



6 CLEAN WATER AND SANITATION 

TAMKANG UNIVERSITY

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CLEAN WATER AND SANITATION

Water consumption per person

Water consumption tracking

As an academic research institution, the water used on campus is mainly tap water supplied and measured by the public water treatment plant. No consumption of water is through extracting from lakes or aquifers. The water consumption is tracked and monitored by the Environmental Protection and Safety and Sanitation Center of the university according to the number provided by the public water treatment plant. Relevant data is posted on the website on a monthly basis.

The three campuses of the university, which are located in Tamsui, downtown Taipei, and the mountain area in Yilan County, are all in areas with abundant rainfall all year round. With the rainy nature of the region as a focus point, our school has been developing methods of collecting and reusing rainwater in recent years. The collected rainwater is then used for plants irrigating within the campus, which can not only reduce the burden of relying on purchased tap water but also take into consideration the responsibility of environmental protection.

In 2021, the total tap water consumption of the school is 438.89 million liters (438,890 cubic meters); rainwater collected for plant sprinkler irrigation is about 4,056 liters (4 cubic meters).

Water consumption per person

The average yearly per capita water consumption in 2021 is about 16,729.97 l/y (that is, 45.84 l/day per person), which is better than the average water consumption per capita of colleges and universities in Taiwan of 110 l/d per person.

Water usage and care

Following the risk adaptation strategies, the university conducts water planning and water resources management and has formulated various measures. The measures are categorized into three aspects: water safety, water source conservation, and wastewater treatment.

1. Water safety: The university use tap water supplied and quality-ensured by Taiwan Water Corporation as the source of campus water. To further secure water safety, the school conducts the inspection, maintenance, and cleaning of water storage towers and pipelines on a programmed basis. As for the drinking water, over three hundred drinking fountains are placed on campus to provide free drinking water for school members and visitors. To ensure the quality of the drinking water, the school conducts constant inspection and maintenance of the drinking fountains according to relevant national laws and regulations. We undertake the sampling operation on 1/8 of the drinking fountains every quarter to ensure the drinking water's quality.



2. Water conservation: Water conservation (including reuse) and reduction of water squandering are the concerns of the university. In terms of water conservation, both the Tamsui campus and the Lanyang campus are located in areas with abundant rainfall all year round. The large green spaces of the two campuses have a great function of water conservation and carbon neutrality. New buildings on campus are more in line with the concept of green buildings, emphasizing the water retention function of the base, effectively retaining rainwater and preventing it from becoming runoff. In terms of reducing water waste, we plant native plants and drought-tolerant plants to reduce the water used for sprinkler

irrigation. In addition, water-saving faucets, flushing toilet seats, and technological non-flushing urinals have been installed to reduce water consumption in baths and toilets.

3. Wastewater treatment: Campus domestic sewage is taken over to the public sewage treatment plant through the sewage sewer and discharged after it meets the discharge standards. The waste liquid generated in the laboratory is collected for temporary storage in the university and then managed by qualified manufacturers of the Environmental Protection Agency to clear and transport it every semester.



Water treatment

Before 2019, Tamsui Campus housed five on-campus sewage treatment plants at the gymnasium, swimming pool, chemical building, engineering building, foreign language building, and another one in Lanyang Campus. All the sewage treatment plants were operated and maintained by qualified manufacturers every year to ensure the operation of the sewage plant equipment. The wastewater produced by the school first enters the sewage plant for chemical treatment, then is discharged into the off-campus sewage pipeline. The quality of the discharged water is subject to regular sampling inspections by the school and aperiodic sampling inspections by local environmental protection agencies. The results have been meeting the discharge water standard.

Starting from 2019, since the public sewage sewers implemented by the government had been completed, the Tamsui campus sewage is fully incorporated into the public sewage and sewer pipelines of New Taipei City and concentrated in the government-run Sewage Treatment Plant. The sewage is treated and discharged until it meets the national standard to prevent polluting the river water quality.

Preventing water system pollution

To prevent polluted water from entering the clean tap water system, the university has installed a total of 38 tap water storage towers on the Tamsui campus, Taipei campus, and Lanyang campus. The opening of each water

storage tower is locked and under safety control by the management personnel. Every year, a professional manufacturer is commissioned to clean the tower body. After the cleaning is completed, the Taiwan Inspection Technology Co., Ltd. (SGS) will conduct a water quality sample inspection (once every 3 months).

In addition, the school has established a map illustrating the distribution of tap water pipelines and sewage pipelines on campus, assisting professional hydropower technicians in arranging inspection plans. In the case of abnormal water leakage, repairs will be carried out immediately to avoid cross-contamination between water pipelines. The sewage generated by the laboratory is also subjected to primary treatment before being discharged into the sewage pipe and then taken over to the off-campus sewage treatment



plant through the sewage sewers for further treatment.

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Free drinking water provided

A total of 257 water dispensers are installed in 26 buildings and outdoor courts on the Tamsui campus, 17 on a single building on the Taipei campus, and 33 water dispensers installed on the Lanyang campus, providing free drinking water for faculty, staff, students, and visitors. All the dispensers are maintained periodically by replacing and checking the filters to ensure the drinking water quality. In addition to inspection by an impartial third party entrusted by the water dispenser equipment company, the school's Environmental Safety Center also conducts regular sampling inspections every year to ensure the safety of drinking water with a double inspection mechanism. The results of the water quality inspection will not only be announced on the website of the General Affairs Office, but also through QR codes posted on each water dispenser station. Those interested can scan the QR code for detailed test report, replacing the traditional paper reports that cannot update in real-time.

Water-conscious building standards

The school applies relevant building standards to improve water efficiency, reduce water use, and reduce water waste, including:

Green building standards: The school stipulates that new buildings and reconstructed buildings must follow the green building standard and refer to the relevant criteria of water resources indicators to strengthen the protection and utilization of water resources and create a water-saving environment. The first phase construction project of the Lanyang Campus was approved and awarded the Green Building Label by the Ministry of the Interior in September 2006; the Hsu Shou-Chlien International Conference Center, which was completed on Tamsui Campus by 2018, obtained the same honor at Silver Level in May 2019.

Green procurement: When purchasing software and hardware equipment, consumables, and construction materials, the school always prioritizes products that are certified with the following five kinds of green labels: the environmental protection label, energy saving label, water saving label, green building material label, and carbon label.

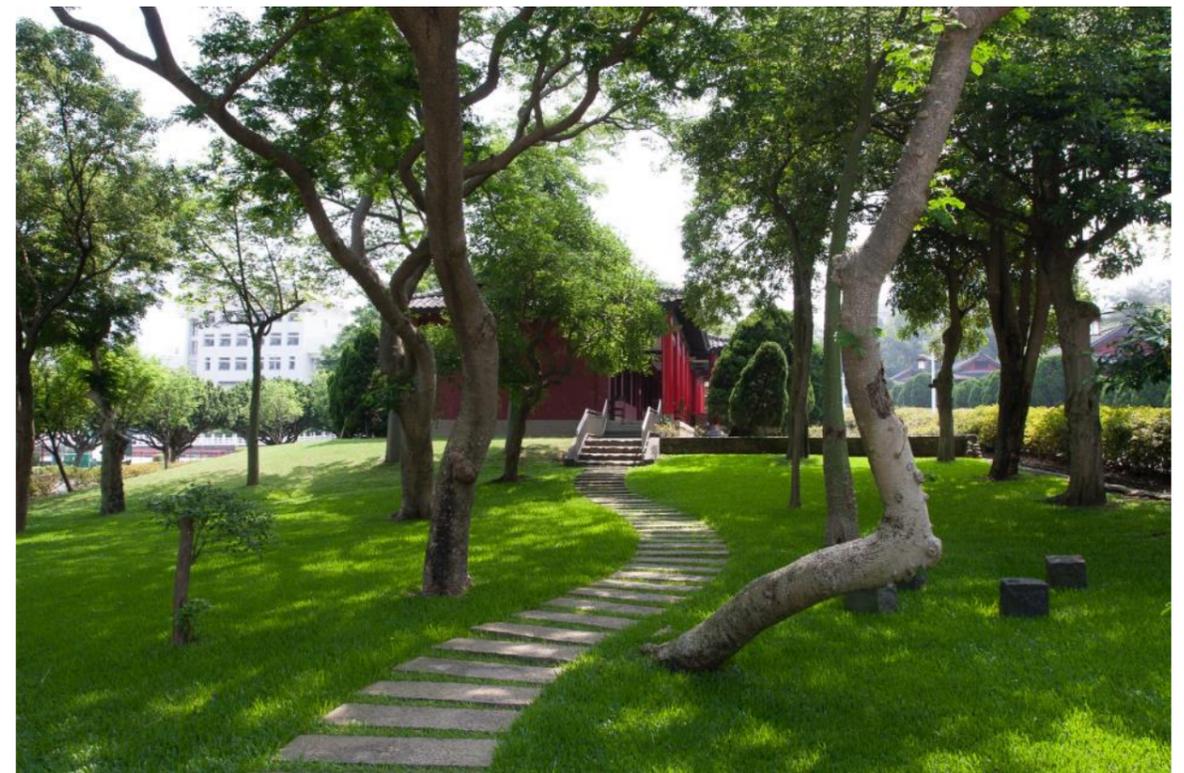
Water efficiency labelling product: When repairing or replacing the faucet and toilet flushing equipment, equipment that conforms to the National Standard of the Republic of China (CNS) and has the water-saving label is fully adopted. There are 231 urinals in the whole school, which can save about 5.06 mil-

lion liters of water every year (estimated at 6L/10 times per day).

Drought-tolerant plants: Local native plants are prioritized for campus planting. With the principle of vegetation diversity, both landscape beauty and ecological conservation are taken into consideration when planning landscape. More drought-tolerant plants are planted on campus every year to reduce water consumption and meet campus greening needs. The sprinkler irrigation system all over the campus also adopts water-saving valves, which can adjust the sprinkler irrigation time and intensity according to the weather conditions and reduce the water consumption of sprinkler irrigation.

Water-conscious planting

Both the Tamsui campus and the Lanyang campus of the university are located in areas with abundant rainfall all year round and are with high green coverage rate. The large green space functions smoothly in terms of water conservation and carbon neutrality. Local native plants are preferred for campus planting. With the principle of vegetation diversity, both landscape beauty and ecological conservation are taken into consideration when planning landscape. More drought-tolerant plants are planted on campus every year to reduce water consumption and meet campus greening needs. The sprinkler irrigation system all over the campus also adopts water-saving valves, which can adjust the sprinkler irrigation time and intensity according to the weather conditions and reduce the water consumption of sprinkler irrigation.



Water reuse

In the face of problems regarding water resource management brought about by climate change, in addition to planning water consumption and formulating various water-saving measures based on risk adaptation strategies to reduce water consumption, water recycling and reuse are also effective means to cope with the water shortage crisis under climate change. Therefore, rainwater reusing and wastewater recycling are key tasks for the school's water resources management.

For rainwater recycling, we mainly set up water recycling equipment such as rainwater flooding and rainwater storage tanks, as well as cooperating with measures such as reducing surface runoff and evapotranspiration to reduce water footprint and achieve the goal of water resource recycling.

In terms of wastewater treatment, the school has invested in relevant research to improve wastewater recycling technology and enhance wastewater treatment efficiency. The results have been fruitful. In addition, starting from 2021, the school will rely on self-employed water trucks to carry reclaimed water to the sewage plant for use in campus sprinkler irrigation, building floor cleaning, or toilet flushing purposes, continuously increasing the campus water reuse rate.

Water reuse policy

Since older buildings are generally not equipped with water recycling devices, the water recycling devices are mainly designed with newer buildings in mind. The Lanyang

Campus Teaching Building, Hsu Shou-Chlien International Conference Center, etc., are all equipped with rainwater storage tanks. In October 2021, a rainwater collector (500L capacity) was newly installed behind the Song Tao Hall on the Tamsui Campus. The Tamsui Campus has also set up a meteorological observation station to collect meteorological information on rainfall, wind speed, and temperature. In the future, the station will further function to estimate the surface runoff and evapotranspiration in the campus, grasp the distribution of water resources, and cooperate with the expansion plan of the water recycling system to reduce the water consumption to reduce the water footprint and achieve the goal of water recycling.

In terms of wastewater treatment, our school has invested in relevant research and achieved fruitful results, including the project of "Total Recycling and Cleaning Process of Ceramic Filter Membrane for Waste Incineration Recycling Production Wastewater" and the patent of "Fluorinated Wastewater Treatment System" to improve wastewater recycling technology, as well as to enhance the efficiency of wastewater treatment.

Starting from 2021, the school not only increased the number of rainwater recycling equipment (rain flood) but also coordinated with the sewage treatment plant, relying on self-employed water trucks to carry reclaimed water from the sewage treatment plant for campus sprinkler irrigation, floor cleaning, and toilet flushing use, continuously increasing the campus water reuse rate, while reducing the cost of sewage treatment.

Water reuse measurement

Since older buildings are generally not equipped with water recycling devices, the water recycling devices are mainly designed with newer buildings in mind. The Lanyang Campus Teaching Building, Hsu Shou-Chlien International Conference Center, etc., are all equipped with rainwater storage tanks. In October 2021, a rainwater collector (500L capacity) was newly installed behind the Song Tao Hall on the Tamsui Campus.

According to comprehensive statistics, the amount of rainwater recycled in the whole school accounts for about 0.34% of the overall water consumption of the campus. The recycled water is used for campus sprinkler irrigation, building floor cleaning, or toilet flush-

ing. On the one hand, reducing the amount of tap water can reduce the expenditure on on-campus water and electricity; on the other, it can be used in tandem with environmental education to practice the field of campus environmental protection teaching.

In the future, we will continue to expand the installation of (rain) water recycling equipment, as well as increasing the utilization rate of campus water recycling.

Water in community

The teaching, research, extension, and educational advocacy functions of a university play a key role in improving water resources management. Therefore, Tamkang



University strives to drive the community in the Tamsui area to manage and utilize water resources. Relevant practices are mainly in two aspects: on-campus water-saving actions and off-campus water-saving cooperation:

1. On-campus water-saving actions: In addition to the continuous maintenance and installation of water-saving equipment, the more important thing is the education and promotion of water conservation on the user side. By experiencing the changes in the marine environment and human culture from a personal visit to the Maritime Museum on the Tamsui campus, to the warm reminder of the A6 posters placed in front of each urinal or toilet seat, as well as the promotion on campus multimedia including the Cyber Channel and TKU Times's insatiable temptation, the school strives to raise the awareness of the importance of water resource management by multiple ways of education in life.

2. Off-campus water-saving cooperation: Out of campus, student associations take advantage of the opportunity of winter and summer vacation service teams to visit the countryside elementary and middle schools to educate future students; through the implementation of the plan, teaching faculties combine the power of the public sector or enterprises to guide the community and people to care for the water resources in the township as part of the university's support for the sustainable use of water resources. In addition, from the past Water Resources Research Center to the current Information Center for Water Environment, Center for Ocean and

Underwater Technology Research, and other institutions, TKU continues to cooperate with government water resources related ministries, such as the Environmental Protection Agency, the Water Resources Agency, or the regional river bureaus. Other units maintain close cooperation to support water management practices with academic research energy and provide opportunities for faculties and students of relevant departments to develop their strengths.

Water management educational opportunities

In order to help promote water resources management, the school provides educational opportunities related to water resources management for local communities or people outside the school. According to the free and paid methods, the descriptions are as follows:

1. Free activities and lectures:

- Experience Sharing by "Shui Shui Rice Warehouse": The General Affairs Office held a series of lectures on environmental sustainability at the Hsu Shou-Chlien International Conference Center on December 9, 2021. The former principal of Mi Cang Elementary School in Bali District, Lin Ailing, was invited to share the experiences of "Shui Shui Rice Warehouse" and to introduce how Mi Cang Elementary School properly preserves and utilizes its campus water resources. The lecture was open to the faculty, staff, students, and community residents, free

of admission, and a total of 42 people participated.

- Chemistry Tour Activity: The Science Education Center and the Department of Chemistry jointly promote the popular science education activity "Chemistry on the Go." The trucks are refitted to travel to elementary schools, middle schools, and communities nationwide to conduct experiments and activities to popularize science, combination lectures, sample collection and analysis, experiments, etc., to discuss water-related issues. In 2021, a total of 42 "Chemistry on the Go" was held across Taiwan, serving nearly 10,000 teachers and students.
- Water Resources Forum: On July 29, 2021, the "SIG Water Resources Forum" was held to discuss sustainability issues in the Tamsui area. It united several universities, primary and secondary schools, village offices in the Tamsui area, and

the Cambodian NGO ECC School. With the theme being water resources, it discusses four topics: coastal pollution, the relationship between mountains and seas, the water cycle, and the international field. Nine lectures are arranged to share experiences and report on results.

- Water patrol tasks and local ecological observation: The Department of Economics held a water patrol on ancient pathways on December 10, 2021, and conducted water patrol tasks regarding local water resources, assisting local water patrol team members.
- 2. Paid degree programs: The school provides the local community with educational opportunities to learn about water management. We have a Department of Water Resources and Environmental Engineering, which is divided into two groups: a water resources engineering group and an



environmental engineering group, both of them are dedicated to providing water safety for human society and inspiring students to use engineering and scientific means to achieve purposes of benefiting society. The characteristics of the two groups are briefed as follows:

- **Water Resources Engineering Group:** The courses provided are based on hydrology and water science, with water conservancy engineering as the axis, as well as being supplemented by the field of information computing technology. The subjects covered include fluid mechanics, hydrology, open channel hydraulics, flood prevention, coastal engineering, etc. The main goal of the courses is sustainable utilization of water resources, along with the aim of water beneficiation and the elimination of water harm acts.

- **Environmental Engineering Group:** The courses provided are based on water supply and sewage engineering and water quality treatment engineering, combined with scientific fields such as waste treatment and recycling and air quality monitoring. The subjects cover environmental chemistry, solid waste, water supply, sewage engineering, microbiology, Water quality management, etc., to achieve the vision of safe, quality water resources, and a sustainable ecological environment. Professional courses related to clean water and sanitation, water quality testing, sewage treatment, waste treatment, etc. are provided by the group.

Promoting conscious water usage

The school promotes conscious water use through channels such as Tamkang Times



(The school newspaper), OA official document system, electronic signage, cyber channels, restroom advertising and other channels.

Outside the school, student associations visit communities, primary and secondary school campuses, and promote the effective use of water resources through channels such as posters, drama performances, and community activities. Relevant acts include:

Since 2020, the University has cooperated with the construction company, the historical site Cheng's old residence, and local cultural workers to plan the vision project of the "Linzih River Protection Plan", and the "Linzih River Protection Declaration" event was held on May 2 to announce the official launch of the plan.

On July 29, 2021, the "SIG Water Resources Forum" with the theme of "water resources" was held. Guests from educational institutions, local organizations, and private units at all levels on the North Coast were invited to discuss topics including coastal pollution, the relationship between mountains and seas, the water cycle, and the international field of study. Nine speeches were arranged to share the experience and achievements of the contacts and implementations within the field. A total of more than 80 people participated in the event.

The General Affairs Office held a series of lectures on environmental sustainability on December 9, 2021. The former Principal of Mi Cang Elementary School in Bali District, Lin Ailing, was invited to share the experiences of "Shui Shui Rice Warehouse" and how Mi Cang Elementary School properly con-

serves and utilizes its campus water resources. The lecture was open to the free admission of faculty, staff, students and community residents, and a total of 42 people participated.

Water patrol tasks and local ecological observation: The Department of Economics held a water patrol on ancient pathways on December 10, 2021, and conducted water patrol tasks regarding local water resources, assisting local water patrol team members.

Off-campus water conservation support

A department of water resources and environmental engineering has been set up in our school, and the school-level research center also houses a water environment information research center. With the United Nations' sustainable development goal of "clean water and sanitation" as the research goal, we continuously cooperate with the government, private enterprises, or third parties to support water conservation off campus. Relevant acts include:

- Teachers of our school serve as independent directors of Taiwan Water Company, assisting the Environmental Protection Agency in promoting the Water Safety Plan.
- Assist private enterprises in the treatment of industrial wastewater, improve the water quality testing capabilities of water purification plants, and jointly develop clean water technology.

- The professor from the Department of Water Environment has obtained the patent for the "Fluorinated Wastewater Treatment System," which can improve the efficiency of wastewater treatment and solve the problem of insufficient space and equipment for small and medium-sized enterprises. At present, we are cooperating with well-known power plants to assist in the construction of wastewater treatment equipment and will continue to cooperate with the industry, so that fluorine-containing wastewater can be reused in a circular economy, creating a win-win situation for the economy and environmental protection.
- Teachers of our school serve as members of the governmental disaster prevention advisory committee, entrusted by the Water Resources Administration of the Ministry of Economic Affairs to provide consultation on the maintenance and operation of the flood control operation system of the reservoir, evaluating the capacity of the reservoirs and effectively discharge floods to reduce flooding disasters caused by floods and reduce the risk regarding the loss of life and property caused by flooding and typhoons.
- The teachers of the Department of Water Environment and National Taiwan University jointly formed a research team, working with data of the typhoon path collected from the Meteorological Bureau, and used AI technology to predict the rainfall in the catchment area, which can be handed over to the Shimen Reservoir Management Center two days in advance to facilitate the decision-making of

the reservoir's regulatory water release. Cooperation with the Malaysian government regarding the project has also been carried out through the Taiwan Hydrological Information Society, to assist Malaysia in building a regional flood forecasting system through technology export.

- To provide the local community with high-quality education on water resources management, we designed the "Chemistry on the Go" activity, a promotion tour service jointly supported by the Ministry of Science and Technology, the Ministry of Education, the Chemical Society and the industry, with the plan of having appropriately refitted trucks visiting elementary schools, middle schools and communities to conduct popular science activities, combined lectures, sample collection and analysis, and experiments to discuss water resources-related issues.
- Students from the Department of Water Environment and teachers from the Department of Chinese teamed up to participate in the "2021 Fun with Water Conservation Creativity Competition", integrating the concepts of soil and water conservation and environmental protection and won the national championship with the ranking of first place.

Sustainable water extraction on campus

The school's water mainly comes from tap water treated by the public water purifica-

tion plant, therefore does not involve water extraction methods from rivers, lakes, and groundwater.

The three campuses of the university are all located in areas with abundant rainfall all year round. With the rainy nature of the region as a focus point, the school has been developing methods of collecting and reusing rainwater in recent years. The collected rainwater is then used for plants irrigating within the campus, which not only helps to reduce the burden of relying on purchased tap water but also takes into consideration the responsibility of environmental protection. In addition, the school employs water trucks to carry recycled water from the sewage treatment plant, which then acts as a water source for sprinkler irrigation on campus. In addition to reducing the burden of relying on purchased tap water, it is also responsible in terms of environmental protection.

Facing the uneven phenomenon of drought and flood in Taiwan caused by global climate change, teachers from the Department of Water Resources and Environmental Engineering and National Taiwan University jointly developed a sustainable management strategy for groundwater water resources, with the needs of people's livelihood being taken heavily into consideration, as well as industrial water use, the environment, and reducing the environmental impact caused by groundwater development.

In addition, the research topics of our teachers have also expanded to the reuse of recycled water, from the early biological treatment, membrane treatment, and electro dialysis water regeneration, to the research and de-

velopment of innovative filter membranes, assisting the continuous improvement of recycling technology in our country's wastewater treatment industry. For example, the use of nanofiber membrane, with the charge of the composite layer, can be used for water treatment and filtration at low voltage, and the membrane material can be customized and adjusted to effectively remove sodium, calcium, magnesium, and other ions from water, saving wastewater treatment costs by three to fifty percent

Cooperation on water security

To promote water resources management and environmental security, Tamkang University continues to work with international, government, private enterprises, and the third sectors. Relevant acts include:

1. Tamsui area

- River protection : The school cooperates with Tamsui based construction companies and historical site protection units to plan the vision project of the "Linzih River Protection Plan" and invites the chief of the River Planning Section of the New Taipei City Government and local people to jointly issue a declaration on the protection of the river. It is expected that in ten years, the river ecological restoration will be carried out.
- Environmental protection watershed curriculum: With the theme of "Watershed Courses," we cooperate with primary and secondary schools and local workers in the region to develop local environmen-

tal education curricula in a coordinated manner. The course content includes stream water quality monitoring, watershed model map production, and three sets of UbD (Understanding by Design) course lesson plans.

- Community video dissemination: Promoting the "Environmental Protection Documentary" project, using the "participatory documentary model" and "narrative communication" concepts, combined with the school's film and television project planning and production courses, to carry out "community video stories" recording the stories of influential people and institutions that have contributed to the development of a sustainable environment in Tamsui areas, including ecological environment, pollution prevention and control, resource recycling, and community environmental protection, and provide a back-end network platform as a collection to construct effective communication methods.

2. Government units

- Research plans: The University's Water Environment Information Research Center and Ocean and Underwater Technology Research Center cooperates with various government units and enterprises to implement water environment safety related plans, including: "Development of sustainable management strategies for groundwater resources and short-term Long-term work blueprint", "Construction of neural network flood forecasting system in Changhua County and Pingtung County", "Deep sea water

intake technology and feasibility assessment of potential sites", "Construction of arsenic-rich underground concentration change prediction model and water safety Adaptation plan", "Application of composite embedded/capacitive deionization system to remove ammonia nitrogen and nitrate nitrogen from groundwater", "He Ping power plant desulfurization equipment wastewater boron removal model plant test", "Typhoon intensity forecast model update commission", "Typhoon Forecast Application System for Historical Forecast on a Seasonal Scale", "110th year Consultation on Maintenance and Operation of Shimen Reservoir Flood Control Operation System", "Using Artificial Intelligence Technology to Build Regional Sewer System Water Level Forecast Model and Pumping Machine Smart Operation Strategy", "In-depth "Professional service case for resource planning and analysis of high-value seawater research", "Pingtung area target industrial zone screening and groundwater follow-up development planning work", "Industrial waste acid recovery technology development" and "Mesoscopic structure applied to industrial wastewater treatment".

- Professional training: Entrusted by the Environmental Protection Agency, a training course for special personnel in waste (sewage) water treatment was organized to assist relevant environmental protection companies or specific businesses in setting up special environmental protection personnel and ensure the safe and sustainable development of environmental protection.

3. Domestic

- Environmental Protection Alliance: The school is a founding member and permanent member school of the "Green University Union of Taiwan" (Green University Union of Taiwan) and continues to exert influence on issues related to the practice of SDGs.
- Promotion of water resources management education: The planning of the "Chemistry on the Go" activity was assisted by two central government ministries and six local education bureaus, and a total of 10 companies from various industries provided funds and teaching materials. The tour activity was selected as "2021 World Education Innovation Leader" and reported by 3BL Media in the United States. More than 69 schools have participated in the event so far.

4. International

- International forum: Held the "2021 SIG Water Resources Forum" with the theme of "water resources", schools at all levels, village offices, and non-governmental organizations were invited, as well as Cambodia NGO ECC School and other co-organizers. The topics discussed consist of "coastal pollution, the relationship between mountains and seas, water cycle, international field".
- Research plan: The Water Environment Information Research Center assists Yunlin County to build a "Smart City Flood Forecasting System" and cooperates with the Malaysian government through the Taiwan Hydrological Information Society to assist Malaysia in building a regional flooding forecasting system through technology output.





SDG6

潔淨水與衛生

人均用水量

用水量的測量

本校為學術研究單位，用水類型以校園生活用水為主，主要皆為公共淨水廠處理後之自來水，並無抽取自河流、湖泊以及地下水之用水方式。用水量依自來水廠記錄，並於本校環境保護與安全衛生中心進行監測，按月將相關數據公告於網頁。

本校三個校園分別位於新北市淡水、台北市區及宜蘭縣礁溪山區，常年雨量充沛。針對地區多雨特性，本校近年來開始著重雨水收集與再利用，收集之雨水作為校園植物澆灌使用，除可減輕仰賴外購自來水使用負擔，並可兼顧環境保育之責。2021年，本校自來水總用水量為 438.89 百萬公升；收集雨水作為植物噴灌使用，約 4,056 公升。



年度關鍵成果

- 2020 年人均用水量約為 58.08 公升/日，2021 年降低至 45.84 公升/日，優於國內一般大專院校人均用水量 133 公升/日（資料來源：經濟部水利署）。
- 舉辦「2021 SIG 水資源論壇」，邀集各級教育機構、地方組織及民間單位參與，以「水資源」為主題進行 9 場演講及分享。

用水與水源涵養

本校依據風險調適策略，進行用水規劃及水資源管理，制定各項措施，分為用水安全、水源保育及廢水處理三個面向，說明如下：

1. 用水安全：三個校園皆使用符合我國水質標準之自來水，作為校園生活用水主要來源；透過蓄水塔、管線及飲水設備的巡檢管理、保養清洗及水質檢測，確保用水安全無虞。飲用水部分，依據我國飲用水連續供水固定設備使用及維護管理辦法，每季實施飲水機台總數 1/8 的抽測作業，確保供水符合飲用水水質標準。
2. 水源保育：水源涵養（含再利用）和減少水資源浪費也是本校所關注的議題；在水源涵養方面，本校淡水校園及蘭陽校園分別位於新北市淡水及宜蘭縣礁溪山區，常年雨量充沛。校園裡綠草如茵，綠覆率高，大片綠地兼具涵養水分及碳中和之功用。校園新建建築須符合綠建築概念，強調基地保水功能，有效留住雨水不讓其成為逕流。減少水資源浪費方面，則是透過種植原生植物及耐旱植物，減少噴灌用水，另以設置節水標章水龍頭、沖便座及科技免沖水小便斗等設備，提升用水效能。
3. 廢水處理：校園生活污水透過污水下水道接管至公共污水處理場，經處理後符合排放標準才進行放流；實驗室產生之廢液則藉由校內暫存收集，每學期定期委由環保署合格廠商清運處理。

廢水處理

2019 年之前，淡水校園設有體育館、游泳館、化學館、工學大樓及外語大樓，共計 5 座污水處理場。蘭陽校園設置生活污水場 1 座，每年皆委託合格廠商操作、保養及維護，確保污水場設備正常運作。本校所產生之廢污水先是進入污水場進行化學處理，處理後再行排放入校外污水管道；放流水質經學校定期抽檢、地方環保機關不定期抽檢，皆符合放流水標準。

2019 年起，配合政府施作之公共污水下水道完工，淡水校園污水全面納入新北市公共污水下水道管線，集中至政府設立之淡海污水處理廠處理，由本校負擔污水處理費用，經由處理廠的設備將污水處理至符合國家放流標準後再排放，達到不污染河川水質的目標。

防止用水系統污染

為防止受污染水進入乾淨的自來水系統，本校淡水校園、台北校園及蘭陽校園共計設有 38 座自來水蓄水塔，每座蓄水塔清潔口皆有上鎖管制，非管理人員無法任意開啟。每年委請專業廠商進行塔體清理，清理完成後由台灣檢驗科技股份有限公司（SGS）進行水質樣品檢驗（每 3 個月一次），檢驗結果皆符合我國環保署訂定之「飲用水水質標準」。

另外，本校建立校園淨水管道與污水管道分布地圖，由專業水電技術人員排定巡檢計畫，遇有發現異常漏水情事可即時搶修，避免輸水管道之間交叉污染。經實驗室產生之污水亦進行初級處理後，方可排入污水管，經由污水下水道接管至校外污水處理廠進行最終處理。

2019 年起，配合政府施作之公共污水下水道完工，淡水校園污水全面納入新北市公共污水下水道管線，集中至政府設立之淡海污水處理廠處理，由本校負擔污水處理費用，經由處理廠的設備將污水處理至符合國家放流標準後再排放，達到不污染河川水質的目標。

免費飲用水的供給

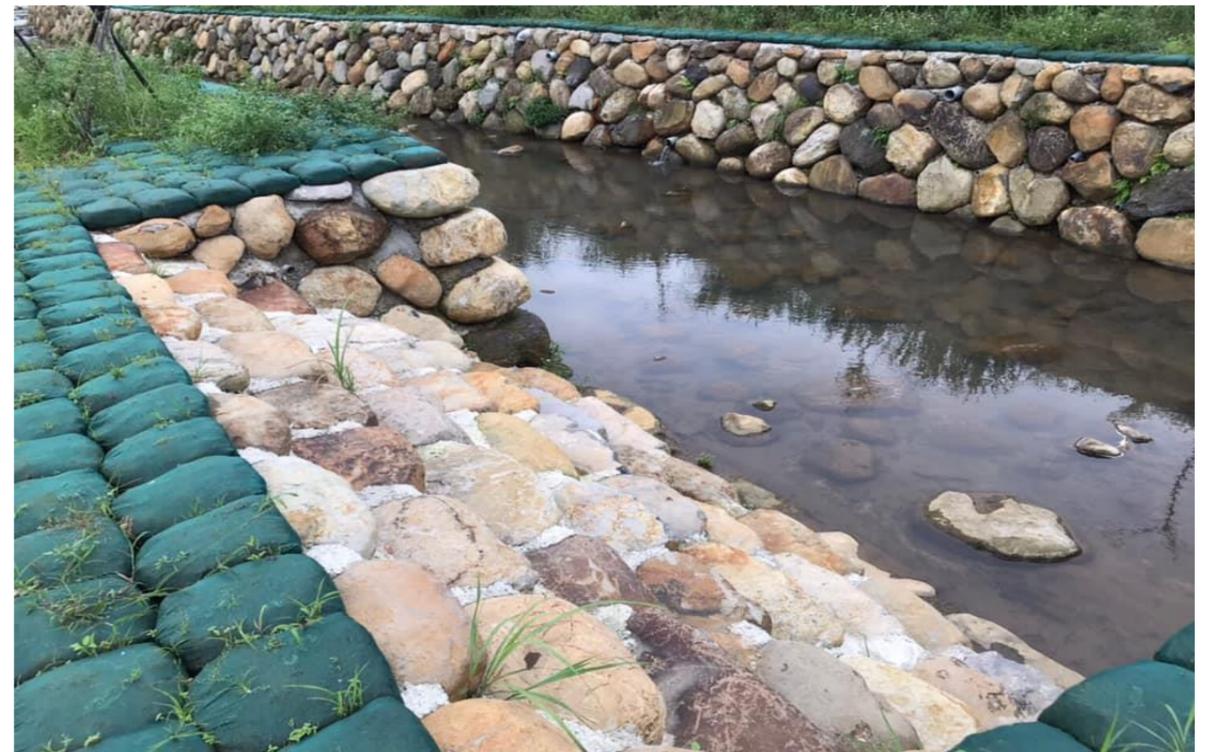
淡水校園 26 棟樓館及戶外球場區共裝設 257 台飲水機，台北校園 1 棟大樓裝設 17 台飲水機，蘭陽校園全境 33 台飲水機，全校累計共 307 台飲水機，皆提供教職員工生及訪客免費飲用，並定期維護保養、更換濾心及檢驗水質狀況，確保飲用水安全無虞。檢驗除了由飲水機設備公司委託公正第三方檢測外，本校環安中心亦每年定期抽樣檢查，雙重檢測機制確保飲用水安全；水質檢驗結果除公告於總務處網頁之外，也利用 QR code 張貼於飲

水機台上，有興趣瞭解者可藉由掃描 QR code 連結到雲端查閱檢測報告書，取代傳統紙本報告書無法即時更新之缺點。

維護水資源的建築

本校應用相關建築標準，以提升水資源使用效能、減少水資源使用量，以及減少水資源浪費，包括：

1. 綠建築標準：本校規定新（改）建大樓須依循綠建築標準，參照樓館新（改）建之水資源指標相關準則，強化水資源的保護與利用，營造節水環境。本校蘭陽校園第一期建築工程於 2006 年 9 月獲得內政部核定頒發綠建築標章；淡水校園 2018 年落成之守謙國際會議中心大樓，亦於 2019 年 5 月獲得綠建築標章銀級。
2. 綠色採購：本校針對軟硬體設備、耗材及建築工程材料等辦理採購時，以能提供環保標章、節能標章、省水標章、綠建材標章及碳標籤等 5 大綠色標章產品之廠商優先承做。
3. 省水節水標章：維修或汰換水龍頭及馬桶沖水設備時，全面採用符合中華民國國家標準（CNS）及具備省水標章之設備；男廁全面使用免沖水之科技小便斗，全校計有 231 座小便斗，每年可省下約 506 萬公升用水（以每次 6L/日 10 次估算）。



3. 耐旱植栽：校園植栽優先選擇本地原生種植物，在植被多樣性的原則下，兼顧景觀優美與生態保育；校園內逐年改種植較為耐旱植物，以節省用水量並達成校園綠化需求；遍佈校園的噴灌系統，也採用省水式噴閘，視天候狀況調整噴灌時間與強度，降低噴灌所耗費的水資源。

維護水資源的植栽

考量本校地理環境與氣候條件，優先選擇本地原生種植物，在植被多樣性的原則下，兼顧景觀優美與生態保育。淡水校園於學生活動中心郵局前方、化學館西側紅 28 公車站旁、工學大樓前方，以及鄰近水源街二段勤務中心旁等角落區域，改種植較為耐旱植物種類約 600 株，以節省用水量並達成校園綠化需求。總務處並逐年汰換校內消耗水分較多之景觀盆栽，盡量選用耐旱植物為導向，不但可以減少用水量，也可減少校內人工實施照顧頻率。

蘭陽校園紹謨紀念活動中心周邊、校園道路及山坡，栽種較為耐旱植物約 17,950 株，以節省用水量並達成校園綠化需求。

再利用水

面對水資源問題，除依據風險調適策略，進行用水規劃，制定各項節水措施，以減少使用量之外，水的回收與再生利用，亦是氣候變遷下因應缺水危機的有效手段。因此，透過雨水回收，以及廢水回收再利用，亦是本校水資源管理的重點工作。

在雨水回收方面，以設置雨水撲滿、雨水蓄水池等水回收設備為主，配合降低地表逕流及蒸發散量等措施，以降低水足跡並達到水資源循環利用之目標。

在廢水處理方面，本校投入相關研究，以改良廢水回收技術，提升廢水處理效率，成果豐碩。另外，自 2021 年起，本校自雇水車至污水廠載運再生水，利用於校園噴灌、樓館地面清洗或沖廁使用，持續增加校園水再利用比率。

水再利用政策

本校因歷史悠久，舊大樓普遍未設置水回收裝置，但規定新（改）建大樓須依循綠建築標準九大指標之水資源指標，設置水回收設備，例如蘭陽校園教學大樓、守謙國際會議中心等建物，皆設置雨水蓄水池；2021 年 10 月起，淡水校園松濤館後方新設置雨撲滿（容量 500L）。淡水校區設置氣象觀測站，收集降雨、風速、溫度等氣象資訊，未來將進

而推估校園內的地表逕流量與蒸發散量，掌握水資源分布情形，搭配水回收系統擴充規劃，以降低水足跡並達到水資源循環利用之目標。

在廢水處理方面，本校投入相關研究，成果豐碩，包括「垃圾焚化飛灰循環利用生產廢水陶瓷濾膜之全回收清潔製程」計畫，以及「含氟廢水處理系統」專利，以改良廢水回收技術，提升廢水處理效率。

2021 年起，本校除透過增加雨水回收設備（雨撲滿），亦與污水廠協調，由本校自雇水車至污水廠載運再生水，利用於校園噴灌、樓館地面清洗或沖廁使用，持續增加校園水再利用比率，同時可降低污水處理的費用。

水再利用率測量

本校由於舊大樓普遍未設置水回收裝置，因此水回收設備以搭配新建築設計為主，例如蘭陽校園教學大樓、守謙國際會議中心等，皆設置有雨水蓄水池。2021 年 10 月起，淡水校園松濤館後方新設置雨撲滿（容量 500L）。

綜合統計全校雨水回收量，約占校園整體用水量之 0.34%。回收水利用於校園噴灌、樓館地面清洗或沖廁使用，一方面降低自來水用量，可減少校園水電經費支出；另一方面搭配環境教育，實踐校園環境教學場域。

未來將持續擴大設置（雨）水回收設備，持續增加校園水回收使用率。



社區用水

本校以具體行動，帶動大淡水地區社區，進行水資源管理與利用，相關作為主要分為校園內節水行動和校園外節水合作兩方面：

1. 校園內節水行動：除持續更新使用節水標章等各項省水設備，更重要的是對使用端進行節約用水的教育及宣導，從親身走訪淡水校園海事博物館領略海洋環境與人類文化的變遷，到每個小便斗或便座前的 A6 海報之溫馨提醒，以及校園內多媒體的諄諄善誘，在在都是養成教職員工生珍惜水資源，寓教育於生活的多元途徑。
2. 校園外節水合作：走出校園之外，學生社團利用寒、暑假服務隊下鄉到中小學的機會，紮根於未來學子；教師則透過計畫的執行，結合公部門或企業力量，引導社區民眾愛護鄉里的水資源環境，都是本校支持水資源永續利用的一環。本校從過去的水資源研究中心，到現在的水環境資訊研究中心、海洋及水下科技研究中心等機構，持續和政府水資源相關部會，如環保署、水利署或各地區河川局等單位保持密切合作，以學界研究能量支援水域管理實務，並提供相關科系師生發揮所長之機會。

社區性的水管理教育

本校為協助推動水資源管理，為當地社區或校外人士提供水資源管理相關教育機會，依免費及付費方式，說明如下：

1. 免費活動及講座：
 - (1)「水水米倉」經驗分享：總務處於 2021 年 12 月 9 日於守謙國際會議中心辦理環境永續系列講座，邀請八里區米倉國小前任林愛玲校長分享「水水米倉」之推動經驗，介紹米倉國小如何妥善保存、利用校園水資源。講座開放校內教職員工生及社區居民自由入場，共計 42 人參加。
 - (2)化學遊樂趣活動：科學教育中心與化學系聯手推廣科普教育活動「化學遊樂趣」，以改裝貨車至各地國小、國中及社區進行科普活動，組合講座、樣本收集與分析、實驗等方式，探討水資源相關議題。於 2021 年間於台灣各地舉辦共計 42 場化學遊樂趣活動，服務近萬名師生。
 - (3)水資源論壇：2021 年 7 月 29 日舉辦「SIG 水資源論壇」，共商大淡水地區永續議題，聯合淡水地區數所大學及中小學、鄉里辦公室，以及柬埔寨 ECC

School，以水資源為主題，討論海岸污染、山海之間、水的循環、國際場域四個議題，安排九場演講，進行經驗分享與成果報告。

- (4)巡水任務與在地生態觀察：經濟系於 2021 年 12 月 10 日舉辦古道巡水，與在地巡水隊隊員進行古道裡巡水管線任務，協助地方進行水資源工作。

2. 付費學位課程：本校為當地社區提供學習良好水管理的教育機會，設有水資源及環境工程學系，分為水資源工程組及環境工程組，皆以提供人類社會用水安全為職志，啟發學生以工程及科學的手段達成造福社會的目的。兩組特色分別簡述如下：

- (1)水資源工程組：以水文及水理為基礎，水利工程為主軸，佐以資訊運算科技範疇，課目涵蓋範圍包含流體力學、水文學、明渠水力、洪水防災、海岸工程等範圍，達成興水之利、除水之害之水資源永續利用為目標。
- (2)環境工程組：以給水污水工程及水質處理工程為基礎，結合廢棄物處理循環再利用及空氣品質監測等科學範疇，課目涵蓋範圍包含環境化學、固體廢棄物、給水污水工程、微生物學及水質管理等，達成安全用水、品質及生態環境永續的願景。開設潔淨水與衛生、水質檢測、污水處理、廢棄物處理等相關專業課程。

用水觀念宣導

本校透過校內刊物淡江時報、OA 公文系統、電子看板、賽博頻道、廁所文宣等管道，宣傳及促進有意識的用水。

校外，則透過學生社團深入社區與中、小學校園，以社區張貼海報、戲劇表演、社團活動等機會，促進水資源有效利用。相關作為包括：

- 1.2020 年與宏盛建設公司、程氏古厝等合作規劃「公司田溪守護計畫」願景工程，並於 5 月 2 日舉辦「公司田溪護溪宣言」活動，宣示計畫正式啟動。
- 2.2021 年 7 月 29 日上午舉辦「SIG 水資源論壇」，邀請北海岸各級教育機構、地方組織及民間單位的來賓，以「水資源」為主題說明並討論「海岸污染、山海之間、水的循環、國際場域」四個議題，安排 9 場演講，分享所接觸及實施場域經驗與成果，活動共計逾 80 人參與。

- 3.總務處於 2021 年 12 月 9 日舉辦環境永續系列講座，邀請八里區米倉國小前任林愛玲校長分享「水水米倉」之推動經驗，介紹米倉國小如何妥善保存、利用校園水資源。講座開放校內教職員工生及社區居民自由入場，共計 42 人參加。
- 4.經濟系於 2021 年 12 月 10 日舉辦古道巡水，與在地巡水隊隊員進行古道裡巡水管線任務，協助地方進行水資源工作。

支援校外水資源保護行動

本校設有水資源及環境工程學系，校級研究中心亦設有水環境資訊研究中心，以聯合國永續目標「潔淨水與衛生」為研究之主要目標，持續與政府、民間企業或第三部門合作。相關作為包括：

- 1.本校教師擔任台灣自來水公司獨立董事，協助環保署推動水安全計畫（Water Safety Plan）。
- 2.協助民間企業處理產業廢水，提升淨水場水質檢測能力，共同研發潔淨水技術。
- 3.水環系教授取得「含氟廢水處理系統」專利，可提升廢水處理效率，為中小企業解決空間和設備不足的困難。目前與知名電廠合作協助建設廢水處理設備，並將持續與業者合作，以使含氟廢水能成為循環經濟再利用，創造經濟與環保雙贏。



- 4.本校教師擔任政府部門之防災諮詢委員，並受政府經濟部水利署委託，提供水庫防洪運轉系統維護與操作諮詢，評估水庫容量有效排洪，以降低洪水造成的溢淹災害，減少因受颱風洪水侵襲而導致之生命財產損失。
- 5.水環系教師與國立台灣大學組成研究團隊，結合氣象局颱風路徑大數據，利用 AI 技術預測集水區降雨量，可提前兩天讓給石門水庫管理中心以利於水庫調節性放水決策參考。該計畫已透過台灣水文資訊學會與馬來西亞政府合作，以技術輸出方式，協助馬來西亞建置區域淹水預報系統。
- 6.為提供當地社群優質的水資源管理教育，設計「化學遊樂趣」活動，由科技部、教育部、化學學會及產業界共同支持的推廣巡迴服務，以改裝貨車至各地國小、國中及社區進行科普活動，組合講座、樣本收集與分析、實驗等方式，探討水資源相關議題。
- 7.水環系學生與中文系教師組隊參加「2021 水保好好玩創意大賽」，融入水土保持及環境保護觀念，勇奪全國冠軍，創作之《搬家的白魚一家》繪本，榮獲水保局繪本比賽全國第一名。

可永續的取水技術

本校校園用水主要皆來自公共淨水廠處理後之自來水，並無抽取自河流、湖泊以及地下水之取水方式。

本校三個校園分別位於新北市淡水、台北市區及宜蘭縣礁溪山區，常年雨量充沛。針對地區多雨特性，本校近年來開始著重雨水收集與再利用，收集之雨水作為校園植物澆灌使用，另外，本校淡水校園試辦自僱運水車，從淡海污水處理場載運回收處理過之再生水，作為輔助校園植栽噴灌使用。除可減輕仰賴外購自來水使用負擔，並可兼顧環境保育之責。

面對全球氣候變遷造成台灣旱澇不均現象，本校水資源及環境工程學系教師與台灣大學共同研擬地下水水資源永續管理策略，兼顧民生及工業用水需求與環境，降低地下水開發所造成之環境衝擊。此外，本校教師研究主題也擴展到回收水的再製利用，從早期的生物處理、薄膜處理、電透析水再生，到研發創新的濾膜，協助我國廢水處理產業回收技術不斷精進。例如使用奈米纖維濾膜，搭配複合層電荷，因此低電壓操作即可進行水處理過濾，還能客製化調整濾膜材料，有效分別去除水中鈉、鈣、鎂等離子，節省廢水處理成本三至五成。

為維護水環永續的合作夥伴

本校為推展水資源管理與環境安全，持續與國際、政府、民間企業或第三部門合作。相關作為包括：

1.淡水地區

- (1)護河行動：本校與淡水地區建設公司及古蹟保護單位，合作規劃「公司田溪守護計畫」願景工程，邀請新北市政府河川計畫科科長及地方人士，共同發表護河宣言，預計以十年的時間，進行河川生態復育。
- (2)流域課程：以「流域課程」為主題，與所在地區中小學及地方工作者展開合作，協同發展地方環境教育課程。課程內容包括溪流水質監測，流域模型地圖製作，並發展出三套 UbD (Understanding by Design) 課程教案。
- (3)影像傳播：推展《環保志》計畫，以「參與式紀錄片模式」和「敘事傳播」的概念，結合本校影視專案企劃與製作的課程，進行「社區影像」，記錄淡水區永續環境有貢獻和影響力的人物和機構的故事，包含生態環境、污染防治、資源循環和社區環保等面向，提供後端網路平台作為典藏，建構有效之傳播方法。

2.政府單位

- (1)研究計畫：本校水環境資訊研究中心及海洋及水下科技研究中心與各政府單位及企業合作，執行水環安全之相關計畫，包括：「研擬地下水資源永續管理策略及短中長期工作藍圖」、「彰化縣與屏東縣類神經網路淹水預報系統建置」、「深層海水取水技術及潛力場址可行性評估」、「建構富砷地下濃度變化預測模型與用水安全調適方案」、「複合型嵌入式/電容去離子系統應用於移除地下水之氨氮與硝酸氮」、「和平電廠脫硫設備廢水除硼模廠試驗」、「颱風強度預報模式更新委託案」、「季內尺度歷史預報之颱風預報應用系統」、「110 年度石門水庫防洪運轉系統維護及運轉操作諮詢」、「運用人工智慧技術建置區域下水道系統水位預報模式與抽水機智慧操作策略」、「深層海水高值化研究資源規劃與分析專業服務案」、「屏東地區目標工業區篩選與地下水後續開發規劃工作」、「工業廢酸回收技術開發」與「介觀構造應用於工業廢水處理」。
- (2)專業人員訓練：受環境保護署委託，辦理廢（污）水處理專責人員訓練班，協助相關環保公司或特定事業設置環保專責人員，確保環境保護安全永續發展。

3.國內

- (1)環保聯盟：本校為「臺灣綠色大學聯盟」(Green University Union of Taiwan) 創始會員及永久會員學校，並於 2019 至 2021 年擔任監事學校，2022 年起擔任理事學校，就大專校院節能減碳與實踐 SDGs 的議題，持續發揮影響力。
- (2)水資源管理教育推廣：「化學遊樂趣」活動獲得 2 個中央政府部會、6 個地方教育局處協助，來自各產業共 10 家企業提供經費與教材，入選親子天下 2021 教育創新領袖，獲美國 3BL Media 外媒的報導，至今已有超過 69 所學校參與活動。

4.國際

- (1)國際性論壇：舉辦「淡江大學大學社會責任 2021 SIG 水資源論壇」，邀集各級學校、鄉里辦公室、民間組織，以及柬埔寨 ECC School (Cambodia) 等協辦單位，以水資源為主題，討論「海岸污染、山海之間、水的循環、國際場域」議題。
- (2)研究計畫：水環境資訊研究中心協助雲林縣建置「智慧城市淹水預報系統」，並透過台灣水文資訊學會與馬來西亞政府合作，以技術輸出方式，協助馬來西亞建置區域淹水預報系統。

