KFUPM

King Fahd University of Petroleum & Minerals

جامعة الملك فهد للبترول والمعادن

6 CLEAN WATER AND SANITATION

Water Sustainability Strategy

2025–2026



OVERSEEN BY

Projects and Maintenance Department

ISSUE DATE

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At KFUPM, we highly regard water as a vital resource. Through research, educational programs, and water security projects, we actively preserve this precious resource. Our continuous efforts ensure its conservation, making it available for the benefit of future generations.

This Environmental Sustainability Strategy responds to rising matters of environmental sustainability due to bad economics or poor infrastructure. It comprehends actions, processes and policies to address consumption, usage, care and community engagement to mitigate environmental risk in the framework of environmental compliance and due diligence.

OVERSEEN BY	ISSUE DATE	CONTACT
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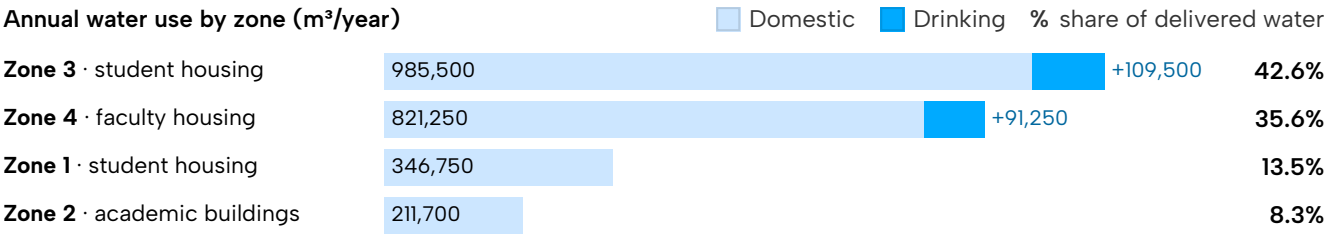
Key themes

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This edition condenses the full strategy and adds the 2025–2026 initiatives of the Agriculture & Pest Control Section (Community & Office Services Department), marked **2025–2026 update**

Water consumption and conservation on campus

KFUPM provides inhabitants on campus with clean, safe water for drinking and household use. The supply system serves four zones: student housing in zones 1 and 3, academic buildings in zone 2 and faculty housing in zone 4. In zone 3 it also serves the central kitchen, storehouse, workshops and student mall.



Domestic use accounts for 92.2% of the water supply and drinking use for 7.8%.

109 m³
annual water use per capita at KFUPM (18,412 people, 2,007,500 m³)

368 m³
per capita in the Eastern Province (2018)

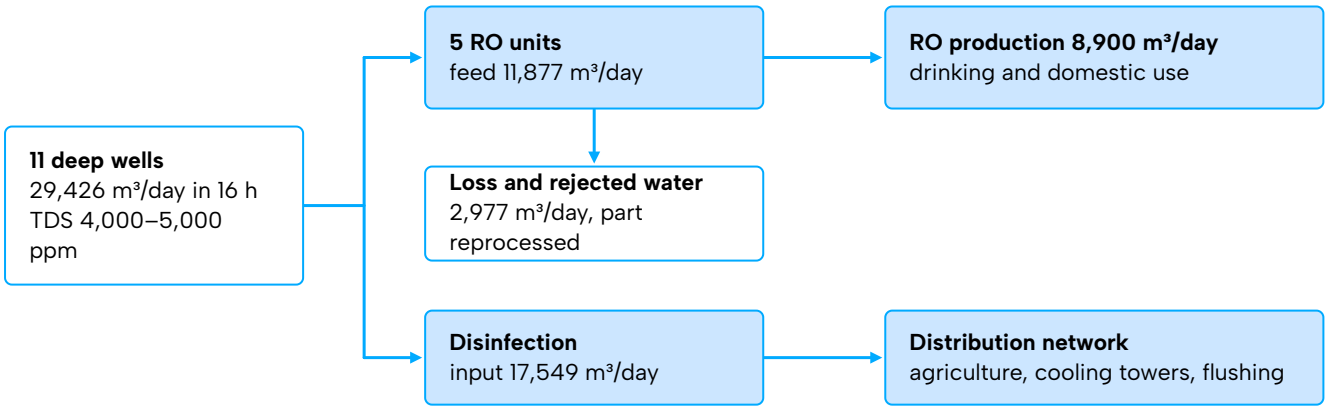
99.16%
of the Kingdom's population used safely managed drinking water (2020)

88.89%
of domestic and industrial wastewater flows safely treated

For water conservation, KFUPM applies the regulations of the Ministry of Environment, Water and Agriculture (MEWA), deploying water-saving equipment in households and providing public workshops and seminars on water security.

Water sources and treatment

Two sources supply the campus. KFUPM's brackish deep groundwater aquifers (TDS 4,000–5,000 ppm) produce 29,426 m³ per day over 16 hours from 11 deep wells. Desalinated water from Al Aziziah / Al Khobar (TDS 700–1,100 ppm), around 2,500 m³ per day, is connected directly to the network and mainly used for showering in faculty and staff housing. Raw well water is treated by five reverse osmosis (RO) units, which lower TDS to 200–250 ppm.



Process and distribution of KFUPM's deep-well water.

Important research output

Jamiu, Z. A., Jagaba, A. H., Abdulazeez, I., Salhi, B., Lawal, D. U., Baig, N., Khan, N. A., & Aljundi, I. H. (2025). 2D transition metal dichalcogenide membranes for efficient oil-water separation. *Colloids and Surfaces A*, 726, 137933. https://doi.org/10.1016/j.colsurfa.2025.137933

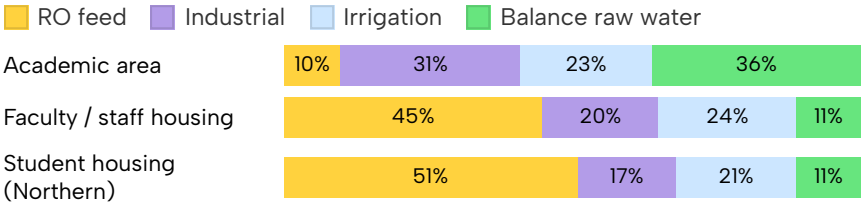
Waleed, S., Haroon, M., Ullah, N., Tuzen, M., Rind, I. K., & Sarı, A. (2025). A comprehensive review on advanced trends in treatment technologies for removal of Bisphenol A from aquatic media. *Environmental Monitoring and Assessment*, 197(1), 83. https://doi.org/10.1007/s10661-024-13460-x

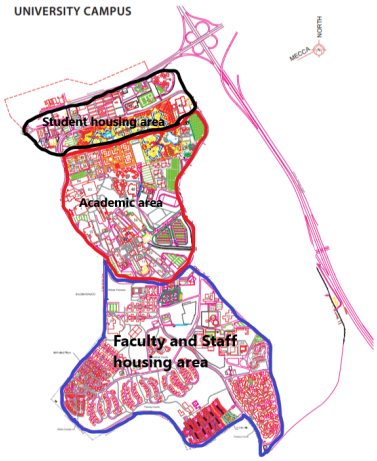
Firmansyah, M. L., Alwan, Y., & Ullah, N. (2025). A comprehensive review on the adsorptive removal of pharmaceutical pollutants: Occurrence, toxicology, molecular simulation and mechanistic insights. *Talanta Open*, 12, 100491. https://doi.org/10.1016/j.talo.2025.100491

Water distribution by campus area

Distribution is divided into three areas, each fed by its own deep wells: the academic area, the faculty and staff housing area (Eastern pump house) and the student housing area (Northern pump house and the new SCADA pump house). In each area, raw water is divided into RO feed, industrial use, irrigation and flushing.

Raw water distribution





The three distribution areas

m³/day	Academic area	Faculty / staff housing	Student housing
Deep wells	1, 2, 9, 12	5, 6, 10	7, 8, 11 · SCADA: 13
Raw water	10,172	7,629	8,719 · SCADA: 2,906
RO feed / produced	1,000 / 600	3,471 / 2,250	4,500 / 3,450 · SCADA: 2,906 / 2,600
Industrial	3,200	1,500	1,450
Irrigation and flushing	5,972	2,658	2,769
Sweet water required	200 of 600	4,084 (2,250 produced)	4,834 of 6,050
Irrigation required	2,349 of 5,972	1,806 of 2,658	1,805 of 2,769
Other supply	–	Khobar municipality, about 2,500 (TDS 700–1,200)	–

Maintenance Department report and Projects Department design calculations.

Findings and recommendations

Academic area

- Sweet and raw water sources are sufficient.
- Install a digital water meter in the pump house to measure actual use.
- Deep-well water (TDS 3,500–5,000 ppm) damages cooling towers and boilers; treated water (TDS 500–1,000 ppm) is recommended for industrial use.
- Automatic blowdown on existing cooling towers can cut industrial water use by 30–40%.
- Segregate industrial water tanks and network to avoid summer shortages of cooling tower make-up water.

Faculty / staff housing

- A sweet water shortfall of 1,834 m³/day is covered by Khobar municipality water in winter; there is no municipal supply in summer.
- The new Eastern pump house has 2 RO units (3,000 m³/day), but only one runs (1,500 m³/day) because the sewer cannot take the reject water from both.
- Upgrading the sewer network would let both units run and secure enough sweet water.

Student housing

- Sweet water for domestic and drinking use comes from the Northern and SCADA pump houses; calculations include student housing Phase 5B.
- The SCADA plant (3 primary and 3 secondary RO units, 4,800 m³/day capacity) produces 2,600 m³/day because of a raw water shortage.
- A new deep well near building 40 is recommended to support the SCADA RO plant.

Wastewater, pollution prevention and drinking water

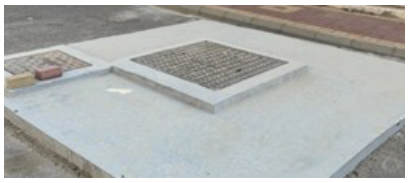


Dhahran wastewater treatment plant

KFUPM's sewage system is connected to the municipal sewage system. Campus wastewater is treated at the nearby Dhahran wastewater treatment plant of the National Water Company, which operates the main sewage system in Dhahran; the purification process is regulated by an ongoing agreement with the company.

Preventing polluted water from entering the water system

- Wells, pipelines and pumps are built to operate independently and to be switched on or off individually in an emergency.
- Valves regulate what goes where.
- Supply and storage systems are enclosed and accessible to authorized personnel only.
- Manholes allow regular inspection, cleaning and removal of obstructions.
- Research Institute EH&S resources provide guidelines, awareness documents and procedures for hazardous materials.
- A pollution prevention concept minimizes or avoids pollution from accidents and incidents.





How polluted water is kept out of the main water system

Water-conscious building standards

- Aerators on faucets to reduce tap water flow.
- Re-circulating pumps in hot water lines of residential villas for an instant flow of hot water.
- Water-efficient flush tanks.
- Separate drain lines that collect wastewater from wash basins, showers and kitchen sinks for future greywater recycling.

KFUPM applies the Saudi Building Code (SBC) to all building works, from design and operation to maintenance, demolition, modification and rehabilitation, and is committed to the Saudi Green Building Code, whose section 7 calls for water-conscious equipment. All water equipment installed is classified as SASO category A, the most efficient. KFUPM is a member of the SBC National Committee and adheres to MEWA's Water Regulations (Water Law, Articles 37–42), which require the judicious use of water and approved water-rationalizing tools and equipment.



SASO water efficiency label

Water-conscious planting

Planting actions minimize grass cultivation, reduce water use and enhance greenery around student housing. Drought-resistant flowering shrubs, some grown in university nurseries, are planted across campus, and trees are planted in residential areas to expand green spaces and combat desertification. The selected species need minimal water and provide shade and pest control; examples include *Atriplex halimus*, Ficus plants and *Azadirachta* (neem), which thrives in poor soils. Drip and sprinkler systems irrigate the planted areas.

Water reuse policy

Policy	Created	Implemented	Reviewed
Water Policy	2021	2021	2025

The university is dedicated to efficiently managing water resources and maximizing water reuse within the campus. One of KFUPM's main goals is to reshape and enhance the water recycling program. Actions include:

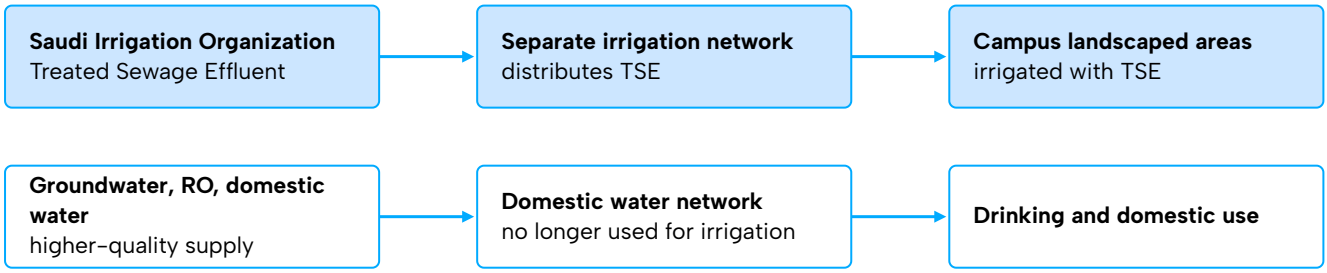
- Collecting greywater on campus for potential recycling and reusing rejected water for irrigation.
- A separate drain line in new buildings collects greywater from bathtubs, showers and kitchen sinks for future recycling; processed greywater can be safely used for irrigation.
- Reverse osmosis technology reclaims about 30% of salty (rejected) water, and KFUPM aims to increase this share. At the Eastern pump house, reject water is directed to a 500 m^3/day tank for domestic water production.
- The Maintenance Department oversees reused water, estimated to reach 500 m^3/day, mainly for irrigating green areas.
- Campus sewage is treated by the National Water Company, which plans to increase treated water reuse to 25% by 2030, in line with KFUPM's vision.
- Proactive maintenance on all water facilities prevents leaks and water loss, and conscientious water use and sustainable landscaping are promoted.

2025–2026 update

Treated Sewage Effluent (TSE) for irrigation

The Agriculture & Pest Control Section (Community & Office Services Department) is working with the Saudi Irrigation Organization (SIO) to supply Treated Sewage Effluent (TSE) for campus irrigation. This is part of a wider project to separate the irrigation network from the domestic water network.

- **Sustainability:** TSE reuses water that has already been used once, reducing reliance on groundwater abstraction and on RO and domestic water for landscape irrigation, and leaving higher-quality water for drinking and domestic use.
- **Better for irrigation:** TSE contains nutrients such as nitrogen and phosphorus that benefit plant growth and can reduce fertilizer use.
- **Lower cost:** TSE costs less than domestic water and avoids the energy and treatment costs of producing RO or domestic-quality water for irrigation.
- **Network separation:** separating the networks will stop domestic water being used for irrigation and allow TSE to be distributed across the landscaped areas.



Planned separation: TSE for irrigation; higher-quality water kept for drinking and domestic use.

Government partnership: the TSE initiative is a collaboration with a national government entity, the Saudi Irrigation Organization (SIO), and forms part of KFUPM's local government and industry partnerships for water efficiency.

2025–2026 update

Campus Landscaping Strategy

The Agriculture & Pest Control Section will develop a Campus Landscaping Strategy based on the guidance manual issued by the Ministry of Environment, Water and Agriculture (MEWA). It will align campus landscaping, planting and irrigation with the goals of Saudi Vision 2030 and its related national programs:

Saudi Green Initiative (SGI)
Expand vegetation cover and combat desertification by planting native and drought-tolerant trees and shrubs across campus, increasing green cover and shade while keeping water demand low.

National Water Strategy 2030 and Qatrah (MEWA)
Reduce the use of groundwater and high-quality water for irrigation by choosing water-sensitive plants, reducing lawn areas, and moving irrigation to TSE and efficient, weather-based irrigation.

National Center for Vegetation Cover (NCVC)
Favor native plant species suited to the local climate and soil. They need less water, fertilizer and maintenance, and support local biodiversity.

Quality of Life Program
Create shaded, attractive and usable green spaces for students, staff and families, improving outdoor comfort and wellbeing on campus.

The strategy will:

- Unify the landscape character of the campus under one approved standard.
- Adopt an approved palette of native and water-sensitive plants in line with the MEWA guide.
- Start planting water-sensitive plants across campus, grown in the University's own greenhouses and nurseries.
- Reduce lawn areas in non-visible and low-use areas, replacing them with xeriscape and drought-tolerant planting.
- Keep lawns only where they serve a clear function, such as parks, family areas and event spaces.
- Prioritize shade trees along pedestrian routes to reduce heat exposure and improve thermal comfort.

Together, these measures help the campus contribute to the Kingdom's targets for water conservation, greener cities and sustainable agriculture, and position KFUPM as a model campus for Vision 2030 sustainability goals.


Pruning bougainvillea


Drought-tolerant plants


Periwinkle seedling beds


Atriplex, Ficus and Aloe vera


Inside a University greenhouse


Tending greenhouse plants


Caring for potted plants


Greenhouse shrubs and trees

Water in the community and water management

In 2024, KFUPM's objectives included engaging with schools and MOOCs organizations, using emails, posters and social media to raise awareness about water conservation. The KFUPM Institute for Knowledge Exchange has held four workshops and two seminars on water security, open to the public. On campus, KFUPM reuses treated water for toilet flushing and cooling towers, installs water-saving devices and tap filters, uses automatic irrigation and small drip sprinklers for trees, operates desalination and purification machines in its water stations, reclaims about 30% of rejected water, and runs awareness campaigns, including reminders in most campus washrooms.

2025–2026 update

Automatic and smart irrigation

About 70% automatic controllers (Hunter, Rain Bird, Toro)

Remaining manual areas: conversion ongoing

Current state: about 70% of campus irrigation is now controlled by automatic irrigation controllers. Automatic scheduling reduces over-watering, operator error and water losses compared with manual irrigation. Converting the remaining manual areas to automatic control is ongoing.

Future state: irrigation will become weather-based, coupled with field sensors. Schedules will be set from evapotranspiration (ET) data and adjusted automatically by rain and wind sensors, so water is applied only when and where plants need it, with a central SCADA control room for real-time monitoring and control.



Hunter X2 controller



Rain Bird ESP-Me controller



Toro Evolution controller

Sustainable extraction and approvals

KFUPM runs water optimization projects with industry partners as part of its Environmental Impact Assessment (EIA) initiatives, which identify and mitigate potential environmental and health impacts of proposed projects. Extraction is monitored to maintain balance, and supply losses are reduced. Any new water well on campus requires pre-approval from MEWA, and off-campus sources require permission from the National Water Company.

Partnerships on water security

Saudi Irrigation Organization: water allocation and optimizing agricultural water use; now also working on TSE supply for campus irrigation.

Massachusetts Institute of Technology: joint clean water and energy initiatives.

Ministry of Interior: securing wheat water demand under water scarcity conditions.

MEWA: strategic collaboration on environmental and water-related projects.

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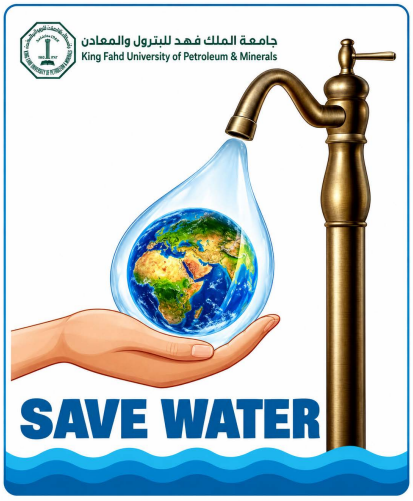
KFUPM Institute for Knowledge Exchange (KIKX)
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Free drinking water: KFUPM buildings provide free drinking water through drinking water coolers (except labs and workshops).









RI Safety Unit (RISU), CRF

KFUPM actively engages in Water Optimization projects with industry partners, integral to our Environmental Impact Assessment (EIA) initiatives. EIA serves as a formal process to identify potential environmental and health impacts of projects, exploring means to mitigate these effects. This involves studying the environmental feasibility of proposed projects, ensuring they don't harm natural resources or human health.

At KFUPM, we utilize a variety of methods for sustainable water extraction, meticulously monitored to maintain balance. The university constantly enhances campus water consumption efficiency by implementing sustainable practices. This includes reducing losses in the supply system, utilizing water-saving equipment, and employing automatic irrigation systems.

Moreover, for any water well installation on campus, pre-approval from the Ministry of Environment, Water & Agriculture is essential. Similarly, if the water source is off-campus, permission from the National Water Company is required. Adhering to the stringent regulations reflects the university's dedication to increasing water-use efficiency and ensuring sustainable withdrawals and freshwater supply across all sectors.

The university collaborates continuously and emphatically with various agencies to address water security, fostering partnerships with government water utilities in Saudi Arabia and international institutes: