Water is Life..

Foreword

As the fourth most water-impoverished country in the world, Jordan has stood face to face with water shortages for more than two decades. The annual amount of water availability per capita is less than one-third of the international water-poverty line. Global climate change may lead to greater strain on already limited resources. This ongoing water shortage has caused drastic over pumping of groundwater aquifers that has resulted in a major decrease of available water. On the other hand, Jordan's stability, tourism attraction, and the quality of its business and health services make it as a prime regional hub for investment. This challenging situation provides a great opportunity for Jordan to efficiently use each drop of its water.

The government of Jordan began taking steps since late 1980s to improve water management through policies, regulations, institutional reforms, and the use of new technologies. Water-use efficiency programs were launched afterwards to promote water conservation in the agricultural sector which uses more than 60 percent of the national water resources. In early 2000, the Kingdom embarked on a nationwide program to introduce urban water-use efficiency to the public and create a culture of water conservation for all parts of society. This was followed in 2007 by an institutional program that developed a water-demand management policy for the urban and agricultural sectors, and established the institutional model for urban water demand management at the Ministry of Water and Irrigation, the water utilities, and relevant public and private institutions. The program produced a set of water saving standards and a plumbing code for water-use efficiency. It also identified large consumer categories and conducted water audits and surveys to better help users understand their water use and pinpoint potential water use efficiency measures. A menu of best management practices was prepared for each water-use category to make efficient use of supplied water and benefit from water saving. The saved water will be accompanied by savings in energy and wastewater treatment and financial benefits, and will provide additional resources to reduce water shortage. The water use efficiency best management practices are presented in seven guides covering the residential, health, and tourism sectors, high rises, office buildings, and landscaping, as well as a guide for communication.

The introduction of this hospitals water use efficiency guide to the health sector will help this sector benefit from the best practices and technologies for water-use efficiency in both existing and new health facilities.

Acknowledgements

This guide was prepared by Mohamed Chebaane and Bill Hoffman with assistance from Eyad Barakat, Louis Qaqish, Nour Esoh, Hala Dahlan and Lara Zureikat, under Instituting Water Demand Manegement Project (USAID-IDARA).

Special thanks to Setta Tutundjian, USAID, for her valuable input and her effective review of this guide.

Special appreciation to the Water Demand Management Unit, Ministry of Water and Irrigation, for their thorough review of this guide

Sincere thanks to the following members of the hospitals BMPs guideline committee for their beneficial contribution:

- Tony Gregg, USAID-IDARA
- Rania Abdel Khaleq, Ministry of Water and Irrigation
- Fatin Sha'aban, WDMU, Ministry of Water Irrigation
- Ola Alqawasmi, WDMU, Ministry of Water and Irrigation
- Joumana Al Ayed, Miyahuna
- Amr Khattab, Miyahuna
- Mustafa Al Assaf, WAJ, Ministry of Water and Irrigation
- Ma'ab Abu Saleem, Royal Scientific Society
- Hanada Khbeis, Ministry of Public Works and Housing
- Mahmoud Al Zoubi, Jordan Standards and Metrology Organization
- Mohammed Abu Taha, Jordan Engineers Association
- Munjed Al Sharif, Jordan University of Science and Technology
- Maha Halalsheh, The University of Jordan
- Hayat Bakir, Jordan Forum for Business and Professional Women
- Bashar Al Ali, USAID-IDARA

High appreciation to the following institutions for their invaluable review of the BMPs:

- Private Hospitals Association
- King Hussein Cancer Center
- AlEssra Hospital

Deep appreciation to Cory Eldridge for his excellent editing work

Contents

Introduction

Hospitals in the Kingdom are highly developed and constitute a regional hub for healthcare services. The health sector is among the large water consumers in Jordan. Water audits conducted in ten hospitals show that considerable savings in water and money can be made by adopting water-use efficiency best practices. This guide was developed to help the health sector to be water efficient. It provides owners, managers, developers, planners, designers, builders, water providers, operators, and staff with water use efficiency best practices that apply to both existing and new hospitals.

The guide leads you through a step by step process that presents the reasons for saving water, where and how much water is currently used, and where and how to save water. A list of tips and technologies for best management practices are provided for indoor- and outdoor-water uses, including water use in inpatient rooms, common areas, offices, restaurants and kitchens, laundry, heating, cleaning, medical processes, and landscaping. The guide also helps you identify and fix leaks, manage water pressure, and accurately monitor water use. It offers you opportunities to benefit from potential alternative-water sources such as harvested rainwater, gray water, and treated wastewater.

To help you build a strong business case for adopting a water-use efficiency program, a cost-benefit analysis is presented for selected best management practices. This is illustrated by a case study that demonstrates investment cost, savings benefits, payback periods, and benefit-cost ratios for various water conservation interventions. A series of implementation tools are also illustrated, including the policy, code, and regulations that make water-use efficiency possible, the various public and private institutions that support water conservation, steps for successful management of a water use efficiency program, and a comprehensive water-saving checklist[1].

[1]Since technology changes over time, the information in this guide needs to be updated periodically

Understanding your Water Use

PART 1

Why Save Water in Hospitals?

It Saves You Money

Saving water means reducing your water and wastewater bill. It also means reducing your energy bill because you will pump less water, heat less water, and have more water recycling for heating. Water savings will lower treatment costs and capital costs by scaling down pumps and water heaters. Being more water-efficient means you can run your business and still have water available for tomorrow.

It Helps You Gain National and International Recognition

Saving water puts you in good position to compete for national awards such as the prestigious King Abdullah Center of Excellence Award, which includes water-efficiency as a key sub-criterion. It also prepares you to qualify for national and international green building certifications. These awards and certifications put you at the vanguard of the competition.

It is a Noble National Cause

Every drop of saved water provides an opportunity for increased supply for other users who are in dear need of it, especially during water shortages and drought periods. Water saving contributes to sustainable water use, a national responsibility of the public and private sectors and all citizens.

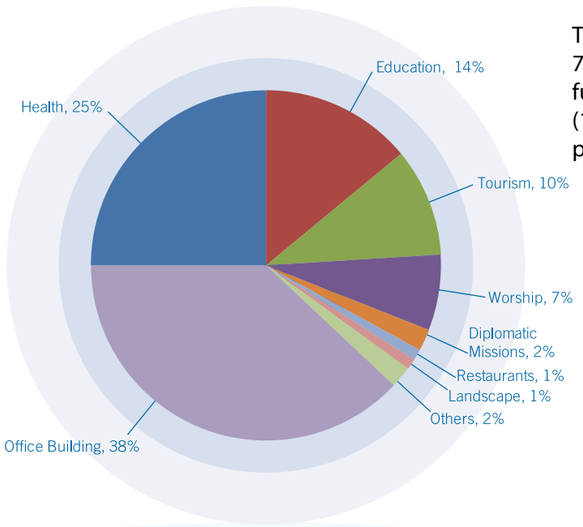
A Snapsot of Hospital Water Use in Jordan

Where and How Much Water is Used?

Hospitals and medical facilities are major consumers of water in Jordan. Billing data from Jordan Water Company (Miyahuna) show that health facilities account for 25 percent of institutional and commercial water consumption in the capital.

To help users understand water consumption in Jordanian hospitals, water audits and end-use analysis were conducted at ten Jordanian hospitals in 2008.

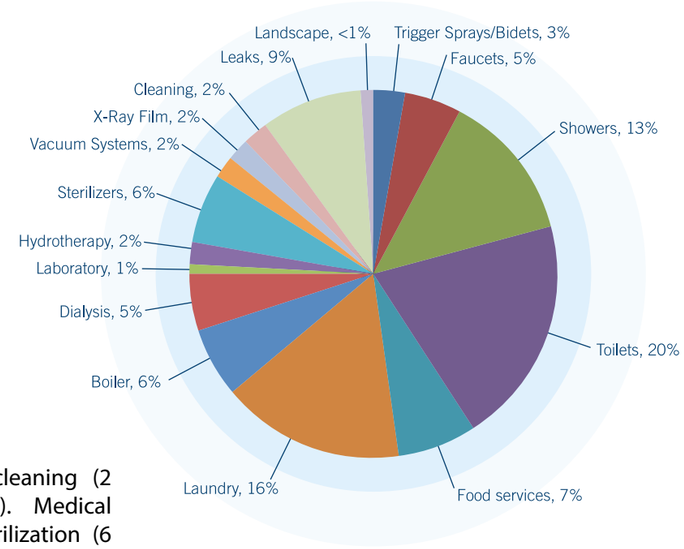
The hospitals water use profile shows that around 73 percent of a hospital's water is used in domestic functions, including toilets (20 percent), laundry (16 percent), showers (13 percent), food services (7 percent), boilers (6 percent), faucets (5 percent),



Water Consumption for Non-Residential Users in Miyahuna Service Area

Where is your water going?

Water-use Profile for Ten Jordanian Hospitals



trigger spray and bidets (3 percent), cleaning (2 percent), and landscape (<1 percent). Medical processes use 18 percent, including sterilization (6 percent), kidney dialysis (5 percent), hydrotherapy (2 percent), X-ray films (2 percent), vacuum systems (2 percent), and laboratories (1 percent). The remaining 9 percent is lost by water leaks. The average daily water use for Jordanian hospitals is 916 liters per occupied bed.

Water-use Baselines versus Water-use Benchmarks

The water-use baseline is the average water consumption for each water-use category, fixture, appliance, or process obtained from the ten audited hospitals. A water-use benchmark is the targeted water use based on best management practices and standards recommended for each water-use category, fixture, appliance, or process in Jordanian hospitals. Achieving the benchmark is the goal of a water-efficient facility.

Where and How to Save Water?

The water savings is the difference between the baseline and the benchmark for water use. The analysis of water use at the audited hospitals revealed that around 30 percent of the water used could be saved. The current and recommended water use specifications table shows the baseline average water-use, the benchmark water-use, and the potential percentage of water savings for key fixtures and processes. Considerable savings can be achieved when you adopt the standards for plumbing fixtures and the best management practices for processes. Savings can also be accomplished as a result of good behavioral practices as presented in the best management practices section.

Current and recommended water use specifications for key plumbing fixtures and processes in Hospitals

End Use Area	Baseline average water use for fixtures[2] and processes	Benchmark water use for fixtures[3] and processes	Potential Percent Savings
Private Lavatory Faucet	10 liter/min	4.5 liter/min	55%
Public Lavatory Faucet	10 liter/min	4.5 liter/min or 1.0 liter/cycle[4]	55%
Showerhead	12 liter/min	7.6 liter/min	37%
Toilet	7.8 liter/flush	4 liter/flush	49%
Urinal	6 liter/ cycle	1.9 liter /cycle	68%
Kitchen faucet	20 liter/min	8.3 liter/min	59%
RO Water Treatment	3 liter rejected for 1 liter produced	1 liter rejected for 1 liter produced	50%
X-Ray film processing		Digital- no water	100%

[2]Based on the 10 audited hospitals
[3]Based on Jordan Standards and Metrology Organization (JSMO) standards and technical regulations
[4]Based on 12 seconds per one use

Hospital Water Audit

A water audit[5] is essential for identifying where and how water is used in your hospital and helps you establish a business case for identifying potential water use efficiency opportunities. These are the key objectives of a water-use efficiency audit:

- Understand the water supply and distribution systems
- Identify water-use patterns
- Identify deficiencies in the water network system, including leaks and wastage
- Identify baseline and benchmark water use
- Identify water conservation opportunities, including water reuse

Performing a water audit at your hospital requires the following steps:

1. Preparation and information gathering. A thorough preparation will maximize the efficiency of your audit. It includes a preliminary visit to the site that covers:
   - Identification of decision maker (owner, business manager, etc.) and operation manager.
   - Collection of information regarding hospital address, contact information, physical size of the facility and its various buildings.
   - Inspection of access to water supply and sanitation distribution systems.
   - Gathering information on operating schedules, occupancy rate, and average number of patients, visitors, and employees.
   - Identification of type of indoor and outdoor water usages, water supply sources (utility, private tankers, private well), and any water harvesting.
   - Gathering of any previous water and energy audits, available records about water use metering and sub-metering, and water-energy billing. These records are used to create a preliminary estimate of per bed water use to determine whether or not your hospital is a high water-use facility.

2. Conducting facility survey to:
   - Walk through the hospital with the people, who are familiar with the daily operations, particularly the manager of operations and maintenance, to understand how water is used in the various areas of the facility. Interview relevant hospital staff and employees to confirm the information obtained in the preparation phase. Establish assumptions such as the frequency of use per day of the plumbing fixtures (faucets, toilets, urinals, showers, etc), water use per meal, water use per cleaned bed, etc.
   - Check water-using equipment such as boilers, coolers, water processing systems, laundry and kitchen appliances, plumbing fixtures, and medical equipment (X-ray processing systems, dialysis machines, sterilizers). It is also important at this time to discuss any recent water use efficiency improvements or changes.
   - Measure flow-rates for each type of water-use fixture and the amount of water-use for each type of water-consuming equipment. Direct flow-rate measurements can be done by using a bucket or plastic bag and a stopwatch. It can also be determined by using temporary strap-on meters on water pipes. Measurements of the volume of toilet flushes can be determined by special volumetric metering devices or estimated based on the toilet tank and observation of the actual flush. These measurements of plumbing fixture flow-rates and amounts of water use by the various equipments will help identifying inefficient fixtures and equipment, leaks, and inappropriate water use. This step also includes recommendations for sub-metering of major water- uses such as laundry and heating.
   - Estimate outdoor water use, especially water used for landscape irrigation. Obtain data for irrigated areas, water requirement of all irrigated vegetation, and inventory of water delivery systems and devices (sprinklers, drippers, etc.) to determine irrigation volume.

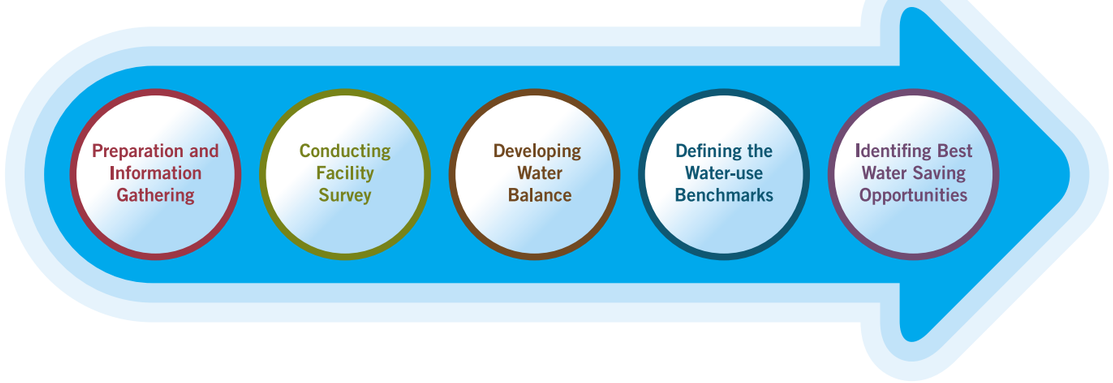
[5]Audits should be done on a recurring basis, preferably once every two years.

   - Measure water quality to determine parameters such as pH, conductivity, total dissolved solids (TDS), and temperature. This will identify water-saving opportunities such as the increase of water-cooling and water-heating cycles based on TDS values, and rerouting of water from one process to another. For instance, water dialysis reject can be use for laundry.

3. Developing a water balance for the water use baselines defined above, and make sure that the hospital total indoor and outdoor water consumption including leakages, if any, matches the total water-supply figures from the utility, private tankers, private wells, and other sources.

4. Defining the water-use benchmarks following the plumbing fixtures and appliances efficiency standards and best management practices shown in Part 2. These benchmarks are essential for identifying your water-savings target.

5. Identifying best water-saving opportunities based on baseline and benchmarks water uses, and prioritizing these opportunities according to amount of water savings, cost of saving, and payback period.



Best Management Practices

PART 2

Defining Best Management Practices

Best management practices (BMPs) are a set of hands-on recommendations that help you identify opportunities and implement programs to save water in your hospital. BMPs are developed for the various water-use categories in Jordanian hospitals and for monitoring and operational procedures. They are grouped according to domestic water-use, medical processes water use, landscape water use, and monitoring and operational procedures. You can tailor your water-saving program by using part or all the BMPs depending on your budget and your environmental and regulation requirements. Tips and information are provided on water-saving amounts and cost recovery to help you prioritize your measures and make the most bang for your buck.

Saving in Domestic Water Use

Hospital domestic water use includes water used in faucets, showers, toilets, spray triggers/bidets, food services, laundry, boiler, cleaning, and landscape. According to the audit on water use at ten Jordanian hospitals, domestic use accounts on the average for around 73 percent of the total water use and offers great opportunities for water savings at affordable costs and with reasonable payback periods.

Faucets and Showers

Faucets and showers use close to one fifth (18 percent) of hospital water use. In some of the audited health facilities faucets run at up to 20 liters per minute and showers flow at more than 18 liters per minute. Faucets and showers flows can easily be reduced without affecting the comfort of the water user by using appropriate flow regulator technology[6] for these fixtures. This will result in impressive savings of around 40 percent of faucets and shower water use as shown in the water use specifications table. Flow regulators, especially the aerators[7] are inexpensive, some cost around JD 2.5 a piece, and are easy to install and maintain. This is why they are often considered as the low hanging fruits of water saving programs. Here are the recommended best management practices for achieving water savings for faucets and showers at your health facility.

Faucets

- Use pressure compensating and tamper proof aerators that can only be removed with a 'special' tool to reduce vandalism and theft.
- Use self-closing faucets in public lavatories.
- In medical areas, install laminar flow faucets or in-line flow restrictors, instead of aerators, to avoid trapping airborne pathogens in the water. Sensor faucets or foot-pedal-actuated faucets reduce the potential for cross-contamination by touching faucet handles.
- Respect recommended flow rates for the various uses that are illustrated in the table.
- Regularly clean faucets as sediments may accumulate and reduce the flow.

Recommended flow rate for different type of uses	
Public hand-washing faucet or Self-closing faucet	≤ 4.5 liters/min ≤ 1.0 liter/cycle
Patient room faucet	≤ 4.5 liters/min
Kitchen faucet	≤ 8.3 liters/min
Surgical scrub station faucet	≤ 8.3 liters/min

Showers

- Use shower-head aerator with a recommended flow rate of less than or equal to 7.6 liters per minute.
- Mixing-valves with water-temperature settings should be used in all patient showers to prevent scalding. Use appropriate circulation system to avoid cold water wastage.

[6] Flow regulators have been standardized by the Jordanian Standards and Metrology Organization (JSMO) as shown in the water use specifications table.

[7] Aerators reduce the water coming through the faucets or showerheads by mixing it with air and maintaining a constant pressure (if the aerators are pressure compensating). This is why most people don't notice a difference in the amount of water coming out of an aerated faucet or showerhead.

Toilets

Toilets use around 20 percent of hospital water consumption. The majority of toilets in Jordan hospitals are gravity type, though there are also Turkish (squat) toilets. Based on the audited hospitals in Jordan, current Toilets flushing varies from 2 liters/use for bucket type Turkish toilets to more than 10 liters/flush for gravity toilets, with an average baseline 7.8 liters per flush. Standards for high efficient toilets (HET) have been set by JSMO and were passed as technical regulation. Recommended flushing volumes are 6 liters per flush for single flush toilets and an equivalent of 4 liters per flush for dual flush toilets. The Royal Scientific Society (RSS) constructed

Recommended flow rate for different type of toilets	
Dual-flush toilets	≤ 3/6 liter/flush[8]
Single flush	≤ 6 liter/flush

a water efficiency laboratory in 2010 to test locally manufactured and imported plumbing fixtures and appliances for compliance with JSMO technical regulations. Replacing old toilets having an average of 7.8 liters/flush with 4.0 liters/flush dual flush toilets will result in a reduction of nearly 50 percent of toilet water use with a payback period exceeding 10 years. More cost-effective results can be achieved by replacing only the toilet flushing (trim) system.

Don't Flush Your Money Down The Drain

- Follow recommended flush volumes for toilets as illustrated in the table.
- During adjustment or replacement of the flushing system, make sure you don't impede waste removal or violate the manufacturer's recommendations.
- Test for leaks and make necessary repairs promptly. Dye-test all tank type toilets for "silent leaks" every six months by putting tablets or several drops of food coloring in the tank. Do not flush. Wait ten minutes. If the dye shows in the bowl, the toilet is leaking.
- Keep the toilet in working order by periodically inspecting and replacing flappers and other defective parts.

Trigger Sprays, Bidets, and Urinals

Trigger sprays, bidets, and urinals water use account for 3 percent of hospital water use. Current flow rates for trigger sprays, bidets, and urinals in Jordan

Recommended flow rate for bidets and urinals	
Urinal	≤ 1.9 liter/cycle
Bidet	≤ 4.5 liter/min
Trigger Spray	≤ 4.5 liter/min

often exceed the new Jordanian water and sanitation plumbing code recommended standards. The standards shown in the table, offer a good water-saving opportunity for owners and managers of hospital facilities. The new code also allows waterless urinals under specific designs that respect hygiene and environmental considerations.

Laundry

Laundries are high water-use areas in hospitals. In Jordan, laundry operations consume 16 percent of a hospital's water. You have excellent opportunities for saving water and energy in your laundry operation. This can be achieved by the following water-efficient practices.

Pre-washing

- Sort laundry by level of cleaning needed.
- Use laundry scales to weigh loads.
- Operate laundry equipment with full loads only.
- Set the number of cycles to accomplish the proper cleaning. Eliminate unnecessary cycles.
- Where possible, lower the level of water in a cycle.
- Select appropriate washing chemicals (detergents, softeners) that require fewer wash and rinse steps.

[8]Equivalent to an average of 4.0 liters/flush

Appliances and Equipment

- For large laundry volumes, use tunnel washers that can reduce water use by 30 to 60 percent compared to washer-extractors.
- Use water- and energy-saving equipment following national standards and labeling programs, when available.
- Use water recycle or ozone equipment when feasible. This can reduce water use up to 50 percent.
- Choose easily programmable equipment to use no more water than what is required for cleaning a load.
- Choose dryer equipment with dry lint collection systems.

Food Services

Water used in food services represents approximately 7 percent of a Jordanian hospital's total water consumption. Kitchens are main areas of water use and are choice targets for water and energy conservation. Here is a menu of BMPs for saving water in your food services operations.

Refrigeration

- Use adequate refrigerators to thaw frozen foods instead of thawing under running water. Thawing under flowing water is always wasteful and should be avoided whenever possible. If water thawing is required, use a low flow stream. Do not use running water to melt ice in bar-sink strainers.
- Eliminate all water-cooled equipment using once-through cooling and replace them with air cooled models that don't require any water for condenser cooling. This applies to icemakers, refrigeration equipment, and ice cream machines. Air cooling with remote (outside) compressors that exhaust heat outside the building is recommended.

Cooking and Food-Service Equipment

- Use dry-steam tables that use no water to keep food hot while serving.
- Return and reuse condensate for all boiler-type kettles and properly size steam traps to operate efficiently and not inadvertently dump condensate. Insulate condensate return lines.
- Food steamers should be self-contained and connectionless because they don't need a water supply or a wastewater drain. Boiler-less steamers are also recommended.

Waste Disposal

- Eliminate garbage disposals and sluice-trough systems in favor of garbage cans and strainer baskets. Strainer baskets also eliminate the need for a pulper system, thus eliminating water and energy use for disposal.

Dishwashing

- Use pre-rinse dishwashing spray valves with water flow rate of 6 liters per minute or less. Spray valves should not be locked in the open position.
- Dishwashing equipment is more efficient than hand washing.
- Use dishwashers only with full load.
- Install steam doors on dishwashers to reduce evaporation loss of water.

Select water and energy saving kitchen appliances and equipment following local standards and labeling programs, if available

Steam and Water-heating Boilers Operations

Around 6 percent of water-use in Jordanian hospitals is consumed by boilers for various purposes including hot-water supply, comfort heat for building spaces, and steam for kettles, diswashers, laundry, and sterilizers. Steam boilers offer many opportunities for water- and energy-savings. Here is a list of BMPs that help you save water and energy.

- Don't use a central steam boiler in hospital operations. Instead:
  - » Use stand-alone steam boilers for sterilizers with condensate return where applicable.
  - » Use separate hot-water boilers for laundry, food service operations, faucets and showers, and comfort heating.
- Install make-up meters for cold feedwater lines on important steam-boiler operations.
- Install steam-condensate return to all steam boilers and meter condensate return when feasible.
- Use conductivity controllers for automatic blowdown of boilers which will better manage the treatment of boiler make-up water and maximize the cycles of concentration. For most hospitals, steam boilers operate in the range of 15 to 40 cycles of concentration.
- For hot-water boilers, have boiler temperature and make-up meters clearly visible to the operator.
- Regularly check steam traps and lines for leaks and make repairs as soon as possible.
- Follow all the procedures related to heating in the Jordanian new water and sanitation plumbing code.

Comfort Cooling

None of the audited hospitals in Jordan uses water cooling systems for air conditioning. Because of the Kingdom's water scarcity, they use split-unit air cooling systems or air-cooled chillers instead of evaporative cooling. This practice should be maintained for existing and new hospital facilties. It is enforced by the new water and sanitation plumbing code, which stipulates, "Cooling systems that evaporate potable water shall be prohibited for district cooling plants."

Cleaning Operations

Cleaning operations consume around 2 percent of hospital water use in Jordan. Most hospitals have a variety of cleaning and rinsing applications that can consume large volumes of water. The cleaning practices presented here can add up to significant water savings in your health facility.

- For outdoor areas such as sidewalks and parking lots, use brooms and dust-pans. Water should not be used to clean these areas.
- For indoor areas, follow these recommendations:
  - » Use a broom and dust-pan to clean solid wastes before mopping.
  - » Install a self-closing nozzle on the wash-down hose, so the water will not run when not needed.
  - » Use new enzyme floor-cleaning products for areas that have a lot of grease residue such as kitchens. The new enzyme products help break down grease on the floor and do not require large volumes of water for cleaning.
  - » Install drains close to areas where liquid discharges are expected.
  - » Use a squeegee to push water to the floor drain prior to the final rinse.
  - » Use pressurized, air-assisted spray nozzles to provide more cleaning force with less water.
- Reuse reject water or process water from other parts of the facility for mopping, provided this complies with health regulations.

Saving in Medical Processes Water Use

The medical processes water use is surprisingly high, making up about 18 percent of hospital water consumption. This is more water than laundry services uses, and is about three times the water needed for steam and water-heating boilers. Dialysis[9] uses 5 percent of this water, and sterliiziers (6 percent) use nearly as much water as boilers and only slightly less than kitchens (7 percent). X-ray filming, hydroptherapy and vacuum systems use 2 percent each, and labortaries consume 1 percent of a hospital's water. Considerable water savings can be accomplished by adoptintg the following water conservation practices.

Dialysis

- Select Reverse Osmosis (RO) equipment that minimizes water rejection to a one-to-one ratio. Replacing existing one-to-three ratio water rejection RO systems with one-to-one ratio systems will result in 50 percent water savings.
- Capture RO reject for reuse in laundry operation, irrigation or other appropriate purposes.

Sterilizers

- Prohibit use of Venturi-type vacuum systems on steam sterilizers.
- Use dry sterilizers instead of Venturi systems.
- Where available, connect steam sterilizers to the hospital central vacuum system.
- Return condensate to the boiler instead of discharging it to the drain.
- Equip all stand-alone steam sterilizers with condensate-tempering systems. Recover this condensate water and reuse it in laundry operation, irrigation, or other appropriate purposes.

Vacuum Pumps

- For medical and dental vacuum pump systems, use dry vacuum systems to eliminate water use and save energy.
- Prohibit Venturi aspirator vacuum systems.
- Eliminate liquid-ring vacuum systems by using mechanical dry vacuum equipment.

X-ray Equipment

- Use digital X-ray imaging equipment instead of film X-ray equipment to eliminate water use.
- For existing non-digital X-ray equipment
  - » Install water-saver kits on the cooling water loops of the film developers to eliminate continuously flowing cooling water.
  - » Recycle rinse-bath water as make-up for the developer/fixer solution.
  - » Install a pressure-reducing device on equipment that doesn't require high pressure.

Hydrotherapy

- Determine and use the exact volume of water required for each hydrotherapy tank. Record the use.
- Follow proper practices for cleaning and disinfection of vessels .
- Where large pools are used and the risk of cross infection is not a major issue, filtration and disinfection equipment should be installed to circulate and clean the water rather than dumping the water.

[9]An average person drinks 10-14 liters of water per week. An average dialysis patient is exposed to 1,050 to 2,230 liters of water per week.

Saving in Landscape Water-use

Landscape water use averages less than 1 percent of the total water used in Jordanian health facilities. True, it appears to be a very small amount, but why not adopt more efficient watering to cut this percentage down or even expand your landscape using alternative water sources? The rate by which water is lost through evaporation, soil infiltration, and plant transpiration as well as the soil-holding capacity and the size of the area you irrigate control the amount of water you need for your facility landscape. A lively and colorful landscape can be created using a series of water-conserving landscape practices. The following principles are recommended to create water-wise landscaped areas:

Water Wise Planning and Design

Proper planning during the design phase of any landscape project can significantly reduce water use by:

- Conducting a comprehensive site analysis to maximize benefits from local-climates, sun/shade exposures, topography, and wind protection.
- Employing Proper zoning of functions according to water use is essential. A minimum amount of water should be allocated for areas with the least amount of use, while highly visible areas can be given more water.
- Hydro-zoning of plants by using plant grouping according to water need.
- Utilizing appropriate mixes of hard and soft areas to minimize both water consumption and maintenance cost.

Soil Analysis and Improvements

Soil textures in Jordan range from clay loam mixtures to sandy soils. To improve your landscape soil:

- Add organic matter to soils before planting to increase their water holding capacity, and improve plant growth and efficient use of water.
- Avoid soil compaction, as it reduces water and air circulation in the soil.

Plant Selection

A wide range of low water-use plants is available in the market. The following needs to be considered when selecting appropriate water-wise plants:

- Group plants with similar water needs together
- Utilize only drought tolerant, native plants ,trees and deep rooting shrubs
- Less emphasis should be placed on small shrubs, perennials and groundcovers

Limiting Grass Areas

Grass areas consume high quantity of water and need excessive maintenance. For this reason the following practices are recommended:

- Limit the size of the grass areas and use it only to provide functional benefits.
- Use only drought tolerant grasses such as Bermuda or Paspalum.
- Prohibit the use of grass to provide a green appearance when groundcovers or low shrubs offer an acceptable alternative.

Efficient Watering

The most efficient water use practices include:

- Use efficient drip irrigation system for large landscapes
- For new and large health facilities landscape, consider automated system for large landscapes if proper supervision by qualified staff could be guaranteed
- Use sprinkler systems only for turf areas
- Prohibit hose watering and watering using the hose of transport tanker
- Water in the early morning or late evening to maximize absorption and minimize evaporation
- Adopt your frequent irrigation to changes with the season and the local weather variables such as temperature, humidity, wind and hours of sunlight
- Consider grading and directing surface run-off and rainfall gutters to landscapes
- Consider alternative water sources for irrigation, including reused gray water and harvested rainwater. These alternatives are discussed thoroughly in Part 4 of this guide.

Use of Mulches

Mulches (organic or inorganic) should be applied at the base of all plants to retain soil moisture and reduce the growth of weeds

Maintenance Practices

Appropriate maintenance practices are essential to sustain your water-wise landscape and achieve the desired water savings and appearance. These practices include:

- Use proper pruning, weeding, and fertilizing methods.
- Establish a regular maintenance program for irrigation systems and checking for leaks and damaged equipment

Saving Water Through Monitoring and Operational Procedures

Identifying and Fixing Leaks

The average water-use profile for the audited Jordanian hospitals shows that water loss via leaks in hospitals is considerable; it represents approximately 9 percent of the total use. Hidden water leaks can be wasting considerable water and energy without anyone being aware of it. Even what appears to be a small leak can amount to large volumes of water loss. Leaks become larger with time, and they can lead to other equipment failure. Fix that leaky pipe, toilet, faucet, or roof top tank and you will be amazed at how much money and water you can save. The establishment of a leak detection and repair program would be your most cost-effective way to save money and water in your health facility. Here are best practices to assist you in establishing and benefitting from this program:

- Management is committed to providing the staff and resources needed to maintain plumbing fixtures and equipment on a regular basis and assuring prompt identification and repair of leaks.
- Repair staff is given the tools needed and is trained to make leak repair a priority activity.
- Staff is taught to report leaks and other water-using equipment malfunctions promptly.
- Staff is rewarded for success.
- Standard leak-repair equipment and parts are kept on hand so that repairs can be made without needing to wait for parts to arrive.
- Rooftop tank overflow or leakage water should flow to rainwater gutter system not to sewage system to allow detection of rooftop water loss.
- Records of the type, location, number, and repair of leaks are kept in a central location.

Water Metering and Sub-metering

Without accurate measurement tracking of your hospital's water use, improving water use efficiency is extremely difficult, if not impossible. Monitoring your water use allows you to know where and when water is being used and where your best opportunities for water savings exist.

Metering Water Supply

To accurately track your hospital's water use, it is essential to meter all your sources of water supply from the water utilty and other sources such as private tankers, your own wells, and harvested rainwater.

- Coordinate with the water utilty to ensure the utility's water meter is working properly.
- Install water meters to accurately measure each of your other sources of supply, if you have any. For water tankers, keep record of all supplied amounts.
- Test all meters on a regular basis to ensure their accuracy.
- Keep track of and file electronically all your water supply records on a monthly basisis.
- Graph and analyze the data on a monthly basis to:
  - » Identify any abnormal increases due to leaks and any errors related to data reading and recording.
  - » Track water saving and evaluate your efficiency interventions.

Sub-metering Water Use

Track the volume of water used by sub-metering the major water-using equipment and processes within the hospital. This includes any equipment or function (water treatment, kitchens, laundry, laboratories, sterilizers, landscape, etc.) that uses a major portion of the facility's water and those that use more than ten cubic meters per day.

Specific water uses that should be sub-metered are:

- Water supplied to separate buildings.
- Hot and cold feedwater in laundry operations.
- Food service areas.
- Water for kidney dialysis water treatment systems.
- Both the feed and product water from a reverse osmosis or other water treatment system.
- Steam boiler feed and condensate return.
- Hot-water boiler feed.
- Cooling tower makeup and blowdown, if any.
- Large evaporative cooling systems, if any.
- Separately leased spaces in the building.
- Makeup water to therapeutic pools and ornamental water features.
- Landscape irrigation.

The following actions should be followed for data accuracy, recording, and analysis of the sub-metered water flows:

- Test all meters on a regular basis to ensure their accuracy.
- Keep track of and file electronically all the metered amounts on monthly basis.
- Graph and analyze the data on a weekly basis to:
  - » Quickly identify possible leaks, equipment malfuction, and any other data reading or recording errors.
  - » Track water saving and evaluate your efficiency interventions.

Pressure Management

Pressure management is an effective way to control the water pressure in buildings and reduce unnecessarily high flows, lessen leaks and pipe bursts, and improve the life of plumbing fixtures. Many hospitals in Jordan receive their operating pressure from a roof tank system. This means that the top floor may have low pressure while the bottom floor has extremely high pressure. For hospitals with flush-valve systems, approximately two bars pressure is needed, but for regular tank-type toilets, such as those found in most hospitals in Jordan, only one bar is needed. This is appropriate for the second and third story below the roof top tanks and or for a floor no more than ten meters below the tank. Any floors lower than that would be candidates for a pressure control valve.

Other Procedures

The procedures and devices listed in this section are used to limit water losses during pipe ruptures, leaks, equipment failures, and other emergencies.

Emergency Shut-off Valve and Isolation Valves

These valves are extremely important. They are used to quickly shut off water flow when pipes rupture, connections leak, or equipment fails. This can help prevent major water damage. They also help isolate water use inside a building so the whole building does not have to be taken out of operation during repairs or replacement. These valves should be installed to isolate each critical water-use area in your health facility such as restrooms, kitchen, surgical rooms, etc. Valves should be clearly marked stating which portions of the facility they serve and should be accessible to appropriate staff.

Water-heater-temperature, Pressure-relief Valves (TPRVs) and Relief Valves

TPRVs are found on the upper part of water heaters. They prevent the build-up of hazardous pressure by releasing water to an overflow pipe. Water-supply pressure should be within the range recommended by the manufacturer. The discharge from these valves should be clearly visible so leaks can be easily detected. These valves need to be inspected and tested every two months.

Backflow Preventers

Backflow preventers protect the water supply from contamination by sewer water and other sources of pollution. They prevent cross-contamination from cross-connections or when pressure is lost. Backflow preventers should be placed at clearly visible locations to facilitate leak detection, inspection, and testing by staff. They need to be inspected and tested on a regular basis.

Fire Protection System

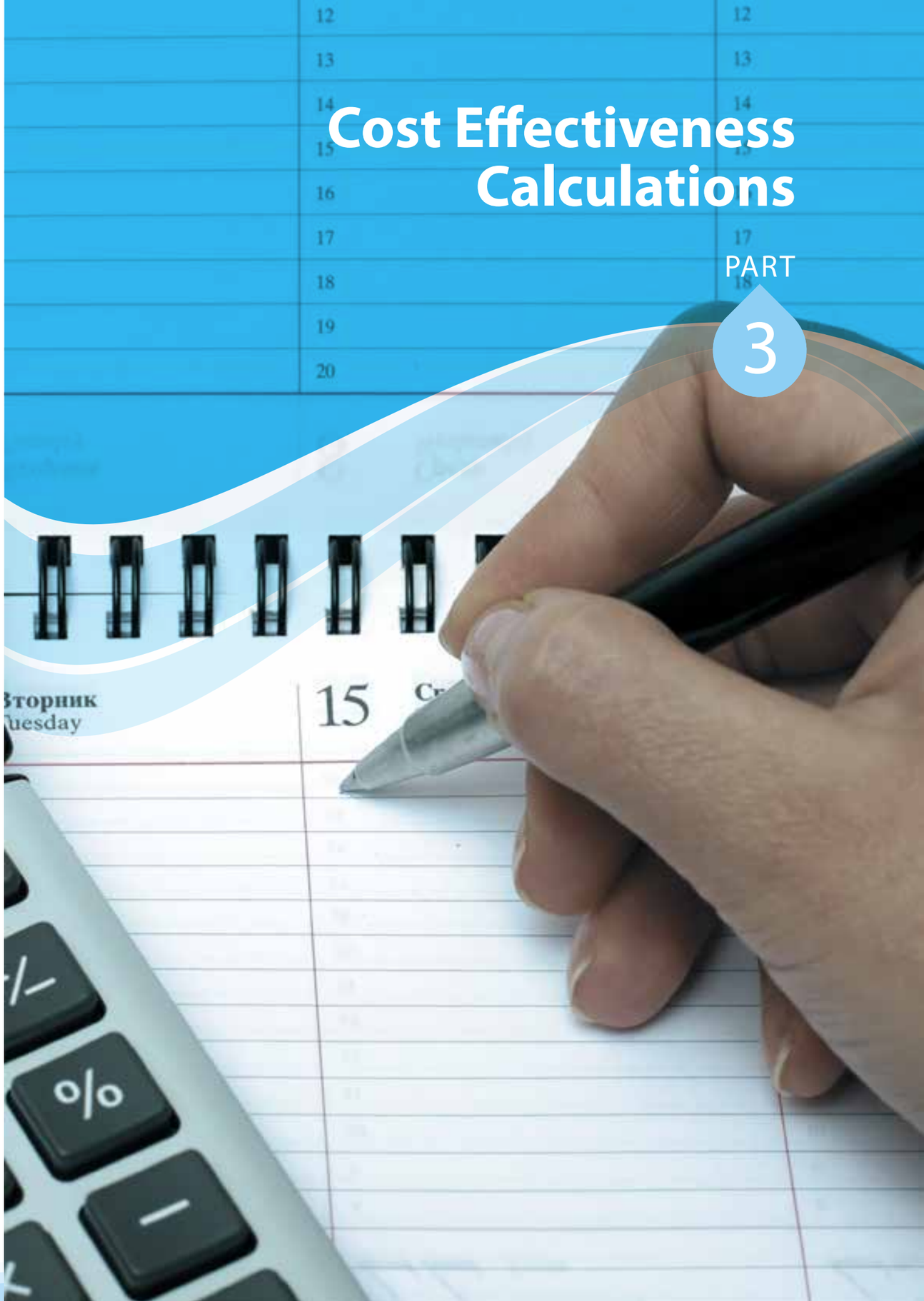
The fire protection system includes on-site fire hoses and sprinkler systems. No flow should occur except in a fire emergency or testing. The system should have a method of recovering water used during periodic testing and flushing of the lines. It should be easy to inspect to ensure that any accidental connections to the water pipes have not been made. Fire system meters should be installed on all major fire-service connection lines.

Surge Tanks and Other Forms of Potable Water Storage

These tanks are important components of most building's water systems. They help store water for times when water service is not available and regulate pressure. They should have proper level controls to prevent overfilling or, in the case of pressure bladder surge tanks, over-pressurization. Overflows should be easily observed and some form of overflow indicator device should be used.

Cost Effectiveness Calculations

PART 3



Cost-effectiveness for Selected BMPs

The way to build a strong business case for your water-use efficiency program is to carry out a cost-benefit analysis demonstrating investment cost, saving benefits, payback periods, and benefit-cost ratios. The following are key steps to help you complete your cost-benefit analysis to retrofit faucets, showerheads, and toilets. The retrofit consists of installing flow regulators for faucets and showerheads and replacement of toilet trim (flushing system). An example of a case study for a selected hospital is also shown.

Step 1: Identify the Investment Cost

The investment cost for this example represents the retrofit costs that include the cost of the water-saving devices (WSDs) and their installation or replacement. The calculator below shows the approximate cost for the retrofit of each fixture, based on the Jordanian market. The installation cost is only considered for the replacement of the toilet trim by a professional plumber, assuming that the installation of the faucet and shower regulators is done by your hospital maintenance staff.

Step 2: Identify the Benefits

Plumbing-fixture retrofit holds the most promise for water-saving and financial benefit. The financial benefits are roughly the savings in your water and energy bills as a result of savings in water consumption, wastewater, and hot water. Other financial savings such as the cutback on freshwater treatment cost and tanker water cost can also be considered.

Step 3: Calculate the Payback Period and Benefit-Cost Ratio

The payback period represents the amount of time required to recover the investment cost. It is simply the ratio of the investment cost over the annual financial benefit. For example, if the retrofit of all faucets, showerheads and toilets in your hospital costs you JD10,000 with an expected saving (benefit) on your water and energy bills of JD20,000 annually, the payback period will be JD10,000/JD20,000 or half a year. You can also calculate your payback period separately for each of the retrofit measures as shown in the case study.

The benefit-cost ratio for a given fixture is equal to the present value of the benefit during the life of this fixture divided by the investment cost for its retrofit.

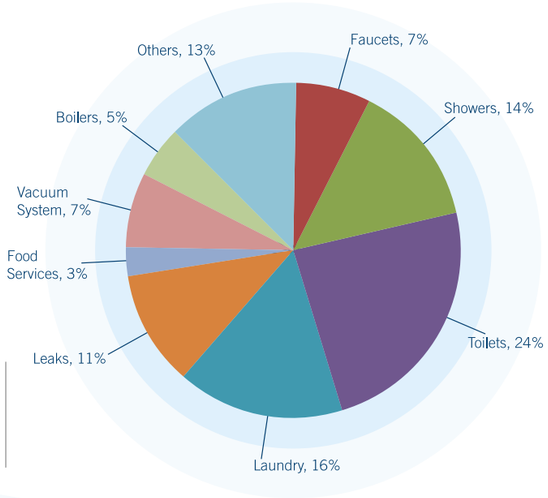
Case Study: A Jordanian Hospital

Facility Information

This large medical facility has all major medical disciplines. It has 500 beds with a 300-inpatient average daily occupancy and 2,250 staff and doctors, and receives approximately 4,000 visitors and 2,500 outpatients a day. It gets all its water supply, which is approximately 132,130 cubic meters per year, from the water utility. The facility has been continuously upgraded, except for the plumbing fixtures.

Current Water Use

Based on the water audit, this hospital has 400 faucets, 200 showerheads, and 300 toilets. The average flow rates are 7.5 liters per minute for the faucets, 11 liters per minute for the showerheads, and 8 liters per flush for the toilets. The water-use profile illustrated in this section indicates that the water use for faucets, toilets, and showerheads represents around 45 percent of the hospital's total water consumption. These fixtures annual use is around 59,500 cubic meters with 9,300 cubic meters for faucets, 18,500 cubic meters for showerheads, and 31,700 cubic meters for toilets.



Water Use Profile at the Hospital

Investment Cost

The retrofit program consists of an upgrade of the plumbing fixtures to meet the flow rates recommended in JSMO standards and the new water and sanitation plumbing code. These standards are, as mentioned in the best management section, 4.5 liters per minute for faucets, 7.6 liters per minute for showerheads and 4.0 liters per flush for the dual-flush toilets. The total investment cost is JD 9,000 including JD 1,000 for retrofitting 400 faucets, JD 500 for retrofitting 200 showerheads, and JD 7,500 for replacing trims for 300 toilets as shown in the calculator presented in this section.

Benefits

The expected benefits include 25,290 cubic meters or 19 percent of water savings per year that would result in approximately JD 37,935 reduction in the water and wastewater bill, and around JD 9,940 in energy saving. Details for water and financial savings are shown in the calculator.

Payback Period and Benefit-Cost Ratio

The payback period and benefit-cost ratio presented in the calculator show that the retrofit of faucets, showerheads, and toilets is a highly profitable water-use efficiency measure. You only need 11 days to recover your showerheads' retrofit cost, 1.4 month to pay back the money for retrofitting your faucets, and a maximum of 3.8 months to get back your toilets' retrofit cost. The benefit-cost ratios are 129 for showerheads, 34 for faucets, and 13 for toilets.

Cost Effectiveness Calculator					
		Toilets	Faucets	Showerheads	Savings Factors
a	Average flow rate of existing fixtures (baseline water use)	8 liter/flush	7.5 liter/min	11 liter/min	
b	Percent of water use (%)	24	7	14	
c	Annual consumption (m^3)	31,711	9,249	18,498	c=b x annual consumption c= b x 132,130 m^3
d	Average flow rate of retrofitted fixtures (benchmark water use)	4.0 liter/flush	4.5 liter/min	7.6 liter/min	
e	Number of fixtures	300	400	200	
f	Cost of retrofit for each fixture (JD)	25	2.5	2.5	
g	Total cost of retrofitting (JD)	7,500	1,000	500	g=e x f
h	Percent of saving per fixture	50	40	31	h= (a – d)/a
i	Average annual water savings (m^3)	15,856	3,700	5,734	i= h x c
j	Average annual savings[10] in water and wastewater (JD)	23,784	5,550	8,601	j= 1.5 x i
k	Percent of water heated	0	30	50	
l	Annual energy savings[11] (JD)	0	2,775	7,168	l= k x i x 2.5
m	Total annual savings (JD)	23,784	8,325	15,769	m=l+j
n	Discounted benefits over life time[12] of fixture (JD)	97,519	34,134	64,656	
o	Benefit-cost ratio	13	34	129	o=n/g
p	Payback period	3.8 months	1.4 months	11 days	p=g/m

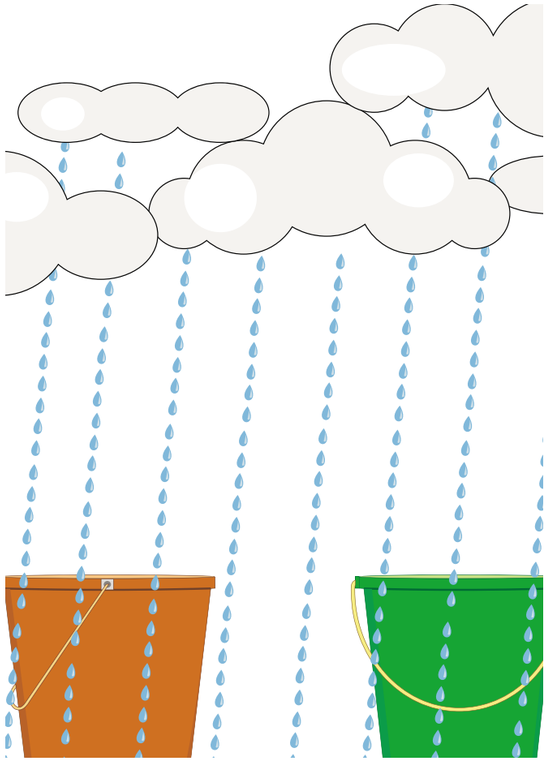
[10]Water supply and wastewater tariff = JD1.5/m^3
[11]Cost of energy (Diesel) per heated cubic meter of water = JD2.5/m^3
[12]Life time of each fixture is 5 year, and 7% return rate

Alternative Water Sources

PART 4

Rainwater Harvesting

Rainwater harvesting is a technology used for collecting and storing rainwater from rooftops, land surfaces, road surfaces, or rock catchments using simple systems such as pots, tanks, and cisterns. Rainwater harvesting has been used in Jordan since 850 BC. A number of distinctive historical examples that incorporate effective water-harvesting systems exist today in the country. These include the cut-stone reservoirs of the Nabatean city of Petra, as well as the underground cisterns found in the Umayyad desert palaces, Crusader-period castles, and traditional village houses. Most people neglected rainwater harvesting with the arrival of modern urban water supply. However, water scarcity and shortage during the past two decades revived interest in rainwater harvesting as an alternative water source and became part of the National Water Strategy. The Ministry of Public Works and Housing, in cooperation with the Ministry of Water and Irrigation, have recently included rainwater harvesting in the new water and sanitation plumbing code. This code illustrates where and how rainwater harvesting is feasible and cost effective. The reader is referred to this code for details related to feasibility of rainwater harvesting and design of rainwater collection systems. In what follows are guidelines specific to the use of the technology in health facilities.



How Much Rainwater Can You Capture?

Hospitals usually offer more than rooftops for rainwater harvesting. To maximize water collection, other impervious (hard surface) areas such as paved or tiled open spaces, where feasible, can be considered for rainwater harvesting. The amount of harvested rainwater is directly related to the size of the impervious area and the average annual precipitation. Considering 80 percent rainwater collection efficiency, to account for losses due to evaporation, splash-out from gutters, and first flush diversion, the annual potential amount of harvested rainwater is calculated as follows:

Annual rainwater captured potential (m^3) = Impervious area (m^2) x annual rainfall (mm) x 0.80/1000

For instance, a hospital facility in Amman that receives 350mm average annual rainfall and has 1,000m^2 of impervious area, the potential rainwater that can be captured is approximately 280m^3. Potential rainwater harvesting in various Jordanian governorates, and for varying sizes of collection areas, are illustrated in the new water and sanitation plumbing code. The amount of rainwater storage that would be cost-effective to build is based on the monthly inflows of harvested rainwater, the monthly extracted water use, and the storage construction cost.

What is The Quality of Harvested Rainwater?

The quality of harvested rainwater is related to the rainfall area and the surface of the collecting area. Rainwater in an industrial area is more likely to collect airborne pollutants. Roofs of hospitals may collect contaminants like dust, leaves, bird feces, and even, occasionally, dead birds. Rainwater collected from paved areas contains significantly higher level of pollutants.

How do You Improve Your Harvested Rainwater's Quality?

Here are key recommendations to protect the quality of your harvested rainwater:

- Install a "first-flush diverter device" between the roof downpipe and the rainwater storage tank to dispose of the first rainfall runoff collected by your roof.
- Install filtering screens and clean roofs on a regular basis to remove dust, leaves, bird feces, and other impurities to improve water quality and reduce the clogging of gutters and collecting systems.
- Clean tank water on a regular basis to reduce sediment deposits and water contamination.
- Add disinfecting agents such as chlorine to

reduce biological contamination.
- Locate rainwater storage tanks far from contamination sources such as sewage networks.
- Regularly monitor storage-tank water quality to assess, especially, potential bacteriological contamination

Where Do You Use Harvested Rainwater?

If the above water quality protection recommendations are followed, harvested rainwater can be used in health care facilities for watering landscape, laundry, toilets flushing, and floor cleaning.

Gray Water Reuse

Gray water[13] is untreated waste water that has not come onto contact with toilet waste, kitchen sink waste, dishwasher waste or similarly contaminated sources. Gray water includes waste water from bath-tubs, showers, bathrooms wash basins, clothes-washers and laundry tubs. The Ministry of Public Works and Housing, in cooperation with the Ministry of Water and Irrigation, have recently included Gray water reuse in the new water and sanitation plumbing code. The reader is referred to this code which illustrates where and how gray water reuse is feasible. In what follows are some specifics related to gray water reuse in health care facilities.

How Much You Can Generate?

Based on the average water-use profile of the ten hospitals audited in Jordan, raw gray water from showers, bathroom sinks, and laundry services is considerably high. It adds up to approximately 41 percent of the hospitals' water consumption. To identify the optimum gray water potential in your hospital, you need to conduct a water audit and also consider adjusting your gray water values in case you retrofit the water fixtures and appliances. For a new facility, your gray water potential is based on the estimated flows of the fixtures in your showers, bathroom faucets as well as the estimated water use by laundry machines.

How Much You Can Reuse?

There is enough gray water for toilet flushing and landscape irrigation, which use respectively, 20 percent and less than one percent of the audited Jordanian hospitals' water supply. Note that even if the laundry gray water is not included, gray water from showers and bathroom faucets will generally meet the water demand for both toilet flushing and landscape irrigation. This will likely be true even after retrofit of water and sanitation fixtures. However, before deciding on the reuse options, you need to analyze the quality of the gray water and identify the contaminants it contains and determine the necessary treatment process, considering the health and environmental risks associated with gray water reuse. The following precautions are recommended to prevent health and environmental risks, according to the gray water chapter of the new Jordanian water and sanitation plumbing code:

- Exclude laundry water from soiled diapers or from any items soiled with feces or other excrements.
- Use treated wastewater for landscape irrigation under the following conditions:
  - » Use showers and bathroom sinks gray water after on site primary treatment to remove hair and sediments, and disinfection to prevent risk of harmful bacteria
  - » Use subsurface irrigation, installed at least ten centimeters underground, to prevent human exposure to any potential pathogens.
  - » Avoid water logging your soil, do not irrigate after rain.
  - » Divert gray water that is not used for irrigation to the sewer system.
  - » Regularly monitor water quality and divert gray water to sewer system in case of water contamination or malfunction of treatment process.
- Do not use gray water for toilet flushing to prevent infection risk due to pathogenic micro-organisms. Overload of pathogens may affect treatment process. Note that efforts are being made in Jordan to use advanced gray water treatment technology. This is currently done at the pilot level at the Dead Sea Spa Hotel. This exclusion may be reconsidered if this scheme or any other future technology is proven to prevent health risks and is cost effective.

Wastewater Reuse

More than 90 percent of all wastewater collected via the national sewage system in Jordan is currently treated and reused. The new water and sanitation plumbing code requires the establishment of satellite treatment plants within the premises of high-rise high-density (HRHD) developments for collection and reuse of wastewater. In addition to compliance with the Jordanian standards for wastewater reuse, it is recommended to take the following actions for reuse of treated wastewater at your health facility:

- Use landscape irrigation with treated wastewater under the following conditions:
  - » Use subsurface irrigation, installed at least ten centimeters underground, to prevent human exposure to any potential pathogens.
  - » Avoid water logging your soil, do not irrigate after rain.
  - » Divert any treated wastewater that is not used for irrigation to the sewer system.
  - » Regularly monitor water quality and divert wastewater to sewer system in case of water contamination or malfunction of treatment process.
- Do not use treated wastewater for toilet flushing to prevent infection risk due to pathogenic micro-organisms. Overload of pathogens may affect treatment process. This exclusion may be reconsidered if tertiary wastewater treatment is proven to prevent health risks and is cost effective.

[13] Gray water defined according to the new water and sanitation plumbing code.

Enabling Tools

PART 5

SAVE WATER

How to Implement Hospital Water-use Best Management Practices

This section provides you with a comprehensive set of policy, institutional, management, and economic tools that will help you develop and implement water-saving measures and programs based on best management practices. These tools are based on more than a decade of Jordanian experience in water-demand management, including the Instituting Water Demand Management Program (USAID-IDARA) that received the Global Distinction Award from the Global Water Intelligence, as the largest and most comprehensive water efficiency initiative in the world in 2010.

Policy, Codes, and Regualtions

Jordan is the first country in the region to develop a comprehensive water-demand management policy, which was prepared in 2008 by public and private stakeholders to promote efficient water use. This policy paved the way for the following developments, which are relevant to hospital water-use management:

- Preparation of a new water and sanitation plumbing code that includes national technical regulations for the recommended water use specifications and sanitation for plumbing fixtures such as faucets, toilets, and showerheads as well as appliances. These specifications can be applied to your existing or new health facility. The code also includes provisions for gray water reuse, rainwater harvesting, and managing water use and reuse for health facilities in high-rise and high-density buildings.
- Establishment of a water-efficiency laboratory at the Royal Scientific Society to test the locally manufactured and imported water and sanitation plumbing fixtures and appliances for compliance with JSMO standards that save you water, energy, and money.
- Creation of Master Plumber certification and training program that provides plumbers with the qualification and capacity building for installation of water-efficient fixtures, appliances and equipment in your existing or new facility according to the new plumbing code instructions.
- Promotion of research and development in water-use efficiency to inform water users of new developments of technologies and best practices that promote water saving.

Institutional Support

Water-use efficiency has been instituted at the national and water utility levels. Here are the key entities and program that can support you:

- The Water-Demand Management Unit (WDMU) was established in 2002 at the Ministry of Water and Irrigation (MWI) as the entity that promotes water-use efficiency nationwide. The WDMU will assist you on any advancement in water conservation in the health sector.
- Water Utilities: Miyahuna, Aqaba Water (AW), and Al Yarmouk Water (ex. NGWA) have developed Water-Use Efficiency (WUE) plans to support implementation of water conservation programs in their respective service areas. They will be able to guide you in identifying and implementing water-efficiency measures in your health facility. They have a state-of-the-art tracking tool that helps you assess potential water-saving opportunities with potential amount of water saving, associated energy saving, cost-benefit analysis, and recovery period for each one of your interventions such as installation of water-saving devices for faucets and showers, toilet replacement, implementation of water and sanitation code, etc.
- King Abdullah II Center for Excellence (KACE) has included water- and energy- efficiency among its award criteria for all public and private institutions entering the competition. This provides you with an incentive to save water, energy, money, and win the award, which will make you stand out from your competitors.

Steps for Successful Management of a Water-use Efficiency Program

Without effective and structured management you cannot achieve your long-term sustainable saving objectives. Here are eight key steps to guide you in developing and managing a successful water-efficiency program at your hospital facility:

1. Conduct a water audit to assess water uses and costs: A complete water audit is needed to identify water-use efficiency opportunities and give you firsthand estimates of expected savings in water, energy, and money.

2. Get commitment and leadership from top management: Hospital owners and managers need to value and take the lead in water use efficiency programs. Showing them the utilities bills and sharing recommendations of water and energy audits would make them realize that valuable energy savings, wastewater, and water-treatment cost reductions can be achieved by water savings. This in turn would encourage them to accept and lead changes in processes and behavior to achieve all these savings.

3. Set realistic objectives and prepare an action plan: You need to set realistic annual water-savings targets based on your water audit results, and prepare an action plan listing and prioritizing all planned water-efficiency measures. Identify funds, schedules, and personnel needed for their implementation. And estimate savings, benefits, and payback period for each measure. The plan can also include other targets such as green building certification, the King Abdullah II Center for Excellence Award, etc.

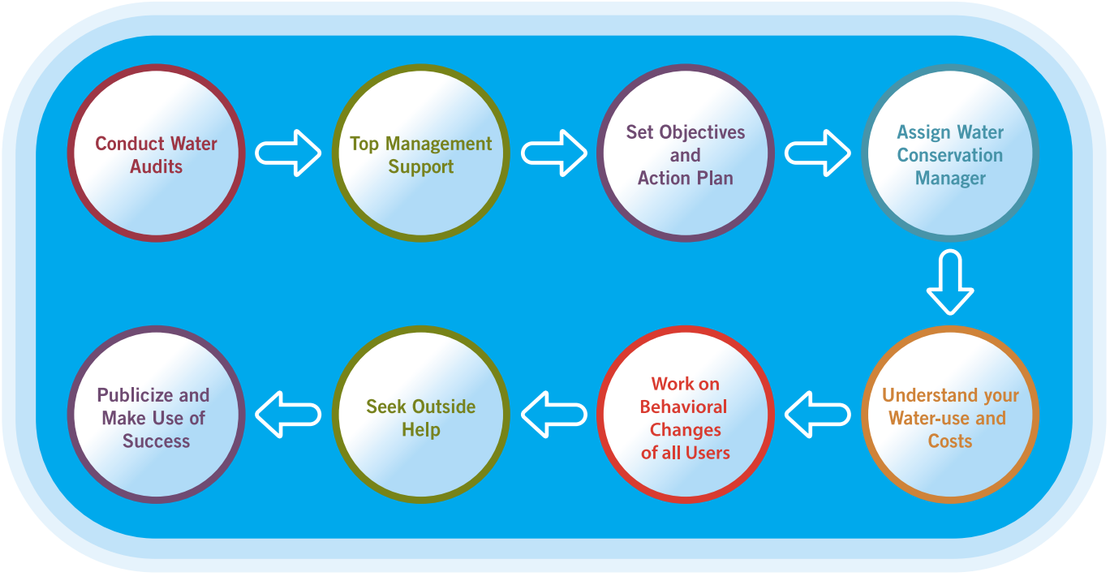
4. Assign a water-conservation manager: Having a person dedicated to water conservation, although this does not need to be his/her sole task, will get you the most out of your efficiency program. The same person can also be responsible for energy conservation.

5. Understand your water-use systems and associated water-use costs: Sub-metering key water uses and conducting water audits help you tremendously in developing accurate monitoring of where, how, and when water is used. Developing a simple database to track your water-use, water-heating, and water-treatment costs will guide you in identifying and prioritizing water-saving measures and evaluating your water use efficiency program.

6. Work on behavioral changes of employees, patients, and visitors: Establish an educational and awareness program at your facility to increase staff, clients, and visitor awareness on water conservation through signs, newsletters, and posters. Incorporate water conservation into employee training programs, and hold competitions to reward doers and achievers among your staff.

7. Get outside help: Consult the Chamber of Commerce, your local water utility, WDMU at MWI, the Ministry of Health, the Ministry of Environment, and other relevant institutions to make contacts for technical information and training, and look for opportunities for water conservation incentives.

8. Publicize and use success: Hospitals with successful water-conservation programs deserve to be recognized by the public. The public will certainly appreciate that your business is a socially and environmentally responsible partner in the community.



Water Saving Checklist

PART 6

Hospitals Best Management Practices Checklist

Understanding Your Water Use	Yes/No		Recommended Practice
Do you know your hospital water use?	Yes	No	If No, read and record utility's water meter information so you can identify changes in your facility water use, ensure utility's water meter is working properly.
Have you conducted a water audit for your hospital?	Yes	No	If No, conduct water audits to find where, when, and how water is used in the facility and identify the best opportunities for water savings.
Do you know how much water and all its associated charges are costing your business?	Yes	No	If No, calculate your own water cost and associated charges as indicated in the cost-effectiveness section.
Do you know where water is used in your hospital?	Yes	No	If No, install sub-meters in the facility to develop your own water balance. All major water-using equipment and processes in the hospital should be sub-metered as indicated in the sub-metering section.
Do you have water conservation educational and awareness programs?	Yes	No	If No, establish educational and awareness program at your facility to increase staff, clients, and visitor awareness of water conservation through signs, newsletters, and posters.
Have you assigned a water conservation manager?	Yes	No	If No, assign a conservation manager responsible for water and energy conservation.

Monitoring and Operational Processes	Yes/No		Recommended Practice
Leak Detection			
Do you regularly check for leaks?	Yes	No	If No, establish regular leak detection program to ensure that all plumbing fixtures and systems and all water-using equipment are checked routinely and repaired immediately.
Do you record building leaks?	Yes	No	If No, keep records of the type of leaks, their location, and number in a central location.
Do you read your water meters regularly?	Yes	No	If No, regularly read your meter. If there has been a sudden unexplained increase in your water bill, chances are you have a leak. Use your water meter to help you check for «silent leaks.»
Does the facility manager have standard-leak repair equipment and parts?	Yes	No	If No, make sure staff has tools and parts to make timely repairs.
Pressure Management			
Have you checked pressure at your building floors?	Yes	No	If No, install pressure controls on building floors if pressure is over 3 bars.
Treatment Processes			
Have you checked the ratio of treated water to reject water for reverse osmosis equipment?	Yes	No	If No, 1to1 is the optimum ratio of treated water to reject water for reverse osmosis equipment.

Domestic Use	Yes/No		Recommended Practice
Faucet			
Is your faucets flow rate less than or equal to 4.5 liters/minute?	Yes	No	If No, install faucets flow regulators (aerators) at flow rate less than or equal to 4.5 liters/minute.
Do you regularly check for faucets leaks?	Yes	No	If No, faucets should be checked routinely and maintained or replaced as necessary.
Shower			
Do showers at your facility have flow rate less than or equal to 7.6 liters/minute?	Yes	No	If No, replace showerheads or install shower flow regulators to reduce flow rate to less than or equal to 7.6 liters/minute.
Toilet			
Does your building have dual flush toilets?	Yes	No	If No, replace inefficient single-flush toilets in high-use areas with 6/3 liters dual-flush types, or retrofit toilet trims (flushing systems) to less than or equal to 6 liters per flush.
Do you regularly check for toilet leaks?	Yes	No	If No, arrange for leak test to identify hidden leaks using dye or food coloring in the toilet tank.
Urinal			
Do urinals at your facility operate at less than or equal to 1.9 liter per cycle?	Yes	No	If no, replace them with efficient urinals that reduce flow rate to less than or equal to 1.9 liter per cycle.
Do you have automatic on-demand urinals?	Yes	No	If Yes, check urinals regularly to see that sensors are working properly and that worn or faulty parts are replaced. Adjust urinal flow rates to less than or equal to 1.9 liter per cycle.

Laundry			
Are your clothes washers operated in full load?	Yes	No	If No, operate your clothes washer with full loads only.
Do you sort laundry by the level of cleaning?	Yes	No	If No, segregate clothes by the level of cleaning needed.
Have you checked the number of cycles in the clothes washer?	Yes	No	If No, set the number of cycles to accomplish the proper cleaning, and eliminate any unnecessary cycles.
Cleaning			
Do you use hose in cleaning?	Yes	No	If Yes, clean sidewalks and parking lots with brooms and dustpans. Using water for cleaning these areas is prohibited. Use mops or squeegees instead of hoses for indoor areas.
Do you use a hose for washing car?	Yes	No	If Yes, wash your cars using bucket.
Boiler			
Do you use central steam boiler in your hospital operations?	Yes	No	If Yes, use stand-alone steam boilers for sterilizers with condensate return where applicable.
Do you control boiler blowdown by conductivity controllers?	Yes	No	If No, install conductivity controllers to control all boiler blowdowns.
Food Services			
Are your refrigeration and ice making machines air-cooled?	Yes	No	If No, use air-cooled machines for both refrigeration and ice-making equipments.
Do you use water to thaw food?	Yes	No	If Yes, use adequate refrigerators to thaw frozen food instead of thawing under water.
Are your dish washers operated in full load?	Yes	No	If No, operate the dishwasher only when full load.
Do you use pre-rinse spray valves?	Yes	No	If No, use pre-rinse spray valves of less than or equal to 6 liters per minute flow rate to rinse dishes before going into the dishwasher.

Medical Processes	Yes/No		Recommended Practice
Sterilizer			
Do you use dry vacuum pumps?	Yes	No	If No, return condensate from sterilizers to the boiler, do not discharge to the drain.
X- ray			
Does your X-ray equipment use water?	Yes	No	If yes, use digital X-ray equipment or have water- saving kits installed.
Hydrotherapy			
Do you meter hydrotherapy use?	Yes	No	If No, meter water supplied to hydrotherapy units or determine the exact volume of water required for each hydrotherapy tank.
Do you circulate water used in hydrotherapy pools?	Yes	No	If No, install filtration and disinfection equipment to treat and circulate the water rather than dumping it.
Vacuum pump			
Do you use Venturi aspirator vacuum systems or liquid-ring vacuum systems?	Yes	No	If Yes, eliminate Venturi aspirate and liquid-ring vacuum system, use dry vacuum systems in medical and dental facilities.

Outdoor Use	Yes/No		Recommended Practice
Landscape and Irrigation			
Do you have a water-efficient landscape?	Yes	No	If No, ensure a water efficient landscape by following appropriate soil preparation, plant selection and placement, and efficient irrigation system and practices.
Do you use fresh water in irrigation?	Yes	No	If Yes, use recycled water according to recommendation given in the alternatives water sources section.

References

- Abdalla, Fayez. "Rainwater Harvesting Potential for Municipal and Industrial Use in Rural and Urban Areas in Jordan." USAID-IDARA. 2011.
- Abu El Sha'r, Wa'il. "Gray Water Reuse for Domestic Use in Rural and Urban Areas in Jordan." USAID-IDARA. 2011.
- Brown, C., et al. 2005. The Texas Manual on Rainwater Harvesting, 3rd ed., Texas Water Development Board.
- East Bay Municipal Utility District. Watersmart Guide— A Water-Use Efficiency Guide for New Business. Oakland, USA. 2008.
- Fisher-Nickle Inc. Best Practices—How to Achieve the Most Efficient Uses of Water in Commercial Food Service Facilities. February 2005.
- Hoffman, B. Rainwater Harvesting and Alternate Water Sources in Austin, Texas. Austin Water Utility. 2006.
- Hoffman, Bill, Chebaane, Mohamed, Qaqish, Louis and Esoh, Nour. End Use Analysis for Large Consumers-Hospitals Water Audits Report. USAID-IDARA. 2009.
- Hoffman, H. W. (Bill), and Sutton, John T. State Energy Conservation Office Suggested Water Efficiency Guidelines for Buildings and Equipment at State Facilities. Texas State Energy Conservation Office. Austin, Texas. 2003.
- Hoffman, H. W. (Bill). Building Reduced Water and Wastewater Cost into the Design. Austin Water Utility. Austin, Texas. March 2006.
- Jordanian National Building Council. Jordanian New Water Supply and Sanitation Plumbing Code. 2011.
- New Mexico Office of the State Engineer. A Water Conservation Guide for Commercial Institutional and Industrial Users. 1999.
- Sydney Water. Best Practice Guidelines for Water Conservation in Commercial Office Buildings and Shopping Centres. Sydney South, Australia. 2007.
- TDK Consulting Services. The Reduction in Water Consumption of Sterilizer Equipment Resulting from the Installation of Water-MizerTM Systems. Parkville, Missouri.
- Torke, Ken. Best Management Practices for Hospitals and Medical Facilities. Palo Alto Regional Water Quality Control Plant. September 1994.
- USAID-IDARA, Guidelines for Best Management Practices for Water Efficiency in Hospitals, Draft Report, 2008
- U.S. Environmental Protection Agency. WaterSense Program. http://www.epa.gov/WaterSense/.
- Veritec Consulting Inc. Koeller and Company. Maximum Performance (MaP) Testing of Popular Toilets. November 2006.
- Vickers, A. Water Use and Conservation. 2001.