We must value and keep our waterways clean, and at the same time, build a healthy relationship with water such that all of us can enjoy our precious water resources.
Water –
The Giver Of All Life

We have come very far in tackling our water challenge. Singapore does not have abundant natural freshwater sources, hence water will always remain as a strategic resource. Over the years, we have transformed this vulnerability into a strength through technological advancements and efforts to grow our water industry to give us a more robust and resilient water supply.

PUB, a statutory board under the Ministry of the Environment and Water Resources, is the water agency that manages Singapore’s water supply, water catchment and used water in an integrated way. For the past few decades, water has flowed readily at the turn of a tap and PUB will continue to ensure this with our ‘Four National Taps’ strategy.
Our Tapping Strategy

Tap No. 1
The first ‘tap’ refers to the supply from our local water catchments. Stormwater is channelled into our 14 reservoirs through an extensive drainage system.

At hand, there are several schemes/initiatives which we are embarking on to expand our water catchment areas and enhance the robustness of our first tap.

The Seletar-Serangoon Scheme (SSRS)
The SSRS involves the development of reservoirs downstream of the existing Lower Seletar Reservoir; with the aim to increase water supply from the local catchments by tapping runoff from the north-eastern part of Singapore. SSRS will be implemented in two phases.

Under Phase 1 (Punggol-Serangoon Reservoir Scheme), Sungei Punggol and Sungei Serangoon will be converted into reservoirs by 2009. Under Phase 2, the waterways of Sungei Khatib Bongsu, Sungei Simpang and Sungei Seletar will be impounded to create Coastal Seletar Reservoir. This phase will be developed later in tandem with land reclamation by HDB in Simpang/Sembawang in 2015 or later.

Marina Barrage/Marina Reservoir Scheme
With the completion of the Marina Barrage across the mouth of the Marina channel in 2009, the waters of the Marina basin will be turned into an inland reservoir. The Marina Reservoir Scheme dovetails the development of the Marina Barrage. The construction of the Barrage is nearing completion. Together with the Punggol-Serangoon Reservoir Scheme, the
new Marina Reservoir will add to the local water supply and increase the water catchment area from half to two-thirds of Singapore’s land area.

**Reservoir Integration Scheme**

The Reservoir Integration Scheme involves the construction of pumping stations and laying of pipelines to link our local reservoirs. Once completed, it will optimise our storage capacity and enhance the local catchment yield as excess water from one reservoir can be channelled to another. Costing about S$18 million, the project was completed in February 2007.

**Tap No. 2**

The second ‘tap’ refers to imported water from Malaysia. Under the two water agreements, Malaysia has been supplementing our local water supply and will continue to do so until 2061 when the second water agreement expires.
Tap No. 3

Leveraging on the technology of reverse osmosis, PUB has successfully introduced our third national ‘tap’, NEWater. While NEWater is used mainly for non-potable industrial and commercial uses such as wafer fabrication, it can also be used to supplement our potable water supply. PUB adds a small quantity of NEWater to the rain water collected in our reservoirs (indirect potable use (IPU)), a process that is also practised in the United States to naturalise reclaimed water. This constitutes about 1.5% of total potable water consumption, a level that will increase progressively to about 2.5% by 2011.

NEWater provides a sustainable and reliable way to solve the increasing demand for water. Singapore’s water supply has become more robust and resilient since the introduction of NEWater:

The NEWater Process

NEWater is the high grade water produced after treated used water has been further purified using a 3-step process involving advanced membrane technologies like Microfiltration, Reverse Osmosis, and the final disinfection of the product water using ultraviolet light. The result from this multiple-barrier membrane treatment process is consistently good quality NEWater that PUB produces at the Bedok, Kranji, Seletar and Ulu Pandan NEWater factories.

Although NEWater itself is already of drinking water standards, PUB currently blends it with reservoir water for indirect potable purposes. Several cities in the United States have mixed reclaimed water with reservoir water to supply households. Reverse osmosis is widely used in the water industries such as the production of bottled water for drinking and ultra-pure water for wafer fabrication. It is even used to recycle water for drinking on space shuttles.

The NEWater Infrastructure Plan

- To meet increasing NEWater demand, the Ulu Pandan NEWater factory was commissioned in March 2007.

- A NEWater factory has been planned at Changi to recycle used water that is channelled to the Changi Water Reclamation Plant via the Deep Tunnel Sewerage System in the eastern part of Singapore.

- Major NEWater factories and demand clusters will be integrated by NEWater pipelines to enhance the robustness and supply reliability of the NEWater system.
Tap No. 4

Desalinated water, ie. freshwater converted from saltwater, is Singapore’s fourth ‘tap’. Desalination used to be an expensive option, but recent technological advances have turned it into an affordable choice.

In September 2005, Singapore’s Prime Minister Lee Hsien Loong turned on the tap at the desalination plant in Tuas, one of the world’s largest. Built by homegrown water-treatment firm, Hyflux, it was completed just about 20 months after construction began in January 2004, three months ahead of schedule.

The Desalination Plant’s Opening Is A Milestone In The History Of Singapore’s Water Supply.

The $200 million plant can meet up to 10% of Singapore’s daily water needs. Its energy-efficient design allows it to produce desalinated water at one of the cheapest rates in the world.

Desalination, together with NEWater, helps to diversify our water resources and opens up a new paradigm to meet our water needs.

PUB Wins Prestigious Water Prize At World Water Week 2007

Over the last 40 years, we have worked hard to overcome our water challenges, turning our vulnerability into a strategic asset for the country. Indeed, Singapore is fast being recognised as a model city for good water management. Many international water companies are setting up operations on local shores, be it in the area of R&D, engineering or manufacturing, making Singapore a focal point of their businesses in the region.

Described as “an exemplary model of integrated water management in a framework of good policy and innovative engineering solutions”, PUB – the National Water Agency was recognised for its efforts in 2007 when it won the Stockholm Industry Water Award1 at the World Water Week in Stockholm.

1 Established in 2000, the Stockholm Industry Water Award recognises innovative corporate development of water and wastewater process technologies, contributions to environmental improvement through improved performance in production processes, new products and other significant contributions by businesses and industries that help improve the world’s water situation.
Conserving Water

PUB adopts a multi-pronged approach in managing water demand through pricing measures, mandatory water conservation requirements, encouraging ownership and volunteerism in water conservation. This strategy has worked well as our per capita domestic water consumption has decreased from 176 litres per day in 1994 to 157 litres per day in 2007.

Under the Singapore Green Plan 2012, PUB targets to lower our per capita domestic water consumption to 155 litres per day by 2012. To achieve this target, PUB will continue to reach out to the population through its existing water conservation programmes, along with the roll-out of new initiatives.

PUB has in place a comprehensive water conservation plan targeting both the domestic and non-domestic customers to ensure that water is used efficiently. This plan is regularly reviewed to ensure that our water resources are effectively utilised.
The following are some of the measures for domestic customers (both young and old):

**Public Education And Publicity Programmes**

It is important to educate Singaporeans on the importance of water conservation and the need to save water. As such, the ongoing public education and publicity programmes by PUB aim to affect behavioural change in the way water is being used so that saving water becomes an ingrained habit. Various activities were organised to target various groups of customers, such as households and schools. Some of the major activities carried out were the inclusion of water conservation topics in school textbooks where the contents are regularly updated, and the conducting of water conservation talks.

The ‘Water Detective Programme’, a joint development by NTU students and PUB, is also organised to reach out to lower primary school students to educate them on the importance of water conservation through interactive skits. PUB also works closely with Science Centre Singapore in various programmes to educate the public on the water conservation message.

**10-Litre Challenge**

In 2006, PUB embarked on the ‘10-Litre Challenge’ programme to challenge every Singaporean to save 10 litres of water a day. A dedicated website (www.sec.org.sg/10litrechallenge) was launched in March 2006 to educate Singaporeans on how they can save water at home. Under this programme, PUB works with the People’s Association (PA) and Community Development Councils (CDCs) to form Water Volunteer Groups (WVGs) made up by grassroots organisations. The WVGs, supported by PUB Officers, conduct house-to-house visits to educate households on water conservation practices and assist in the installation of water-saving devices. The WVGs also visit lower income and needy families to help them save on their water bills.

As of end 2007, 38 resident committees and 30 voluntary welfare organisations/other organisations under 39 constituencies have been formed. Results have been positive, with households showing substantial savings in water consumption and therefore their utility bills.

**Water Efficiency Labelling Scheme**

Another programme under the ‘10-Litre Challenge’ is the voluntary ‘Water Efficiency Labelling Scheme’ (WELS), jointly developed by PUB and Singapore Environment Council (SEC). The water fittings covered are taps, showerheads, dual flush low capacity flushing cisterns (LCFCs), urinals and washing machines. The scheme is fronted by SEC and jointly administered by SEC and PUB. This voluntary WELS helps to raise public awareness on water conservation and encourage the infiltration of more water-efficient products into the market. The objectives of the scheme are as follows:

- Facilitate consumers to make informed choices when purchasing products.
- Increase public awareness on water conservation.
- Encourage manufacturers/importers to bring in more water-efficient products.
- Promote water-efficient building designs.
- Encourage innovation and R&D.
‘GOOD’, ‘VERY GOOD’ and ‘EXCELLENT’ are the 3 ratings under the WELS. The number of ticks is used to distinguish between the ratings whereby a label with more ticks indicates a more water-efficient product. The water fittings must meet current PUB requirements in order to be labelled under WELS. For LCFCs, only dual flush types are labelled to promote the use of dual flush LCFCs. Suppliers are also encouraged to have their products labelled in order to appeal to consumers that their products are water-efficient.

Launched on 31 October 2006 during the Eco-Product International Fair, response from the public towards the WELS was good. As at end 2007, more than 500 models of the water fittings had been certified under the scheme. In view of the favourable response, the labelling scheme will be made mandatory from July 2009. For a start, flushing cisterns and urinals must come with water efficiency labels. This may be extended to showerheads and washing machines in the future when more water-efficient models are available. The use of dual flush LCFCs will also be made mandatory from July 2009.

The non-domestic sector is another key group of water consumers, accounting for about half the water consumption in Singapore. PUB has several initiatives to manage water demand in this sector. For example, users are encouraged to run Water-Efficient Buildings by using water-efficient fittings and monitoring their water consumption. They are also encouraged to use NEWater in place of potable water and to recycle water, whenever possible. In addition, PUB launched the Water Efficiency Fund in 2007 to provide financial incentives to companies to take on water conservation measures, such as recycling, and develop alternative water sources.

**Water-Efficient Buildings**

PUB encourages building owners to run water-efficient buildings (WEBs) by reviewing and reducing their water consumption and repairing leaking fittings promptly. They are also advised to recycle/reuse used water where feasible. Circulars are sent to large non-domestic customers, including government agencies/statutory boards, urging them to reduce the flow rate at the washbasin taps in all their staff and public toilets within their premises. Response has been encouraging.

In addition, building owners are advised to conduct checks on the water fittings in their premises to ensure that flow rates are not excessive, and to adopt water-efficient flow rates for the various water fittings. As at end 2007, more than 1,100 buildings/premises, including government-owned buildings like ENV Building, URA Building, MOE HQ, DSTA Tower, etc., have joined the WEB programme, putting in place water-saving devices in these buildings.

In 2008, PUB embarked on a ‘10% Challenge’ programme to challenge the non-domestic customers to reduce their water consumption. PUB will work with building owners starting with the public and commercial buildings, hotels and schools to work towards becoming a WEB and save 10% of their monthly water consumption through the various programmes under the 10% Challenge.
Promoting Recycling Through Water Efficiency Fund

Previously, customers in the wafer fabrication, semiconductor and electroplating industries have been practising recycling as they found it viable to recycle their process water for reuse. With the advance in water treatment technology, more industries can now tap on recycling to reduce their water consumption.

To further encourage manufacturing industries to either recycle their process water or improve on their existing recycling rate, PUB has offered a fund to assist the industries to defray a portion of the initial capital outlay and overcome the difficulty in obtaining commercial funding. The Water Efficiency Fund (WEF) was launched in July 2007 to encourage companies to look into efficient ways of managing their water demand through the recycling of potable water (PW), NEWater (NW), and Industrial Water (IW). Use of alternative sources of water supply as well as initiatives to promote water conservation in the community can also tap on this fund.

NEWater Substitution

PUB actively promotes the use of NEWater for substituting potable water for non-potable purposes in commercial and industrial premises. NEWater, which is of a high grade water quality, is well-suited for process use in wafer fabrication plants and other industries, and for air-cooling purposes in commercial buildings. As of end 2007, more than 350 NEWater agreements had been signed, with NEWater from NEWater factories at Bedok, Kranji, Seletar and Ulu Pandan being supplied to more than 260 companies (including all the ten wafer fabrication plants at Tampines/Pasir Ris/Woodlands/Ang Mo Kio). NEWater intake (excluding IPU) as of end December 2007 was 169,500 m²/day (37.3 mgd).

Used Water Infrastructure

Progress Of Construction Of Deep Tunnel Sewerage System And Changi Water Reclamation Plant – In The Pipeline

Given how important an effective used water management system is, Singapore has to look at how the system will cope with the increase in population and industries in the long term. To ensure sustainability, we have started to build a large-scale Deep Tunnel Sewerage System (DTSS).

Phase 1 of the DTSS project, which costs $3.65 billion, is on schedule for completion in 2008. The first part of the project involving the construction of some 48km of deep tunnel sewers, a large pumping station at Changi Water Reclamation Plant and a 5km outfall, has already been completed in 2006. The remaining works of the Changi Water Reclamation Plant will be completed and fully operational by 2008.
ABC Waters

Transforming Our Waterways Into Aesthetically Attractive Landscapes

Singapore has an extensive network of reservoirs and waterways comprising 14 reservoirs, 32 major rivers and 7,000km of canals and drains. Many of these waterways lead into our reservoirs as about half of Singapore serves as water catchment areas. With the completion of Marina Reservoir (MR) and Punggol-Serangoon Reservoir by 2009, two-thirds of Singapore will become water catchments.

Since 2005, PUB has embarked on many programmes to generate greater awareness in the community on the importance of valuing and enjoying our water, the implications of living in water catchment areas and the need to keep our catchments clean. With the launch of the ABC Waters Programme, PUB will continue with our efforts to transform our utilitarian concrete drains, canals and reservoirs into beautiful, vibrant and flowing streams, rivers and lakes. Coupled with more water-based activities, the programme will transform our waterways and their vicinities into vibrant lifestyle attractions, and create a sense of collective stewardship of our water resources among Singaporeans.

The ABC Waters Programme Serves Three Important Objectives:

ACTIVE: Providing new community space
The intricate network of reservoirs and waterways will create new community spaces and bring people closer to our waters. With more opportunities for interaction, we hope to connect our people with our waters, giving them a greater sense of ownership so that they will better value our waters.
BEAUTIFUL: Integrating reservoirs and waterways with urban landscape
PUB will expand the scope of reservoirs and waterways beyond flood control and water storage, developing them into vibrant and aesthetically pleasing lifestyle attractions that integrate with our parks, estates and even commercial developments.

CLEAN: Improving water quality
PUB will incorporate features to improve water quality, e.g. natural nutrients removal using aquatic plants, retention ponds, fountains and recirculation. We will also seek to minimise pollution in our waterways through public education and by building closer people-water relationships.

ABC WATERS MASTER PLAN
Under the ABC Waters Master Plan, Singapore is divided into three ‘watersheds’, each with its own themes and projects. For each watershed, a consultant is appointed to develop the plans in consultation with other public agencies. The initial Master Plan has been completed and about 28 projects have been identified for implementation over the next five years across the three watersheds. Besides these initial projects, PUB will also put in place a water recirculation system that will provide the waterways with clean and flowing waters.