How much water does a golf course need?

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It is useful to have an answer to that question. In this presentation, I discuss the question, and calculate some answers, in four distinct sections.

1. Why might we want to know?
2. How can we figure it out?
3. What happens if I change locations?
4. What happens if I change grasses, or soil, or the way I manage the turf?

Why might we want to know?

It would be nice to have enough water, and not to run out. That's the first reason. With no water, grass stops growing. When the grass stops growing, it can be difficult to produce the desired playing surfaces. For many golf courses, especially those with golf carts driving on the turf, the business model is based on turf not going dormant. If one knows how much water the grass will use, one can use the water in a way to prevent it from running out.

Second, it's the right thing to do. The R&A say that "water is a precious resource and golf courses should only use what is absolutely necessary."[1] The USGA say "it is essential for everyone involved in the game to strive to conserve and protect the world's most vital resource."[2]

And then there is cost. Water costs money, or even if the water happens to be free, it costs money to pump it and apply it. Using water efficiently will save money.

[1] See "Using water efficiently" at the R&A website: http://golfcoursemanagement.randa.org/en/Environmental-Impact/Using-water-efficiently.aspx

[2] For more information, see the USGA's Water Resource Center at http://www.usga.org/content/usga/home-page/course-care/water-resource-center.html

How can we figure it out?

The water requirement can be calculated in different ways. One way, through a water budget, is described in detail by Gross and Hartwiger in their *Green Section Record* article, "How to develop a water budget for your golf course."[3] That method involves taking the expected water use (the evapotranspiration, or ET) and subtracting the effective precipitation. If the amount the grass uses is high, and the effective precipitation is low, then the amount of water required as irrigation will be high. However, if the effective precipitation is high, and the ET is low, then there may be no water required as irrigation at all.

[3] http://gsrpdf.lib.msu.edu/ticpdf.py?file=/article/gross-hartwiger-develop-4-1-16.pdf

This water budget method gives an exact amount of water required as irrigation and I think it is a reasonable number for dry climates. The difficult comes in determining just what is effective rainfall.

In the presentation, I describe how a daily soil water balance can be used, in which the soil water content is tracked from day to day, and show that for locations in East and Southeast Asia, this daily soil water balance provides a more precise estimate of the irrigation water requirements for golf course turf.

What about changes in location, or in grass type or management?

Every location will have a different irrigation water requirement based on weather, soil conditions, grass type, and management practices at that location.

There are two components of the irrigation requirement. One is the amount of water used by the grass, and the other is the amount of water that can be stored in the soil.

Over time, grasses that are more drought tolerant, such as bermudagrass (*Cynodon dactylon*) or manilagrass (*Zoysia matrella*) will require less water than will species such as seashore paspalum (*Paspalum vaginatum*) or tropical carpetgrass (*Axonopus compressus*). One must also consider how much water can be stored in the rootzone, and how deep the rootzone is. If the effective rootzone is 15 cm deep, that means the effective rainfall will be more, and the irrigation requirement will be less, than if the rootzone is only 10 cm deep. Also, if the soil can hold more water, the effective rainfall can be more.

For the lowest irrigation water requirement in East and Southeast Asia, one wants to use the most drought tolerant grasses, combined with a rootzone that can hold the highest amount of water while still producing the desired playing surface, and one wants an effective rootzone (depth) as deep as possible to maximize the use of precipitation.