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# IDARA (INSTITUTING WATER DEMAND MANAGEMENT IN JORDAN)

## Task 2.2.2-Recommended Code Provisions to Achieve Efficient Water Use for Buildings in High-Rise and High-Density Developments in Jordan

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# CONTENTS

**ACKNOWLEDGMENT** ..... **2**
**ABBREVIATIONS AND ACRONYMS** ..... **2**
**INTRODUCTION** ..... **4**
**BACKGROUND** ..... **4**
**THE NEED FOR WATER EFFICIENCY CODES IN JORDAN** ..... **5**
**PROPOSED CODES TO ACHIEVE WATER EFFICIENCY** ..... **6**
LANDSCAPE WATER EFFICIENCY MEASURES CURRENTLY IN CODES ..... 6
**CONCLUSION** ..... **17**
**REFERENCES** ..... **17**
**APPENDIX A: CODES AND STANDARDS IN JORDAN** ..... **18**
**BUILDING CODES IN JORDAN** ..... **18**
DUTIES AND AUTHORITIES ..... 18
CODE UPDATING ..... 19
ENTITIES AFFECTED BY CODES: ..... 20
**PERFORMANCE MEASUREMENT AND TESTING - JORDAN INSTITUTION FOR STANDARDS AND METROLOGY** ..... **22**
PURPOSE OF WORKING WITH JISM ..... 22
**APPENDIX B: GREEN BUILDING STANDARDS AND BUILDING CODES** ..... **23**

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# Abbreviations and Acronyms

| | |
|---|---|
| ASHRAE | American Society of Heating Refrigeration and Air Conditioning Engineers |
| AS/NZS | Australia New Zealand Standards |
| CSBE | Center for the Study of the Built Environment |
| BOT | Build-Operate-Transfer |
| BMP | Best Management Practices |
| CASBEE | Comprehensive Assessment System for Building Environmental Efficiency |
| CEE | Consortium for Energy Efficiency |
| DMM | Demand Management Measures – refers to water conservation measures, programs, and incentives that prevent the waste of water and promote the reasonable, beneficial, and efficient use and reuse of available supplies. |
| EBMUD | East Bay Municipal Utility District |
| ET | Evapotranspiration – the water used by plants for transpiration and by surrounding soils in evaporation |
| GAM | Greater Amman Municipality |
| HRHD | High Rise High Density |
| IAPMO | International Association of Plumbing and Mechanical Officials |
| JISM | Jordan Institution for Standards and Metrology |
| JNBC | Jordanian National Building Council |
| L/min | Liters per minute |
| LCPD | Liters per Capita per Day or liters per person per day |
| LEED | Leadership in Energy and Environmental Design |
| MWI | Ministry of Water and Irrigation |
| USAID | United States Agency for International Development |
| USEPA | United States Environmental Protection Agency |
| WAJ | Water Authority of Jordan |
| WDM | Water Demand Management |
| WELS | Water Efficiency Labeling Scheme |
| WWTP | Wastewater Treatment Plant |

# Introduction

The construction of High-Rise buildings and High-Density (HRHD) developments are new types of developments in Jordan. As a result of the water issues related to construction of the first high-rise building, Jordan Gate, and the launch of the Abdali master planned development, the Ministry of Water and Irrigation (MWI) requested USAID to provide an amendment to the scope of work of the IDARA project to investigate and provide recommendations for water use efficiency in high rise and high density developments.

While high-rise and high-density developments pose a serious water supply challenge to Jordan, it also provides a great opportunity to introduce the most effective, tried and proven water use efficiency code requirements available.

The recommendations contained in this document are consistent with two other products of the IDARA Project: the "Best Management Practices Guide for Efficient Water Use in High-Rise and High-Density Developments in Jordan" and the "Water Efficiency Recommendations for High Rise and High Density Development Including GAM Area C."

To identify HRHD code provisions applicable to Jordan, a survey was conducted of existing building codes, labeling programs, and green building programs in the United States, Australia, Europe, Japan, UAE and other countries. Many water use efficiency measures have been identified, although the measures are not specifically focused on HRHD developments.

Provisions in plumbing codes and appliance standards in countries such as the United States and Australia include provision of building blocks for achieving a basic level of water use efficiency. Although code provisions and standards are usually a consensus process, the level of efficiency standards lags behind what is available in the field. Fortunately with the increased awareness of water efficiency as well as the interest in green building, there is a good selection of advanced water efficiency standards and specifications that can be adopted in Jordan.

# Background

USAID-IDARA is currently working with the Ministry of Public Works and Housing (MPWH) to develop a new plumbing code for Jordan and is cooperating with the Jordan Institution for Standards and Metrology (JISM) in developing new technical regulations/standards for water using products in Jordan. The plumbing code will reference many technical regulations/standards that JISM has or will be developing in the future. When a technical regulation/standard is required through a plumbing code, then it will be mandatory for all design engineers and contractors to follow that technical regulation/standard.

With assistance from IDARA, the MPWH is currently in the process of developing new plumbing code for Jordan. The two current Jordanian codes, The Water Supply for Buildings Code and the Drainage and Sewage Code, are being combined into one code following the structure and updated provisions of the Uniform Plumbing Code. For this report, the new code will be called the Jordan Uniform Plumbing Code.

In the United States and many other countries, the application of codes is a multistep process:

- Site owner presents detailed design plans to the local planning agency for approval and the issuance of a construction permit. The plans are reviewed to assure compliance with applicable codes.
- At each stage of construction inspectors from the local planning agency conduct on site inspections of the project for compliance with the plans and codes. If the inspection identify non-conforming practices, the inspector has the authority to halt construction until the non-conforming practices are corrected.
- Following construction completion, final inspections are made, for each code, after which the local agency issues a certificate of occupancy that allows the building to be used.

Currently, Jordan does not have an efficient inspection system that follows the last step as sited above to ensure compliance with the types of water efficiency provisions proposed in this report. Such system is needed in Jordan but is beyond the scope of this report.

JISM with technical assistance from IDARA is in the process of updating the technical regulations/standards for water using products and appliances in Jordan. The Ministry of Water and Irrigation has requested JISM to issue standards for water saving products as technical regulations so that the enforcement powers of JISM and the Customs Department will be employed to enforce these technical regulations. The technical regulations/standards recommended in this report are consistent with those JISM is already considering or planning to review in the near future.

## The Need for Water Efficiency Codes in Jordan

The absence of water efficiency practices in building standards was recognized by the National Water Demand Management Policy adopted by Council of Ministers in 2008. The same policy also recognized the need for performance standards for water efficiency products. The policy states:

**"On Codes and Equipment Certification**

- Jordan shall include water use and water efficiency within the definition of national security to ensure technical specifications are enforced for all water using products.
- Jordan shall periodically update codes and technical regulations to require the lowest water use and maximum efficiency for all plumbing fixtures, appliances, and equipment while maintaining the intended performance. These regulations specify the maximum water use in liters per minute or liters per flush for all plumbing fixtures that are installed in newly constructed buildings.
- Technical specifications for all plumbing products such as pipes, tools, and other materials shall be adopted in Jordan because it will save large quantities of water by ensuring only high quality products are used, thereby minimizing water leakage in households.
- Programs should be established to replace all inefficient plumbing fixtures, appliances and equipment with the latest most efficient models.

- Jordan should actively promote the transition of local manufacturing to the production of water efficient products.
- Jordan should ensure that other important national initiatives, such as membership in the World Trade Organization, do not constrain the ability of Jordan to prohibit importation of inefficient or poor quality water using products."

# Proposed Codes to Achieve Water Efficiency

Table 1 lists specific water efficiency measures and performance objectives presented in established building codes. For each efficiency measure, the table recommends when appropriate the Jordan Uniform Plumbing Code. Where performance objectives are specified for plumbing fixtures, equipment or appliances, JISM is referenced as the appropriate organization to develop the technical regulation/standard including testing procedures and certification. Where there is no appropriate code or standard for the efficiency measure, no reference is listed with the assumption that the provision would be part of a development permit or agreement. Table 1 also provides the sources for the code and standards language. As described in the Water Efficiency BMP Guide, these code elements provide the basic building blocks for sustainable water use.

## Landscape Water Efficiency Measures Currently in the Codes

Several recent code changes have incorporated measures for water wise landscape practices into the codified building regulations. Landscape irrigation criteria are included as Requirement number 20 of table 1. Depending on the legal structure and enforcement mechanisms that can be offered in Jordan, GAM and Miyahuna (Jordan Water Company) may regulate implementation of the landscape irrigation efficiency measures. Water utilities and municipalities in several states in the United States (as indicated by the source code references in table 1) have established ordinances, or regulations which offer means of landscape plan review and enforcement of regulations.

Public landscapes are relatively easy to control to ensure compliance with water wise landscape practices. Private landscapes, on the other hand, are controlled by individual owners and may be best brought into compliance with voluntary systems through education, outreach, technical assistance and provision of free or subsidized water saving devices and control mechanisms.

Table 1. Recommended Water Efficiency Technical Regulations/Standards for Jordan

| Water Efficiency Requirement | Criteria for Required Measures | Recommended Legal Authority | Source Code References |
|---|---|---|---|
| 1. Recycled Water Systems | A. Treat all wastewater at a satellite treatment plant and use disinfected tertiary recycled water as a water source for toilet and urinal flushing, landscape irrigation and other non-potable uses. | A. Development Permit | B. Calif. Green Bldg Stds. Title 24, Part 11, 603.4 |
| | B. Install and use systems that collect, store and, where necessary treat, recycled water, rainwater, gray water, and condensate for various non-potable purposes including toilet and urinal flushing, landscape irrigation and other non-potable uses. Ensure cross connection control and backflow prevention. | B. Plumbing Code | ASHRAE 189.1P-6.3.2.3 |
| | Expand Jordanian Standard No. JS 893:2006 concerning (Reclaimed Domestic waste water) to include urban uses of recycled water and corresponding water quality criteria (e.g., toilet flushing, cooling towers—if used, water features, vehicle washing, etc.) | C. JISM | |
| | C. Right to recycled water. Preserves recycled water users' right to continue receiving recycled water in the amount for which the customer applied until such time as that use is discontinued | D. Development Permit | D. Calif. Water Law § 13550 |
| 2. Prohibition of Water Cooled-Air Conditioning | Cooling systems that evaporate potable water shall be prohibited for district cooling plants unless WAJ agrees to the use of recycled water for evaporative cooling. | Plumbing Code | |
| 3. Dual Plumbing | New buildings and facilities shall be dual plumbed for potable and recycled water systems. | Plumbing Code. | Calif. Green Bldg Stds. Title 24, Part 11, 603.5 |
| 4. Automatic Vehicle Wash Facilities: | Where available, all source water shall be recycled water. In addition, recycle water from previous vehicle rinses in subsequent washes. The station shall be designed so no water runs off the site. | Plumbing Code | |

| Water Efficiency Requirement | Criteria for Required Measures | Recommended Legal Authority | Source Code References |
|---|---|---|---|
| 5. Discharge of Saline and /or Brackish Waters | Prohibit the discharge (such as from water softener regeneration or reverse osmosis reject water) of brackish or saline water to the community sewer system or groundwater that may be eventually used for irrigation. Instead, evaporate in solar evaporator or discharge to a saline sink. | Plumbing Code | Calif. Green Bldg Stds. Title 24<br>Part 11, 603.3 |
| 6. Source Meters | All water sources, potable and non-potable, piped or tanker delivered shall be metered. The water consumption data from the meters shall be collected and retained in a retrievable database by the water utility. | Water Utility | California<br>Water Code<br>Section 520-523, 525-529.5<br><br>ASHRAE 189.1P-6.3.3.<br><br>Green Star Australia |
| 7. Meter Customer Water Consumption and Bill Each Customer for Water Use | A. All buildings, apartments, villas shall be individually metered<br>B. If there is more than one customer within a commercial or residential building, meters or submeters shall be installed for each tenant within the building.<br>C. The water utility shall bill each customer based on the metered volume of water consumed.<br>D. Dedicated irrigation meter shall be required for irrigated landscaping of 2,500 $m^2$ or more. | WAJ | D. EBMUD Section 31D2bv |
| 8. Install Sub-meters to Manage Water Use. | A. Submeters shall be installed on major water using equipment so that water use for that area or process can be monitored and leaks and other malfunctions may be identified. Submetered locations, using over 3,800 L/day, shall include:<br>a) laundry operations<br>b) swimming pools and spas<br>c) food service & kitchens<br>d) irrigation systems<br>e) separate water heating systems<br>f) makeup/feed water for blowdown water from cooling towers and boilers<br>g) condensate return lines to boilers<br>h) in-house water treatment system and for the reject water<br>i) kidney dialysis water treatment systems | Water Utility or WAJ | A. Calif. Green Bldg Stds. Title 24, Part 11, 603.1<br><br>A. d. EBMUD Section 31D2bv |

<table>
<tr><th>Water Efficiency Requirement</th><th>Criteria for Required Measures</th><th>Recommended Legal Authority</th><th>Source Code References</th></tr>
<tr><td></td><td>j) other types of water using equipment or process that consumes water<br><br>B. Threshold water use for other submeter locations are:<br><br><table><tr><th>Subsystem</th><th>Sub-Metering Threshold</th></tr><tr><td>Cooling Towers</td><td>Primary Flow> 30 L/sec</td></tr><tr><td>Evaporative Coolers</td><td>Makeup water>0.04 L/sec.</td></tr><tr><td>Steam and hot water boilers</td><td>>50kW input</td></tr><tr><td>Irrigated landscape</td><td>> 2,500 $m^2$</td></tr><tr><td>Separate campus or project building</td><td>Consumption > 3800 L/day*</td></tr><tr><td>Separately leased or rented space</td><td>Consumption > 3800 L/day</td></tr><tr><td>Any large water using process</td><td>Consumption > 3800 L/day</td></tr></table>* A day is defined as any continuous 24-hour period of time.<br><br>C. All building meters and submeters installed to comply with the Sub Meter Threshold limits (see above meter requirement) shall be configured to communicate water consumption data to a meter data management system. Meters shall provide data at least as frequently as daily and shall record a minimum of hourly consumption of water.<br><br>D. The meter data management system shall be capable of electronically storing water meter and sub-meter data and creating user reports showing calculated hourly, daily, monthly and annual water consumption for each meter and sub-meter and provide alarming notification capabilities.</td><td></td><td>B. ASHRAE 189.1P-6.3.3.2<br><br>C. ASHRAE 189.1P-6.3.3.2<br><br>D. ASHRAE 189.1P-6.3.3.3 BREEAM BES 5053: ISSUE 2.0; Green Star AUS</td></tr>
<tr><td>9. Control Maximum Pressure within Buildings</td><td>When static water pressure in a building exceeds 3.0 bars, an approved type of pressure regulator and pressure relief valve shall be installed and properly maintained by the customer so that the water pressure is reduced to 3.0 bars or less.</td><td>Plumbing Code</td><td>Australia AS/NZS 3500.1 - 3.3.4 2005; Uniform Plumbing Code Section 608.2;</td></tr>
<tr><td>10. Water Waste Regulations</td><td>All customers, government buildings, and other places receiving water, tanker water, or treated recycled water in Jordan shall observe and honor the following water efficient practices, with significant fines for violations:<br>A. All cars shall be washed (except at commercial carwash facilities) in areas</td><td>WAJ or Environmental Police – supplemented with</td><td>J. California Water Code § 43550 et seq.</td></tr>
</table>

| Water Efficiency Requirement | Criteria for Required Measures | Recommended Legal Authority | Source Code References |
|---|---|---|---|
| | where the runoff is captured and used for irrigation.<br>B. Hoses shall have shutoff devices installed<br>C. Sidewalks, streets and parking lots shall not be washed using hoses.<br>D. Shutoff valves shall be maintained in water storage tanks so that tanks do not overflow<br>E. Faucet, service line, or other type of leaks shall be fixed immediately<br>F. Irrigation systems water waste prevention:<br>G. Prohibition of irrigation during daylight hours from June to September for all automatic irrigation systems<br>H. Prohibition of irrigation of landscape more than required, based on 60% of evapotranspiration.<br>I. Prohibition of runoff (caused by irrigation) into the street, driveway or sidewalk<br>J. Declare use of potable water a waste if recycled water is available and appropriate for that use—such as toilet flushing, landscape irrigation, cooling towers, floor trap priming, etc.<br>K. Ponds, Fountains and Decorative Water Features shall use recirculating water systems.<br>L. Covers shall be required for all pool and spa water features to reduce evaporation when they are not in use. | extensive public education and outreach. |  |
| 11. Prohibition of Green Roofs | Green roofs (vegetation grown on building roofs to reduce building heat load), which will require supplemental irrigation in Jordan, shall be prohibited—unless Water-Wise landscaping principles are followed and all irrigation is with non- potable water. | Plumbing Code | |
| 12. Plumbing Fixtures | A. Toilets shall be dual flush models with a maximum average flush volume of 6/3 liters per flush).<br>B. Pressure assist toilets models shall not have a maximum flush volume of more than 4.8 liters per flush.<br>C. Single flush toilets with a maximum average flush volume of 4.8 liters per flush.<br>D. Urinals shall have a maximum flow of 1.9 liters/flush at 3 bars, or shall be zero water consumption urinals. | Requirements to use fixtures by Plumbing Code<br><br>Technical Regulations/ Standards by JISM | A. JISM, Recommended<br>B. JISM, Recommended<br>C. EBMUD Section 31 D1a<br>D. EBMUD Section 31 D1b<br>E. Australia AS/NZS 3500.1-10.4 |

<table>
<tr><th>Water Efficiency Requirement</th><th>Criteria for Required Measures</th><th>Recommended Legal Authority</th><th>Source Code References</th></tr>
<tr><td></td><td>E. Urinal Walls: The quantity of water discharged for sanitary flushing shall be not more than 2.5 L each 600 mm length of continuous urinal wall. The maximum quantity of water to be discharged per flush shall be in accordance with the following Table:
<table>
<tr><th>Number of urinals per flushing cistern</th><th>Maximum length of urinal wall per flushing cistern, mm</th><th>Minimum number of spreaders permitted</th><th>Maximum quantity of water to be discharged per Flush, L</th></tr>
<tr><td>1</td><td>450 (wall-hung unit)</td><td>1</td><td>2.5</td></tr>
<tr><td>1</td><td>600</td><td>1</td><td>2.5</td></tr>
<tr><td>2</td><td>1200</td><td>3</td><td>5.0</td></tr>
<tr><td>3</td><td>1800</td><td>4</td><td>7.5</td></tr>
<tr><td>4</td><td>2400</td><td>5</td><td>10</td></tr>
</table>
F. Showerheads shall have a maximum rated flow of 7.6 liters per minute at 3 bars.<br>
G. Sensor activated faucets with preset flow times shall be installed on lavatories intended to serve the transient public and shall deliver not more than 1.0 liters of water per use.<br>
H. For faucets in public lavatories, other than faucets with preset flow times, the maximum flow rate and consumption of these faucets shall not exceed 2 liters/min at 3 bars.<br>
I. Faucets for homes and hotel guest rooms shall not exceed a maximum flow of 4.5 liters/min at 3 bars.<br>
J. Residential kitchen faucets shall not exceed a maximum rated flow of 9.0 liters/min at 3 bars.</td><td></td><td>F. JISM, Recommended<br>G. 2006 International Plumbing Code Table 604.4; Calif. Green Bldg Stds. Title 24 Part 11, 603.2 ; ASHRAE 189.1P<br>H. JISM Recommended<br>J. Australia AS/NZS 3500.4-8.7</td></tr>
<tr><td>13. Residential Appliances</td><td>A. Dishwashers shall useless than 24 liters per load (Standard) and 16.7 liters per load (Compact).<br>B. Clothes washers shall have a water factor not to exceed 8.75 liters per kilogram of wash load</td><td>Technical Regulations/ Standards by JISM</td><td>A. Calif. Green Bldg Stds. Title 24 Part 11, 603.3<br>B. EBMUD Section 31.</td></tr>
</table>

| Water Efficiency Requirement | Criteria for Required Measures | Recommended Legal Authority | Source Code References |
|---|---|---|---|
| 14. Food Service Equipment | A. Commercial kitchen hand washing faucets shall not exceed 4.5 liters per minute. Sensor-type hand washing faucets shall not exceed 2.0 L/min at 3 bars<br>B. Ice making machines shall be air-cooled, Water-cooled ice machine are prohibited<br>C. Commercial refrigeration shall be air-cooled, or if water-cooled, shall have a closed looped system. No once-through, single-pass systems are permitted.<br>D. Combination ovens shall not consume more than 38 liters/min in the full operational mode.<br>E. Food steamers shall be boiler-less or self–contained models where applicable.<br>F. Pre-rinse dishwashing spray valves shall have a maximum rated flow of 6.0 liters/minute.<br>G. Dipper wells shall have an in-line flow restrictor limiting flows to no more than 3 liters per minute.<br>H. Commercial dish washing machines shall meet all the following water use standards:<br>• Commercial dishwasher conveyor type:<br>○ high temperature sanitizing machines shall use not more than 2.6 liters per rack.<br>○ chemical sanitizing machines shall use not more than 2.3 liters per rack.<br>• Commercial dishwasher door type:<br>○ high temperature sanitizing machines shall use not more than 3.6 liters per rack.<br>○ chemical sanitizing machines shall use not more than 4.4 liters per rack.<br>• Commercial dishwasher under-counter type:<br>○ high temperature sanitizing machines shall use not more than 3.4 liters per rack.<br>○ chemical sanitizing machines shall use not more than 3.7 liters per rack. | Technical Regulations/ Standards by JISM | A. JISM Recommended<br>B. Calif. Green Bldg Stds. Title 24 Part 11, 603.3; EBMUD Section 31 D1i<br>C. EBMUD Section 31 D1j; Seattle Energy Code Chapter 14 Building Mechanical Systems Section 1411.1<br>E. Calif. Green Bldg Stds. Title 24 Part 11, 603.3; EBMUD Section 31 Dh<br>F. EBMUD Section 31 D1k ASHRAE 189.1P – 6.4.2.2 |

| Water Efficiency Requirement | Criteria for Required Measures | Recommended Legal Authority | Source Code References |
|---|---|---|---|
| | I. Food Service Kitchen Faucets: Maximum flow rate and consumption shall not exceed 8.3 L/min at 4.0 bars<br>J. Hands-free faucet controllers (foot controllers, sensor-activated, or other) shall be installed for all faucet fittings within the food preparation area of the kitchen and the dish room, including pot sinks and washing sinks. | | H. Calif. Green Bldg Stds. Title 24, Part 11, 603.3<br>I. Calif. Green Bldg Stds. Title 24, Part 11, 603.2; EBMUD Section 31 D1e |
| 15. Medical, Dental and Laboratory Equipment (including. clinics, hospitals, medical centers, physician and dental offices, and medical and non-medical laboratories of all types) | A. Dry vacuum pumps shall be used, unless fire and safety codes for explosive, corrosive or oxidative gasses require a liquid ring pump.<br>B. The most water-efficient steam sterilizers available shall be used. Such sterilizers shall utilize (1) water tempering devices that only allow water to flow when the discharge of condensate or hot water from the sterilizer exceeds 60 C and (2) mechanical vacuum equipment in place of venturi-type vacuum systems for vacuum sterilizers.<br>C. Digital imaging and radiography systems shall be used instead of water-consuming film development.<br>D. Where large-frame x-ray films of more than 150 mm in either length or width are required, film processor water recycling units shall be used.<br>E. Where fume hood cleaning systems shall use a dry-hood scrubber system or, if it determined that a wet-hood scrubber system is required, the scrubber shall be equipped with a water recirculation system. For perchlorate hoods and other applications where a hood wash-down system is required, the hood shall be equipped with self-closing valves on those wash-down systems. | [Acquire expertise to evaluate water efficiency of medical and dental equipment while maintaining the original function of the equipment and to provide a path for eventual adoption of appropriate plumbing code sections] | EBMUD Section 31<br><br>ASHRAE 189.1P – 6.4.2.2 |

| Water Efficiency Requirement | Criteria for Required Measures | Recommended Legal Authority | Source Code References |
|---|---|---|---|
| 16. Water Treatment Systems | A. Use the most efficient water treatment systems available for all filtration processes. For filters with backwash capability, pressure gauges shall be installed and used to determine and display when to backwash or change cartridges. A sight glass shall be installed to determine when to stop the backwash cycle. If water quality permits, recover filter backwash water for reuse on landscaping or other applications, or treat and reuse backwash water within the system.<br>B. For all ion exchange and softening processes, recharge cycles shall be set by volume of water treated or based upon conductivity or hardness.<br>C. Reverse osmosis (RO) equipment should reject not more than one liter of water for every one liter of permeate produced for water conditioning.<br>D. Reject water from RO systems should be reused, either with or without additional treatment as required, for appropriate uses such as laundry and landscape irrigation. | Plumbing Code | ASHRAE 189.1P – 6.4.3 |
| 17. Swimming Pools and Spas | A. Pool splash troughs, if provided, shall drain back into the pool system.<br>B. Covers shall be required for all pool and spa water features. | Plumbing Code | A. ASHRAE 189.1P – 6.4.3<br>B. EBMUD Section 31 C2ci |
| 18. Special Water Features | A. Ornamental fountains and other ornamental water features shall be supplied either by alternate on-site sources of water or by tertiary treated municipally reclaimed water acceptable to the authority having jurisdiction. Exception: Where alternate on-site sources of water or municipally-reclaimed water are not available within 150 m of the building project site, potable water is allowed to be used for start-up and make-up water.<br>B. Fountains and other features with greater than 10 $m^3$ of storage shall be equipped with:<br>(1) make-up water meters<br>(2) leak detection devices that shut off water flow if a leak of more than 3.7 L per hour is detected, and<br>(3) equipment to recirculate, filter, and treat all water for reuse within the system. | Municipality (GAM) | ASHRAE 189.1P – 6.4.3 |

| Water Efficiency Requirement | Criteria for Required Measures | Recommended Legal Authority | Source Code References |
|---|---|---|---|
| 19.Rainwater | In addition to the marking requirements as mentioned in the plumbing code, water supply system from a rainwater tank shall be clearly marked at intervals not exceeding 500 mm with the word "RAINWATER' in contrasting color. Water outlets shall be identified as 'RAINWATER', or with a rainwater tap identified by a green colored indicator with the letters 'RW'. A typical sign is shown herewith.<br><br>(Copyright Australian /New Zealand Standards)   | Plumbing Code | Australia AS/NZS 3500.1-14.3: |
| 20.Landscaping | A. All landscapes shall be designed and maintained in accordance with Water-Wise Landscaping Principles.<br>B. Landscapes including parks and medians, gardens, and potted plants shall be required to irrigate with non-potable water<br>C. Ponds, fountains and decorative water features shall use recirculating water systems.<br>D. Install plant materials or appealing features that do not require permanent irrigation<br>E. Plans shall be submitted to the authority for review and approval by authority for compliance with these regulations prior to planting. Landscaping shall be designed to be irrigated at no more than 60% of the reference evapotranspiration (the amount of water required to maintain a healthy landscape accounting for the evaporation of water from the soil surface and the transpiration of water through the plant foliage) for the irrigated area.<br>F. At least 80% of the plant selection shall be native or climate appropriate low water use species and require minimal water once established. Up to 20% of the plants may be of a non-drought tolerant variety as long as they are appropriately grouped together and irrigated separately and efficiently.<br>G. Soil bedding must be mulched to a depth of 50-120 mm. | GAM or Development Permit | E. EBMUD Section 31 D2a<br>F. EBMUD Section 31 D2aiii<br>Frisco TX - new single family residences EBMUD Section 31 D2bi |

| Water Efficiency Requirement | Criteria for Required Measures | Recommended Legal Authority | Source Code References |
|---|---|---|---|
| | H. Irrigation systems shall be designed and installed to avoid overspray and runoff.<br>I. Automatic, self-adjusting irrigation controllers shall be required on all irrigation systems and shall automatically activate and deactivate the irrigation system based on changes in the weather. All automatic irrigation systems shall be equipped with a moisture sensor and/or rain sensor shutoffs.<br>J. Valves and circuits shall be separated (individual hydrozones) based on plant material and water use.<br>K. Utilize drip irrigation emitters for all areas of the landscape plan<br>L. Provide water efficient landscape design that reduces the use of all water beyond the initial requirements for plant installation and establishment. Methods shall include: plant coefficient, irrigation efficiency and distribution uniformity, captured rainwater, recycled water, graywater, and treated for irrigation purposes by a water district of public entity.<br>M. Either as a site design feature or as a constructed system (rain cistern) and other constructed water collection devices may store water for landscape irrigation.<br>N. Install a graywater collection system and treatment system for onsite subsurface irrigation using graywater collected from bathtubs, showers, bathroom wash basins and laundry water. | | K. EBMUD Section 31 D2biii<br>L. EBMUD Section 31 D2biv<br>L. Calif Green Bldg Stds Title 24, Part 11, 604.5<br>M. Calif Green Bldg Stds Title 24, Part 11, 604.4 |

## Conclusion

The tables presented in this report provide specific language that can be used in Jordan to develop water efficient sustainable building standards for new developments. Using these recommended standards; Jordan can make major strides to becoming water sustainable. In most cases, these recommended codes are based on proven cost-effective ways to conserve the nation's water resources and stretch them to accommodate additional development and the anticipated population growth. In some cases, the codes may not be the least expensive path for an individual developer, but it is a path that will help to preserve the rich history and culture of Jordan.

## References


- 2006 International Plumbing Code, International Code Council
- Australian / New Zealand Standard 3500, Third Edition 2003, Standards Australia Internationals Ltd.
- California Green Building Standards Code, California Code of Regulations Title 24,
- City of Riverside Calif. Public Utilities Department, Section 608.2
- Seattle Energy Code Chapter 14 Section 1411.1 Building Mechanical Systems
- 2006 Uniform Plumbing Code, International Association of Plumbing and Mechanical Officials


## Internet Sources for Referenced Building and Plumbing Codes

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc ASHRAE 189.1P; spc189.ashraepcs.org/

Australia AS/NZS 3500.1 -3.3.4 2005, Pressure Requirements: www.saiglobal.com/
Australia AS/NZS 3500.1-10.4, Urinal Walls; www.saiglobal.com/
Australia AS/NZS 3500.4- 8.7 Water Efficiency; www.saiglobal.com/

California Green Bldg Standards Title 24, Part 11
www.documents.dgs.ca.gov/bsc/prpsd_stds/2007/2007_cgbsc_9-23-08.pdf

California Water Code Section 520-523, 525-529.5, Meters
California Water Code § 43550 et seq; www.leginfo.ca.gov/calaw.html

East Bay Municipal Utility District Section 31;
www.ebmud.com/services/account_information/new_service/regulations/water_efficiency_requirements.pdf

2006 International Plumbing Code Table 604.4; www.iccsafe.org/

Seattle Energy Code Chapter 14 Building Mechanical Systems Section 1411.1
www.seattle.gov/DPD/Codes/Energy_Code/Nonresidential/Chapter_14/default.asp#Section1411

Uniform Plumbing Code Section 608.2: www.iapmostore.org/

# Appendix A: Codes and Standards in Jordan

# Building Codes in Jordan

Water efficiency measures for building codes should be proposed in coordination with the Ministry of Public Works and Housing and with the appropriate technical subcommittee of the Jordanian National Building Council (JNBC). Once approved by the technical committee, a recommendation for modification of the code would be made to the JNBC. The JNBC would then make a recommendation for consideration by the Council of Ministers. If approved by the Council of Ministers then the Code changes are subject to a review and waiting period before implementation by the engineering, construction and permit issuing agencies.

Initially created in 1989, the Jordanian National Building Council[1] (JNBC) was promulgated in accordance with Law No. 7 of 1993 and amended by Law No. 7 of 2004.

## *Duties and Authorities*

The JNBC is entrusted with the following functions and responsibilities:

1. Laying down the bases and principles related to the National Building Codes and define the scope of each code subsequent to the recommendation of the Jordanian National Building Codes.
2. Approving the various codes of the Jordanian National Building Codes and their submission to the Council of Ministers for their approval.
3. Examining the Technical Committee's recommendations and taking appropriate decisions with regard thereto.
4. Finalizing any objection on the approved codes or any amendment thereon in accordance with the provisions of the Law.
5. Concluding contracts with any scientific party to prepare any new code or amend any approved one and fixing the cost of such contract and approval of their disbursement.
6. Publishing and circulation of the approved codes.
7. Issuing the instructions pertaining to the application of codes during the stages of design, execution, supervision, maintenance, operation, public safety works and all the engineering works related to them.

The Technical Committee of Jordanian National Building Codes is chaired by H.E. the Secretary General of the Ministry of Public Works and Housing. The technical committee is responsible for the following functions:

- Preparing the bases and principles of the Jordanian National Building Codes and making recommendations concerning them to the Building Council.
- Recommending to the Council any amendments of the approved codes.

[1] www.jnbc.gov.jo/Web

- Looking into the objections to the codes referred to the Technical Committee and submitting its recommendations thereon to the Council.
- Following up the works of specialized committees and scientific parties which are charged with the preparation, modification and development of codes.
- Any other tasks and duties related to the codes and entrusted to the Technical Committee by the Council including the regulation related to the application of the codes.

Specialized committees related to any code may be established by the Chairman of the Council upon recommendation by the Technical Committee.

Products of the Technical Committee of the Jordanian National Building Codes have included:

- Preparing Codes and Scientific Issues which the Council publishes.
- Providing training to engineers of the Ministry of Public Works and on the use of Jordanian National Building Codes that will be circulated to all the relevant ministries, departments and engineering parties in all construction works in the Kingdom.
- Published 35 codes which include the technical principles and conditions as well as the necessary requirements which must be followed as a minimum at the stage of design and execution to realize safety and efficiency in various engineering field for all installation at the stages of work.
- Published Extracts of Building Codes to simplify and facilitate the use of fifteen codes. These summaries include the Water Supply for Buildings Code and the Drainage and Sewerage Code. The water supply and drainage codes directly affect plumbing and water use practices.

## *Code Updating*

The Jordanian National Building Council has started updating the second stage of building codes, and listed additional codes to be updated which includes Water Supply and Drainage and Sewerage in Buildings Codes. Changes to include water efficiency practices in the Drainage and Sewerage in Buildings Code and the Water Supply for Buildings Code would be affected by the process outlined in Article 10 of the Jordanian National Building Law. Preliminary to the Article 10 process, the Technical Committee (and subcommittees) would provide recommendations to the JNBC. The JNBC would make recommendations for consideration by the Council of Ministers. If approved by the Council of Ministers, a public review process begins.

A. Once approved by the Council, any code shall be displayed for review at the Office of the Council's Secretary by the general public. Its display shall be announced in at least two local daily newspapers. Any person may submit his objection towards the code to the Chairman of the Council within sixty days from the date of announcement of the display.

B. The Chairman of the Council shall refer the objections he has received to the Technical Committee within a period of not more than fifteen days as of the date expiry of the objection period. The Committee shall examine these objections and

submit its recommendations in respect thereof within a period not exceeding three months from the date of its referral thereto.

C. The Chairman of the Council shall transmit the code and any amendments made thereon after they have been approved by the Council of Ministers for adoption upon the lapse of thirty days on its publication in the Official Gazette.

D. Following the recommendation made by the Council, the Council of Ministers shall determine the works of construction, and the planning areas where the implementation of any adopted code subsequent to the provision of this Law has become mandatory. In this case the code shall become an integral part of the conditions of the construction license. Every natural or legal person shall be obligated to conform under the penalty of legal liability.

## *Entities Affected by Codes:*

### Article (11) describes to whom the codes apply:

A. All Ministries, Government Departments, Official and Public Institutions, Municipalities, Public and Private Shareholding Companies, Jordanian Engineers Association, Jordanian Construction Contractors Association and the Engineering Offices and Companies Body shall have to act in accordance with the provisions of this Law and take all necessary measures to this end.

B. With due observance to the provisions of paragraph (d) of Article (10) of this Law, no construction works shall be started except according to engineering plans which meet all the technical rules and requirements prescribed in the accredited building codes which are issued by a party authorized for design or by an engineering office which is registered with and certified by the Jordanian Engineers Association.

C. All the agencies entrusted with the certification of the plans of construction works, and under the penalty of legal liability, shall not approve any engineering plans until they have made sure that such plans duly conform with their congruity with the requirements prescribed in the codes and shall be stamped with the seal of the concerned agencies without any prejudice to the responsibility of the designing agency.

D. With due observance to the provisions of paragraph (C) of this Article, all ministries and bodies which issue construction licenses have to abide by the following:

- Refrain from issuance of building licenses or approval of construction projects unless the plans related to any of them are certified by the competent agency.
- Follow-up supervision of projects since the beginning of the execution works and until the end thereof to ensure that all code requirements provided for in the construction license and the terms and conditions that must be fulfilled have been duly complied with, in addition to faithful application of Jordanian Engineers Association and the Jordanian Constructions Contractors Association Laws and implementation of the Engineering Offices and Companies Body By-Law issued in accordance with the Jordanian Engineers Association Law and the legal measures required in this regard have been taken.
- None issue of work permits for construction works within the respective areas thereof unless the application for obtaining such permits has been accompanied

with a matching certificate issued by the party authorized to supervise execution and certified by the Jordanian Engineers Association if the supervising agency is an engineering office.

**Code Violations**: Article (12) describes the process of reporting code violations:

A. Engineering offices and companies as well as construction contractors and other bodies which carry out construction works must abide by the codes which are adopted in the design, supervision, execution or maintenance of these works. Each of the above entities must inform the concerned professional association of any violation thereof as soon as the violation is discovered. The concerned professional association must make sure that the violation has occurred and inform the competent planning authorities of same.

B. If the planning authority which issued the license has discovered that construction works are being carried out in contradiction with the license stipulations, this authority must issue an executive warning or notification to the employer and contractor to stop work until the committed violation is corrected. In case the notified person fails to remove the causes of violation within the period defined in the notification, the authority which has issued the notification may take legal action against the employer and contractor to implement the necessary penalties against them including their obligation to remove the causes of violation.

C. The Council is entitled to take the necessary measures to insure that the adopted codes are applied in all stages of the engineering work including design, checking, supervision, execution, operation maintenance, public safety works and all the engineering works related thereto.

**Reference to GAM**: Article 7 of the Building License Application regulations

The Planning Committees in Greater Amman Municipality (GAM), and the official concerned municipalities and parties shall not issue any work permits for the buildings and installations within the municipal and other areas unless the application made for obtaining such permits has been accompanied with a reconciliation certificate issued by the supervising engineering office and certified by the Engineers Association.

This article (or other bylaws) may allow GAM to review landscape design plans for water efficiency measures.

## Performance Measurement and Testing - Jordan Institution for Standards and Metrology

*Purpose of Working with JISM*

Proposed water efficiency products need to be tested and certified to assure that the products and services perform to the desired technical regulations/standards. Such products include plumbing fixtures, equipment and appliances. The Standards and Metrology Law No. (22) of 2000 designates and authorizes Jordan Institution for Standards and Metrology (JISM) with the responsibility of:

> The preparation, approval, revision, amendment and monitoring the implementation of standards and technical regulations with regard to all services and products (with the exception of pharmaceutical products, medicines, veterinary medicines, serums & vaccines).

Responsibilities of JISM include:

- Developing standards and technical regulations,
- Designating testing procedures,
- Accrediting testing and calibration laboratories and certification bodies,
- Concluding agreements with regional and international organizations and bodies regarding the mutual recognition of certificates of conformity, including quality marks, certificates of laboratory accreditation and competence of the bodies granting such certificates.
- Allowing the use of the Jordan mark on products meeting the standard
- Inspecting products to assure performance meeting standards
- Enforcing the proper use of certification marks.

# Appendix B: Green Building Standards and Building Codes

Several large US cities and the State of California have amended building codes to include green building practices for new structures in their area of jurisdiction. These local regulatory actions have 'jumped over' the slower moving national and international code development organizations. Examples of codes with green building practices are provided below:

- In 2007, the City of Longmont Colorado (population 71,000) enacted a new chapter of the Longmont Municipal Code creating green building requirements. The stated purpose is to encourage cost effective and sustainable residential building methods, conservation of fossil fuels, water, and other natural resources, recycling of construction materials, reducing solid wastes and improved indoor air quality. Instead of using LEED, Longmont assigned its own point system and point requirements for buildings of different sizes. Water elements focus on landscape design, plant material selection and irrigation techniques.

- In April 2008 the Dallas (Texas) City Council adopted a resolution for implementation of the citywide green building program and an ordinance establishing the green building program. The stated goal is to improve air quality, reduce water use and improve transportation and land use through green building strategies. Effective October 2009, all new residential construction and all new commercial construction will meet at least four water reduction requirements involving lavatory faucets, showerheads, toilets, USEPA Water Sense specifications, Energy Star labeled dishwashers and clothes washers, and landscape irrigation. Effective October 2011, mandatory measures require that all proposed projects must be LEED certifiable under the LEED standard for homes and include at least one point in the indoor water use category. It is interesting to note that formal certification by the USGBC, Green Built North Texas or an equivalent entity is not required. (This saves the developer certification costs.) Commercial construction water use is required to be reduced by 20% in 2011.

- In July 2008, the California Building Standards Commission adopted green building standards into the California Building Standards Code. Elements effective in 2008 are already part of the building codes and relate to plumbing fixtures. In 2011, more stringent standards will be required for all new structures.

- The East Bay Municipal Utility District (EBMUD) provides water and wastewater services to approximately 1.3 million people in 22 communities along the eastern shores of San Francisco Bay. In 2007, the EBMUD Board of Directors adopted Section 31 of the procedure and standard for new water service. For a new customer to obtain water, or for an existing customer to obtain water for major building renovation, the prescribed water efficiency measures are:

    - Water saving features should be included in building plans,
    - Building plans should be presented to EBMUD,
    - Building plans shall be reviewed by expert EBMUD staff,
    - Water saving equipment should be included in the new construction, and
    - Construction shall be inspected by EBMUD representatives.

The program has been operating successfully for more than one year.

- On June 23, 2004, the Houston (Texas) City Council adopted the Green Building Resolution, which set a target of silver level LEED certification for new construction, replacement facilities and major renovations of city of Houston-owned buildings and facilities with more than 10,000 square feet (1,000 $m^2$) of occupied space. Additionally, the Code Enforcement division of the City of Houston offers a 'Quick Start' service to any project, which has registered for LEED certification regardless of construction cost and/or size. The City also offers financial incentives for LEED certified buildings. LEED projects qualify for a graduated rebate of the building permit fees. The rebate is based on the level of achievement – certified, silver, gold or platinum The levels of achievement and rebates are: Platinum Level – 100%, Gold Level – 75%, Silver Level – 50%, Minimum Level – 25%.

- The Japan Sustainable Building Consortium reports that the cities of Osaka, Yokohama, and Nagoya require building permit applicants to submit the CASBEE[2] assessed data, part of which is to be disclosed on the website of the local government.

There are financial advantages to building owners meeting green standards that are incorporated in building codes:

- Costly applications and review by the Green Building council are avoided;
- Cost of a certification appraiser is avoided
- Current and future building owners and occupants will have more environmentally friendly facilities and lower cost for energy, water and other resources

[2] Comprehensive Assessment System for Building Environmental Efficiency