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Clean, Green and Blue

Advance Praise for Clean, Green and Blue

I welcome this book as an inspiring how-to guide for any city seeking to improve its environment, and particularly its management of water resources, in sustainable ways. It goes beyond a description of technical innovations to document the importance of forward-looking policies, partnerships, economic planning, and a willingness to invest for the future. Above all, the book shows that investment in environmental sustainability can indeed be fully compatible with economic growth.

The expertise, experience, and practical wisdom embodied in this report are well worth study and replication on a broad international scale. This is especially true at a time when climate change increases the certainty of water scarcity in many regions of the world, and adds urgency to the quest for efficient and sustainable solutions.

The book's overarching message is clear: with political commitment supported by good planning and technical innovation, any city can achieve a clean environment. By soundly substantiating this conclusion, Singapore makes an admirable contribution to some of the most pressing challenges facing the world, today and into the future.

Dr Margaret Chan

Director-General, World Health Organisation

Behind the clean and green environment that Singaporeans enjoy today lies a story of strong political will, sustained effort and a committed citizenry. Tan Yong Soon and his team at MEWR give a comprehensive account of how Singapore turned "green" before it became the fashion. Their account also reminds us that Singapore's achievements are the result of far-sightedness and hard work.

Peter Ho

Head of Civil Service, Singapore

No city in the world has done a better job than Singapore at planning for and managing environmental quality. Their success in this very complex task is reflected every day in the lives of its citizens who benefit from clean air and water. This book is a useful guide to cities, governments and their people on learning from the experience of Singapore over several decades on how to build more sustainable cities.

Peter Schwartz

Chairman, Global Business Network

If you always wanted to know how a government could develop a sustainable water strategy, this is the book to read. It is a remarkable story well documented with references to official government publications and a record of vision, strategy and implementation. It is commended to all administrators and policy analysts as both source material and a model.

Dr David Garman

President, International Water Association

While other nations talk about climate change and environmental issues like clean air, water and waste management, Singapore implements sustainable solutions. This little gem of a book explains what they are doing, how and why to preserve their ecosystem. The associated management actions position the city state of Singapore at the forefront of world's best practice. Moreover, the lessons contained herein are readily applicable in other cities and nations.

Dr Allan Hawke

*Chairman of the MTAA Superannuation Fund, Australia and
Chancellor of the Australian National University (2006–2008),
Secretary of Defence, Australia (1999–2002), and
Secretary to the Department of Transport and Regional Services (1996–1999)*

When Singapore became a sovereign state in 1965, the fledgling nation faced very similar problems as most other developing countries: high unemployment, low standard of living, and poor environmental conditions. In a scant four decades, it has become the sixth wealthiest country in the world in terms of per capita GDP and has managed its environment so well that it is now considered to be one of the best in the world. In this remarkable book, Tan Yong Soon authoritatively and objectively analyses how the environmental conditions were radically transformed within this period, and the enabling conditions which made this extraordinary transformation possible. This book will unquestionably make all Singaporeans proud of their environmental achievements, and at the same time enable other countries, both developed and developing, to learn many lessons from a most remarkable success story. This book is a must read for any individual interested in environment-development issues.

Professor Asit K. Biswas

*President, Third World Centre for Water Management, Mexico and
Distinguished Visiting Professor, Lee Kuan Yew School of Public Policy, Singapore*

With our planet in peril, not least from the looming crisis of freshwater scarcity worldwide, this book is sounding a timely call to action. Yong Soon's exposition of Singapore's response to the challenge of balancing "can-do" economic development with environmental and water sustainability makes fascinating reading, even for readers beyond the shores of the tiny city state. The coverage of water desalination, recycling and management would hold special interest for those in arid land masses such as Central Asia, Australia, the sub-Saharan, and the Middle East.

Professor Shih Choon Fong

*President, National University of Singapore (2000–2008) and
President designate, King Abdullah University of Science and Technology*

The Ministry of the Environment and Water Resources of Singapore has been doing very interesting and useful work in the field of environment and water sustainability. I have been visiting and participating in the different international conferences held in Singapore. Providing infrastructure and using modern technologies and processes which are environmentally friendly to fulfill water needs of the population is key to their success in achieving the goal of clean environment and water sustainability. Now again this attempt to write a book on Singapore's journey towards environment and water sustainability to bring awareness among populace is another step forward to achieve clean environment not only for Singapore but for humanity in general world wide.

H.E. Fehied F. Alshareef

Governor, Saline Water Conversion Corporation, Kingdom of Saudi Arabia

This is a comprehensive and unique record of how Singapore approaches the environmental issues in development. It is recommended reading for those who wish to rise to the challenge as we – public, private and people sectors – better understand the opportunities ahead for sustainable development.

Lee Tzu Yang

Chairman, Shell Companies in Singapore

Water is truly the lifeblood of society. Recognizing this imperative, Singapore continues to demonstrate innovative approaches to sustaining this vital resource for its citizens. The country's leaders also play a significant role in providing a roadmap for others by balancing social, economic, environmental, government and public interests for the benefit of current and future generations.

Len C. Rodman

Chairman, President and CEO, Black & Veatch

Singapore's environmental aspirations and achievements are presented with clarity and insight in this book. Its inclusive perspective recognizes not just the government's major role but the importance of community and NGO participation/partnerships in attaining the vision of environmental sustainability.

Dr Geh Min

President, Nature Society of Singapore (2000–2008)

This book illustrates the magnitude of Singapore's achievement through foresight and prudent planning. It comprehensively captures Singapore's commitment to environmental sustainability, recounting the unprecedented challenges this nation has overcome in the past and the possible challenges it will face in the future. Reading this book is essential for understanding how Singapore has managed its environmental resources, not only for ensuring national security but also for creating a cleaner and greener home for the people of Singapore.

Eugene Heng

Chairman, Waterways Watch Society, Singapore

The surge in interest in climate change has resulted in many publications on the whys and wherefores of environmental issues. Yong Soon and his team have rightly sought to reach out to everyone who is concerned with the sustainability of our planet and who wishes to play a role in improving the living environment. I congratulate them and their collaborators for their noble and outstanding endeavour which is based on Singapore's experience but relevant to others who are also interested in promoting sustainable development and living.

Lim Chee Onn

Executive Chairman, Keppel Corp

Singapore's Ministry of the Environment and Water Resources has shown global leadership in many areas. For example, in water recycling, a critical area in a water short world, Singapore managed to grab world leadership in record time. The planning and the flawless execution of the whole program were far beyond anything I have ever seen. It was also of great service to the world because Singapore's health studies and full-scale installations removed the fear that others felt in proceeding with large-scale water reuse. Thanks to this book we can now learn the way one can organize so that such great successes happen systematically.

Dr Andrew Benedek

*Founder of ZENON Environmental Inc. and
Winner of the 2008 Lee Kuan Yew Water Prize*

This book is much more than a history of how Singapore has achieved its unique combination of environmental and economic prosperity. It is also a thoughtful explanation of the policy considerations, trade offs, and constraints faced by Singapore's leaders in making strong environmental stewardship an integral part of the nation's economic development strategies. In today's world of rapid urbanization, environmental stress, and sustainability concerns, Singapore's remarkable environmental success story sets the world standard for sustainable economic growth in the twenty-first century.

Ralph Peterson

Chairman and CEO, CH2M Hill

Singapore is one of the twentieth century's most successful development stories. I am proud to say that the Asian Development Bank is working very successfully with Singapore in both the water and urban management sectors, with the aim of spreading best practices throughout developing Asia and the Pacific. Now is the time for inspired leadership to improve water governance, performance and knowledge management.

Haruhiko Kuroda

President, Asian Development Bank

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Clean, Green and Blue

Singapore's Journey
Towards Environmental and
Water Sustainability

TAN YONG SOON

WITH

LEE TUNG JEAN • KAREN TAN



INSTITUTE OF SOUTHEAST ASIAN STUDIES

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First published in Singapore in 2009 by
ISEAS Publishing
Institute of Southeast Asian Studies
30 Heng Mui Keng Terrace
Pasir Panjang
Singapore 119614
E-mail: publish@iseas.edu.sg
Website: <http://bookshop.iseas.edu.sg>

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ISEAS Library Cataloguing-in-Publication Data

Tan Yong Soon.

Clean, green and blue : Singapore's journey towards environmental and water sustainability / Tan Yong Soon with Lee Tung Jean and Karen Tan.

1. Water supply—Singapore.
2. Water resources development—Singapore.
3. Environmental protection—Singapore.

I. Lee Tung Jean.

II. Tan, Karen.

III. Title.

TD299 S6T23

2009

ISBN 978-981-230-860-3 (soft cover)

ISBN 978-981-230-861-0 (hard cover)

ISBN 978-981-230-862-7 (PDF)

The cover illustration shows Lower Peirce Reservoir, in Singapore.
Photo courtesy of PUB.

Typeset by Superskill Graphics Pte Ltd
Printed in Singapore by Utopia Press Pte Ltd



This book is printed on recycled paper.

*This book is dedicated to
Mr Lee Kuan Yew,
Prime Minister of Singapore (1959–1990),
whose vision and leadership have made Singapore
a clean, green and blue city.*

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PREFACE

The idea for this book originated from my first day in the Ministry of the Environment on 1 January 2004. It was a dream job. Singapore has had a wonderful record in environment protection. The staff of the Ministry, including its two Statutory Boards, the Public Utilities Board (PUB) and National Environment Agency (NEA), are passionate, competent, and professional. The job is also a constantly evolving one, as new environmental challenges such as climate change and sustainability issues continue to confront us. One never gets bored. And the work is rewarding, as we know that what we do will leave a lasting impact on future generations.

I wanted to produce a book to explain how Singapore came to choose the environmental path it did. Not just what we did, but how we made our calculations and reached our decisions. And through reflecting on the past, I wanted to synthesize the principles that would lead us forward into the future.

But like many good ideas, this book had a long gestation period. Over the years, I have become engrossed in my work. The Ministry was renamed the Ministry of the Environment and Water Resources (MEWR) in August 2004 to better reflect its work, which is not just about environment, but also water resource management. At the time when I was discussing names with my Minister, other names being considered were “Ministry of Resource Conservation” and “Ministry of Environment Sustainability” as these were longer-

term challenges that we would have to grapple with. However, we eventually agreed to recommend the more straightforward name, as ideas such as resource conservation and environmental sustainability would not have resonated as well with the public until we could gain their understanding and buy-in on these issues.

As Permanent Secretary of the Ministry, I have included increasing the investment on environmental infrastructure as well as environmental ownership among my priorities because while it is critical to ensure that the necessary infrastructure is in place, it is only by actively involving people that we can hope to achieve the goal of resource conservation and environmental sustainability. We continue to embark on public education and consultation and open up our water and environmental resources for the community to enjoy as these steps can spur them onto taking better care of the environment. In addition, promoting and developing a vibrant environment and water industry is important, in order to grow the economy and increase employment, as well as facilitate the transfer of Singapore's expertise and solutions to other parts of the world. This is done through outsourcing environmental services to the private sector and public-private partnership (PPP) projects, helping companies to internationalize and grow, as well as developing technology and manpower for the sector and within the Ministry. In preparation for the impact of climate change, Singapore acceded to the Kyoto Protocol and put together a National Climate Change Strategy, among other initiatives, to anticipate the risks and opportunities posed by climate change, as well as to adopt suitable mitigation and adaptation measures.

The Ministry has received numerous delegations from countries all over the world, ranging from Australia to China to the Middle East, who came to Singapore to learn more about our environment and water management practices. Many wondered how Singapore could have achieved so much in such a short span of time. A few understood immediately when I told them that the simple and straight answer was "Mr Lee Kuan Yew". But I realized that several

others would have benefited from a more detailed explanation. I was thus reminded of the book and started work on it at the end of 2007. I assembled a team of officers to carry out extensive research in order to enable us to recount the work of the Ministry, as well as our partner and predecessor agencies in delivering the environment all of us enjoy today.

I hope this book will be read by Singaporeans who wish to play a role in improving the living environment, whether they are working in the government or the environment and water industry, or are just concerned members of the public. The latter group is especially important because the environment is everyone's business, and is too important to be left to only the professionals and policy-makers. It will be an added bonus if professionals in other cities also find the book useful to their work. Since more than half of the world's population live in cities and all of us live on the same earth, each person taking action to improve his local environment will collectively result in significant improvements for the global environment.

Tan Yong Soon
September 2008

ACKNOWLEDGEMENTS

This book is the work of a team from MEWR, NEA, and PUB, led by myself, and ably managed by Karen Tan. It has benefitted from tight editing by Lee Tung Jean. It is made possible only because of the hard work and achievements of past officers in the Singapore Ministry of the Environment and PUB (since 1972 and 1963 respectively), and the continuation of the good work by existing officers in MEWR, NEA, and PUB.

I would like to express my appreciation to the following Ministers and past Permanent Secretaries, Ministers Mah Bow Tan, Teo Chee Hean, Lim Swee Say, and Dr Yaacob Ibrahim, as well as Permanent Secretaries Lee Ek Tieng, Tan Guong Ching, and Tan Gee Paw, who despite their many commitments and busy schedules, generously shared their time and insights and provided their comments which have helped to improve the book.

My appreciation also goes to an extraordinary team of dedicated officers who spent many hours and days conducting research and writing the draft. The following officers helped in the research and writing, or acted as key resource persons:

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I would like to thank Ong Ho Sim, former CEO PUB; Loh Ah Tuan former DCEO and Director-General Environmental Protection, NEA; Daniel Wang, former Director-General Public Health, NEA; Goh Chin Tong, former Director, Hawkers Department, NEA; and Koh Hee Song, former Head, Engineering Services Division, NEA, who despite having retired, made time to meet with me and the team to recount their experiences and other perspectives from their many years in the environmental field.

The book has also benefited from the insightful comments of Tommy Koh, Chair of the Asia Pacific Water Forum Governing Council and UNEP Champion of the Earth; Lord Ronald Oxburgh, Chairman of the House of Lords Select Committee on Science and Technology (2000–2004); Asit K. Biswas, President, Third World

Centre for Water Management, Mexico; Chew Tai Soo, Ambassador-At-Large; Koh-Lim Wen Gin, Chief Planner, URA; Leong Chee Chiew, Commissioner of Parks & Recreation; Chua Mui Hoong, Senior Writer, *Straits Times*; Ong Choon Nam, Professor, Department of Community, Occupational and Family Medicine and Director, Life Sciences Institute, NUS; Ng Wun Jern, Professor and Executive Director, Nanyang Environment and Water Research Institute, NTU; and Malone-Lee Lai Choo, Senior Lecturer and Programme Director, MSc (Environmental Management), NUS.

I would also like to thank the following from MEWR, NEA, and PUB who assisted the team in the production of this book: Khoo Teng Chye, Chief Executive, PUB; Lee Yuen Hee, Chief Executive Officer, NEA; Rosa Daniel, Deputy Secretary, MEWR; Ong Eng Kian, Director, Singapore Environment Institute, NEA; Eng Wee Hua, Deputy Director, Water Reclamation (Plants) Department, PUB; Fong Peng Keong, Deputy Director, Regional Cooperation Department, International Relations Division, MEWR; Foo Chee Sai, Deputy Director, NEWater Business Development, Water Supply (Network) Department, PUB; Ho Cheng Hoon, Deputy Director, Policy and Planning Division, NEA; Hazri Hassan, Deputy Director, International Cooperation Department, International Relations Division, MEWR; Lim Chee Leong, Executive Engineer, Water Supply (Network) Department, PUB; Lim Meng Check, Deputy Director, Planning, Modelling and Hydrology Division, Catchment and Waterways Department, PUB; Lim See Gan, Deputy Director, Project Management, Best Sourcing Department, PUB; Lye Wing Kai, Manager, North East Regional Office, NEA; Martin Nathan, Head, North East Regional Office, NEA; Ng Cheng Tong, Senior Manager, North East Regional Office, NEA; Ngaim Hai Guan, Deputy Director, Strategic Planning, Policy and Planning Department, PUB; Ong Hian Hai, Deputy Director, Project Management, Best Sourcing Department, PUB; Ong Puay Son, Engineer, Chemical Control, Pollution Control Department, NEA; Sam Ow, Assistant Director, Planning, Modelling and Hydrology

Division, Catchment and Waterways Department, PUB; Indrani C. Rajaram, Chief Scientific Officer, Environmental Monitoring and Assessment Unit, Pollution Control Department, NEA; Ramahad Singh, Deputy Director, Water Demand Management and Inspectorate, Water Supply (Network) Department, PUB; Arasu Sivaraman, Assistant Director, Strategic Planning, Policy and Planning Department, PUB; Soh Suat Hoon, Senior Assistant Director, International Relations Department, Policy and Planning Division, NEA; Francis Tan, Assistant Director, 3P Network Division, MEWR; Tan Eng Keong, Assistant Director, Manpower, Environment and Water Industry Development Council, MEWR; Teo Eng Dih, Senior Assistant Director, Climate Change Office, MEWR; Wong Nung Sim, Deputy Director, Water Reclamation (Network) Department, PUB; Wong Wai Cheng, Senior Manager, Water Demand Management and Inspectorate, Water Supply (Network) Department, PUB; William Yeo, Assistant Director, Central Watershed Division, Catchment and Waterways Department, PUB; Young Joo Chye, Deputy Director, DTSS Project, Best Sourcing Department, PUB; Yuen Sai Kuan, Deputy Director, Finance and Admin, Environment and Water Industry Development Council, MEWR.

Finally, I would like to thank Triena Ong, Head of the Publications Unit at the Institute of Southeast Asian Studies and her colleagues for their professionalism in putting this book together.

INTRODUCTION

The high priority that Singapore has placed on the environment since the early days has endowed it with reliable environmental systems and practices. The Singapore Government spent a vast amount of money on the engineering and provision of environmental infrastructure and services even at a time when the country was poor and had to attend to pressing economic, social, and security development programmes.

Achieving environmental and water sustainability is a strategic goal. As Prime Minister of newly-independent Singapore, one of the first things Lee Kuan Yew did was to give water top priority – setting up a unit in his office to coordinate this at the whole-of-government level. At a dialogue session with delegates of the inaugural Singapore International Water Week in June 2008, he recalled that “This (water) dominated every other policy. Every other policy had to bend at the knees for water survival.”

Attaining a high environmental standard is never a waste of time, energy, or resources. In planning the sewerage system for instance, the government decided to put in place a comprehensive sewage network with proper used water treatment facilities, even though many countries had been discharging their used water without treating it. Subsequently, as Singapore had well-equipped used water treatment plants and island-wide sewer coverage, it was able to harness the used water for the production of NEWater

through the reclamation of treated used water. Hence, having taken care of the environment in the early days (at a considerable cost even when it did not seem necessary at the time) has proved rewarding for Singapore decades later.

Singapore's approach to better environment management may be summed up by the 5Es of Engineering, Economics, Education, Enforcement, and Engagement. Engineering provides the foundation. Singapore invested heavily on environmental infrastructure such as sanitation and flood alleviation schemes, water production capacity, and incineration plants, as well as on technology improvements and the necessary manpower development. Economics is applied to ensure services are produced efficiently and scarce environmental resources are priced right. It would be tempting to subsidize environmental services, but that would lead to over-consumption and compound the problem for the future as it would be difficult, if not impossible, to wean people off the subsidies after that. Education is important to help people change their behaviour to look after the common good, but education must be complemented by enforcement as there must be consequences to irresponsible behaviour. Finally, it would be costly and unsustainable if the government was to be relied upon to do everything to protect the environment. There must be engagement. People can and must want to take ownership of the environment.

While such sound environmental practices have served Singapore well, it would not suffice to merely maintain the status quo. Unless there is strong will and commitment to safeguarding and enhancing the environment, it would be increasingly difficult to tackle the challenges ahead.

In the early post-independence period, Singapore faced severe environmental problems that threatened its survival, ranging from the spread of diseases to the prospect of not having sufficient water for its people. These national crises served to galvanize the people and lent strong support to the government's call for action. However,

as environmental standards have improved and people now enjoy a high quality of life, will Singaporeans become less conscious of the need for a good environment, and let complacency creep in?

There is a need for Singapore to be responsive to the growing affluence of society and the effect this will have on the environment: Do rising income levels point towards a society which, having satisfied its more basic needs, will be increasingly conscious of the importance of the environment and the shared responsibility of safeguarding it? Or do rising income levels paint a bleaker picture – one where material goods become more desirable? As the world becomes more globalized and markets more competitive, certain trade-offs may become harder to make. In such a situation, the environment could be at a distinct disadvantage, particularly when the benefits that accrue to those who care for the environment are often non-monetary, or cannot be realized immediately.

Cognizant of the scale of the challenges ahead, the government has formed a Ministerial Committee to review Singapore's strategies for sustainable development. For Singapore, sustainable development means achieving growth without sacrificing the quality of our living environment. Because of rising resource prices, a key priority area will be studying ways to improve overall resource efficiency – whether in energy and water, or in minimizing waste – and increasing recycling, since this not only optimizes the use of scarce resources, but will also boost overall economic competitiveness.

As in the past forty years, keeping pollution in check will continue to be important since ensuring clean air, clean water, and clean land is critical to safeguarding public health in Singapore. Given further population and industrial growth within Singapore's limited land area, the government will have to look at more innovative ways of managing the pollution load, without imposing unreasonable costs on businesses and the economy. Finally, maintaining Singapore's clean and green living environment, where public spaces are pristine, and green spaces and waterways are lifestyle attractions for all to enjoy, will allow Singapore to be

a vibrant and liveable city. A city where residents will enjoy quality of life alongside vibrant economic growth for generations to come.

This book traces how Singapore has arrived at the good environment it enjoys today. However, rather than just recording chronologically the key milestones in its environmental history, the book attempts to highlight the policy considerations, constraints and trade-offs in each area of the environment, explain how decisions were made, and discern the key learning points.

Part I reflects on Singapore's environmental journey, beginning from the early days of post-independence Singapore, and discusses the fundamental principles and success factors that have guided environmental policy-making in Singapore from the onset:

- Clear Vision
- Long-term Planning
- Constant Innovation
- Practical and Effective Approach

Part II considers how Singapore has controlled and managed air, land, and water pollution, and achieved a clean environment.

Chapter 2 describes the challenges to air quality Singapore faced in its early days of industrialization and explains how Singapore's strategies of air quality monitoring and long-term integrated urban and industrial planning and development control have enabled the government to pre-empt pollution and put in place preventive air pollution control measures. The chapter also touches on how practical legislation and enforcement measures have helped the government to ensure that air quality standards are maintained in the long run.

Chapter 3 details Singapore's experience in cleaning up the land and rivers, explaining the motivations behind this clean-up programme – to improve the standard of living for its people – and how cleanliness was elevated to a national and nationwide

priority as the government understood that success could not be achieved without the understanding and participation of all residents. The chapter also explains how achieving clean land and rivers requires a long-term perspective and long-term programmes based on practical solutions which are implemented effectively.

Chapter 4 explains how Singapore has put in place an integrated solid waste management system – from waste collection and disposal to incineration and landfill – that also encourages recycling and waste minimization. It highlights the importance of both leveraging on technology and investing in environmental infrastructure, ranging from mechanized refuse collection vehicles to incineration plants and an offshore landfill, as well as addressing the behavioural people-related aspects through programmes to increase recycling and waste minimization. The chapter also describes Singapore’s experience in opening up its waste collection and disposal sector to private-sector participation, and the lessons learnt from that process.

Part III encapsulates Singapore’s water story, and how Singapore has managed to close the water loop, ensuring long-term water sustainability.

Chapter 5 traces the development of Singapore’s sources of water supply – the Four National Taps of water from local catchments, imported water, NEWater, and desalinated water. It explains how integrated planning has allowed land-scarce Singapore to set aside sufficient land for water catchments, and how the upfront implementation of pollution control measures allows the city state to tap on unprotected and urbanized catchments. The chapter also describes how Singapore has managed to turn vulnerability, in terms of lack of local water sources, into a strategic advantage, through successfully developing NEWater technology, which effectively doubles water sources through recycling, and piloting desalination.

Chapter 6 describes how long-term sustainability in water cannot be achieved by boosting water supply alone. Complementary to

this is the management of water demand, which has been a key thrust of Singapore's water management policy from its early days. The chapter explains the government's holistic approach to managing water demand – both domestic and non-domestic water demand – which ranges from national-level campaigns and the provision of water efficiency information to encourage voluntary efforts to conserve water, to pricing water at the correct level, to imposing mandatory performance standards. It also touches on the government's efforts to improve water supply quality and reliability through improving service reliability and keeping unaccounted-for-water low.

Chapter 7 considers Singapore's efforts to provide effective modern sanitation and used water management systems for its population as it regards this as being critical not only to improving the standard of living, but also to supporting further economic growth and industrialization. The chapter describes how the country has progressed from the early days of the night soil collection system to the present-day water reclamation plants and integration of used water management under the Deep Tunnel Sewerage System (DTSS), achievements which were only possible with long-term planning, coupled with technological innovation and the willingness to invest up front in capital-intensive infrastructure.

Chapter 8 details Singapore's strategies to manage and prevent flooding, which have been successful due to the long-term approach adopted. For instance, anticipating drainage challenges early and making land-use provisions to cater for possible solutions up front allows the government greater flexibility in implementing these solutions subsequently. The chapter also reflects on how the government is moving beyond just flood control and flood management to transforming utilitarian reservoirs and waterways into Active, Beautiful and Clean Waters. This is a bold and long-term programme through which the government hopes to encourage greater public ownership and responsibility for keeping the waterways clean by bringing people closer to the water.

Part IV discusses some of the cross-cutting strategies and approaches that have been applied to Singapore's environmental and water policies.

Chapter 9 highlights the role economics plays in guiding environmental policies and legislation in areas such as decision making, setting prices, introducing market competition, and dealing with market failures. While we value the environment, government decisions must be made on the basis of stringent analysis as the government has to prioritize competing demands in the face of limited resources. The full environmental cost of a certain initiative should, therefore, be factored into the decision-making process in order to arrive at the correct decision. In practice, this is seldom straightforward, due to the inherent complexity in environmental issues, such as quantifying intangibles and externalities. Through the use of various case studies and examples, the chapter discusses how economics has been applied in some of Singapore's environmental policies and decisions.

Chapter 10 discusses Singapore's experience in engaging the public to achieve shared environmental outcomes. It traces the evolution in Singapore's approach over the past decades in response to changes in the national context as well as in social attitudes and demographic characteristics, which ranges from targeting individuals to communities. The chapter also introduces the concept of 3P or Public, Private, People sector partnerships, in which the focus is not just on building public awareness of environmental issues, but engaging and empowering the public to act to address these challenges.

Chapter 11 covers the external angle, explaining the considerations underpinning Singapore's interactions with the international community on the environmental front. It moves from the early days, when Singapore benefited greatly from the technology and expertise of more developed countries, to the present day when Singapore is fortunate to be in a position where it is able to share its expertise with others and assist in bringing

foreign technology into the region. The chapter also touches on Singapore's efforts to play its part in contributing to collective efforts to respond to global challenges such as sustainable development and climate changes.

Finally, Part V considers upcoming environmental challenges which are confronting not just Singapore, but, in fact, the entire global community, and the steps which the Singapore Government is taking today to prepare itself to deal with them.

Even as this book is being written, there are new chapters in Singapore's environment story that are unfolding. Emerging challenges such as climate change and increasing scarcity of resources are forcing the world to pay more heed to the environment. Environmental problems are also becoming increasingly regional and global, requiring strong international cooperation and long-term vision. Singapore itself must learn the lessons from its past, in forging a better world for all of us.