

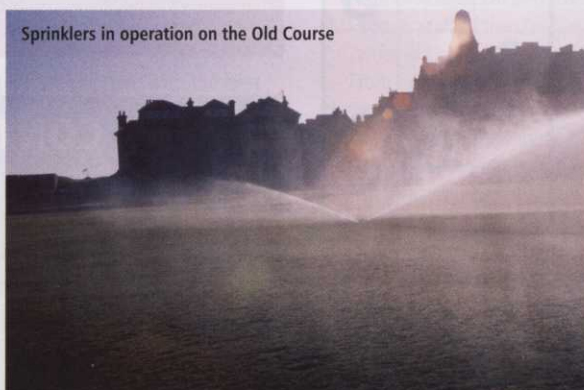
# Planning for Performance

## The Challenge of St. Andrews Links

Irrigation was first supplied to the Links at St. Andrews by a gravity-fed system in the late 19th Century when a source of water, high in the town, was linked to a mains system and a stop valve located beside the Swilken Burn. In the following decades there were various additions and improvements made to this original system.

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In 1996, with the Millennium Open getting ever nearer, the St. Andrews Links Trust decided to embark upon a major redevelopment of their automatic irrigation system covering the entire Links, encompassing all six courses, 99 holes of golf, the driving range, turf nurseries and the Bruce Embankment, to bring the system into the 21st Century. Their approach was to begin with a detailed feasibility study of the existing systems which covered the greens, tees, fairways and approaches on the Old, New, Eden, Strathtyrum, Balgove and Jubilee Courses. At this time there was no automatic irrigation on the Golf Practice Centre, Bruce Embankment and new turf nursery.



Sprinklers in operation on the Old Course

The feasibility study involved a detailed assessment of the following areas in comparison with up to date technologies and included the status of the existing water resources and storage facilities. The study also embraced the suitability of the existing pumping system, distribution pipework and control valves; the control system and field electrics and most importantly the application of water to meet the modern demands of both agronomy and conservation to the greens, approaches, fairways and tees where appropriate.

As well as looking at the existing system, an assessment was made of the need for irrigation on all areas of the courses making up the Links. In this respect discussions took place on the requirement for irrigation to replace soil moisture lost through evapo-transpiration and the requirement to facilitate undertaking maintenance practices with ease. These discussions were conducted in conjunction with the STRI as agronomists and consultants to the R&A Championship Committee. At this stage important decisions were made which included:

- Each of the six courses would have its own dedicated irrigation system.
- There would be a separate feed main to each course from one common pump station and separate computerised control systems.
- The Old Course would receive irrigation coverage to all areas, including spectator routes to help aid recovery to these areas.
- All sprinklers on the Old Course were to have artificial grass covers to minimise their visual impact when playing the course and during televised championship events.
- The Golf Practice Centre and the fairways on the Strathtyrum and Eden Courses would receive full irrigation to ensure a speedy recovery and maintenance following Major Championships as parts of these courses are used for car parking, while the Golf Practice Centre is used as the tented village.
- A network of ducting would be installed around the Old Course for use by the media during championship events, particularly with the rise in fibre optic technology.

To ensure an accurate and area-specific irrigation design could be undertaken, there was a need to obtain scaled plans of the courses detailing all the areas to be irrigated including spot heights and contours where necessary. With the recent advent of GPS technology, and back up from conventional techniques, the entire

280 hectares of the Links was surveyed and coupled with OS data, a digital drawing produced in AutoCAD software. This formed the basis for the design of the system.

The irrigation time cycle for each course during dry weather conditions was decided at 480 minutes (8hrs). During Major Championships, however, there was a requirement to reduce the irrigation cycle on the Old Course, for example, to 360 minutes (6hrs) to take into account hours of play and the working regimes of the maintenance staff.

To establish initial design data, water requirements and ultimately accurate budget

costs it was imperative that a base sprinkler layout and sprinkler schedules were produced. Final sprinkler selection with regard to an international manufacturer would be decided at a later date, as would the precise location of sprinklers on each course be decided with each individual Head Greenkeeper.

The base sprinkler layout was determined by assessing the individual areas to be irrigated on each course and selecting sprinkler spacings to suit. The overall design used over 4,000 sprinklers, compared with 300 on an average course in the UK. Where possible no sprinklers were positioned within either the green putting surface or tees playing surface, and sprinklers were all located with arc specifications to irrigate only those areas requiring irrigation and avoid excessive overthrow onto areas not requiring additional precipitation, such as gorse or heather, thus conserving water and sensitive ecology.

Having decided upon sprinkler spacing and arc configuration, sprinkler flows and pressures were determined bearing in mind the wind, so that all square spacings were at 45 per cent of their diameter and triangular spacings at 50 per cent where possible. The sprinkler design was undertaken in accordance with BTLIA recommendations. Once this criteria had been established, it became apparent that the choice of sprinkler manufacturer would be a very important one, particularly in relation to the size of the putting surfaces on the Old Course. The



Pump station for the entire Links

## Adrian Mortram reviews the renewal of the irrigation system throughout St. Andrews Links.



5/13th green, for example, measuring 55m wide and having a surface area of some 3,300sq m.

Following technical presentations and interviews with the major manufacturers, the Links Management appointed their preferred supplier who supplied detailed information on their product range from which suitable sprinklers, valves and control equipment were selected to match the design requirements. Knowing the flow of the sprinklers to be used enabled accurate water quantities to be calculated and work in relation to water resourcing could begin in earnest.

The existing water source was from two wells along the boundary of the Balgove Course at a point farthest away from the sea to mitigate saline intrusion. The capacity of those sources was investigated by hydro-geological engineers and found to be insufficient for the system's needs. An extensive feasibility study into the possibilities of obtaining further ground water established that a series of four wells equidistant into the same strata would provide the requirements of the system. Engaging the services of hydro-geological engineers to resource sufficient water was expensive. However, for the Links management, this ensured that the chances of borehole drilling and not finding water at the required quantities was minimal.

The decision had already been made to centralise the storage tank and pump house location at the Jubilee Maintenance facilities primarily due to the fact that the existing concrete storage tank would be reused and that electricity supplies to operate the new pumping station were of suitable capacity. The maximum designed water use for a worst case scenario was calculated to be 3,780m<sup>3</sup> per day to successfully irrigate all areas of the six courses and driving range.

The capacity of the existing storage tank was some 1,600m<sup>3</sup> (352,500 gallons), which was insufficient to enable watering within the specified time window. Therefore there was a requirement to increase the storage capacity by some 1,805m<sup>3</sup> (397,500 gallons) to give a total storage capacity of 3,405m<sup>3</sup> (750,000 gallons).

At this stage it was decided to have two separate storage tanks with a series of transfer pumps to move water from the existing tank into the new tank. The advantage of the two storage tanks enables the Links to monitor the pH in the first tank and treat accordingly before transfer (and mixing) into the second tank.

The courses were split into individual flow zones from which the mains pipework sizing was calculated. The required operating pressure of the sprinklers had already been decided, as had the pipework specification and rating. The system was to use all polyethylene (PE) pipework with fusion-welded joints. This enabled friction losses, fitting and valve losses, and static rise and falls to be considered in the context of the whole design when sizing pipework. The largest pipework to be used was 315mm PE (12 inch). The completed system used some 120,000m (75 miles) of polyethylene pipework and 270,000m (169 miles) of control, communication and power cable.

Once the irrigation design covering all six courses, driving range, turf nursery and Bruce Embankment was finalised and approved by the Links Management, an accurate pump duty was confirmed at 573m<sup>3</sup>/hour (127,000 gallons per hour). For those of you who enjoy a cold beer this equates to over 300 pints per second. With pumping levels at this scale, a specialist pumping manufacturer was appointed to design the pump station in accordance with the tank engineers and the irrigation design team.

The final pump design was to utilise canned pumps - miniature extended shaft turbines - with variable speed on the lead pump and smaller jockey pump for hand watering purposes. The motors were also rated to operate at 1,450rpm as opposed to the standard 2,900rpm as they are more efficient during operation, and along with the variable speed will, over time, save the Links on running costs.

To ensure total flexibility during operation of each course system a separate central computer controller was located within each of the Head Greenkeeper's offices. This enables each Head Greenkeeper to be in total control of their watering regime on their individual courses. A master computer is also used to ensure each course stays within their water quota to ensure the central pump station operates smoothly and within the overall designed capacities.

The choice of field control was between central satellites and decoders. Even though a

central satellite system would have been more economically viable, a decoder based system was chosen due to the visual impact which standalone satellites would have had throughout the Links and the fact that the land over which the golf courses are played is bequeathed to the people of St. Andrews in an Act of Parliament and as such is open to public access. During the design of the central control system a compromise was actually chosen by locating remote interface units at strategic locations throughout the Links to reduce cabling requirements.

Needless to say, over a period of four years the complete irrigation infrastructure throughout the St. Andrews Links was carefully and painstakingly renewed by a dedicated team who must be commended for their considerable efforts. The system today forms one of the largest golf course irrigation systems outside areas of the United States.

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Computerised control system training