



msw-กรุงเทพมหานคร
METROPOLITAN WATERWORKS AUTHORITY

Grow Sustainably Together

Metropolitan Waterworks Authority
Sustainability Report 2017-2018





MWA proceeds towards a high performance organization that provides water supply services with excellent corporate governance and reaches international standards



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About This Report

Since 2013, Metropolitan Waterworks Authority (MWA) has been publishing Sustainability Report to distribute and disclose the guideline of sustainability management and performance results, in the aspects of the economy, society, and environment of the Authority. In 2016, MWA has started implementing the method of Sustainability Reporting Standards from Global Report Initiatives (GRI) to be part of information disclosure guideline.

This Sustainability Report of 2017-2018, covers the operation information from October 1st, 2016 to September 30th, 2018, and it has been prepared in accordance with GRI Standards: Core Option. It also shows the commitment of conducting business that supports Sustainable Development Goals (SDGs).

Furthermore, this report also includes the performance progress that aligns to 20-Year National Strategy, which emphasizes to develop national foundation of stability, prosperity, and sustainability in order to advance into Thailand 4.0, as according to the 12th National Economic and Social Development Plan, Digital Economy Development Plan, Ministry of Interior Strategic Plan, and State Enterprise Strategy for Public Facilities. The report also follows Sustainable Development Goals of the United Nations in Article 6: Water and Sanitation Management, Article 9: Industrial Infrastructure Innovation, Article 11: Sustainable City and Human Settlements, Article 12: Sustainable Consumption and Production Plans, and Article 17: Cooperation for Sustainable Development. This Sustainability Report mainly focuses on the essence that responds to the expectations of all stakeholders, as well as presenting other performance results which are important to the MWA.

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For the references, additional information, or content other than the scope of this report covered, as well as digital version of Metropolitan Waterworks Authority Annual Report 2016 - 2017, please visit <https://www.mwa.co.th> or scan the provided QR code.



Message from the President of MWA CG & CSR Subcommittee

Developing in All Aspects: Economy, Society, and Environment



It is well-known that “Metropolitan Waterworks Authority” or MWA, a state enterprise under the Ministry of Interior, has the mission to produce, distribute, and deliver tap water, which is one of the primary infrastructures for national development. Therefore, MWA emphasizes on conducting business and operation along with social and environmental responsibility in every process that affects all stakeholders. The Authority has set clear policies on social responsibility, as well as made these policies aligned with vision, missions, and values of MWA to create the balance and impact in the economy, society, and environment.

In economy aspect; MWA concentrates on enhancing the quality of tap water as well as delivering the services by using information technology and communication to systematically employ in all operational process; such as creating digital service innovation for clients and water consumers through website <https://www.mwa.co.th> and mobile application MWA onMobile. Furthermore, the Authority also aims to integrate technology to increase efficiency as well as create stability and confidence in the waterworks system.

In social development aspect; MWA is determined to create strengths for societies and communities through various social responsibility activities and projects, such as MWA Plumbers for People Project, Watershed Forest Conservation Project to honor King Rama 9, MWA meets people activity, building community network and relationship in Mae Khlong and Chao Phraya Watershed Areas through the School Tap Water System Project, and the Water Saving Camp Project. In addition, the Authority also emphasizes on professional development through numerous training courses, both domestic and international level.

In the environment development aspect; MWA focuses on the environment preservation by issuing clear policies on promoting and supporting raising awareness on the value of water. For example, supporting the manufacturing of water-saving devices, increasing water using awareness campaigns under the project of “Reduce Study time, Increase Water Conservation Learning Time”, supporting Energy-Saving Project; by switching to use energy-saving LED lamps, as well as expanding the project of using alternative energy to reduce waterworks production costs.

However, the composition of this Sustainability Report of 2016-2017 was made referencing to Global Reporting Initiative Standards framework, in order to ensure the acceptance and reliability of information disclosure of Sustainability Report for all stakeholders. Metropolitan Waterworks Authority hopes that, to all stakeholders, it would be able to well-display the concepts, visions, processes, and management practices of the Authority, in order to achieve long-term stability and sustainability of the corporate.

Mr.Nattakit Tangpoonsinthana
President of MWA CG & CSR Subcommittee

Message from MWA Governor



Creating Better Things

Metropolitan Waterworks Authority (MWA) is proud and honored that since the foundation, the Authority has been continuously developing and proceeding into the half-century milestone of operation. Today, MWA still strives to produce, distribute, and deliver tap water with high-quality, clean, and safe to every household in Bangkok, Nonthaburi, and Samut Prakan areas, by focusing on improving stability and efficiency of water services to create confidence for consumers that the water services will be accessible and sufficient in all areas. To ensure these confidences, the Authority operates under MWA Management Strategy Issue 4 (2016-2020), which is the corporate operational frameworks to achieve the vision of “To be a high-performance organization that provides water supply services with good governance along with international standards”.

MWA has set key policies in the operation into 3 concentrations, which are Water Safety Plan according to World Health Organization (WHO) standard, Loss-Water Management, and Digital MWA policy to increase the efficiency of the services to respond to consumers’ needs and expectations. These policies also set to align with Thailand’s 20-Year National Strategy framework, which aims to create stability, prosperity, and sustainability to advance into Thailand 4.0, as well as the 12th National Economic and Social Development Plan, Digital Economy Development Plan, Ministry of Interior Strategic Plan, State Enterprise Strategy for Public Facilities, and Sustainable Development Goals (SDGs) of the United Nations; in Article 6: Water and Sanitation Management, Article 9: Industrial Infrastructure Innovation, Article 11: Sustainable City and Human Settlements, Article 12: Sustainable Consumption and Production Plans, and Article 17: Cooperation for Sustainable Development. These implementations and policies strive to provide accessibility and sufficiency of water services with high quality, safety, and appropriate water pressure to all consumers. The Authority also cooperates with various organizations to develop technology to be employed within the corporate, in order to jointly enhance the national prosperity to grow towards stability and sustainability in the future.

On behalf of the management, executives, employees, and operation workers of MWA, we would like to show gratitude to all stakeholders for the continuous support to the MWA. We commit to operate within the responsibility of the economy, society, and environment in regards to Sustainable Development Goals (SDGs), and aim to be sustainable organization henceforward.

(Mr. Parinya Yamasamit)

MWA Governor



Becoming MWA

Over 50 years that **Metropolitan Waterworks Authority (MWA)** has been established with a strong foundation. As the state enterprise with the main missions in exploring, sourcing, producing, and deliver clean tap water, operates under the standards of World Health Organization (WHO), for consumption of people in Bangkok, Nonthaburi, and Samut Prakan. MWA has never given up to improve the organization, with determination to be Digital MWA in the future as well as to be a high performance organization (HPO) that provides international standard of quality in tap water services.



Beginning from the Strong Foundation

Back on August 16th, 1967, MWA was founded from the formation of 4 waterworks offices in 3 provinces which are Bangkok Waterworks Office, Thonburi Municipal Waterworks Office, Nonthaburi Waterworks Office, and Samut Prakan Municipal Waterworks Office. The formation was made as a state enterprise under the Ministry of Interior, which had authority and duties under the Metropolitan Waterworks Authority Act, BE 2510 in the followings:



Survey and source for raw water supply as well as provide raw water for the uses in the waterworks system.



Produce, distribute, and deliver water supply in the provincial areas of Bangkok, Nonthaburi, and Samut Prakan as well as control water supply quality of private waterworks offices in the areas.



Conduct other businesses that relate to water supply and beneficial to the Metropolitan Waterworks Authority as well as consider the benefits of people and the states as the main priority.

Throughout the years of operation, MWA has adhered to conduct the business operation in accordance with the Government's Statement of Direction for State Enterprises in all 3 levels, which are:



1

Overall policy for state enterprises

To be a mechanism which drives national strategy in economy and society based on the effective operation and good governance.



2

Policy for state enterprises in public facilities

To meet basic needs and enhancing people life quality as well as real estate development into maximum potential.



3

Policy for Metropolitan Waterworks Authority

To improve and expand water supply system to cover the needs of city expansion, quality expectation, and sufficient accessibility as well as developing relate-business in order to create added value to the organization.

The Authority also determines to operate following MWA Management Strategy Issue 4 under the vision, missions, and values as followings:

“

Vision

To be a high-performance organization that provides water supply services with excellent corporate governance and reach international standards

”

Missions

- 1 To develop organization growth and sustainability
- 2 To implement Water Safety Plan according to the World Health Organization (WHO) standards by assuring the stability of water resource production and transmission
- 3 To deliver professional water supply service to reach and balance stakeholder needs
- 4 To improve people’s life quality by expanding water services and societal responsibility all over Thailand

Values

MWA has set the corporate value of QWATER for employee and operation workers at all levels to adhere as practice for the benefit of the organization and leads to sustainable growth.



With strong determination to be a high performance organization in digital era, MWA aims to move forward steadily in the near future, MWA is going to invest in a large-scale waterworks infrastructure to create better stability in the services. Therefore, the Authority has set future performance goal of: “To be an expert in water production and waterworks service in large cities as well as operate other related businesses that are beneficial to the waterworks”, by emphasizing on improving the development in 3 issues, which are:



Reduce loss water rate into an appropriate level in accordance with Economic Level of Leakage (ELL)



Improve the waterworks system by using the Water Safety Plan

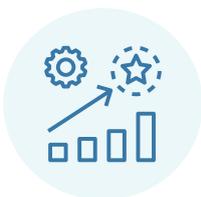


Enhance the organization towards Digital MWA



Strategy 1: Build Stability of the Organization

- Tap water distribution service expansion project in the boundary area, which has the potential to support the demand of tap water needs according to city expansion, economic growth, and projects that might happen in the future.
- Business unit structure study project; to support related businesses that are proper to the Authority context, and related business potential development project; to obtain funding for the extension of large-scale waterworks infrastructure in order to create stability in services. It is expected that by the year 2021, the projected revenue from related businesses would be at least 900 million baht.



Strategy 2: Enhance the Capability of the Organization to the Excellence

- Development project of big data analysis system and data warehouse management to meet the policy of Thailand 4.0 as well as enhance MWA towards Digital MWA, by integrating information from both within the organization and with the country onto the same level of standards, which purposely to provide the most efficient waterworks services.
- Digital service development project, in order to meet the changing behaviors of water consumers. The service will be able to support requests of new water supply installation, receiving additional requests, as well as able to make water bill payment via mobile applications and internet. By the year 2021, MWA also plans to provide services in the form of Virtual Branch.
- Personnel development project to support the implementation of strategies effectively as well as to provide personnel with multiple abilities and skills in digital practices, loss water management, and Water Safety Plan.



Strategy 3: Build Stability and Efficiency of Waterworks System

It is divided into 2 sections.

The **first section is loss water management** as MWA aims to maintain loss water rate to be lower than 20 percent as well as in the appropriate level of Economic Level of Leakage.

The first section consists of 4 main projects as following:

- Water gauge management project
- Surveillance area management project
- Pipeline improvement project
- Technology application for water loss management project

The **second section is the long-term waterworks** infrastructure development, which consists of:

- 30-Year Master Plan development project
- The 9th and 10th Waterworks major plan improvement projects, which are going to create efficiency and stability of waterworks system
- Water Safety Plan project, which aims to enhance complete the waterworks system, from receiving raw water to water uses location, to be better than the Guidelines for Drinking-Water Quality from the World Health Organization
- Educational project to increase the efficiency in using resources and reducing environmental impacts from water production, as well as increase sustainability in water services in order to future extend the Water Footprint analysis in the future



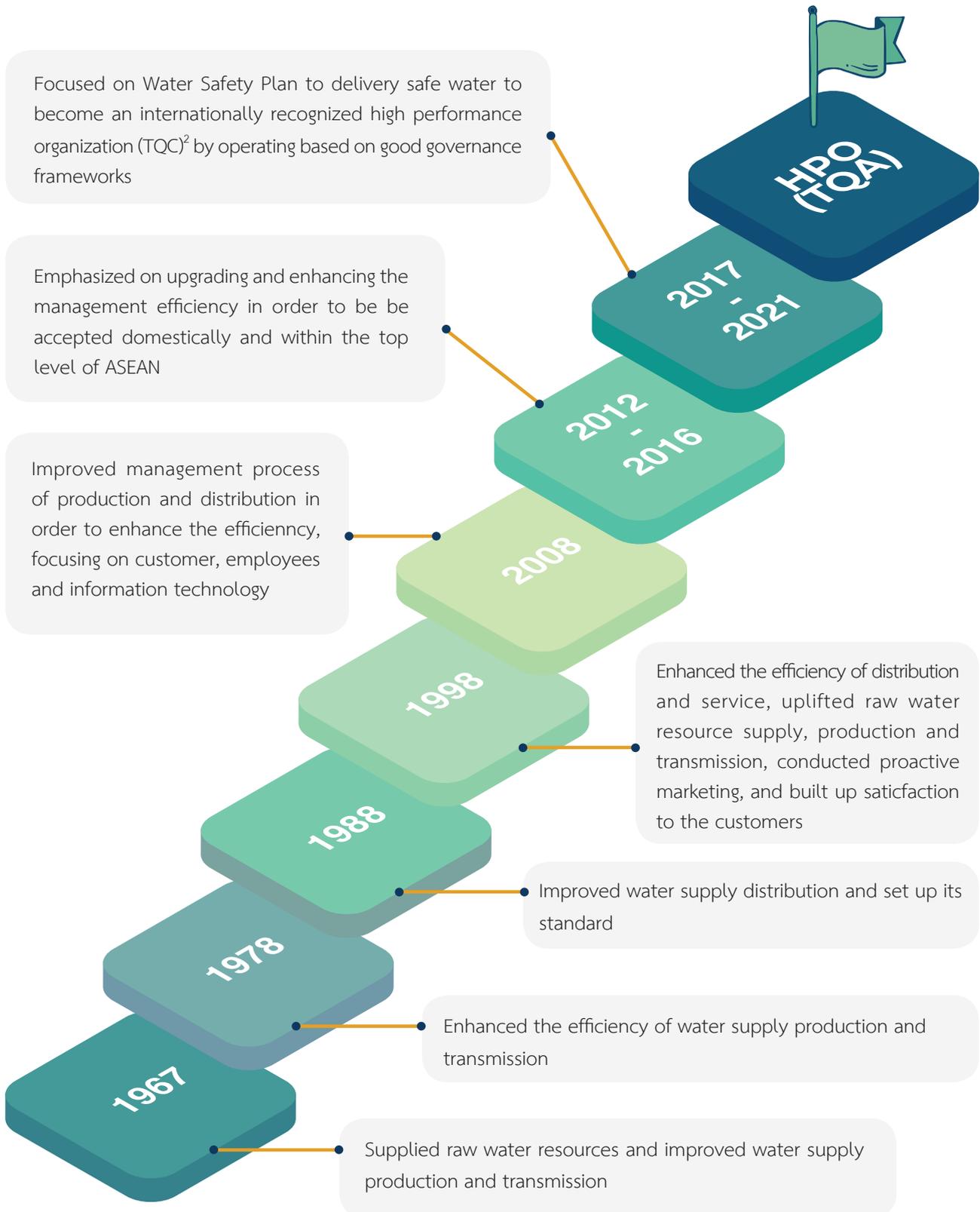
Strategy 4: Build Engagement with Stakeholders

- Energy saving project; by reduce the amount of fossil fuel energy usage and electricity, as well as reduce the emissions of, both direct and indirect, carbon dioxide from water product processes
- setting operational standards and quality control of services project for outsourcing employees, in order to standardize the construction works, pipe laying, pipe repairing, as well as to reduce complaints and create satisfaction for stakeholders in retiring pedestrian and traffic surfaces.
- Stakeholders satisfaction level raising project (excluding water consumers); which aims to respond to needs and expectations of stakeholders equally. The project consists of an improvement of the operational process, such as the procurement process, corporate internal and external communication process, research, development, and innovation process.



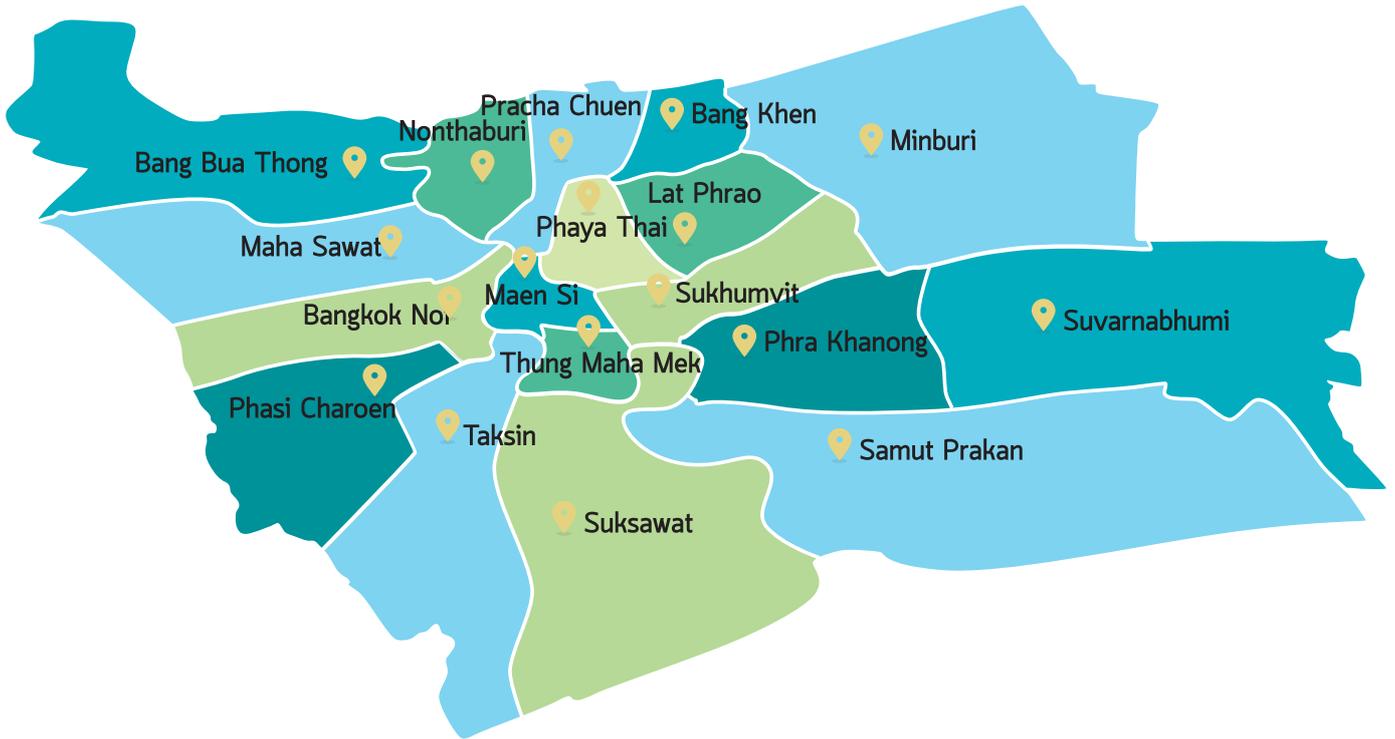
Roadmap of Metropolitan Waterworks Authority Strategic Plan Issue 4

Over the past 50 years, MWA has defined a clear path in the operational framework, by aiming to become a high performance organization: HPO (TQA)¹ with international recognition within the time frame according to the strategic plan, or the year 2021, as well as taking Water Safety Plan to deliver safe water.



18 Branch Offices & 4 Water Treatment Plants in 3 Provinces

MWA operates in the 3 provincial areas with a total of 18 branch offices and 4 Water Treatment Plants



Water Treatment Plants



Bang Khen Water Plant:
daily production capacity
4,400,000 cubic meter.

Total water distribution

2017	2018
1,404.5	1,334.4
million cubic meter	million cubic meter



Sam Sen Water Plant:
daily production capacity
550,000 cubic meter.

Total water distribution

2017	2018
120.7	116.4
million cubic meter	million cubic meter



Thon Buri Water Plant:
daily production capacity
170,000 cubic meter.

Total water distribution

2017	2018
40.5	37.4
million cubic meter	million cubic meter



Maha Sawat Water Plant:
daily production capacity
1,600,000 cubic meter.

Total water distribution

2017	2018
498.1	508.9
million cubic meter	million cubic meter

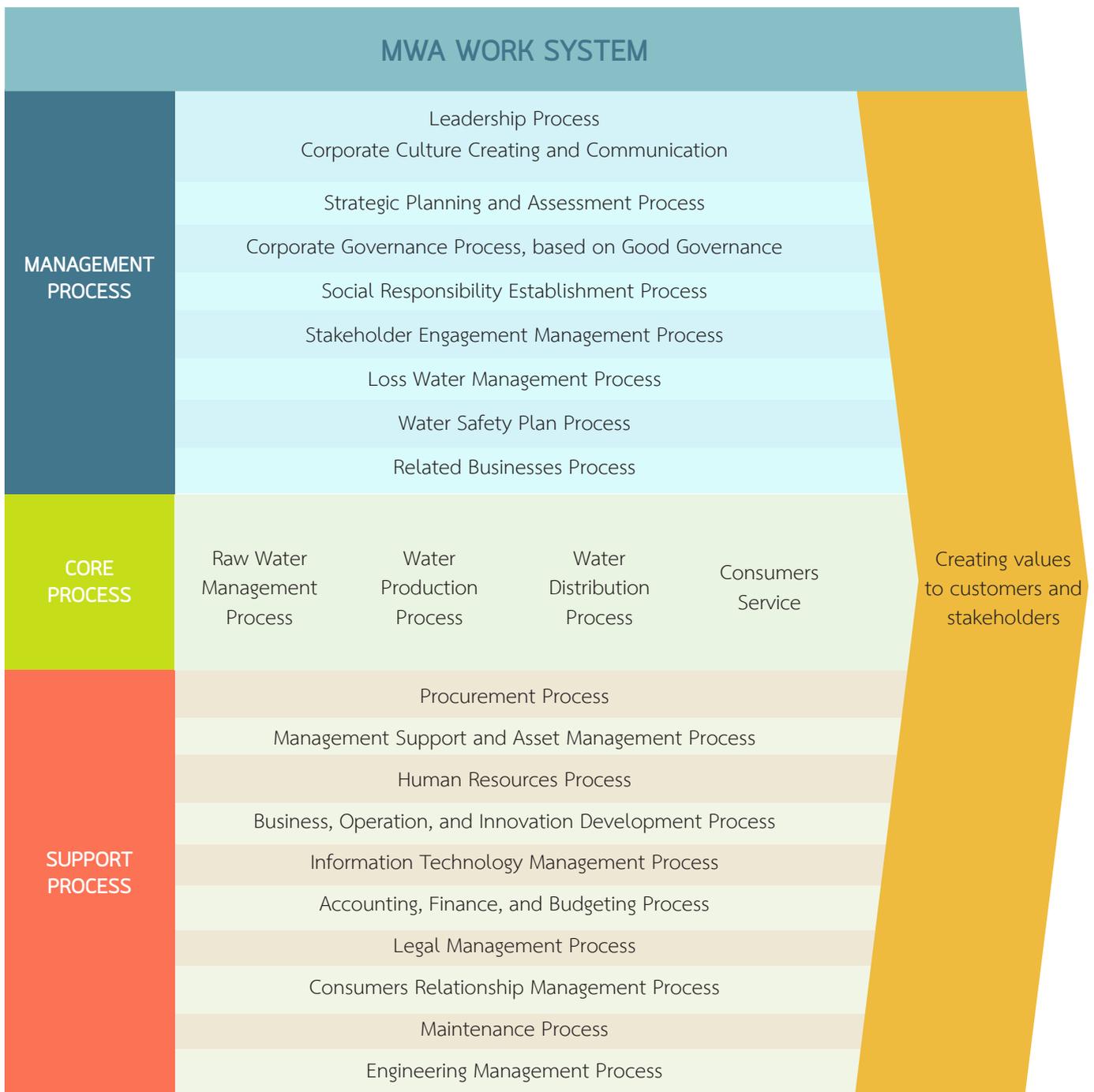
MWA Values Chain

The main mission of MWA is to delivery water supply and services for the highest quality in order to meet water consumers’ needs and expectations. Additionally, the Authority also operates under the conception of good governance, including corporate standards and guidelines of operations.

To sustain the operating standards and guidelines, the process of MWA Work System is categorized into 3 primary parts, which are;

1. Management process
2. Core Process, risk management process for overall supply chain from downstream to the beginning of the main operational process
3. Support process

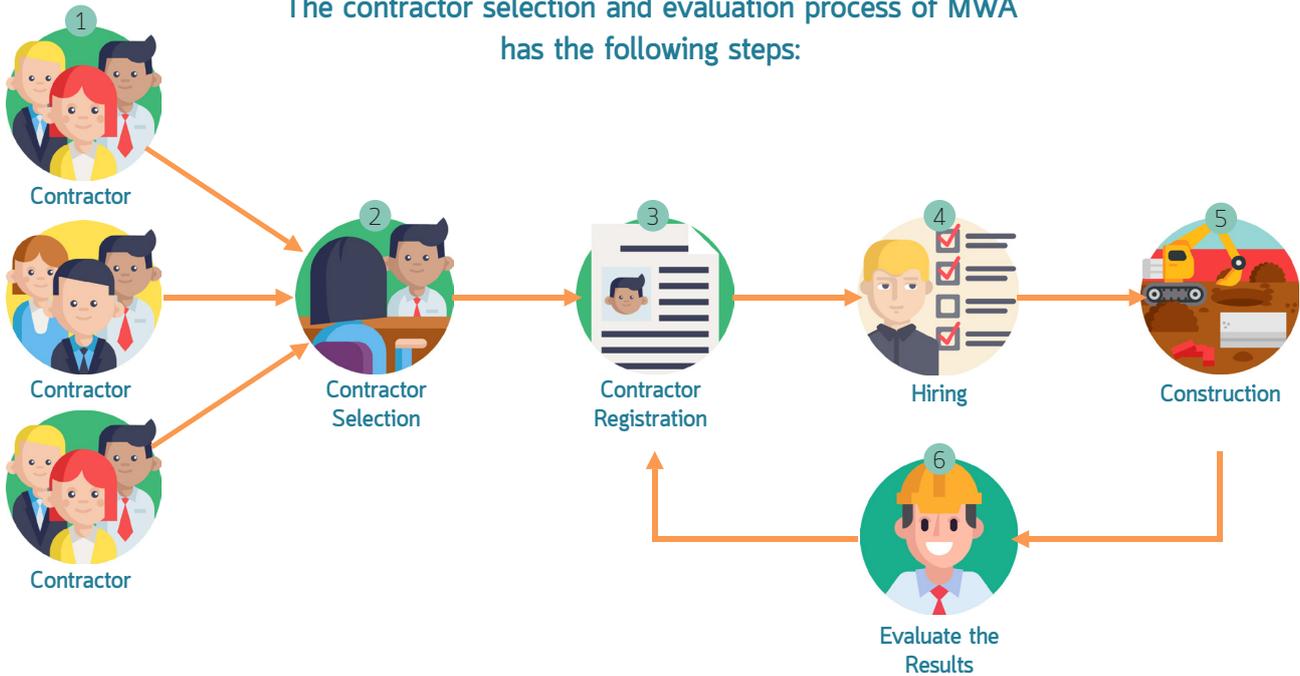
All of these processes are meant to give the value to water consumers and stakeholders sufficiently and completely in all service areas, and drive the growth of the Authority mutually and sustainably.



Contractor Selection and Evaluation Process of MWA

To make the operations in every division productive and efficient as the corporate goals, MWA has conducted the hiring standards with systematic selection and evaluation process. Furthermore, the Authority also uses criteria and regulations to develop the organization in every perspective, as well as aiming to operate under the guideline and corporate good governance.

The contractor selection and evaluation process of MWA has the following steps:

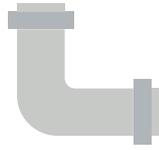


The construction contractor selection process is considered as one of the main missions of MWA since they are involved in all processes of water production, and distribution in various projects. To make the construction works completed according to the planned schedule, it is crucial to select and evaluate the contractors, following the regulations of contractor registration, and evaluation guidelines that have been set.

Therefore, the contractor selection and evaluation process doesn't not only create jobs for the operations but also need to have quality control in order to achieve the objectives, create satisfaction to water consumers in quality and sufficiency as well as without creating any negative impacts on the surrounding communities and societies.

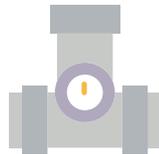
- 1 Contractors submit the registration documents in MWA selection process.
- 2 MWA evaluates and selects the contractor.
- 3 MWA registers the qualified contractor into the assigned works.
- 4 Upon contraction project, MWA will proceed to hire by specifying the qualification of the bidder to be registered in that hiring category.
- 5 Contraction starts.
- 6 MWA evaluates the construction progress, both during the construction and at the end of the contract. The assessment results will be used to consider the contractor performances whether to be promoted or penalized.

Work Categories that Contractors Need to be Registered with MWA



1 Main pipeline construction works, consists of 4 methods:

- 1.1 laying method¹
- 1.2 Pipe Jacking method²
- 1.3 HDD (Horizontal Directional Drill) method³
- 1.4 Slip Lining method⁴

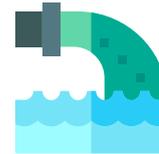


2 Serviced pipeline construction works, consists of 4 methods:

- 2.1 Laying method
- 2.2 Slip Lining method
- 2.3 HDD method
- 2.4 CIPP method (Cure-In-Place Pipe)⁵



3 Civil construction works



4 Water distribution system construction works



5 Water production system construction works



6 Water plant and tank construction works

¹ a pipe laying method by trenching along the sidewalk or the road then pipeline the groove

² the technology of pipe laying method without digging up the soil groove, but opening ponds in the appropriate distances, then, the machine will drill or push the pipe into those ponds

³ a pipe laying method by horizontal directional drilling pushing and pulling pipe backwards

⁴ a pipe laying method by pulling pipe with a puller in order to insert the attached pipe into the original one

⁵ the improvement of the original pipe by inserting the new pipe into the original one with water or air pressure

Importances of Contractor Selection and Evaluation

- 1 To get qualified contractor with expertise to complete the construction works effectively within the specified schedule
- 2 To control the construction quality to be met with MWA standards
- 3 To reduce traffic complaints and delay in construction

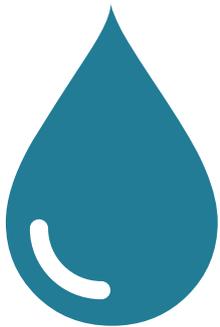


At present, there are 419 registered contractors in MWA registration database. Please visit this website to review MWA contractors in different categories: https://www.mwa.co.th/main.php?filename=PQ_News&t=top

MWA Products and Water Consumer Groups

Water Consumers Support Services

Main Products



Tap Water



New water meter installation



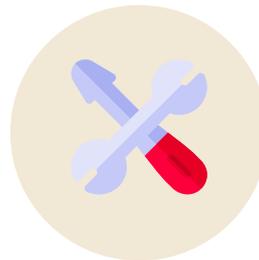
Information and transaction support



Fire hydrant installation



Complaint management



Pipe installation and repair



Water consumer relationship management

MWA Service Areas



The service areas of MWA covers a total of 3,195 square kilometers in Bangkok, Nonthaburi, and Samut Prakan. As of present, MWA is able to provide tap water services in all urban communities. This service coverage means that the Authority has given an opportunity for people to access to clean, safe, and high quality of tap water to improve their quality of life, which follows the section 6 of United Nations Sustainable Development Goals (SDGs) as well as the policy of “Suffering Alleviation and Happiness Creation” from the Ministry of Interior, the supervising office of MWA. To produce, distribute, and deliver tap water by using 2 raw water resources, which are **Chao Phraya River and Mae Klong River**.

Water Consumer Groups

In 2017, MWA has divided water consumers into 2 groups according to water consumption criteria that are consistent with the water meter size, where water meter sizes below 1½ inch classified as small consumers group, and water meter sizes ranging from 1½ inch and above classified as large consumers group.

Later in 2018, to make the categorization more

reasonable, MWA has changed the criteria to classify water consumer group by using characters and behaviors of the consumers combined with the amount of water consumption, in order to respond effectively to the expectation of water consumers in a high amount of consumption. The Authority has classified 2,375,490 water consumers into 3 major groups as follows;



Residential (R)

The group of water consumers who uses for personal consumption in household or residence, mostly use in a periodic pattern, especially in morning or evening. The consumption amount is usually less than 10,000 cubic meters per month. This group consists of 2,302,989 consumers.



Non-residential (N)

Unlike Residential, this group uses water throughout the day. The example of Non-Residential are corporations, enterprises, and companies. The consumption amount is usually less than 10,000 cubic meters per month. This group consists of 42,665 consumers.



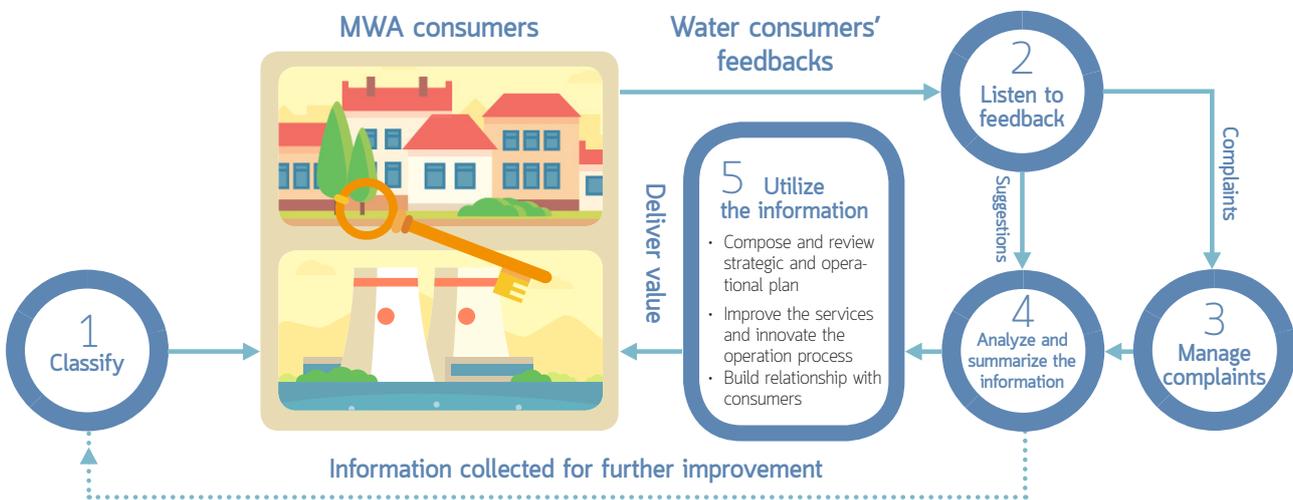
Key Account (K)

The water usage pattern of this group could be similar to both Residential and Non-Residential group, but the amount of consumption is usually a range of 10,000 cubic meters and higher. It is the group that expects in the high quality of services. There is a total of 506 consumers in this group.

Remark: data as of 30 September 2018

However, after classifying water consumers, MWA has established a framework to manage water consumers in order to learn their needs, expectations, and key requirements. Then, the Authority uses this information to provide services to meet the needs of water consumers from all groups.

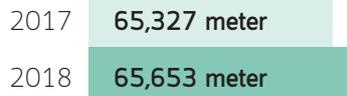
MWA Consumer Management Framework in Overview



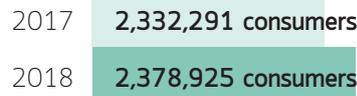
- 1 Classify water consumers into 3 groups by using water consumption behavior and amount.
- 2 Listen to feedback from consumers through both online and offline channels, to ensure that the voices of customer (VOC), feedback, and complaints are acquired from the water consumers, both by proactive and inactive methodologies such as monitoring consumers comments on social media through Social Contact Center (SCC) and Data Opinion Mining (DOM) as well as receiving feedback through the Authority own social media platforms such as MWA onMobile application, website, E-mail, Facebook, Twitter, Line, Line@, Call Center (24 hours), survey, and site visit.
- 3 Manage complaints and requests by acting on each request and complaint within a timely manner as stated in the Service Level Agreement (SLA).
- 4 Analyze and summarize the information from all channels to analyze and prioritize in order to determine the key requirement of the water consumers group on both product and service aspects.
- 5 Utilize the received information or key requirement from water consumers group to use in response to the needs of water consumers; through the strategic plan, as well as improvement and development of management system and consumers relationship management (CRM)

Key Performance Results in Market Aspect

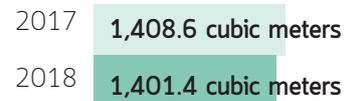
Numbers of new water meter installation



Numbers of water consumers in the service areas

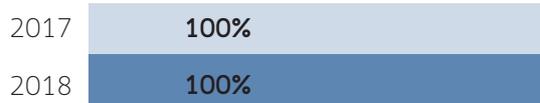


Amount of distributed water



Key Performance Results in Product Aspect

Physical tap water quality

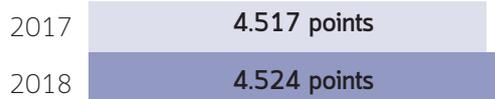


Chemical tap water quality

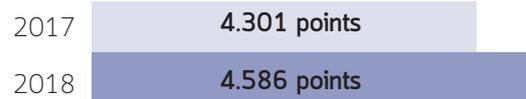


Key Performance Results in Consumers Aspect

Satisfaction in water quality out 5 points



Overall consumers engagement with MWA out 5 points



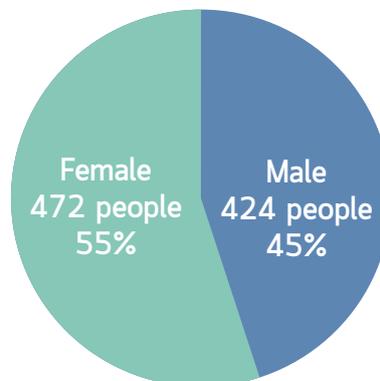
Organization Size



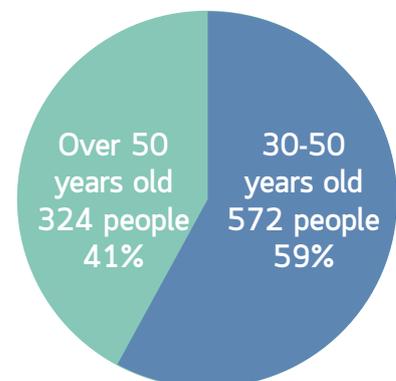
Corporate Executive Group

Classified by gender, age, and related factors.

Graph displays the ratio of executives group classified by gender



Graph displays the ratio of executives group classified by age

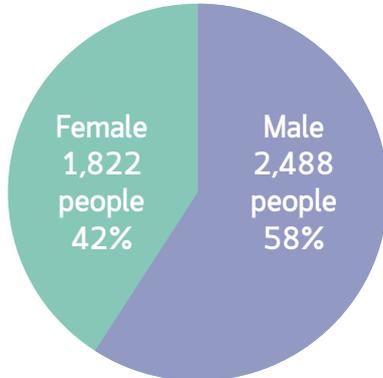


Data as of 30 September 2018
Executives group includes employees in level 6-10 who holds executive and management positions

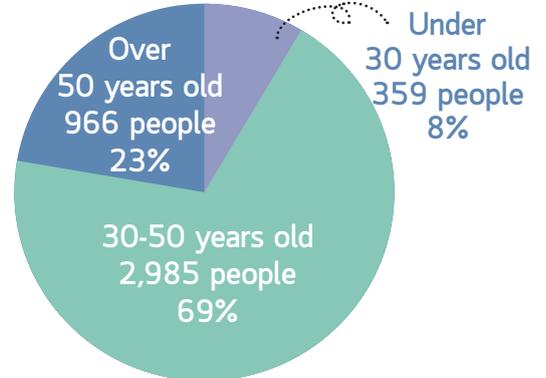
Employee Group

Classified by gender, age, and associated factors.

Graph displays the ratio of employees group classified by gender



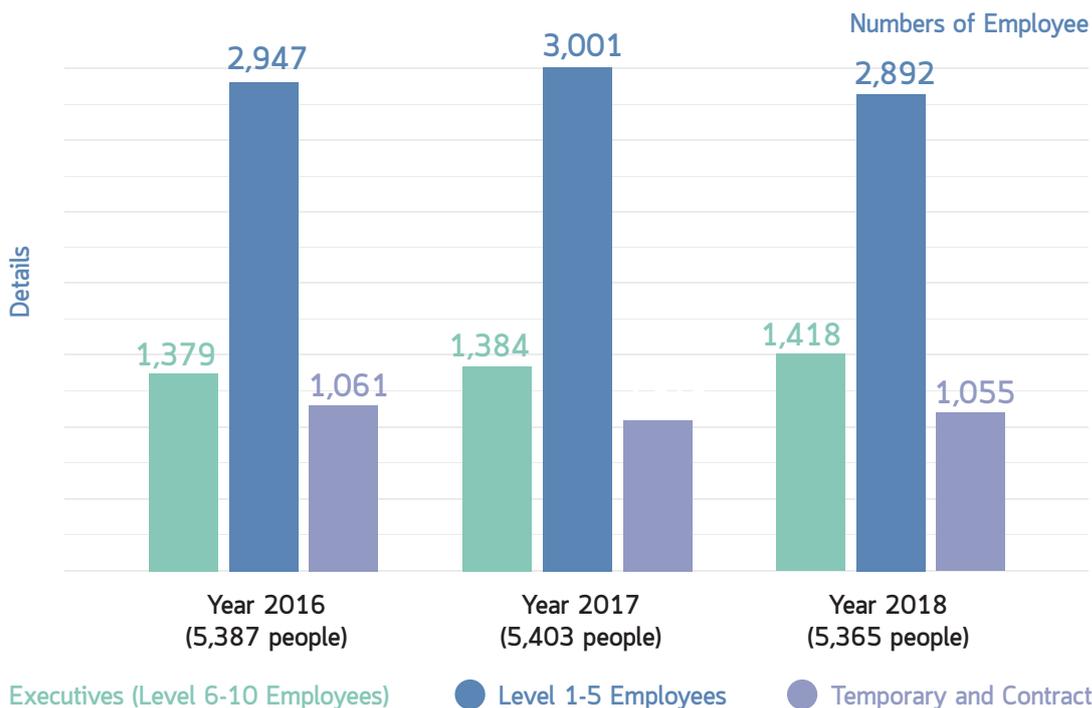
Graph displays the ratio of employees group classified by age



Data as of 30 September 2018

General employee group includes employees in level 1-10

Numbers of Employees and Temporary and Contract Workers



- Data as of 30 September 2018
- Employee is classified as permanent contract as of the Metropolitan Waterworks Authority Act, B.E. 2510 and Standard Qualifications Act for Directors and Employees of State Enterprises, B.E. 2518 and 2519.
- Temporary and contract workers are hired with the annual employment contract, which could be divided into 4 groups as follow:
 - Administrative group (vocational education level)** including administrator, public relation officer, audio-visual officer, parcel officer, accountant, call center staff, and scientist assistant officer.
 - Technician group (vocational education level)** including all types of technicians, production control system officer, and production quality control officer.
 - Automotive group (compulsory)** including general car driver, water transport driver, motorboat driver, and excavator driver.
 - Other groups** including workers, civil pipe repair worker, and pipe welder (not limited in qualification).

Rules, Regulations, and Authority that the Organization Practices for Economic, Social, and Environmental Development

Laws / Regulations	Details of the Relevant Laws and Regulations
Occupational Health and Safety	<ul style="list-style-type: none"> ● Labor Protection Act, B.E. 2551 ● Safety, Occupational Health, and Working Environment Act, B.E. 2554 ● Safety, Occupational Health, and Working Environment Standards Committee ● Electronic Transaction Act, B.E. 2544
Certifications and Registrations	<ul style="list-style-type: none"> ● Metropolitan Waterworks Authority Act, B.E. 2510 ● Codes of Conduct ● Good Governance Act, B.E. 2542
Industry Standards	<ul style="list-style-type: none"> ● WHO Water Quality Standards of 2017 ● HACCP ● GMP ● ISO9001:2015,ISO/IEC17025:2005,ISO/IEC27001:2013, ISO/IEC29110, ISO26000 , ISO14001:2015
Environmental, Financial, and Product Management	<ul style="list-style-type: none"> ● ISO14001:2015 ● Budget Procedure Act, B.E. 2502 ● Regulations of the Office of the Prime Minister on State Enterprises Investment Statement, B.E. 2550 ● Regulations of the Ministry of Finance on State Enterprises Accounting and Finance, B.E. 2548 ● State Fiscal and Financial Disciplines Act, B.E.2561 ● WHO Water Quality Standards of 2017



To ensure that the operations in MWA Code of Conduct are completed, effective and clear, the MWA has set policy and guideline in ethics management in the organization, by adhering the MWA regulations no. 133 on the code of ethics of the governor and MWA employees, B.E. 2552, and MWA regulations no. 27 on the ethical standards of the governor and MWA employees, B.E. 2559.

However, from the assessment in 2017-2018, there was no event of human rights violations has been found in the MWA.



Participations and Supports of External Associations and Networks

- Foundation for a Clean and Transparent Thailand Network
- MOU between the Office of National Anti-Corruption Committee (NACC), the Office of State Enterprise Policy Committee, and 55 State Enterprises on Cooperation in Corruption Prevention and Suppression
- Asian Waterworks Utilities Network of Human Resource Development (A1-HRD)
- Water Quality Asian Cooperation Network (WaQuAC Net)
- International Water Association (IWA)
- Asia Water Council (AWC)
- American Water Works Association (AWWA)
- Thai Waterworks Association
- The Engineering Institute of Thailand Under H.M. The King's Patronage
- Thailand Concrete Association (TCA)
- Thai Hydrologist Association

MWA CSR Policies

As MWA is aware of operating the corporate missions along with social and environmental responsibility, therefore, to achieve the maximum efficiency and effectiveness across the organization in social and environmental responsibility operations, the MWA CSR policies have been set as following:

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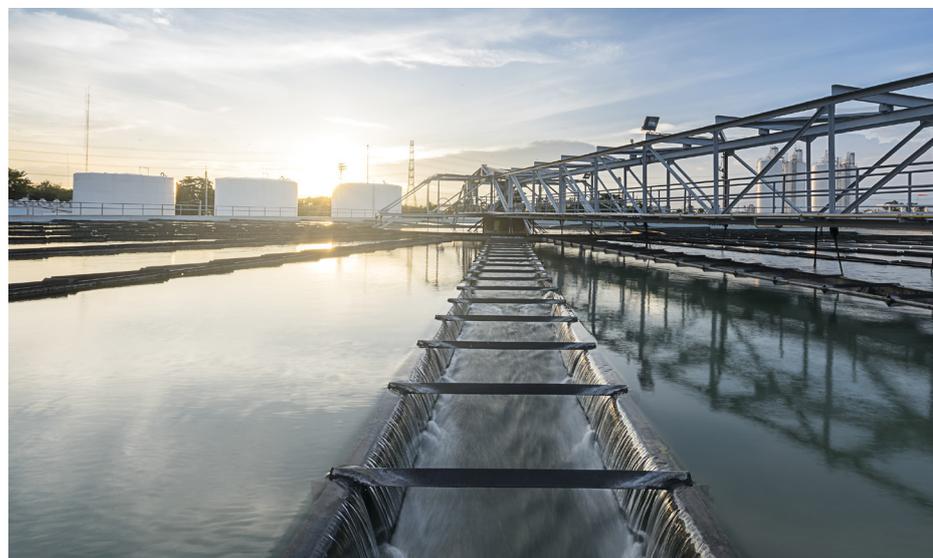
1 Commit to develop water services as the corporate main mission, by adhering to the principles of good corporate governance, integrity, transparency, and inspectable as well as the rules of law and human rights in accessing to water, which is the fundamental services of the organization, with regards to responsibility of consumers, communities, environment, and stakeholders in all sectors.

2 Cultivate and build awareness of employees at all levels to operate with social and environmental responsibility mindset, and adopt it as corporate culture. Be a transparent organization with morality and ethics. Improve the quality of life of employees and care for the well-being, as well as promote a good working atmosphere to create happiness in the workplace, and couple with development of potentials in operations effective in order to respond to the corporate goals.

3 Support the operations in social and environmental responsibility as the main process of the business (CSR In-Process), by preventing the negative effects on society and environment that might be caused from MWA operations, as well as taking ISO 26000 standards as the operational guidelines.

4 Promote the sustainable development of the organization by taking the framework of Global Reporting Initiative (GRI) in the operation, as well as consistently report the performance results in social and environmentally responsible operations and improve the reliability of the report to be accepted in international levels.

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Good Corporate Governance

The MWA Board of Directors has been adopting the principles of good governance, by clearly defining these principles as MWA Good Governance Policy since 2006, in which accordance to Principles and Guidelines of State Enterprise Good Corporate Governance, B.E. 2552, as well as Good Corporate Governance principles of Stock Exchange of Thailand in order to elevate the organization to achieve its vision of “To be a high performance organization that provides waterworks services with good governance and international standards”

MWA CG Principles



1. The Rule of Law

To have rules and regulations that are equivalent to all parties with equally enforced. There is also a supervision to ensure compliance within the frameworks of rules and regulations, as well as preventing misused exploitation



2. Virtue

To adhere to the good practices in operation so as to be a good role model for the society without committing or supporting corruption as well as controlling and preventing corruption within the organization collaboratively



3. Transparency

To ensure transparent administration and operations in all areas, including transparent disclosure of information to the public



4. Participation

To grant equal opportunity to employees to participate in the management and administration by providing suggestions and decisions on various issues



5. Accountability

To be aware of having a sense of responsibility, rights, and duty as well as accepting the consequences of the performances from duties and operations



6. Efficiency & Effectiveness

To manage efficiently and effectively within existing resources for the best benefits of the public

Thus, MWA operates under good governance and aims to prevent the corruption concretely, by having the MWA board of directors, subcommittee, the governor, and every employee and staff to declare on intention of “MWA - Transparent, Investigable and Corruption-Free” in order to display the intention to manage and operate the business with honesty. In 2018, MWA also set “No Gift Policy”.

Furthermore, there is the Corporate Governance Council of Metropolitan Waterworks Authority to promote the participation and involvement of employees and staff in organizational benefit protection, as well as creating immunity for the organization from any interference, both from external and internal sources, in order to make the MWA to be a sustainable transparent organization corruption free. Additionally, there is the Anti-Corruption Operation Center of



Metropolitan Waterworks Authority (MWA ACOC), which locates at the MWA Information Center, 1st Floor of MWA Head Office. People can report complains and issues about frauds and misconducts through various channels (telephone, fax, internet, and intranet) as this is a solid process to prevent and suppress corruption of MWA. It is also aligned with the National Strategy on corruption prevention and suppression and met the government policy in promoting good governance in national administration. All of these actions aim to create a strong network to drive the policies and actions together with the Anti-Corruption Operation Center of the Ministry of Interior (MOI ACOC).



Conflict of Interests Management

The MWA Board of Directors has prioritized in the conflict of interests from related parties, by prescribing regulations and guidelines of operations on conflict of interests within the policies of good corporate governance, which specifies that the board of directors, executives, and all staff to disclose information to prevent the conflict of personal benefits against the benefit of MWA, whether it is direct or indirect. The policies state that the reports of conflict of interests need to be submitted in the prescribed form to the hierarchical supervisor on a regular basis at the end of each fiscal year. If there is an operation that might be considered a conflict, the report needs to be made to the supervisor strictly. To make the report accurate and transparent, the Office of Audit will summarize all reports of conflict of interests for the entire organization.

However, in the fiscal year 2018, the report of conflict of interests from the board of directors, subcommittee, and employees disclose the result that there is no conflict of interested occurred.

As for related transaction which might cause a conflict of interests and benefit of the organization, the procurement process will perform, both direct and indirect, investigation on the interests between the parties who submitted the bid proposal, whether that party is individual, juristic person, or other reference markets. The investigation also considers the relationship and mutual benefits between management and joint venture, as well as the inspection of the connection between the contractors and employees of MWA

Stakeholder Engagement

In 2018, MWA has reviewed and assigned the groups of stakeholders by categorizing into operational frameworks and the corporate supply chain. This implementation aims to create balance between the Authority and stakeholders, by categorizing into 9 groups as:

Stakeholders	Engagement Creation Method	Engagement Frequency	Concerned Issues Obtained from Stakeholders
<p>Policy Agencies and Public Sector Shareholder</p> <p>The agencies who are responsible to oversee the state enterprises such as the National Economic and Social Development Committee, Ministry of the Interior, and the Ministry of Finance</p>	<ul style="list-style-type: none"> meetings Forum to receive feedbacks and opinions Att ending MWA activities Satisfaction survey 	<p>More than one time a year</p> <p>One time per year</p> <p>More than one time a year</p> <p>One time per year</p>	<ul style="list-style-type: none"> Coordination between organizations is efficient and fast Potential of coordinators Able to meet fundamental needs and raise life quality of people Diversity and accessibility of communication channels Participation in national development promotion and support Cooperation between organizations to share sustainable growth together Ability to generate revenue and fulfill the corporate missions Implementation the principles of good governance
<p>Associated Agencies in Missions Aspect</p> <p>The government agencies who has mutual missions such as Royal Irrigation Department, Department of Water Resources, Department of Highways, and Department of Rural Roads</p>	<p>Meetings</p>	<p>Every month</p>	<ul style="list-style-type: none"> Able to meet fundamental needs and raise life quality of people Potential of coordinators Coordination between organizations is efficient and fast Diversity and accessibility of communication channels Operate the works in environmental responsibility aspect Publish up-to-date information consistently Suitability of rules, regulations, and procedures of MWA Involvement in MWA strategic planning

Stakeholders	Engagement Creation Method	Engagement Frequency	Concerned Issues Obtained from Stakeholders
<p>Business Partner, Supplier, and Alliance</p> <p>Business partner: organizations or individuals who agree to operate with the Authority to achieve the common goals, or to improve performance of the operation. The agreement usually is a formal deal for particular targets or intentions, such as to achieve strategic objectives, or to deliver specific products and services. Essentially, the formal cooperation often specifies the agreement duration as well as a distinctive role and mutual benefits that each party received. Therefore, MWA does not form any business partnership but only suppliers of products and services.</p> <p>Alliance: organizations or individuals who agree to operate with the Authority to achieve the common goals, or to improve performance of the operation. The agreement usually is a formal deal for particular targets or intention, such as to achieve strategic objectives, or to deliver specific products and services. Forming an alliance is essentially specified with time frame as well as distinctive roles and mutual benefit that each party received.</p> <p>Supplier: organizations or individuals who cooperate with the Authority to work in supporting partial activities or projects, or occasionally participate in any projects when the short-term goal of both parties is aligned. Regularly, this form of cooperation does not involve any official agreements.</p>	<ul style="list-style-type: none"> • a forum to receive feedbacks and opinions • Satisfaction survey • Publishing information via website • Announcements 	<p>One time per year</p> <p>One time per year</p>	<ul style="list-style-type: none"> • Coordination between communities is fast and efficient. • Operates within the principles of corporate good governance as well as transparent, inspectable to all stakeholders • Coordinators • Fair and appropriate system that is able to evaluate the performances of contractors and external agencies • Inspection of work and disbursement process is accurate and fast • Able to provide various communication channels with easy to access • Estimate costs in each project are fair and up-to-date • Publish up-to-date and information consistently
<p>Consumer</p> <p>People who receive services of the Authority, such as water consumers, both major and minor ones</p>	<ul style="list-style-type: none"> • MWA Meets People activities • Consumers Satisfaction Survey Project • Focus Group • MWA Call Center 1125 • Best Care Service project • Key Account project 	<p>72 times per year (each of 18 waterworks branch offices organized the activities 4 times per year)</p>	<ul style="list-style-type: none"> • Tap water such as continuity, sufficiency, clean, and odorless • Customer services such as information publishing that might affect the uses of water, and consumers support via social media • Prompt advice and troubleshooting

Stakeholders	Engagement Creation Method	Engagement Frequency	Concerned Issues Obtained from Stakeholders
<p>Employees and Operational Workers</p> <p>Every person that in the responsible of Authority and has direct involve in the operation which makes the works of the Authority succeeded, as well as all the staffs that the Authority compensates in all levels, including leaders, managers, and executives.</p> <p>Operators: representatives or contractors who are assigned to operate in the name of MWA.</p>	<p>Employee engagement survey</p>	<p>Twice times per year</p> <p>One time per year</p>	<ul style="list-style-type: none"> ● Career stability ● Corporate image and reputation ● Success and Accomplishment Awareness ● Social Responsibility
<p>Community and Society</p> <p>Community</p> <p>Community: Residents in service areas, by prioritizing communities affected by pipeline installation and repairing</p> <p>Society: group of people who reside out of service areas, by prioritizing the areas that are not accessible to clean water and might affect MWA operations</p>	<ul style="list-style-type: none"> ● a forum to receive feedbacks and opinions ● CSR activities 	<p>One time per year</p> <p>Several times per year</p>	<ul style="list-style-type: none"> ● Coordination between communities is fast and efficient. ● Able to respond to the needs of the community ● Able to provide an assists in the event of an emergency that affects the community ● Able to provide appropriate prevention and reduction of environmental impacts or various pollutions from the Authority operations ● Able to access news and other communication channels of MWA conveniently ● Publish up-to-date and information consistently
<p>Media</p> <p>Medium that brings news and all kinds of content of infomation to public such as newspapers, radio, television, movie, reporter, or journalist.</p>	<ul style="list-style-type: none"> ● Press Conference ● Opening ceremonies of special events ● Interview with the press in crisis situation ● News Release ● Informal meeting ● Opinion Survey 	<p>more than one times per year</p>	<ul style="list-style-type: none"> ● An easy access to the news sources of MWA in order to publicize the right information ● The accurate and true disclosure of the information both on positive and negative sides ● A spokesperson who can provide updates in crisis events apart from general interviews ● Quick and timely clarification of information with various communication channels that are easy to access

MWA Materiality

Defining Materiality Process

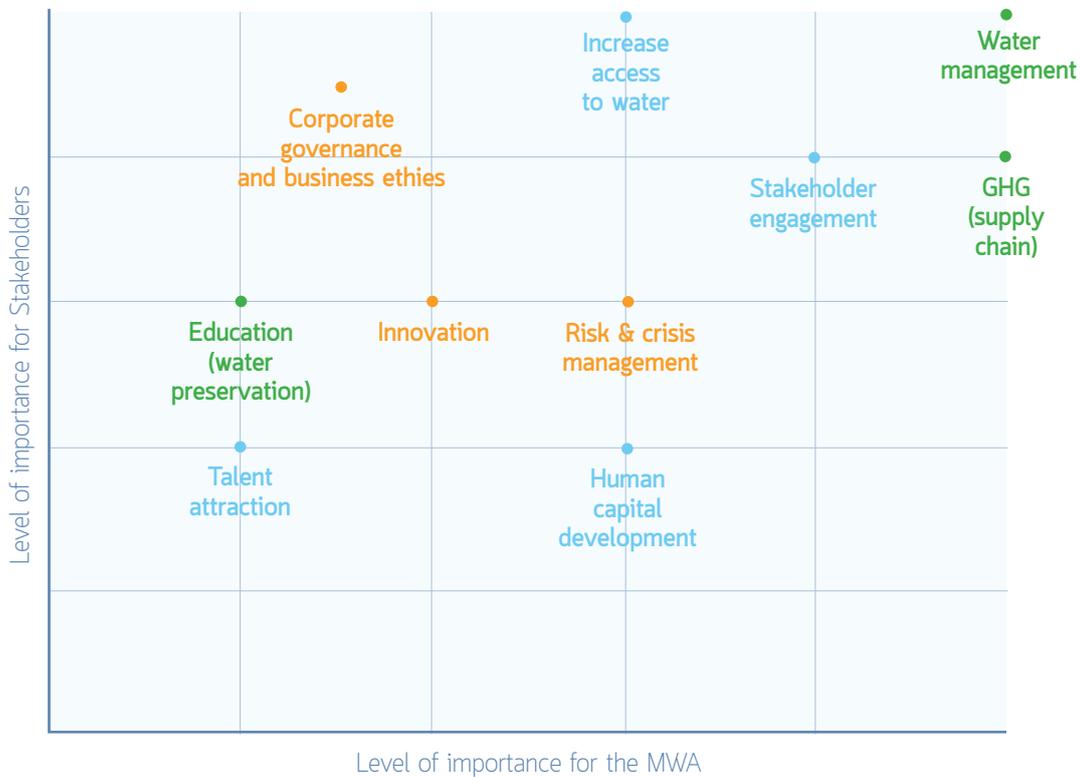
Identification: MWA has reviewed and gathered key issues that affect the operations of the Authority and stakeholders. The identification process is made in regard to the corporate direction and MWA Strategic Plan 4, along with Global Reporting Initiative (GRI) frameworks, and Sustainable Development Goals (SDGs) of the United Nations together with demands and expectations of all stakeholders of the Authority.

Prioritization: The prioritization process is implemented by responsible agencies and MWA sustainable development reporting working group, which act as representative from all departments of the Authority. The process emphasizes on issues that affect the Authority and stakeholders as key prioritization.

Validation: The validation process begins with the presentation of identified and prioritized results of material issues, which was completed by responsible agencies and reporting working group, to the committee meeting. At this point, the deputy governor and assistant governors would audit the meeting to consider approving the presented results.

Revision of Material Issues Improvement of 2017 - 2018

Materiality Matrix Evaluation



Material issues of MWA can be divided into 3 categories as follows:

• **Economy Aspect**

Risk & Crisis Management

Implementing integrated risk and crisis management as the international guidelines of the Committee of Sponsoring Organizations of the Treadway Commission (COSO)



Corporate Governance and Business Ethics

Assigning the Metropolitan Waterworks Authority corporate governance principles to be used as the main approach in management and operation, by building stability for the organization as well as concerning stakeholders equally



Innovation

Prioritizing on innovation creation that is continuously beneficial to MWA business and stakeholders to enable sustainable innovation



• **Society Aspect**

Increase Access to Water

Expanding the water supply services to cover the areas where clean water is not yet accessible in order to improve the life quality of people within the communities



Stakeholder Engagement

Providing processes of receiving feedbacks, needs, and expectations as well as exchanging opinions from stakeholders



Human Capital Development

Potential development and productivity improvement for employees, such as workshops and trainings



Talent Attraction

Creating organizational engagement as well as organizational culture, career path, work balance, and fair compensation for employees



• **Environment Aspect**

Water Management

Planing, managing, and controlling the water supply to effectively meet with consumer needs



Education: Water Preservation

Implementing the projects that promote water preservation to save water resources for the next generations



GHG: Supply Chain

Energy consumption management and greenhouse gas reduction





Grow Sustainably Together

MWA intends to operate on the basis of sustainable development to encourage all stakeholders to get better life quality in all aspects.



Driving the Economy
Towards Digital MWA



Implementing Water Safety
Plan for the Bright Future
of Water consumers



Preserving Natural
Resources and Environment
to Grow Sustainably
Together



Driving the Economy Towards Digital MWA

As the world is advancing to full digital era, MWA also aims to become an organization with potential to drive the economy with innovation and modern technology without stopping to create new innovations to push towards the Digital MWA under the comprehensive risk management of the organization as well as adhering to good governance and business ethics in parallel.

Risk & Crisis Management

MWA implements integrated risk management at all levels by following the international guidelines of The Committee of Sponsoring Organizations of the Treadway Commission (COSO) by distributing the policies to all levels, from the Risk Management Subcommittee to employees, in order to consider the comprehensive risks, conduct systematic risk management plan, monitor the risk management results, prepare to handle any risk that might occurred in every situations, as well as assigning risk management policy into corporate culture in response to the needs of all stakeholders in these following aspects:



1 Raw Water Quantity and Quality Aspect

MWA monitors and inspects water quality closely, and coordinates with associated agencies in water management. Additionally, the Authority also track Key Risk Indicators (KRI) both in aspects of water quality and quantity regularly in order to provide information for the monitoring and decision making support in raw water management including conducting action plan to handle a crisis that might arise in the future.

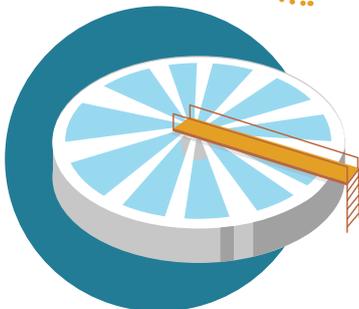
2 Sanitary Aspect: To Elevate and Maintain Water Quality to Meet International Standards

MWA has continuously and concretely implemented the Water Safety Plan by assigning it as the main mission of the Metropolitan Waterworks Authority Strategic Plan issue 4 (2017-2021). The Authority also received the cooperation from the World Health Organization (WHO) in the assessment of Water Safety Plan and training in water management, hazardous and dangerous event identification that might affect on water quality; from raw water receiving area through water plant to water consumers. It is to ensure that the water that delivered to the consumers is clean, and safe to consume, and accessible with a fair price.



3 Stability Aspect in Water Production, Delivery, and Pumping System

MWA has invested in the Waterworks Improvement Project No. 9 (2017-2022) by raising the production capacity and water supply infrastructure to support the city expansion in the future, as well as to create sustainability and stability of water production and supply system of MWA to be able to cope with unexpected situations or crises that might occur. Additionally, there was a development of the Business Continuity Plan (BCP) to support the key process, from the raw water system to water consumer services, to ensure that MWA is able to operate and provide services for water consumer consecutively even in the crisis events. There are also regular revision and practices of the plan for the Authority employees in order to prepare to cope with the incident.



4 Financial Aspect

MWA consecutively manages the liquidity of the organization and prioritizes the disbursement of investment budget process by managing the risk of accelerating disbursement in order to make the process met with the target. The methods include revision of the necessity and demand for investment budget to be aligned with actual operation, improvement of procurement process, specification of medium pricing, scope of work (TOR) drafting, as well as recruiting the appropriate contractor with experiences and skills to ensure that the operation of each project is effectively accomplished as the set goal.



5 Information Technology Aspect

MWA has reviewed and improved the Business Continuity Plan (BCP) in information technology aspect including continuously provided training as the standards of ISO 27001:2013 to achieve expertise for the staff. The Authority also prevents the vulnerability by implementing the prevention of network intrusion and malicious attacks to ensure that the information technology system of the organization is safe and able to operate in all kinds of situation.



6 Loss Water Reduction Efficiency Improvement

MWA is aware of the importance of utilizing water resources for the maximum benefits. Therefore, the Authority managed the risk of loss water reduction efficiency improvement by having special operation unit (Attack Team) with responsibility to explore the leaky pipes as well as using modern technology to manage loss water, such as in-pipe leak detection equipment and installation of surveillance system in serviced area, to ensure that the prevention of loss water has met the target goal.



With these regards, MWA has specified the Corporate Risk Appetite as a policy to be used as the framework for analyzing and determining the acceptable risk appetite and risk tolerance in different categories, which are classified into 4 categories as follows:



S: Strategic Risk

MWA does not accept the risks that might affect on the operations to be lower than the target in the strategic plan, which might lead to situations that deviate the strategic operations. The Authority also does not operate without participation from the public sector or cooperation with other organization, as well as without a balanced response to stakeholder needs (consensus).

The in strategic management, MWA does not accept the risk that might lead to wrong decisions, as well as decision misused. It is acceptable during the year that the operation might be deviated to be lower than the set goal, but eventually the end-year results of operation must meet the target.



O: Operational Risk

MWA does not accept the risk that associated to non-standard operations or below all criteria, such as service quality, water quality, stability in operation and service, water quantity, water pressure as well as the interruption of services for more than 24 hours, which may affect the water consumers satisfaction. However, it is acceptable if the deviations might be caused by natural disasters or any force-mejeure.

MWA does not accept any non-compliances associated with safety and environmental standards as well as events that might cause severe damage to an individual or corporate branding. However, MWA accepts the events of a small incident or minor accidents that may occur during the operation.



F: Financial Risk

MWA does not accept any risk that associated to the financial performance below the target, as well as any risk that associated with budget and financial management, such as improper financial administration that might lead to improper performance and not able to keep up with the situation. This includes the risk related to the financial status of the organization, such as insufficient budget estimation and inconsistent with operational procedures. However, it is acceptable if the financial operation result is lower than the target during the year, but eventually, the end-year results of operation must meet the target.



C: Compliance Risk

MWA does not accept risks that associated with rule or regulation violations, both from intentional violation and risks from laws, ordinances, including any legal acts that related to the operation of the Authority that is not clear or comprehensive.

Metropolitan Waterworks Authority commits to promoting risk management to be a part of corporate culture, by encouraging employees to participate in numerous risk-management activities aside from following the risk management plan. This is to ensure to the public that the operation of Metropolitan Waterworks Authority in risk management is effective and efficient as well as a high-performance organization that provides water supply services with excellent corporate governance and reach international standards sustainably.

Corporate Governance and Business Ethics

Throughout the years of operation, MWA has been reviewing and improving the Good Corporate Governance Manual annually by appointing working groups from associated divisions to prepare and publish the manual to executives and MWA employees as a guideline for good corporate governance in action. The manual adheres to the ethical standards and code of conduct for the organization. Therefore, all executives and employees had signed their intention into the covenant manual, and collected at the Corporate Governance Department before started using the manual is operational guideline afterward.

Additionally, there were the provisions of training activities in the topic of good governance compliances, rules, and regulations in the orientation program for new employees every year with the curriculum of “MWA Good Governance Seedlings” at MWA head office. The participants will be receiving the manual to be used as operational guideline. There is also a knowledge test, both before and after the training session, in order to evaluate the attendances and understandings of new employees every year.



Morality and Transparency Policies

Integrity and transparency policy of the MWA is defined in accordance to the policy of the Ministry of Interior, which states that MWA has declared the intention to operate with integrity, as in the statements of the Constitution of the Kingdom of Thailand (Temporary Edition) B.E. 2557, Official Information Act, B.E. 2540, Royal Decree on Rules and Procedures for Good Governance, B.E. 2546, National Strategy on Corruption Prevention and Suppression, Phase 3, (B.E. 2560-2564), and the Government Policy Issue 10: the promotion of public administration with good governance and corruption prevention and suppression and misconduct in the government sector. The policy also requires to instill values, morality, ethics, and awareness in maintaining the civil servant dignity together with effective public administration in order to prevent and suppress corruption of misconducted officers, as well as to respond and facilitate to needs and expectations of people to build confidence in bureaucracy.

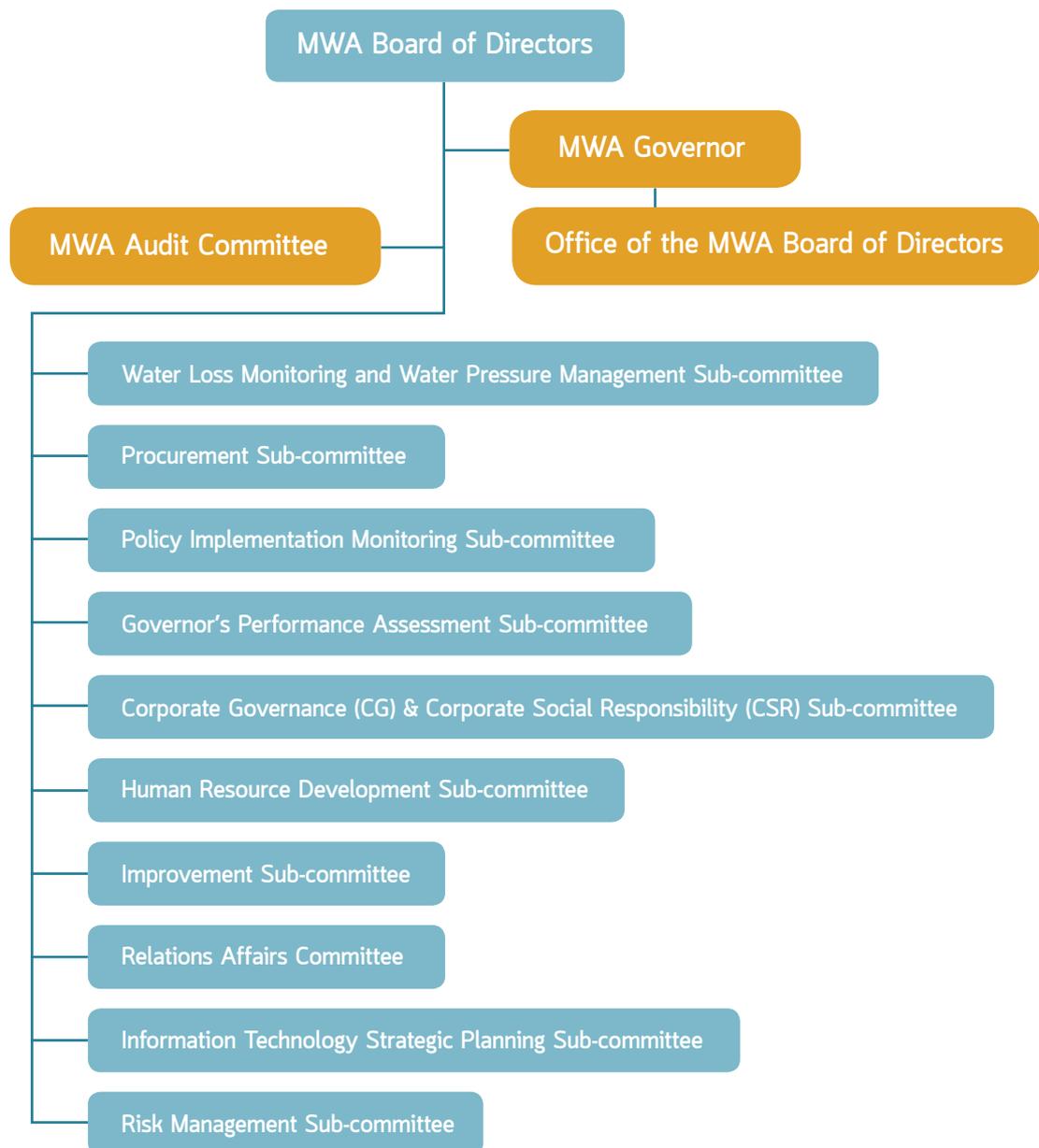
Management Structure of MWA



Composition of MWA Board of Directors

The Board of Directors consists of the Chairman, directors; at least 9 persons but not exceeding 13 persons, and the governor; who is entitled as director by the default of the title. The MWA Board of Directors has authority to appoint committee and subcommittee in each division, in order to help scrutinize the operations in each aspect, such as economy, society, and environment, as well as the authority to appoint executives to be subcommittee members or secretary to report the performances in various areas of operation.

MWA Board of Directors Management Structure

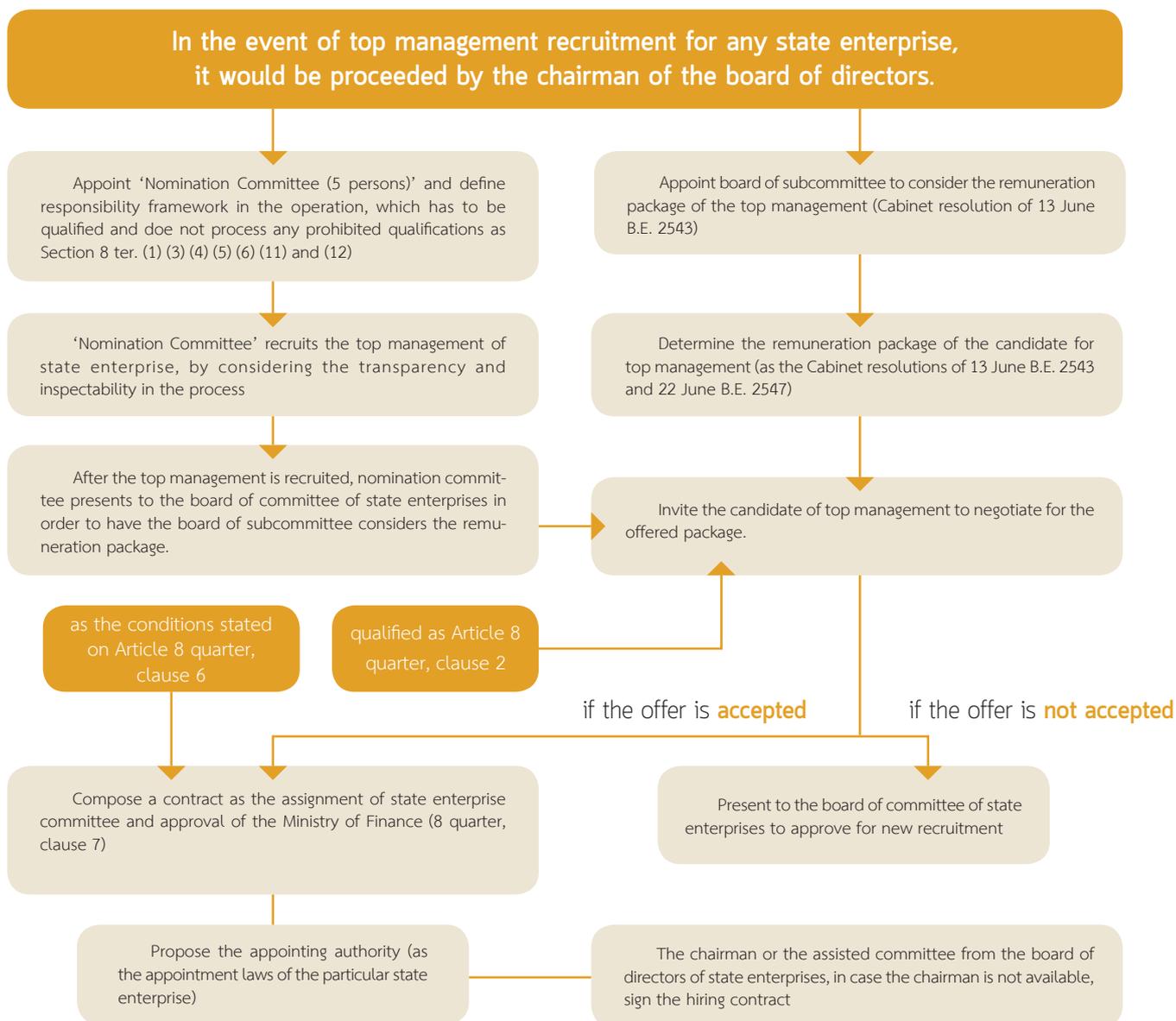


The Board of Directors has set important policies for MWA to operate under the principles of Corporate Governance (CG) along with Corporate Social Responsibility (CSR), by assigning the subcommittee of corporate governance and corporate social responsibility to define solid strategies, targets, and action plans to order to be consistently aligned with MWA corporate social responsibility operations. It is also to allow high-level leaders in all divisions to get involved in social and community supports, by contributing to setting up policies to develop society, community, and environmental conservation.

Recruitment and Selection Process of Top Management

- The committees and subcommittees are appointed by MWA Board of Directors.
- The Governor of MWA is appointed by MWA Board of Directors and must be approved by the Cabinet. However, the governor is entitled as committee by the default of the position. There are steps and guidelines of recruitment as follows:

Illustration of Recruitment and Selection Process of State Enterprise Top Management
As of The Standard Qualifications Act for Directors and Employees of State Enterprises (Issue 6), B.E. 2550



1. The recruitment process of top management of the state enterprise must be completed within 1 year after the previous executive has resigned.
2. In case of the hiring the current executive after the expiration of the contract, as the executive performance is excellent, efficient, and beneficial to the state enterprise. There is no need to start the recruitment process to seek for new candidate. However, the maximum of hiring of current executive must not exceed 2 terms.

In the process of determining the remuneration package, as MWA does not have an advisor, inquiries provided, or voting results of the stakeholders to determine the offer package, therefore the package has to follow the Cabinet resolution.

Top Management Roles in Defining Organization Strategy, Values, and Goals

The MWA Board of Directors attended and participated in workshop and seminar with MWA executives to determine the organization strategies as well as focusing on creating additional values to the organization, which includes:



2017

Participation in the seminar on MWA Strategic Management Plan Revision Issue 4 (B.E. 2560-2564) and Operation Plan of 2018 in order to review the strategies to be aligned with the facts and current situations, as well as able to support the changes that might occur in the future, and to set the operation framework to move forward sustainably

The signing of the declaration on the intention of “MWA: Transparency with the Heart of Good Governance” by the board of committees, subcommittees, and MWA executives

Meeting Participation to drive the operation of the 9th Waterworks Masterplan project

The granting of “MWA 50 years of Happiness”, as all employees of MWA declared the intention to operate under the concept of “MWA for People: Create Happiness and Raise the Quality of Life towards the Future”

2018

Participation in the seminar to analyze the draft of MWA Strategic Management Plan Issue 4 (B.E. 2560-2564) (1st Revision) to receive suggestions and exchange ideas on the strategies, and improve the information in MWA water supply operations to meet the expectations of stakeholders, to ensure that this revision of the strategic management plan would make the Authority able to keep pace with the global changes for sustainable development

The signing of the declaration on the intention of “MWA: Transparency, Accountability, Anti-Corruption” by the board of directors, subcommittees, and MWA executives to display the strong determination of MWA in good governance operation, as well as to create fairness and reliance in the services, the Authority strives to operate by adhering to good governance and to able to meet the needs of all stakeholders fairly

Meeting with the Royal Irrigation Department to discuss the improvement possibilities of western waterworks canal in order to support the increasing demand of water consumption, as well as the guidelines for raw water system development in the future

Organization of meeting to drive the budget disbursement policies to be aligned with the government regulations, which has key issues such as investment guidelines of MWA, investment budget overview of 2018-2019, and the discussion of investment budget of 2019 of each operational divisions

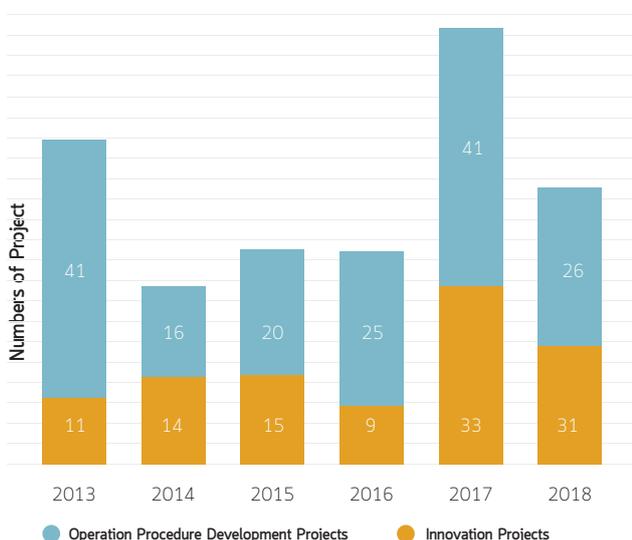
Value Creation Innovation MWA Innovation Culture

MWA always aims to build innovations that advantageous to the business and stakeholders.
In order to create sustainable innovation,
MWA has taken numerous actions to create the innovation culture of the organization.

MWA creates an atmosphere for the every level of employees to think and start doing new things, continuously improve their works and operational units, and exchange the knowledge between people both within the organization and external agencies to make useful changes to the organization and be able to solve important problems as well as leading to the organization goals. The activities include:



Innovation and Operation Procedure Development Projects



- Organizing the contest to create a learning organization, which will help to encourage employees participation by applying creativity in knowledge management to improve the operational procedures and build innovative works, the creative projects will be presented in the annual Academic Week of the Metropolitan Waterworks Authority

- Opening a channel for employees to present ideas for work improvement, by using information system 'i-Connex' as the channel to submit the ideas for solving problems and improving operation efficiency, the employees can use this channel to publish and exchange the knowledge, which is part of the knowledge management process provided by MWA

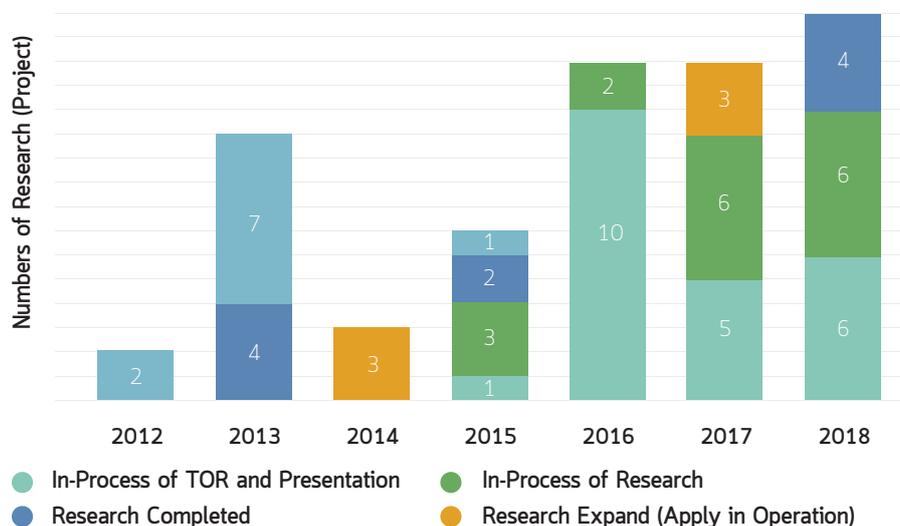
- Creating a space for knowledge exchange, consists of the annual Academic Week, Knowledge Management Contest, Operation Procedure Development Content, Knowledge Management Camp workshop for knowledge managers, Knowledge Management for Productivity workshop, Knowledge Management to Innovation workshop, field trip activities to exchange information from visiting both domestic and international events, Knowledge Management Day from each operational divisions. Knowledge exchange through information technology of KM/LO (consists of KM Blog, i-Connex, Wiki, Intranet) of the organization



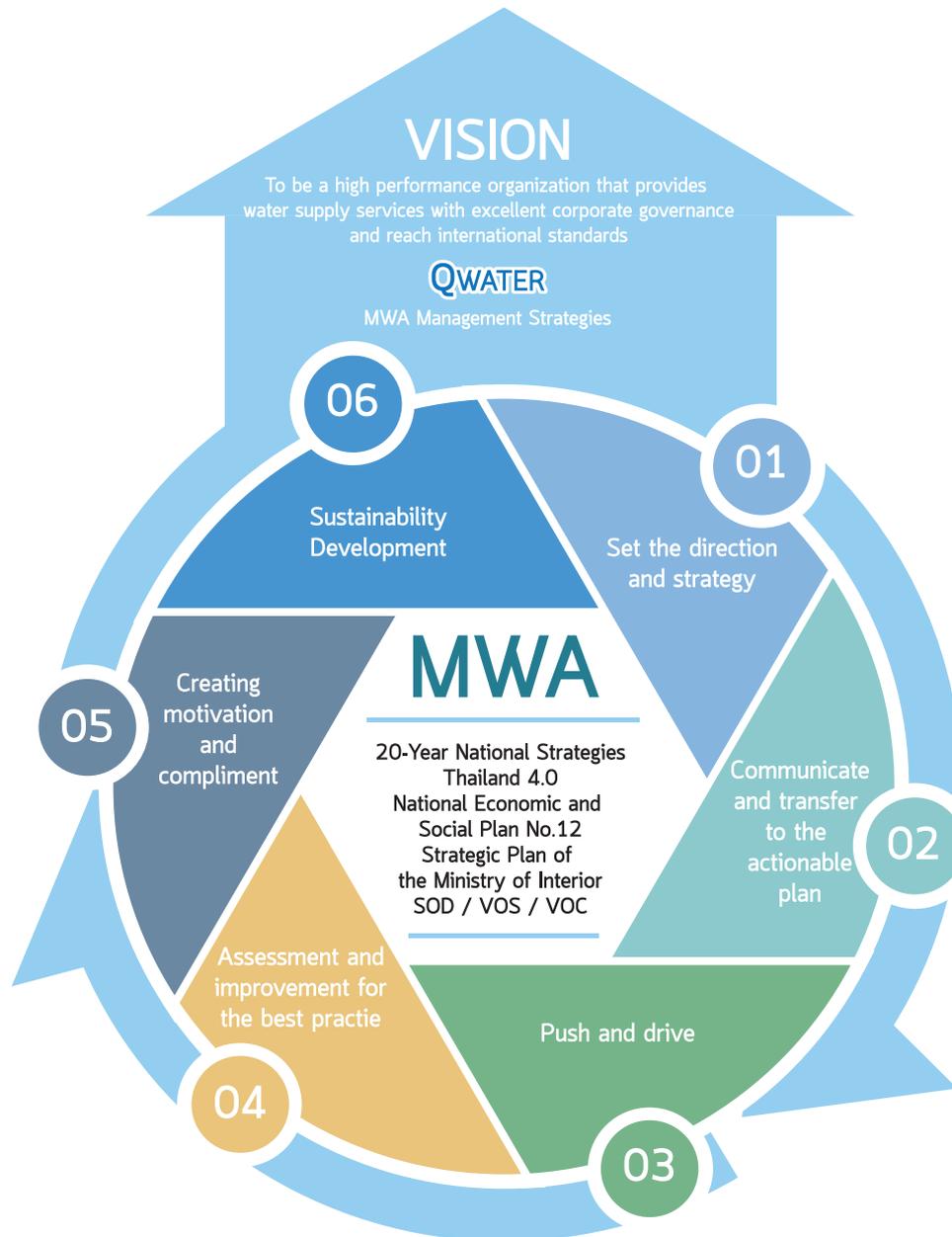
- Composing the MWA Regulation Issue 74, which is about the funding and promotion of research and innovation of 2015, to motivate the employees by supporting funds to be used in creative research and innovative projects that are beneficial to waterworks business, which have good prospects and the numbers of project presentation are increasing every year

- Supporting the implementation of innovative projects by implementing Inno-Market, the selection of potential innovative projects to be applied in the actual operation. The selection will encourage the use of innovative works that are beneficial to waterworks business and meet the operation demand and will be delivered to the divisions to be used in the operation afterward

Research Projects



To lead the organization with a commitment of innovation creation as a corporate culture, therefore, MWA takes the following strategies to drive the organization;



The illustration displays the process of the mechanism to innovation culture.

- Set up the innovative strategy in Section 1, to create sustainable growth of the organization, and strategy no. 1.8, to promote the opportunity in innovative research projects
- Communicate the innovation through the communication calendar of top management, and corporate value of T: Team - to improve the operation
- Encourage to build innovation by participation and self-motivation
- Involve in the selection process to provide suggestion and to improve the projects
- Support, promote, and reward the research and innovative projects of the employees
- Open opportunity for employees to submit idea

MWA OnMobile for Water Consumers in 4.0 Era

In the past, water consumers were able to access MWA services through various online channels. The consumers can request for new water meter installation via the website <http://www.mwa.co.th>, check water bill and payment through e-Services, internet banking and credit card, as well as checking the water usage statistics, receiving information about the area where the water supply is not available, reporting the usage problems, both about water consumers information and water quality, through mobile application MWA onMobile, which has been developed to meet the needs of water consumers increasingly.

Until now, as people are more familiar with using services through mobile applications, and different transactions are more reliable in security, MWA has improved the mobile application to better facilitate water consumers and create the better brand image for the organization, as well as to respond to the government policy of Digital Economy. The improved version of the mobile application includes these following features:



Bilingual display (Thai-English)



New water meter installation



Request submission, such as unusual water bill, unavailable water service, low water pressure, turbid water, water with bad smell



Available on both iOS and Android



Water bill payment notification in advance

Notification of temporary water service suspension

Notification of the renewal for water measurement deposit

High water usage alert

Report the leaking pipe by pinning the location



Payment with QR Code

Display the due payment statement (e-Bill)

Payment with credit cards (Master/Visa Card)

Payment with bank account

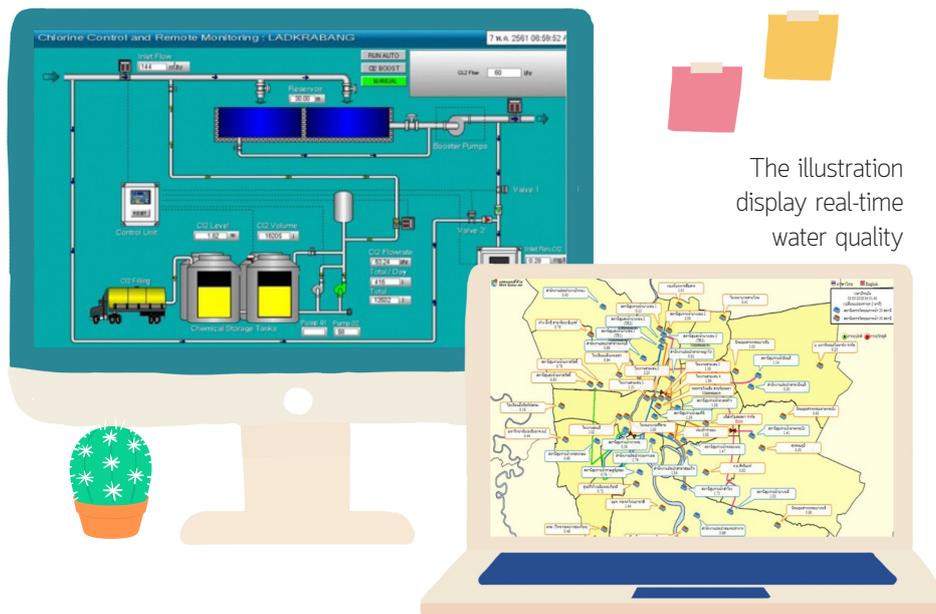


Additionally, the Authority also improved the electronics services for water consumers (e-Service) within the website <http://www.mwa.co.th> to support the needs of water consumers, by adding the displayed QR code for water bill payment from each payment agent.

Chlorine Plus: Deliver Clean Water to Water Consumers

With the strong emphasis on health and safety in water consumption in public sectors, MWA has installed the Chlorine Plus system to manage the end-of-line chlorine at the distribution plants, which was newly developed by MWA employees in 9 MWA Pump stations, to dispense additional chlorine in remote areas from the pump stations. Originally, the chlorine dispense was set as a timely basis. But with the new system, it is adjusted to be dispensed from the water sources at Bang Khen water plant to the destinations. By using the KAIZEN principle to calculate the chlorine dispensing rate, the dispensing process has been continuously improving ever since.

The interface of the SCADA system that is used to adjust the chlorine dispensing rate via “Chlorine Plus” system



The illustration display real-time water quality

Pipe Exploration Robot “Krai Thong”

“Krai Thong” is a pipe exploration robot, which is domestically produced with 30 times lower price than importing the equipment from abroad. It can be used to explore water pipes with over 100mm diameter. The robot will transfer video images to the surface as it checks for leaking spot and determines the accurate repairing area. It can be concluded that this project meets the policy of reducing water loss and increasing the confidence in pipeline cleanliness, which accords to Drinkable Water policy.

Krai Thong robot can dive more than 10 meters, and able to operate for more than 2 hours. The robot’s camera can be directional controlled as well as able to send information and recorded videos. With its capabilities, it makes “Krai Thong” won the 2nd place of National Innovation Award 2016 in Social Aspect, presented by National Innovation Agency, and Outstanding Innovation Award 2017 by the State Enterprise Policy Office (SEPO)





ADD[...]**SPACE** - Enhance the Water Meter Maintenance Efficiency

Over the past, the operations in water meters maintenance and water meter replacing often faced with the problems from the fixed installation, especially for the meter with 1/2 inches and 3/4 inches sized on residential areas which are counted as 90 percents of all water meters. With the fixed installation, the joints of these water meters could not be adjusted or have some limitations in the operational field. Thus, there was a need to remove the cement in the area, causing dissatisfaction and minor damages to water consumers' properties.

Therefore, MWA has developed water meter maintenance equipment called "ADD[...]**SPACE**", which is range-extension equipment that facilitates the maintenance of small water meters. There have been 5 models of development version for the equipment until the present, and it can significantly help to increase the efficiency and reducing operational time in the field works, as well as preventing damage of water meter and decreasing water loss from the operations.

With its efficiency and effectiveness, "ADD[...]**SPACE**" Project has received the Golden Award in Genba Kaizen category at Thailand Kaizen Award 2018 from Technology Promotion Association (Thailand-Japan) on 31 August 2018. The event is a platform for creative exchange with the award of honor for those individuals have outstanding Kaizen performances and the organizations that brought Kaizen to improve their operational processes consecutively.

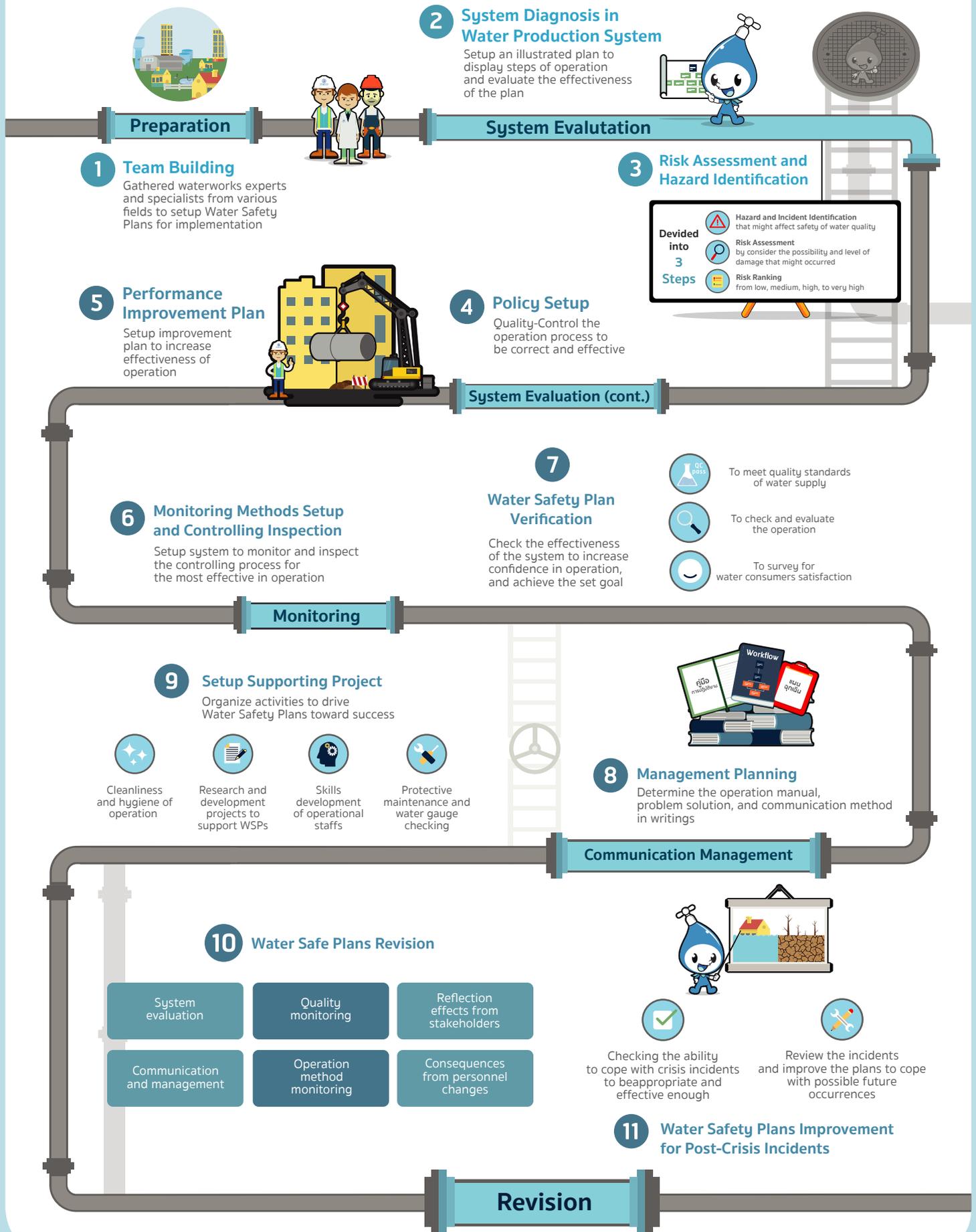




Water Safety Plan for the Bright Future of Water Consumers

As the main role of MWA is to deliver clean and safe tap water, with standards reached, for water consumers in the responsible areas thoroughly. Therefore, MWA is not only determined to expand the water services to the rural areas but also intended to improve the waterworks system under Water Safety Plan, in order to provide the best water services for all water consumers.

Water Safety Plan: WSP





Increase Water Accessibility

MWA has initiated the project to expand the service areas to cover the entire urban communities, in order to increase the access of water supply to the areas where the water supply are unavailable. It is also to improve the quality of life of people in the communities as well as responding to the government policies on reducing social inequality and increasing the opportunities to access to government services, to ensure that every people receive the services from government equally, thoroughly, and fairly.

In the business aspect, although this project is a service that is not worth investment, the Authority sees it as proactive operation in pipeline installation, which has been starting since 2006 and has continued ever since. It is to prepare for the future service and to keep up with upcoming urbanization.

Operation output: During 13 years of the project, there are 52,420 households, 167,744 people in Bangkok, Nonthaburi, and Samut Prakan areas benefitted from the projects since the fiscal year of 2006-2017, with 99 percent water coverage in the urban areas from the water distribution system. Furthermore, MWA also got to establish a relationship with local authorities, and become a cooperative network with the MWA to create awareness in helping society eventually.

Operation outcome: The implementation of the project to expand water supply service area to cover the urban communities gave an achievement of higher accessibility to clean water sufficiently and equally for consumption. People in the areas are able to use tap water to replace the other sources, such as surface water from river and canal, or groundwater sources from artesian wells, which result in a reduction of household expenditures in water supply for consumption. It could be said that the projects created the strengths and sustainability for people in the community in both livelihood and occupation aspects. As most of the communities that are not accessible to the water supply are mostly agricultural communities; which they suffer from drought and saltwater crisis for 2-3 times per year, providing water supply to them could be implied to providing a solution for their agriculture, including the opportunity to do fruit and flower gardening.

Operation impact: the results from project implementations are the reduction in the land subsiding problem, reduction of hygiene problems, and ability to improve the quality of life as well as helping to build a relationship with the communities proactively. However, as of the land subsiding problem, if MWA has fully expanded to cover all service areas, and all communities have completely changed to use tap water, it would help to reduce the land subsiding problem by up to 9 centimeters within the 20 years period.¹

¹as the Department of Groundwater Resources has organized survey and study project of land subsidence exploration in groundwater crisis zone, as in page 3-31 to 3-33 as follows: "In 2012, there was a forecast of future subsidence, in the case of controlling water pumping by maintaining groundwater levels in different layers to the same level in 2003, found that in the next 20 years (2003-2023), the land continues to subside for approximately 40 centimeters. And if there is a delay in water pumping, by limiting to the areas with water supply are unavailable, the land will further subsiding for 9 centimeters in the 20 years period in the future".

The Project Results on Water Supply Service Area Expansion to Cover All Urban Communities

Fiscal Year	Numbers of routes	Distance (Kilometer)	Investment Budget (Million Baht)	Numbers of people received direct benefit (households)	Numbers of people received direct benefit (people)*	Numbers of people received direct benefit (Latent population) (people)**	Numbers of people received the benefits	Reduction of household expenses in water supply consumption (Baht)***
2006-2007	170.00	210.00	314.00	10,045.00	32,144.00	17,839.92	49,983.92	1,627,792.25
2008	111.00	124.00	141.00	3,700.00	11,840.00	6,571.20	18,411.20	599,585.00
2009	93.00	118.00	193.00	3,540.00	11,328.00	6,287.04	17,615.04	573,657.00
2010	127.00	201.00	276.00	5,950.00	19,040.00	10,567.20	29,607.20	964,197.50
2011	189.00	230.00	331.00	6,930.00	22,176.00	12,307.68	34,483.68	1,123,006.50
2012	419.00	344.00	674.00	8,315.00	26,608.00	14,767.44	41,375.44	1,347,445.75
2013	55.00	70.00	153.00	2,284.00	7,308.80	4,056.38	11,365.18	370,122.20
2014	96.00	138.00	250.00	2,610.00	8,352.00	4,635.36	12,987.36	422,950.50
2015	186.00	178.83	320.33	4,160.00	13,312.00	7,388.16	20,700.16	674,128.00
2016	238.00	273.44	389.27	4,886.00	15,635.20	8,677.54	24,312.74	791,776.30
2017	113.00	157.87	296.16	2,367.00	7,574.40	4,203.79	11,778.19	383,572.35
2018	162.00	198.03	422.24	1,620.00	5,184.00	2,877.12	8,061.12	262,521.00
Total	1,959.00	2,243.17	3,760.00	56,407.00	180,502.20	100,178.83	280,681.23	9,140,754.35

* The average number of population per household is 3.2 people
Source: Population and Housing Census Results of 2010, the Statistical Office (2000-2010)

** The average number of latent population in Bangkok is 1.776 people her household. (Source: the article of Bangkok population, <http://cpd.bangkok.go.th/cpd/tp/planpop.html>, from Technical and Planning Division, Office of Urban Planning.

*** The average expense reduction of water supply sourcing for consumption in each household is average of 162.05 baht/month/household.
Source: survey of satisfaction from the sample of people who resides in water pipeline laying area, and received the benefits from the project in the fiscal year 2013





Human Capital Development

At present, MWA has improved the model of human resources (HRD Remodeling) to reach the needs of employees and divisions, by concentrating on the development in Non-Classroom Training and increase its availability in order to support the personnel of MWA to have appropriate knowledge and skills in various roles, as well as able to fully operate under the corporate strategies, roles, missions, and ready to the future changes. The MWA skill development programs for employees include:



Executive Development

Project to develop high-level leaders by following Leadership Development Model to encourage the executives to develop skills and knowledge towards excellent. The project consists of a variety of development models that are suitable for each executive skills and divisions.

Project to create employee readiness for a succession of important positions, as the MWA will have guidelines and procedures to create readiness for executives to inherit important positions in the time of expectation, by having Strategic Succession Plan for Key Position as the main guideline in the project.

Project to develop Line Manager into the HR Manager in order to promote and support the operation of the HR Manager Professional. It is to ensure the MWA that executives have a good understanding of the HR Manager role, and able to perform their roles concretely, as well as able to develop the growth progress support of the personnel. The project considers the guideline, tools, methods, and details of the subordinates to be able to operate effectively as the corporate expectation. By having HRD tools to implement the project, and considering the changing environment, internal, and external factors to evaluate the performances of subordinates.



Development of operational employees

by focusing on human resources development to drive the corporate strategies, such as:

- Digital knowledge development program
- Personnel development project in water loss management
- Water Safety Plan support project
- MWA Young Smart promotion project to support potential employees
- MWA to ASEAN preparation project
- Enhance the service to the excellence project
- Human resource development project to support the 9th Waterworks Master Plan Project
- Training in CSR education through projects from 9 operational divisions, and MWA CSR Day



Outsource staff development to enhance the services to the excellence.

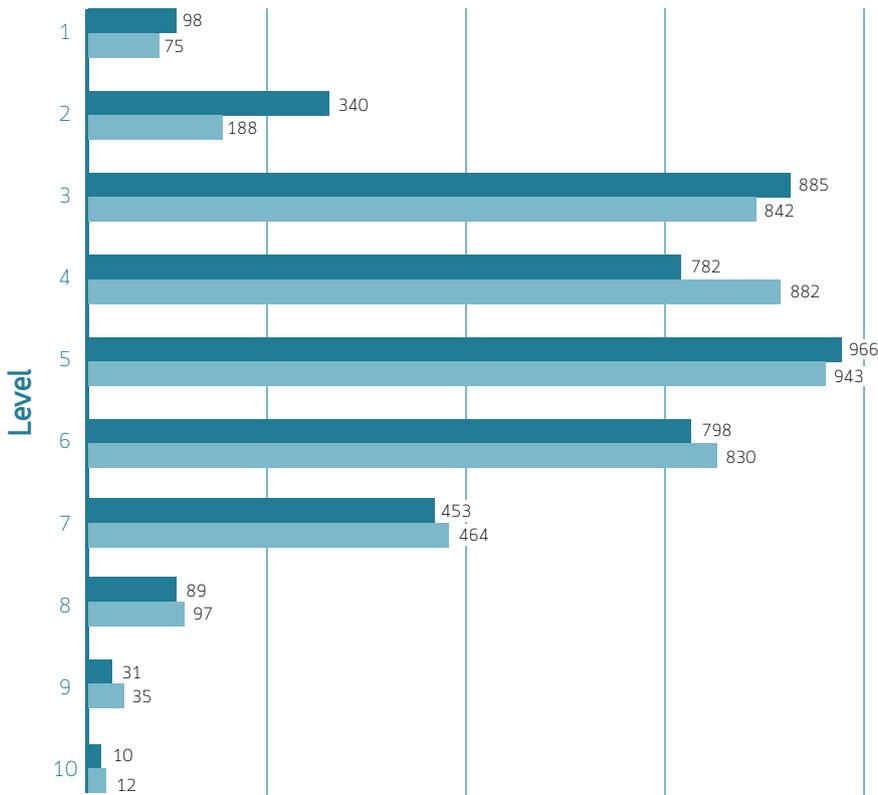
- Consumers relationship enhancement project.
- Predictive maintenance improvement project.
- Corporate relationship creation and enhancement project.
- Safety Health Environment (SHE) management enhancement project.
- Courses in parcel management.
- Courses in selecting an appropriate tool to increase work efficiency.



Project to support the value creation of personnel and management after retirement or termination of employment.

MWA has a support program to encourage employees to show their potentials to create value for the personnel, by having a systematic storage database of knowledge and skilled staffs. In addition, there is also a project to provide knowledge about living in retirement, as the employees who are nearly retired would feel the self-worth after their retirement.

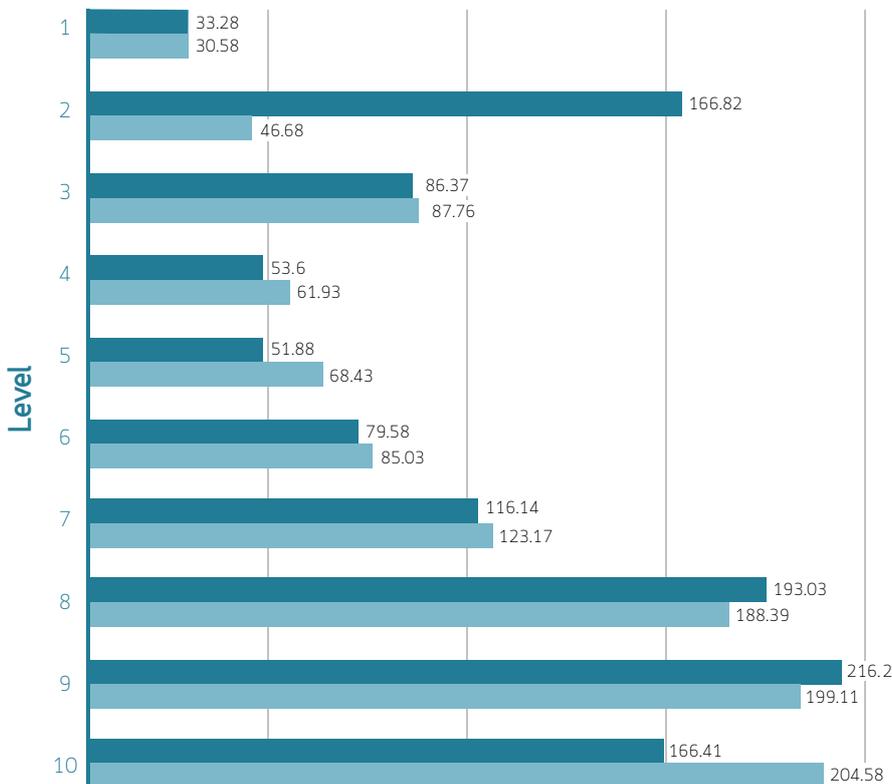
Numbers of Attended Employees



■ In the fiscal year 2017, MWA has organized training programs to educate MWA employees at all levels with total of **4,452** people.

■ In the fiscal year 2018, MWA has organized training programs to educate MWA employees at all levels with total of **4,368** people.

Average Training Hours per Person



■ In the fiscal year 2017, **116.33** hours per person in average.

■ In the fiscal year 2018, **109.56** hours per person in average.

Additionally, MWA also has evaluated performances of employees in different categories, which are:



Core Competency Evaluation (CC)



Functional Competency Evaluation (FC)



Leadership Competency Evaluation (LC)

All Performance Evaluation Results

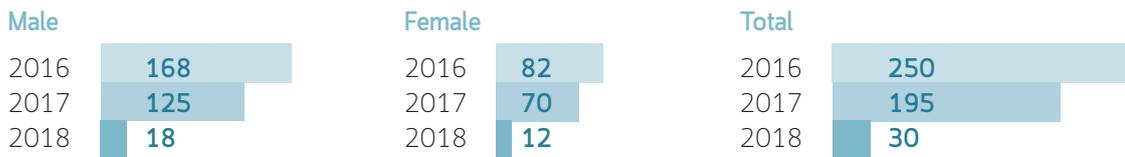
Goal : 95%
(measured from the percentage of those who received the scores that meet every expectation (Gap0 and Gap+))

Evaluation	2015	2016	% Max-Min	2017	% Max-Min	2018	% Max-Min
CC	99.62	99.68	0.06	99.05	-0.63	99.79	-0.74
FC	98.36	97.09	-1.29	96.93	-0.16	97.72	0.79
LC	99.38	98.76	-0.62	99.56	0.80	99.45	-0.11

Furthermore, The Institute of Water Resources Development also has a project of Professional Workforce Training Roadmap to support career path growth for employees in the organization to work effectively and provide opportunities based on the potential and readiness of the employees sustainably.

Numbers and hiring rates of new employees during the reporting period, categorized by gender, age

Numbers of new employees, divided by gender.



Numbers of new employees, divided by age.

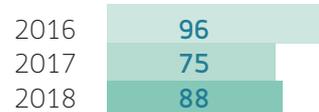


Numbers and resign/retire rate of employees

Resigned employees



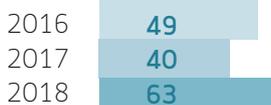
Retired employees



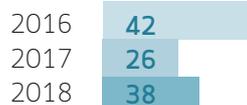
Employee Maternity Leaves and Returns

Maternity Leaves

Numbers of employees on leave requests



Numbers of returned employees after leaves



Parental leave, continuing from maternity leave

Numbers of employees on leave requests



Numbers of returned employees after leaves



*Data as of 30 September 2018



9 Divisions Project in Year 2017-2018

As building perception and participation of employees on social responsibility is a fundamental factor that enables the Authority to grow sustainably along with the society, MWA, therefore, has organized projects to create awareness and consciousness instilling in social and environmentally responsible operations for every stakeholder at all levels in 9 divisions with the same direction and guideline to the operational team of social responsibility promotion. The projects have been ongoing for 3 years until the present, where every division has applied knowledge from the projects to operate and organize activities that related to their own divisional works and then exhibit the results in MWA CSR Day every year.

9 Divisions - Continue on the Father's Creation" Project



9 Divisions - Unite for Sustainability



perception/understanding

Good Hygiene Promotion with School Tap Water System Project

School Tap Water System Project is aligned with the government policies and the Ministry of Interior, including the United Nation Sustainable Development Goals, Article 6: Water and sanitation management in regards to the provision of clean, safe, and hygienic water to create sustainable sanitation for the people in upstream communities.

MWA has been constructing and improving the school plumbing system in the areas that are inaccessible to clean water since 2016, with the goal of 4 schools per year. On 2018, there are 19 schools had received the project. Additionally, the Authority also created the school team (school personnel) to maintain the system, and if there is any problem occurred to the system, the team can contact MWA through social media directly.

In additional, MWA also provided an education in water usage to students and people in the communities. It is to promote the awareness of natural resources and water resources conservation to create true sustainability. With the implementation, the project of "School Plumbing System - From Rin Luang to Mae Khlong" has received the Outstanding State Enterprise Award in Outstanding Social and Environmental Performance of 2017.





MWA Plumber for People Project: Create Opportunity, Career, and Deliver Values to Society

MWA Plumber for People is an educational project in waterworks, which is the core competency and expertise of the Authority, providing to the public without limitation in gender, educational background, and any expense charged. People who have completed the training can apply the knowledge and skills to real situations, rely on themselves, and help neighbors within their own community. The provided knowledge and skills would help to solve initial problems of pipe leakage and broken equipment, as well as preventing clean water loss, which is one of the important resources of the world.



MWA Plumber for People Project

operates since the fiscal year 2014 to the present (30 September 2018), with 32 batches of fundamental-level training and 5 batches of high-level training. There are total of 1,213 people who completed the program.



This project aims to create a role model as next-generation training under the main objective to create strong networks in communities and plumbing professionals. Furthermore, MWA has brought voluntary plumber trainees to participate in public activities and utilize the knowledge gained from the training in the actual works together. Additionally, the technicians who have completed the training also applied the knowledge to develop and invent “Intelligent Artificial Thread” which is an artificial thread that can be used conveniently, reduce the work procedures, save cost, and create satisfaction for the people. As a result, the project has received the Outstanding State Enterprise Award in Outstanding Social and Environment Performance of 2015.



Grow Sustainably with Natural Resources and Environmental Preservations

Natural resources and environmental preservation are one of the key issues that have received high interests in the world, especially the exhaustible resources such as “water”. MWA, as the organization that directly related to water products and services, has aware the importance of this matter, by not only attempt to reduce the water loss rate in the production process to the appropriate level, but also undertakes various associated activities and projects with the determination to help preserve natural resources and environment for the sustainable growth henceforth.



Water Management

Water Quantity to be used in Production from Different Sources

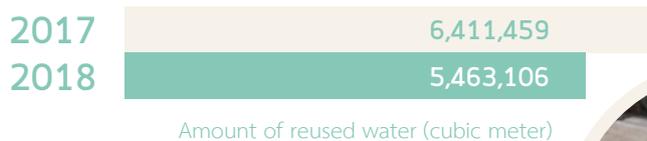
Sources for MWA Water Production	Water Sources	Water quantity used in production (million cubic meter), Year 2017	Water quantity used in production (million cubic meter), Year 2018
In Eastern side, uses water source from Chao Phraya River	Bhumibol Dam, Sirikit Dam, Kwai Noi, Bamrungdan Dam, Pa Sak Jolasid Dam	≈1,700	≈1,610
Total amount of usable water in 4 dams	18,175 million cubic meter	Accounted for 9 percent of total usable water	
In Western side, MWA receives raw water from Mae Khlong River	Sinakharin Dam and Vajiralongkorn Dam	≈540	≈532
Total amount of usable water in 2 dams	13,328 million cubic meter	Accounted for 4 percent of total usable water	

From the information of raw water from Chao Phraya River and Mae Khlong River to be used in water production in 6 dams water sources, the used rates are 9 percent and 4 percent of usable water. Thus, using raw water from these sources in production does not effect the quantity of usable water from the water sources.

Promoting the Awareness of the Value of Water

It is known that “water” is one of the exhaustible resources. For this reason, every sector has started the concept and policy on water resource conservation, including MWA, which has a direct role in water consumers. Therefore, there are several projects that promote the value awareness in water consumers, starting from the design of Maha Sawat water plant to reuse water in the production process during the turbidity level of raw water is neutral. There are satisfactory statistics as follows:

Information of Reused Water in the Fiscal Year 2017-2018 of Maha Sawat Water Production Plant



Zero Waste for MWA Process

Usually, in the water production process, there will be a large number of sediments left from the production. According to the report from Bang Khen water plant, there are 247 tons of sediment left per day, causing Metropolitan Waterworks Authority to spend a large number of expenses in the process of making the sludge into the dry sediment, and convey all the sediments to be used for soil filling in Bangkok and surrounding areas. For this cause, MWA has formed the concept to develop the sediment into various products, such as interlocking blocks, pavement slabs, and lightweight concretes. It is the operation to achieve the goal of zero waste in the water production process.



Greenhouse Gas Reduction Supply Chain

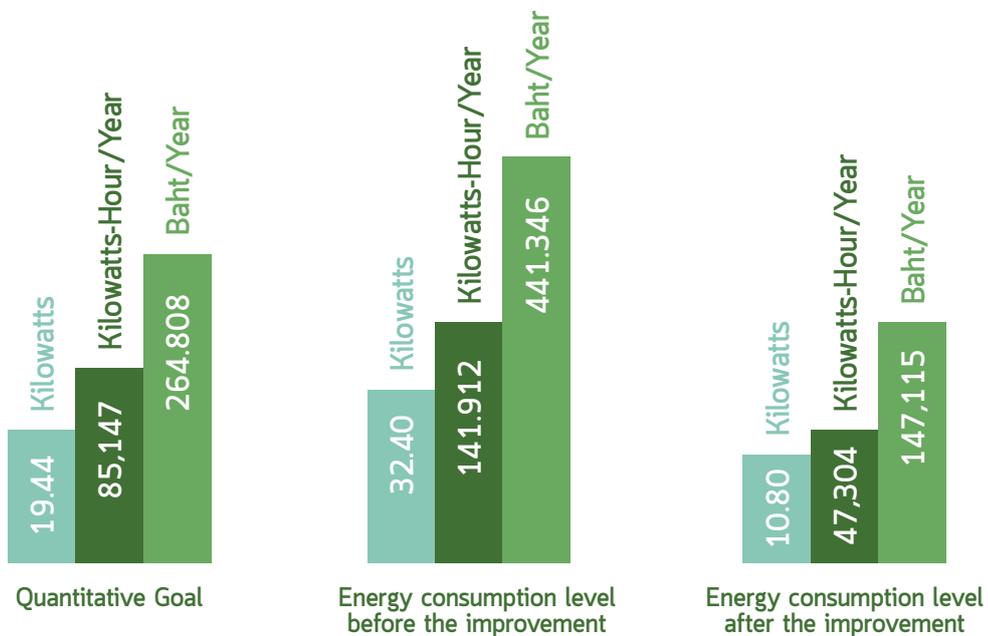
Amount of electricity consumption and carbon dioxide emission in water production and distribution process for the fiscal year 2017-2018

Electricity consumption amount (kWh)		CO2 emission amount (kg CO ₂)	
2017	429,015,401	2017	261,399,084
2018	391,772,439	2018	238,706,947

- Notes:
1. Electricity units are based on the details of electricity charges, separated by departments as of October 2017 - September 2018 (Source: Purchasing and Other Payables Division, Finance Department).
 2. Consider only the departments involved in the main process of water production and distribution, and does not include any support units.
 3. Emission Factor is referenced from electricity usage from the Greenhouse Gas Management Organization (Public Organization).

Policy or Guideline in Greenhouse Gas Reduction

To help saving energy consumption and be a part of greenhouse gas reduction, MWA has policy to change all the lamps on the road number 1,3,4,5,6,8 of Bang Khen water plant from Metal Halide 250W to 108W LED street lamps with the following results:



Note: the level of energy consumption is based on measured electricity, which is found that the consumption decreased in accordance with the energy-saving measures that have been implemented.

The reduced energy can be calculated to Carbon credits of 57,644.65 KgCO₂eq / year.

Environmental Preservation and Good Working Environment

In order to show the intention in environmental focuses and awareness creation in water production and service, which is the main process in the value chain and other operations. The MWA has, therefore, announced the Safety Health Environment Policy (SHE), which is the corporate-level policy in occupational health and safety, and continuing to support social and environmentally responsible activities in the core process (CSR In-Process) as follows:



1 Assign all departments to comply with laws, regulations, and standards associated with safety, occupational health, and environment.



2 Encourage communication to educate and provide better understanding, awareness, and participation in safety, occupational health, and environment.



3 Promote and support resources in order to initiate earnest and sustainable operations in safety, occupational health, and environment.



4 Consider the operation of safety, occupational health, and the environment as one of the duties and part of job responsibilities.

In addition, there was a forming of Safety, Occupational Health, and Working Environment Committee, by dividing into 2 sets as:



1 **The Committee on Health, Safety, Occupational Health, and Work Environment**, which is responsible for conducting the policy and managing the safety of the MWA, by having MWA State Enterprise Labor Union joining the committee to participate in determining the policy and safety management of MWA.



2 **The Committee on Safety, Occupational Health and Work Environment**, which is the committee appointed by the legal department, consisting of 21 subcommittees from representative of employers and employees. This set of the committee is responsible for safety management in their own workplaces.

Furthermore, the MWA has also formed the group of occupational health and safety in workplace offices, by selecting qualified employees (level 6 for supervisor course, and level 7 or equivalent for manager course) to attend the training for 12 hours until completing a diploma from from the MWA. Then, MWA will appoint the attendants to workplace safety supervisors and managers, by collecting the names of those who have completed the training and presented to the governor for the appointment approval.

These 2 groups of occupational health and safety in workplace offices will jointly set policies to supervise and drive the operations on safety, occupational health, and environmental standards at all categories, such as lightings, sound, and dust for both inside and outside the office, company, and factory that might affect the employees and communities, as well as to prevent all kinds of disaster and danger, including fire drilling, disease outbreak prevention, landscape adjustment, exercise for health, and annual health checkup for employees.

For the accident statistics in workplace, MWA has gathered the data of accidents as 2 factors of:

1. Injury Frequency Rate (I.F.R.):

the calculation of frequency rate in employee and staff injury from operations in one period per 1,000,000 hours of operation. The I.F.R. result from October 2017 to September 2018 equals to 0.14, which means

every 1 million hours of operation, there are **0.14** people injured.

2. Injury Severity Rate (I.S.R.):

the calculation of severity rate of employee and staff needed to take the days off for medical treatment per 1,000,000 hours of operation. The I.S.R. result from October 2017 to September 2018 equal to zero, which means

every 1 million hours of operation, there is **none** of employee or staff needed to days off due to work injuries.

Therefore, it is figured that there is no relation between accidents or work-related disease to the nature of works performed by employees.

To build awareness in safety, occupational health, and environment in every process of operations, MWA has been providing trainings for employees and operational staffs every year, such as:

- Training in work safety for supervisor and management level
- Fire drill and evacuation drill
- First aids and basic life support
- Training in safety, occupational health, and work environment for general employees and new employees, as according to the Safety and Occupational Act, B.E. 2554
- Training for licensors, supervisors, assistants, and operational staffs who works in confined spaces.



Water Preservation Awareness Education

Water Saving Project: Demand Side Management (DSM)

The MWA has implemented a project to promote and support the awareness in water consumers, Demand Side Management, by using 3 strategies of: (1) pricing for conservation, (2) water saving technology, and (3) water saving campaign, as well as 1 support project, which is the development of database system in water consumers, by calculating the average daily water consumption per person in the year 2018 and then proceeding to select agencies to carry out a pilot project to replace water tap in 6 locations, which are:

- 1 Airports of Thailand PLC. (Suvarnabhumi Airport)
- 2 Phra Pradaeng Hospital (Rajapracha Samasai Institute)
- 3 Phranangklaow Hospital
- 4 Rajavithi Hospital
- 5 SF Development Co., Ltd. (Mega City Bangna Shopping Center)
- 6 Nonthaburi Provincial Administration Organization



Performance Results

From the opinion survey of the MWA in sustainable water consumers from 6 same groups,

93.6%

water consumers from 6 same groups

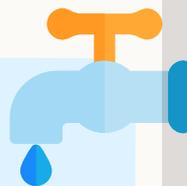


found that activities in water using awareness is the matter that most-received opinions and feeling changed, resulting in

38.37%

of the respondents.

The satisfactory level before and after the organization is noticeably increased, which can conclude that these public relation activities could stimulate the awareness in water consumers effectively.



But after changing to a water-saving faucet with the average period of 107 days, the total water consumption amount is 6.834 cubic meter,

which is **0.051** cubic meter daily.

There was also the analysis study on water use measure,

which found that the sample group of people who consumes water from common water faucet with the average period of 34 days has a total amount of water consumption of 2.198 cubic meters, with daily consumption amount of **0.084** cubic meters.



This can be concluded that all of 3 models of water-saving faucet could save **daily water consumption more than common faucet up to 0.032** cubic meters.

In addition, MWA also promotes public relation campaigns to educate people and create awareness in the value of water consumers, such as organizing a game activity for souvenirs, publicizing essential information, and distributing stickers of 'water saving promotion' at the target locations of faucet replacement, which has the following details:

1. **Airports of Thailand PLC. (Suvarnabhumi Airport)** - organized the campaign on 24 August 2018.
2. **Phra Pradaeng Hospital (Rajapracha Samasai Institute)** - organized the campaign on 4 September 2018.
3. **Phranangklao Hospital** - organized the campaign on 29 August 2018.
4. **Rajavithi Hospital** organized the campaign on 30 August 2018.
5. **SF Development Co., Ltd. (Mega City Bangna Shopping Center)** organized the campaign on 5 September 2018.

Currently, MWA has 2 labels to show the efficiency for water-saving equipment, which are water-saving faucet and sink and water-saving shower. This is to allow the product owners to request registering their water-saving products, which is another way to promote the efficiency of water consumers. Also in the year 2019, the MWA is going to organize a public relation event to launch another official water-saving label.

Water Saving Camp

MWA initiated the project of Water Saving Camp in the fiscal year 2015, because the Authority realized the importance of upstream communities that could participate in natural resources conservation, as well as involve in social and community development together. The project emphasizes on educating students in the schools located on upstream areas, through 4 bases of activities. The activities aim to create consciousness in water saving and maintaining rivers in the community, including basic plumbing pipe extension and value of water consumers. It is to create the networks to help to prevent and maintain rivers and canals as well as public water resources within the community.

In addition to organizing educational activities to students, MWA also provided scientific tools to schools that participated in the activities, to allow the schools to inspect water quality from the sources within their own community, along with 5,000 baht funding to support the lunches in each school.



Target Groups

The target groups of Water Saving Camp project includes grade 5 to grade 7 students of the schools in environmental saving networks. Starting from the beginning until the year 2018, the projects have been carried out for 12 times. There are 48 schools in Mae Khlong and Chao Phraya river basin communities attended, with 40 students from each school. In each project session, there were 250 people joined the activities with half-day activities from 09:30-12:00 hrs. It aims to educate students on the water production process, tap water quality standards, water quality inspection in the canals, and water use with value awareness. There are 4 learning bases of environmental conservation activities, which are:

1. Saichol Ngam Na Mong Base (Beautiful River), which educates in the sources of river, the water cycle, the origin of Mae Khlong River Basin, as well as water conservation activity through matching games and trivia activities.

2. Scientific Experiment Base, which educates in scientific knowledge of 2 parameters:

- **Dissolved oxygen parameter:** a lecture of dissolved oxygen and demonstrations of its analysis, by demonstrating the laboratory analysis and field-based analysis methods. There is also a matching game of dissolved oxygen parameter to aquatic organisms.

- **Acidity-alkalinity parameter:** a lecture on acidity-alkalinity knowledge and demonstrations of the pH analysis from different samples with litmus paper, such as soft drinks, soap water, pure water, as well as matching game of acidity-alkalinity to each water sample.



3. Clean and Safe Water Base: which provides knowledge about types of water sources, both from natural sources such as surface water, sea water, rivers and canals, and human-made sources such as dam and reservoir. There was a game about categorizing water sources as well as providing knowledge on "electrical conductivity" which can be used as an indicator of water contamination, both from wastewater and seawater invasion. There were also demonstrations of using portable conductor in various water samples, such as water in Mae Khlong River, school tap water, and distilled water, to show the differences of conductivity level in each sample.

4. MWA Cares for Community Base: which provides knowledge in tools and equipment in waterworks system maintenance, thus the students would be able to be a junior plumber at their own house to help maintain their tap water in basic levels.



Project Results

Students who participated in the projects have gained knowledge of water quality measurement, which can be used to measure the water quality in their community, as well as learning about the value of water uses and awareness of river water conservation. The students also joined the network to help preserve and maintain river and canal, as well as public water sources. It also creates a good image of the MWA as the organization with social and environmental responsibility.

Grow Forward to Sustainability Together

Throughout the year 2017 and 2018, there were various social-responsible activities and projects that the MWA has organized as a part of delivering sustainability to society. Initially, every activity and project focus on the operational staffs and serviced areas, by applying knowledge and expertise of the organization to create prosperity and benefits to society and the environment. There are outstanding projects as follow:

Watershed Forest Conservation Project to honor King Rama 9

After consecutively conducting the Watershed Forest Conservation Project to honor King Rama 9 for 5 years from 2012 to 2016, in the year 2017, the Authority has integrally improved the project for sustainability for the first year, by having activities of tree planting, vetiver grass planting, and fruits planting in the upstream community areas, as well as developing the schools and communities in Ban Rin Luang, Muang Na Subdistrict, Chiang Dao District, Chiang Mai Province.

The group of volunteers, which consists of MWA employees and people in communities, local administrative organizations, and military officers, has planted new 544,000 trees and vetiver grasses, with a total of 715 Rai (1.14 square kilometers). The group also improved and developed new plumbing system for Ban Rin Luang School, as well as building a total of new 1,348 weirs to conserve and develop the water sources in many areas, both in Chao Phraya and Mae Klong River basins. As a result, there was an establishment of “Metropolitan Waterworks Authority Project on Watershed Forest Conservation by following the Royal Determination of His Majesty King Bhumibol Adulyadej”, which is the integrating sustainability project.

2017



The activity to improve the quality of life of students and the upstream community. The MWA has cooperated with the government sector and public sector network to renovate, repair, and extend the school and community plumbing systems in 4 locations in Nan province. There are more than **2,000** beneficiaries from this activity.



The activities of reforestation and weir construction. There are 15,000 trees newly planted in the area of 54 Rai (86,400 square meters, with 700 fruit seedlings given to the community. There are a total of **50** households in 5 communities received the benefits from the activities.

The activity to improve the quality of life of students and the upstream community, by renovating, repairing, and extending the school and community plumbing system, which are Ban Thung Klang, Moo 4, Ouan Subdistrict, Pua District, Nan Province, and Ban Yod Doi Wattana School, Bo Kluea District, Nan Province. There are **2,000** beneficiaries from this activity.

2018



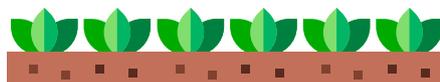
For the weir construction, which aims to conserve and improve water sources in various areas in Chao Phraya and Mae Klong River basins, there are **532** weirs newly built with a total of 6 times of operation.



The activities of reforestation and weir construction - 2nd year, at Santisuk District, Nan Province.

There were 166 participants planting **15,999** trees and **100,000** vetiver grasses on the area of 59 Rai (94,400 square meters).

The participants also joined with the MWA to build **406** weirs, with a total of 4 times of operation. The target goal was exceeding the expected amount to 199 weirs. There were **221** participants in this weir building activity.





MWA CSR DAY

MWA CSR Day is held annually as a platform and channel to communicate and publicize the operational performances of the organization, by taking into account on social and environmental responsibility in terms of employees, operational staffs, external agencies, and all stakeholders. The activity also aims to create better understanding and relationship between MWA and stakeholders.

In 2018, MWA CSR Day was organized under the concept of “Unite for the Sustainability” by taking the issue of Sustainable Development Goals (SDGs) to encourage all employees to be aware of global sustainable development trend, and able to operate in accordance with the goal of participation in important societal problems alleviating. There were presentations of CSR projects from the representatives of 9 divisions, which associated to sustainable development goals and main missions from each division, as well as taking into accounts on the needs and expectations of all stakeholders in 3 dimensions of economy, society, and environment.

MWA CSR DAY 2017

“Carry On the Father’s Creation”. There were **869** participants. The satisfactory level of participants was at **77.80** percent.

MWA CSR DAY 2018

“Unite for the Sustainability”. There were **1,044** participants. The satisfactory level of participants was at **83.26** percent.



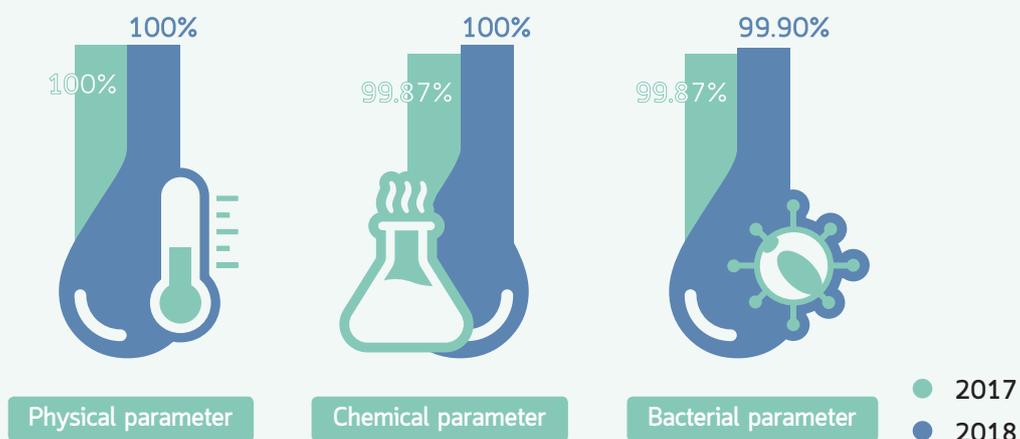
..... MWA Meets People Project

MWA Meets People Project is a project that allows the branch offices to create good relationships with minor water consumers in each service area of those branch offices. All of 18 offices have organized activities to listen to problems, opinions, and suggestions from water consumers to improve the products and services. There was also a provision of mobile waterworks service and community support in various forms, such as tap water education, mobile medical unit, and water quality inspection by a team of scientists.

As for the communities affected by pipeline installation or repairing, MWA also provided information and created a better understanding of water consumers in order to reduce the complaints and receive the problem requests. The visits from this project were made with a total of 72 times per year.

..... The Overview of Water Production in 4 Water Production Plants

Metropolitan Waterworks Authority has adopted various standard systems to be suited in the production process, such as HACCP system, ISO 9901, ISO14001, as well as Water Safety Plan, which focuses on the assessment and risk management on entire waterworks processes. It is to ensure that the water is a safety at all times until reaching the consumers. Additionally, there was a checking of water quality for the entire system, from raw water to tap water, including in physical parameter, chemical parameter, and bacterial parameter. The results of water quality inspection have passed the quality standards, which was set by following the guideline of the World Health Organization. In the fiscal year 2017 and 2018, it can be concluded that there was no event from MWA products and services that affect health and safety, as the details below:





Pride of MWA

One of the pride of the MWA is to receive the prestigious award as it is a confirmation of high-standard of operations. It is also proof of potential in services with genuine quality and innovation.

Year 2018

- 1 Commemorative Plate Awarded in the Outstanding Executive of the Year 2018, in the category: Waterworks Innovation for People - Best Practice Award, given to Mr. Parinya Yamasamit, the Governor of Metropolitan Waterworks Authority.
- 2 Golden Award in Thailand Kaizen Award 2018 Competition, given to the project of “ADD[...]SPACE” the water meter maintenance equipment.



Year 2017

- 1 Asia Pacific Entrepreneurship Award 2017 (APEA 2017) in State Owned Enterprise.
- 2 Outstanding State Enterprise Award in Outstanding Social and Environmental Responsibility Operation, from the School Plumbing Project “From Rin Luang to Mae Klong”.
- 3 Organizational Level Consolation Prize on Outstanding State Enterprise Award in Outstanding Innovation, from the project exploration robot “Krai Thong”
- 4 Excellent State Enterprise Award in Integrity and Transparency Index of 2017, as the details follow:
 - Outstanding Prize in Corruption-Free Operation from Metropolitan Waterworks Authority Corporate Governance Committee Establishment
 - Consolation Prize in Integrity Culture from the Project “Dare to Do Good Deeds”
 - Master Prize in Good Governance Promotion Involvement and Corruption Prevention, given to Mr. Parinya Yamisamit, the Governor of MWA
- 5 Best Practice Awards 2017 in Good Management, given to Mr. Parinya Yamisamit, the Governor of MWA
- 6 Consolation Prize on the 7th NACC Integrity Awards 2017
- 7 International Innovation Awards: IIA 2017, First Prize in Services & Solutions from the project “Leakage Yard on Cyber”

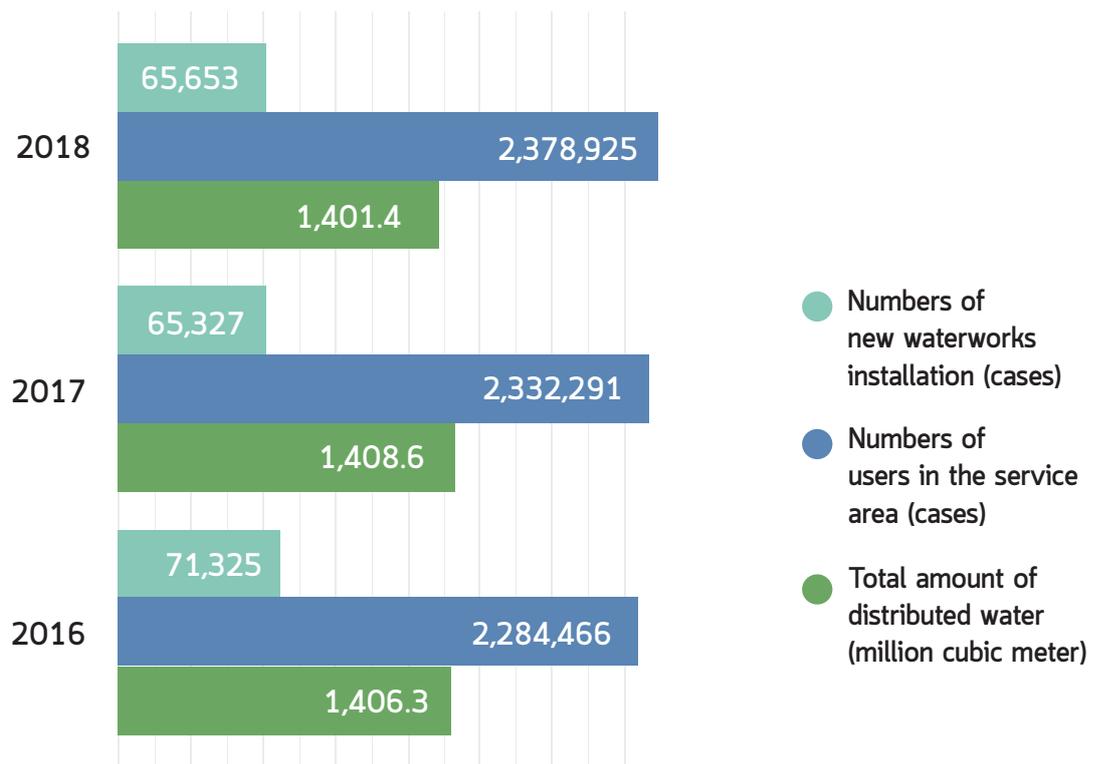


Appendix

Water Quality

Water Quality	2016	2017	2018
Escherichia coli (cfu/100 ml)	0	0	3
Target	0	0	0
Turbidity / NTU	0.4	0.5	0.41
Target	0.5	0.5	0.5
pH Value / units	7.33	7.24	7.21
Target	7.0 - 8.0	7.0 - 8.0	7.0 - 8.0
Residual Free Chlorine (mg/L) (data collection started in 2016)	n/a	0.47	0.5
Target	>0.2	>0.2	>0.2
Water quality in physical parameter (percent)	99.94	100	100
WHO recommendation (percent)	95	95	99
Target (percent)	99.78	99.94	100
Water quality in chemical parameter (percent)	100	99.87	100
WHO recommendation (percent)	95	95	99
Target (percent)	99.81	100	100
Water quality in chemical parameter (percent)	99.72	99.87	99.90
WHO recommendation (percent)	95	95	99
Target (percent)	99.63	99.74	99.87
Water pressure (meter)	8.802	10.028	8.814
Target (meter)	9.25	10	9.5
Plan & Unplanned Pumping Pauses (times)	90	73	60
Unplanned pumping pauses (times)	30	30	30
Unplanned Target (times)	30	30	30

Market Aspect Results



Consumers Satisfaction Score (Out of 5)

Overall satisfaction

2016	4.497
2017	4.517
2018	4.524

Water quality

2016	4.257
2017	4.279
2018	4.248

News/Information

2016	4.281
2017	4.23
2018	4.328

Communication channels

2016	4.275
2017	4.142
2018	4.184

Payment channels

2016	n/a
2017	4.370
2018	4.420

Branch office services

2016	4.739
2017	4.784
2018	4.764

New tap water installation

2016	4.607
2017	4.608
2018	4.598

Pipe placement and repairs

2016	4.220
2017	4.227
2018	4.206

Requests management

2016	4.332
2017	4.356
2018	4.380

Consumers Aspect Results

Consumers Engagement Score (Out of 5)

Overall engagement

2016	4.258
2017	4.301
2018	4.586

Brand image

2016	4.451
2017	4.574
2018	4.564

Amount of Water Production and Distribution

Data and Statistics

General Information	Fiscal Year	
	2014	2015
Total distributed water (million cubic meter)	1,797.8	1,835.1
Bang Khen Water Plant	1,163.4	1,152.9
Samsen Water Plant	124.5	137.9
Thonburi Water Plant	30.0	33.7
Maha Sawat Water Plant	479.9	510.6
Total water sold (million cubic meter)	1,377.2	1,406.3
Residences	646.9	657.8
Business, enterprise, government, etc.	703.6	724.8
Public water and etc.	26.7	23.7
Percent sold	76.61	76.63
Numbers of water consumers (user)	2,171,371	2,226,707
Residences	1,733,655	1,784,541
Business, enterprise, government, etc.	437,716	442,166
Minor water consumers (user)	2,136,214	2,190,943
½ inch water meter	1,338,653	1,367,682
¾ inch water meter	733,475	757,753
1 inch water meter	64,086	65,508
Major water consumers (user)	35,157	35,764
1 ½ inch water meter	14,156	14,502
2 inches water meter	13,796	13,919
2 inches water meter above	7,205	7,343
New tap water installation (case)	75,570	72,865
Average water consumption (cubic meter)	52.49	52.34
Residences	31.54	31.13
Business, enterprise, government, etc.	134.84	137.23
Average monthly water expense (baht)	12.00	12.02
Residences	10.01	10.01
Business, enterprise, government, etc.	13.83	13.84
Total employees (person)	5,347	5,339
End-year employees	4,185	4,246
Operational staffs	1,162	1,093
Ratio of water consumers per 1 employee	406	417
Total population in service areas (people)	8,127,684	8,156,851
Total household in service areas (house)	3,868,216	3,958,491

Fiscal Year		
2016	2017	2018
1,965.9	2,063.8	1,997.1
1,290.9	1,404.5	1,334.4
129.7	120.7	116.4
30.9	40.5	37.4
514.4	498.1	508.9
1,406.3	1,408.6	1,401.4
653.8	656.8	651.5
723.7	723.4	719.6
28.8	28.4	30.3
71.53	68.25	70.17
2,281,058	2,328,598	2,375,490
1,835,430	1,878,888	1,921,897
445,628	449,710	453,593
2,244,815	2,292,106	2,338,779
1,394,915	1,421,764	1,459,347
783,235	802,913	811,431
66,665	67,429	68,001
36,243	36,492	36,711
14,804	15,058	15,610
14,015	13,972	13,672
7,424	7,462	7,429
71,325	65,327	65,653
50.88	49.85	48.55
30.08	29.44	28.56
135.57	134.54	132.56
12.02	12.01	11.98
10.03	10.03	9.99
13.83	13.82	13.79
5,386	5,403	5,365
4,326	4,385	4,310
1,060	1,018	1,055
424	431	443
8,192,123	8,222,916	TBA 31 Dec 2018
4,099,437	4,210,444	TBA 31 Dec 2018

Amount of electricity consumption and carbon-dioxide emission in water production and pumping process in the fiscal year of 2017.

System	Location	Items	Unit	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Total in fiscal year 2018	
Raw water system	Samlae	Electricity consumption	kWh	458,487	804,996	1,046,845	1,095,673	1,059,458	1,146,486	1,104,466	1,072,428	977,952	889,223	757,536	701,194	11,114,744	
		CO2 emission amount	kg CO2	279,356	490,484	637,843	667,594	645,528	698,554	672,951	653,430	595,866	541,804	461,567	427,238	6,772,214	
	Bangsue	Electricity consumption	kWh	450,000	441,003	432,000	667,013	632,053	707,000	675,003	711,022	685,001	703,002	682,003	553,000	7,338,100	
		CO2 emission amount	kg CO2	274,185	268,703	263,218	406,411	385,110	430,775	411,279	433,226	417,371	428,339	415,544	336,943	4,471,104	
Water production system	Bangkhen	Electricity consumption	kWh	15,637,784	15,552,793	15,920,177	16,706,619	15,944,758	18,250,883	17,143,981	18,599,366	17,046,431	17,409,082	18,614,574	17,663,621	204,490,069	
		CO2 emission amount	kg CO2	9,528,102	9,476,317	9,700,164	10,179,343	9,715,141	11,120,263	10,445,828	11,332,594	10,386,390	10,607,354	11,341,860	10,762,444	124,595,799	
	Maha Sawat	Electricity consumption	kWh	6,872,000	5,961,000	6,337,000	6,453,000	6,034,000	6,988,000	6,586,000	7,054,000	6,604,000	6,819,000	7,098,000	6,808,000	79,614,000	
		CO2 emission amount	kg CO2	4,187,110	3,632,037	3,861,134	3,931,813	3,676,516	4,257,788	4,012,850	4,298,002	4,023,817	4,154,817	4,324,811	4,148,114	48,508,810	
	Samsen	Electricity consumption	kWh	2,149,382	2,072,134	2,044,161	2,059,170	1,998,102	2,185,965	2,053,122	2,172,287	2,092,119	2,097,518	2,117,067	2,056,000	25,097,027	
		CO2 emission amount	kg CO2	1,309,618	1,262,551	1,245,507	1,254,652	1,217,444	1,331,908	1,250,967	1,323,574	1,274,728	1,278,018	1,289,929	1,252,721	15,291,619	
	Thonburi	Electricity consumption	kWh	338,000	331,000	350,000	448,000	419,000	458,000	442,000	490,000	473,000	495,000	461,000	408,000	5,113,000	
		CO2 emission amount	kg CO2	205,943	201,678	213,255	272,966	255,297	279,059	269,311	296,557	288,199	301,604	280,887	248,594	3,115,351	
	Khlong Toei	Electricity consumption	kWh	266,047	344,001	409,044	419,060	443,000	450,080	384,001	411,000	404,000	404,000	386,000	344,001	369,000	4,629,234
		CO2 emission amount	kg CO2	162,102	209,600	249,231	255,333	269,920	274,234	233,972	250,422	246,157	235,190	209,600	224,832	2,820,592	
	Samrong	Electricity consumption	kWh	1,022,000	932,000	956,000	1,008,000	950,000	1,107,000	1,123,041	1,313,000	1,266,000	1,231,000	1,223,000	1,293,000	13,424,041	
		CO2 emission amount	kg CO2	622,705	567,868	582,491	614,174	578,835	674,495	684,269	800,011	771,374	750,048	745,174	787,825	8,179,268	
Lad Krabang	Electricity consumption	kWh	503,000	433,000	489,000	609,000	625,000	736,000	686,000	770,000	729,000	731,000	713,000	683,000	7,707,000		
	CO2 emission amount	kg CO2	306,478	263,827	297,948	371,064	380,813	448,445	417,980	469,161	444,180	445,398	434,431	416,152	4,695,875		
Minburi	Electricity consumption	kWh	691,000	676,001	682,145	761,000	723,134	803,000	750,000	768,000	731,000	731,000	759,007	754,000	795,175	8,893,462	
	CO2 emission amount	kg CO2	421,026	411,887	415,631	463,677	440,606	489,268	456,975	467,942	445,398	462,463	459,412	484,500	5,418,786		
Bang Phli	Electricity consumption	kWh	794,009	722,093	750,001	830,067	859,000	996,000	824,000	871,000	870,000	870,000	851,000	885,000	790,000	10,042,170	
	CO2 emission amount	kg CO2	483,790	439,971	456,976	505,760	523,389	606,863	502,063	530,700	530,091	518,514	539,231	481,347	6,118,694		
Lat Phrao	Electricity consumption	kWh	631,000	612,000	555,000	597,000	535,000	686,000	673,000	724,000	718,000	737,000	734,000	706,000	7,908,000		
	CO2 emission amount	kg CO2	384,468	372,892	338,162	363,752	325,976	417,980	410,059	441,133	437,477	449,054	447,226	430,166	4,818,344		
Lumphini	Electricity consumption	kWh	561,000	551,059	560,000	701,000	681,000	786,042	722,000	793,000	765,000	826,000	830,000	784,000	8,560,101		
	CO2 emission amount	kg CO2	341,817	335,760	341,208	427,119	414,933	478,935	439,915	483,175	466,115	503,282	505,719	477,691	5,215,670		
Petch Kasem	Electricity consumption	kWh	1,021,005	1,004,037	1,040,041	1,178,036	1,300,043	1,372,083	1,190,034	1,369,054	1,432,045	1,470,027	1,365,086	1,338,082	15,079,573		
	CO2 emission amount	kg CO2	622,098	611,760	633,697	717,777	792,116	836,010	725,088	834,165	872,545	895,687	831,747	815,293	9,187,984		
Tha Phra	Electricity consumption	kWh	485,590	458,148	454,153	524,204	531,651	684,618	558,456	577,177	525,196	453,141	481,208	466,255	6,199,797		
	CO2 emission amount	kg CO2	295,870	279,150	276,715	319,397	323,935	417,138	340,267	351,674	320,002	276,099	293,200	284,089	3,777,536		
Rat Burana	Electricity consumption	kWh	1,050,018	964,000	1,054,000	1,134,000	1,122,000	1,256,000	1,150,000	1,235,011	1,205,000	1,214,000	1,224,008	1,197,046	13,805,083		
	CO2 emission amount	kg CO2	639,776	587,365	642,202	690,946	683,635	765,281	700,695	752,492	734,207	739,690	745,788	729,360	8,411,437		

1. Electricity consumption unit is referred from the details of electricity rate in each division from October 2016-March 2017 (Purchasing and Other Payables Division, Finance Department)
 2. Consider from the relevant agencies in main water production and distribution process. Not including support divisions.

Amount of electricity consumption and carbon-dioxide emission in water production and pumping process in the fiscal year of 2018.

System	Location	Items	Unit	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Total in fiscal year 2018	
Raw water system	Samlae	Electricity consumption	kWh	242,073	418,825	1,016,558	1,081,289	952,591	1,043,893	988,231	1,050,328	1,067,959	1,037,047	995,118	926,748	10,820,660	
		CO2 emission amount	kg CO2	147,495	255,190	619,389	658,829	580,414	636,044	602,129	639,965	639,965	650,707	631,873	606,325	564,668	6,593,028
	Bangsue	Electricity consumption	kWh	518,392	404,347	414,363	394,362	386,327	423,337	406,397	421,438	418,391	418,391	623,452	724,413	693,422	5,828,641
		CO2 emission amount	kg CO2	315,856	246,369	252,471	240,285	235,389	257,939	247,618	256,782	254,926	254,926	379,869	441,385	422,502	3,551,391
Water production system	Bangkhen	Electricity consumption	kWh	15,906,555	15,871,809	15,774,228	15,560,988	14,567,699	16,516,105	15,595,393	16,769,597	16,458,421	16,345,910	17,235,762	17,016,596	193,619,063	
		CO2 emission amount	kg CO2	9,691,864	9,670,693	9,611,237	9,481,310	8,876,099	10,063,263	9,502,273	10,217,715	10,028,116	9,959,563	10,501,750	10,368,212	11,797,095	
	Maha Sawat	Electricity consumption	kWh	6,178,000	5,557,000	5,863,000	6,192,000	5,881,000	6,576,000	5,901,000	6,073,000	5,732,000	5,763,000	5,948,000	5,703,000	71,367,000	
		CO2 emission amount	kg CO2	3,764,255	3,385,880	3,572,326	3,772,786	3,583,293	4,006,757	3,595,479	3,700,279	3,492,508	3,511,396	3,624,116	3,474,838	43,483,913	
	Samsen	Electricity consumption	kWh	2,024,002	1,972,000	2,017,000	1,947,003	1,833,088	2,027,000	1,943,019	1,980,095	1,886,066	1,961,367	1,800,111	1,817,060	23,207,811	
		CO2 emission amount	kg CO2	1,233,224	1,201,540	1,228,958	1,186,309	1,116,901	1,235,051	1,183,881	1,206,472	1,149,180	1,195,061	1,096,808	1,107,135	14,140,519	
	Thonburi	Electricity consumption	kWh	436,000	361,000	353,000	330,000	323,000	363,000	352,000	365,000	337,000	337,000	415,000	454,000	439,000	4,528,000
		CO2 emission amount	kg CO2	265,655	219,957	215,083	201,069	196,804	221,176	214,474	222,395	205,334	205,334	252,860	276,622	267,483	2,758,910
	Khlong Toei	Electricity consumption	kWh	217,001	251,000	270,087	230,000	372,053	436,116	316,111	361,030	338,001	338,001	341,048	298,086	259,001	3,689,534
		CO2 emission amount	kg CO2	132,219	152,934	164,564	140,139	226,692	265,725	192,606	219,976	205,944	205,944	207,801	181,624	157,809	2,248,033
	Samrong	Electricity consumption	kWh	1,007,010	1,057,000	1,026,000	1,025,000	911,066	1,046,000	957,000	1,019,000	978,000	978,000	1,002,000	1,085,000	980,000	12,093,076
		CO2 emission amount	kg CO2	613,571	644,030	625,142	624,533	555,113	637,328	583,100	620,877	595,895	595,895	610,519	661,091	597,114	7,368,311
Lad Krabang	Electricity consumption	kWh	581,000	522,009	516,000	536,000	478,000	421,136	588,000	623,000	539,000	539,000	520,000	737,088	546,108	6,607,341	
	CO2 emission amount	kg CO2	354,003	318,060	314,399	326,585	291,245	256,598	358,268	379,594	328,413	328,413	316,836	449,108	332,744	4,025,853	
Minburi	Electricity consumption	kWh	562,002	498,000	472,000	493,002	451,000	600,279	667,000	716,000	586,089	586,089	580,103	657,000	645,000	6,927,475	
	CO2 emission amount	kg CO2	342,428	303,431	287,590	300,386	274,794	365,750	406,403	436,259	357,104	357,104	353,457	400,310	392,999	4,220,911	
Bang Phli	Electricity consumption	kWh	660,000	698,000	639,000	644,000	555,000	615,108	562,000	636,000	596,035	596,035	606,000	623,000	650,000	7,484,143	
	CO2 emission amount	kg CO2	402,138	425,291	389,343	392,389	338,162	374,785	342,427	387,515	363,164	363,164	369,236	379,594	396,045	4,560,088	
Lat Phrao	Electricity consumption	kWh	688,000	655,000	663,000	662,000	641,000	716,000	691,000	717,000	645,000	645,000	639,000	601,000	538,000	7,856,000	
	CO2 emission amount	kg CO2	419,198	399,092	403,966	403,357	390,561	436,259	421,026	436,868	392,999	392,999	389,343	366,189	327,803	4,786,661	
Lumphini	Electricity consumption	kWh	621,349	584,289	618,277	714,429	570,428	657,565	616,425	667,363	658,327	658,327	660,326	737,335	721,657	7,827,770	
	CO2 emission amount	kg CO2	378,588	356,007	376,716	435,302	347,562	400,654	375,588	406,624	401,119	401,119	402,337	449,258	439,706	4,769,460	
Petch Kasem	Electricity consumption	kWh	1,277,031	1,182,168	1,159,062	1,200,145	1,057,114	130	2,115,422	913,057	878,029	878,029	864,023	924,058	970,034	12,540,273	
	CO2 emission amount	kg CO2	778,095	720,295	706,216	731,248	644,100	79	1,286,927	556,326	534,983	534,983	526,449	563,029	591,042	7,640,788	
Tha Phra	Electricity consumption	kWh	378,532	374,301	422,259	407,321	376,237	450,395	422,155	415,042	466,153	466,153	421,228	400,258	393,000	4,926,881	
	CO2 emission amount	kg CO2	230,640	228,062	257,282	248,181	229,241	274,426	257,219	252,885	284,027	284,027	256,654	243,877	239,455	3,001,949	
Rat Burana	Electricity consumption	kWh	977,151	945,000	901,000	1,018,009	992,144	1,121,107	1,033,110	1,122,026	1,071,029	1,071,029	992,000	1,108,000	1,168,195	12,448,771	
	CO2 emission amount	kg CO2	595,378	575,789	548,979	620,273	604,513	683,090	629,474	683,650	652,578	652,578	604,426	675,104	711,781	7,585,036	

1. Electricity consumption unit is referred from the details of electricity rate in each division from October 2017-September 2018 (Purchasing and Other Payables Division, Finance Department)

2. Consider from the relevant agencies in main water production and distribution process. Not including support divisions.

3. Emission factor is referred from Thailand Greenhouse Gas Management Organization (Public Organization).

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Satisfaction Survey of
MWA Sustainability Report 2017-2018





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