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# THE WATERLINKS ALLIANCE FINAL REPORT



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# THE WATERLINKS ALLIANCE FINAL REPORT

**Submitted to:**

USAID Regional Development Mission for Asia

**Prepared by:**

AECOM International Development

AECOM Principal Contact:

Kelly Ryan  
AECOM Program Manager  
Kelly.Ryan@aecom.com

In Thailand:

Rose Lang, Chief of Party  
WaterLinks Alliance  
rlang@waterlinks.org

The authors' views expressed in this document do not necessarily reflect the views of the United States Agency for International Development or the United States Government.

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Finally, we offer our heartfelt gratitude to all the partners, volunteers, staff and beneficiaries identified in this report for their tireless efforts and contributions. Each individual effort and each single act have come together to constitute a formidable and sustainable impact on the lives of men, women and children living in Southeast Asia.



# ACRONYMS

ADB	Asian Development Bank
BOT	Board of Trustees
CSR	Corporate Social Responsibility
DMA	District Metered Area
D.O.	Dissolved Oxygen
GDA	Global Development Alliance
GIS	Geographic Information Systems
GWOPA	Global Water Operators Partnerships Alliance (UN-Habitat)
IWA	International Water Association
IWK	Indah Water Konsortium
KOICA	Korea International Cooperation Agency
K-water	Water Resources Corporation (South Korea)
LAWACO	Lam Dong Water Supply and Sewerage Company (Vietnam)
MDG	Millennium Development Goals
MOU	Memorandum of Understanding
NGO	Nongovernmental Organization
NRW	Non-revenue Water
NTU	Nephelometric Turbidity Unit
PAWD	Philippines Association for Water Districts
PBAPP	Perbadanan Bekalan Air Pulau Pinang Sdn Bhd
PDAM	Perusahaan Daerah Air Minum
PERPAMPSI	Indonesia Water Supply Association
PPCWD	Puerto Princesa City Water District
PWA	Provincial Waterworks Authority (Thailand)
ORP	Oxidation-Reduction Potential
RDMA	Regional Development Mission for Asia (USAID)
SOP	Standard Operating Procedures
SVI	Sludge Volume Index
UN	United Nations
USAID	United States Agency for International Development
WHO	World Health Organization
WOP	Water Operator Partnership
WSP	Water Safety Plans
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

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# EXECUTIVE SUMMARY

The WaterLinks Alliance, a USAID Global Development Alliance (GDA) between AECOM and WaterLinks, improved the lives of hundreds of thousands of individuals in Indonesia, the Philippines, Thailand and Vietnam. Building on an innovative twinning partnership model developed by AECOM, the WaterLinks Alliance facilitated five Water Operator Partnerships, or WOPs, between water operators in these four countries and counterparts in Malaysia, Australia, and South Korea to improve access to safe water and replicate best practices through regional and bilateral activities.

The two-year GDA focused primarily on WOPs which entailed partnership development, implementation, and replication. In Year 1, the Alliance focused on steps 1-3, enabling WaterLinks to connect with new partners, deepen facilitation capabilities and establish the WOPs. AECOM led initial efforts with WaterLinks support in Indonesia, Thailand and Vietnam to familiarize new WaterLinks staff with the facilitation process and WOP partners. WaterLinks then led implementation of steps 1-3 for the remaining WOPs in Indonesia and Philippines with AECOM support.

In Year 2, the Alliance efforts targeted implementation and replication of good practices and essential management and coordination of WOPs. AECOM continued to transfer core facilitation capabilities to WaterLinks through joint implementation of the five WOPs. WaterLinks took greater responsibility to manage and work with the WOP partners to carry out WOP activities while AECOM helped coordinate. AECOM and WaterLinks worked together to ensure each WOP met its objectives to improve access to water services and build resilience against climate change impacts.

All the while, during typhoons and political coups, the WaterLinks Alliance worked through challenges to develop the institutional capacity of WaterLinks and shared best practices at regional and international forums. In all, the WaterLinks Alliance improved access to cleaner drinking water supply to 482,572 people across target areas in Thailand, Indonesia, and the Philippines. In addition, WaterLinks was able to support improved access to sanitation facilities for 27,700 people in targeted areas. This report marks the final report of the two year project and incorporates the projects successes, challenges and key activities.

# CONTEXT

In Asia and the Pacific, widespread migration to urban centers is placing tremendous stress on urban water and sanitation services. Across Asian cities, 340 million people lack access to safe water supply and more than 680 million do not have sustainable sanitation services, leading to increased risks of waterborne illnesses and lost economic productivity. While decision-makers in the Asia-Pacific region achieved and are continuing to improve upon the U.N. Millennium Development Goals (MDG) to halve the proportion of people without sustainable access to safe drinking water and basic sanitation by 2015, many water services providers in the region continue to face challenges related to outdated infrastructure, inadequate skills development and limited investment.

Intensifying extreme weather events linked to climate change, such as the 2010 drought in Vietnam, the 2011 floods in Cambodia, and the 2013-14 typhoons in the Philippines, are further disrupting the adequate provision of urban water services, impacting lives and livelihoods as well as water resources. Water services providers, therefore, are rethinking their own planning processes and current operations to reduce their vulnerabilities and risks by considering climate change-related factors like water scarcity,

degraded raw water quality, heavy flooding and sea water intrusion. In its 2013-2018 Global Water and Development Strategy, USAID outlines approaches for addressing global challenges in water services and climate resilience by emphasizing innovative applications that combine science and technology, private sector participation, partnerships and greater involvement of local organizations.

Since 2008, the USAID Regional Development Mission for Asia (RDMA) has developed partnerships that bring together the application of innovative technologies and systems to improve access to urban water services and build climate resilience. Through its Environmental Cooperation – Asia (ECO-Asia) project implemented by AECOM from 2006-2012, USAID joined hands with the Asian Development Bank (ADB) and the International Water Association (IWA) in 2008 to establish WaterLinks. WaterLinks, a non-profit organization, is a regional network aimed at promoting and facilitating twinning or WOPs among urban services providers to increase or expand delivery of safe water and sustainable sanitation (see [www.waterlinks.org](http://www.waterlinks.org)).

## WATERLINKS

With USAID support through the ECO-Asia project, AECOM initially functioned as the WaterLinks secretariat from 2007 to 2011 by implementing WOPs and leading outreach and knowledge management. In 2011, AECOM helped establish WaterLinks as an independent, non-profit organization in the Philippines to take over secretariat functions. In the process, WaterLinks developed its organizational structure, business plan, and key outreach products such as a website and knowledge products, including the WaterLinks Twinning Partnership Facilitation Guidelines. Facilitation of WOPs, which includes WOP development, implementation, and replication, remains core business of WaterLinks.



## WATERLINKS ALLIANCE

Under a GDA, USAID, in coordination with AECOM and WaterLinks, established the WaterLinks Alliance project under Cooperative Agreement No. AID-486-A-13-00002. Operating from 2013 to 2015, the WaterLinks Alliance aimed to further strengthen the capability and sustainability of WaterLinks to implement twinning partnerships and regional capacity building initiatives in Asia and the Pacific by achieving two development objectives:

1. Improve access to urban water supply and sanitation services of at least 220,000 people as a result of enhanced operational efficiencies of water services providers in support of the Paul Simon Water for the Poor Act; and,
2. Increase the adaptive capacity and resilience of water services providers to address potential climate change impacts in support of the USAID Global Climate Change Strategy.

Through twinning partnerships, international and regional forums, and capacity building, WaterLinks Alliance developed the capacity of water service providers in Indonesia, Philippines, Thailand and Vietnam. This report details Alliance successes and challenges, as well as the methodologies used to impact the lives of over 482,572 people in Southeast Asia.

## GLOBAL DEVELOPMENT ALLIANCES (GDAs)

are USAID's model for public-private partnerships, helping to improve the social and economic conditions in developing countries and deepen USAID's development impact. GDAs leverage market-based solutions to advance broader development objectives. GDAs are co-designed, co-funded, and co-managed by all partners involved, so that the risks, responsibilities, and rewards of partnership are shared.

For more details, see: <http://www.usaid.gov/gda>

# OVERALL ACHIEVEMENTS AND MILESTONES

## WATER AND WASTEWATER SERVICES

- ✓ Aided 482,572 people through improved access to drinking water supply across target areas in Thailand (338,776), Indonesia (15,796), and the Philippines (128,000).
- ✓ Improved access to sanitation facilities for 27,700 people in targeted areas.
- ✓ Decreased water losses by up to 30% in Indonesia saving over 40,000 cubic meters of water.
- ✓ Increased ammonia removal efficiency by 20% to improve wastewater treatment for 6,700 customers in Vietnam.
- ✓ LAWACO more frequently removes sludge at a rate of 250m<sup>3</sup>/h for recirculation volume, every 15 minutes for 30 seconds.
- ✓ Decreased the risk of waterborne diseases for over 60,000 people in PPCWD by lowering the turbidity rate of the Campo Uno WTP.
- ✓ Decreased manganese levels by 80% in Udon Thani for safer drinking water.

## LEVERAGING THE PRIVATE AND PUBLIC SECTORS

- ✓ Leveraged **US\$1.7 million** in contributions from the public and private sector.
- ✓ Private sector firm, Borouge, supported provision of 2.8 km of new main pipes and 300 meters of service connections and associated fittings for the Serangan area pilot.
- ✓ Identified funding sources and prepared applications to the local government, the Development Bank of the Philippines and Bank of the Philippine Islands for PPCWD to support a USD 22 million project.
- ✓ PWA installed a permanent polymer dosing unit benefitting approximately 96,180 people in Chiang Rai.

## SUSTAINABILITY THROUGH INSTITUTIONAL CAPACITY BUILDING

- ✓ Mentored PERPAMSI to effectively manage its own WOP program.
- ✓ Introduced proven systems and processes to smaller water companies who encountered similar water loss challenges through PBAPP.
- ✓ WaterLinks Forum 2014, a global forum, was attended by 219 participants from 23 countries.
- ✓ Managed two grants to WaterLinks totaling approximately USD 433,000.
- ✓ Supported WaterLinks to engage with other potential funders and clients resulting in 17 submitted proposals to public and private development partners that included Coca Cola Foundation, Nestle Foundation, IBM, Borouge Inc., UN-Habitat GWOPA, and the World Bank.





# METHODOLOGY

Over the two-year implementation period, AECOM worked with WaterLinks to transfer technical know-how on WOP facilitation and replication of good practices. AECOM also expanded the networks of WaterLinks with strategic partners in the Asia-Pacific region that included various water services providers, multilateral and bilateral development agencies, industry associations, and private sector firms.

The Alliance activities aimed to enhance WaterLinks core capabilities while advancing the achievement of MDGs by improving access to urban and sanitation services, and building the climate resilience of water services providers. AECOM and WaterLinks jointly prepared and undertook:

- (1) at least five WOPs that focus on building the capacity of urban water services providers and improving their operational efficiency in such areas as water loss management and continuous supply, water quality

management, sustainable sanitation services, and climate change adaptation;

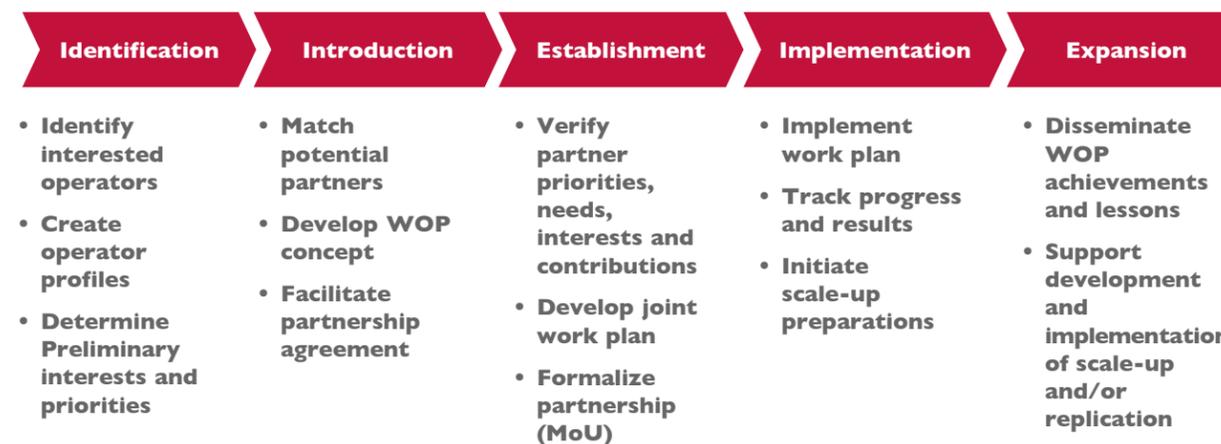
- (2) Replication of good practices in urban water services delivery and WOPs through the regional training/forum events, development of knowledge products, and website management; and,
- (3) WaterLinks institutional strengthening by enabling technical and financial sustainability through support for staffing, operations and outreach at global/regional/national events.

Central to these activities, AECOM and WaterLinks focused on a cross-cutting principle of no regrets. No regrets refers to actions that facilitate operational efficiency improvements and support sustainability of water services delivery regardless of whatever changes in circumstances and increases in risks that climate change might bring. This philosophy was intertwined at every level and

aspect of the WaterLinks Alliance to promote the climate resilience of the water operators. In some cases, the Alliance addressed water loss to increase the amount of water supply available for distribution during drought and raise revenue to allow for expansion of the network. Elsewhere, it meant reviewing and understanding how to improve water quality with increased contamination levels occurring during intense precipitation or prolonged drought.

Through these activities and cross-cutting principles, the Alliance demonstrated best practices and achieved on-the-ground impacts, promoting replication and dissemination of results through WaterLinks partners. Additionally, the WaterLinks Alliance implemented AECOM's best practices in twinning to guide the WOPs and ensure that both the mentor and mentee organizations benefitted as much as possible from the two year program. Details about the process can be found on the following page.

FIGURE 1. Twinning Partnership Process



## TWINNING PARTNERSHIPS: HOW THEY WORK TO EXPAND ACCESS TO WATER SERVICES

**Relying on the spirit of good will and mutual benefits, twinning partnerships enable the exchange of good practices, information and replication of practical innovations to build capacity in expanding access and strengthening operational efficiencies of water services providers. The WaterLinks Alliance created partnerships based on shared goals to achieve specific services improvements and build capacity, leverage resources, and share and implement best practices.**

### Key features of partnerships included:

- **facilitation of peer-to-peer exchange of proven know-how to manage water services and increase resilience to climate change;**
- **demonstration of innovative and applied technologies to improve operations and maintenance of systems; and,**
- **regional training events that promote knowledge sharing among practitioners.**

**Robust and well-coordinated facilitation yielded tangible results in terms of increased capacity and operational efficiencies, and led to improved and/or expanded access to urban water services. Both partners shared information to address service delivery challenges, and at the same time build their own capabilities. Recipient partners gain practical know-how and access to technology, while mentor partners broadened their experience and visibility.**

## ALLIANCE PARTNERS

Another fundamental aspect to implementing the WaterLinks Alliance successfully included recognizing the vast number of stakeholders in the region and globally and incorporating them into the Alliance activities. By tapping into these stakeholders, the Alliance facilitated greater dialogue and promoted a sense of ownership, encouraging the likelihood that the project's goals and objectives will continue on long after the project ended. Key Alliance partners include USAID as the main funding agency and development partner; AECOM and WaterLinks as primary project implementers; other development organizations; water services providers; and the private sector including water supply technology firms. These stakeholders are summarized in **Figures 2,3 and 4**, while their roles are discussed in more detail in **Table 1**.

As a part of the Alliance, AECOM and WaterLinks also set out to identify and leverage financial and in-kind donations to support the project's goals and objectives. In all, more than US\$1.7 million was successfully leveraged from these private and public sector partners.

## IMPLEMENTING PARTNERS

As the principal implementing partner of the Alliance, AECOM led and managed all Alliance activities, including financial management, program reporting and coordination with all partners. WaterLinks jointly implemented activities with AECOM, including facilitating WOPs; organizing regional activities; developing toolkits and knowledge products; and replicating good practices through knowledge management, publications, and participation in targeted global, regional and national events.

AECOM and WaterLinks engaged the various Alliance partners to identify and expand areas for cooperation.

## WOPS

To initiate the WOPs, AECOM and WaterLinks targeted services provider partners in Indonesia, Philippines, Thailand and Vietnam in coordination through USAID Missions, PERPAMSI, and the Philippines Association for Water Districts (PAWD). These organizations participated in previous WaterLinks regional training workshops and demonstrated an interest to connect with other, more advanced peers in the region to improve operational efficiencies. AECOM and WaterLinks approached mentor partners in Malaysia, South Korea and Australia that had remained engaged in past WaterLinks efforts

and who had expressed continued willingness to demonstrate their best practices with and build the capacity of peer practitioners. All WOP partners agreed to contribute in-kind and at-cost resources, which represented prerequisites for WOP participation under WaterLinks.

## DEVELOPMENT PARTNERS

Principal development agencies in the Alliance were founding partners of WaterLinks and champions of WOPs. USAID provided principal and strategic funding for the Alliance to strengthen WaterLinks by implementing WOP and replication activities. ADB, also undertaking its own WOP activities, supported selected regional training events in

the Alliance and also jointly funded a partnership between Australian and Thai services providers. GWOPA, global coordinator of WOPs, supported targeted events that promoted WOPs and regional events, and developed linkages between WaterLinks and other similar organizations. Having modeled a domestic WOP program in Indonesia with WaterLinks, PERPAMSI contributed assistance to promote replication of good practices through national workshops. By partnering with AECOM and WaterLinks, PERPAMSI also gained insights and practical experiences to strengthen its WOP program.

## PRIVATE SECTOR PARTNERS

Private sector partners that supported the Alliance included water technology firms such as Borouge and water services providers such as Ranhill. They offered direct funding for such materials as water pipes and laboratory equipment, and provided in-kind support through their staff expertise to train and demonstrate model actions to improve delivery of services.

The following sections summarize the three key activities in the Alliance: Twinning Partnerships (WOPs), Replication and Institutional Strengthening.

FIGURE 2. Cost-share from Public Sector Partners and International Donors in USD

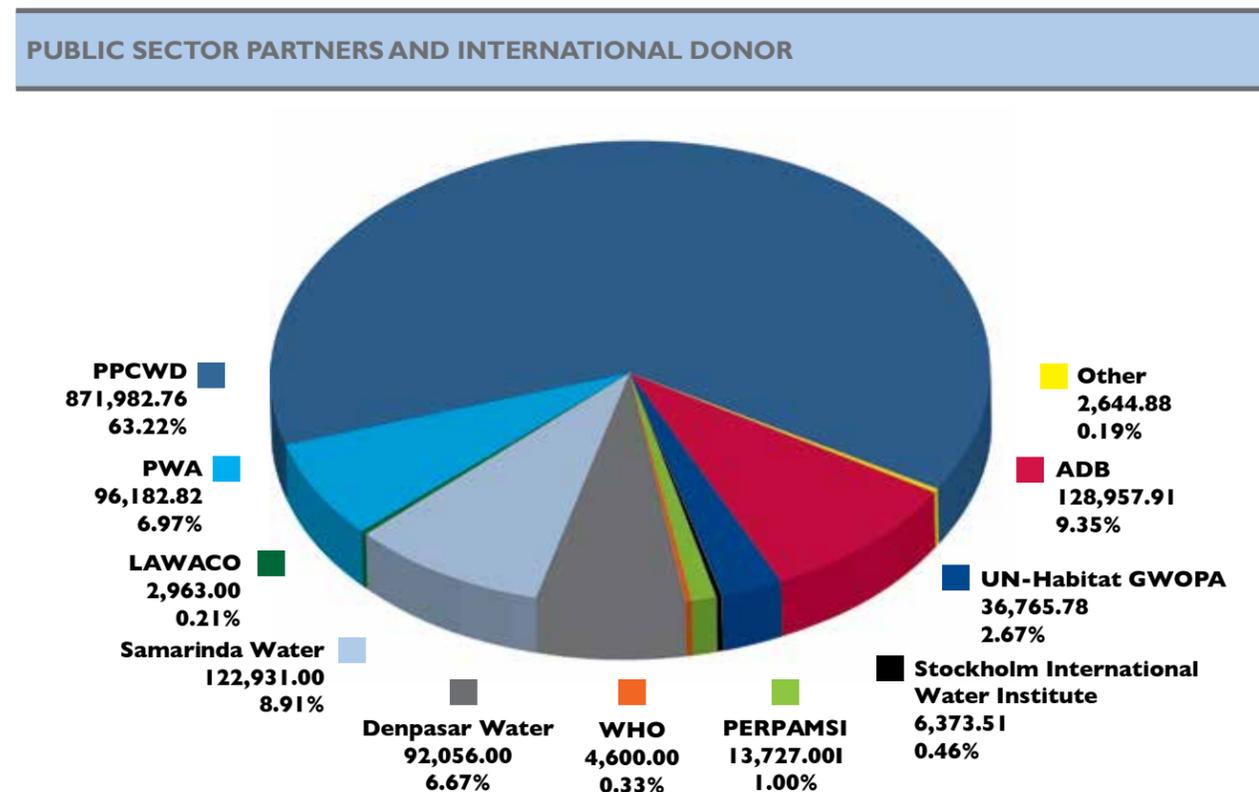
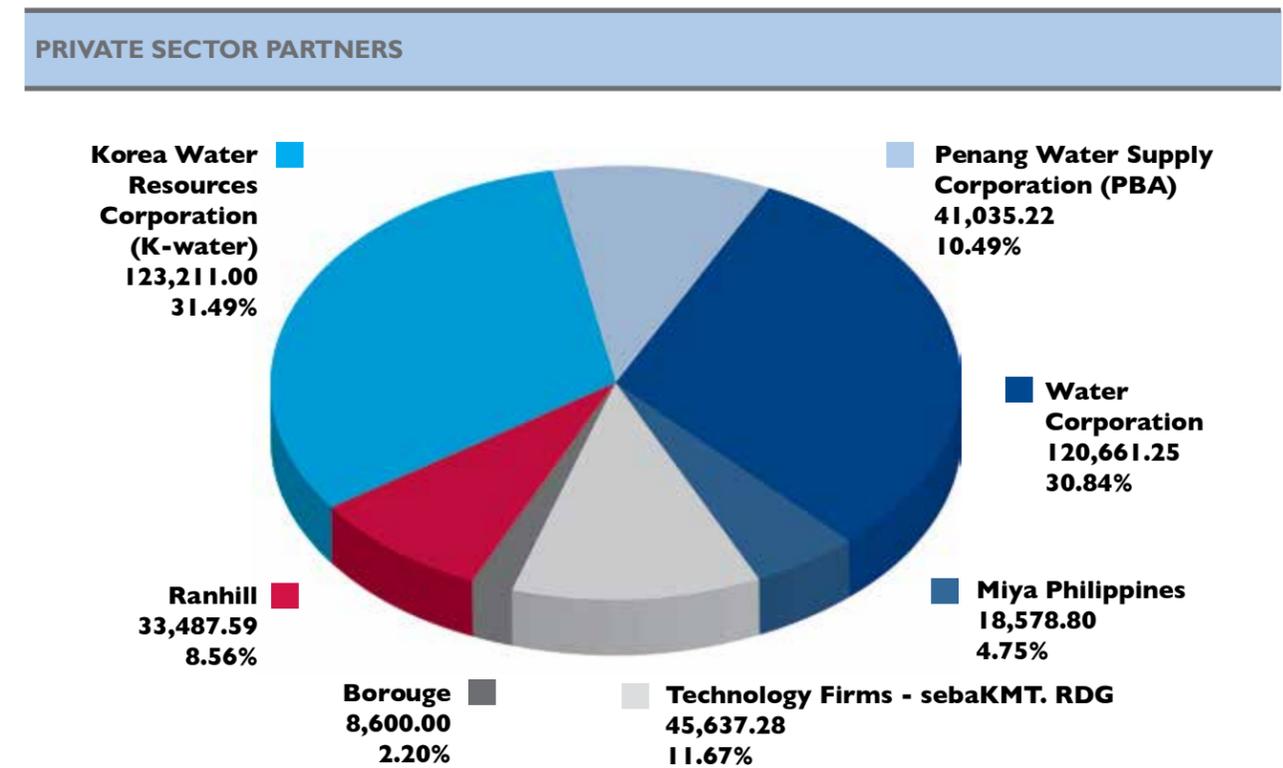
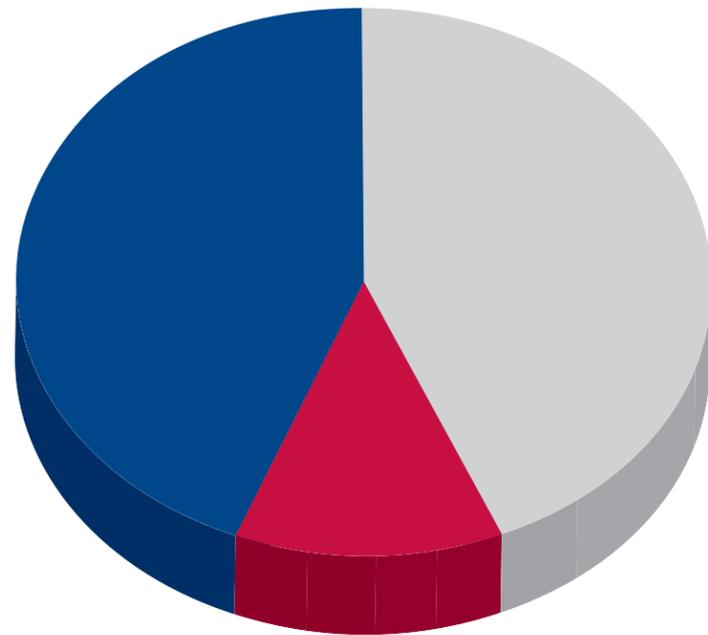


FIGURE 3. Cost-share from Private Sector Partners in USD



**FIGURE 4. Cost-share from USAID, Public Sector Partners and International Donors, and Private Sector Partners**

**SUMMARY OF TOTAL LEVERAGING**



**USAID Leveraging**  
**\$1,399,757.00**  
**44.15%**

**Private Sector Leveraging**  
**\$391,211.14**  
**12.34%**

**Public Sector & International Donor Leveraging**  
**\$1,379,184.66**  
**43.51%**



**TABLE I. SUMMARY OF WATERLINKS ALLIANCE PARTNERS**

Partners	Designation	Role
USAID	Development Partner	<ul style="list-style-type: none"> <li>• Provided financial support and technical guidance for partnership activities</li> <li>• Shared achievement of results and outcomes</li> </ul>
AECOM	Implementing Partner	<ul style="list-style-type: none"> <li>• Designed, implemented and managed all activities with WaterLinks</li> <li>• Strengthened capacity of WaterLinks</li> <li>• Reported results</li> <li>• Evaluated lessons learned and partner contributions</li> <li>• Monitored results and outcomes</li> </ul>
WaterLinks	Implementing Partner	<ul style="list-style-type: none"> <li>• Supported design, implementation and management activities</li> <li>• Supported coordination of all activities, results reporting, partner contributions</li> <li>• Reported on progress regularly</li> </ul>
Asian Development Bank (ADB)	Development Partner	<ul style="list-style-type: none"> <li>• Supported replication activities</li> <li>• Co-funded a WOP in Thailand</li> <li>• Shared lessons learned and good practices in WOP management</li> </ul>
UN-Habitat Global Water Operators Partnerships Alliance (GWOPA)	Development Partner	<ul style="list-style-type: none"> <li>• Supported replication activities</li> <li>• Supported outreach and networking for WaterLinks</li> </ul>
Indonesia Water Supply Association (PERPAMSI)	Development Partner	<ul style="list-style-type: none"> <li>• Supported replication activities</li> <li>• Supported WOPs in Indonesia with AECOM and WaterLinks</li> <li>• Helped with outreach for WaterLinks</li> </ul>
Borouge	Private Sector Partner	<ul style="list-style-type: none"> <li>• Provided materials and technical support for a WOP in Indonesia</li> <li>• Promoted private-public partnership</li> </ul>
Technology firms • sebaKMT • RDG	Private Sector Partner	<ul style="list-style-type: none"> <li>• Supported services improvements in WOPs by demonstrating innovative technologies</li> </ul>
Service provider partners (mentor): • Ranhill Utilities (Malaysia) • Penang Water (Malaysia) • Korea Water Resources (South Korea) • Water Corporation (Australia)	WOP Mentors	<ul style="list-style-type: none"> <li>• Provided technical guidance and mentorship for operational efficiency and services delivery improvements for recipient partners</li> <li>• Contributed resources to share good practices and build capacities for recipient partners</li> <li>• Promoted private-public partnerships</li> </ul>
Service providers partners (recipients): • Denpasar Water (Indonesia) • Samarinda Water (Indonesia) • Puerto Princesa Water (Philippines) • Provincial Waterworks Authority (Thailand) • Lam Dong Water Services (Vietnam)	WOP Recipients	<ul style="list-style-type: none"> <li>• Adopted good practices and practical innovations shared by resource partners according to local conditions in order to improve services delivery</li> <li>• Contributed resources (capital expenditures) to enhance operational efficiencies</li> <li>• Shared lessons and good practices with peer services providers</li> <li>• Promoted private-public partnerships</li> </ul>



# TWINNING PARTNERSHIPS

During the two-year Alliance, USAID, AECOM and WaterLinks collaborated to develop, establish and implement five WOPs: two in Indonesia (Denpasar and Samarinda) and one each in the Philippines (Puerto Princesa), Thailand (Chiang Rai/Udon Thani) and Vietnam (Da Lat). **Table 2** summarizes the target water services providers and their resource counterparts from Australia, South Korea and Malaysia, working on improving operational performance, demonstrating sustainable sanitation solutions, and building climate change resilience.

All WOP activities consisted of hands-on and classroom training; consultations; technology and best practice demonstrations; and technical discussions. Each activity revolved around proven solutions and relied on real-world knowledge from practitioners. Demonstration of innovative technology to improve water services delivery was a cornerstone of every WOP. The following sections describe the activities and results of each twinning partnership in detail.

**TABLE 2. SUMMARY OF WOPS**

	Location	Topic	Partner Water Services Providers
1	Samarinda, Indonesia	Continuous Water Supply	<ul style="list-style-type: none"> <li>Samarinda Water Supply Company (recipient)</li> <li>Malaysia's Penang Water Supply Corporation (PBAPP) (resource)</li> <li>PERPAMSI</li> </ul>
2	Denpasar, Indonesia	Continuous Water Supply	<ul style="list-style-type: none"> <li>Denpasar Water Supply Company (recipient)</li> <li>Malaysia's Ranhill Utilities (resource)</li> <li>PERPAMSI</li> </ul>
3	Puerto Princesa City, Philippines	Water Quality and Resources Management	<ul style="list-style-type: none"> <li>Puerto Princesa City Water District (recipient)</li> <li>South Korea's Korea Water Resources Corporation or K-water (resource)</li> </ul>
4	Da Lat, Vietnam	Wastewater Management	<ul style="list-style-type: none"> <li>Lam Dong Water Supply and Sewerage Company (recipient)</li> <li>K-water (resource)</li> </ul>
5	Chiang Rai and Udon Thani, Thailand	Climate Resilient Water Supply Operations	<ul style="list-style-type: none"> <li>Provincial Waterworks Authority (recipient)</li> <li>Australia's Water Corporation (resource)</li> <li>ADB</li> </ul>



ENABLING CONTINUOUS WATER SUPPLY IN

# SAMARINDA, INDONESIA



## KEY TECHNICAL TERMS:

### **Non-Revenue Water (NRW)**

is water that is produced for public use but becomes “lost” before it reaches the paying customer. This can happen through a number of events including broken pipes, theft, metering inaccuracies, etc. and result in a waste of physical and financial resources.

### **A district metered area (DMA)**

is a discrete area of a water distribution network to monitor water leakage. It is usually created by closing boundary valves or permanently disconnecting one neighborhood from another so that it remains flexible to changing demands.

## BACKGROUND

The Samarinda Water Supply Company (PDAM Tirta Kencana) serves more than 115,000 customers in Samarinda, the rapidly growing capital of the East Kalimantan province in Indonesia. With an eight percent population growth anticipated as a result of a new highway and airport leading to increased water demand, Samarinda Water recognized the need to improve its 4,000-km water supply distribution system by reducing water losses or non-revenue water (NRW) to supply water continuously and manage water pressure. In addition, Samarinda has sea water intrusion and occasional water shortages.

Samarinda Water initiated efforts to improve water distribution by establishing distribution management centers; investing in Geographic Information Systems (GIS), identifying potential district metering areas (DMAs), and implementing smart meter reading systems. In spite of these efforts, Samarinda Water Supply Company continued to experience water loss, which equated to nearly 60 percent of its total system production volume, while supply was intermittent in several key service areas with pressure averaging a mere 0.5 bars.

To assist Samarinda Water, the WaterLinks Alliance created a partnership between Samarinda Water and Malaysia’s Perbadanan Bekalan Air Pulau Pinang Sdn Bhd (PBAPP), a private company and regional leader in water loss management and continuous water supply. With AECOM/

WaterLinks facilitation for past twinning partnerships, PBAPP had assisted two other Indonesian water supply companies as a mentor partner. In the process, PBAPP became familiar with water supply operations in Indonesia.

Additionally, the Alliance engaged Indonesia's national association of water utilities, PERPAMSI, to help promote replication of good practices emerging from the Samarinda Water-PBAPP WOP and strengthen its capabilities in WOP facilitation.

The partners jointly developed a 16-month WOP work plan and signed a WOP agreement with the following objectives:

- Capacity building via on-site training, workshops and consultations to enhance water supply distribution;
- Transfer of practical knowledge in model water distribution operations including NRW reduction, pressure management, and network analysis;
- Establishment of pilot DMAs and adoption of comprehensive standard operating procedures (SOP) for DMA management;
- Adoption and implementation of a proper asset management program including recording, identification, monitoring, movement, handling, etc. of key assets;
- Replication of innovations introduced through the WOP for other interested water companies in coordination with PERPAMSI; and,
- Supporting PERPAMSI to develop and implement WOPs.

## KEY ACTIVITIES

Throughout the WOP's duration, Samarinda Water and PBAPP set up two pilot DMAs in the residential areas of Bengkuring and Puspita where water supply varied between intermittent and continuous for 1,560 customers. The two pilots served as target areas for services improvements and for training in water loss management; GIS application; network modeling and asset management.

Samarinda Water procured and installed the necessary infrastructure for DMA operations, such as meters, data recorders, and pipe fittings. PBAPP guided efforts to establish and manage the DMAs and trained Samarinda Water on operations. The WOP engaged technology firms such as sebaKMT, RDG, and George Kent to demonstrate innovative leak detection tools and customer meters. The WaterLinks Alliance also worked with PERPAMSI to replicate these innovations during a training workshop involving various water companies from the neighboring districts.

## RESULTS

Samarinda Water, with PBAPP support, gained hands-on and practical knowledge to enable more continuous water supply distribution for over 1,500 customers in the two model areas of Bengkuring and Puspita. Through the WOP, Samarinda Water strengthened its capability to operate and manage DMAs and water pressure, which, over time will lower water losses. Samarinda Water also recognized the need for having a dedicated NRW management team which it plans to develop down the road. During the WOP,

Samarinda Water also connected with technology providers to better detect leakages with greater accuracy and establish proper infrastructure to measure water losses, such as data loggers and bulk water meters.

Moving forward, using the management and operational skills they gained, the staff at Samarinda Water will replicate water loss management activities in 2015 in four additional DMAs - Sambutan Permai; Sempaja/Griya; Rapak Benuang; and Keledang Mas. As a result of these activities, more than 13,476 customers will have gained improved water supply access. Samarinda Water also plans to establish a new division to specifically lead and maintain the initiative.

Furthermore, PERPAMSI reached out to its members and encouraged additional peer-to-peer learning under the Samarinda WOP. PERPAMSI involved water operator members near Samarinda in the WOP's training activities and simultaneously introduced the WOP as a capacity building process. Demonstrating their level of commitment to improving water services providers, PBAPP and technology partners took the WOP one step further and introduced proven systems and processes to smaller water companies near Samarinda who encountered similar water loss challenges. This process enabled PERPAMSI to build capacity in developing its own WOP development and facilitation program.



# SUCCESS STORY

## Denpasar and Borouge: Leveraging the Private Sector to Improve Water Services Delivery



**Water flows from the new pipes provided by Borouge for the first time at the inaugural event in Seragan.**

In Denpasar, a rapidly growing city in Bali, Indonesia, the demand for water supply has been on the rise. Searching for ways to meet this demand, Denpasar Water needed to improve operational efficiency while minimizing water losses, connecting low income households in the town of Seragan to the water supply system, and managing a limited raw water source.

The WaterLinks Alliance connected Denpasar Water with Malaysian-based Ranhill Utilities and the private sector firm, Borouge. Through its corporate social responsibility (CSR) program, Borouge worked with Denpasar Water to address issues in water connection. Borouge contributed close to USD35,000 to connect the small community of fisher folks to the water supply system in Seragan Island, a place known to local and tourists for its work in rehabilitating turtles.

With Borouge's private sector support, the pipe replacement project was completed with new UPVC pipes of 150mm, 75mm and 50mm dimensions with a combined length of 2.8km, and dimension 20mm of 300 meters service connection pipes in February 2015. As a result, to 586 low-income households, representing almost 3,000 people in Seragan, now have access to a clean and regular water supply.

ACHIEVING 24/7 CONTINUOUS SUPPLY IN

## DENPASAR, INDONESIA



### BACKGROUND

The Denpasar Water Supply Company (PDAM Wiwitaning Kauripan) supplies water for over 73,000 customers in the growing city of Denpasar. Increasing water demand coupled with limited raw water sources, frequent droughts, and rising water losses have required Denpasar Water to better manage its water supply. Estimated water loss throughout its 1,400 km of distribution pipes has increased since 2009 from about 22 to 29 percent in 2014. As a result, selected service areas encountered intermittent supply between 12 to 20 hours per day. Recognizing these inefficiencies, Denpasar Water prioritized improving the management of its water supply distribution, including to low-income communities; reducing water losses/NRW; mobilizing continuous water provision; and better managing water pressure.

As the local PERPAMSI representative in Bali, Indonesia, Denpasar Water requested a linkage with peer water services providers in the region to build its capability to reduce water losses and optimize distribution. With PERPAMSI coordination, the Alliance paired Denpasar Water with Malaysia's Ranhill Utilities. Experienced in holistic water supply operations, Ranhill instituted innovative water loss and management techniques that further strengthen its operational efficiencies and resilience against raw water scarcity impacts. Ranhill has had extensive experience as a mentor for several Indonesian PDAMs through past WaterLinks-facilitated WOPs.

As part of the private sector outreach, AECOM and WaterLinks engaged Borouge Ltd., a raw material supplier for the piping industry that sought water supply initiative for its corporate social responsibility, Water for the World, program. Borouge's program specified provision of water supply to low-income communities. AECOM and WaterLinks collaborated with Denpasar Water, Borouge and PERPAMSI to identify service areas in Denpasar that were in line with partner mutual interest and community readiness.

The WOP explored opportunities to expand and distribute water supply to Denpasar's marginalized

communities, and aimed to benefit at least 13,000 customers. Principally, the WOP aimed to: strengthen Denpasar Water capability to manage water losses; improve customer service through a better supply pressure distribution; and increase water access to low-income areas as a pilot.

### KEY ACTIVITIES

Denpasar Water initiated the WOP by identifying an area in Serangan Island for the pilot efforts to reduce water losses. The isolated system on Serangan offered a starting point for learning and applying water loss reduction techniques. Occupied by nearly 3,000 residents, the area predominantly consisted of low-income fishermen and had

experienced 23 percent water losses resulting, primarily, from pipe leakages and inaccurate customer meters. Based on the initial activities in Serangan, Denpasar Water also began replicating in two other areas – Subita and Teras Ayung. WOP activities consisted of hands-on and classroom training; consultations; technology and best practice demonstrations; and technical discussions.

Various partners contributed to the initiatives in Denpasar. Borouge supported provision of 2.8 km of new main pipes and 300 meters of service connections and associated fittings for 580 service connections in Serangan area pilot. Ranhill collaborated with Denpasar Water

to initiate and sustain water loss reduction approaches using DMAs and gave insights on organizational restructuring required to maintain such efforts. Private sector technology firms like RDG and sebaKMT also participated in the hands-on training activities to introduce their innovative equipment for detecting leakages. PERPAMSI continued to promote replication by involving other water companies in Bali to join in the WOP training events, and gained experience in WOP implementation and replication demonstrated by AECOM and WaterLinks.

### RESULTS

Denpasar Water, with Ranhill support, strengthened its capability to lower water losses and now provides continuous water supply for over 1,300 customers in the Serangan, Subita and Teras Ayung areas. From January 2014 to January 2015, water losses decreased by 4-5 percent in Serangan and Subita and by nearly 30 percent in Teras Ayung saving Denpasar Water over 40,000 cubic meters of water. In the process, Denpasar Water gained practitioner-based knowledge to develop and implement DMAs and water pressure; exposure to innovative tools and equipment to address leakages and measure water distribution; and established relationship with Ranhill as peer mentor. It also set up a new, dedicated NRW team consisting of nine staff that will oversee replication in nine new DMAs by 2017 - KeboIwa Utara, Batukandik, Pemamparan, KeboIwa Selatan, Gumitir, Tanjung Sari, Siulan 1 & 2 and Perumnas Monang Maning.

The WOP also helped Denpasar Water build its resilience against

climate change impacts of limited water supply and droughts. By reducing water losses, Denpasar Water will have greater supply to meet increasing water demand brought by the growing city.

Aside from Denpasar Water, the WOP achieved objectives of its other main partners. Borouge effectively contributed over \$35,000 of resources that ultimately improved water supply services as a part of Borouge's corporate sustainability program. By collaborating with AECOM and WaterLinks, PERPAMSI also gained insight into the importance of facilitating WOPs that improved water supply delivery. After shadowing this WOP operation and facilitation event, PERPAMSI effectively learned how to run WOPs. The close facilitation and understanding of WOPs will benefit both mentor and mentee on the real problem observation, analysis and determine on which aspects could be addressed during the limited WOP time period, and to generate measureable result afterwards, with sustained outcomes. PERPAMSI was also looking at capacity building at that time period to enhance internal WOPs and also to run regional and international WOPs, maybe under GWOPA's sponsorship, this will eternally strengthen the PERPAMSI's institutional capacity on WOP operation. The WOP supported PERPAMSI's efforts to link with Ranhill and implement future national WOPs. PERPAMSI included all nine PDAMs from Bali province, in addition to PDAM Jayapura, PDAM Kabupaten Malang, PDAM Sukoharjo and USAID IUWASH additional members for a total of nearly 45 participants in selected WOP activities in Denpasar, strengthening its own member services.



# PUERTO PRINCESA, PHILIPPINES



## BACKGROUND

The Puerto Princesa City Water District (PPCWD) supplies water to over 32,500 customers (2013) in the city of Puerto Princesa, a major tourist destination in the Philippines. Despite the improvements made to the water system, PPCWD experiences variable level of service. During the summer season, the flow of water in Irawan River, PPCWD's water intake location, drastically reduces to result in water shortages, poor water quality, and water rationing schemes. In the rainy season, intensifying rain causes

## KEY TERMS:

**High turbidity** levels decrease the permeability of light into the water. It can be harmful to aquatic growth and contain dangerous pathogens and chemicals.

Chlorine acts as a disinfectant in water, destroying harmful organic matter. Once the chlorine is used in this reaction, a residual is left over. The **chlorine residual** remains as a safeguard for water treatment. Levels that are too low may not provide the safeguards against organic matter in the water throughout the water treatment and distribution process, posing a threat to consumers.

high turbidity levels in the raw water entering its water treatment plants. Low chlorine residuals also occur in the distribution networks. With extreme events attributed to climate change projected to intensify in the Philippines, such as typhoons, heavy precipitation and prolonged droughts, managing water quality and securing adequate water resources are top priorities for PPCWD as it builds its climate resilience.

The Alliance linked PPCWD with the Korea Water Resources Corporation (K-water), a national water services provider from Daejeon, South Korea recognized for its innovative technologies and systems and high level of service. K-water has participated in several WOPs facilitated by WaterLinks in the past in the Philippines, Thailand and Vietnam. PPCWD learned of K-water during previous WaterLinks activities when it participated in a 2012 replication workshop, and requested a WOP with K-water. The principal WOP objectives as agreed by both partners during the 16-month partnership covered:

- Improving PPCWD's water treatment process to reduce turbidity;
- Supporting the development of new water resources; and
- Enhancing the pipe network distribution system.

## KEY ACTIVITIES

The WOP activities focused initially on improving operational efficiencies of the Campo Uno Water Treatment Plant (WTP) which treats and directs water for most of Puerto Princesa. K-water recommended changing protocol

of water treatment processes in filtration and chemical dosing to address high turbidity. K-water gave PPCWD jar test equipment essential for its laboratory to prepare proper chemical dosages to treat raw water. A jar test determines what dosing concentration is required to treat raw water turbidity. The jar test replaced the laboratory's egg beaters that had been in use for the mixture and sedimentation experiments.

The WOP also supported PPCWD in identifying a new water source near Lapu-Lapu to address challenges in water demand in the dry season and in optimizing its network modeling and operations. For the source identification, K-water assisted with the pre-feasibility study. Like most cases in raw water management, the water service provider lacks the administration rights for the newly identified water source. The Lapu-Lapu River is under the administration of the Department of Justice, within the Iwahig Penal Colony, and managed by the national government. In order to legally utilize this as a water source in Puerto Princesa, K-water worked with PPCWD to develop recommendations that formed the basis for PPCWD's proposal to its local government.

Furthermore, K-water worked with PPCWD to address the financial constraints associated with engaging in this type of project. With close AECOM and WaterLinks facilitation, PPCWD and K-water also collaborated on a preliminary proposal to acquire support from the Korea International Cooperation Agency (KOICA) for the water source development. The proposal originally requested

a loan from KOICA, though after passing several phases, it was determined that PPCWD did not meet KOICA's objectives which focused on supporting water supply provision for poorer, rural areas. Shifting gears, together, K-water and PPCWD then identified funding agencies including the local government, the Development Bank of the Philippines and Bank of the Philippine Islands who could provide a total of up to USD 22 million. PPCWD reviewed and incorporated K-water's recommendations into a technical and financial proposal for the approval by local government on feasibility and by lending partners to finance source development.

Finally, while PPCWD has an existing hydraulic pipeline network model, the input data in the model was not accurate resulting in errors during simulations. K-water and PPCWD reviewed PPCWD's existing system and helped with calibration and improving network modeling.

## RESULTS

By the end of the WOP, PPCWD gained practitioner-based knowledge and innovative technologies to manage water quality; establish new water source; and monitor hydraulic flow. It modified water treatment processes in the Campo Uno WTP – filtration and chemical dosing – to control turbidity levels within established limits during extended rainy and dry seasons.

By lowering the turbidity; PPCWD has helped over 60,000 people in the city served by the Campo Uno WTP to have improved water supply and decrease the risk of

waterborne diseases. PPCWD also adopted new procedures to install an online turbidity meter; measure the true color of the treated water (after filtration); and analyze turbidity removal efficiency presented by K-water. K-water also introduced PPCWD to EPA-modeling--a pipeline hydraulic modeling method--to optimize the use of its pipes, water pressure and water consumption and improve network operation.

K-water and PPCWD collaborated effectively to prepare a preliminary feasibility study on tapping into the Lapu-Lapu River for a new water source. K-water engaged over nine experts to review the water source and prepare the study. PPCWD incorporated K-water's recommendations and developed its own final feasibility study and project proposal, it had derived several key elements on water treatment and conveyance from the preliminary study. PPCWD received approval from the relevant local government to proceed with the project, and has linked with the Development Bank of the Philippines and Bank of the Philippine Islands to finance the anticipated USD 22million effort. It is, however, still working with the national government for clearance since the Lapu-Lapu River intake resides inside the Iwahig Penal Colony operated by the national government.

# SUCCESS STORY

## Puerto Princesa City Water District: Planning for the Present and Future



**K-water and the staff of PPCWD conduct one final visit to review progress and areas for improvement.**

Puerto Princesa City Water District (PPCWD) in the Philippines is responsible for providing water supply to over 32,500 customers --roughly 161,000 people. Puerto Princesa, a major tourist destination, projects that the population will almost triple by 2020. Facing more extreme climate events like typhoons and extended droughts, PPCWD struggles with high turbidity levels in the water, especially during heavy precipitation, coupled with discoloration and low chlorine residuals at the distribution networks as well as preparing for the rapidly growing population.

The WaterLinks Alliance paired PPCWD with the Korea Water Resources Corporation (K-water) for a 16 month Water Operators Partnerships (WOP) to (1) build the capacity of PPCWD to ensure safe water quality provision and effectively meet the Philippine National Drinking Water Standards issued in 2010 and; (2) improve PPCWD's water quality management/monitoring operations to address water quality constraints.

Through various activities, such as technical on-site diagnosis and assistance, remote information sharing, classroom discussions and on-the-job training, K-water mentored PPCWD and together addressed the needs of Puerto Princesa. They:

- Improved water treatment process for reducing turbidity
- Increased access to safe drinking water to customers in 36 out of 38 barangays currently serviced by PPCWD
- Introduced technologies and practical innovations in water treatment operations and maintenance
- Introduced the design for new water resources and water supply system expansion.
- Adopted procedures/protocol and other applicable solutions by PPCWD to improve water supply system (including development of new water resources)

## DEMONSTRATING SUSTAINABLE SANITATION IN DA LAT, VIETNAM



### KEY TERMS:

**Effluent levels** are a measurement of the amount of liquid waste or sewage in the water. Among other indicators effluent levels look at the amount of **ammonia** or a powerful fertilizer for plants and algae and a toxic compound to fish; and **coliform**, which is a type of fecal bacteria.

### BACKGROUND

In Vietnam, the national government has prioritized improvements in urban sanitation services through a decree passed in March 2013 and has involved various development partners such as ADB and the World Bank to expand urban sanitation services. In Da Lat, the World Bank has assisted the Lam Dong Water Supply and Sewerage Company (LAWACO) to build its first centralized wastewater treatment plant (WWTP) that began operating in 2005. LAWACO collects and treats wastewater from over 6,700 customers—including slaughterhouses—using mechanical and biological processes that discharge into nearby Cam Ly stream. Even though it was a relatively recent project, the current operational load is nearly double the designed capacity, and the treatment capacity is far less than adequate. In part as a result of this, LAWACO is designing a new wastewater system to increase wastewater treatment capacity and thereby further increasing wastewater treatment coverage for another 12,000 customers in the next four years. In the meantime, however, LAWACO has encountered a number of operational challenges in its existing WWTP, with fluctuating effluent levels of ammonia and coliform; that at times exceeded local standards stemming from an unstable nitrification process in the trickling filters at the plant.

To support improved sanitation services in Da Lat, AECOM and WaterLinks paired LAWACO with K-water. K-water, which served as a resource partner for a WOP on sanitation services improvements in Indonesia, operates 115 sewerage treatment plants with various technologies throughout South Korea. The WOP aimed

to (1) improve the wastewater treatment process of LAWACO WWTP, specifically for reducing the effluent pollutant and (2) build capacity on WWTP operations and maintenance and laboratory management.

### KEY ACTIVITIES

The WOP focused on improving operational efficiencies at the existing WWTP by targeting ammonia and coliform reduction and enabling better water quality monitoring practices. K-water offered recommendations at each stage of the treatment process and recommended optimal sampling procedures to understand the WWTP influent loading.

LAWACO and K-water formalized the partnership with a work plan and WOP agreement, focusing on capacity building and consultations to optimize treatment plant operations and maintenance. WOP activities entailed site visits to Da Lat and Daejeon for system assessment; consultations to modify existing operations; and selected technology highlights. With K-water's guidance, LAWACO improved treatment capabilities by reducing influent loading. In addition, through the partnership, K-water reviewed LAWACO's treatment expansion plans and provided feedback on system modification.

### RESULTS

In the WOP, LAWACO acquired additional technical knowledge to better operate and maintain its WWTP processes. LAWACO applied its know-how with K-water support to change its trickling filter operations to better remove

ammonia; more frequently remove sludge at a rate of 250m<sup>3</sup>/h for recirculation volume, every 15 minutes for 30 seconds; and collect samples, not just from end-points, but using sampling techniques from 'end to front' in the WWTP chain for better analysis. As a result, LAWACO increased ammonia removal efficiency by 20 percent to improve wastewater treatment for its 6,700 customers. However, due to financial limitations, LAWACO did not implement actions to reduce coliform levels at the effluent and increase dissolved oxygen concentrations in its current ponds. LAWACO is planning to include these modifications in the upcoming World Bank phase II project to build the second WWTP.

K-water also expanded support by reviewing the phase II feasibility study. For instance,

K-water explained advantages and disadvantages of each proposed WWTP design in the study and suggested new treatment methods such as using existing lagoons as aeration ponds, a sludge volume index (SVI) to analyze samples, the installation of a chlorination facility at the end of the ponds, and the installation of an aerator at the end of the ponds to provide dissolved oxygen (D.O.); that may be applicable in Da Lat. In addition, K-water also gave longer term solutions to address the increasing loading into the existing WWTP such as (1) upgrade and optimization by 50 percent; (2) building the second WWTP in the same compound that would entail closer analysis of technical design and projected population growth; and (3) adoption of a treatment method to manage the untreated organic waste from slaughterhouses.





BUILDING CLIMATE RESILIENCE OF WATER SERVICES PROVIDERS IN

# THAILAND



## BACKGROUND

The Provincial Waterworks Authority of Thailand (PWA) supplies water to most urban areas in Thailand through 231 water treatment plants (waterworks). Since 2009, PWA through WaterLinks has partnered with other water operators in the region to develop and implement actions

that contribute to building climate resilience such as water quality management and water loss reduction. Many waterworks, however, still face degrading raw water quality and availability due to prolonged drought as well as increased runoff from heavy rains.

PWA facilities in Chiang Rai and Udon Thani have faced drought conditions, affecting water quality and increasing energy inputs to operate their facilities. The two waterworks are also coping with increasing water losses. PWA Chiang Rai serves more than 20,000 customers and is dealing with high turbidity from its main water source, the Kok River, especially during the rainy season. The larger PWA, Udon Thani, supplies water for more than 65,000 customers, taking raw water mainly from a reservoir with elevated manganese levels during the dry season. Both high manganese and turbidity levels increase risks to water contamination and waterborne diseases. In addition, PWA requested assistance to explore new treatment processes that could minimize plant footprint in a third facility, Rangsit, which serves over 200,000 customers. PWA also plans to replicate these solutions throughout its network of waterworks.

To support PWA, AECOM and WaterLinks, together with ADB, connected PWA with the Water Corporation (Water Corp), an Australian utility that manages several waterworks throughout Western Australia and has operated in water stress conditions. Experienced with past WOPs in the region, Water Corp has instituted innovative water loss and water quality management techniques that further strengthen its operational efficiencies as well

as its resilience against climate change impacts, and has embarked on initiatives to reduce energy use in its operations. The PWA-Water Corp WOP aimed at improving services for 15,000 customers and at helping to build resilience by (1) reducing water loss/NRW and manganese in Udon Thani; (2) optimizing water treatment and distribution processes in Chiang Rai; and (3) demonstrating innovative water treatment technologies for potential adoption in Rangsit.

### KEY ACTIVITIES

The WOP activities entailed multiple subjects – water quality management; water loss reduction; energy efficiency and advanced design for water treatment. While the Chiang Rai and Udon Thani waterworks had differing priorities, similar capacity building and technology demonstration activities took place in both waterworks. Support for introducing innovate treatment technologies for PWA Rangsit consisted of technical discussions and visit to Water Corp facilities.

### CHIANG RAI

Water quality management efforts focused on primarily reviewing raw water intake; chemical dosing; sedimentation and filtration processes at the two WTPs - Chiang Rai and Phaya Mengrai. Water Corp and PWA collaborated to identify optimal chemical dosing using polymers and water sampling operations for better settling and filtration that would ultimately lower turbidity as well as manganese in both plants. The partners also worked on conducting an energy audit to pinpoint high energy use in the water production system.

### UDON THANI

WOP activities addressed high levels of manganese in the Nongramsong WTP and water loss reduction from commercial losses (e.g. ineffective water meters). Water Corp and PWA analyzed flocculation, chemical usage and raw water intake facilities, and determined appropriate procedures for removing manganese. They also conducted step tests to identify leakages in the distribution system. After finding limited leakage points, the partners embarked on a pilot meter replacement project for one DMA.

### RESULTS

PWA Chiang Rai and PWA Udon Thani implemented key recommendations based on the technical training and demonstrations in the WOP. For example, PWA Chiang Rai conducted jar tests with different chemicals and parameters to determine proper dosing to enhance flocculation and controlled Oxidation-Reduction Potential

(ORP) values that effectively reduced manganese levels. By managing ORP values through addition of chemicals, PWA Chiang Rai was able to oxidize, or remove manganese. In its Phaya Mengrai plant, PWA Chiang Rai utilized polymer together with alum and lime to significantly reduce turbidity and manganese levels. See comparison form before and after WOP tested value results in **Table 3**. PWA then installed a permanent polymer dosing unit benefitting approximately 96,180 people in Chiang Rai.

PWA Udon Thani applied an improved method, recommended by Water Corp, to measure dissolved manganese. This procedure enabled PWA to implement measures such as increasing pH and ORP values as well as implementing pre-chlorination and lime dosing to control manganese levels. Manganese levels dropped by an average of 80 percent following the application. See the comparison form before and after WOP tested value results in **Table 4**.

Items	Start of WOP tested value	End of WOP tested value	Remarks
Turbidity	(Chiang Rai WTP) 0.60-1.0 NTU (Mengrai WTP) 4.30 NTU	0.40 NTU 0.79 NTU	PWA Standard is 5.00 NTU
Manganese	(Chiang Rai WTP) 0-0.09 mg/L (Mengrai WTP) 0.10-0.21 mg/L	0-0.09 mg/L 0.04-0.18 mg/L	PWA Standard is 0.40 mg/L (0.02mg/L recommended by Water Corporation)

**TABLE 4. BEFORE AND AFTER MANGANESE AND TURBIDITY LEVELS IN UDON THANI**

Items	Start of WOP tested value	End of WOP tested value	Remarks
Turbidity	(Nongprajak WTP) 0.70-1.20 NTU (Banthon WTP) 0.80-1.50 NTU (Bannikom WTP) 0.80-1.50 NTU	0.80-1.00NTU 0.80-1.00 NTU 0.50-0.90 NTU	PPWA Standard is 5.00 NTU
Manganese	(Nongprajak WTP) 0.04-0.50 mg/L (Banthon WTP) 0.03-0.30 mg/L (Bannikom WTP) 0.04-0.60 mg/L	0.08-0.09 mg/L 0.06-0.09 mg/L 0.03-0.12 mg/L	PWA Standard is 0.40 mg/L (0.02 mg/L recommended by Water Corporation)

Improving water quality management helped PWA build resilience against climate change impacts from prolonged drought and intense rain in Chiang Rai and Udon Thani, safeguarding 338,776 customers from potential waterborne diseases.

Other WOP results improved PWA's operational efficiencies. Through an energy use audit with support from Water Corp, PWA Chiang Rai determined inefficiencies in one of its distribution pumps that caused excessive power uptake. By the end of the WaterLinks Alliance, PWA Chiang Rai was planning to replace the costly unit after thoroughly researching and identifying the best pump for the system. PWA Chiang Rai intends to roll out similar audits in other waterworks as part of its energy efficiency initiative. PWA's main office in Bangkok intends to set up a specialized division that will review energy use and enable energy efficient operations.

In Udon Thani, PWA's pilot efforts to reduce water loss/NRW through a meter replacement program were less effective due to the replacement protocols. Water Corp and PWA planned to continue discussions in setting new standards for meter

replacement program beyond the WOP duration.

For efforts to implement low footprint WTP design in Rangsit, Water Corp demonstrated various technologies and specifications that may be suitable. These included practical system capacity design based on daily, seasonal and annual timeframes for water demand, coupled with population projections, available resources and quality and operational design; as well as to encourage plant operators to provide feedback on their work space requirements. Water Corp strongly suggested that whenever a new water plant is proposed that there should be a consultation with the current WTP operators to obtain their opinions on how to better design the plant for easier, better and more economical operation. The operators typically have more knowledge gained from experience about improved layouts and methods to improve operations that should be incorporated from the design phase, before the plant is even constructed. If the employees are not engaged at this planning phase, the plant runs the risk of being cumbersome and difficult to manage once it is built.

## SUCCESS STORY

### Building a Climate Resilient Water Service Providers in Thailand



**Water Corp conducts an initial visit to PWA's laboratory to understand processes and offer recommendations for improvement.**

Located in the northern provinces of Thailand, Chiang Rai and Udon Thani provide water services to over 450,000 people through the local branches of the Provincial Waterworks Authority of Thailand (PWA). Both Chiang Rai and Udon Thani experienced high turbidity and manganese levels in their water supply, especially during periods of heavy rainfall affecting the quality of drinking water. Chiang Rai and Udon Thani also faced water losses of up to 33% of water they produced.

In July 2013, with assistance from the USAID and the Asian Development Bank (ADB), through the WaterLinks Alliance project, established a water operator partnership (WOP) between Water Corporation of Australia and PWA to address these issues. Throughout the WOP, Water Corporation, Chiang Rai and Udon Thani addressed these challenges through the development and implementation of a water quality management protocol that improved water quality, introduction to water loss management techniques including a meter replacement program that reduced water losses, and introduction to energy efficiency initiatives in the water pumping stations.

At the completion of the WOP, PWA Udon Thani and Chiang Rai improved drinking water quality for their customers by managing turbidity and manganese levels. Moreover, PWA implemented a pilot water meter replacement program and has successfully replaced a total of 1,023 out of 4,425 water meters that contributed to the reduction of water losses and increased revenues. Given its success, PWA has agreed to promote these new approaches in its other waterworks that are currently experiencing the same challenges.

# REPLICATING GOOD PRACTICES FOR WATER SERVICES DELIVERY

The WaterLinks Alliance implemented activities and events aimed at promoting WOPs and best practices emerging from the WOPs to facilitate replication and generate continued interest for peer-to-peer exchange. Activities included: workshops and seminars, publications of toolkits and case studies, and website development. The following section summarizes replication efforts during the WaterLinks Alliance.

## GLOBAL/REGIONAL EVENTS

Regional/global events are platforms for: (1) promoting replication of innovation and good practices in water services delivery as well as climate resilience; and, (2) demonstrating how twinning partnerships serve as an effective capacity building model. Key events in the WaterLinks Alliance project included:

### ASIA-PACIFIC SESSION – 2013 GWOPA CONGRESS BARCELONA, SPAIN

Supported by the WaterLinks project and GWOPA and in coordination with ADB, WaterLinks and

AECOM facilitated the WOPs Asia-Pacific Session during the GWOPA Congress in Barcelona on November 27. Attended by over 40 people, the session showcased a variety of WOP experiences from the Asia-Pacific region focusing on principal gains, pitfalls, and opportunities for an expanded program in the future. The session demonstrated the range of priority topics in the region including energy efficiency, water loss reduction, water quality management, and wastewater management.

### MASTER CLASS ON SEPTAGE MANAGEMENT 2014

#### KUALA LUMPUR, MALAYSIA

With support from ADB and the WaterLinks Alliance, WaterLinks organized the 2014 Master Class on Septage Management in Kuala Lumpur, Malaysia on April 28-30, with technical mentorship by Indah Water Konsortium (IWK), Malaysia's national wastewater management services provider. Building on the USAID ECO-Asia project efforts to promote septage management, the class aimed at raising awareness among services providers to ensure



support for the implementation of septage management programs and initiatives. IWK introduced the basics of septage management program development and implementation, demonstrating its technical practices. WaterLinks also facilitated exchanges of lessons learned and plans for establishing septage management efforts, and encouraged linkages among the participants through WOPs. A total of 13 participants from eight countries – Bangladesh, Cambodia, Indonesia, Nepal, Philippines, Papua New Guinea, Tonga and Vietnam – attended the event.

### WATERLINKS FORUM 2014 MANILA, PHILIPPINES

WaterLinks with support from ADB and WHO organized the WaterLinks Forum 2014, entitled “Scaling-Up Water Operator Partnerships” in Manila on August 11-13. Attended by 219 participants from 23 countries, the Forum aimed at: (a) introducing WOPs to private sector and development partners as a model for achieving corporate social responsibility (CSR) goals,

ensuring business continuity, and building capacity for sustainable service delivery improvements; (b) recognizing good practices in improving delivery of water services and addressing climate change impacts; and (c) demonstrating innovative technologies for water services operations.

The Forum consisted of 13 water technology companies that exhibited innovative tools and systems for leakage detection; water quality monitoring; and pressure management. The Forum also included program tracks on water loss reduction; water quality management; wastewater management and recycling; and climate change adaptation. Each track featured technology sessions, as well as a WOP matchmaking event. Manila Water and Maynilad Water showcased their innovations and successes in water loss and septage management. The Forum also facilitated a MoU signing among USAID, WaterLinks, Miya, PERPAMSI and Borouge on expanding access to water services through partnerships and replications.

### REGIONAL TRAINING ON WATER QUALITY MANAGEMENT THROUGH WATER SAFETY PLANS CHIANG RAI, THAILAND

AECOM, with support from ADB, PWA and WaterLinks, organized a regional training workshop on how to develop and implement Water Safety Plans (WSP) in Chiang Rai on May 19-21, 2015. Attended by 22 participants including water services providers from Indonesia, Laos, and Thailand, the event introduced the basic concepts of a WSP and helped participants identify hazards and risks associated with the safety of water supply from catchment through treatment and distribution. Participants discussed barriers to address each risk. The workshop also highlighted PWA's capabilities in developing and maintaining WSPs resulting from past WOPs, and showcased PWA as a regional mentor in water quality management and WSP implementation.

## KNOWLEDGE PRODUCTS

Knowledge products include toolkits and other resources that document how partnerships can overcome services delivery constraints and demonstrate innovations in improving operational efficiencies or building climate resilience based on real practitioner inputs. During the ECO-Asia project, AECOM developed knowledge products on behalf of WaterLinks focusing on water loss reduction, septage management, and climate resilience readiness of water services providers. In the Alliance, AECOM shared toolkit development processes with WaterLinks to assist in new toolkit preparation.

With GWOPA and the WaterLinks Alliance support, WaterLinks drafted *“Adapting to Climate Change: A Toolkit for Coastal & Small Island State Water Utilities”*. The toolkit supports coastal and small island state water services providers to identify and evaluate climate change impacts on their operations and develop a sound response with a peer services provide for example through WOPs. The toolkit primarily drew on the principles and experiences from WaterLinks’ experience with a WOP between Yarra Valley Water of Melbourne (Australia) and the National Water Supply and Drainage Board of Sri Lanka and study on readiness of water operators to address climate change impacts from the ECO-Asia project.

WaterLinks and AECOM developed two WaterNotes – one on the PWA-Water Corp WOP and the other on Denpasar Water-Ranhill-Borouge WOP - to recognize climate resilience building of the recipient partners; effectiveness in

addressing water quality and water loss constraints; and public-private partnership in action.

As part of its outreach efforts, WaterLinks is disseminating these products to promote WOPs and its capabilities to link water services providers to overcome specific operational and technical challenges.

## WEBSITE

The WaterLinks website, [www.waterlinks.org](http://www.waterlinks.org), remains an essential portal for disseminating best practices and promoting twinning partnerships. Having maintained the WaterLinks website since 2011, AECOM transferred it to WaterLinks and supported website improvements. As a result, WaterLinks has updated the overall design of the website and refined its content during the Alliance project. WOP case studies and regional training remain key features as well as technical materials/knowledge products on good practices in water/wastewater services delivery and climate resilience development. WaterLinks is now fully managing the website, taking the lead populating the website with information from various WOP-related activities. To sustain website management, WaterLinks has recruited a full-time Information Technology Specialist who also supports outreach activities.

# ENSURING SUSTAINABILITY OF TWINNING AND REPLICATION ACTIVITIES

The Alliance helped establish a stronger foundation for WaterLinks to continue operating as a self-sustaining organization. The Alliance activities for WaterLinks institutional strengthening included staff recruitment and capacity building; strategic plan development; activities implementation; and networking/outreach to private sector and development partners.

To support institutional strengthening, AECOM managed two grants to WaterLinks totaling approximately USD 433,000 to fund operational costs including staff salaries; office provision; staff travel; documents preparation; website redevelopment; and events management. More importantly, AECOM collaborated hand-in-hand with WaterLinks to transfer its know-how and practical knowledge on WOP facilitation (based on the *WaterLinks Twinning Facilitation Guidelines*); replication events organization; knowledge product preparation; administration of grants; and introductions to public and private development partners.

## STAFFING AND CAPACITY BUILDING

The Alliance utilized a grants mechanism to support WaterLinks two full-time and several part-time staff in Manila including the WOP Program Coordinator, the Finance Officer, and the Executive Director to carry out all project-related activities. The Alliance also supported travel and office space costs.

AECOM closely worked with the Executive Director and WOP Program Coordinators to facilitate all WOP and replication efforts, transferring technical expertise and helping to broaden outreach in the process. AECOM organized three in-house training efforts for key personnel on how to follow and apply the *WaterLinks Twinning Facilitation Guidelines*. The Alliance also supported part-time technical specialists to work with WaterLinks in redesigning and restructuring its website and to help facilitate on-the-ground activities in Indonesia and Vietnam.

Initially, AECOM personnel together with WaterLinks staff led three

WOP initiation, establishment, and implementation activities in Indonesia, Philippines and Vietnam in the beginning of Year 1 of the Alliance (April 2013). In this phase, AECOM introduced WaterLinks to WOP partners and development partners and co-facilitated preparation of WOP concept notes, MOUs, and work plans as part of the WOP establishment process. Towards the end of Year 1, WaterLinks acted as lead facilitator in establishing the two remaining WOPs in Indonesia and Thailand while AECOM supported these efforts.

Following WOP establishment and during the implementation of all WOPs, AECOM initially took greater coordination responsibility, while WaterLinks helped monitor WOP progress. By the start of Year 2, WaterLinks, now familiar with WOP partners as well as other development partners engaged in WOPs, led the facilitation of WOP activities to achieve intended objectives. In this process, AECOM and WaterLinks as a team organized and participated in technical visits by mentor partners to their recipients, and vice-versa. AECOM and WaterLinks tracked WOP progress, captured key events, results, and lessons as part of the activity reporting to USAID and for WaterLinks publication development.

AECOM and WaterLinks established procedures to monitor activities and to enhance internal WaterLinks operations. Using an agreed monitoring system, AECOM held bi-weekly discussions with WaterLinks to update on WOP progress, replication events, and outreach activities. WaterLinks developed internal procedures including a General Personnel Policy and Financial Management Policy to guide in staff recruitment and funds

management. Since WaterLinks also facilitated activities funded by other projects and development partners (e.g. USAID Be Secure project in the Philippines and UN-Habitat GWOPA in Sri Lanka), it had applied these procedures to organize coordination requirements and optimize use of staff time.

## STRATEGIC PLANNING

The Alliance supported the development of medium- to long-term plans. In early 2014, WaterLinks organized an internal strategic planning/team building meeting to prepare its 2014-2016 Business Plan that built on the Alliance activities. The meeting gathered inputs from WaterLinks staff and AECOM. The Plan outlined four key priorities: (1) implementation of WOPs and review of past WOPs results to facilitate appropriate scale-up; (2) expanded development cooperation through outreach to a larger pool of partners including private sector, charities, foundations, and national water associations; (3) communications and outreach to promote WaterLinks and build brand equity; and (4) institutionalization of WaterLinks to gear towards performance improvement at all levels-organizational, activity and WOPs. **Table 5** summarizes the Business Plan priorities.



**TABLE 5. WATERLINKS BUSINESS PLAN 2014-2016 PRIORITIES**

PRIORITIES	Scope and Priorities	Activities
Promote Innovations in Water and Wastewater Services Delivery	WOPs	<ul style="list-style-type: none"> <li>• WOPs establishment and facilitation</li> <li>• Training and knowledge products development</li> <li>• Documentation and review of 70+ WOPs delivered to explore potential post WOP scale up, expanding the scope or coverage of model practices to impact larger beneficiaries</li> </ul>
Expanding WaterLinks Partner Support	Expanded Development Cooperation	<ul style="list-style-type: none"> <li>• Cooperation with Bilateral and Multilateral Agencies</li> <li>• Cooperation with Foundations, Charities and Private Firms</li> <li>• Services offered to Future Development Partners</li> </ul>
Building WaterLinks Center Brand Equity	Communications and Outreach	<ul style="list-style-type: none"> <li>• Website</li> <li>• Functional database</li> <li>• Master Classes</li> <li>• Knowledge Products</li> <li>• Knowledge events such as the WaterLinks Forum</li> <li>• WaterLinks Award</li> </ul>
Institutionalizing WaterLinks Center	WOPs	<ul style="list-style-type: none"> <li>• Strengthening Staff</li> <li>• Systems Implementation and Improvement at all levels</li> <li>• Staff capacity development in expertise in WOP facilitation development and replication of good practices</li> </ul>

WaterLinks organized two Board of Trustees (BOT) meetings to guide and confirm the 2014-2016 Business Plan support to ensure financial and institutional sustainability. The Board emphasized the need to ensure quality of WOP facilitation and results capture and to expand support to sustain sustainability. One BOT member departed while another from Australia's Yarra Valley Water joined. WaterLinks continues to find additional BOT members who can reach out and help gather new partners for support.

## OUTREACH AND NETWORKING

Outreach and networking remained a constant activity during the Alliance. Through an outreach specialist, WaterLinks drafted a Strategic Communications Plan which outlined targeted activities for connecting with various public and private development partners. As part of the Plan, WaterLinks created a new organization profile; prepared case studies of ongoing activities; coordinated outreach efforts with various public and private entities; and presented at numerous global,

regional, and local seminars and workshops. All staff participated in implementing the Plan.

WaterLinks and AECOM attended domestic and international events to promote WaterLinks and WOPs via presentations and to network with potential partners. **Table 6** summarizes key events where WaterLinks participated and presented.

Since the Alliance inception, WaterLinks with AECOM assistance held discussions and submitted 17 proposals to public and private development partners that included Coca Cola Foundation, Nestle Foundation, IBM, Borouge Inc., UN-Habitat GWOPA, the World Bank and others. Borouge Inc. agreed to support a WOP activity in Denpasar, Indonesia, while GWOPA and the World Bank established separate working agreements directly with WaterLinks to facilitate WOPs in Sri Lanka and in Central Asia.



**TABLE 6. KEY EVENTS – WATERLINKS PRESENTATION**

Event	Location	Date	Partner Water Services Providers
Stockholm International Water Week	Stockholm, Sweden	August 2013	<ul style="list-style-type: none"> <li>• Art of Partnerships</li> <li>• WaterLinks and WOPs in Asia Pacific</li> </ul>
GWOPA 2nd Congress and Assembly	Barcelona, Spain	November 2013	<ul style="list-style-type: none"> <li>• WaterLinks and WOPs in Asia Pacific</li> <li>• WaterLinks Facilitation Guidelines</li> </ul>
USAID Infrastructure Week	Washington D.C., USA	December 2013	<ul style="list-style-type: none"> <li>• WOPs in Water Quality Management</li> </ul>
The World Bank	Washington D.C., USA	December 2013	<ul style="list-style-type: none"> <li>• WaterLinks and WOPs</li> </ul>
African Water Association Congress 2014	Abidjan, Ivory Coast	February 2014	<ul style="list-style-type: none"> <li>• WaterLinks and WOPs in Asia Pacific</li> </ul>
Philippine Association of Water Districts 33rd National Convention	Cebu, Philippines	February 2014	<ul style="list-style-type: none"> <li>• WaterLinks and WOPs in Asia and Philippines</li> </ul>
Stakeholder's Forum on Indonesia International Water Week	Surabaya, Indonesia	May 2014	<ul style="list-style-type: none"> <li>• WaterLinks and WOPs in Asia Pacific</li> </ul>
Singapore International Water Week: WHO/IWA Side Event	Singapore	June 2014	<ul style="list-style-type: none"> <li>• WOPs in Water Quality Management</li> </ul>
PERPAMSI WOP Workshop	Bandung, Indonesia	June 2014	<ul style="list-style-type: none"> <li>• WaterLinks Facilitation Guidelines</li> </ul>



# LESSONS LEARNED

Within a period of two years, the WaterLinks Alliance successfully implemented five twinning partnerships, developed the institutional capacity of WaterLinks, and engaged in a number of regional and international knowledge sharing events. The past two years, coupled with our successes, were often filled with twists and turns that now provide useful lessons to future donors, private sector firms and NGOs alike who aim to work on twinning partnerships and/or in the field of water service providers. This section explains several of the main challenges the WaterLinks Alliance faced during implementation and the innovative solutions we developed alongside our counterparts and colleagues.

## TRAININGS

Fundamental to the WOP arrangement was training. Training provides key skills and knowledge through hands-on experience, in class learning, and best practices. However, in some situations, participants identified areas for improvement. Among these included the need for limiting the training group size in order to allow for more interaction and opportunities to interpret data needed for cost proposals. Additionally, the WOPs, particularly in Indonesia, recognized the need for follow-on support. PERPAMSI encouraged follow-ups after trainings by PBAPP, to give the learning structure a holistic approach.

## HUMAN RESOURCES

Lack of qualified and consistent trainers and recipients remained a constant challenge throughout the project. In Samarinda, internal rotations limited the effectiveness of several of the trainings offered through the WOP. Furthermore, without a core team, replication of DMA establishments suffered delays due to lack of internal coordination and overall funding allocation. Mentors, on the other hand, on occasion, lacked technical experts who were skilled trainers. For example, experienced Ranhill staff who participated in the training enabled better delivery of workshops, as opposed to its less experienced experts. While Ranhill staff were all technical experts, some possessed the necessary skills than others to carry out training events.

## FINANCIAL RESOURCES

While limited with financial resources, particularly on the part of the WOP recipients, sometimes progress was delayed. In these situations, such as in the case of PPCWD with the Campo Uno WTP, the Alliance encourage PPCWD to implement modifications as much as feasible. This resulted in improved treated water quality, even amid the financial constraints. Additionally, the Alliance discussed with LAWACO to request fund allocation from the phase II project that would address their existing plant's inefficiencies and provide a funding stream to cover the costs.

## ANTICIPATION OF DELAYS IN PROCUREMENTS

In Denpasar, there was the need to anticipate delays in procurement of equipment and tools due to internal administration procedures. While the WOP had closely worked with the Denpasar Water management team to ensure resources availability, internal processing procedures slightly delayed the specifications and purchase of data loggers and meters for DMA establishments.

Planning ahead was another key lesson, given that (1) Ranhill at the time had multiple commitments with other WOPs and its own day-to-day operations and (2) Borouge required approvals from several managers for releasing and approving the support. AECOM and WaterLinks fortunately had established relationship with Ranhill to recognize its scheduling, and took time to meet with high-level Borouge managers as needed to expedite the project approval process.

## POOR EXISTING INFRASTRUCTURE

A key challenge, as in many other WOPs, was setting aside allocations for greater improvement infrastructures during the course of the WOP. Although under WaterLinks this was a prerequisite for WOP participation, field practice usually limited time and planning required for service provider partners to work through its own internal processing. Therefore, WOP facilitation will need to recognize the funding allocation period more closely to sync with investments needed for WOP activities.

## LANGUAGE BARRIERS

Particularly in Vietnam and Thailand, WOPs language barriers often created challenges to implementation. To address communication shortcomings, AECOM and WaterLinks placed extra effort to engage a local coordinator/technical expert during all WOP events who helped bridge all discussions and helped increase partners' understanding. For PWA, Water Corp also involved a staff member from Thailand throughout the WOP to facilitate and coordinate activities.

## POLITICAL ENVIRONMENT

One challenge was the delay in WOP implementation due to the unstable political situation in Thailand that pushed activities back for about six months. The partners however remained committed and flexible, and were able to collaborate in a compressed timeframe to achieve key objectives. Possessing flexibility in WOP implementation therefore was a key lesson for effective partnerships.

## WATERLINKS

A key effort of the WaterLinks Alliance has been to develop sufficient internal operating procedures to enable WaterLinks to continue operating in a sustainable manner. It became clear of the course of implementation that a written, targeted business plan and organizational strategy are of great importance to ensure that in the course of natural staff turnover there is no loss of institutional capacity or strategic vision. In addition, it is

important to develop a performance feedback mechanism, to identify and correct any weaknesses in the training process for new staff.

## PUBLIC PRIVATE PARTNERSHIPS

Communication between partners is of great importance to the successful conclusion of a partnership between private and public institutions. Different organizational cultures and operating procedures can cause friction and delay even when well communicated, and if not communicated can damage the relationship between partners. In the event of unforeseen delays, threats, or opportunities, implementers should swiftly communicate with partners who can then provide feedback on any knock-on effect within their organizational framework with regards to timing or the availability of promised support.

Each of these challenges is difficult in their own right, but when combined, can they make implementation nearly impossible. Through the hard work of the WaterLinks Alliance team and our counterparts to develop innovative solutions, the twinning partnerships achieved great strides in improving water quality and service provision throughout Thailand, Indonesia, Vietnam, and the Philippines.

# WAY FORWARD

The Alliance has worked to set building blocks for WaterLinks to operate and establish its foundation for financial sustainability. To build its core capabilities of partnership management, AECOM jointly facilitated WOP activities with WaterLinks by providing hands-on training on WOP development. In the process, AECOM not only built the capacity of WaterLinks to facilitate partnerships, but also expanded or improved services delivery and strengthened climate resilience.

To expand visibility for WOPs and promote replication of best practices, AECOM also collaborated with WaterLinks to organize regional events and develop knowledge tools that promoted replication of good practices and technical innovations in water services delivery. Finally, AECOM introduced various private and public partners to WaterLinks in support of WaterLinks outreach. AECOM promoted WaterLinks in multiple local, regional and global events and networked with development partners and private sector affiliates to take part in selected WaterLinks activities.

While the Alliance has helped strengthened WaterLinks institutionally, it has also identified shortcomings for further improvements. The following highlights key needs that will further

benefit WaterLinks in moving forward to secure is technical and financial sustainability.

## ORGANIZATIONAL OPERATIONS

While WaterLinks has made great strides institutionally, more work is required in further preparing internal operating procedures. Additionally, feedback on performance could help incoming staff understand better strengths and improvement needs.

## OUTREACH

The Alliance has helped recognize WaterLinks as the pioneer and premier WOP facilitator in the Asia-Pacific region. New development partners such as UN-Habitat and the World Bank have discussed cooperation with WaterLinks. Services providers in the region meanwhile have continued to demand assistance for WOPs from WaterLinks.

While the Alliance has introduced WaterLinks to private sector partners, further outreach and follow-up remain crucial. The relationship and cooperation model with Borouge for instance could be replicated with new private sector partners. Connecting with local private sector foundations and entities in various Asian countries could also bring WaterLinks closer to supporting water services delivery

improvements and building service provider resilience to climate change impacts. This would require WaterLinks to partner with in-country partners, such as with PERPAMSI in Indonesia. WaterLinks may also benefit by linking with established non-profits such as Water.org or the Gates Foundation to implement activities on their behalf.

WaterLinks could also expand and improve outreach through social media and better infographics of past WOPs. Preparation of new printed materials and continued updating of the WaterLinks website could further strengthen outreach efforts.

Improvements in organizational arrangements and outreach will elevate WaterLinks further and attract funding for long term sustainability. WOPs remain in demand and have proven a worthwhile development model. Multilateral banks could follow-up with grants and loans following a WOP to implement operational efficiencies and services delivery improvements. With WaterLinks covering an important region, it is in position to link and work with public and private sector partners in improving water services access and in building resilience against climate change impacts.



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