimed at a longer time horizon until the year 2050.

To date, studies addressing some 10 IWRM sub-themes have been completed. The Component Plan reports for each sub-theme include a list of strategies recommended together with an implementation road map. Upon completion, these Component Plan study reports have been submitted to relevant authorities for consideration and adoption prior to implementation. Some have even been referred further by relevant Ministries to MSAN for endorsement to ensure concurrent attention and support from State Governments.

Table 3.1 shows the current status of submission and approval/endorsement by relevant authorities of the completed IWRM sub-theme reports.

Table 3.1: Component Plan Study Reports by ASM

No.	Component Plan Report	Date of Completion by ASM	Submission to Lead Implementing Ministry	Endorsement by MSAN where relevant
1	*Integrated Lake Basin Management*	2009	NRE 2010	1 November 2012 (MSAN 07)
2	*Integrated Aquifer Systems Management*	2011	NRE 2012	NA
3	*Water Demand Management*	2016	EPU/NRE/ KeTTHA/ MOA 2016	NA

4	*Water Supply and Wastewater Management*	2016	KeTTHA 2016	NA
5	*National Agenda for Integrated Water Research*	2014	NRE/MOSTI 2015	15 October 2015 (MSAN 10)
6	*Climate Change and Water*	2014	NRE/MOSTI 2015	15 October 2015 (MSAN 10)
7	*Integrated River Basin Management*	2016	NRE	NA
8	*Agriculture Water Services for Agribusiness*	2016	MOA	NA
9	*NKPA on Water*	2015	NA	NA
10	*ASM Mega Science Study: Water Sector*	2011	Cabinet 2012	NA

NA: Not applicable

3.1 Summary Briefs of Component Plans

Some of the component plan study reports have been published and available to the public for reference. Electronic versions of all the reports can be accessed from the ASM website. Only summary briefs of each component plan study are included in this chapter of this report, highlighting mainly the recommended strategies and respective implementation road maps. The summary briefs prepared have been accredited to the respective ASM Task Force Chairs or Authors directly involved with the studies.

For uniformity, a common format was adopted in preparing the summary briefs following headers as prescribed hereunder:

(i) Defining the Sub-theme,
(ii) Review of Current Status and Needs Assessment,
(iii) Recommended Strategies under four broad categories namely:
- Enabling Environment;
- Institutional Framework;
- Management Instruments; and
- Investments in Water Infrastructure.

(iv) Strategies Implementation Road Map with Timelines and Designated Lead Agency (ies).

The 10 summary briefs are appended in Volume 2 of this report following the sequence as per listing (Table 3.2) that includes the names of the accredited Task Force Chairs/ Authors.

Table 3.2: Component Plan Summary Briefs

Appendix No.	Component Plan Summary Briefs	Task Force Chair/ Author
3.2.1	*Integrated Lake Basin Management*	Academician Tan Sri Ir. Shahrizaila Abdullah FASc and Prof Dr Fatimah Md Yusoff FASc
3.2.2	*Integrated Aquifer Systems Management*	Academician Datuk Fateh Chand FASc
3.2.3	*Water Demand Management*	Tan Sri Ir. Syed Muhammad Shahabudin FASc and Datuk Ir. Mohd Adnan Mohd Nor FASc
3.2.4	*Water Supply and Wastewater Management*	Prof Dr Zulkifli Yusop FASc
3.2.5	*National Agenda for Integrated Water Research*	Prof Dr Ahmad Fauzi Ismail FASc and Prof Dr Zulkifli Yusop FASc
3.2.6	*Climate Change and Water*	Dr Salmah Zakaria FASc
3.2.7	*Integrated River Basin Management*	Dato' Ir. Lim Chow Hock FASc and Dato' Ir. Hanapi Mohamad Noor
3.2.8	*Agriculture Water Services for Agribusiness*	Datuk Ir. Mohd Adnan Mohd Nor FASc
3.2.9	*NKPA on Water*	Dr Low Kwai Sim FASc
3.2.10	*ASM Mega Science Study: Water Sector*	P. Loganathan

Chapter 4

Complementary Component Plan Studies: Summary Briefs and Reports/Expert Reviews

IWRM encompasses the integration of both natural and human systems. It also seeks to address trans-boundary issues. The ASM Water Committee had identified the following list of sub-themes and topics that are deemed relevant to the IWRM agenda:

- Integrated River Basin Management*
- Integrated Lake Basin Management*
- Integrated Aquifer System Management*
- Water Demand Management*
- Water Supply and Wastewater Management*
- Integrated R&D Agenda for Water*
- Climate Change and Water*
- Integrated Urban Water Management
- Integrated Flood Management
- Integrated Drought Management
- Water Quality Management
- Water and Health
- Water and Agriculture*
- Water and Land Use (National Physical Plan)
- Water, Energy, Food (WEF) Nexus
- Virtual Water and Water Footprint
- Water and Green Growth
- Water Financing
- Water as a Business
- Water and Gender
- S&T Awareness, Advocacy, and Capacity Building
- International Networking and Collaboration

Since the year 2008, the ASM Water Committee has undertaken detailed studies on eight of the sub-themes and topics marked with (*) in the list above. In addition, a special study focusing on *NKPA on Water* was undertaken in 2014, whilst the first phase of the ASM Mega Science Study completed in 2009 had included a Water Sector component. The outcomes of these studies including the development of respective Component Plans were reported under Chapter 3.

ASM noted that other agencies have undertaken similar studies on some of the listed sub-themes or topics, such as Integrated Flood Management, Integrated Drought Management, Water Quality Management and the National Physical Plan. These agencies/authors were invited to provide *summary briefs* of their work for inclusion in this chapter as complementary component plan studies and have been duly accredited to the respective contributing agencies/authors.

As for the remaining items on the list above, they were recognised as being important for the formulation of a National IWRM Plan and hence contributions were out-sourced to subject matter specialists who were known to have expert knowledge regarding the topics. The guest

contributions provide an overview regarding the selected topic, its scope, the advances made internationally and their relevance for adaptation to suit the Malaysian context. The *expert reviews* also contain recommended strategies deemed appropriate for implementation in the country. These *expert reviews* accredited to the respective guest contributors are included in this chapter as complementary component plan studies.

4.1 National Water Resources Policy (2012) Action Plan

The year 2012 saw the launch of the much awaited National Water Resources Policy by the Deputy Prime Minister of Malaysia cum Chairman of the National Water Resources Council. This contemporary policy based on the three essential principles of water resources security, water resources sustainability and collaborative governance, falls under the purview of the NRE Ministry for its adoption and implementation. Since the launch, ASM also noted that the NRE Ministry has embarked on an initiative to develop a NWRP Action Plan for implementation nationwide. Hence, the NRE Ministry was requested to provide a summary report concerning this initiative and its current state of progress. The *summary report* accredited to the NRE Ministry and the designated author is included in this chapter as yet another complementary component study. The NWRP Action Plan must be regarded as an integral component of the proposed National IWRM Plan and hence its incorporation represents a convergence in the implementation of recommended strategies and to avoid any undesirable overlap.

4.2 Complementary Component Plans

As elaborated above, complementary component studies undertaken by others are included in this chapter and grouped into three categories as follows:

- Summary Briefs of IWRM sub-themes undertaken by other agencies/authors;
- Expert Reviews of IWRM related topics; and
- Summary Report of NWRP Action Plan.

Summary briefs accredited to respective agencies follow a prescribed format comprising headers as listed hereunder:

(ii) Defining the Sub-theme,
(iii) Review of Current Status and Needs Assessment,
(iv) Recommended Strategies under four broad categories namely:
  - Enabling Environment,
  - Institutional Framework,
  - Management Instruments; and
  - Investments in Water Infrastructure.

(v) Strategies Implementation Road Map with Timelines and Designated Lead Agency (ies).

Expert reviews by designated subject matter specialists are as far as possible also kept to a prescribed report format as follows:

(i) Defining the Sub-theme/Topic,
(ii) Brief review of Global Trends,
(iii) Snapshot of Current Status in Malaysia; and
(iv) Recommended Strategies for nationwide implementation categorised under four broad headers namely:
  - Enabling Environment,
  - Institutional Framework,
  - Management Instruments; and
  - Investments in Water Infrastructure.

Only the summary report of the NWRP Action Plan accredited to the NRE Ministry and its designated author follows a format as deemed appropriate by the reporting agency to cover the scope and content of the Plan. The complementary component plan study reports have been listed in Table 4.1 according to their relevance to IWRM.

Table 4.1: Complementary Component Plan Studies and the IWRM Agenda

No.	Complementary Component Plan Studies	Relevance to IWRM	Lead Implementing Ministry/ Authority/Agency
1	*Integrated Flood Management*	Water as a Resource	NRE/State Governments
2	*Integrated Drought Management*	Water as a Resource	NRE/State Governments
3	*Water Quality Management*	Water as a Resource	NRE/State Governments
4	*Water and Land Use (National Physical Plan)*	Water as a Resource (*addressing trans-boundary issues*)	MUWHLG/State Governments
5	*Water and Health*	Water as a Resource and for Livelihood	MOH/State Governments
6	*Water and Green Growth*	Water as a Resource and for Livelihood	KeTTHA/NRE/MOA/ State Governments
7	*Water and Gender*	Water as a Resource and for Livelihood	NRE/KeTTHA/MWFCD/MOA/MPIC/ MOSTI/MUWHLG/MRRD/MOHE/ MOH/State Governments
8	*Virtual Water and Water Footprint*	Water as a Resource and for Livelihood	EPU/NRE/KeTTHA/MOA/MPIC/ FMM/State Governments
9	*Water Financing*	Water as a Resource and for Livelihood	EPU/MOF/State Governments
10	*Water-Energy-Food Nexus*	Water as a Resource (*addressing trans-boundary issues*)	EPU/NRE/MOA/KeTTHA/ State Governments
11	*S&T Awareness, Advocacy, and Capacity Building*	Water as a Resource and for Livelihood	NRE/KeTTHA/MOA/MPIC/ MOSTI/MUWHLG/MRRD/ MOHE/State Governments
12	*International Networking and Collaboration*	Water as a Resource and for Livelihood	NRE/KeTTHA/MOA/MPIC/ MOSTI/MUWHLG/MRRD/ MOHE/State Governments
13	*Integrated Urban Water Management*	Water as a Resource and for Livelihood	MUWHLG/State Governments
14	*NWRP Action Plan*	Water as a Resource and for Livelihood	NRE/State Governments

The 14 Summary Briefs and Reports/Expert Reviews are appended in the Volume 2 of this report following the sequence as per listing (Table 4.2) that includes the names of the accredited agency/ author/expert:

Table 4.2: Complementary Component Plan Studies Summary Briefs and Reports/Expert Reviews

Appendix No.	Category	Complementary Component Plan	Agency/Author/Expert
4.2.1	Summary Brief	Integrated Flood Management	Dato' Ir. Hanapi Mohamad Noor
4.2.2		Integrated Drought Management	Dato' Ir. Hanapi Mohamad Noor
4.2.3		Water Quality Management	Dato' Halimah Hassan and Dr Saim Suratman
4.2.4		Water and Land Use (National Physical Plan)	Datin Paduka Dr Dahlia Rosly
4.2.5	Expert Review	Water and Health	Prof Dr Yang Farina Abdul Aziz FASc
4.2.6		Water and Green Growth	Prof Dr Chan Ngai Weng
4.2.7		Water and Gender	Sunitha Bisan
4.2.8		Virtual Water and Water Footprint	Dr Zainura Zainon Noor and Noor Salehan Mohammad Sabli
4.2.9		Water Financing	Datuk Ir. Mohd Adnan Mohd Nor FASc
4.2.10		Water-Energy-Food Nexus	Dr Hezri Adnan
4.2.11		S&T Awareness, Advocacy, and Capacity Building	Prof Dato' Dr Mazlin Mokhtar FASc and Dr Rahmah Elfithri
4.2.12		International Networking and Collaboration	Dr Salmah Zakaria FASc
4.2.13		Integrated Urban Water Management	Dr Low Kwai Sim FASc
4.2.14	Summary Report	NWRP Action Plan	Dato' Ir. Hanapi Mohamad Noor

Chapter 5

State IWRM Plans: Case Study on LUAS (Selangor)

As highlighted in Chapter 1 of this report, implementation of IWRM has yet to gain adequate traction on a national scale. This is largely related to governance issues, among which is the lack of concerted efforts for parallel action by State Governments to ensure that IWRM principles and practices are implemented in tandem with the Federal Government initiatives and programmes to ensure statewide penetration and reaching river basin, district, and grass root levels. It is all the more incumbent in the spirit of collaborative governance professed by the NWRP 2012 considering that 'ownership' of water as a resource is vested with the respective states.

The recent adoption by UN of the post-2015 SDGs over a 15-year time frame until 2030 has again endorsed IWRM with SDG 6.5 (reproduced below) specifically setting a target to implement IWRM at all levels by the year 2030.

> *"6.5. By 2030, implement integrated water resources management at all levels, including through trans-boundary cooperation as appropriate".*

In the Malaysian context achieving the SDG target demands that the 13 State Governments (11 in Peninsular Malaysia, Sabah, and Sarawak) assume shared responsibility with the Federal Government to implement the IWRM agenda. This is in compliance with the provisions of the Federal Constitution regarding Federal/State jurisdiction.

Water resources comprise lentic and lotic systems in both surface water (lakes and rivers) and groundwater (aquifers, underground storage dams, and groundwater flows). Under the Federal Constitution, water and land are state matters. The Federal Government has limited powers over shared waters (contained in rivers and aquifers); water-related infrastructural development works; and with regard to obligations under international treaties, conventions and agreements. Under Legislative Lists provided in the Constitution, apart from separate Federal and State lists, the Concurrent List includes matters pertaining to irrigation and drainage; and water supply and services. Hence, the sustainable management of water resources occurring within the state's administrative boundaries is very much a state responsibility. There are trans-boundary issues that need to be addressed that would

involve consultations and agreements with neighbouring State Governments which may require Federal Government intervention.

Majlis Sumber Air Negara **(MSAN)** or the National Water Resources Council was established in 1998 as an apex body to provide a forum for a holistic approach to the planning and management of water resources of the country. It is currently chaired by the Deputy Prime Minister with the Chief Ministers of all 13 States, Minister of Federal Territories, and water-related Federal Ministers as members. Since its establishment, there have been numerous decisions by MSAN that are dependent on nationwide implementation by the state administrations, especially those that are water resource management related. As for those which are water services related, in accordance with the Concurrent List, they require collaborative action and support from the states as part and parcel of their shared responsibility with the Federal Government. Listed below are some of the significant MSAN decisions that require prompt and concerted action by both parties:

- Inaugural Meeting held in June 1998 discussed and confirmed agreement on the formation of MSAN with the YAB Prime Minister as Chairman and members comprising the Deputy Prime Minister, all Chief Ministers and selected Federal Ministers with the Secretariat placed at the Ministry of Works. The Meeting discussed and agreed on the functions of MSAN and the need for an MOU binding the Federal and State Governments on decisions taken. Inter-state water transfer and related compensation and payment of royalties were also discussed.

- At its second meeting in July 2003, MSAN considered the paper MSAN 5/2003 from then Ministry of Agriculture regarding Integrated River Basin Management (IRBM) and directed that river basin management be carried out in an integrated manner to ensure that the use of land and water resources can be managed in a sustainable manner. MSAN also directed that river basin development master plans for each of the 189 major river basins in Malaysia be prepared and adopted by each state.

- MSAN 03 held in March 2007 discussed the need to arrest pollution at its source prior to entry into river systems. The meeting endorsed the proposal for the use of rainwater harvesting as a supplementary water source. Members were also informed on “Restructuring of the National Water Services Industry” and the potential of groundwater as a supplementary water resource for sustainable development.

- MSAN 04 held in July 2008 focused on the need to gazette river reserves; flood mitigation measures in flood areas; findings and recommendations from a NAHRIM led study on the impacts of climate change on water resources in Peninsular Malaysia. Information papers were also tabled at this meeting regarding the National Strategy Plan for Groundwater Resources Management; management and conservation of water catchment areas within permanent forest reserve areas in Peninsular Malaysia; and the role of JPBD in water resources management.

- MSAN 05 held in August 2010 addressed matters related to the resolution of issues involving rivers shared between states; water harvesting systems in public and private buildings; and reaffirmation of the one state, one river programme.

Information papers tabled were in relation to palm oil industry's efforts at effluent control into rivers; future directions in the development and management of agricultural water services; the need for maintenance of infrastructure and retention ponds by local authorities in compliance with MSMA; and *Kejayaan Sistem Tagal Dalam Memelihara Kualiti Sumber Air dan Kepelbagaian Biodiversiti di Negeri Sabah*.

- MSAN 06 held in October 2011 was of special significance as it saw the tabling (by NRE) and endorsement of the landmark National Water Resources Policy.

- MSAN 07 that met in November 2012, considered and approved the NRE/ NAHRIM submission for the adoption of the Strategy Plan for Integrated Lake Basin Management in Malaysia based on an ASM-led study report entitled *Strategy Plan for the Sustainable Management of Lakes and Reservoirs in Malaysia*. Information papers dealt with were regarding Federal-State cooperation in addressing flood issues; *infobanjir* as a media to disseminate early flood warning to the public; and the adoption of the second edition of MSMA.

- MSAN 08 that met in October 2013 directed State Governments for the early establishment of State Water Resources Councils. The meeting also passed for adoption guidelines for the control of integrated development in the coastal zone of the national coastal areas. The meeting was informed regarding guidelines developed pertaining to flood-proofing measures for development in flood corridors; interceptor systems along river reserves to mitigate pollution of rivers; adoption of guidelines for river sand extraction (amendment 2012); and water use and management for oil palm cultivation.

- MSAN 09 that met in October 2014 and focused on four main issues: developing long-term solution from urban flash floods; management of impacts from development of rainwater shelter structures for highland crops; developing a framework for sharing of water resource and treated water between neighbouring states, and strengthening capacity of dam operators for systematic and effective maintenance of dams.

- MSAN 10 was held in October 2015. Matters deliberated were: (a) The problem of illegal dumping of rubbish into river reserves and waterways; (b) The controlling of sand mining activities through the adoption of a revised and updated sand mining guideline; and (c) A strategy plan to address climate change impacts on water, considered together with the setting of a national agenda on integrated water research and the need for a research consortium to be formed.

- MSAN 11, held on 26 May 2016, agreed to the following: (a) Federal and State Governments to use groundwater as an alternate source to augment supplies to WTPs during droughts; (b) JPS and NAHRIM to develop a master plan for conjunctive use of rain water, stormwater, low surface flows and groundwater for Wilayah Persekutuan; (c) Consider inter-basin transfers to augment storage capacities in water deficit states; and (d) Water Demand Management and NRW reduction strategies pursued actively especially with regard to potable water supply.

5.1 State IWRM Plans: Governance, Scope, and Content

The National Water Resources Policy (2012) was formally launched in March 2012, having been endorsed earlier by MSAN. The Policy is based on the three essential principles of water resources security, water resources sustainability and collaborative governance. Its formal adoption by the states (with or without the inclusion of special provisions to meet the peculiar needs of each state) is vital to ensure national coherence and uniformity.

As reported above, MSAN at its eighth meeting in October 2013, had directed that State Water Resources Councils or *Majlis Sumber Air Negeri* (MSANg) be established in every state to ensure better coordination in implementing decisions made by MSAN. MSANg was also tasked with the role to discuss, implement, and coordinate with other government agencies when implementing these decisions that involve the state.

Consistent with NWRP 2012, IWRM is the adopted national paradigm moving forward and away from past fragmented approaches. The IWRM General Framework is best illustrated in the Figure 5.1. It is essentially about balancing development between "water as a resource" and "water for livelihood" and applicable at all hierarchical levels of water management.

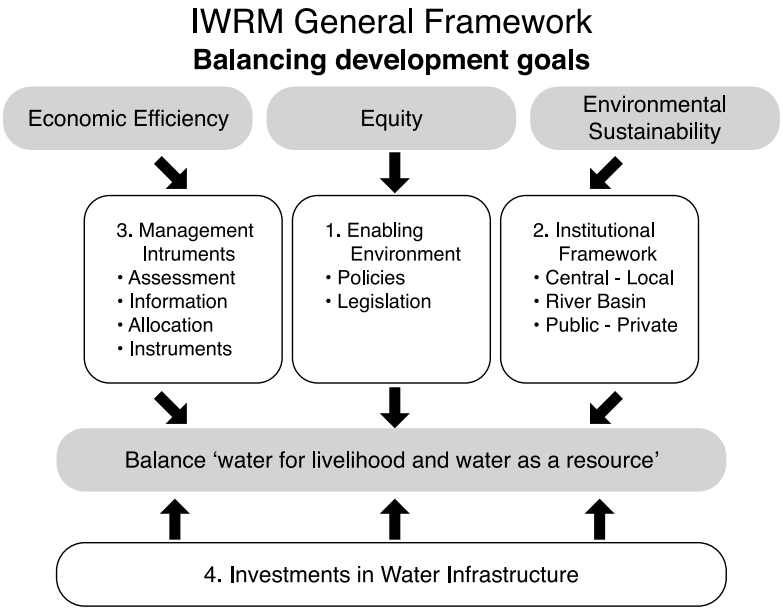

Figure 5.1: IWRM General Framework

Hence, in order to ensure compliance and timely delivery, it is vital that appropriate governance structures are established by all state administrations and comprehensive State IWRM Plans developed for implementation statewide. These plans would comprise IWRM implementation strategies complete with a road map organised according to a common IWRM

general framework format to address both aspects of "water as a resource" and "water for livelihoods" under the following headers:

(i) Enabling Environment;
(ii) Institutional Framework;
(iii) Management Instruments; and
(iv) Investments in Water Infrastructure.

5.2 Overview of Current Status Nationwide

As reported in Chapter 1 regarding the evolution of IWRM in the country, current progress by states in actively pursuing the implementation of IWRM to reach all levels of the hierarchy has not been encouraging. Sound policy and effective legislation managed by competent and efficient institutions formed the bedrock for good water governance. The contemporary NWRP launched in 2012 has provided the central policy thrust towards the sustainable management of the country's water resources.

(i) **Legislation:** Only three states have to date enacted water legislation that enables the holistic management of water resources within their respective state boundaries. The laws passed to date by the respective State Legislature are:
   (a) Sabah Water Resources Enactment 1998;
   (b) Selangor Waters Management Authority (LUAS) Enactment 1999; and
   (c) Kedah Water Resources Enactment 2008.

   States like Pahang, Johor, Pulau Pinang, Negeri Sembilan, Melaka, Perak, and Perlis that have enacted water resources enactments or have instituted amendments to existing water enactments, *have not incorporated fully provisions needed for the integrated management of water resources* as the enacted legislations were tailored more towards providing for regulatory functions to be performed by the state to complement the passing of the National Water Services Industry Commission Bill and WSIA in 2006. The state laws have only included elements like control in water catchment areas, provision for the post of State Director of Water Resources, licensing arrangements for raw water withdrawal and imposition of charges, drought orders, listing of offences, and penalties for breach of orders. The enactments are not comprehensive enough and far from meeting the requirements of IWRM principles and practices. The Sarawak Water Ordinance of 1994 has similar shortcomings.

(ii) **Institutional Structure:** Only three states have to date established State Water Resources Management bodies for the holistic management of their respective state's water resources and following IWRM principles and practices. They are:
   (a) Selangor WMA (LUAS) established in 2000 chaired by the MB of Selangor
   (b) Sabah Water Resources Council established in 2006 chaired by the CM of Sabah; and
   (c) Kedah Water Resources Board formed in 2008 chaired by MB of Kedah.

   Lembaga Urus Air Selangor (LUAS), for example, has since taken further steps to gazette the state's river basins for which appropriate institutional support structures have been set up to facilitate the implementation of integrated water management approaches, such as IRBM and ICZM, that not only enables but encourages greater stakeholder consultation and participation.

In response to MSAN 08 directive of October 2013, it is reported that Pahang, Perak, Melaka, Terengganu, Johor, Kelantan, and Perlis have respectively formed State Water Resources Councils.

In Sarawak, it is referred to as Sarawak Water Resource Council *(Majlis Sumber Air Sarawak)*, chaired by the State Secretary and instituted under the provisions of the Sarawak Water Ordinance of 1994.

Some states like Pahang, Johor, Pulau Pinang, Negeri Sembilan, Melaka, and Perlis who have enacted separate water resources enactments to complement the WSIA 2006, have also established State Water Regulatory Bodies with units placed under the State Secretary's Office, led by a designated Director. In the case of Sarawak, the State Water Authority appointed under the provisions of the Sarawak Water Ordinance performs this regulatory role.

(iii) **Urgent Need for Commonality:** What is clear from the above is that there is no common legal and institutional framework that has been adopted and practiced by all states, an essential prerequisite for good water governance both singly and collectively. The case for it is all the more demanding now that there is a NWRP 2012 in place which has the endorsement of MSAN and binding on all State Governments. It is understood that the NRE Ministry is in the final stage of drafting a common National Water Resources Act applicable to all states which professes IWRM as its central paradigm and is tailored to be in conformity with the aims and objectives of the NWRP 2012. Its urgent adoption by all states would ensure uniformity of application across the country, thereby providing the appropriate enabling environment and institutional framework to collectively advance the implementation of the IWRM agenda nationwide. It would also provide a suitable mechanism for States to act promptly on all MSAN decisions and directives, all within the spirit of collaborative governance espoused by NRWP 2012.

5.3 Majlis Sumber Air Negeri (MSANg)/ State Water Management Authorities (SWMAs)—LUAS as a Case Study

Currently, the status of development of MSANg in all states is at varying levels of progress. Hence, no attempt is made to venture into a detailed assessment of each of the MSANg. Noting that LUAS in the State of Selangor as being one of the earlier ones to be operative going back to the year 2000, ASM has included the LUAS experience as a case study. It is presented in the form of a summary brief (Volume 2 - Appendix 5.5) and highlighted the progress made since its inception and the strategies that are in place for the holistic and sustainable development and management of the state's water resources. A road map charting the strategies until the year 2030 organised according to the IWRM General Framework is also attached. The case study would form the basis for other states to follow or improve on to suit conditions peculiar to their respective states.

5.4 Implementation Road Map for State IWRM Plans Nationwide

Pursuant to Sections 5.2 and 5.3 above and the formation of MSANg, it is vital that all states take early action to expedite the reinforcement of the legal and institutional framework that would be catalytic to the institutionalisation of IWRM in the management of their respective

state water resources. One of the first tasks for the implementation agency (SWMA or equivalent) servicing the MSANg would be the formulation of State IWRM Plans and implementation road map designed over a 3MP time frame until 2030. It is recommended that for uniformity the plans follow a common format covering four elements consistent with the IWRM General Framework. Sample templates are attached in Appendices 5.1 to 5.4 to facilitate the early preparation of these plans which requires the commitment and undertaking to target completion during the first couple of years of the 11MP.

Appendix 5.1: Template of NIWRM Strategy Plan and Implementation Road Map for State IWRM Plans: Enabling Environment

Water as a Resource							
Category	**Strategy**	**Hierarchical Level**	**Lead Authority**	**Implementing Agency**	**Current Status**	**Target Completion**	**Remarks**
Policy							
Legislation							
Regulation							
Finance							

Appendix 5.2: Template of NIWRM Strategy Plan and Implementation Road Map for State IWRM Plans: Institutional Framework

Water as a Resource							
Strategy	**Hierarchical Level**	**Lead Agency**	**Composition**	**Functions**	**Current Status**	**Target Completion**	**Remarks**

Appendix 5.3: Template of NIWRM Strategy Plan and Implementation Road Map for State IWRM Plans: Management Instruments

Water as a Resource						
Category	**Strategy**	**Lead Agency**	**Collaborating Partners**	**Current Status**	**Target Completion**	**Remarks**
Information Management						
Planning and Development						
Operation & Maintenance						
Economic & Financial Instruments						
Legal (Licenses & Penalties)						
Research, Development & Innovation						
Awareness Raising, Advocacy and Capacity Building						
Participatory Management						
International Collaboration						

Appendix 5.4: Template of NIWRM Strategy Plan and Implementation Road Map for State IWRM Plans: Investments in Water Infrastructure

Water as a Resource							
Item	**Water Infrastructure Development Programme**	**Lead Implementing Agency**	**Collaborating Partners**	**Entry Point Projects**	**Estimated Cost**	**Target Completion**	**Remarks**
1							
2							
3							
4							
5							

Chapter 6

Transforming the Water Sector: National Integrated Water Resources Management Plan Strategies and Road Map

6.1 Malaysia's Vision 2020 and the National Transformation Programme

Since the early 1990s, Malaysia has embarked on Vision 2020 to attain developed nation status by the year 2020. In renewed efforts for timely achievement of this goal and to help fast-track the process, the country has in the year 2010, launched the National Transformation Programme (NTP) comprising both a Government Transformation Programme (GTP) and an Economic Transformation Programme (ETP) which was followed by the Political Transformation Programme, the Community Transformation Programme, Social Transformation Programme, and the Fiscal Transformation Programme.

The GTP is a broad-based programme of change to fundamentally transform the Government into an efficient and people-centred institution. It focuses on seven pressure points designated as National Key Results Areas (NKEAs) to improve the socio-economic growth of the country.

The ETP was launched in September 2010 with its goal to elevate the country to a developed nation status by 2020, targeting a gross national income (GNI) per capita of USD15,000. To achieve this, USD444 billion in investments is targeted, which will create 3.3 million new jobs.

The ETP's targets for 2020 will be achieved through the implementation of 12 NKEAs representing economic sectors which account for significant contributions to GNI and job creation. The ETP is also centred on raising Malaysia's competitiveness through the implementation of six Strategic Reform Initiatives, comprising policies which aim to strengthen the country's commercial environment to ensure Malaysian companies are globally competitive.

The 12 NKEAs are indicated in Table 6.1. Each NKEA has Entry Point Projects (EPPs), which explore new growth areas and business opportunities (BOs) to enable the sector to move further up the value chain.

Table 6.1: National Key Economic Areas (NKEAs)

1. Oil, Gas, and Energy. 2. Palm Oil and Rubber. 3. Financial Services. 4. Tourism. 5. Business Services. 6. Electronics and Electrical.	7. Wholesale and Retail. 8. Education. 9. Healthcare. 10. Communications Content and Infrastructure. 11. Agriculture. 12. Greater Kuala Lumpur/ Klang Valley.

Water is an integral part of the Water-Energy-Food Nexus and an important element in nine of the NKEAs listed above. Water is also high on the agenda both internationally and nationally. Hence water should have deservedly been on the list of NKEAs under the ETP.

6.2 The Malaysian Water Vision and Framework for Action

The **Malaysian Water Vision** formulated in the year 2000 is as reproduced below:

> *"In support of Vision 2020 (towards achieving developed nation status), Malaysia will conserve and manage its water resources to ensure adequate and safe water for all (including the environment)".*

The key objectives of the Malaysian Water Vision are:

(i) **Water for people** — all communities will have access to safe, adequate and affordable water supply, hygiene, and sanitation;

(ii) **Water for food, agriculture and rural development** — provisions of sufficient water to ensure national food security and promote rural development;

(iii) **Water for economic development** — provisions for sufficient water to spur and sustain economic growth within the context of a knowledge-based economy and e-commerce;

(iv) **Water for the environment** — protection of the water environment to preserve water resources (both surface and groundwater resources) and the natural flow regimes, biodiversity and cultural heritage as well as the mitigation of water-related hazards; and

(v) **Water for Energy** — this has been added in to reflect the current trends on the water-energy-food nexus, looking at it in terms of both policy and process, as water is inextricably linked to agriculture, food production and where there is an urgent need for continuous improvements in water and energy efficiencies to ensure sustainable economic growth.

To complement the Vision statement, a National Framework for Action was also developed and structured to achieve the key objectives, entailing:

(i) Managing water and water resources efficiently and effectively (addressing both quantity and quality aspects) as water demands increase in tandem with population growth and industrialisation;

(ii) Moving forward towards IRBM and ILBM taking full cognizance of river and lake basins as geographical units with well-defined boundaries containing the sum of all hydrological processes operating within them, and transcending political and administrative constraints, making them ideal water management units to address water problems;

(iii) Translating awareness to political will and capacities to create an enabling environment for the much needed institutional reforms to deal with the deterioration of water quality, a decrease in water availability and conflicts among users (irrigation, hydropower, industry, and domestic users). There is also a need to instil awareness of the economic, social, and environmental values of water among politicians, decision makers, and all stakeholders; and

(iv) Moving towards adequate (safe) and affordable water services (befitting a developed nation status by 2020) through the provisions of adequate infrastructure for water delivery to all sectors of the economy.

6.3 The Malaysian Water Scenario

The National Water Resources Study (NWRS) 2011 commissioned by the Ministry of Natural Resources and Environment (NRE) and completed in the year 2011 provides a comprehensive assessment of the current water situation in Malaysia both at the national level and also broken down according to the various states. The Study has also undertaken projections of the state of the country's water until the year 2050 addressing issues related to supply and demand as well as measures required to ensure the sustainable management of water resources and the protection of the environment.

In brief, the Study reports that Malaysia's annual rainfall is around 973 billion cubic metres (BCM), of which 414 BCM is lost to the atmosphere as evapotranspiration, surface runoff amounts to 496 BCM and some 63 BCM contributes towards groundwater recharge. Consumptive demand was assessed to be 14.8 BCM in 2010 and predicted to rise to 17.2 BCM in 2020 and to 18.2 BCM in 2050 (Figure 6.1).

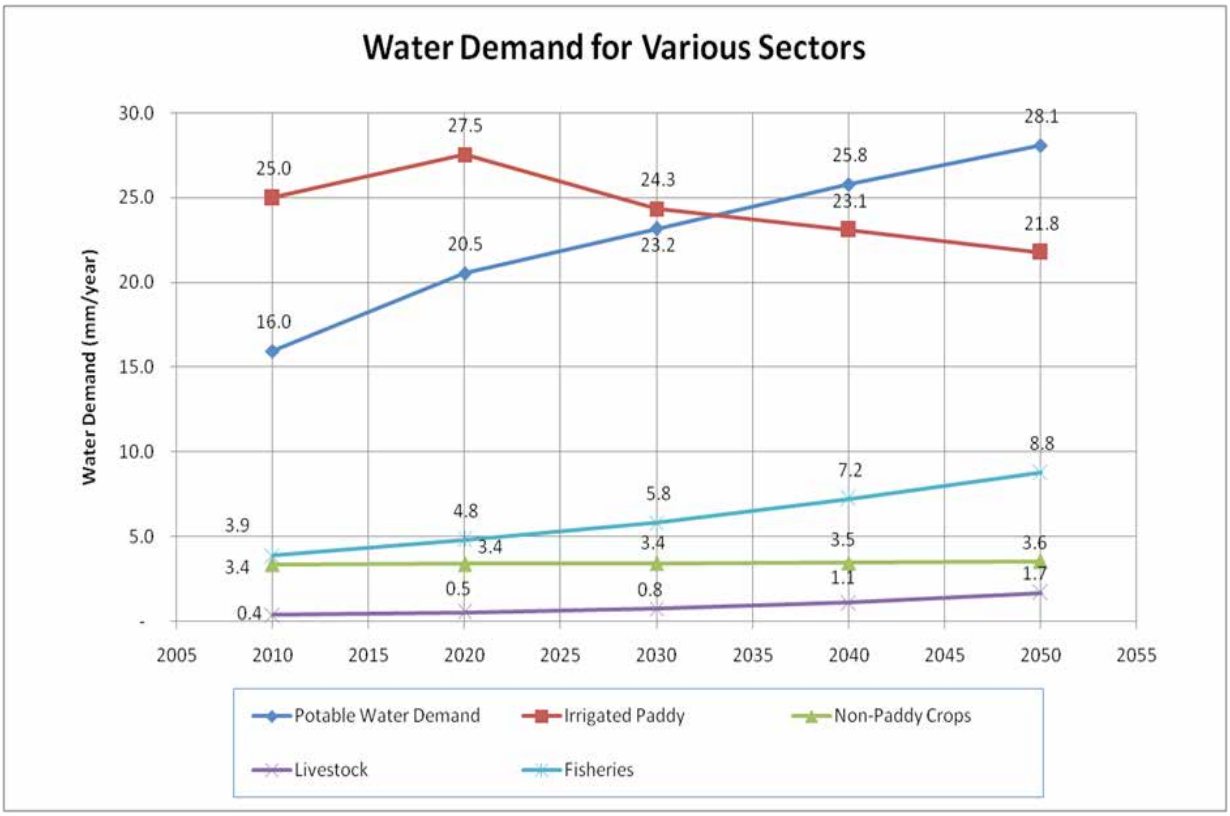

Figure 6.1: Consumptive Water Demand Projections (BCM/Year)

With total effective rainfall estimated at around 74 BCM, it makes the available resource four times above the projected need and yet Malaysia suffers from seasonal water shortages.

Some of the **major water-related issues and challenges** that need to be addressed nationwide are as follows:

(a) **Regional Water Stress:** Based on the current and projected consumptive water demand against total surface water availability, the NWRS 2011 highlighted some 'water-stressed' growth regions and states such as Perlis, Kedah, Pulau Pinang, Selangor, and Melaka were reported as water deficit states (Table 6.2).

Table 6.2: Total Consumptive Water Demand against Total Surface Water Availability for all Sectors

State	Land Area sq km	Total consumptive Water demand (MCM)					Effective rain (MCM/Year)	Excess/deficit (MCM) - Unregulated Flows				
		2010	2020	2030	2040	2050		2010	2020	2030	2040	2050
Perlis	821	306	299	286	284	281	60	(246)	(239)	(226)	(224)	(221)
Kedah	9,500	2,922	2,976	2,842	2,873	2,876	1,070	(1852)	(1906)	(1772)	(1803)	(1806)
Pulau Pinang	1,048	765	829	835	874	894	130	(635)	(699)	(705)	(744)	(764)
Kelantan	15,099	1,632	1,619	1,586	1,600	1,604	2,650	1018	1031	1064	1050	1046
Terengganu	13,035	884	975	970	999	1,026	3,310	2426	2335	2340	2311	2284
Perak	21,035	1,949	1,923	1,798	1,801	1,811	3,140	1191	1217	1342	1339	1329
Selangor	8,396	2,238	2,491	2,570	2,760	2,922	960	(1278)	(1531)	(1670)	(1800)	(1962)
Pahang	36,137	726	946	897	911	959	6,460	5739	5514	5563	5549	5501
Negeri Sembilan	6,686	340	361	358	366	374	640	300	279	282	274	266
Melaka	1,664	323	366	376	409	439	140	(183)	(226)	(336)	(269)	(299)
Johor	19,210	715	881	1,033	1,164	1,301	3,290	2575	2409	2257	2126	1989
Pen Malaysia	132,631	12,800	13,664	13,551	14,040	14,488	21,170	8370	7506	7619	7130	6682
Sabah	73,631	912	1,356	1,392	1,442	1,469	16,210	15298	14854	14818	14768	14741
Sarawak	124,450	1,054	2,162	2,125	2,175	2,247	27,440	26386	25278	25375	25265	15193
WP Labuan	91	18	24	26	28	29	30	12	6	4	2	1
East Malaysia	198,172	1,985	3,541	3,542	3,645	3,745	53,190	51205	49649	49648	49545	49445
Total Malaysia	330,803	14,785	17,205	17,093	17,685	18,233	74,350	59565	57145	57257	56665	56117

Source: National Water Resources Study (2011)

This has been borne out by recurring crises of potable water shortages that occurred recently in 2014 and 2015 in several states which had led to water rationing. The affected states were Selangor, Negeri Sembilan, Johor, Perak, and Federal Territory (Kuala Lumpur and Putrajaya).

Temporal and spatial variability of rainfall, coupled with high population densities and/or extensive agricultural activities in these regions have led to water demands exceeding the carrying capacity of the respective river basins. The situation has been further exacerbated by resultant pollution affecting the ecology and the functional capacity of the aquatic ecosystems. Measures taken in the past to augment supplies have largely been through shared river basins and inter-basin water transfers. The sharing of the Klang, Langat, and Selangor rivers and supplemented further with waters transferred from Pahang (Langat 2) to service the densely populated greater Klang Valley is a case in point. Similarly, the high water demand to support the granary areas of MADA and Seberang Perai is serviced by regulated waters drawn from the Muda River catchment (falling largely in the state of Kedah) and shared among the States of Perlis, Kedah, and Pulau Pinang.

(b) **Flooding:** Located in the humid tropics, Malaysia is subject to seasonal torrential rains brought by the south-west and north-east monsoons with

the year-end north-east monsoon normally being the more severe one. There are 189 main river systems in Malaysia of which 85 are prone to frequent flooding. Despite the many flood mitigation measures undertaken over past years, recent trends indicate that the magnitude of flooding is on the rise and hence has become a major national issue. Following the rapid pace of Malaysia's economic growth coupled with pressures from an increasing population, development has inevitably encroached into catchment areas, river corridors, and flood plains which have led to greater incidences of floods and ensuing damages. An estimated 29,720 km^2 or 9% of Malaysia is flood prone and the annual flood damages in Malaysia is approaching closer to RM2 to RM3 billion in recent years.

Based on information obtained from National Disaster Management Agency, the 2014/2015 Northeast Monsoon season resulted in the worst flooding the country had experienced in modern times, in the East Coast of Peninsular Malaysia namely the States of Kelantan, Terengganu, and Pahang. The States of Perak, Johor, Selangor, Perlis, Sabah, and Sarawak were also inundated. DID rainfall records showed that for the upper reaches of Sg. Kelantan, Sg. Pahang, and Sg. Perak, the rainfall exceeded the 100-year return period. The other contributing factors were reported to be extensive land-clearing in the highlands and encroachment into the flood corridors.

According to data from the Department of Welfare, 541,896 people were affected nationwide and the Government had to bear a total of RM2.58 billion in losses to public infrastructure alone.

During a Special Address on 20 January 2015 regarding current issues which includes measures to be undertaken by the Government following the floods, the Prime Minister of Malaysia had allocated a budget of RM893 million for flood mitigation works, RM800 million as initial allocation for the repair and reconstruction of basic infrastructure like schools, hospitals, roads, and bridges, RM500 million for rehabilitation works and welfare programmes, and RM500 million special relief facility for SME loan financing.

Severe landslides and debris flow in Kampung Raja, Pekan Ringlet, and Bertam Valley in the resort area of Cameron Highlands in November 2014 killed five people and affected 100 victims from 28 families. A similar event occurred in 2013. The main causes for these recurring flood events have been attributed to the use of rain shelters made out of plastic roofing materials for extensive vegetable farming in the highlands resulting in increased surface water runoff being directly discharged into rivers triggering flash floods. The flash floods have been further aggravated over the years by the uncontrolled opening of forest lands for illegal vegetable farming and also due to the lack of enforcement by the local authorities.

(c) **Pollution of Water Sources:** Pollution of water bodies, either lentic or lotic systems, has evidently been on the rise nationwide. A 2004 report entitled *A Study on the Status of Eutrophication*

of Lakes in Malaysia, confirmed that out of the 90 lakes that were studied, 56 (62%) were in a poor condition (eutrophic), while the balance was in a mediocre to reasonably good state (mesotrophic). The Study went on to conclude that eutrophication of lakes has reached levels for serious concern and restoration efforts were urgently needed for many lakes.

The Department of Environment (DOE) under the NRE Ministry is responsible for enforcing the Environmental Quality Act (EQA, 1974). The Act was enacted for the abatement and control of pollution and enhancement of the environment, which includes river water quality. According to the DOE, Malaysian rivers are degraded by both point and non-point sources of pollution. The major point sources of pollution in rivers are from sewage treatment plants, agro-based industries, manufacturing industries, sullage or grey-water from commercial and residential premises, and pig farms. Non-point source (or diffuse) pollution is largely due to storm runoff after a downpour. Earthworks and land clearing activities contribute to siltation of rivers and can be both point and non-point sources of pollution. The many recent shut-down of the water treatment plant (WTP) in the Sg. Langat area was reported to be attributed to pollution caused by factories upstream.

For groundwater, the *ASM Ground Water Advisory Report* (2011) had stated that pollution and habitat degradation are important factors leading to the loss of functional value in groundwater. In 2009, out of the 81 wells sampled by the Department of Environment, most recorded levels of arsenic, iron, manganese, and coliforms exceeding the limits set by the National Guidelines for Raw Drinking Water, established by the Ministry of Health. While some of these would have arisen from the surrounding sediment, parameters such as coliforms would have clearly had an anthropogenic origin. The NWRS (2011) had further stated that through pollution from solid wastes, surface, and groundwater pollution by leachates (heavy metals, toxic organic compounds, acidity) had several adverse effects on human health reflected in the form of carcinogenic symptoms, skin disorders, neurotoxicity, kidney damage, suppressed immunity, digestive disorders, as well as adverse effects on flora and fauna. Protecting groundwater recharge areas need emphasis. Careful planning, comprehensive resource management, and enforcement of regulations in relation to pollution and soil conservation, would mitigate much of the impacts that befall groundwater.

(d) **Environmental Degradation:** Decades of economic development, comprising large-scale land development, urbanisation and industrialisation, coupled with efforts to meet the needs and provide opportunities for a rising population, have significantly changed both the urban and rural landscape. Such change has inevitably had its toll in the continuing degradation of both the terrestrial and aquatic ecosystems.

Ecosystem services are the benefits people obtain from ecosystems (Figure 6.2). These include provisioning, regulating, and cultural services that directly affect people and supporting services needed to maintain the other services.

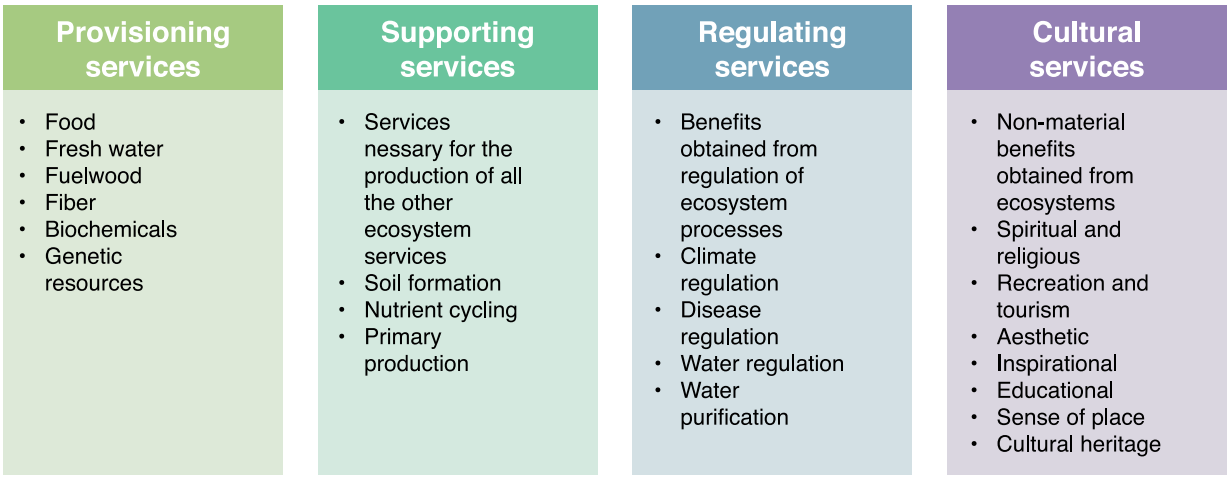

Figure 6.2: Ecosystem Services (Millennium Ecosystem Assessment 2005)

Based on the country's track record to date and as reported in NWRS (2011), one can reasonably conclude that in exploiting the ecosystem provisioning service functions for multiple purpose use and development, the ecosystem-regulating service function has largely been neglected resulting in depleted and degraded stream flows threatening loss of biodiversity in both the terrestrial and aquatic environment and particularly so in the more developed river basins.

(e) **Fragmented Management and Conflicts among Sectors:** Under the constitution, matters pertaining to natural resources such as land, minerals, forests, and water fall under the jurisdiction of the states. Water becomes a Federal matter only if a dispute arises as in the case of a shared river basin between two or more states. Otherwise, State Governments are responsible for water management including the gazettement of water catchments. Currently, only three states have the equivalent of a State Water Resources Council backed by appropriate legislation to oversee water resources governance in their respective states. They are Selangor (Selangor Water Management Authority); Kedah (Kedah Water Management Board); and Sabah (Sabah Water Resources Council).

At the Federal level, the governance and administration of water resources involve several ministries, departments and agencies. Water resources development is sectorally based, a legacy from the past. Since the year 2004, however, the creation the NRE Ministry saw the clear separation of powers between "water as a resource" and "water for utilities". Management of water as a resource is vested with the NRE Ministry which also includes the management of water-related hazards such as floods and droughts. Water for agriculture comes under the purview of the Ministry of Agriculture and Agro-based Industries, while potable water supply, sewerage services, and hydropower generation falls under the

Ministry of Energy, Green Technology and Water (KeTTHA). The Ministry of Health deals with water supply and sanitation in areas not covered by KeTTHA. Urban drainage and stormwater retention in urban areas is under the Ministry of Local Government and Housing. Water legislations are contained within the laws that are enforced by the various water-related government agencies and are focused on specific aspects of water resources that are under the jurisdiction of the respective agencies. There are gaps and overlaps. Conflicts in water resources management such as allocation of water rights, flood management, pollution control, and environmental protection are resolved through inter-agency coordination and consultation.

In order to resolve persistent disagreements, the Federal Government established the National Water Resources Council (NWRC) in June 1998 with the foremost intention to pursue a more effective and cohesive water management by various states that includes the initiation of inter-state water transfers. The NWRC as the apex advisory and coordinating body for water resources governance was entrusted to formulate, among others, a national water policy as well as establish guidelines to ensure long-term sustainable development and management of the country's water resources. The National Water Resources Policy (NWRP) has since been formulated and officially launched in March 2012.

(f) **Climate Change Impacts:** Exposure of people and assets to hydro-meteorological hazards in Asia Pacific, including Malaysia, has been growing over the past few decades. Malaysia has seen rapid urbanisation, economic growth, and changes in local environmental conditions whereby more assets and people are located in hazardous areas such as flood plains and coastal lowland areas. The country has of late experienced extended droughts and widespread flooding and expected to continue to be more exposed and vulnerable to such natural hazards. Climate change is anticipated to create extreme events, with some projections including an increase in the frequency of years with above normal monsoon rainfall or extremely rainfall deficient.

An increase in rainfall extremes of landfall cyclones in South and East Asia have been recently projected in the IPCC's AR5 (Fifth Assessment Report), along with greater monsoon precipitation and increased drought in some areas over the long term. Consequential impacts from two likely scenarios are listed in Table 6.3:

Table 6.3: Climate Change and its Impact on Water Resources

Scenario 1: Increases in temperature and increase in rainfall	Scenario 2: Increases in temperature and reduced rainfall
Increased inflow to water storages	Reduced inflows to water storages (dams and reservoirs)
Increased pressure on water storage infrastructure	Reduced stream flows
Increased availability of water for rain-fed agriculture	Reduced water availability for rain-fed agriculture
Increase risk of flood damage	Reduced recharge of groundwater
Possible changes to ecosystems	Threatened water supplies to cities and towns, agricultural, industrial, and environmental needs
	Severe droughts

The World Economic Forum's Global Risks Report 2016 found that the risk with the greatest potential impact in 2016 is the failure of climate change mitigation and adaptation. This year, it is considered to have greater potential damage than weapons of mass destruction (2nd), water crises (3rd), large-scale involuntary migration (4th), and severe energy price shock (5th).

6.4 Transforming the Water Sector: National IWRM Plan and Implementation Road Map

Rationale

As highlighted in *Section 6.3* above, Malaysia is blessed with fairly abundant rainfall. The adequate provision of quality water to meet the country's short-, medium-, and long-term needs is hence not one of water resources availability but more of sound management and good governance. "Business as usual" following past fragmented approaches and practices is no longer an option in moving forward towards meeting the country's Vision 2020 aspiration and subsequent 2030 SDGs targets.

Chapter 1 of this report *(Section 1.1)* has provided an overview of the evolution of IWRM since its adoption in Malaysia in the early 1990s, reporting both the limited successes achieved to date and the weaknesses observed in its implementation. While most of the efforts taken to date have raised general awareness regarding IWRM and some changes to institutional arrangements, such efforts have yet to translate into tangible actions by water-related authorities at Federal and State levels to ensure the infusion of IWRM principles and practices in their respective sector or sub-sector activities. Intra-ministry integration

and mechanisms for inter-ministry dialogue to enable the holistic management of water both as a resource and as a utility have yet to be institutionalised. The situation is no better with the state administrations though a few of the states have taken positive steps to enact contemporary legislation adopting IWRM as the central philosophy and have established institutional structures (such as LUAS) to facilitate holistic management of water resources.

Expectations

Concerted and sustained efforts in the adoption and implementation of the IWRM nationwide is the way forward to meeting the goals of *national water security* and to ensure the *transformation of the water sector* into a vibrant and integral component of the NTP.

Attaining "water security" (Box 6.1) in the Malaysian context involves the timely and successful delivery of a host of expectations listed hereunder:

- To ensure the pivotal role of water in economic development and as an integral part of the water-energy-food nexus;
- Implementation of IWRM across all sub-sectors and levels of hierarchy;
- A well-structured and regulated water and sanitation industry providing quality and efficient services and rationalised tariff settings with provisions for targeted subsidies;
- Green growth and the adoption of the 3Rs to minimise water footprints and ensure better care for the environment;
- Optimum use of the full range of water resources development options used singly or conjunctively including wise wastewater reuse, treated or otherwise;
- Improved agricultural water management to ensure "more crop per drop";
- Shift towards more Water Demand Management than Supply Management in both potable and agricultural water usage;
- Integrated Urban Water Resources Management to counter urbanisation

Water Security Defined

Water Security (UNESCO – IHP 2010) is the capacity of a population to safeguard access to adequate quantities of water of acceptable quality for sustaining human and ecosystem health on a watershed basis, and to ensure efficient protection of life and property against water-related hazards — floods, landslides, land subsidence, and drought

Water Security (UN Water 2013) is the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability

Box 6.1: Water Security Defined

impacts and the "twin dilemma of cities" (provision of safe, clean water and adequate sanitation);

- Ecosystems regulating functions restored and sustained;
- Disaster ready (floods, droughts, water-borne diseases, tsunamis, land, and mudslides);
- Climate change prepared;
- Harnessing of science, engineering, technology, and innovations developed through multi-disciplinary R&D programmes;
- Efficiency enhancement through continuing skills development of water resources managers and water utility providers at all hierarchical levels delivered by Training Centres established in strategic locations nationwide. These centres would also conduct awareness and capacity building programmes for public and community stakeholders targeted towards encouraging greater participatory management; and
- Achievement of 2030 Sustainable Development Goals and Solutions, and Concerted Public-Private-People support for a vibrant water sector, wealth creation, and export of products and services.

IWRM General Framework

The NWRP 2012 has reaffirmed Malaysia's commitment to IWRM for the sustainable management of the country's water resources. IWRM is defined as *"A process which promotes the coordinated development and management of water, land, and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems"* – GWP.

IWRM calls for the balanced development and management of "water as a resource" and "water for livelihood". Implementation of the IWRM agenda involves the integration of both natural and human systems (see Figure 6.3 below). On the natural system front, it would entail the integration of land and water management, of surface water and groundwater management, of quantity and quality, and of upstream and downstream water-related interests. On the human system front, it would involve ensuring that policies and priorities take account of water resource implications; that there is cross-sectoral integration in policy development; that macroeconomic effects of water resource development are properly accounted for; and that water management considerations are integrated into urban planning.

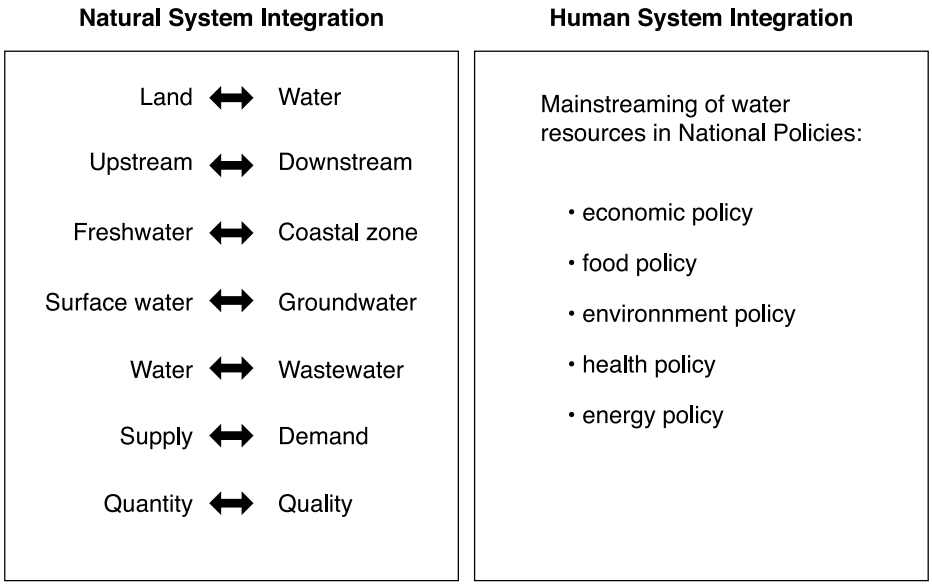

Figure 6.3: The IWRM Agenda Involves the Integration of both Natural and Human Systems

The IWRM General Framework aims at balancing development goals founded on the 3E's principle of economic efficiency, equity, and environmental sustainability as depicted in Figure 6.4:

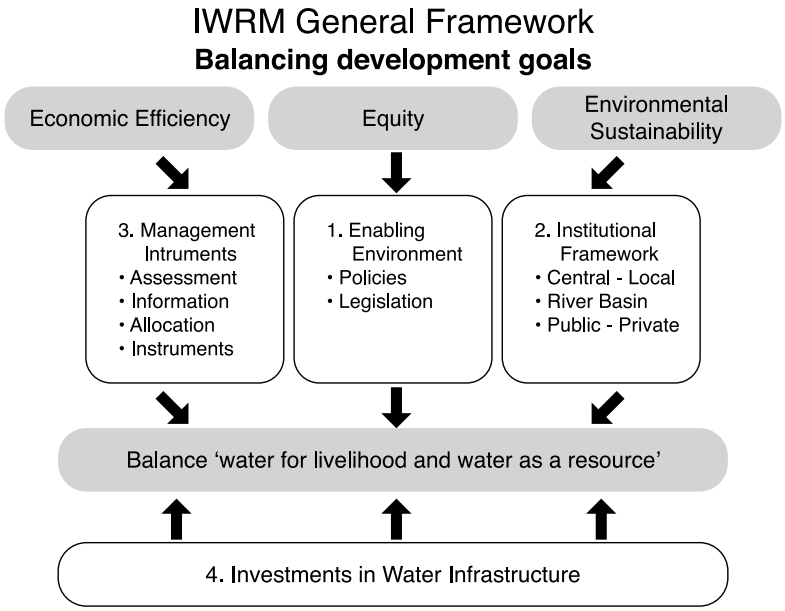

Figure 6.4. IWRM General Framework

For its successful implementation, planned strategies and action plans are categorised under four practical elements (Box 6.2) summarised as follows:

(a) An enabling environment comprising policies, laws, and plans;

(b) An institutional framework;

(c) Use of management and technical instruments; and

(d) Investments in water infrastructure.

Integration in IWRM must work horizontally (through cross-sector and stakeholder dialogue) as well as vertically (across all levels of hierarchy from the river basin to state, national and trans-boundary basin levels).

IWRM General Framework

GWP introduced four practical elements that have shaped the agenda on IWRM since 2000:

- A strong enabling environment — policies, laws, and plans that put in place 'rules of the game' for water management that use IWRM;
- A clear, robust, and comprehensive institutional framework — for managing water using the basin as the basic unit for management while decentralising decision-making;
- Effective use of available management and technical instruments — use of assessments, data, and instruments for water allocation and pollution control to help decision makers make better choices; and
- Sound investments in water infrastructure with adequate financing available — to deliver progress in meeting water demand and needs for flood management, drought resilience, irrigation, energy security, and ecosystem services.

Box 6.2: IWRM General Framework

Source: Integrated Water Resource Management: A New Way Forward — Discussion Paper of the World Water Council Task Force on IWRM at the 7th World Water Forum 2015.

Component Plan Development and Stakeholder Consultations Chapter 2 of this report has elaborated in depth regarding the ASM initiative undertaken since 2008 to develop a National IWRM Plan. In pursuing this objective, the overarching IWRM concept was broken down into discrete sub-sets or sub-themes identified with the view of developing Component Plans that adopt a common IWRM General Framework and hence assimilate IWRM principles and practices relevant for each sub-set or sub-theme. The methodology adopted was multi-disciplinary and included strategic consultations held with associated stakeholder groupings. The outcome of this ASM initiative has to date yielded some nine Component Plan study reports.

Chapter 3 of this report comprises a compilation of the summary briefs of the completed nine Component Plan study reports (Volume 2 - Appendices 3.2.1 to 3.2.9). The summary briefs include a listing of recommended strategies supported by an implementation road map organised following the IWRM General Framework format.

ASM also undertook the Mega Science Study aimed at a longer-term horizon until the year 2050. The first phase of this study included the Water Sector. The Study, completed in the year 2009, recommended the inclusion of "water for wealth creation" in addition to sustaining the resource which recognises the sector as a source of growth of the national economy by way of exploitation of the full potential of income-generating value-added products and services that can be derived from it. A summary brief of this Mega Science Study has been included as yet another ASM Component Plan which is reported as an appendix in the Transforming the Water Sector: NIWRM Plan: Strategies and Road Map, Volume 2 - Appendices 3.2.10

While Chapters 2 and 3 focused on component plan development undertaken by ASM through its respective Task Forces, there have also been similar parallel initiatives by others on IWRM related sub-sets and sub-themes. ASM has solicited expert reviews on those topics that are identified and considered significant but not as yet addressed directly by ASM or others. Chapter 4 of this report has been devoted to capturing such initiatives and reviews referred to as Complementary Component Plans to ensure optimum depth and coverage of the IWRM paradigm prior to the formulation of an overarching National IWRM Plan. A total of 14 complementary reports are included as Appendices 4.2.1 to 4.2.14.

State IWRM Plans: The National IWRM Agenda cannot be complete and effective without a matching set of State IWRM Plans to ensure nationwide penetration and implementation. This is all the more relevant in the Malaysian context since the country is for all intents and purposes a Federation of 13 States (11 in Peninsular Malaysia plus Sabah and Sarawak) where the respective state's sovereign rights, especially over land and water, are safeguarded by the Federal Constitution.

Chapter 5 of this report is specially devoted to the development and formulation of State IWRM Plans by respective State Governments organised on similar lines and format adopted under the common IWRM General Framework for the sake of uniformity and consistency in application. ASM also noted that not all state administrations are ready as yet with the necessary governance structures in place to undertake this task. Hence, ASM has used the work undertaken by LUAS, a State Water Resources Management Authority created by the State of Selangor in the year 2000 as a case example to illustrate the extent and scope of the efforts required for the formulation of a comprehensive set of State IWRM Plans for implementation complete with road map. Similar parallel commitments and efforts are required by all states to develop such State IWRM Plans as a matter of urgency. They would then complement and become an integral part of the proposed National IWRM Plan: Strategies and Road Map. The NRE Ministry as the custodian ministry for the country's water resources is best placed to oversee this parallel action by states.

National IWRM Plan: Strategies and Road Map

NBOS and the National IWRM Plan: Under the GTP, the Malaysian government has adopted Blue Ocean Strategy in its strategic planning and operations to deliver programmes and services to the public that are high impact, low cost, and rapidly executed. Through the NBOS, over 80 ministries and agencies are collaborating to formulate and execute creative blue ocean strategy initiatives that are transforming the country.

Similarly and in line with NBOS, the Transformation of the Water Sector requires integrated solutions to move away from past fragmented approaches. This is best realised from concerted efforts to effect change through a wide array of component action plans and State IWRM Plans anchored by a central National IWRM Plan (Box 6.3).

What are National IWRM Plans?

Simply put, a National IWRM Plan is a plan for better water management — a road map to guide the changes needed to move from fragmented to integrated ways of developing, managing and using a country's water resources, and accelerate actions towards those ends. It clearly establishes the goal posts and the road to achieving them, and the milestones along the way. A Plan, therefore, must:

- Describe the current way water resources development and management decisions are made and actions taken;
- Outline where the country wants to be in the future in terms of decisions made and actions taken to solve problems; and
- Map out how it plans to move from where it is now to where it wants to go, with milestones and time frames.

Box 6.3: What are National IWRM Plans?

Source: GWP Guidelines for preparing National IWRM and Efficiency Plans (April 2004).

Component and state plans and programmes would need to be implemented concurrently nationwide and led by the key ministries and relevant state administrations with entrusted responsibilities, be it under water resource management or water utility provision and working closely within the spirit of collaborative governance.

The three principles of water resource security, water resource sustainability and collaborative governance laid down by the NWRP 2012 will be the core rationale underpinning the transformation process.

Under the ongoing ETP, water underlies all of the 12 NKEAs to varying degrees and scale. Some of the areas like agriculture and energy rely heavily on the availability and harnessing of water for growth and yet water was not explicitly recognised as an NKEA. Hence, it is vital that water is accorded the high priority that it deserves on the national agenda and recognised as a National Key Priority Area (NKPA) with a slew of EPPs implemented to ensure the timely transformation of the water sector.

Taking into consideration the enormity of the proposed National IWRM Plan, it may now be no longer practicable to aim for a 2020 transformation target. A more realistic target over three Malaysia Plans by the year 2030 is considered feasible thereby coinciding with the target year set by UN to achieve the Sustainable Development Goals (SDGs).

The Plan: The component and state plans developed through a process of strategic consultations described above provide a sound basis for the development and implementation of a holistic and inclusive National IWRM Plan spanning over the short, medium, and long term. The Plan would be then instrumental in driving the transformation of the water sector nationwide for a better future.

The component and state plans have been structured and formatted conforming to a common IWRM general framework (Figure 6.4) that include an implementation road map where relevant.

The NKPA on Water (Volume 2 - Appendix 6.5) undertaken by ASM in 2014 with the twin objectives of water security and water economic opportunities recommended 15 major investment programmes (10 under "water as a resource" and five under "water for livelihood") that include a total of 72 EPPs that have been identified for implementation. Since

then, the Component Plan studies referred to under Chapter 3 of this report have identified additional investments required for specific programmes raising the total to 95 EPPs. A combination of the outputs from these two sources makes up the list of **"Investments in Water Infrastructure"** rearranged and classified into three categories, namely:

(a) Cross-cutting Programmes (5 programmes and 14 EPPs);
(b) Programmes related to "Water as a Resource" (5 programmes and 48 EPPs); and
(c) Programmes related to "Water for Livelihood" (5 programmes and 33 EPPs).

A summary list of the programmes is shown in the table 6.4:

Table 6.4: List for Programme for Investments in Water Infrastructure

A. Cross-cutting Programmes (14 EPPs)	
1. Central Water Resources Database 2. Integrated Water Research 3. Climate Change Adaptation 4. Awareness Raising, Advocacy, Capacity Building 5. Meetings, Incentives, Conference, and Exhibition	
B. Programmes related to "Water as a Resource" (48 EPPs)	**C. Programmes related to "Water for Livelihood" (33 EPPs)**
1. Integrated River Basin Management and Integrated Aquifer Systems Management 2. Water-related Hazards 3. Ecosystem Services 4. Water Pollution Monitoring and Rehabilitation 5. Water-based Recreation and Tourism	1. Development of Alternative Water Sources 2. Water Supply and Wastewater Services Sector 3. Energy Sector 4. Agricultural Water Services 5. Commercial Water to Shipping

The proposed National IWRM Plan: Strategies and Road Map (henceforth referred to as the **Plan**) is a synthesis of the strategies recommended by the component, state and NKPA study reports for implementation over a 15-year time frame spanning three Malaysia Plans until 2030. They are attached as appendices categorised under four separate headers as follows:

1. Enabling environment (Appendix 6.1);
2. Institutional framework (Appendix 6.2);
3. Management instruments (Appendix 6.3); and
4. Investments in water infrastructure (Appendix 6.4).

Plan Implementation: Preparing for plan implementation nationwide entails ensuring the Plan's endorsement and adoption at the highest political level, and mobilising resources and designing effective management structures for plan implementation.

The Plan comprises Component Plans and State IWRM Plans that require joint action by both the Federal and State Governments. MSAN, currently chaired by the Deputy Prime Minister, with all the Menteri Besar and Chief Ministers as members, is the country's apex body on water resources. Hence, MSAN, with the endorsement of the Cabinet, is best placed to assume "ownership" and oversee the execution of the Plan. By the same token, State IWRM Plans would require corresponding "ownership" and oversight by the MSANg, backed by their respective State Executive Councils.

Mobilising adequate funding for plan implementation both at the Federal and State levels is vital for the success of the Plan. The Plan comprises four elements. Funding for the implementation of the first three elements of the Plan is relatively modest, as they comprise 'soft' interventions—policy work and law making, institutional and governance reforms, development of management instruments and capacity building, etc.—which are minimal when compared to the costs of infrastructure. Hence, funding for these three elements could normally be appropriated under the annual Federal and State budget provisions. The fourth element involving "Investments in Water Infrastructure" would require substantial investments. Since the earlier opportunity to include "water" as an NKEA under the NTP was lost, it is recommended that a NKPA is incepted to cater for the national water sector needs. Following consultations with PEMANDU and relevant water-related ministries, ASM had undertaken a special study justifying the case for an NKPA, which report is attached (Volume 2 - Appendix 6.5). It is essentially a program approach comprising major investment programmes that include a portfolio of EPPs identified for implementation.

A recommended management structure for effective implementation of the Plan at various levels of hierarchy is as follows:

a) The Plan shall be managed nationally at the highest political level by MSAN which has the NRE and KeTTHA as its joint secretariat. Correspondingly, at the respective state levels, it would be MSANg or its equivalent.

b) A National Steering Committee (NSC) comprising the KSUs of all water-related ministries and the State Secretaries shall oversee the implementation of the Plan. KSUs of NRE and KeTTHA shall be the joint Chair of the NSC (Figure 6.5). The NSC will meet periodically. An independent Advisory Panel comprising experts drawn from water and allied disciplines shall assist the NSC in providing critical reviews of programmes and activities planned and implemented nationwide under the IWRM agenda. A dedicated IWRM-IU headed by a Senior Executive well versed on IWRM be instituted and made responsible for ensuring the timely and coordinated implementation of the Plan. The IWRM-IU would report to the NSC and serve as its Secretariat. At the state level, the MSANg or its equivalent would undertake the corresponding role with its implementation arm being the Office of the Director MWA/ Water Resources as relevant for each state.

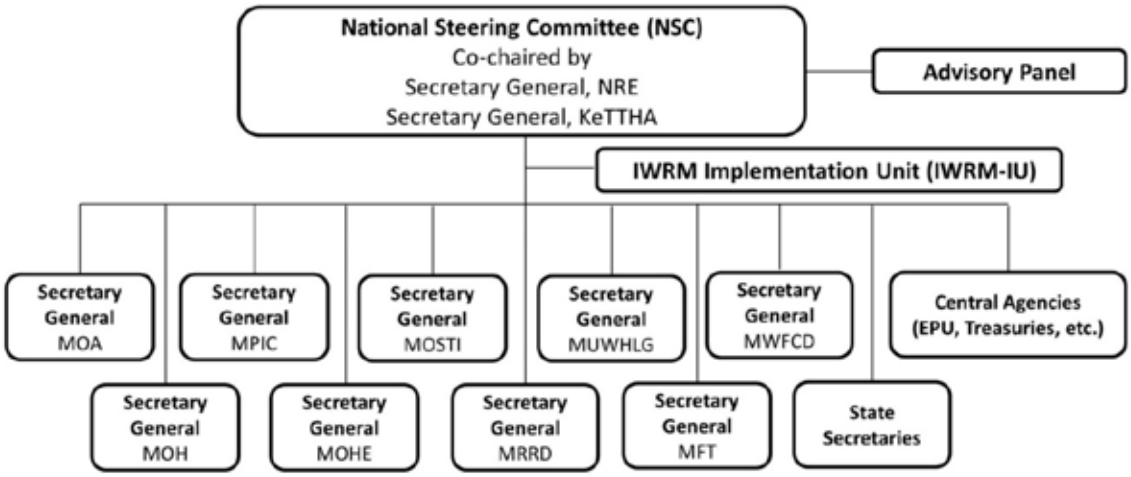

Figure 6.5: Proposed National Steering Committee

A National Technical Committee (NTC), reporting to NSC, comprising the heads of water-related departments and agencies, would meet frequently to resolve technical issues and assist in streamlining operational matters. It would be jointly chaired by the DG of DID and the CEO of SPAN (Figure 6.6).

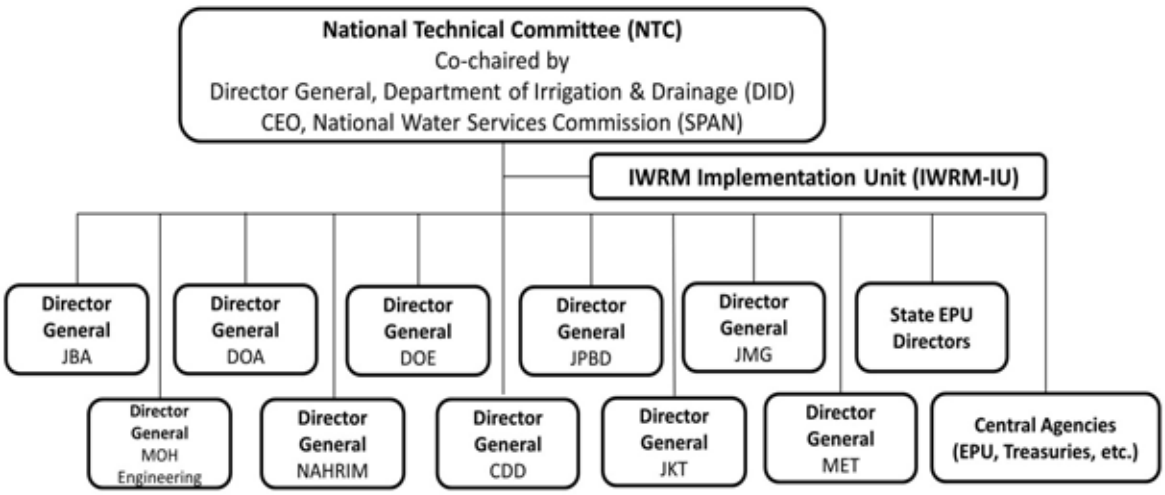

Figure 6.6: Proposed National Technical Committee

Appendix 6.1: NIWRM Strategy Plan and Implementation Road Map : Enabling Environment

Category	Water as a Resource							
	Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks	
POLICY	1. National Integrated Natural Resources Policy	National	NRE	All State Governments	NIL	11MP	NR — Land, Water, Forests, Inland Fisheries, Marine Parks, Wildlife, Minerals and Rock Materials. An overarching policy to address trans-boundary issues and linkages	
	2. WEF Nexus Policy Framework	National	EPU	MOA, NRE, KeTTHA, State Governments	NIL	11MP	Setting an optimal balance with regard to Water Security, Energy Security, and Food Security	
	3. National Water Resources Policy	National	NRE	All State Governments	Completed in 2012	NIL	Launched in March 2012. Now awaiting adoption by states	
	4. Integrated River Basin Management Policy	National	NRE	All State Governments	In progress	11MP	Lentic and lotic systems management inclusive of ICM, IDM, IFM, ILBM, IASM, IUWM, and ICZM	

	Water for Livelihood						
	Strategy	Hierarchical Level	Lead Authority	Implementing Agency	Current Status	Target Completion	Remarks
	1. Review *Dasar Agromakanan Negara* (2011-2020)	National	MOA	Line agencies	Proposed	11MP	Review policy to emphasise the importance of water in agricultural development and optimum yield attainment
	2. National Integrated Water Supply Services Policy	National	KeTTHA, MOA, NRE, MOTAC, MOT, MHLG, MFT, MOH, State Governments	Line agencies and water operators	NIL	11MP	Policy to encompass both consumptive use (domestic and industrial, agriculture, ecosystem regulating services) and non-consumptive use (hydropower, recreation, tourism, navigation)

Appendix 6.1: NIWRM Strategy Plan and Implementation Road Map : Enabling Environment (continued)

Category	Water as a Resource							
	Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks	
LEGISLATION	1. National Water Resources Act	National	NRE	All State Governments and MFT	Draft Act is ready	11MP	To replace outdated Waters Act 1920	
	2. State Water Resources Enactments	All States	MSANg or equivalent	Relevant state agencies	Kedah, Selangor, and Sabah	11MP	In states that have yet to pass new legislation	
	3. Review Streets, Drainage and Buildings Act 1974	Peninsular Malaysia	MUWHLG	Relevant local authorities	–	11MP	To incorporate Integrated Urban Water Management principles and practices. Consider also extending to Sabah and Sarawak	
	4. Review EQA 1974	National	NRE	DOE and respective Sabah and Sarawak agencies	Proposed	11MP	To strengthen DOE's ability to take punitive actions against all polluters	
REGULATIONS	1. Rules for specific purpose management of: • Catchment Areas; • Rivers and Lakes; • Groundwater ; • Coastal Zone; • Estuaries; and • Navigation	States	MSANg or equivalent authorities	State line agencies	Varying	11MP	Agencies responsible need to develop appropriate rules to govern/manage these areas	

	Water for Livelihood						
	Strategy	Hierarchical Level	Lead Authority	Implementing Agency	Current Status	Target Completion	Remarks
	1. WSIA 2006 and SPAN 2006	Peninsular Malaysia and Labuan	KeTTHA	SPAN, line agencies, and water operators	Completed	–	Consider extending legislation to Sabah and Sarawak.
	2. Promulgate Agricultural Water Services Act	National	MOA	Line agencies	New	11MP	To replace outdated Irrigation Areas Ordinance 1953 and the Drainage Works Ordinance 1954, Drainage and Irrigation Ordinance Sabah
	3. Safe Drinking Water Act	National	MOH/ KeTTHA	KeTTHA	Draft is ready	11MP	Review the standards of drinking water
	4. AWS Enactment	All States	State Governments	State line agencies	New	11MP	Adoption of AWS Act and passing of enactment for state application repealing existing ordinances
	1. Rules for specific application pertaining to potable Water Supply and Sewerage Services	National	SPAN	Water operators	Ongoing	11MP	Agencies responsible need to develop appropriate rules to govern/manage these areas. Sewerage services to include sullage. Consider extending to Sabah and Sarawak
	2. Rules for specific application pertaining to AWS	National	MOA	Line agencies	–	11MP	Agencies responsible need to develop appropriate rules to govern/manage these areas

Appendix 6.1: NIWRM Strategy Plan and Implementation Road Map : Enabling Environment (continued)

Category	Water as a Resource							
	Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks	
FINANCE	1. Federal funding to continue on following activities: • Water resources assessment; • Information management; • River basin and coastal zone management planning; • Integrated water R&D; • Awareness raising, advocacy and capacity building; • Mitigation of water-related hazards (such as floods, droughts, tsunamis, coastal erosion, and landslides); and • Ecosystem rehabilitation and restoration	National	NRE	All States	Inadequate funding and no funding at all in some areas	11MP and beyond	Funding from yearly OPEX and allocation from 11MP and beyond	

	Water for Livelihood						
	Strategy	Hierarchical Level	Lead Authority	Implementing Agency	Current Status	Target Completion	Remarks
	1. Federal funding to continue for those states that have migrated. Funding discussions need to be continued for those states that have yet to migrate	National	KeTTHA	SPAN and water operators	Ongoing	11MP and beyond	Funding from yearly OPEX and allocation from 11MP and beyond
	2. Federal funding for AWS to continue in all agricultural areas	National	MOA	Line agencies	Ongoing	11MP and beyond	Funding from yearly OPEX and allocation from 11MP and beyond

Appendix 6.2: NIWRM Strategy Plan and Implementation Road Map: Institutional Framework

Hierarchical Level	Water as a Resource					
	Strategy	**Lead Authority**	**Implementing Authority**	**Current Status**	**Target Completion**	**Remarks**
NATIONAL	1. *Majlis Sumber Air Negara*	NRE/KeTTHA	Water-related ministries and all State Governments	Ongoing	Established 1998	Apex body on WR Management Chaired by DPM
	2. National Steering Committee on IWRM	NRE/KeTTHA	Water-related ministries and MSANg or equivalent	Proposed	11MP	To be jointly chaired by KSU NRE and KSU KeTTHA Oversee the coordinated implementation of the IWRM agenda nationwide
	3. National Technical Committee	DID and SPAN	Line agencies	Proposed	11MP	Jointly chaired by DG DID and CEO SPAN Resolve technical issues and assist in streamlining operational matters
	4. Department of Water Resources	NRE	NRE	Proposed	11MP	Restructured department under NRE through the merger of current DID and Groundwater division under JMG
	5. National Water Research and Development Centre	NRE	NRE	Proposed	11MP	NWRDC to be established as a statutory body to act as clearing house and one-stop centre for all water R&D. In the interim Water Research Consortium led by NAHRIM comprising water-related public and private sector ROs, research centres at IHLs
	6. National IWRM Training Centre	NRE, MOA, KeTTHA and water operators	Line agencies	Proposed	11MP and beyond	Inter-Ministry Consortium jointly chaired by NRE and KeTTHA to set up One-stop Training Centres at national and state levels providing AACB integrated training modules to multi-level target groups from the public, private, and community stakeholders

Hierarchical Level	Water for Livelihood					
	Strategy	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks
NATIONAL	1. National Steering Committee on Water Safety Plan	KeTTHA and MOH	NRE, MSANg or equivalent, line agencies and water operators	Proposed	11MP	Jointly managed by KeTTHA, MOH, NRE, and MSANg or equivalent
	2. Water Supply and Sewerage Services Department	KeTTHA	SPAN, water supply and sewerage operators	Proposed	11MP	Integration of water supply and sewerage services to ensure holistic management of water and wastewater under KeTTHA
	3. Agricultural Water Services Department	MOA	BPSP (MOA), KADA, MADA, IADA	Proposed	11MP	Reinstatement of a dedicated department for AWS under MOA thereby replacing current BPSP
	4. Water Demand Management Division in all Federal water supply service agencies	MOA, KeTTHA, NRE	Line agencies, MSANg or equivalent	Proposed	11MP	Consistent with WDM report recommendations, a division devoted to ensure water for environmental needs be incorporated.

Appendix 6.2: NIWRM Strategy Plan and Implementation Road Map: Institutional Framework (continued)

Hierarchical Level	Water as a Resource						
	Strategy	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks	
STATE	1. Majlis Sumber Air Negeri	MSANg or equivalent	The implementing arm of MSANg or equivalent	Ongoing	11MP	MSAN 08 directive. Exceptions — LUAS, Sabah SWRC, and LSANK already in existence. Ensure dedicated section to address water for environmental needs under its implementing agency	
	2. State IWRM Technical Committee	State Governments	UPEN	Ongoing	11MP	Chaired by UPEN to oversee implementation of state IWRM programmes. Implemented in Selangor	
RIVER BASIN	1. River Basin Committees	MSANg or equivalent	The implementing arm of MSANg or equivalent	Ongoing	11MP and beyond	Depending on size of river basin, either individual RBC or for a cluster of RBs. Dedicated unit to address water for environmental needs to be incorporated	
LOCAL	1. Local Action Community-based groups	MSANg or equivalent	The implementing arm of MSANg or equivalent	Ongoing	11MP and beyond	Facilitated by RBCs with support from NGOs to advance participatory management	

	Hierarchical Level	Water for Livelihood					
		Strategy	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks
	STATE	1. Agricultural Water Services Department	State Governments	Line agencies	Proposed	11MP	Realignment of current State DID
		2. AWS divisions in IADAs	MOA	Line agencies	Ongoing	11MP	To be renamed AWS from Project Engineer's Office
		3. Water Demand Management Section in all State water supply service agencies and water operators	All State Governments	Line agencies	Proposed	11MP	Institutionalising WDM
	DISTRICT/ RESIDENCY	1. AWS Department	State Governments	State AWS	Ongoing	11MP	Realignment of current District DID
		2. WDM Units in water supply service agencies and water operators	State Governments	Water supply agencies and water operators	Proposed	11MP	Institutionalising WDM
	LOCAL	1. Water User Groups	State Governments	Line agencies	Proposed	11MP	Consumers, Farmers, etc

Appendix 6.3: NIWRM Strategy Plan and Implementation Road Map: Management Instruments

Category	Water as a Resource						
	Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks
1. Information Management	1. Centrally managed IWRM database be established at the NRE Ministry	National	NRE	Line agencies	Proposed	11MP and beyond	Built around the 189 river basins as its platform. Shall be appropriately linked with customised systems that are in place for sectoral use
	2. IWRM Tool Box of Malaysian Case Studies and BMPs	National	NRE	Line agencies	Proposed	11MP and beyond	Styled on similar lines of the GWP IWRM Tool Box
	3. State of the Waters Annual Report	National	NRE	Line agencies	Proposed	11MP and beyond	If not annually, at least triennially to keep stakeholders and the public informed on the management of the country's waters according to river basins nationwide
2. Planning	1. Foresight studies on IWRM and its sub-sets	National	NRE	Line agencies	Proposed	11MP and beyond	NRE to lead such studies nationwide
	2. Development of management guidelines	National	NRE	Line agencies	Ongoing	11MP and beyond	NRE/DID to prepare management guidelines through stakeholder consultations
	3. River Basin Studies and Management Plans	National	NRE	Line agencies	Ongoing	11MP and beyond	NRE/DID to undertake such studies and prepare RB management Plans nationwide

	Category	Water for Livelihood						
		Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks
	1. Information Management	1. Customised information management systems for O&M of water supply and sewerage systems	National	KeTTHA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	Including real-time information on source pollution, breakdowns, interruption of supply, and leakage detected
		2. Customised information management systems for O&M of Agriculture Water Supply Services	National	MOA	Line agencies	Ongoing	11MP and beyond	Including real-time information during prolonged drought or floods causing crop damage
	2. Planning	1. Develop alternative sources of water supply for use singly or conjunctively with surface water	National	KeTTHA, MOA & NRE, Sabah and Sarawak State Goverments	Line agencies	Ongoing	11MP	KeTTHA and MOA,together with NRE, Sabah and Sarawak to lead studies to develop alternative sources of water supply
		2. Evaluate Centralised versus Decentralised Wastewater Treatment System	National	KeTTHA	Line agencies	Proposed	11MP	KeTTHA /*Jabatan Perkhidmatan Pembetungan* and IWK to lead the study nationwide with collaboration of appropriate agencies in Sabah and Sarawak
		3. Review Scope and Coverage of Sewerage Services to ensure proper management of STP effluent	National	KeTTHA	Line agencies	Proposed	11MP	KeTTHA/*Jabatan Perkhidmatan Pembetungan* and IWK to lead the study nationwide with collaboration of appropriate agencies in Sabah and Sarawak

Appendix 6.3: NIWRM Strategy Plan and Implementation Road Map: Management Instruments (continued)

Category	Water as a Resource							
	Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks	
3. Economic & Financial Instruments	1. Payment for ecosystem services	National	NRE	MSANg or equivalent	Ongoing	11MP and beyond	NRE/State Water Authorities to develop PES Models and appropriate legislation for respective states	
	2. Application of "polluter pays" principle	National	NRE	MSANg or equivalent	Ongoing	11MP and beyond	NRE/State Water Authorities to develop appropriate legislation for respective states	
	3. Uniform Pricing Model for Water Resources	National	MSAN and NRE	MSANg or equivalent	Proposed	11MP and beyond	NRE/State Water Authorities to develop Pricing Models and appropriate legislation for respective states	
4. Legal (Licenses and Penalties)	1. Enforcement of water-related laws and regulations: a. gazetting of reserves and protected areas; b. the issue of licenses for various uses; and c. imposition of penalties for breaches and offences committed	State Governments	MSANg or equivalent	The implementing arm of MSANg or equivalent	Ongoing	11MP and beyond	NRE/Peninsular States/Sabah/ Sarawak authorities to ensure strict enforcement nationwide	

	Category	Water for Livelihood						
		Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks
	3. Economic & Financial Instruments	1. Water demand management instruments:						
		a. incentive schemes to encourage the use of water saving devices or systems; and	National	KeTTHA, MOA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	KeTTHA/MOA, Sabah and Sarawak State Governments to develop appropriate incentive schemes
		b. Incentive schemes to encourage the use of alternate water resources	National	KeTTHA, MOA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	KeTTHA/MOA, Sabah and Sarawak State Governments to develop appropriate incentive schemes
		2. Mechanisms for optimal cost recovery of services with provisions for targeted subsidies	National	KeTTHA, MOA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	KeTTHA/MOA, Sabah and Sarawak State Governments to develop such mechanisms
		3. Equitable tariff setting	National	KeTTHA, MOA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	KeTTHA/MOA, Sabah and Sarawak State Governments to develop appropriate tariff setting
	4. Legal (Licenses and Penalties)	1. Enforcement of water supply and sewerage services related laws and regulations;						
		a. gazetting of WTPs and protected areas;	National	KeTTHA	Line agencies	Ongoing	11MP and beyond	SPAN to work with appropriate authorities in Sabah and Sarawak to ensure strict enforcement nationwide.
		b. the issue of licenses for various uses; and	National	KeTTHA	Line agencies	Ongoing	11MP and beyond	
		c. imposition of penalties for breaches and offences committed	National	KeTTHA	Line agencies	Ongoing	11MP and beyond	
		2. Gazetting of AWS areas and enforcement of associated legislation and regulations.	National	MOA	Line agencies	Ongoing	11MP and beyond	Proposed AWSD (MOA) to work with state AWSD and IADAs

Appendix 6.3: NIWRM Strategy Plan and Implementation Road Map: Management Instruments (continued)

Category	Water as a Resource							
	Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks	
5. Technical Instruments	1. Buffer zones around water bodies 2. Interceptor buffers along rivers 3. Artificial Wetlands 4. River Bank Filtration 5. Protection of groundwater recharge areas	State Governments	MSANg or equivalent	The implementation arm of MSANg	Ongoing	11MP and beyond	NRE/State Water Authorities to gazette buffer and inceptor zones, protection of groundwater recharge areas, artificial wetlands and undertake River Bank Filtration studies	

	Category	Water for Livelihood						
		Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks
	5. Technical Instruments	1. Water conservation measures:						
		a. water reuse;	National	KeTTHA, MOA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	KeTTHA/MOA to incentivise such measures
		b. water recycling;	National	KeTTHA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	
		c. water saving devices (including retrofitting);	National	KeTTHA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	
		d. leakage control;	National	KeTTHA, MOA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	
		e. rainwater harvesting	National	KeTTHA, MOA, MUWHLG	Line agencies	Ongoing	11MP and beyond	
		2. Modifying agronomic practices:						
		a. adjustment of cropping patterns;	National	MOA	Line agencies	Ongoing	11MP and beyond	MOA to undertake appropriate studies with its research bodies
		b. adoption of dry-seeding techniques in paddy planting; and	National	MOA	Line agencies	Ongoing	11MP and beyond	
		c. choice of less thirsty crop varieties	National	MOA	Line agencies	Ongoing	11MP and beyond	

Appendix 6.3: NIWRM Strategy Plan and Implementation Road Map: Management Instruments (continued)

Category	Water as a Resource							
	Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks	
6. Operation and Maintenance	1. Periodic review of river basins with regard to: a. Water allocation according to use; b. Water accountability; and c. Water audit	River basin	MSANg or equivalent	The implementation arm of MSANg	Ongoing	11MP and beyond	To ensure the security, integrity, resilience and safety of water-related systems. Water allocation through a process of stakeholder consultations	

	Category	Water for Livelihood						
		Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks
	6. Operation and Maintenance	1. Implementation of WSPs nationwide conforming to WHO guidelines;	National	KeTTHA, MOH, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	KeTTHA/MOH, Sabah and Sarawak State Governments to implement WSPs
		2. Development of SOPs for all process-related operations;	National	KeTTHA, MOA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	KeTTHA/SPAN/ MOA, Sabah and Sarawak State Governments to develop SOPs
		3. Reduction of water losses:						
		a. NRW under potable water supply; and	National	KeTTHA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	KeTTHA/SPAN/ State Water Authorities to enhance efforts to reduce NRW nationwide
		b. Reticulation system losses in Agricultural Water Supply	National	MOA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	MOA to enhance efforts to reduce system losses nationwide
		4. Development of maintenance manuals to ensure control systems, facilities and equipment associated with water supply, sewerage and drainage systems remain functional at all times	National	KeTTHA, MOA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	KeTTHA/SPAN, Sabah and Sarawak State Governments to develop appropriate manuals for distribution to all water supply and wastewater operators
		5. SOPs to address emergencies such as breakdown of water supply, pollution of water sources, floods, droughts, and water-borne diseases	National	KeTTHA, MOA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	KeTTHA/MOA/ NRE/ MOH to jointly develop SOPs for nationwide application

Appendix 6.3: NIWRM Strategy Plan and Implementation Road Map: Management Instruments (continued)

Category	Water as a Resource						
	Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks
7. Participatory Management	1. Community participation in lakes and rivers watch programmes	River basin	MSANg or equivalent	The implementation arm of MSANg	Ongoing	11MP and beyond	MSANg or equivalent to work with appropriate NGOs nationwide to develop such participatory management groups
	2. Formation of *"rakan sungai"* and *"rakan tasik"* groups	River basin	MSANg or equivalent	The implementation arm of MSANg	Ongoing	11MP and beyond	MSANg or equivalent to work with appropriate NGOs nationwide to develop such participatory management groups
8. Research and Development	Integrated research on 14 thematic areas identified by the ASM report *Setting a National Agenda for Integrated Water Research in Malaysia* that was endorsed by MSAN 10 in October 2015	National	NRE	NWRDC	Proposed	11MP and beyond	NRE/NAHRIM to immediately initiate discussions to form the interim Water Research Consortium and prepare for the establishment of the National Water Research and Development Centre over the long term

	Category	Water for Livelihood						
		Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks
	7. Participatory Management	Engaging the Consumers/Farmers and the Public in Water Conservation Initiatives	National	KeTTHA/ MOA, Sabah and Sarawak State Governments	Line agencies	Ongoing	11MP and beyond	KeTTHA to further enhance role of Forum Air so that it is able to play its role effectively and efficiently. MOA to engage and involve farmers and farm operators in planning and O&M activities
	8. Research and Development	Integrated research on seven thematic areas identified by the ASM report *Setting a National Agenda for Integrated Water Research in Malaysia* that was endorsed by MSAN 10 in October 2015	National	KeTTHA/ MOA	NWRDC	Proposed	11MP and beyond	KeTTHA/ MOA to hold discussions with NAHRIM/ WRC during the interim and National Water Research and Development Centre over the long term

Appendix 6.3: NIWRM Strategy Plan and Implementation Road Map: Management Instruments (continued)

Category	Water as a Resource							
	Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion	Remarks	
9. Awareness, Advocacy and Capacity Building	1. Holistic training to O&M personnel comprising a blend of a common IWRM modules and specialised training pertaining to resource management 2. IWRM awareness and participatory modules targeted at NGOs and CBOs 3. Advocacy modules on IWRM tailored at political leaders	National	Inter-Ministerial Consortium	National IWRM Training Centre	Proposed	11MP and beyond	Inter-Ministerial Consortium and operators to undertake appropriate training courses for wide-ranging stakeholders nationwide	
10. International Collaboration	1. Networking and links with regional and international institutions based on common subject matter and focus areas 2. National research and Capacity Building institutes endeavour to enter into strategic alliances with renowned regional and international water research and training centres for mutual benefit 3. Regular participation in reputed water-related international water fora related to resource management	National	NRE and State Governments	Line agencies	Ongoing	11MP and beyond	NRE and State Governments to enhance international networking and linkages	

	Category	Water for Livelihood					
		Strategy	Hierarchical Level	Lead Authority	Implementing Authority	Current Status	Target Completion
	9. Awareness, Advocacy and Capacity Building	1. Holistic training to O&M personnel comprising a blend of a common IWRM modules and specialised training pertaining to respective utility service provision 2. WDM and participatory management modules targeted at NGOs and CBOs 3. Advocacy modules on WDM for political leaders	National	Inter-Ministerial Consortium	National IWRM Training Centre	Proposed	11MP and beyond
	10. International Collaboration	1. Networking and links with regional and international institutions based on common subject matter and focus areas 2. National research and Capacity Building institutes endeavour to enter into strategic alliances with renowned regional and international water research and training centres for mutual benefit 3. Regular participation in reputed water-related international water fora related to water utility services provision	National	KeTTHA, MOA, and State Governments	Line agencies	Ongoing	11MP and beyond

Appendix 6.4: NIWRM Strategy Plan and Implementation Road Map: Investments in Water Infrastructure

Cross-cutting Programmes					
Item	**Water Infrastructure Development Programme**	**Lead Implementing Agency**	**Collaborating Partners**	**Entry Point Projects**	
1	Central Water Resources Database	NRE	Water-related Ministries/ SWRCs	• Develop and maintain a central water resources database built around river basin platform	
2	Integrated Water Research	NRE / NAHRIM	IHLs/ Water-related Ministries/ SWRCs	• Set up a dedicated National Water Research and Development Centre (NWRDC) • Water Research based on 21 Themes and 96 Research Topics (14 Water as a Resource and 7 Water for Livelihood Thematic Areas) • Develop Centres of Water Excellence in Local Academia	
3	Climate Change Adaptation	NRE	Water-related Ministries/ SWRCs	• Establish a Regional Water Hub for Climatic Change Adaptation • Weather and climatic change forecasting and modelling • Climatic change adaptation • Carbon sequestration/ financing	
4	Awareness Raising, Advocacy, Capacity Building	NRE	Inter-Ministerial Consortium compromising of NRE, KeTTHA, MOA, MOH and Water Operators	• Development of IWRM Training Centre • Development of Training Modules for different target groups • Development of communication packages	
5	Meetings, Incentives, Conference, and Exhibition	NRE	Water-related Ministries/ SWRCs	• Develop Malaysia as Water Hub • Develop Malaysia as MICE for water sector/ industry • Host global/ regional/ national water events	

	Target Completion	Remarks
	11MP and beyond	• All 189 river basin data to be deposited in the central database • To be populated based on a priority of river basins • Linked to all water-related Ministries
	11MP and beyond	• Water Research Consortium is an interim measure comprising of NAHRIM, 20 IHLs and RIs until establishment of proposed NWRDC
	11MP and beyond	• All relevant ministries, agencies, and all State Governments
	11MP and beyond	• Inter-Ministerial Consortium
	11MP and beyond	-

Appendix 6.4: NIWRM Strategy Plan and Implementation Road Map: Investments in Water Infrastructure (continued)

Water as a Resource						
Item	**Water Infrastructure Development Programme**	**Lead Implementing Agency**	**Collaborating Partners**	**Entry Point Projects**	**Target Completion**	
1	a. Integrated River Basin Management	NRE	Water-related Ministries/ SWRCs	• Setup River Basin Organisations for all major river basins • Watershed management/ restoration programmes • Develop IRBM Plans • Develop trans-boundary water resources management		
	i. ICM	NRE	Water-related Ministries/ SWRCs	• Watershed management/ restoration programmes		
	ii. ILBM	NRE	Water-related Ministries/ SWRCs	• Develop information management and decision support system • Development of Lake Briefs • Development and Implementation of Integrated Lake Basin Management Plan • Lake Rehabilitation Programmes • Rehabilitation of lakes • Urban landscape projects for recreational lakes • Conservation of Lake Ecosystem • Storage system for unregulated flow	11MP and beyond	
	iii. ICZM	NRE	SWRCS	• ICZM/ ISMP Network for all Malaysian States • Coastal Erosion Monitoring and Rehabilitation Programme • Estuarine and Marine Fishery Management. • Offshore Sand Mining, Reclamation and Dredging Industry • Coral Triangle Initiative (CTI) • Trans-boundary Pollution Monitoring		
	iv. IUWM	MUWHLG	Local Authorities	• Develop integrated urban water resource management • Improve stormwater management • Rainwater harvesting • Water efficient design/ buildings • ROL		
	b. Integrated Aquifer System Management	NRE	Water-related Ministries/ SWRCs	• Groundwater mapping and assessment • Groundwater metering and licensing • Groundwater recharge technology		

	Water for Livelihood					
	Item	Water Infrastructure Development Programme	Lead Implementing Agency	Collaborating Partners	Entry Point Projects	Target Completion
	1	Development of Alternative Water Sources 1. Consumptive Use: a. Groundwater; b. Rainwater Harvesting; c. Wastewater Reuse / Recycling; d. Storage of unregulated flows; and e. Desalination of Brackish / Saline Water 2. Non-consumptive Use: a. Hydropower Development; b. Fisheries; c. Recreation and Tourism; and d. Navigation	NRE, KeTTHA, MOA, MUWHLG, MOTAC, MOT	Line agencies	• Groundwater infrastructure and service sector development including mineral water • Storage of rainwater for multiple use • Wastewater reuse with or without treatment • Off-channel storage in ponds / bunded impounding facilities below or above ground • For island and coastal areas • Identify potential sites for hydropower • Sustainable aquaculture development in freshwater and brackish water • Identify water bodies for sustainable recreation and tourism activities • Undertake feasibility studies for river and coastal navigation	11MP and beyond

Appendix 6.4: NIWRM Strategy Plan and Implementation Road Map: Investments in Water Infrastructure (continued)

Water as a Resource						
Item	**Water Infrastructure Development Programme**	**Lead Implementing Agency**	**Collaborating Partners**	**Entry Point Projects**	**Target Completion**	
2	Water-related Hazards a. Flood Mitigation b. Drought Mitigation c. Tsunami Readiness d. Landslides and Sinkholes Mitigation	NRE	Relevant States	• Develop catastrophe insurance industry • Develop and improve flood forecasting centre and technology • Structural and non-structural flood mitigation works • Develop flood sensitive designs/ solutions for commercialisation • Improve flood relief, response and recovery mechanism/ institutions • Develop drought infrastructure and alternative water sources • To be identified by line agencies • To be identified by line agencies	11MP and beyond	
3	Ecosystem Services	NRE	SWRCs	• PES framework and mechanism for Malaysia • Watershed rehabilitation and management of river basins and resources • Wetland restoration and management • Mangrove replanting and coastal protection		
4	Water Pollution Monitoring and Rehabilitation	NRE	DOE/MOH/ SWRCs	• River Basin Pollution Management Programme • Superfund for clean-up of polluted rivers in Malaysia • Modernising water quality monitoring network • Develop water quality modelling tools and infrastructure • Community river management programmes • Pollution control at source		
5	Water-based Recreation and Tourism	MUWHLG	MOTAC/MFT/ Local Authorities	• Water tourism products • Conservation of high-value tourism areas • Hosting of water-related events, competitions and festivals		

Note: Financial cost of each programme to be estimated by respective Ministries concerned.

	Water for Livelihood					
	Item	Water Infrastructure Development Programme	Lead Implementing Agency	Collaborating Partners	Entry Point Projects	Target Completion
	2	Water Supply and Wastewater Services Sector	KeTTHA	SPAN/ Sabah SWA/ Sarawak SWA/ SWRCs	• Privatisation/ corporatisation of water supply sector • Smart water network monitoring systems for non-revenue water reduction • Improve urban and rural water supply infrastructure • Develop water demand management initiatives • Inter-basin water transfer schemes • Commercialisation of technology and expertise • Expand sewerage infrastructure and regionalisation of sewerage networks • Waste to wealth — bioeffluent, biosolids, and biogas industry • Potable and non-potable wastewater recycling • Tertiary treatment for sewage to reduce eutrophication in public waters • Develop industrial wastewater treatment systems • Zero-discharge and zero-energy for wastewater facilities	11MP and beyond
	3	Energy Sector	KeTTHA	TNB/SEB/ SESB/ Sabah LAs/ Sarawak Local Authorities/ SWRCs	• Hydropower development • Improving efficiency of water use in thermal power plants	
	4	Agricultural Water Services	MOA	SWRCs, Ministries of Agriculture Sabah and Sarawak	• Water metering for irrigation areas • Improve productivity of agriculture water • Reuse of wastewater for irrigation • Recycling systems for aquaculture industry • Livestock waste treatment systems • Urban Farming	
	5	Commercial water to Shipping	MOT	SWRCs/Local Authorities	• Water supply for shipping • Navigational channel and port dredging • Ballast water monitoring, management and treatment systems • Urban water transport	

Chapter 7

Conclusions and Recommendations

This initiative undertaken by the Academy of Sciences Malaysia (ASM) is a critical review of water resources and water supply services development and management in the country as seen from an IWRM perspective. Why IWRM? Because it has been the central paradigm and thrust adopted by the Government, and embodied in the National Water Resources Policy (NWRP) 2012 document.

7.1 Conclusions

The comprehensive assessment initiated by ASM in the year 2008 enabled the gaining of valuable insights into a wide range of IWRM water-related thematic areas and topical issues nationwide so as to be able to draw a number of significant conclusions as highlighted hereunder:

- **Water Availability:** Blessed with abundant rainfall, the adequate provision of quality water to meet the country's short-, medium-, and long-term needs is not one of water resources availability but more of sound management and good governance both at national and state levels.

  Malaysia has hitherto largely depended on surface water for its water supply needs. Recurring crises of potable water shortages due to prolonged droughts in recent years affecting several states had led to water rationing. It is imperative now that alternative sources of water and water demand measures be actively pursued to ensure that the national water stock has adequate reserves to effectively deal with the vagaries of weather and reinforce adaptive capacities to address the potential impacts of climate change. Groundwater, rainwater harvesting, and wastewater reuse (with or without treatment) are the more obvious sources to consider for use singly or conjunctively. For island states and coastal areas, recent advances in membrane technology have made desalination of the sea or brackish water of both surface and groundwater, viable options.

- **Ecosystems Degradation and Water-related Hazards:** Extensive land and industrial development had changed the urban and rural landscape which has had its toll on both the terrestrial and aquatic ecosystems. The recent launch of the

revised National Policy on Biodiversity aimed at "sustainable utilisation of biodiversity in the country" and stressing "safeguarding ecosystems" as one of its five goals, is a timely intervention for championing this cause nationally.

River water quality continues to be on the decline. Comparing the Environmental Quality Reports for the year 2013 and 2014, out of the 473 rivers monitored, the percentage of clean rivers has dropped from 58% to 52%, slightly polluted rivers have increased from 37% to 39%, while polluted rivers have also increased from 5% to 9%.

Water-related hazards are on the rise and have become major national issues. Some of the tell-tale signs experienced of late are the widespread floods in December 2014 and January 2015 affecting Kelantan, Terengganu, Perak, Pahang, Johor, Sabah, and Sarawak. Studies have shown that 9% or 29,800 km^2 of the total area of Malaysia lies in flood-prone areas where 22% of the country's total population live.

Yet another hazard is the increase in the occurrence of severe landslides and debris flows, the most recent being in the resort area of Cameron Highlands in November 2014.

In 1997, 1998, 2014, and more recently in 2016, low rainfall and hot temperatures associated with the El Nino phenomenon affected many parts of northern and central Peninsular Malaysia, and Sabah. These extreme events cause depletion in storage levels in many of the country's reservoirs, prompting the need for cloud-seeding operations while causing disruptions to potable water supply and paddy farming activities especially in the northern granary areas.

Periodic occurrence of water-borne diseases is also a threat to human health in the country. Cases of cholera, typhoid, leptospirosis, and dengue are invariably linked to water.

- **IWRM, MDG and SDG:** Subscribing to international water-related conventions, Malaysia has adopted IWRM since the mid-1990s. IWRM is essentially about pursuing balanced development between "Water as a Resource" and "Water for Livelihoods". Malaysia has also joined the global community in committing to earlier Millennium Development Goals, and more recently to the post-2015 Sustainable Development Goals (SDGs).

  However, only minimal and sporadic success has been realised to date on IWRM implementation nationwide. Fragmented management, a legacy from the past, still prevails at the national level and the situation in the states is no better with few exceptions.

- ***Majlis Sumber Air Negara*** **(MSAN)** established in 1998 provided an important platform for ensuring uniformity in the provision of integrated programmes and solutions regarding water development and resource management issues and challenges nationwide. It has also promoted Federal-State and inter-state cooperation and assisted in resolving conflicts that may arise from time to time. What has been observed is that many of the MSAN decisions made that are of

national relevance and application do not get expeditiously implemented due to the absence of complementary and effective structures or mechanisms in most of the states that have the ability to timely execute the programmes and directives.

- **NWRP 2012**: The successful launch of the much-awaited NWRP in March 2012 following the endorsement by MSAN, was a major milestone accredited to the NRE Ministry. While an earlier commitment to the preparation of a National IWRM Plan 2005 had not materialised, the NRE Ministry is currently actively pursuing the preparation of a NWRP Action Plan.

- **Establishment of *Majlis Sumber Air Negeri* (MSANg):** A 1997 Federal Cabinet decision directing the Ministry of Agriculture and the State of Selangor to initiate early action for the holistic management of the state's water resources was an important initiative under the national IWRM agenda to enable penetration to reach grass root levels of management. The directive led to the passing of the SWMA Enactment by Selangor in 1999 and the subsequent establishment of *Lembaga Urus Air Selangor* (LUAS) in the year 2000. It provided the enabling environment to pioneer the shift away from past fragmented approaches to the adoption and application of more contemporary IWRM principles and practices in the state. Selangor through LUAS has made great advances in institutionalising IWRM in the management of its water resources. Sabah and Kedah have progressed on similar lines. The remaining states have not actively pursued this initiative. MSAN 08 that met in October 2013 has since reminded and urged State Governments for early establishment of MSANg.

- **IRBM, ILBM, IASM and IUWM:** MSAN 02 that met in July 2003 had endorsed Integrated River Basin Management (IRBM) to ensure that the use of land and water resources can be managed in a sustainable manner. Holistic adoption and implementation by states complete with the legal and institutional framework structures set in place has only taken root to date in the State of Selangor and to a certain extent in Sabah and Kedah.

  MSAN 04 held in July 2008 had approved a National Strategy Plan for Groundwater Resources Management, which has since been renamed as Integrated Aquifer System Management (IASM) based on an ASM-led study entitled *Strategies for the Sustainable Development and Management of Groundwater Resources in Malaysia*. MSAN 07 that met in November 2012 had endorsed Integrated Lake Basin Management (ILBM) for the management of lentic systems based on the recommendations of yet another ASM-led study report entitled *Strategy Plan for the Sustainable Management of Lakes and Reservoirs in Malaysia*.

  ILBM, IASM, IFM (related to floods), IDM (related to droughts), ICM (related to catchment areas spanning the upper reaches of rivers), and ICZM (related to the coastal zone spanning the interface between freshwater and brackish/sea water) are all sub-sets of IRBM. They fall under the purview of the NRE to oversee their implementation nationwide.

  Urban water management, falling under the Ministry of Urban Well-Being, Housing and Local Government, involves

ensuring access to water and sanitation infrastructure and services to an ever-growing urban population. It also entails the management of rainwater, wastewater, stormwater drainage, and runoff pollution; control waterborne diseases and epidemics; and reduce the risk of water-related hazards, including floods, droughts, and landslides. Conventional urban water management systems that manage each of the above-listed services as separate entities and de-linked from land use planning and economic development would not be able to deal with the issues and challenges in an effective and efficient manner. Integrated urban water management (IUWM), another sub-set of IRBM, promises a better approach than the current system. The EPP entitled RoL Project being implemented under NKEA 12 — Greater Kuala Lumpur/ Klang Valley, is an excellent example how a holistic solution can restore the riverfront landscape while also returning aquatic life back to the rivers, a programme worthy of replication for urban rivers flowing through major cities and towns in the country.

- **Water Supply and Wastewater Management:** The introduction of WSIA together with the SPAN Act in 2006 and the concurrent constitutional amendment to place water supply on the Concurrent List was an important milestone in the transformation of water supply and wastewater management services in the country. However, it is observed that there are shortcomings and setbacks in implementation, notable among which are: water supply and sewerage have yet to be fully integrated; WSIA does not extend to Sabah and Sarawak; only six Peninsular States have migrated so far to the new WSIA regime; absence of a water supply services policy that is aligned to NWRP 2012; reduction of non-revenue water (NRW) still lagging in most states; optimal legal/financial instruments and mechanisms for cost recovery of utility services and for equitable tariff setting still pending; and a pressing need to raise competence of O&M personnel at all levels of management.

- **Agricultural Water Management:** Drainage and irrigation for agriculture has all along been on the Concurrent List under the Federal Constitution. This has enabled the Federal Government, through its Ministry of Agriculture and Agro-based Industries (MOA) to make huge investments over the years in drainage and irrigation infrastructural works to support the growing of food crops to meet self-sufficiency/security targets set by prevailing National Agricultural/ Food Policies. Despite the major share (64.3%) of the country's water resources going to agricultural use, its importance has not been sufficiently emphasised by the current *Dasar Agromakanan Negara* (DAN) 2011–2020. Reference is made only to infrastructure provision but more critical is sound water management to sustain optimum yields which applies also to plantation crops. Low-cost flood irrigation is the norm for water use in rice cultivation, while precision irrigation systems, including some under glass house or rain shelter conditions, are mainly used in horticulture and floriculture for the production of high-value food crops, such as fruits and vegetables and non-food crops such as flowers and ornamental plants. Other water needs under MOA are for livestock, fisheries and aquaculture.

Recognising the symbiotic relation between water, land, and farm management, integrated agriculture management under MOA has been practiced since the 1970s. All the relevant implementing agencies are placed under one roof to manage the larger agricultural project areas in an integrated manner. The forerunners were MADA and KADA, followed by IADAs, and largely Federal funded.

On its road to Vision 2020, the country's agriculture policy has shifted more towards agribusiness and wealth creation. Propelling this change is the ETP launched in September 2010. Under the ETP, 16 EPPs and 11 BOs under the Agriculture NKEA 11 is expected to deliver an incremental GNI impact of RM28.9 billion and 74,600 additional jobs by 2020. EPP10 and EPP11 are aimed at strengthening productivity of paddy Farming in MADA and seven other "granary areas". Adopting more efficient estate farming systems and introducing land amalgamation schemes, they seek to enhance the national productivity of paddy, establish long-term food security and increase the income of paddy farmers. Good progress has been reported to date on these two EPPs thereby justifying its potential of replication in the other granary areas. Agriculture is water sensitive and hence effective and efficient agricultural water services (AWS) is an essential prerequisite to ensure returns on investments and sustainability in agriculture.

Plantation crops that include oil palm, rubber, timber, cocoa, pepper, and tobacco come under the jurisdiction of the Ministry of Primary Industry and Commodities. Hitherto, these crops have largely depended on the provision of drainage facilities. Oil palm is recognised as an NKEA and its eight EPPs and three BOs is expected to provide an incremental GNI impact of RM125.3 billion and generating additional 41,600 jobs in 2020. Supplemental irrigation for oil palm cultivation is being actively pursued noting its potential of being catalytic to a substantive increase in crop yields.

- **Information Management:** Decision Support Systems for the management of water as a resource and for the provision of various utility services depend on reliable data and information readily available on a centrally managed database with appropriate links to customised systems by sectoral users for open access. Following MSAN 02 (July 2003) decision endorsing IRBM for the management of land and water resources in a sustainable manner, the river basin following hydrological boundaries provides an appropriate platform for the collation and dissemination of all data and information for common use.

- **Integrated Water Research:** Past and current research on water in Malaysia has been largely ad-hoc and fragmented more to address engineering infrastructural concerns while at IHTs, research conducted have had a narrow focus to meet academic interests. This has been borne out by an ASM study completed in 2014. The study recommended an integrated water research framework comprising need-based strategic themes that seek and provide sustainable solutions to Malaysia's water resources development and management programmes. MSAN 10 held in October

2015 considered and endorsed the ASM report entitled *Setting of a National Agenda for Integrated Water Research* for implementation by NRE.

- **Awareness raising, Advocacy, and Capacity Building:** A common but important feedback received from the many stakeholder consultations held was that personnel at Federal and State levels are ill-equipped both in capability and numbers to deal with the holistic management of water as a resource and for livelihoods. Similarly, despite past efforts undertaken on awareness raising regarding IWRM largely by water-related NGOs, its spread among communities and the public is minimal.

- **Gender Issues:** In many societies including Malaysian societies, women are largely responsible for reproductive work that includes household tasks and caring for the family. In terms of water, the tasks of ensuring enough water for the household generally rest on the shoulders of women. Added to this is the use of water for small businesses and informal sector economic activity that have higher levels of women's participation. Changes in the availability of water including the issue of drought, heavy rainfalls, and frequency of floods increase women's burdens.

- **Climate Change:** In the recent past, increase in extreme climate variability is already being felt in the country. Shift in rainfall patterns, escalating floods, and drought occurrences of increased intensities (accompanied by forest fires and haze) are some of the ominous signs. An ASM study on Water and Climate Change completed in 2014 reviewed national capacities from various facets of water resources management and had endorsed IWRM approach/processes as a "no regret measure" in building up local resilience in climate change adaptation. MSAN 10 held in October 2015 considered and endorsed the ASM Advisory Report entitled *Strategic Plan for addressing the impacts of climate change on water-related issues in Malaysia* for incorporation by NRE into the overall strategies and action plans to combat climate change over the short and long term in line with the National Policy on Climate Change.

- **Trans-boundary Issues:** Some of the trans-boundary issues highlighted by the expert reviews commissioned by ASM on IWRM-related topical issues are as follows:
  - Water supply security, energy security and food security are inextricably linked under a *Water-Energy-Food nexus*, where all the three components are dependent on the availability of water resources. "Information gap, silo-based governance, and technology lock-in are the forces that hinder the translation of water, energy, food nexus into operational objectives and programmes".
  - Global trends and Malaysia is no exception, show there is a "disconnect" between *land use planning and water resources planning* due to a variety of factors mainly the differing levels of governments and decision-making for land use planning and for water planning. Water quality is often compromised from incompatible

location of land use such as landfills at proximity to groundwater sources. Upstream pollution from conversion of land, clearing of forests or activities on massive tracts of agriculture land is also averse to water quality and conservation, besides increasing the risk of disasters such as flash floods and landslides.

- **Emerging Concepts and Solutions:**
  - *Virtual Water (VW) and Water Footprint (WF)*: WF is the amount of water embedded in products. VW is defined as the volume of water required to produce a commodity or service. VW and WF are closely linked. The term WF is usually used to reflect the perspective from the standpoint of consumers or producers of products, whereas the term VW is mostly used in the context of international or interregional trade. The global WF is estimated at 1240 m^3 per capita in average. Malaysia's WF is around 2344 m^3 per capita per year, rendering it higher than the global WF average, largely due to higher water usage patterns among Malaysians.
  - *Wealth Creation:* The *ASM Mega Science Study report on Water (2011–2050)* has added "wealth creation" as an objective for the water sector over the long term identifying some 10 areas of products and services as opportunities for creating new wealth.
  - *Green Growth and Water Demand Management:* After Rio+20, the goal to sustainable development is repackaged via the "green economy" concept and Malaysia has subscribed to it. For the water sector, Water Demand Management (WDM) and the 3Rs (namely reduce, reuse, and recycle) are important green instruments that can substantially contribute to sustainable water resources management. There is an urgent need for the water consumers to play a more active role in helping to reduce their water demand. Water supply management (WSM) is not green and needs to embrace green building codes and use green processes and products.

- **National Transformation Programme:** In renewed efforts for timely achievement of Vision 2020 and to help fast-track the process, the country has, since 2010, launched the National Transformation Programme, of which one of the component programmes is the ETP. The ETP comprises 12 National Key Economic Areas (NKEAs) representing economic sectors considered significant in contributing to GNI and job creation. Unfortunately, the water sector was not included despite its importance nationally as a resource and for livelihood supporting all sectors of the economy.

7.2 Recommendations

Drawing from the conclusions above, it is clear that there is an urgent need for integrated solutions and concerted efforts that are able to permeate across all sub-sectors and penetrate

all hierarchical levels of management down to the grass roots.

Under the GTP, the Malaysian government has adopted the National Blue Ocean Strategy (NBOS) in its strategic planning and operations which have to date led to the formulation and execution of a number of creative blue ocean strategy initiatives that are transforming the country. For the Transformation of the Water Sector, the ASM recommends to Government the adoption and implementation of the ***National IWRM Plan: Strategies and Road Map*** contained in this report as the way forward to ensuring a better water future. The strategy formulation process for the Plan is akin to NBOS and was developed conforming to the internationally accredited IWRM General Framework that aims at balanced development between "water as a resource" and "water for livelihoods". The Framework is founded on the 3E's principle of economic efficiency, equity, and environmental sustainability.

The recommended strategies under the Plan have been listed under four categories based on the elements prescribed by the Framework as follows:

i) Enabling Environment (Appendix 6.1);
ii) Institutional Framework (Appendix 6.2);
iii) Management Instruments (Appendix 6.3); and
iv) Investments in Water Infrastructure (Appendix 6.4).

Some of the highlights and essential features of the recommended Plan are:

- The Plan is a synthesis of the strategies recommended by the component, state and NKPA study reports and intended for implementation over a 15-year time frame spanning three Malaysia Plans until 2030, and coinciding with target year set for the realisation of the UN endorsed SDGs.

- Component and state plans and programmes included in the report shall be implemented concurrently nationwide and led by the key ministries and relevant state administrations identified in the plan according to their entrusted responsibilities be it underwater resource management or water utility provision.

- ***Appendix 6.1 — Enabling Environment*** contains strategies to strengthen the policy and legal framework both at national and state levels to ensure sound and effective implementation consistent with the provisions of the Federal Constitution.

Natural resources comprising land, water, forests, inland fisheries, marine parks, wildlife, minerals, and rock materials and the environment come under the purview of the NRE Ministry. While separate policies have to date been formulated to address and manage many of these resources, it is recommended that an overarching National Integrated Natural Resources Policy be developed on a priority basis that ensures the integrity and symbiotic relations among them are safeguarded and not compromised at all hierarchical levels.

Similarly, it is recommended that a common policy framework governing the water-energy-food nexus be formalised which would ascertain the balanced development and progress in meeting water security, food security and energy security targets.

To complement the NWRP 2012, supporting policies have been recommended to cater for sound resource management, namely a National IRBM Policy (that is inclusive of related sub-sets such as ILBM, IASM, ICM, IFM, IDM, IUWM, ICZM).

Similarly, for utility provision, it is recommended that a National Water Supply Services Policy that encompasses consumptive and non-consumptive uses be formulated to ensure equitable and efficient services to all users including hitherto neglected ecosystem-regulating service needs.

A review of related policies such as the *Dasar Agromakanan Negara* 2011–2020 is also recommended so as to lay greater emphasis on water as a critical component for crop development and for attaining optimal yields through sound water management.

Due consideration should be accorded to mainstreaming gender issues for the sustainable management of water resources in the country.

The legislation of a common National Water Resources Act, replacing the outdated Waters Act 1920, should be expedited to ensure uniformity in application by all states with the states enacting their respective Enactments/ Ordinances. With the availability of the relevant state laws, this will facilitate more holistic water resource management in the states.

A more contemporary AWS Act be legislated to replace the outdated Irrigation Areas Ordinance 1953, the Drainage Works Ordinance 1954, and the combined Drainage and Irrigation Ordinance 1956 which is applicable only in Sabah. The proposed AWS Act would be catalytic to reinforcing evolving farming systems aimed at revitalising the agriculture sector for wealth creation.

There is a need to review the existing Streets, Drainage and Buildings Act 1974 so as to be contemporary in dealing with urban drainage issues through the application of IUWM principles and practices for holistic management.

Potable water supply was on the State List prior to the year 2006 when WSIA was legislated. With its inclusion in the Concurrent List, water utility services for all users are now financed from both Federal and State resources. It is not the same for water resources management. Ownership of water being vested with the state, funding for its management rests with the state, except where the water source involves an internationally shared river. It is recommended that following current norms, Federal finances continue to be provided to fund some of the resource management related activities such as water resources assessment; information management; river basin and coastal zone management planning; integrated water R&D; awareness raising, advocacy and capacity building; mitigation of water-related hazards (such as floods, droughts, tsunamis, coastal erosion and landslides). It is further recommended that ecosystem rehabilitation and restoration measures be included in the list of Federal funded activities.

- ***Appendix 6.2 — Institutional Framework*** comprises strategies to ensure greater integration within and among water-related institutions, and to supplement or reinforce institutional structures at all hierarchical levels of management.

  At the national level, MSAN, chaired by the Deputy Prime Minister, established in 1998 is the apex body on water matters representing leadership at the highest political level. It is recommended that a second-tier leadership in the form of a National Steering Committee (NSC) on IWRM be established, jointly chaired by the KSU of NRE and KeTTHA with membership comprising KSUs of the other water-related ministries and State Secretaries. The NSC would oversee the coordinated implementation of the national IWRM agenda nationwide. The NSC shall be supported by a National Technical Committee, jointly chaired by the DG of DID and the Chief Executive Officer of SPAN with members comprising the DGs of other water-related departments and agencies.

  In line with the World Health Organization requirements that Water Safety Plans (WSPs) addressing "source to tap" be implemented to ensure safe drinking water, it is recommended that a national steering committee jointly managed by KeTTHA, MOH, NRE, and MSANg be formed to oversee the development of a master plan and its implementation nationwide.

  AWS development and management by a dedicated institution has been proven to be one of the key success factors for agriculture development. Following the recommended legislation earlier for a contemporary AWS Act, it would only be appropriate and justified that a dedicated department for AWS be reinstated at the MOA with adequate capacity to deal with the challenges of a revitalised agricultural sector that is able to support agribusiness while permitting and regulating private sector involvement as AWS Providers or Operators.

  Complying with the MSAN 08 directive urging states to establish MSANg, it is recommended that these state-level institutions be established without further delay and backed by appropriate legislation on similar lines as SWRC for Sabah, LUAS for Selangor, and Lembaga Sumber Air Negeri Kedah. They would provide the highest political leadership on water matters in the state. To ensure greater penetration and facilitate decentralisation in decision making, the formation of river basin level committees is recommended.

  Intra-ministerial integration involving the merger of surface water management (currently under DID) and groundwater management (currently under a division of JMG) to become a single agency under the NRE Ministry and to be designated as the Department of Water Resources; accelerate the integration of water supply and sewerage services at KeTTHA to ensure holistic management of water and wastewater; and the institutionalisation of demand management in all water-related institutions to expedite the cultural shift from hitherto water supply management to more water demand management.

- ***Appendix 6.3 — Management Instruments*** comprise strategies to ensure the effective use of such instruments to assist decision makers in making wise

choices. Management instruments range from information management, planning, economic and financial, legal, technical, operation and maintenance, R&D, capacity building, participatory management, to international cooperation. Some of the main strategies recommended under each category are as follows:

- *Information Management:* In line with MSAN 02 directive for adoption of IRBM nationwide, it is recommended that a centrally managed IWRM database be established at the NRE Ministry built around the 189 river basins as its platform for the collation and dissemination of all water-related data and information for open access. The central repository shall be appropriately linked with customised systems that are in place for sectoral use. Dissemination of real-time data and information pertaining to water-related hazards is an important feature of the RBIMS.

  A national *State of the Waters Report* be released periodically by the NRE, if not annually on a triennial basis, to keep all stakeholders and the public informed on the management of the country's water, to include an assessment on the status of water availability and water quality, its accounting, allocation and use, reported according to river basins nationwide.

- *Planning:* To pursue the IWRM agenda over the long term, foresight studies on IWRM and its sub-sets are recommended, whilst the preparation and distribution of appropriate guidelines would facilitate sound implementation. Early preparation of river basin management plans is recommended to assist basin managers in decision-making processes. River Basin Management Plans should incorporate IFM and IDM plans complete with Early Warning System, flood/drought risk assessment, emergency response, monitoring tools, inventory resources, and identification of areas and groups at risk. The River Basin Management Plans would also ensure there is 'no disconnect' between land-use management and water resources management.

  Alternative water sources, such as groundwater, rainwater, stormwater, wastewater as well as brackish and sea water are possible new sources to be developed.

- *Economic and Financial Instruments:* Under this category, a wide array of water demand management strategies are recommended related to the provision of water utility services. They range from incentive schemes to encourage the use of water saving devices or systems, mechanisms for optimal cost recovery of services with provisions for targeted subsidies, and equitable tariff setting. For resource management, payment for ecosystem services and the application of "polluter pays" principle are options that merit implementation.

- *Legal Instruments:* This category is related to enforcement of water-related laws and regulations. Among them are those pertaining to gazetting of reserves and protected areas, the issue of licenses for various uses, and

imposition of penalties for breaches and offences committed.

- *Technical Instruments:* Strategies under this category are mainly aimed at water conservation measures. Apart from water reuse and recycling, technologies recommended are water saving devices (including retrofitting), leakage control, modifying agronomic practices such as adjustment of cropping patterns and adoption of dry-seeding techniques in paddy planting; and the choice of less thirsty crop varieties.

- *Green Growth and WDM:* Strategies in support of Green Growth for the water sector through the application of the 3Rs are essentially WDM instruments to ensure a cultural shift from WSM to WDM while also ensuring that WSM embraces green building codes and use green processes and products.

- *Operation and Maintenance:* Under this category, strategies recommended are mainly to ensure the security, integrity, resilience and safety of water-related systems. Water allocation, water accountability, and water audit undertaken at the river basin level is a priority action required of water resource managers. For utility providers, operational strategies include the implementation of WSPs nationwide conforming to WHO guidelines; the development of SOPs for all process-related operations; reduction of water losses such as NRW and the like; and the development of maintenance manuals to ensure control systems, facilities, and equipment associated with water supply and drainage systems remain functional at all times. SOPs are also needed to address emergencies such as breakdown of water supply, pollution of water sources, floods, droughts, and water-borne diseases.

- *Research and Development (R&D):* ASM report entitled *Setting a National Agenda for Integrated Water Research in Malaysia* completed in 2014 has been endorsed by MSAN 10 that met in October 2015 for implementation by the NRE as the lead ministry. It is recommended that the findings and recommendations to pursue integrated water research based on a set of need-based strategic themes be implemented on a priority basis. A review of the current governance structure be undertaken based on the options proposed by the report. The appropriation of adequate human and financial resources is equally vital.

- *Awareness Raising, Advocacy and Capacity Building (AACB):* Success of the national IWRM agenda over the long term requires a mindset change among public, private and community stakeholders. Awareness raising of water issues, challenges and integrated solutions that extends to community stakeholders and the public at large are essential ingredients to the IWRM agenda. Similarly, political leaders are best placed to play the advocacy role in promoting IWRM, facilitate participatory management and in resolving conflicts through engagement and dialogue. More importantly, personnel involved in water resource management and water utility provision from both Federal and State administrations at all hierarchical levels require more holistic training comprising a blend of a common IWRM modules prior to being streamed to undergo specialised training based on

their respective sectoral management and service delivery needs.

Currently, water-related training is mainly provided by NRE, KeTTHA, MOA and Water Operators along sectoral lines and targeted mainly at their own personnel. In keeping with NBOS and the spirit of IWRM, it is recommended that the three ministries and water operators pool resources to establish and manage one-stop training centres at national level and in all states that offer integrated modules on AACB to cater for all three target groups mentioned above. It entails the development of appropriate communication and training packages working in collaboration with IHTs and environmental and community-related NGOs.

- *Participatory Management:* The second Dublin principle states "Water development and management should be based on a participatory approach, involving users, planners, and policy-makers at all levels".

Some examples of past initiatives to involve users and beneficiaries in water supply programmes including farmer participation in tertiary system development and O&M activities under MOA; the "water forum" mooted by KeTTHA; and "rakan tasik" or "river brigade" initiated by some states to support water resource management. It is recommended that such initiatives be intensified in the future. There is scope and potential for greater stakeholder participation when programmes such as IRBM and WDM are implemented and operational particularly at the community levels through outreach programmes. There is also the need to help create participatory capacity, and complementary AACB programmes are equally necessary.

- *International Cooperation:* The problems and challenges that beset the water sector in Malaysia are not new. They are also not unique to this country alone but experienced globally. Regional and international institutions and organisations operating both within and outside the UN system are aplenty, each with their area of special focus. These agencies are continually seeking and providing integrated solutions pertaining to a wide range of water thematic issues. Dedicated water-related R&D institutions also operate in various locations in the region and internationally.

It is recommended that national water-related organisations and agencies be proactive in networking and seek to establish links with similar subject matter focused institutions abroad. National research and capacity building institutes should endeavor to enter into strategic alliances with renowned regional and international water research and training centres for mutual benefit. International collaboration and cooperation provides spin-off benefits in the form of business opportunities for both public and private sectors. Regular participation in reputed water-related international water fora also provides good exposure, understanding of current issues and challenges, introduction to future developments, and offer opportunities for interaction and networking worldwide.

- ***Appendix 6.4 — Investments in Water Infrastructure:*** This fourth element would require substantial investments. The list of "Investments in Water Infrastructure" represents a consolidation of programmes and EPPs identified by an earlier ASM study conducted in 2014 justifying a National Key Priority Area on water, together with additional investments recently identified by Component Plan studies for specific programmes complete with a total of 95 EPPs to go with them. The programmes have been rearranged and classified under three categories, namely:
  (a) Cross-cutting Programmes (5 programmes and 14 EPPs);
  (b) Programmes related to "Water as a resource" (5 programmes and 48 EPPs); and
  (c) Programmes related to "Water for Livelihood" (5 programmes and 33 EPPs).

A summary list of the programmes is shown in the table below:

Table 7.1: List of Programmes for Investments in Water Infrastructure

INVESTMENTS IN WATER INFRASTRUCTURE	
A. Cross-cutting Programmes (14 EPPs)	
1. Central Water Resources Database 2. Integrated Water Research 3. Climate Change Adaptation 4. Awareness Raising, Advocacy, Capacity Building 5. Meetings, Incentives, Conference, and Exhibition	
B. Programmes related to "Water as a Resource" (48 EPPs)	**C. Programmes related to "Water for Livelihood" (33 EPPs)**
1. Integrated River Basin Management and Integrated Aquifer Systems Management 2. Water-related Hazards 3. Ecosystem Services 4. Water Pollution Monitoring and Rehabilitation 5. Water-based Recreation and Tourism	1. Development of Alternative Water Sources 2. Water Supply and Wastewater Services Sector 3. Energy Sector 4. Agricultural Water Services 5. Commercial Water to Shipping

With the twin objectives of water security and water economic opportunities, it is recommended that the investments in water infrastructure contained in Appendix 6.4 be urgently incepted to cater for the national water sector needs and to spur the transformation of the water sector. The appendix comes with an implementation road map.

Management Structure for Plan Implementation

Plan implementation nationwide entails mobilising resources and designing effective management structures. A recommended management structure for effective implementation of the Plan is as follows:

(a) The Plan shall be managed nationally at the highest political level by MSAN which has the NRE and KeTTHA as its joint secretariat. Correspondingly, at respective state levels, it would be MSANg or its equivalent.

(b) A NSC comprising the KSUs of all water-related ministries and the State Secretaries shall oversee the implementation of the Plan. KSUs of NRE and KeTTHA shall be the joint Chairpersons of the NSC. An independent advisory panel will assist the NSC in providing critical reviews of programmes & activities. A dedicated IWRM-IU headed by a Senior Executive well versed on IWRM would be responsible to ensure the timely and coordinated implementation of the Plan. The IWRM-IU would be responsible to the NSC and serve as its Secretariat. At the state level, the MSANg or its equivalent would undertake the corresponding role with its implementation arm being the Office of the Director MWA/Water Resources as applicable for each state.

(c) The NTC reporting to NSC and comprising the heads of water-related departments and agencies. They would meet frequently to resolve technical issues and assist in streamlining operational matters. It would be jointly chaired by the DG of DID and the CEO of SPAN.

Closing Remarks

Since the launching of the NWRP in 2012, ASM noted that the NRE Ministry has embarked on an initiative to develop a NWRP Action Plan and has set up an organisational structure to undertake this task. A summary brief regarding this initiative has been included as one of the appendices under Chapter 4 of this report. In lauding this effort, ASM envisages some overlap in recommended strategies. This ASM report is from a more inclusive IWRM perspective of the water sector. Hence, ASM would consider both the undertakings as being mutually supportive and complementary.

The recently released United Nations World Water Development Report 2016 on World Water Day is entitled “Water and Jobs”. The report reiterates that “water is an essential component of national and local economies, and is needed to create and maintain jobs across all sectors of the economy”.

“Sustainable water management, water infrastructure and access to a safe, reliable and affordable supply of water and adequate sanitation services improve living standards, expand local economies and lead to the creation of more decent jobs and greater social

inclusion. Sustainable water management is also an essential driver of green growth and sustainable development".

The early implementation of the National IWRM Plan (NIWRMP) and Road Map would go a long way in compensating for the earlier omission of "water" as an NKEA under the ETP despite its importance and being a key element in nine other approved NKEAs. The NIWRMP would not only be catalytic to the Transformation of the Water Sector but would contribute to meeting the SDGs by 2030. Through its coordinated policy and investments, it would also serve as yet another timely intervention to address the water and jobs nexus, a pre-requisite to sustainable development.

While the report has recommended a management structure for plan implementation, it is equally vital that "champions" emerge to carry the agenda forward. Appropriately, the onus must fall upon the Honourable Ministers of the three key water-related ministries, namely NRE, KeTTHA and MOA, to team up in the true spirit of IWRM to champion this initiative and the transformation process.

References

Selangor Waters Management Authority (LUAS) 2012, *Pelan Strategik Lembaga Urus Air Selangor 2012 – 2016* (*Selangor Water Management Authority Strategic Plan 2012 – 2016*), retrieved from <*www.luas.gov.my*>.

Selangor Water Management Authority (LUAS) 2011, *State of the river report* — Sungai Klang, RETRIEVED from <*www.luas.gov.my*>.

Selangor Water Management Authority (LUAS) 2011, *State of the river report* — Sungai Langat, retrieved from <*www.luas.gov.my*>.

Selangor Waters Management Authority (LUAS) 2011, State of the river report — Sungai Selangor, retrieved from <*www.luas.gov.my*>.

UN-Water 2016, *The United Nations world water development report 2016 — Water and Jobs*, retrieved from <*www.unesco.org*>.

United Nations 2016, *Sustainable development goals*, retrieved from <*www.un.org/sustainabledevelopment*>.

UN-Water & GWP 2007, *Roadmapping for advancing integrated water resources management processes*.

World Economic Forum 2016, *The global risks report 2016*, 11th edn, retrieved from <*www.weforum.org*>.

World Water Council 2015, *Integrated water resources management: a new way forward*, A Discussion Paper of The World Water Council Task Force on IWRM.

ASM Water Sector Reports:

Ahmad Fauzi Ismail 2014, *Setting a national agenda for integrated water research*, vol. 1, Academy of Sciences Malaysia.

Ahmad Fauzi Ismail 2014, *A study on the current status and needs assessment of water resources research in Malaysia*, vol. 2, Academy of Sciences Malaysia.

Chand, F 2011, *Strategies for the sustainable development and management of ground water resources in Malaysia*, Academy of Sciences Malaysia.

Hanapi Mohamad Noor 2016, *A study on the status and issues on integrated river basin management in Malaysia*, vol. 2, Academy of Sciences Malaysia.

Hanapi Mohamad Noor 2016, *Strategic plan for integrated river basin management in Malaysia*, vol. 1, Academy of Sciences Malaysia.

Mohd Adnan Mohd Nor 2016 *Agriculture water services for agribusiness*, Academy of Sciences Malaysia.

Salmah Zakaria 2011 *Study on the status of climate change impact on water-related issues*, ASM Study Report 1/2011, Academy of Sciences Malaysia.

Salmah Zakaria 2014 *Strategic plan for addressing the impacts of climate change on water-related issues in Malaysia,* ASM Advisory Report 1/2014, Academy of Sciences Malaysia.

Shahrizaila Abdullah 2009, *Strategies for the sustainable development and management of lakes and reservoirs in Malaysia*, vol. 2: Conceptual framework, component plans, and position papers, Academy of Sciences Malaysia

Shahrizaila Abdullah 2009, *Strategies for the sustainable development and management of lakes and reservoirs in Malaysia*, vol. 1, Main report, Academy of Sciences Malaysia.

Shahrizaila Abdullah 2009, *Strategies for the sustainable development and management of lakes and reservoirs in Malaysia*, vol. 3, part 1 — A desk study on the status of eutrophication of lake in Malaysia (2005) & part 2 — *Proceedings of the Colloquium on Lakes and Reservoir Management in Malaysia: Status and* Issues (2007), Academy of Sciences Malaysia.

Syed Muhammad Shahabudin 2016 *Strategies to enhance water demand management in Malaysia*, Academy of Sciences Malaysia.

Zulkifli Yusop 2016 *Strategies for the improvement of water supply and wastewater management services in Malaysia*, vol. 1, Academy of Sciences Malaysia.

Zulkifli Yusop 2016 *Study on the current issues and needs for water supply and wastewater management in Malaysia*, vol. 2, Academy of Sciences Malaysia.

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