6.3.1 - Process to treat waste water

- Water recycling and wastewater treatment are central components of the university's integrated water strategy. More than 50% of wastewater is reported to be treated and reused for non-potable applications, including landscape irrigation, agriculture, campus cleaning, and research activities. Recycled water supports green areas, agricultural research farms, rooftop gardens, and aquaculture facilities. Innovative projects include greywater recycling systems, air-conditioning condensate recovery, wastewater treatment units, a 100 m^3 desalination plant, and renewable energy-powered desalination technologies. These initiatives demonstrate the potential of an integrated approach to water conservation, resource recovery, and sustainable development while reducing freshwater demand and wastewater discharge.

- The university also promotes the development and evaluation of advanced water treatment technologies to improve water quality and pollutant removal. Relevant treatment processes include filtration, adsorption, membrane separation, reverse osmosis, and disinfection, depending on the characteristics of the water source and the intended application. Wastewater assessment may include the measurement of ph, or hydrogen-ion concentration, biochemical oxygen demand, dissolved oxygen, nitrogen, phosphorus, and the concentration of heavy metals such as iron, copper, zinc, chromium, and arsenic. These parameters help determine treatment performance, identify potential contamination, and evaluate the environmental impact of pollutants on soil, groundwater, surface water, and aquatic ecosystems.

- To protect water resources, Alexandria university applies water pollution control measures involving wastewater treatment, controlled discharge, laboratory analysis, and continuous water quality monitoring. The university's central laboratory and specialized research facilities conduct physical and chemical characterization of water samples in accordance with recognized analytical standards. Such investigations help assess pollutant concentrations, treatment efficiency, and potential health risks associated with contaminated water. Monitoring and risk assessment also contribute to environmental protection by supporting the identification and control of contaminants that may affect aquatic species, plants, animals, and surrounding ecosystems.

- Research and innovation in sustainable water technologies are supported by the Alexandria university water resilience center of excellence (AWR-CoE), which serves as a platform for applied research, capacity building, professional training, and national and international collaboration. The center advances innovative solutions in wastewater treatment, desalination, membrane technology, water recycling, and climate-resilient water management. Its activities include experimental investigation, process optimization, performance evaluation, and the development of sustainable treatment systems in cooperation with academic institutions and industry. Specialized academic programs, workshops, scholarships, and collaborative projects further strengthen scientific capacity and promote the application of research results to real-world water challenges.

- In addition, community initiatives, including coastal cleanup campaigns, marine conservation, and environmental awareness activities, support the prevention of water pollution and the restoration of aquatic environments. These initiatives contribute to protecting sea water, marine species, and coastal ecosystems while promoting responsible water management among the university community and the wider population.

- Through integrated management, continuous monitoring, scientific investigation, and technological development, Alexandria university aims to improve water quality, reduce water consumption, increase wastewater recovery, and protect groundwater and other water resources. The university's strategic approach emphasizes efficient resource utilization, evidence-based assessment, environmental sustainability, and collaboration with industry and research partners. These efforts provide a foundation for future improvements in water conservation, treatment performance, pollution control, and sustainable water resource management across Alexandria and the surrounding region.



The STDF-funded HMDed project on innovative wastewater treatment technologies concluded with a workshop held at the Faculty of Science, Alexandria University, in December 2025. The workshop combined lectures and hands-on training in water quality analysis and nanomaterial applications, bringing together academics, industry experts, and 51 researchers and students.



The SOA/C workshop was organized by the Alexandria University Water Resilience Center of Excellence (AWR-CoE) to promote knowledge exchange, strengthen research collaboration, and enhance capacity building in sustainable water management and water resilience.



The water Quality Parameters Training and Innovative Strategies Workshop focused on water quality testing, teaching, and the development of innovative strategies for water quality assessment and sustainable water management.



Wastewater treatment unit - Faculty of Engineering



100 m^3 Desalination Unit, Wadi El-Natroom - Faculty of Agriculture



Innovative Renewable Energy (RE) Driven - Multi Stage Flash (MSF) System with Salts Precipitator and Nano Filtration (NF) Feed Water preTreatment (RE-NF-MSF) - Faculty of Agriculture

Water recycling initiatives within the university

Alexandria University also documents smaller-scale water recovery initiatives:

- **Faculty of Engineering:** an air-conditioning condensate collection and reuse unit, along with a wastewater treatment unit.
- **Faculty of Pharmacy:** a greywater recycling initiative intended to treat handwashing wastewater for toilet flushing.
- **Faculty of Agriculture:** reuse of water associated with aquaculture and agricultural research for crop irrigation

Alexandria University program for Sewage Disposal

- Providing a sewage treatment plant at the university to make it suitable for irrigating green areas and gardens inside the university campus.
- The irrigated water supplied to the fish farm at the Agriculture Experimental Research Station of the Faculty of Agriculture is recycled to irrigate the crops, vegetables, and fruits of the land farm. The recycled water is rich withnatural fertilizers and enhances the crops production.
- In addition, the water recycling in Fish Aquaculture of the Faculty of Agriculture, Alexandria University: The watersewage of the Aquaculture of the Faculty of Agriculture, Alexandria

University which consist of eight ponds (one acre and quarter/each) in Abis region. Alexandria University used the recycled water for crops culturing in the adjacent agriculture research center in Abis.

- The use of biochar produced from Agricultural waste and waste Forests in residual removal chlorpyrifos pesticide Imidacloprid is from water agricultural drainage. Cooperation project between the Egyptian Academy of Research Science and Technology and the Czech Academy of Sciences.
- The sewage water will be treated and reused in the irrigation of green areas in Alexandria National University.
- Faculty of Pharmacy is seeking to implement a grey water (wastewater) recycling system that depends on reusing wastewater from sewage basins only (without using wastewater from laboratory basins) by repumping it into the flushing bins in the toilets after work. Filtration and primary treatment. The grey water recycling initiative has a significant impact on rationalizing water use.



The water sewage of the Aquaculture of the Faculty of Agriculture (Alexandria University, Egypt)

The irrigated water supplied to the fish farm at the Agriculture Experimental Research Station of the Faculty of Agriculture is recycled to irrigate the crops, vegetables, and fruits of the land farm.



The sewage water will be treated and reused in the irrigation of green areas in the project (Alexandria University)

- The *Water Recycling Program* demonstrates significant progress in non-potable water reuse and resource recovery. Treated sewage effluent (TSE) from the *Campus*, totaling approximately 1.12 million m^3 annually, is utilized for landscape irrigation. At the *Faculty of Pharmacy*, a greywater pilot system treats hand-wash wastewater for toilet flushing, while air-conditioning condensate recovery systems in select buildings supply irrigation and flushing operations. Rainwater is harvested into a central retention lake, providing an additional source for green-area irrigation. The *Faculty of* aquaculture facility recycles nutrient-rich effluent from its eight-pond fish farm to irrigate adjacent crops, enhancing soil fertility and yield. The University also operates a 100 m^3/day solar-powered desalination unit at *Wadi El-Natroun*. It has developed an innovative renewable energy–driven multi-stage flash desalination system (RE-NF-MSF) with nanofiltration pre-treatment, demonstrating leadership in sustainable water technologies.
- Implementation of *Water-Efficient Appliances* has expanded substantially, with 80.1% of all fixtures on campus now classified as water-saving devices. These include 90.97% of bathroom faucets, 50.48% of toilets, and 57.69% of urinals that have been retrofitted with flow-control mechanisms. The University enforces institutional policies mandating water-efficient design standards in all new buildings and major renovations. The *Abis Campus* exemplifies these efforts, with green infrastructure now covering 52% of its total site area, integrating sustainability principles into the built environment.
- A cooperation protocol was signed between Alexandria University and Alexandria Sewerage Company to employ outstanding graduates from the faculties of Engineering, Commerce, Law, Science, and Arts over the past five years, based on the actual needs and annual workforce plan of the sewerage company. Additionally, the protocol aims to prepare a new generation of skilled professionals in modern technologies. It includes agreements for employees to access masters and doctoral programs at reduced fees and to conduct

workshops and training courses with professors from Alexandria University to enhance partnerships for sector performance and achieve sustainable development goals.

- In relation to *Treated Water Consumption*, Alexandria University channels the entirety of its wastewater 1,116,625.26 m³ annually, through the *Alexandria Sanitation Company* for secondary and tertiary treatment. A substantial portion of this treated water supports Egypt's *New Delta* agricultural reclamation project, thereby contributing to the country's national food security objectives. Treated water is reused for irrigation, aquaculture, and experimental research, establishing a closed-loop water management model that exemplifies the University's commitment to sustainable resource utilization.
- Recent initiatives of the Center of Excellence for Water include student training in wastewater treatment operations, entrepreneurship bootcamps on water innovation, and workshops on EU-funded research opportunities. These activities have positioned Alexandria University as a national and regional leader in sustainable water governance, demonstrating how academic excellence, technological advancement, and environmental responsibility can be effectively integrated to address Egypt's water and climate challenges.





Raising awareness among Alexandria University students about wastewater treatment was achieved through summer training activities conducted at Alexandria Sewerage for students from various faculties,
including Science, Engineering (Civil, Mechanical, and Mechatronics), Commerce, Arts (Surveying, Mapping, and GIS), and Fine Arts (Architecture), September 2024.









The Center of Excellence for Water at Alexandria University is organizing a training program for scholarship students in collaboration with EPROM Company. This initiative aims to equip students with practical skills in water management including training courses about Water Treatment for Industrial Applications, and Wastewater Plant Operations and Troubleshooting, ensuring they are well-prepared for the business sector
and aligned with labor market requirements (March, 2024).

Alexandria University also has a large number of research projects in the field ofwaste recycling, treatment and reuse of sewage and industrial wastewater.

- Enhancing Resource Recovery and Improving Wastewater Reuse Through Synergistic Cooperation Between Bioelectrochemical Systems and Forward Osmosis (2019–2024). This project focused on combining treatment technologies to improve water recovery and resource utilization.
- A novel combined approach for Poultry slaughterhouse wastewater treatment: prototype design and development,(2021-2024).
- Agricultural sustainability and water reuse in Egypt: innovative wastewater treatment and soil health, (2021-2024).
- Towards a green Economy Farm: Innovative Solar Collector for Biochar Production from Agricultural & Food Industry Wastes, Power Generation, and Crops Drying, (2021-2023).
- Wastewater Treatment by Integrated Green Coagulation and Membrane Technology for Reuse, (2021-2024).
- Construction of a Self-Charging Unit for Collecting Wasted Mechanical Energy from Basic Human Motion, (2023-2025).
- Production, modification and new prospects of biochar derived from biomass waste, (2023-2026).
- Microbial technology as a bioremediation tool for heavy metals removal from industrial wastewater throughproteomic and nanotechnological approaches, (2023-2025).