PHASE 2

SIMP@CT IN PRACTICE

FINAL REPORT

SIMP@CT

SMART IRRIGATION MANAGEMENT FOR PARKS AND COOL TOWNS

NSW GOVERNMENT

WESTERN SYDNEY UNIVERSITY

This project took place on the land of the Wann-gal. We treat this land with respect and acknowledge that it always was and always will be Wann-gal land.

This phase of the project received financial support from the Water Group at the NSW Department of Climate Change, Energy, the Environment and Water and administrative support from the Smart Places Team at the NSW Department for Transport and the Sydney Olympic Park Authority.

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EXECUTIVE SUMMARY

Cities are hotspots of climate change. Similar to many capital cities around the globe, Sydney is experiencing the synergistic impacts of rising air temperatures and local heat phenomena related to the urban form and its optical and thermodynamic behaviour. Together, these impacts result in urban overheating, with negative effects on public health, ecosystem services, social fabric and infrastructure performance.

Urban Green Infrastructure (UGI) has been identified as one of the most efficient means to lower summer air temperatures in cities. This cooling effect of UGI can be maximised by irrigation. The present project has developed and operated a novel technological solution that helps to keep UGI well hydrated and thus offers an automated solution to provide maximal cooling through evapotranspiration from plants.

The SIMP@CT project commenced in 2021, and was developed and rolled out at Sydney's Bicentennial Park in 2022. It fully controlled the existing park irrigation system between January 2023 and May 2024 without major technical issues. During this time, SIMP@CT detected irrigation failures and major leaks, engaged with the park visitors via extensive signage and QR codes across the park and won several important national landscape design, sustainability and technology awards.

During Phase 2, SIMP@CT experienced a range of operational, technical and even water supply issues. However, during the operation of the smart irrigation application, not a single tree or lawn died or suffered from drought stress. This was a very positive outcome of the project, as no precedent of the performance of an AI-controlled park irrigation existed before this project. One of the major motivations for SIMP@CT was to prevent drought damage to the park, which happened in the summer of 2019/20 where large sections of the park were severely impacted by extreme heat stress and lack of irrigation due to a technical fault. SIMP@CT's auto-generated daily reports showed irrigation volumes and were thus able to show irrigation managers leaks and faulty systems to prevent this occuring again during its operation.

Detailed environmental monitoring revealed a pronounced Urban Heat Island Effect for the town centre of Sydney Olympic Park. Nighttime air temperatures in the town centre were 10°C or more warmer compared to locations in Bicentennial Park. These large differences were predominately observed in the months outside of summer (e.g., March, September, October). Throughout summer months the average Park Cool Island Effect, which describes the temperature difference between the park and the town centre ranged between 1.3-2.3°C with maximum cooling effects of nearly 8°C.

Of all locations in the town centre, Jacaranda Square had warmest microclimate throughout the project and also the warmest summer nighttime temperatures. The warmest daytime temperatures were recorded along Dawn Fraser Avenue (corner of Abattoir Blues). Inside the park, the warmest area was the forecourt of the Waterview Café where air temperatures could be 5°C warmer during very hot summer days compared to nearby treed areas. The coolest location was at the bottom of the southern staircase from the Treillage Tower towards the intertidal mangroves where on average air temperatures were 1°C lower compared to the Waterview Café (June 2022-July 2024: 17.5°C vs 18.5°C).

A range of analyses are presented in this report that demonstrate the water savings effectively and potentially generated by applying SIMP@CT irrigation technology. The savings are presented in KL as well as monetary value. All analyses attest water savings to SIMP@CT, and those based on self-recorded vs. historic water usage across the park indicate volumetric savings of 44-70% or $24,463. These analyses also indicate that cost savings may be possible when volumes listed in water bills from Sydney Water were cross validated with flowmeter data recorded by the irrigation contractor.

The SIMP@CT project demonstrated that AI-based irrigation of public spaces is possible. This technology can deliver air cooling for effective heat reduction across urban landscapes. The next steps from this research (Phase 1) and demonstration project (Phase 2) will be hardening of the concept and implementation of the technology at different scales to be able to calculate costs and benefits for several applications, including public parks of different sizes, golf courses and other urban green spaces.

SIMP@CT is a unique, trans-disciplinary project that delivers a working solution for climate change adaptation today. In short:

SIMP@CT demonstrates the power of machine learning to address critical urban water challenges. By optimizing irrigation practices, SIMP@CT promotes water conservation, mitigates urban heat island effects, and fosters healthy urban green spaces.

With its potential for broader applications and alignment with Australian policy objectives, SIMP@CT offers a promising solution for building more sustainable and water-secure cities.

By fostering continued research, developing supportive policies, and encouraging widespread adoption, SIMP@CT can play a significant role in creating a greener and more water-efficient future.

It is now an opportunity for government and industry organisations to turn this exciting new technology into a solution that can be implemented widely to keep cities and their communities cool during summer and thus uplift their resilience against the impacts of increasingly hot climates.

CONTENTS

Bicentennial Park **AT SYDNEY OLYMPIC PARK.**
Aerial view, project communication, irrigation infrastructure and application.


Park?
Water Efficiency
Ecology
SydneyOlympicPark

1. SIMP@CT IN A NUTSHELL

Urban landscapes face rising temperatures, increased heat island effects, and water scarcity due to climate change. Maintaining healthy parks and green spaces is crucial for mitigating these challenges, but traditional irrigation practices can be inefficient and wasteful.

SIMP@CT is pioneering the use of machine learning to optimize irrigation schedules for parks and urban areas, achieving water conservation and effective urban cooling, in addition to public health and economic benefits.

INTRODUCTION

Urban green spaces provide numerous benefits for cities and their residents. Parks, gardens, and street trees help regulate temperatures, improve air quality, biodiversity, and provide recreational opportunities with positive impacts on public health. However, maintaining these green spaces in a warming climate is becoming increasingly difficult. Rising temperatures and more frequent droughts are straining water resources, while urban heat island effects make cities dangerously hot during summer.

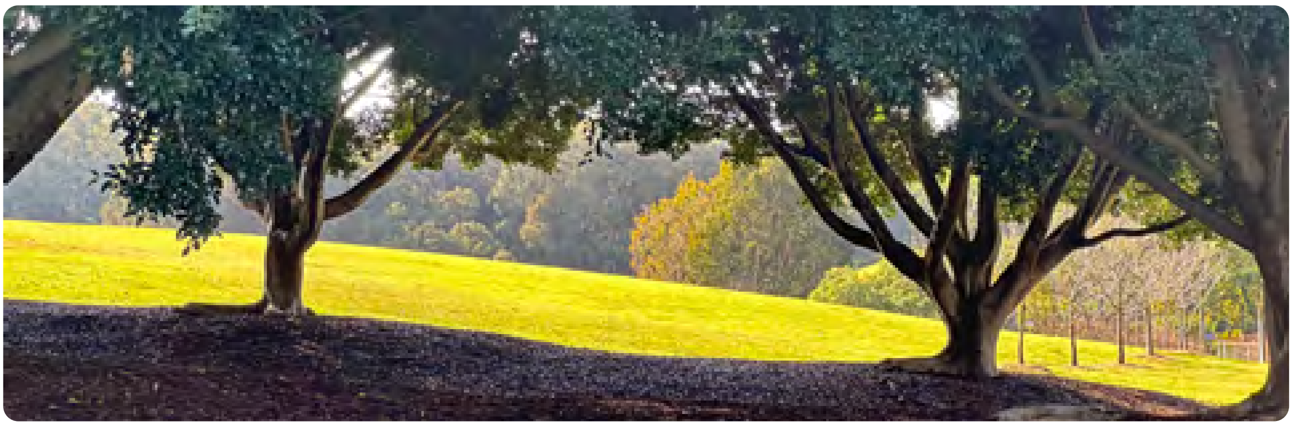
Traditional irrigation practices, which rely on timers or manual adjustments, are often inefficient and can lead to overwatering or underwatering. Overwatering wastes water, promotes fungal diseases and contributes to soil erosion. Underwatering stresses plants, making them more susceptible to pests and diseases, and exacerbates the urban heat island effect, as dry soil surfaces radiate heat into the surrounding environment.

SIMP@CT was delivered in two distinct phases. In Phase 1 the project team developed technology, installed sensors across the park, linked data streams into digital twin environments and created web-based solutions for operational analyses of the system and public communication of microclimate conditions across the park. Phase 1 lasted from May 2021 when project development commenced until July 2023 when all milestones and associated technical solutions were delivered, tested, and deemed functional. Detailed documentation of these works was captured in several reports that focus on the general explanation of the project, its technical components and strategic market analyses for future implication of the technology at new locations. All documents can be downloaded from www.simpact-australia.com.

This report covers Phase 2 of the project – the operation of the technology solution between 1 August 2023 and 31 July 2024. It also provides new results derived from analyses of operational and environmental data that were recorded throughout the entire project life. Set out as a novel solution that helps to mitigate climate change impacts in cities by cooling ambient air, intra-park variation of environmental conditions, as well as temperature differences between the parkland and the nearby urban centre of Sydney Olympic Park will be investigated.

An anticipated side effect of the SIMP@CT system was that high-precision irrigation of UGI results in optimisation of applied volumes of water. Consequentially, a detailed analyses of historical against recent water volumes used to irrigate the park are provided in this report.

Due to the enormous support of the SIMP@CT project by key industry bodies in the technology and digital innovation sectors in NSW, Australia and internationally, we include a list of accolades and testimonies at the end of the report.



2. PROJECT BACKGROUND

SIMP@CT: A MACHINE LEARNING APPROACH TO IRRIGATION MANAGEMENT

SIMP@CT (Smart Irrigation Management for Parks and Cool Towns) is a collaborative research project developing a smart irrigation management system for parks and other urban greenspaces. The project is led by Western Sydney University. Project partners include Sydney Olympic Park Authority (SOPA), Sydney Water and a consortium of universities and technology companies. The SIMP@CT system uses a machine learning model to optimize irrigation schedules based on real-time data from sensor networks. The sensors collect data on soil moisture, temperature, humidity, wind speed, rainfall and sunlight. Irrigation schedules are tested inside a digital twin where geospatial modelling of the park environment adjusts soil moisture levels based on real-time data and weather forecasts from the Bureau of Meteorology. In parallel, historic information is used to analyse how well soil moisture was managed under past conditions similar to those expected in 3-7 days in the future.

The technology is trailed in Bicentennial Park at Sydney Olympic Park. Being the premier events destination and dedicated suburb for urban innovation and sustainability, Sydney Olympic Park is an optimal location to implement this trailblazing technology that delivers effective urban cooling by maximising plant transpiration and thus air cooling. After rigorous testing throughout 2022, SIMP@CT has autonomously and successfully managed park irrigation since April 2023.

THE SCIENCE BEHIND SIMP@CT

The core of the SIMP@CT system is the machine learning model. This model is not a single algorithm but an ensemble of techniques working together. One key component is an artificial neural network, which is a complex computational model inspired by the structure and function of the human brain. Neural networks can learn complex relationships between input data (sensor readings) and output data (optimal irrigation schedule).

Another critical component is a decision tree algorithm. This algorithm works by splitting the data into subsets based on specific criteria (e.g., soil moisture level). Each subset is then further divided based on additional criteria, ultimately leading to a “leaf” that represents the optimal irrigation schedule for a specific set of conditions.

A manuscript, titled “Data optimisation of machine learning models for smart irrigation in urban parks” has been prepared. The text provides details of the process how the machine learning model was trained using K-shape and K-mean algorithms to estimate missing sensor data as well as applying robotics to reduce the need for field-based data collections by large networks of sensors. The text is available for download from the ArXic research repository at Cornell University (https://doi.org/10.48550/arXiv.2410.02335).

The SIMP@CT model is trained on a massive dataset of historical irrigation data, weather data, and plant water requirements. This data is collected from a network of 200 sensors installed in Bicentennial Park. As the model is exposed to new data, it continuously refines its understanding of the complex relationships between environmental factors and plant water needs.

ECONOMIC BENEFITS OF SIMP@CT

The benefits of SIMP@CT extend beyond environmental gains. A Cost Benefit Analysis by DelosDelta for the NSW Government has attested SIMP@CT a BCR of 3.07 and identified benefits to public health worth $2.3 million annually.

Reduced water use translates directly to cost savings for municipalities and park management authorities. Additionally, improved plant health can lead to a reduction in the need for pesticides and fertilizers, further lowering operational costs.

A study by the University of Technology Sydney estimated that the cost savings from water use reduction alone could offset the initial investment in the SIMP@CT system within a few years. When considering the long-term cost savings from reduced pesticide and fertilizer use, as well as the potential for extended plant lifespans, the economic case for SIMP@CT becomes even more compelling.

BROADER APPLICATIONS OF SIMP@CT TECHNOLOGY

The core technology behind SIMP@CT has potential applications beyond urban parks and green spaces. Here are a few promising areas (but also see the SIMP@CT Roadmap document available at www.simpact-australia.com):

- **Agriculture:** SIMP@CT technology could be adapted for use in agricultural settings, helping farmers optimize irrigation schedules for a wide range of crops. This could lead to increased crop yields, reduced water use, and improved soil health. The ability of the model to adapt to different soil types and weather conditions would be crucial for successful implementation in agricultural settings.
- **Urban Greenspaces:** Large irrigated spaces like golf courses or botanic gardens could implement SIMP@CT systems. This would conserve water while maintaining healthy and vibrant landscaping and provide cooling.
- **Environmental Monitoring:** The sensor network used by SIMP@CT can be adapted for broader environmental monitoring purposes. The data collected by the sensors could be used to track soil moisture levels, heat and temperature fluctuations across a wider area. This information could be valuable for urban planners, landscape architects, environmental scientists, and policymakers.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

While the results from SIMP@CT trials are promising, there are some limitations to consider and future research directions to explore:

- **Scalability:** The SIMP@CT system has been developed to meet the needs for a large and complex urban park. The system and its cost effectiveness must also be tested at smaller scales. Testing is also needed to ensure the model can interface with other irrigation infrastructure and technology.
- **Data Security:** The SIMP@CT system relies on a network of sensors that collect real-time data. Robust cybersecurity measures are essential to protect this data from unauthorized access or manipulation.
- **Integration with Smart City Initiatives:** SIMP@CT has the potential to be integrated with other smart city initiatives, such as weather and air quality monitoring systems and traffic management systems. This could allow for a more holistic approach to urban sustainability. Further research is needed to explore these potential synergies.
- **Social Equity Considerations:** The cost of implementing SIMP@CT technology may be a barrier for some organisations. Research and development efforts should explore ways to make the technology more affordable and accessible to all urban areas. Additionally, the potential impact of SIMP@CT on water pricing structures needs to be considered to ensure equitable access to water resources.

ALIGNMENT WITH AUSTRALIAN POLICY OBJECTIVES

SIMP@CT aligns perfectly with Australian policy objectives for sustainable water management and R&D investment. The project addresses water scarcity, a key challenge identified in the National Water Security Plan.

Furthermore, SIMP@CT's innovative approach using machine learning exemplifies the type of R&D investment prioritized in the National Research Infrastructure Roadmap.

POLICY IMPLICATIONS

The success of the SIMP@CT project suggests that machine learning has the potential to revolutionize the way we manage irrigation in urban areas. Governments can play a role in promoting the adoption of smart irrigation technologies by providing funding for research and development, as well as by developing policies that encourage water conservation.
Specific policy recommendations include:

- **Funding for Research and Development:** Continued government funding is essential to support ongoing research and development of smart irrigation technologies like SIMP@CT. This funding can help to address scalability challenges, improve data security protocols, and explore integration with other smart city initiatives.
- **Water Conservation Incentives:** Governments can offer financial incentives, such as tax breaks or rebates, to encourage municipalities and park management authorities to adopt smart irrigation technologies. Additionally, water pricing structures can be adjusted to reward water conservation efforts.
- **Regulatory Frameworks:** Regulatory frameworks can be developed to ensure the responsible use of sensor data collected by smart irrigation systems. These frameworks should address data security concerns and privacy considerations.

3. OPERATION OF PHASE 2

3.1 GOVERNANCE STRUCTURE

- The NSW Dept Planning and Environment was the project owner (Figure 1).
- The Water Conservation Group within the department was the funder.
- The Smart Cities Team provided strategic guidance and knowledge that ensured a successful delivery of the SIMP@CT system.
- Western Sydney University was the project manager, coordinated the project delivery and instructed service providers and park irrigation management of any adjustments of the SIMP@CT system. As part of the project management, Western Sydney University also looked after commercial contracts, procurement, and risk management.
- Service providers included CTS (irrigation application), the ARCs Group (LoRaWAN sensing), HARC (geospatial modelling and web feeds), and Eratos (data and sensor management). Collectively, these companies ensured the technical operation of the SIMP@CT system.
- Sydney Olympic Park Authority granted access to Total Water as irrigation operator at Bicentennial Park. Total Water communicated faults, exemptions and any other irregularities related to irrigation operations to Western Sydney University.
- Management of SIMP@CT sensors was communicated through daily reports to Total Water who took action for maintenance and repairs, as instructed by the service providers and/or Western Sydney University.
- CTS and Total Water retained the authority to override the SIMP@CT system when necessary.

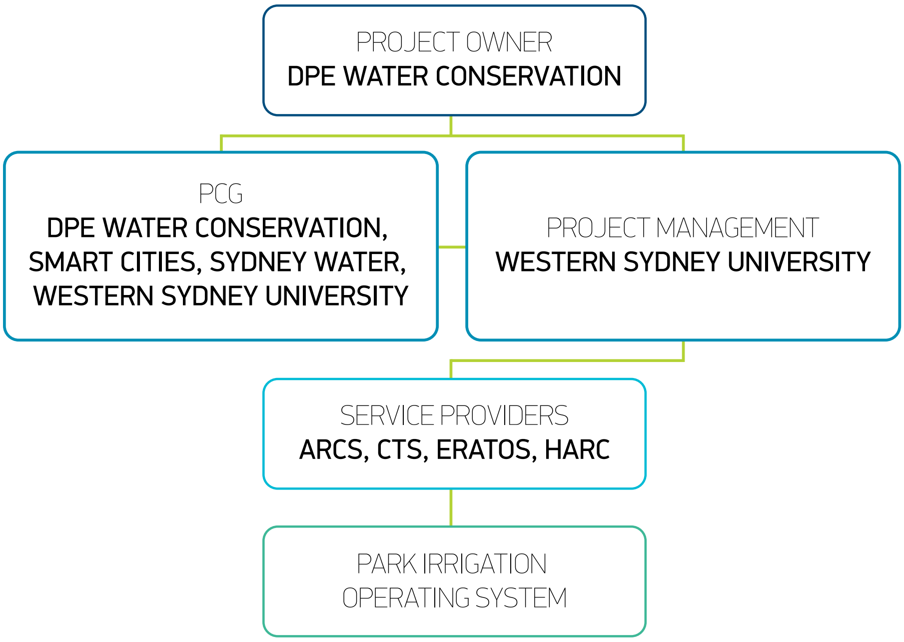


Figure 1: Governance structure of Phase 2.

3.2 TECHNICAL EQUIPMENT

Operation of the environmental sensors and related communication equipment ceased on 31 July 2024. Details about the technical equipment, including LoRaWAN Gateways, weather stations and other environmental sensors are provided.

GATEWAYS

The two gateways in the park and the third at 5 Olympic Boulevarde remained in place for Phase 2 and ownership was transferred to Sydney Olympic Park Authority (SOPA). Information about locations and serial numbers of the gateways is provided in Figure 2.

Figure 2: Technical details, geographic location and images of the three LoRaWAN gateways used during Phase 2.

WEATHER STATIONS

Thirteen weather stations were operated during Phase 2 (Figure 3). Seven weather stations were in Bicentennial Park, and the other six weather stations were distributed across the urban centre of Sydney Olympic Park. Depending on availability of power inside the mounting poles, weather stations were either connected to permanent power supply or equipped with solar panels to ensure continued operation. Data were logged every 15 minutes and stored in the digital repository for the project. All weather stations have been removed by WSU at the end of Phase 2.

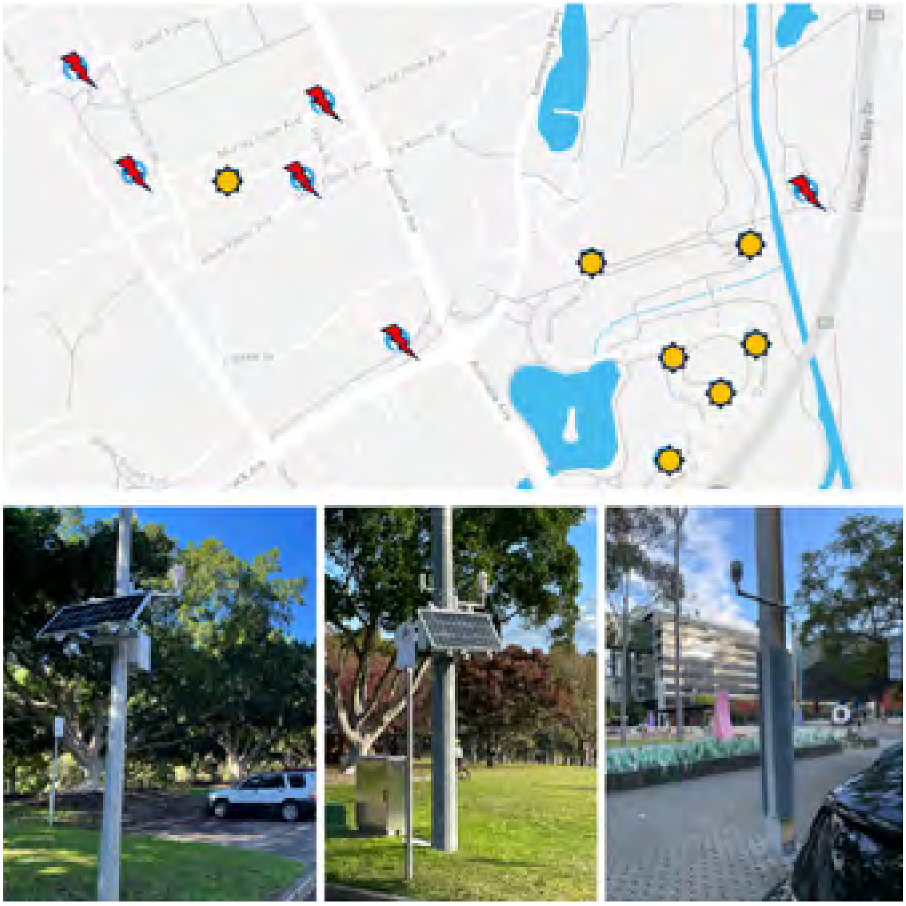


Figure 3: Geographic location and exemplary images of the thirteen weather stations used during Phase 2. Lightning symbols denote weather stations with permanent power, sun symbols indicate solar panel-powered stations. Images show stations: left - 1 (Village Green), middle - 4 (north of Waterview building), right - 11 (Abattoir Blues Corner).

AMBIENT AIR TEMPERATURE SENSORS

Fifty-one above-ground LoRaWAN sensors that measured air temperature and relative humidity were operated inside the park during Phase 2 (Figure 4). Three sensors were in ecologically sensitive areas at Lake Belvedere and two other ecosystems. These were installed using special mounting plates and cords to avoid any damage to trees. The remaining 48 sensors were installed on existing signage, poles and trees throughout the park. All sensors, mounting poles and brackets were removed from the park before 31 July 2024.

Figure 4: (Top) Location of 51 air temperature and relative humidity sensors operated inside Bicentennial Park. (Bottom) Examples of air temperature installations: left – on signpost near bridge across Powells Creek, middle – on announcement sign near pavilion at Concord West, right – on tree west of Waterview. Map © Google.

BELOW-GROUND SOIL MOISTURE SENSORS

Approximately 200 below-ground LoRaWAN soil moisture sensors were installed during Phase 1 of the project. During Phase 2, the number of active soil moisture sensors that recorded quality data declined because of physical damage and/or battery discharge. Total Water continuously monitored the performance of the sensors throughout Phase 2 and replaced batteries when needed. In addition, twenty faulty sensors were replaced with new units during the first 6 months of Phase 2. This strategy was changed during the second half of Phase 2 where the teams from HARC, ERATOS and Western Sydney University developed an aggregation strategy to compensate for sensor losses and reduce the overall complexity of the SIMP@CT system in the park. The strategy was based on the assumption that similar topographies and plantings will require identical amounts of irrigation water and hence the number of sensors measuring soil moisture of those areas could be reduced. The physical devices remain underground in the park.

Figure 5: Location of 200 soil moisture sensors operated inside Bicentennial Park. Map © Google.

GENERAL OBSERVATIONS

Environmental conditions during Phase 1 of the project were dominated by La Nina conditions. This meant long periods of heavy rain and generally low air temperatures. These conditions changed in the spring and summer of Phase 2 that were dominated by El Nino weather patterns. In the Greater Sydney region, such conditions usually are dominated by hot air temperatures. In addition, this El Nino phase was characterised by dry conditions during spring (4th quarter, Q4) and summer (1st quarter, Q1).

SIMP@CT relies heavily on soil moisture data to calculate irrigation commands. Due to La Nina conditions during Phase 1, it was very difficult for the project team to gather high quality training data for the ML and digital twin applications. As shown in Figure 6, monthly amounts of rainfall during the entire project varied widely when compared to rainfall over the previous decade. In 2022 (Q1, Q2, Q3) the soils across the park were saturated by well above average amounts of rainfall. No irrigation was necessary until November 2022, well into the second half of Phase 1 of the project. During the cool and wet summer of 2022/23, the team verified the functionality of the sensor network without continuous irrigation events, including a particularly wet January 2023.

Historically, irrigation during Q2 and Q3 is at its lowest across the park due to low air temperatures in autumn and winter where rates of ET are low. The team ended Phase 1 on 31 July 2023 to transition to Phase 2. At this stage, the entire park irrigation system was controlled by SIMP@CT (following a sequential approach that incorporated Consoles 81-85 into the digital environment of SIMP@CT). In 2023, rainfall during Q2-Q4 was mostly below historic means, and SIMP@Ct commenced operating in the cooler autumn and winter conditions where irrigation requirements were low.

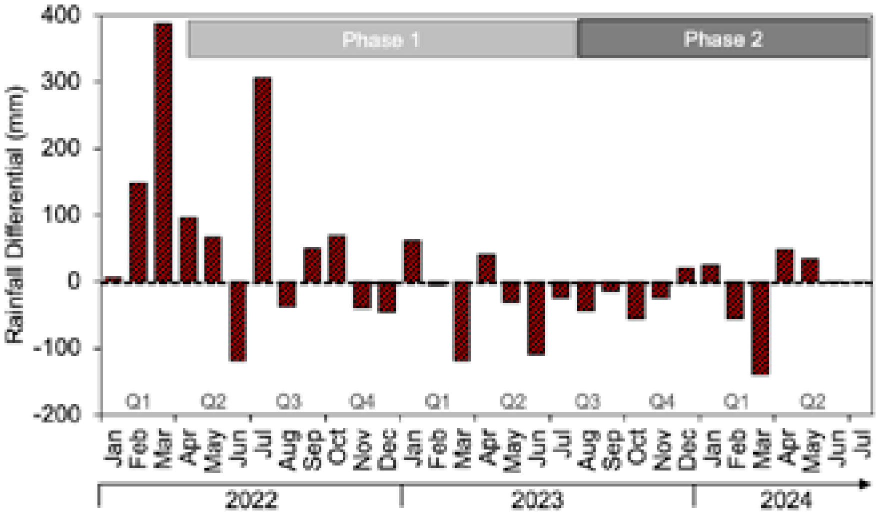


Figure 6: Rainfall differential during the entire SIMP@CT project from January 2022 to July 2024. Differentials were calculated using rainfall data from the Bureau of Meteorology station at Sydney Olympic Park (#066212) spanning from 2011 to 2024. Average monthly rainfall data from 2011-2021 was subtracted from monthly rainfall recorded between January 2022 and July 2024. Positive values indicate surplus rainfall (too wet); negative values indicate deficit rainfall (too dry); the dashed line at zero indicates that monthly rainfall between 2011 and 2021 was equal to that recorded for a specific month between 2022 and 2024. Grey bars indicate the duration of Phase 1 and Phase 2. Also shown are the quarters (Q1-Q4) for the duration of the project.

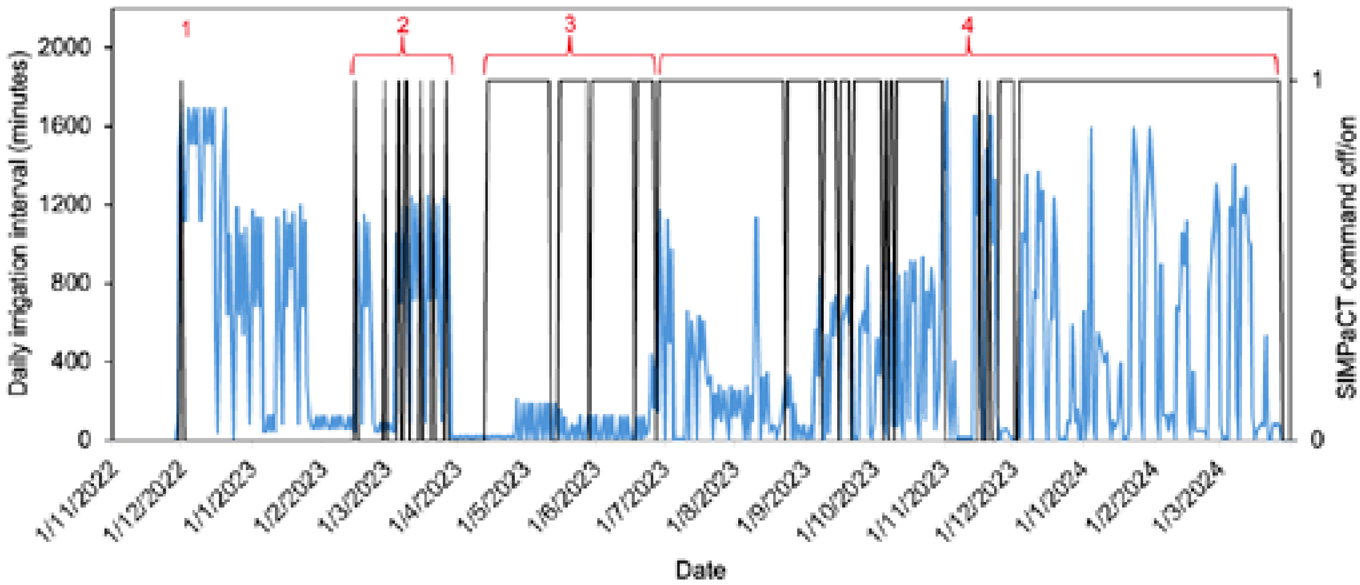


Figure 7: Application of the SIMPaCT system to irrigate Bicentennial Park. The blue line depicts the duration of the daily irrigation interval. The black line shows when SIMPaCT sent a command to the irrigation system, where zero means no signal for irrigation was sent and 1 indicates that SIMPaCT requested irrigation. Red numbers and brackets depict different stages of the implementation of SIMPaCT: (1) a first single, park-wide test in December 2022; (2) a sequence of single, park-wide tests in February and March 2023; (3) continuous control of irrigation across Concord West from April to June 2023 where only short intervals of irrigation were needed due to high amounts of rainfall; (4) park-wide irrigation control by SIMPaCT from late June 2023 until early May 2024.

Repeated technical problems at the RAMS water recycling plant meant that SIMP@CT was unable to operate without interruption. Restrictions in the volume of water for irrigation and also complete shutdown of water supply took place in Q4 2023, Q1 and Q2 2024. In addition, a lightning strike rendered the main irrigation pumps for the park dysfunctional for several weeks in Q1 of 2023. These and other problems like leaking irrigation infrastructure led to the situation where the SIMP@CT system (a) was overwritten by manual intervention from the irrigation contractor, (b) limited continuous data of a fully operational system was collected which in turn meant that (c) ML algorithms were limited in their capacity to optimise irrigation commands in response to fully looped operations (sensing-processing-command-sensing). Figure 7 depicts the different phases of the SIMP@CT system taking control of irrigation at Bicentennial Park and its frequent interruption by manual overrides.

An assessment of SIMP@CT on irrigation management costs was not possible due to the ongoing technical issues with the existing irrigation infrastructure.

Total Water were given training during three interconnected workshops to autonomously operate the system at the end of Phase 1. Customised and automated daily status reports and anticipated irrigation volumes were sent from the SIMP@CT digital twin to the contractor to assist with operating the system. These daily status reports were refined according to the contractor's suggestions.

Although Phase 2 experienced some operational difficulties, no plants were damaged or lost due to drought conditions while SIMP@CT was in operation. Trees were well watered, and lawns remained green and lush. This is an important achievement, as one key motivation to develop the smart irrigation system was the prevention of plant mortality and drought stress across the park. SIMP@CT clearly delivered on this expectation.

4. PARK ENVIRONMENT VS URBAN PRECINCT

Professional-grade weather stations and low-cost LoRaWAN sensors were used to record environmental information around Bicentennial Park and the town centre of Sydney Olympic Park. In total, the LUFFT weather stations and the aboveground Senstick sensors recorded more than 4 million individual measurements during the SIMP@CT project. Data from all stations can be made available in .csv format upon request.

As described earlier, there were seven stations in the park and six stations in the town centre. All stations commenced their operation on 28 July 2022. The weather stations operated until 8 June 2024, when a contractor retrieved them from the field. The stations were programmed to log data every 15 minutes, resulting in 68,190 measurement intervals. Gap analyses for air temperature measurements by the stations showed that on average 8.5% of measurements were missing (i.e., 5,796 out of 68,190 individual measurements). Gaps of missing data among the stations ranged from 0.8% to 32%, indicating that their wireless transmission technology (Fieldmouse OS and 4G modem) and required power supply did not function well in some locations. Environmental, technical and servicing issues resulted in exclusion of data from the station at Concord West (Station #3) and gaps in data from the remaining 12 stations. Their locations are provided in Table S2. Mean daily air temperature across the town centre and the park during the interval of the project was 18.5°C and showed a typical seasonal oscillation (Fig. 8).

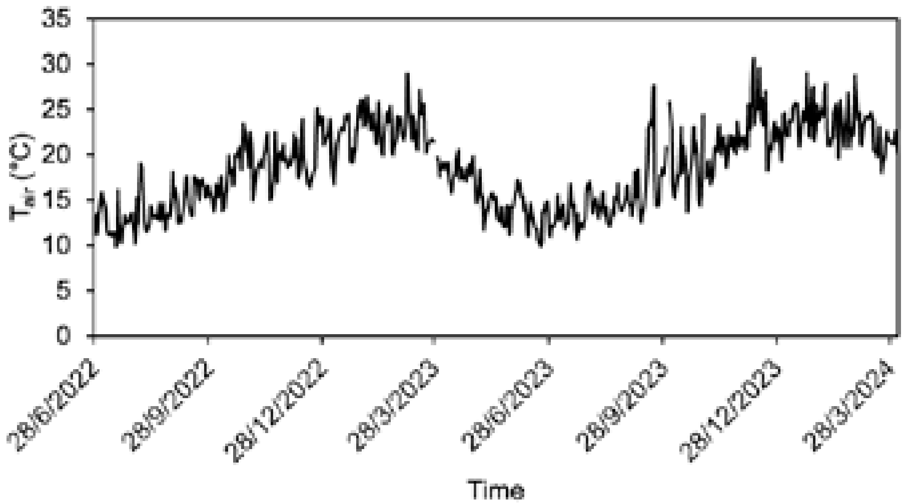


Figure 8: Mean daily (00:00–23:45) air temperature across Bicentennial Park and the town centre of Sydney Olympic Park between 28 June 2022 and 3 April 2024. Data based on n = 12 weather stations.

The La Nina summer months (December – February) of 2022/23 were with 21.6°C slightly cooler than those in the town centre (22.0°C). This pattern repeated in the following summer of 2023/24 that was dominated by El Nino conditions. During that summer, the average air temperature in the park as 23.4°C and that in the town centre was 23.7°C. Average summer temperatures and the absolute maximum air temperatures were higher in 2023/24 compared to 2022/23 (Table 1). Absolute maximum air temperatures were nearly 10°C hotter in the El Nino compared to the La Nina summer.

Table 1: Air temperatures during the summers (December – February) of 2022/23 and 2023/24 in Bicentennial Park and the town centre of Sydney Olympic Park. All air temperatures are °C and are based on n = 6 weather stations in each area.

	Bicentennial Park		Town Centre	
Parameter	2022/23	2023/24	2022/23	2023/24
Average summer	21.6	23.4	22.0	23.7
December	20.0	23.2	20.4	23.5
January	22.0	23.7	22.3	24.1
February	22.9	23.5	23.4	23.8
Number of days <35°C	0	8	0	8
Number of days <40°C	0	1	0	3
Absolute max. air temperature	33.8	42.9	34.9	42.6

Based on the 50 microclimate sensors, mean air temperature across the park between June 2022 and April 2024 varied from 18.4°C at the wooden bridge that crosses the mangroves, south of the Treillage Tower to 19.4°C in front of the Waterview Café where hardscapes were dominant. These values are the mean of more than 33,000 individual measurements from each snesor, unmistakably identifying the coolest and warmest location in the park. The marked microclimatic differences between cool and hot spots in the park were even more obvious when assessing where the absolute maximum temperatures were recorded. On the hottest day throughout the project (9 December 2023, Phase 2) at 15:00, a sensor under the dense canopy of fig trees along Bicentennial Drive west of Waterview recorded 41.6°C and the sensor in front of the Waterview Café topped at 46.2°C, a difference 4.6°C at two locations just 120 m apart.

An analysis of air temperature variation among the stations inside and outside the park unveiled a pronounced Park Cool Island (PCI) Effect throughout the project. The PCI Effect was calculated in different ways as different sources of information for temperatures across the park were available – weather stations and air temperature sensors. The PCI Effects is represented in the 'delta' (i.e., differential) notation using the capital Greek letter delta (Δ).

Calculating the PCI Effect using weather stations in the park and weather station in the town centre is a sound strategy as it utilises the same instruments and similar structures that were used to install the instruments. At both areas, the weather stations were mounted on light poles in open spaces using the identical extension arms. Immediately underneath each station were predominately hard, impervious surfaces. Calculating DT_{air} based on average measurements every 15 minutes between 26 June 2022 and 4 April 2024 in the park and the town centre reveals a mean PCI Effect of -0.5°C, with a range of 6.4·C from +1.3 to -4.9°C. This would be considered the most conservative approach to identifying the PCI Effect for Bicentennial Park.

A different way of calculating the PCI Effect is using minimum temperatures in the park and maximum temperatures in the town centre (Fig. 9). This parameter represents the absolute maximum PIC Effect. This temperature derivate is informative, because detailed microclimate information from inside and outside the park was available using the same instrumentation and installation procedures (i.e., mounting stations on light poles). This maximal DT_{air} ranged from +0.7°C to -8.6°C (amplitude: 9.3°C) and averaged at -1.4°C throughout the duration of the project. When separated by daytime (10:00-18:00) and night-time (22:00-06:00), the PCI Effect was more intense during the night (mean = -1.8°C, max = -8.6°C) compared to the day (mean = -1.1°C, max = -6.6°C).

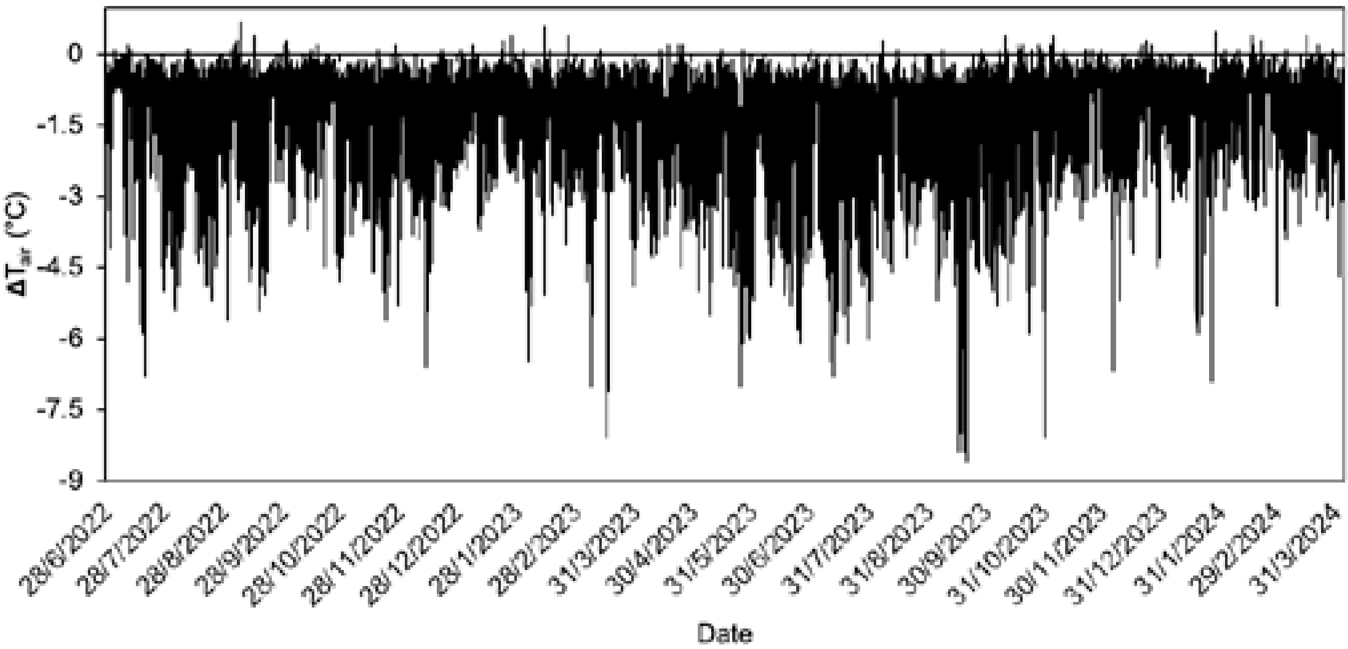


Figure 9: The Park Cool Island (PCI) Effect based on minimum temperatures in the park and maximum temperatures in the town centre recorded using LUFFT weather stations (n = 6 across each area). The data is presented as ΔT_{air}, for the time between 26 June 2022 and 4 April 2024. ΔT_{air} was calculated by subtracting the lowest measurement recorded by an air temperature sensor in the park from the warmest temperature in the town centre for each 15-minute interval.

Lastly, to capture the full extent of PCI Effects that capture the cooling and warming effects of vegetation, water, hard surfaces and buildings, DTair was calculated based on minimum temperature measurements from the air temperature sensors across the park and the maximum temperature measurements in the town centre. While admittedly these calculations use different instrumentation and differ in the dominant site characteristics for their installation (i.e., open space vs. forest block), analyses among the co-located weather stations and air temperature sensors have shown that both instruments recorded highly correlated data (manuscript in preparation). Based on these data, the mean PCI Effect was -2°C and the temperature range of 11.4°C (+0.2°C to -11.2°C) was the largest recorded for the project.

When investigated separately for each summer and for day- and night-time (Table 2), several observations can be made:

» While air temperatures during the summer of 2023/24 were warmer, the average and maximum PCI Effects were smaller compared to the summer of 2022/23.
» During both summers, nighttime PCI Effects were always greater than daytime PIC Effects.
» During daytime, it was possible that the coolest spot in the park and the warmest spot in the town centre have the same temperature.
» The absolute maximum PCI Effects of 10°C and more were recorded outside of summer.

Table 2: Park Cool Island (PCI) Effects between the coolest spot in the park and the warmest spot in the town centre. Values in parenthesis indicate 1 Standard Deviation. The months of December, January and February collectively represent 'summer'.

	Summer 2022/23		Summer 2023/24	
	daytime	nighttime	daytime	nighttime
Average PCI Effect	-1.4 (0.6)	-2.3 (1.3)	-1.3 (0.6)	-1.8 (1.0)
Min. PCI Effect	0.0	-0.4	0.1	-0.2
Max. PCI Effect	-6.1	-7.9	-6.1	-7.4
PCI Effect Range	6.1	7.5	6.2	7.2

PCI Effects where the park environment was >9.3°C cooler compared to the town centre were unanimously recorded during nights (20:00-01:45) in March, September and October 2023. Such large temperature differences over a relatively short distance indicate that the town Centre of Sydney Olympic Park was subject to distinct Urban Heat Island Effects during the night, and that the park has an important local cooling function. The coolest daytime PCI Effect was 9.2°C at 10:30 on 3 October 2023, a sunny day without rainfall or cloud cover. During the morning of that day, the coolest spot in the park was inside the forest block north of the Treillage Tower and the warmest spot in the town centre was at Jacaranda Square.

Quantifying the cooling effect of irrigation by SIMP@CT was extremely technically challenging for a range of reasons. Most importantly, the 2023/24 summer, when SIMP@CT was operating the irrigation of the entire park, was mild, with air temperatures >35°C during just 8 days. Adjusting the irrigation volumes to maximise cooling was not initiated for a single day, as rainfall had provided ample soil moisture prior to these hot days.

However, analyses of some selected data shows that irrigation did indeed lower air temperatures in the park and amplify the PCI Effect. This cooling signal triggered by irrigation was particularly obvious during the morning (Fig. 10).

ΔT_{air} was calculated for time intervals where air temperatures were similar across the town centre, yet at the same time the park was either irrigated or not. On average, the PIC Effect during mild days where summer air temperatures were between 25°C and 30°C reached 0.3°C, with maximum values of up to 3.5°C when the park was irrigated and 2.4°C when irrigation was missing. Figure 9C (black arrows) clearly indicates that a simultaneous and opposite temperature trend could be observed between the park and town centre when irrigation was provided or not: increasingly smaller ΔT_{air} during the night and morning when irrigation was missing (green line in Fig. 9C) and the opposite trend of ΔT_{air} when irrigation was provided (blue line in Fig. 10C). This repeated diametral pattern can be interpreted as a clear indicator of evaporative cooling from irrigation in the park.

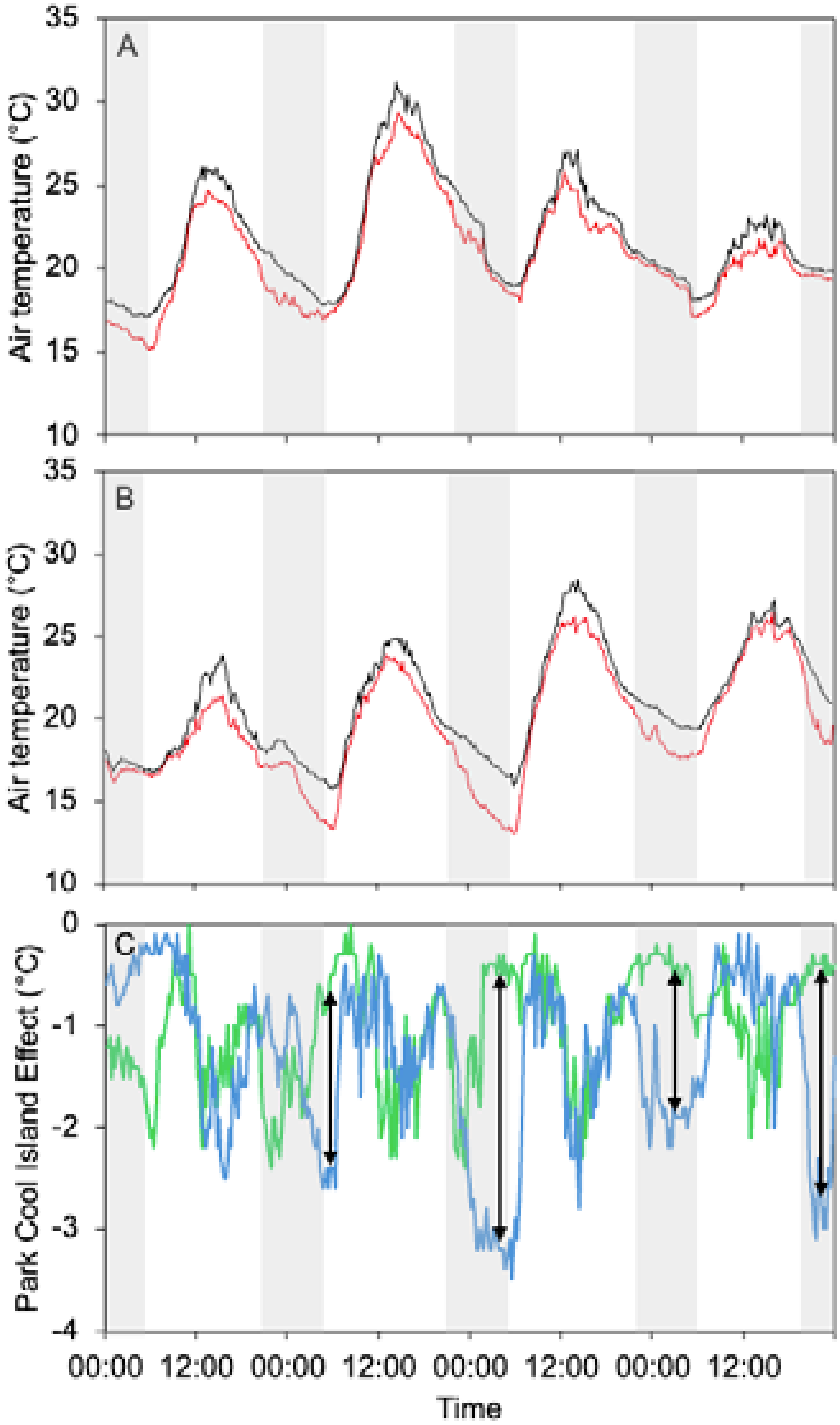


Figure 10: Effect of irrigation on the Park Cool Island Effect. (A) Maximum air temperature in the town centre (black line) and minimum air temperature in the park (red line) between 10 and 13 October 2023 when no irrigation was applied to the park. (B) Maximum air temperature in the town centre (black line) and minimum air temperature in the park (red line) between 17 and 20 October 2023 when the park was irrigated. (C) The park Cool Island Effect for A and B, where the green line represents ΔT_{air} when irrigation was absent, and the blue line shows ΔT_{air} when irrigation was applied. The grey sections in all panels indicate nighttime (20:00–06:00). The black dual arrows mark the point of the largest difference between the Park Cool Island Effect between irrigated and non-irrigated conditions.

As a result of park irrigation requirements and the broader environmental conditions during the project (wet, mild), it was not possible for the team to collect data that allows a detailed analysis about the performance of the SIMP@CT system during dry and hot conditions. A split-experiment, where one section of the park was irrigated while another section was allowed to dry down could not be implemented due to contract requirements that always require proper upkeep of vegetation across the entire park.

5. WATER USAGE

Water use for irrigation of Bicentennial Park is billed quarterly by Sydney Water. The project team was able to source information about water use dating back to the fourth quarter of 2012. Seven water bills between 2012 and the end of 2023 were missing, resulting in information about volume and cost for recycled water from 37 quarters. During this time, the cost per kilolitre (KL, 1,000 litres) varied notably (Fig. 11). The lowest price for 1 KL was $1.38 in the second quarter of 2022. This was possibly due to the high amount of precipitation during the La Nina events in 2021 and 2022. The highest cost for the same volume of recycled water was $2.42 in the first quarter of 2019, most likely the consequence of the prolonged dry conditions leading to the catastrophic events of the Black Summer of 2019/20. The price for recycled water during Phase 2 of SIMP@CT was with $2.34 KL^{-1} nearly 20% above the average water cost per KL between 2012 and 2022, which was $1.99 KL^{-1}.

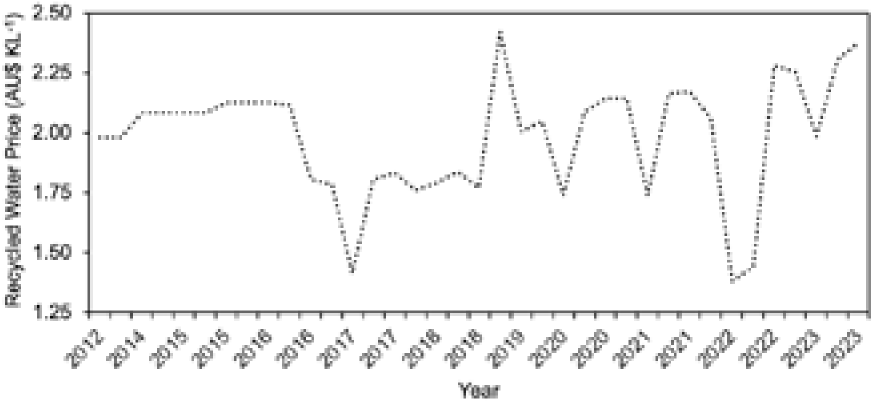


Figure 11: Cost for 1,000 litre (1 KL) of recycled water between 2012 and 2023. The price was calculated using quarterly water bills issued by Sydney Water for Sydney Olympic Park Authority.

The volume of irrigation needed to maintain soil moisture levels that do not compromise hydraulic functioning of plants depends on a range of factors. These include plant type and species, stomatal regulation at the leaf level, and the vapor pressure deficit of the atmosphere. As a rule of thumb, vegetated landscapes featuring trees will use more water than landscapes that feature lawn or shrubs. Water is lost from plants during the process of transpiration. In addition, soil water can evaporate from ground surfaces. Combined, the rate of water loss from a vegetated surface is commonly given as rate of evapotranspiration (ET). Due to greater solar radiation load in summer that leads to warmer air temperatures, ET is higher during summer compared to other seasons. Hence, it can be expected that soil moisture must be replenished more frequently during the fourth quarter (October – December) and first quarter (January – March) where irrigation volumes will be greater.

To ascertain that these general expectations apply to Bicentennial Park, it was necessary to combine the analyses of irrigation volume during Phase 2 with historic and contemporary environmental data. For this purpose, we sourced daily weather data for Sydney Olympic Park from the Bureau of Meteorology for the entire time interval from 2012 to 2023. Monthly and quarterly averages were calculated for solar radiation, maximum air temperature, and rates of evapotranspiration to match with the irrigation water volumes used during each quarter.

Using monthly data, we found strong positive relationships between solar radiation and air temperature (Fig. 12A), demonstrating the warming effect of solar radiation on ambient air. In turn we also observed that increasing air temperatures resulted in higher rates of ET (Fig. 12B). Both findings indicate clearly that plants will require more water in summer when solar radiation is more intense, and air temperatures are high. In contrast, there were no relationships between air temperature and rainfall (Fig. 12C) and between rainfall and ET (Fig. 12D). This indicates that for the site at Sydney Olympic Park, rainfall is independent from seasons. Moreover, the quantity of rainfall cannot be used as safeguard to judge when irrigation is required to replenish soil moisture lost via ET. In this regard, it is important to point out the high variability of ET when rainfall amounts are low (see clustering of data at the low range of x-axis values in Fig. 12D).

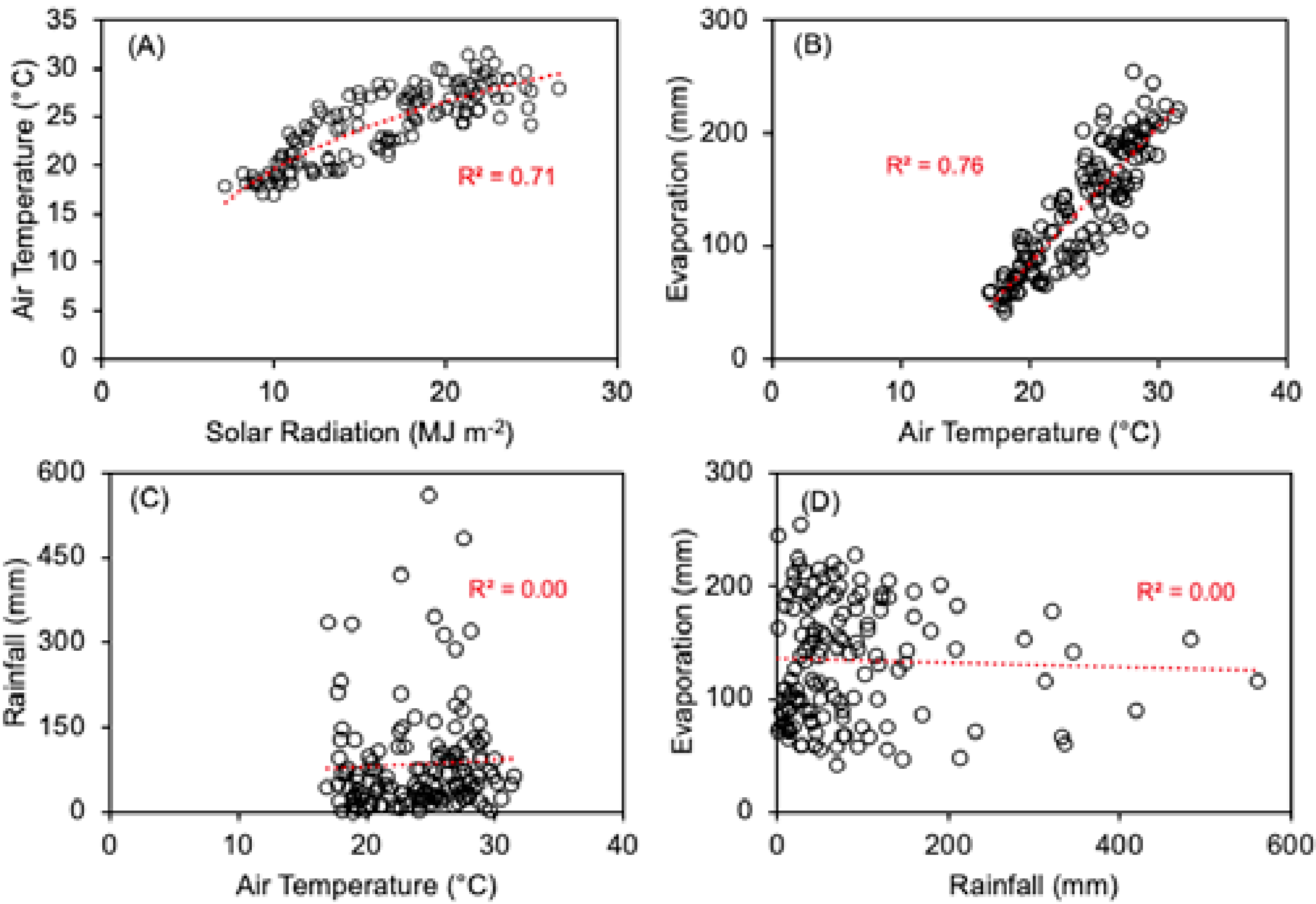


Figure 12: Relationships between environmental parameters at Sydney Olympic Park. Data shown are mean monthly maximum air temperatures, average solar radiation, average rates of evapotranspiration and total rainfall. Data spans the time interval from October 2012 to December 2023. Dotted red lines indicate best fit functions and their coefficient of determination (R^2) is shown in each panel.

The relationship between quarterly ET and the volume of water use by the irrigation system is positive and significant for the decade prior to and during the operation of SIMP@CT (Fig. 13). While data in Figure 8 can be clearly separated in a low and high ET cluster that represent environmental conditions in summer (Q1, Q4) and not summer (Q2, Q3), the trend analysis reveals that water use by SIMP@CT during summer was greater than the average between 2012 to 2021. However, the analysis reflects the data driven approach by SIMP@CT compared to the operation of the park irrigation prior to the project. Variability of water use in response to ET (i.e., the scarcity or abundance of water in the soil) is large between 2012 and 2021, resulting in a much lower coefficient of correlation. During SIMP@CT this coefficient nearly doubles, indicating tight tracking of water use for irrigation with ET. This outcome is a clear indication of how well the technology used empirical measurements of environmental data to derive optimal irrigation schedules for the park.

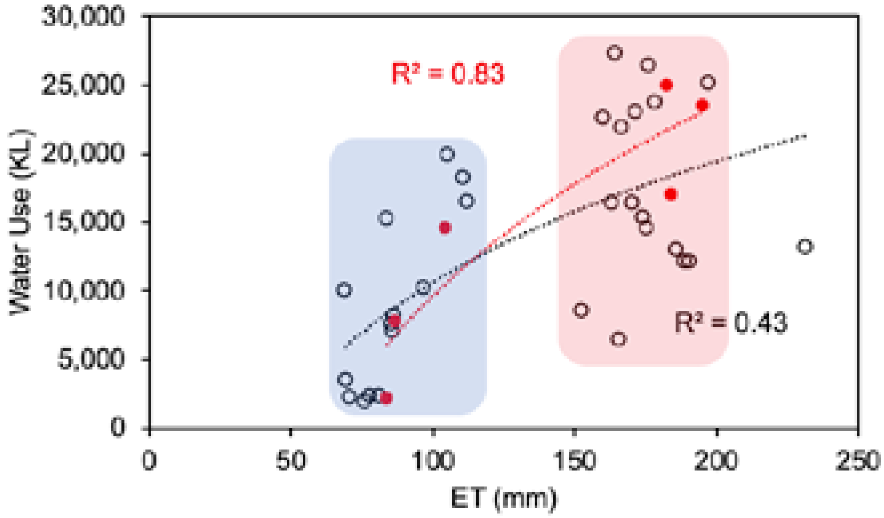


Figure 13: Relationship between evapotranspiration (ET) and water use of the irrigation system. Circles indicate quarterly data collected between 2012 and 2021. Red dots represent quarterly data for the period between July 2022 and December 2023 (six quarters) when SIMP@CT was partly or fully controlling the irrigation system at Bicentennial Park. The red and blue areas depict the clustering for summer (red) and not-summer (blue) quarters. The dotted black and red lines indicate best fit functions, and their coefficient of determination (R^2) is shown.

At a quick glance, the empirically driven approach to irrigation of Bicentennial Park during the wet years of 2023 and 2024 did not result in water savings. Compared to the ten years prior to SIMP@CT being trailed at Bicentennial Park, the loss and replenishment of soil water across the park remained relatively stable with a few noticeable exemptions. During the time SIMP@CT operated the irrigation system of Bicentennial Park, the overall requirement to replace soil moisture lost to ET remained stable throughout the summer and non-summer quarters (Fig. 14A). Moisture lost during Q1, and Q4 as ET was approximately twice the volume of ET during Q2 and Q3.

Differences in how water lost to ET (and runoff) was replenished provide another degree of difference between ten years of human-operated 'business as usual irrigation' compared to the data-driven approach of SIMP@CT. Irrigation during Q1 was relatively similar between the two approaches (Fig. 14B). However, while ET remained somewhat similar, irrigation water use was very different in the quarters 2-4. Most notably, during the spring quarter (Q3), SIMP@CT distributed much less water to the park environment, while in early summer (Q4) it scheduled greater volumes of water for irrigation, although losses to ET during those quarters were similar (Fig. 14B). These observations may be a result of the much shorter duration of SIMP@CT compared to the irrigation operations throughout the previous decade (see differences in the size of error bars). Nevertheless, they indicate a tailored approach to irrigation by SIMP@CT. The following factors could have influenced the outcome of irrigation water use based on SIMP@CT technology:

1. High water needs during hot spells were accounted for immediately by SIMP@CT due to forecasting data ingested from the BoM.
2. Both quarters between July and September in 2022 and 2023 were very wet, allowing SIMP@CT to significantly reduce the volume of irrigation water.
3. For the first time, water requirements of deciduous trees in the park were included for each of the 200 irrigation zones in SIMP@CT (i.e., low requirement in spring, high requirement in summer)
4. Irrigation in Q4 during SIMP@CT was not triggered by human observation of signs indicating drought stress by vegetation but was providing empirically informed volumes of water when soil moisture levels dropped below set thresholds.

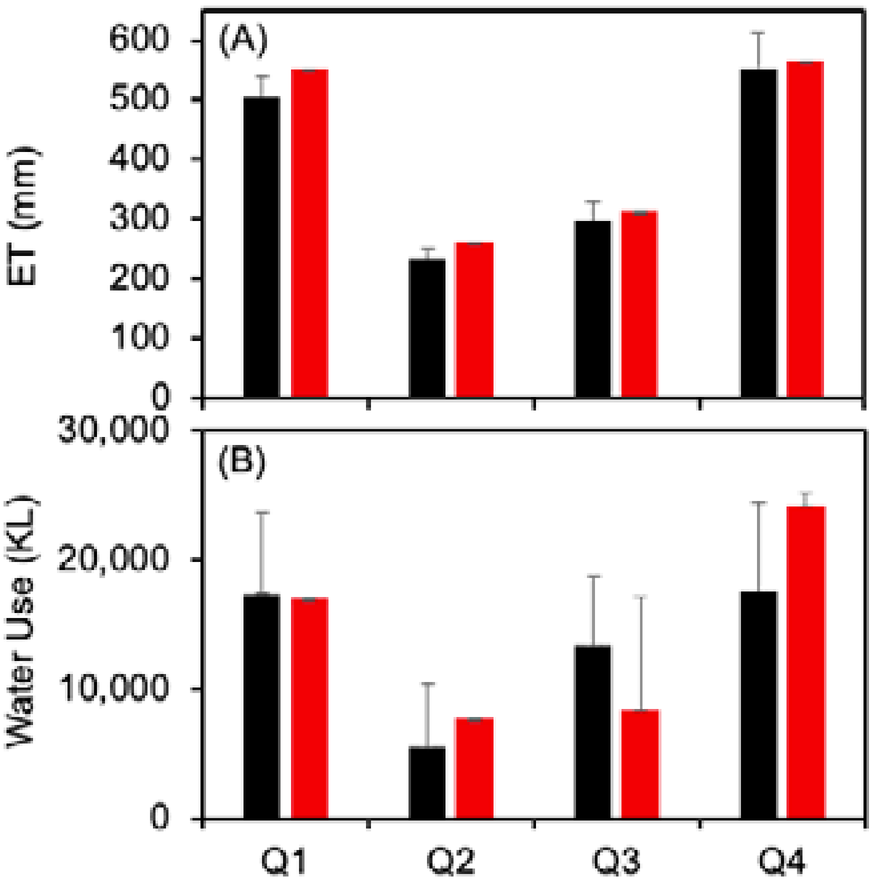


Figure 14: Rates of Evapotranspiration (A) and water use (B) separated into quarterly bins. Black bars are means based on available data from the last quarter of 2012 to the first quarter of 2022. Red bars cover time of SIMP@CT operations, commencing on the second quarter of 2022 until the fourth quarter of 2023. Error bars depict 1 Standard Deviation.

A more nuanced analysis revealed that SIMP@CT did deliver water and cost savings. To understand how these benefits were generated, it is important to note that SIMP@CT used slightly less irrigation per mm water lost to ET (33.95 KL mm^{-1} ET) compared to data from the previous decade (34.15 KL mm^{-1} ET). Bicentennial Park is approximately 42 ha in size. Evapotranspiration is the water loss from vegetated surfaces, so the large and smaller water bodies, roads, carparks and buildings must be excluded. Such surfaces cover 11.2 ha across the park, leaving 30.8 ha for green infrastructure. To replace 1 mm ET ha^{-1} requires 10 KL water. Annual rates of ET between 2012 and 2022 were 1,584 mm and in 2023 were 1,692 mm. The replenishment, proportional to the park size would require irrigating 48,795 KL prior to 2023, and 52,118 in 2023. As per Sydney Water bills, on average 54,095 KL were replenished annually between 2012 and 2022, while 57,450 KL were distributed across the park in 2023 – a surplus of roughly 10% to replace water lost annually to ET in the long-term and the 2023 approaches.

The cost of recycled water during the application of SIMP@CT at Bicentennial Park was higher ($2.34 KL^{-1}) compared to the long-term average ($1.99 KL^{-1}; see beginning of this section). This higher cost led to a deviation of cost for irrigation water from the long-term average (Fig. 15). In addition, and as noted in the above paragraph, annual ET during Phase 2 of SIMP@CT was greater than the long-term average. Both factors, the higher cost and the greater volume required to be replenished will lead to the observed higher cost on the water bills for SIMP@CT (i.e., $128,640 during Phase 2 vs. $102,480 as long-term average annual cost). However, when adjusted for both factors, the cost for SIMP@CT irrigation is about 95.7% of the long-term annual costs – a small but important reduction of 4.3%.

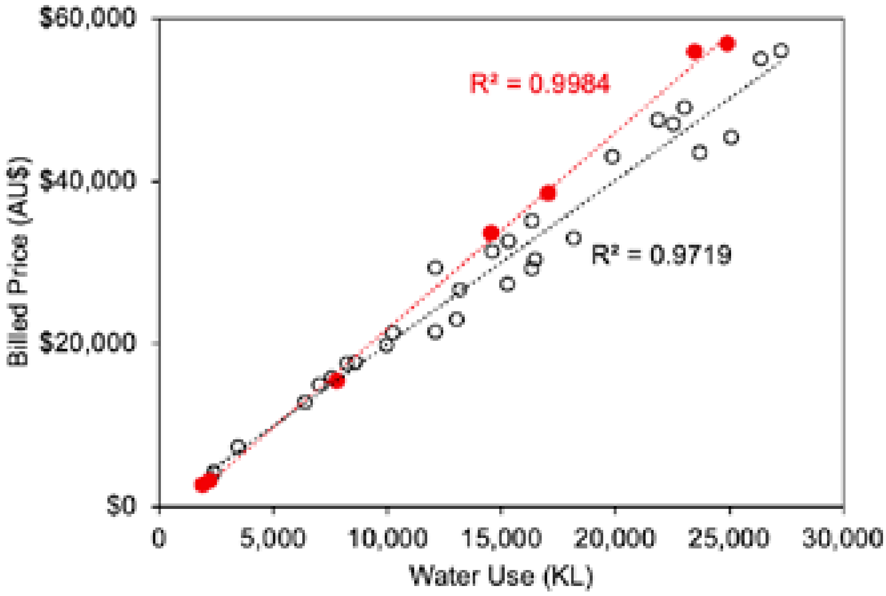


Figure 15: Trend analysis for the cost of recycled water before (black circles) and during (red dots) the operat5ion of SIMP@CT at Bicentennial Park. Dotted lines show best fit functions, and their coefficient of determination (R^2) is shown.

In conclusion when accounting for the variation of cost for irrigation water (18% higher cost per unit irrigation water for SIMP@Ct compared to the long-term mean), environmental variability (7% higher rate of annual ET during SIMP@CT) and taking into consideration that the system operated during a short period of around 12 months where technical interruptions hampered a smooth and as-planned operation, SIMP@CT still delivered water savings and thus cost savings. In the inception phase of the project, the project team estimated relative savings in the volume of water of 15-20%. While actual savings of 4.3% are considerably smaller, it cannot be excluded that this level of water conservation is achievable with the technology developed by the project team.

Key factors for reaching this level of efficiency will be:

1. Uninterrupted operation of the system over a longer time interval, allowing its algorithms to dynamically adapt to changing environmental conditions.
2. Availability of high-quality past environmental information, irrigation data and water bills.
3. Reduced complexity.
4. Effective maintenance of sensors to ensure network integrity and data quality.
5. Permission for the project team to work on site. This was not possible for SIMP@CT, due to site permit approvals, resulting in dependencies on suppliers contracted to SOPA, rather than the project team.

The above analyses are based on data that was extracted from bills sent by Sydney Water to Sydney Olympic Park Authority. SIMP@CT also recorded its own daily water use between 18 June 2023 and 16 July 2024. These measurements were recorded by a smart water meter placed directly after the four pumps that supply irrigation water into the park. According to these data, SIMP@CT used much less water compared to those volumes listed on the water bills (Table 3). For example, during Q4 (October – December) 2023, the official water bill charged $55,875.96 for the usage of 23,519 KL of recycled water. However, SIMP@CT recorded a usage of 13,223 KL for the same period, a reduction of 44%. Given that the price per KL for this billing quarter was $2.376, the cost difference between the billed and effectively used water is $24,463.30. The SIMP@CT team were unable to source information regarding the origin of this mismatch between billed and effectively used recycled water.

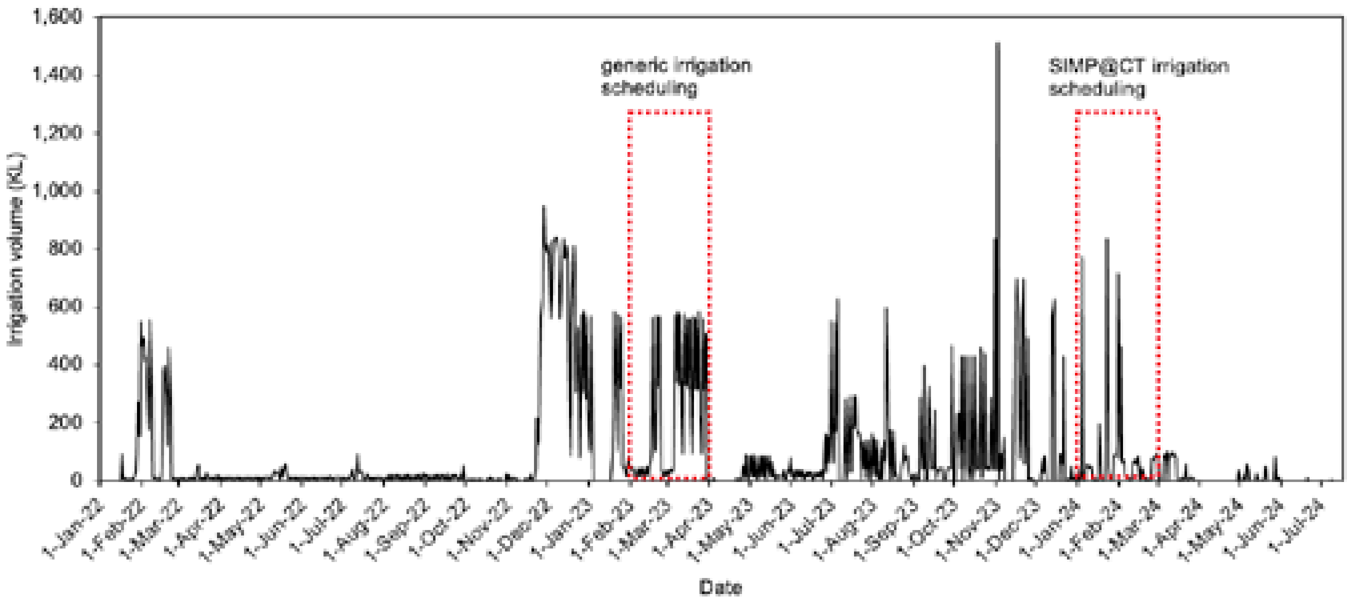
Table 3: Comparison of billed and effectively used recycled water in quarters 3 (Q3, July – September) and 4 (Q4, October – December) of 2023. The price per KL of recycled water was $2.307 in Q3 and $2.376 in Q4.

	Q3	Cost	Q4	Cost
Sydney Water	14,567 KL	$33,604.20	23,519 KL	$55,875.96
SIMP@CT	9,463 KL	$21,831.14	13,223 KL	$31,417.85
Difference	5,104 KL	$11,773.06	10,296 KL	$24,463.30

Another comparison can be done to assess the water usage of SIMP@CT – assessing the volume of irrigation water used across the park before and during SIMP@CT based on flow meter data in the park. Two periods are particularly valuable for this comparison, as they are very similar in overall environmental conditions (Table 4). During February and March 2023, the irrigation was applied as per scheduling from Total Water. During those two months, and according to the flow meter data, a total of 12,963 KL of recycled water were used. SIMP@CT generated the irrigation commands in January and February 2024. Data from the flow meter indicates that during these two months, only 4,798 KL of recycled water were used, representing a reduction in usage of irrigation water of more than 70%.

Table 4: Environmental conditions at Sydney Olympic Park during the late summer of 2023 and 2024 when irrigation was applied to Bicentennial Park using human-generated irrigation scheduling (2023) and machine-generated irrigation scheduling (2024). Data are from the official Bureau of Meteorology weather station at the Archery stadium (station ID: 066195).

	T_{max} (°C)	Rain (mm)	ET (mm)	Radiation (MJ m^{-2})
before SIMP@CT				
February 2023	28.3	129.8	190.2	21.5
March 2023	28.3	44.1	162.1	16.1
during SIMP@CT				
January 2024	28.6	121.7	192.6	20
February 2024	28.6	49.7	114.3	18.2



As shown in Figure 16 above (and see Fig. 7 for an indication when SIMP@CT was operating the irrigation system), SIMP@CT requested irrigation events much more nuanced and at lower volumes compared to the irrigation schedule that was used during the summer of 2022/23. The block-like irrigation applications in Q4 and Q1 of the 2022/23 summer are clearly visible in Figure 16, compared to a patchier irrigation application by the SIMP@CT system. Also visible in Fig. 16 is the event where a mains pipe burst, leading to a high loss of water in late October 2023. SIMP@CT captured this event, supporting a timely detection, repairs and reduced losses to the environment. This type of detection of faults was not possible without SIMP@CT and will have resulted in much higher water losses during similar events in the past. It can be expected that high losses will also occur in the future when SIMP@CT is not producing daily reports that alert the irrigation operator to very high volumetric water usage, indicating a leak in a major pipeline.

Admittedly, a finer, day-to-day analysis could shed more light into the water savings realised by irrigation scheduling with SIMP@CT. However, such an analysis is out of scope for this report. The project team is keen to produce this analysis as part of a manuscript that will be submitted to an international journal for peer-review.

Figure 16: Timeseries of irrigation at Bicentennial Park between January 2022 and July 2024. Clearly visible is a long period of minimal irrigation in 2022 as consequence of high amounts of rainfall and soil saturation across the park. As shown in Figure 7, regular irrigation scheduling by SIMP@CT across the entire park commenced in June 2023. The red boxes highlight the time intervals where environmental conditions were very similar (see Table 4 for details), but irrigation was applied based on generic irrigation schedules or those generated by SIMP@CT. Clearly visible are the resulting differences in the volumes of irrigation water applied to the park using either generic (December 2022 to beginning of April 2023) of ML-based irrigation schedules (July 2023 onwards).

6. FINANCIAL REPORT

The Department of Planning and Environment, represented through the DPE Water Conservation Group, Smart Cities and SOPA, agreed that the existing SIMP@CT Head Contract with the NSW Government was extended to deliver Phase 2 of the project. Therefore, all terms and conditions remained intact.
The operational phase of this agreement covered the interval between 1 August 2023 and 31 July 2024.

For the delivery of the agreed services and milestones, total funding of $77,705 was requested and granted. Table 5 lists project expenses.

Table 5: Breakdown of spend during Phase 2 of the project.

ESSENTIAL SERVICES	Cost
Field Mouse data transfer, irrigation application, hosting and storage, weather station support	5,060
$150 p/h: Ad hoc fees for weather station maintenance if required	
LoRaWAN sensing, Meshnet Vision hosting and sensor services	3,600
$165 p/h: Ad hoc fees for sensor replacement data into MeshNet Vision if required	
Data hosting platform, data management, status and error reports	15,000
Hosting and maintaining Park Live and associated operational dashboard, geospatial model calibration	18,085
Gateway and LoRaWAN Network services	10,400
Operational management of SIMP@CT in Bicentennial Park - irrigation management and sensor maintenance	25,200
Inclusive of in-field sensor maintenance costs	
Public-facing website and dashboard, domain, sub-domain for operational dashboard, operational documentation hosting	360.00
Total ex GST	**77,705**

7. PROJECT COMMUNICATION

The team continued to promote the project and its technological advances during Phase 2. SIMP@CT was presented to government partners (e.g., NSW Department of Planning and Environment in November 2023), to mayors, councillors, directors and General Managers of the cities of Parramatta (April 2024) and Bathurst (February 2024) as well as to members of the Midwestern Regional Council (April 2024) and the Sunshine Coast Council (October 2023).

Details about the project were also presented to community groups (e.g., Greater Sydney Landcare in October 2023, Epping Civic Trust and Greening Bathurst in February 2024), professionals (e.g., Institute of Arboriculturists of Australia in October 2023) and students at Western Sydney University (August 2023 and 2024), University of Sydney (June 2023 and 2024) and the University of NSW (September 2023). In Phase 2, the academics continued presenting SIMP@CT to their peers on national and international conferences. These included the 6th International Conference on Countermeasures to Urban Heat Islands and the 11th International Conference on Urban Climate and the 2023 Environment and Planning Law Conference. SIMP@CT also featured in the national and international media, for example on ABC Radio National (Late Night Live Show), SBS Online Podcasts or in the Berliner Tagesspiegel (Fig. 17).

Politik 11

Künstliche Intelligenz Australiens
Parks sparen mit Sensoren Wasser

Figure 17: Article in a German newspaper reporting about the SIMP@cCT project during Phase 2. The headline reads “Artificial Intelligence – Australia’s parks save water with sensors”.

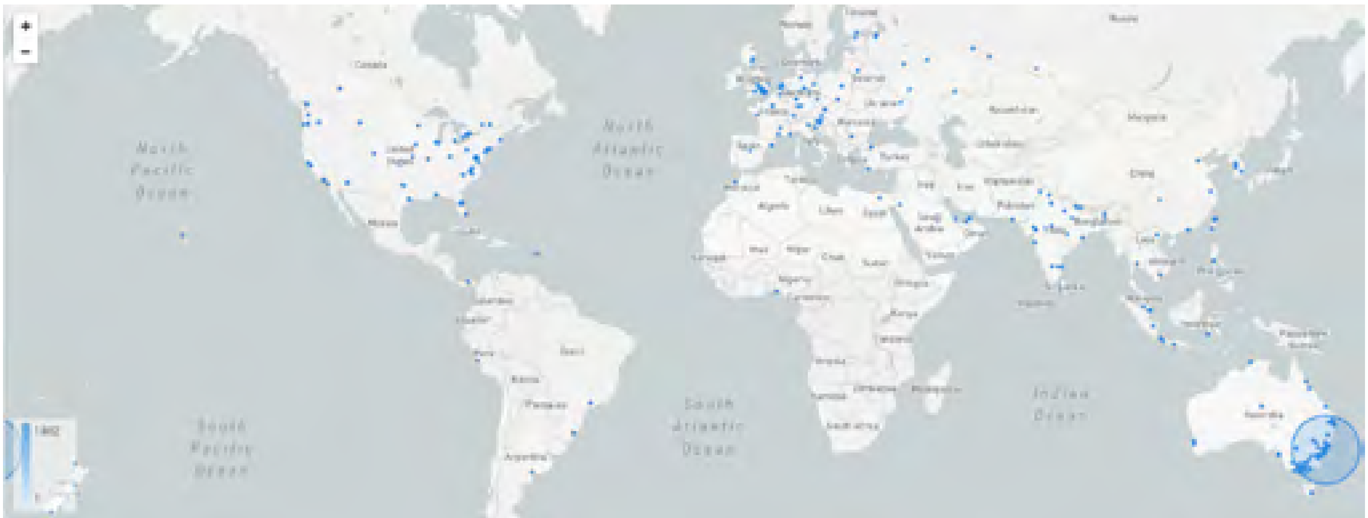


Figure 18: Global distribution of traffic to the SIMP@CT webpage between August 2022 and August 2024.

In December 2023, the project was featured in the news of Digital NSW (https://www.digital.nsw.gov.au/article/what-award-winning-sustainability-looks-like-SIMP@CT) and a large article about the project is continuously updated in the Case Study Library of the Smart Places Group in the NSW Government (https://www.digital.nsw.gov.au/article/what-award-winning-sustainability-looks-like-SIMP@CT). These and other resources have resulted in a wide spread of information about SIMP@CT, where a Google Search in August 2024, using the specific terms "SIMP@CT Irrigation Sydney" generated more than 9,000 hits.

The project website grew into an important tool to communicate the project, its technical and especially digital approach to use park irrigation for urban cooling. The vast majority of website visits (68%) were direct visitors – those that knew about the SIMP@CT site and directly typed www.SIMP@CT-australia.com into their browser. This is a clear indicator that communication of the project was highly effective. Google searches generated just 26% of the traffic to the site. Other search engines that directed traffic to the project website included LinkedIn, Bing and Yandex and came from organisations like Innovation AUS or the Banksia Foundation where SIMP@CT featured as an award winner. The average time visitors browsed across the content of the site was approximately 7 minutes. This is another indicator that people engaged deeply with the content of the site. According to Google Analytics, a strong average session is between 2-4 minutes.

Since August 2023 (Phase 2 = 366 days), 644 visits from new IP addresses were made to the webpage, indicating that interest in the project keeps generating attention. However, more important are the returning visits from those that have viewed the website before. Between August 2023 and July 2024, the webpage host registered 2,159 return visits, which can be interpreted as continued interest in the project by those that learned more about it during their first visit. SIMP@CT had global reach. The website was visited from all five permanently inhabited continents, and from more than 300 cities. While 39% of visitors came from Sydney, cities around the world started at Aalen (southern Germany) to Zgorigrad (western Bulgaria) and included places in Hawaii, Taiwan, Egypt and Peru (Fig. 18).

8. AWARDS & TESTIMONIES

SIMPaCT has won seven important national awards in the IoT, Sustainability and Technology sectors. The project was a 15-times finalist in national and international competitions and was awarded a commendation from Parks and Leisure Australia (NSW/ACT). The judges of these competitions rewarded the team with praise for its elegant and safe digital solution for a pressing real-world problem.

The accolades the project has received are the results of hard work. They emphasise our strong team spirit, shared belief in developing an amazing product and working seamlessly across many disciplines and professions.

We thank all organisations and experts that shone a spotlight on us and rewarded us with words of praise. We stand proud, showing off our awards, because we believe they are the visible manifestation of a unique, novel and trailblazing use of technology that effectively combats the impacts of climate change on cities.

We hope you enjoy learning more about SIMPaCT and how it can transform urban green infrastructure into effective cooling systems.

IoT Alliance Australia, Impact Award Finalist: **Smart Places and Infrastructure**

IoT Alliance Australia, Impact Award: **Research**

IoT Alliance Australia, Impact Award: **IoT for Good**

InnovationAus, 2023 Award for Excellence: **Industry 4.0**

InnovationAus, 2023 Award for Excellence: **GovTech Project, Product or Service,** and **People's Choice**

World Smart City Award 2023: **Energy and Environment**

Banksia Foundation, NSW Banksia Sustainability Award: **Placemaking**

Banksia Foundation, NSW Sustainability Award: **Climate Technology Impact**

Banksia Foundation, National Banksia Sustainability Award: **Healthy Planet, Healthy People**

Banksia Foundation, National Sustainability Award: **Climate Technology Impact**

Australian Institute of Landscape Architects, AILA NSW/ACT 2024 Landscape Architecture Award of Excellence: **Research, Policy & Communication**

Australian Institute of Landscape Architects, AILA national 2024 Landscape Architecture Finalist: **Research, Policy & Communication**

Australian Institute of Landscape Architects, AILA National 2024 **Climate Positive Design Award**

Parks and Leisure Australia, PLA NSW 2024 Awards of Excellence Commendation: **Best Use of Technology**

Australian Water Association, NSW Water Awards 2025 Finalist: **R&D Excellence Award**

To be announced March 2025

9. CONCLUSION

SIMP@CT demonstrates the power of machine learning to address critical urban water challenges. By optimizing irrigation practices, SIMP@CT promotes water conservation, mitigates urban heat islands, and fosters healthy urban green spaces.

With its potential for broader applications and alignment with Australian policy objectives, SIMP@CT offers a promising solution for building more sustainable and water-secure cities.

By supporting continued research, developing supportive policies, and encouraging widespread adoption, SIMP@CT can play a significant role in creating a greener and more heat-resilient future.

10. REFERENCES

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