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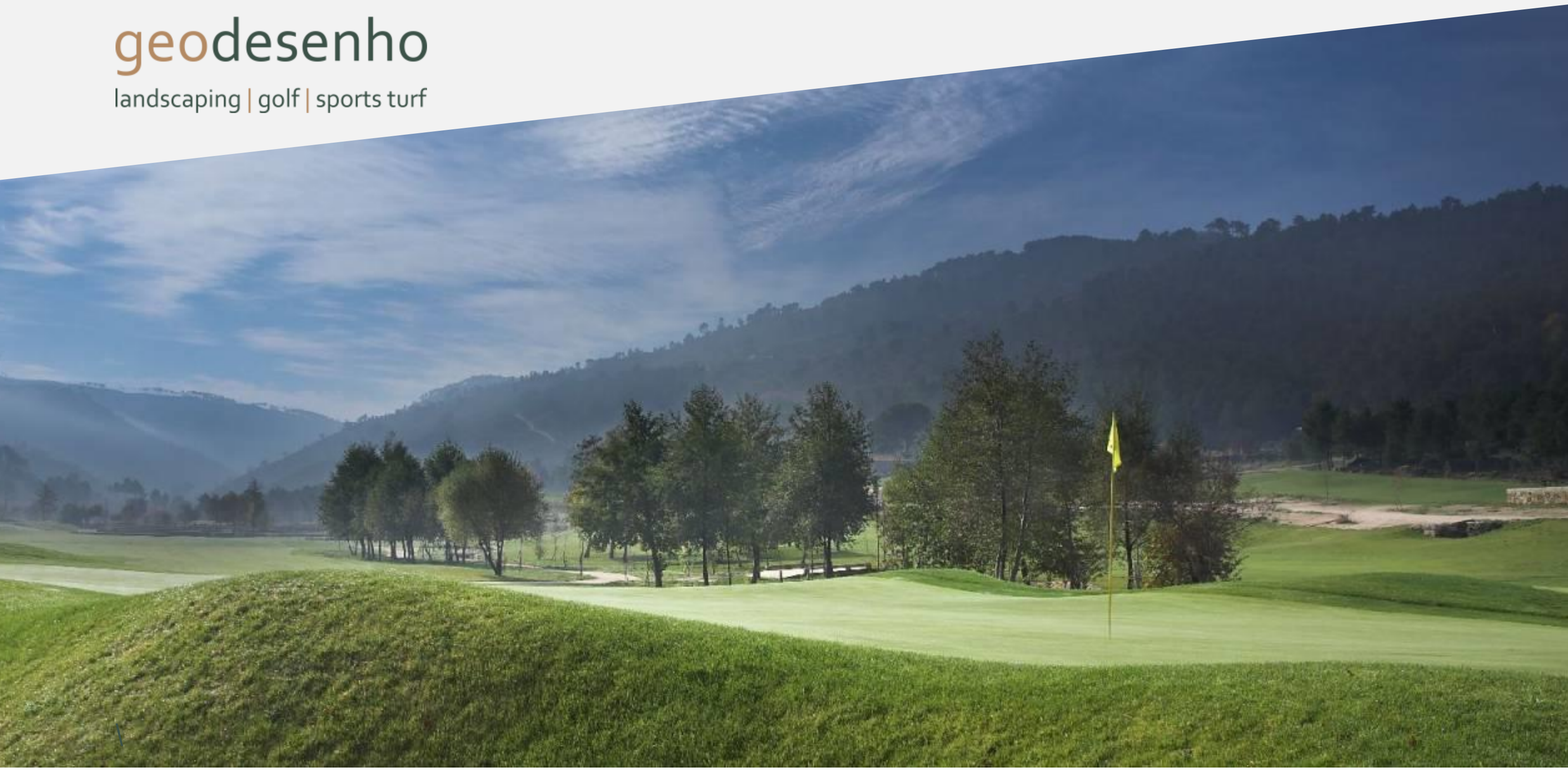
Extended Case Study



Vidago Palace Golf Course

VMPS/UNICER – Vidago - Portugal

Location and history

The small town of Vidago is located in the north of Portugal, in the Douro Valley area. Just 10 miles from Vidago, the medieval town of Chaves dates back to the Romans, whose legacy includes the ruins of a thermal spa. The Vidago aquifer has been explored since the 17th century. Water from Vidago has been bottled since 1886 and can still be tasted direct from the source, in the park surrounding the Vidago Palace hotel. Today, Vidago Water is one of the best known brands in Portugal.

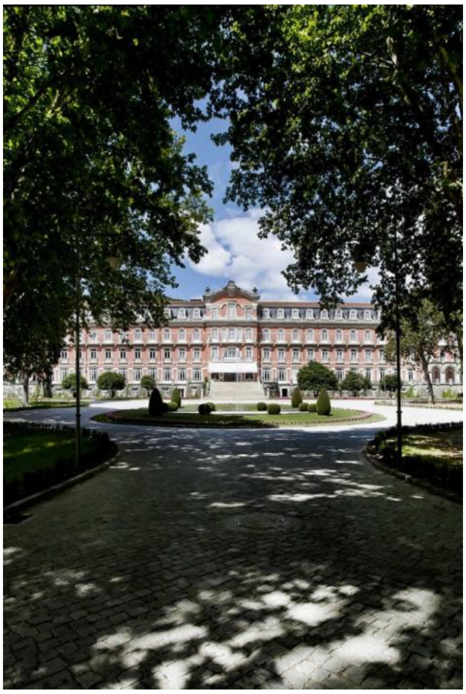
During the 19th century, it was quite fashionable to visit the spas in this area. The Vidago Palace hotel was commissioned by King Carlos of Portugal in 1908, and was originally conceived as a holiday residence for the King. Assassinated later that year, King Carlos never saw his project completed. Nor did his son and successor, King Manuel II, who was deposed in the republican revolution that swept Portugal on October 5th 1910, the day before Vidago Palace opened. 1936 was marked by the opening of a **9 holes golf course**, designed by **Mackenzie Ross**.

Vidago Palace continued to attract visitors, even during the Second World War. The post war period saw Vidago Palace's popularity soar, as families flocked to the resort in the 1950s and 60s. Although it remained well-known in Portugal, Vidago Palace declined since the 1970s. By the late 90s, early 2000s, the course and hotel where basically closed and the only really live and active business area was the aquifer and bottling plant. Now, exactly 100 years since it first opened (October 6th, 1910/2010), Vidago Palace has been brought back, after extensive renovation work in both hotel and golf course.

Redesign and specific constraints

The new golf course is a **Cameron & Powell** redesign of the original **Mackenzie Ross**. The upgraded course meets USGA construction specifications, having been transformed into a standard par 72, but retaining the integrity of the original design style and routing. The original holes were kept, with just a few exceptions. The first holes are played in the park, which occupies a relatively flat valley floor; the later ones in open areas and mountain slopes. Pathways and retaining walls use local stone and centuries-old trees have been preserved. The newly expanded course also includes a golf academy. The new clubhouse was originally the old Vidago water bottling plant. Several problems had to be addressed during the renovation process:

- Aquifer protection. The operating bore holes, feeding the bottling plant, are actually located inside the golf course. So, the preservation and protection of the aquifer was the main requirement for the whole design construction and maintenance process.
- A difficult drainage situation had to be sorted. The course is located in a narrow valley with just one natural outlet for the whole area. This situation led to seasonal flooding and a permanent high water table in parts of the course during winter. Additionally, the high slopes were vulnerable to erosion in high precipitation events.
- The course had to be completely rebuilt, bringing it to state of the art standards (to allow for best practice maintenance procedures) while retaining the old design and character of both the course and the parkland surrounding it.



Concept and implementation

The solution that was chosen to protect the aquifer was simple in concept but complex in practice. Leaching to the aquifer had to be minimized, maintenance practices had to be planned to limit the use of fertilizers and pesticides, and irrigated areas needed to be reduced as much as possible without compromising game quality. The water quality had be controlled by an in-depth monitoring program. The proposed solution included the following steps:

- Adjusting the course design to minimize irrigated
- Designing the irrigation system to allow for an advanced irrigation management
- Implementing an irrigation management system to:
    - Limit total applied volumes
    - Limit leaching and run-off
- Design the drainage system to:
    - Intercept as much leaching and run-off as possible
    - Provide a back-up control for irrigation management
- Set up maintenance practices designed to:
    - Minimize fertilizer use and limit the total amount present in the soil at all times
    - Minimize pesticide use and limit it to times where need is actual
- Set up a monitoring program designed to insure that the aquifer was suffering no impacts from the golf course

The **irrigated areas** were reduced to the minimum by the architect, **Bob Cameron**, during the course redesign process, helping to limit irrigation requirements.

Irrigation design. During the dry months, from May to October, irrigation is fundamental and, if badly managed is also the main cause for leaching chemicals into the aquifer. As this is the main growing season the risk is real. So the irrigation system was specifically designed from the start to allow for an advanced irrigation management system, capable of minimizing irrigation volumes and leaching.

Irrigation management. With the aquifer's protection in mind, soil moisture probes were selected with sensors at 10, 20 and 30cm (greens) and 10, 20, 30 and 50cm (fairways). The first sensors measure water content in the soil area where roots extract water, and are used to manage irrigation. The bottom sensor is used to check for percolation. In the absence of heavy rainfall this sensor must show no change in the soil moisture content, otherwise water is being lost bellow the roots' reach.

The frequency of irrigation was reduced, allowing the soil surface to be dry most time. This option results in a firmer playing surface and a reduced disease risk, requiring less fungicide use. Each irrigation is deeper, allowing turf roots to expand, but without reaching the lower soil moisture sensors.

The sensor suite is complemented by an automatic weather station, including turf diseases risk prediction software. The station is used to monitor ET and precipitation, helping to schedule irrigation. The diseases risk prediction software is used to limit pesticide use to times where threats are significant.

Drainage was designed both to collect leached volumes and to control the high water table, in the low areas, in winter. Additionally, it also intercepts all surface run-off, preventing erosion in the high slopes areas. A final, but important, function for the system is to provide a back-up control for irrigation management: in the absence of rainfall it should not drain at all, as any volumes would have to come from the irrigation system. Percolation only occurs during high precipitation events, in winter, when maintenance requirements are very low and no chemicals should be present in the soil.

Maintenance. The fertilization and pesticides internal policy was defined specifically to minimize possible impacts. Products were selected to be mainly organic, with slow or controlled release. Whenever possible they are foliar, to limit their presence in the soil. Frequency of application is relatively high, with low quantities used, in order to limit the total amounts present in the soil at any given moment. All fertilization planning is based on frequent soil analysis. Turf is always kept at a light hydric stress. This results in a lower growth rate and mowing frequency, reducing maintenance requirements without affecting the course capability to recover from injuries due to normal play. A lower growth rate also requires less fertilizer. Pesticide use is based on the disease prediction software and threat levels analysis. Pesticides are selected for short half lives, allowing a rapid decay. All substances directly applied to the soil have limited mobility.

The management structure implemented was fundamental to set the basis for the maintenance procedures. After the grow-in, a smooth transition was made to the permanent maintenance team, which was responsible for the course maintenance during the first two years.

Monitoring. The monitoring set-up includes multiple sampling points, at different depths. Sampling points include 3 for surface water in the stream (upstream, middle of the course and downstream); 4 points in the superficial water table, spread out in the course; 6 points for the aquifer, using bore holes. Sampling frequency was 3 times during the first year, 2 times per year in the next few years and, finally, if no impacts are detected, once a year after the 5th year.

A list of all substances and agents that might, eventually, be used in course maintenance was compiled and presented to the environmental authorities for approval. Sample analysis initially tested for 55 substances, from fertilizers to pesticides and naturally occurring elements. Remember the aquifer is volcanic mineral water, with some items reading unusual values. Sampling started early, to establish a baseline. After a year, with no impacts detected, frequency was reduced and analysis was limited only to substances effectively applied in the golf course, as per the plan. All these reductions were formally approved by the environmental authorities.

Up to December 2012, no impact had been detected.

Results

Irrigation. The volume of water used during the grow-in, in 2010, was high, as usual. No irrigation management was applied then, as the main objective was to establish turf as fast as possible.

Irrigation management started in earnest in 2011, but the year was spent mostly fine tuning the irrigation management system. First results were seen in 2012 (note that 2012 was had less rain than 2011).

2011 (first year of normal operations) – 134,672m3

2012 – 107,794m3

Further reductions are expected for the next 2 to 3 years, as more knowledge, specific for this course, is accumulated and the next steps of the **Water and Energy Efficiency program** are introduced.

Power. Together with the irrigation management system, actions were taken in 2011 to increase the efficiency of electric power use, both through reprogramming the central control system and managing the pump station. This was reflected in a reduction of 21% from 2011 to 2012. As stated above, further reductions are expected for the next 2 to 3 years as the next steps of the Water and Energy Efficiency program are introduced.

Fertilizer and Pesticide use. It is difficult to quantify the use of fertilizers, given the constraints of the growin phase and first year changes and adjustments to the fertilising program but, cost wise, both values and applied volumes were reduced.

Pesticide use was reduced 20% from 2011 to 2012. The main point being considered as a next step is the introduction of an advanced fertigation system. This system will allow maintaining the current fertilization program; but would significantly reduce the use of manpower, machines and fuel.

Monitoring. In 2012 the frequency and range of sampling was reduced, as per the initial plan, as no impact had been detected. This allowed the cost of the sampling plan to be reduced from 45,000€/year to 9,000€/year. This value will be reduced again by the 5th year if no impacts are detected by that time. Note that these values are not included in the maintenance budget.

Maintenance budget. The approved maintenance budget for 2011 was 125,000€. Actual money spent in 2011 was 90,000€. The planned budget for 2012 was 103,000€ and actual was 85,000€. These values reflect all the attention given to maintenance efficiency by all parties involved in the golf course. Again, further reductions are expected for the next 2 to 3 years.

The Team

The whole process was the result of team work. The results represent a deep involvement from many people, belonging to different firms, working together for a common goal during several years.

VMPS is the firm that owns Vidago Palace and holds the water concession. It belongs to the UNICER group, one of the biggest in Portugal. Three key people from VMPS were fundamental in the renovation process. **Eng. João Caldeira** was the Construction Director for the whole Vidago Palace renovation (hotel and golf course) and, after construction, the General Maintenance Director. **Dr. Antunes da Silva** was the Hydrogeologist responsible for the aquifer quality and the monitoring program. **Arc. Pedro Ginja** was the Landscape Architect responsible for all the interactions between the course and the park, and was a full time member of the project management team.

Cameron & Powell were the architects selected for the redesign. The late **Bob Cameron** was the main architect, with a huge amount of input and patience for all required adjustments during the construction process **Avoguis** was the firm responsible for the golf course maintenance during the first two years of operation. **Dr. Vasco Anjos** was responsible for streamlining all maintenance processes and for managing the huge volumes of information generated. **Eng. João Machado** was the head greenkeeper and was responsible for implementing all proposed concepts into actual results.

GEOdesenho was the firm responsible for overall coordination, plus developing and implementing all concepts for the course renovation, including licensing, planning the aquifer protection and dealing with the environmental authorities, designing the irrigation and drainage systems, managing construction and growin, setting up the irrigation management system and designing the Water and Energy Efficiency program.