**Golf Courses Environmental Impact**

**Summary**

The impact was assessed as being less in the past
Detailed studies have only started to appear in the literature
Golf course management has begun to be taught **at US Universities**
Negative effects of Golf Courses can be **mitigated through proper management**
Negative side effects are more serious in arid areas and where the number of Courses is large.
There is very **little information on the effects of Deerhurst Golf** Course

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| --- | --- |
| **Advantages** | **Disadvantages** |
| Employment and income benefits, both direct and indirect | Loss of biodiversity |
| Tax benefits to local, regional and national governments | Eutrophication or river or seawater through use of fertilisers |
| Attracts new firms to the region | Heavy user of water for irrigation |
| Health and social benefits. Careers can benefit through 'networking'. | Biocides use to maintain the greenness of the 'greens', control insects, fungicides and weeds, contaminate both the air and water |
| Attracts the higher-spending social groups | Golf clubs often portray an elitist and exclusive lifestyle |
| Helps conserve valuable fragments of coastal habitat from encroaching urbanisation and agriculture | Leads to an increase in road traffic |
| Increases local property values | Raises property prices beyond the reach of local young people |

 **Are Golf Courses Negatively Impacting the Environment?**

There is significant concern over the sustainability of the approximate use of 300,000 gallons a day of water for maintenance of U.S. golf courses, especially in areas of California which have sunken by more than a foot in 9 years due to aquifer demand [4]. While these concerns are well documented, there is a lack of regulation associated with golf courses. In Canada, many pesticides are banned for cosmetic use on properties, but golf courses have been exempt from the regulations [5]. It seems about time that governments do a better job to recognize the environmental concerns related to golf courses, and consider thresholds for required EIA of golf courses. British Columbia does currently have “golf resorts” built into its EIA legislation, stating that the resort must occupy an area greater than 200 hectares and possess more than 600 commercial bed units [6]. Considering an average 18 hole golf course requires 120-200 acres, the equivalent of about 50 to 80 hectares, not many new courses will require environmental impact assessments [7].

However, many golf course owners have realized the need to promote good environmental management of their courses. Alan Morton, owner of Golf Griffon Des Sources in Mirabel, Quebec, has implemented woodland corridors throughout his course to reduce habitat fragmentation as well as the use of liquid compost treatment to reduce the need for pesticides [5]. Even the great Nick Faldo, who now designs golf courses after a successful PGA career, promotes the notion that “as the world’s natural landscapes become more endangered, our most fundamental job as course designers is to create beautiful playing venues that also preserve and protect the environment” [8]. Golf courses may have the potential to cause environmental degradation, but the golf community also has an opportunity to be a leader in terms of sustainable development. As more courses are inevitably created, they should be designed in an environmentally friendly manner, so that we can keep enjoying the sport for years to come.

**Audubon Report**

Golf and the Environment Golf courses have long suffered from a reputation of being harmful to the environment. While this perception is not entirely unfounded, golf courses have made great strides in becoming more environmentally responsible in recent years. Audubon International is dedicated to helping golf courses protect the environment while at the same time preserving the natural heritage of the game of golf. By helping people enhance the valuable natural areas and wildlife habitats that golf courses provide, improve efficiency, and minimize potentially harmful impacts of golf course operations, the Audubon Cooperative Sanctuary Program (ACSP) for Golf Courses serves as vital resource for golf courses. Learn more about golf’s environmental issues and opportunities and take action today!

**Why Golf and the Environment?** Golf’s use of chemicals, water, and other resources to maintain pristine golfing conditions has long been criticized for threatening the quality of our environment. While these issues are a real concern, golf actually has a unique opportunity to protect and enhance our environment. By their very nature, golf courses provide significant natural areas that benefit people and wildlife in increasingly urbanized communities across North America and throughout the world. In recent years, through education and certification by the ACSP, golfers and non-golfers alike are taking a second look at the nature of the game. Golf courses offer numerous opportunities to not only provide pleasant places to play, but also to protect drinking water, improve the water quality of on-site and surrounding lakes, streams, and rivers, support a variety of plants and wildlife, and protect the environment for future generations.

**The Effects of Golf Courses**

**Dealing With Golf's Environmental Issues BY JAMES T. SNOW NATIONAL DIRECTOR, USGA GREEN SECTION**

Just what are environmentalists and regulatory agencies concerned about when it comes to the construction and maintenance of golf courses?

In a nutshell:
• Potential for pesticide and nutrient pollution of our water resources
• Use of scarce water resources for irrigation of golf courses
• Loss of "natural" areas
• Potential impact of pesticides on people, wildife and other organismsA summary of peoples' concerns about the pollution effects of golf course activities on water resources follows:Use of pesticides and other potential contaminates — Contamination of groundwater with pesticides or other materials (e.g. gasoline) could render it unusable for drinking and other purposes.
Contamination of surface waters could kill aquatic organisms and affect the biology of the waterways.
Fertilizer Use — Nitrate contamination of groundwater is a potential health hazard. Pollution of surface waters with phosphorus and nitrogen are associated with the process of eutrophication.
Erosion and sedimentation — Sedimentation caused by erosion is primarily a concern during construction, and can cause damage to streams and lakes. Pesticides, phosphorus and other nutrients can be carried to waterways by this process.
Thermal pollution — The removal of vegetation along stream banks and the discharge of warm water into streams from oncourse ponds can change stream ecology to the detriment of desirable fish populations and other organisms.

**Summary** Current maintenance standards and the development of new golf courses in the United States is threatened today by concerns about the detrimental effects of golf courses on the environment. The task facing the game of golf involves the following:
• Develop a **greater scientific understanding of the impact of golf** courses on the environment.
• **Where potential problems exist, develop alternative practices** or programs that minimize the negative effects of golf courses.
• **Educate golf course superintendents**, course officials and golfers about golf's environmental issues and what they must do to help protect the environment and the game of golf.
• **Educate** regulatory officials, environmentalists and the **public about the environmental benefits of golf courses and what is being done** within the game to protect the environment. The United States Golf Association is spending millions for research and educational programs to address golf s environmental issues. As information becomes available through these programs, it will be shared with interested parties throughout the world for the benefit of golf and the environment.

**The effect of Golf courses**

<http://archive.lib.msu.edu/tic/flgre/article/1992jul22.pdf>

    <https://scholar.colorado.edu/cgi/viewcontent.cgi?article=2024&context=honr_theses>

: Do aquatic communities downstream from Colorado golf courses exhibit concentrations of Total Nitrogen (TN) and Total Phosphorus (TP) that are significantly different than upstream concentrations, and are downstream concentrations above the EPA's recommended nutrient concentrations to limit eutrophication?

Fertilizers are used to stimulate growth and success of the grasses, but when these chemicals enter nearby water systems, there can be harmful effects on aquatic ecosystems.

One of the **major problems** that occurs when fertilizers or excess nutrients enter aquatic ecosystems is a phenomenon known as eutrophication. The structure of many aquatic communities is determined by the amount of algae and other plants present, as these organisms are primary producers, which are at the bottom of the food web. The abundance and success of primary producers determines how much energy flows through an ecosystem. Because primary producers synthesize energy from the sun through photosynthesis, the growth of these organisms is significantly limited by essential nutrients, especially nitrogen and phosphorus, which is what most fertilizers are made of

**Conclusions** The results of my research help clarify the potential for golf courses to be a cause of eutrophication in aquatic communities. First, both TN and TP were significantly higher downstream from golf courses than upstream. The distance between each upstream and downstream sample site was small, and it is likely that golf course runoff is causing the increased nutrient levels downstream. During this research, I wanted to determine if golf courses in general could be an overlooked cause of eutrophication. I hypothesized: Aquatic communities downstream from Colorado golf courses exhibit TN and TP concentrations that are significantly higher than upstream concentrations, and downstream concentrations of TP and TN are higher than EPA recommendations, while upstream concentrations are not. I found that indeed, aquatic communities downstream from Colorado golf courses exhibited TN and TP concentrations that were significantly higher than upstream concentrations; however, not all downstream concentrations were above, and not all upstream concentrations were below, EPA recommendations. Only three out of eight courses exhibited downstream TN concentrations that were above EPA recommendations (Figure 4), and only five out of eight courses exhibited downstream TP concentrations that were above EPA recommendations (Figure 5). Also, one course exhibited upstream TN concentrations that were above EPA recommendations (Figure 4), and three out of eight courses exhibited upstream TP concentrations that were above EPA recommendations (Figure 5). From these findings, I believe that golf courses are still a potential source of nutrient enrichment in aquatic communities. As mentioned in the discussion section above, golf courses are large areas with vast differences between courses, which may lead to these differing results between each course sampled.

**Cohen, S., A. Svrjcek, T. Durborow, and N LaJan Barnes. 1999. Water quality impacts by golf courses. Journal of Environmental Quality 28:798.**

A detailed review of 17 **water quality studies of 36 golf courses indicates that widespread and/or repeated water quality impacts by golf courses is not occurring** at the study sites. None of the authors of the individual studies concluded that toxicologically significant impacts were observed, although scattered exceedances of HALs, MCLs, or MACs do occur**.**

 **CEDS publication Protecting the Aquatic Environment from the Effects of Golf Courses**

**When golf courses accounted for more than 50% of the watershed land use, then a moderate to severe level of stream quality degradation was found**

potential causes of the degradation revealed by our study: • stream channelization, • destruction of wetlands, • lack of a wooded buffer along waterways, • elevated water temperature due to; - lack of shading vegetation, - reduction of groundwater inflow, - release of heated water from the surface of ponds, - entry of heated stormwater runoff from impervious surfaces, • reduction of base (dry-weather) stream flow due to ground or surface water withdrawals for irrigation, • release of toxic substances and oxygen deficient water from ponds, • intermittent pollution incidents such as spills of pesticides, fertilizers, or fuel, • loss of pesticides or fertilizers by way of ground or surface water runoff, • entry of stormwater pollutants washed from parking lots and the other impervious surfaces associated with a golf course, • accelerated channel erosion due to increased stormwater runoff velocity or prolonging the amount of time channels are exposed to erosive velocities, • elimination of the scouring benefits of flooding by storing runoff in ponds, • poor erosion and sediment control during the construction phase, and • inadequate treatment of sewage and other wastewater generated on the golf co**urse.**

**Bramble\_Jones\_Govus\_2009.The Effects of Golf Course Runoff on**

**Macroinvertabrates**  We found a significant difference in total Nitrogen level between the two  rivers and a significant difference from upstream and downstream at sitesence between sites on the same river for the majority of our variables,  suggesting that the golf courses were sources of Nitrogen enrichment.

**GOLF COURSE IMPACT ON WATER QUALITY**

**(Credit- THE MOUNTAIN STATE GREEN LETTER-JULY 1989)**

FINDING: Golf courses do not pose a significant pollution threat to the nation's water supplies. This conclusion is based on a review of the scientific evidence that is currently available. Neither groundwater nor surface water is threatened by golf course runoff. Further, studies show that stormwater runoff is near zero from golf courses.

**Solutions**

**Davis, N. M., and M. J. Lydy. 2002. Evaluating best management practices at an urban golf course**. Beginning in year 2, recommendations to alter chemical applications on the course were implemented as part of the BMPs. Surface water sampling during year 2 showed significant declines in nitrate and total phosphorus levels

**Golf Courses: Pollution In Our Ponds**
**An analysis of golf course management by Matt Piccone, John Rosano, Andrew Miller**

Conclusions
1) First when looking upon the PH levels all appear **to be within the average for ponds.** With the best suited PH ranging from a 6.7-7.4 for aquatic life, Wamp’s 7 PH explains why it is the most biodiverse habitat.
2) All three of our trial sites proved to have excess amounts of Phosphate and Nitrate-Nitrogen in the water. The reason for this is a combination of runoff and clear cutting of the vegetation surrounding the perimeter of the pond. This vegetation could have functioned as a buffer for the pond by absorbing some of the incoming nutrient-laden runoff, which is instead flowing into the pond.
3) The process of eutrophication has begun in all of these ponds, as a dark brown algae covers the benthic zone. Algae blooms have all but completely covered the surface of the east and west side of Wamp’s pond, where pipes are continuously dumping runoff from the course into the pond. In every pond we sampled there were at least two storm drainage pipes in which we believed to be point-source polluters.

**Strategies to Minimize Nutrient Runoff from Golf Courses**

One of the most popular remediation strategies is the implementation of **riparian buffers.** Riparian buffers are heavily vegetated land adjacent to water bodies.Another study of riparian buffers stated that a 0.5 kilometer buffer strip between a golf course and a creek efficiently filtered nitrogen and other nutrients, and helped promote ogliotrophic conditions within the creek. e. Implementing small turfgrass buffers may also lead to lower nutrient concentrations in nearby waterways.

 **lowering fertilizer application rates.** Techniques to reduce fertilizer usage and losses include: using smaller, more frequent applications, using slow-release organic forms of fertilizers, and only applying fertilizer when the soil moisture is low and precipitation is not expected for the next 48 hours

**When screening a number of tracts as a possible location for a golf course, it is suggested that priority be given to sites with the following characteristics.**

1. Pesticide and fertilizer movement will be lowest on sites with soils which

are medium-textured, have a high organic matter content, a high cation exchange capacity, a low erosion and runoff potential, and where the water table and bedrock lie at least four feet below the surface). Sites with sandy soils and a **shallowe depth to bedrock or the water table should be avoided** .

1. The layout of the course should permit **a vegetated buffer of 75 to 150-feet in**

**width** along all streams, wetlands, lakes, ponds, or other waterways. Ideally the buffer should be composed of trees and shrubs. A buffer of this width will serve to: retard floodwaters, slow channel erosion, shade the waterway from the heating effects of the sun, filter a portion of the pollutants entrained in surface runoff, and contribute leaves and other plant parts to the food web of small, headwater streams .

3. Waterway crossings should not be needed, or the site selected should require the fewest number of crossings. **By minimizing crossings**, the disturbance of wetlands, stream channels, and the buffer will be diminished.

4. **Sites should be avoided where extremely sensitive species** of aquatic life, such as trout, or rare, threatened, or endangered species may occur in downstream waters.

5. Constructing a pond on a flowing stream can create a number of impacts, which include: barriers to fish migrations, thermal pollution, reduced stream flow, and the proliferation of algae with accompanying dissolved oxygen deficiencies. If a pond is needed at all, then site conditions should allow for **construction of the pond without impounding** an intermittent or perennial stream.

6. Sufficient water must be available to meet irrigation needs without causing either a decrease of more than 5% in the low-flow (7-day, 10-year) of any waterway in the vicinity of the site, nor substantially reduce the yield of existing wells in the area.

7. Infiltration is the most effective means for controlling the effects of stormwater runoff. Sites should be given preferential consideration where parking lots, buildings, and other impervious surfaces can be sited near soils which are suitable for the infiltration of stormwater.

8. To minimize soil erosion and sediment pollution during the construction phase, sites with highly erodible soils or steep slopes (>15%) should be avoided, particularly if the course cannot be built without extensive disturbance on these soils and slopes.

9. Of all land uses, forest produces the least impact upon the aquatic environment. Therefore preferential consideration should be given to sites with little forest cover or where opportunities to plant trees will be greatest. 10. During a literature review a number of references were found to poisonings of waterfowl, raptors, and other birds as a result of ingestion of pesticides applied to turfgrass. **Sites should be avoided that are near congregating areas for waterfowl, raptors, or other** birds, particularly if the golf course can only be built by bringing pesticide-treated turfgrass to the edge of a pond, lake, river, or other open body of water. But measures are also available for minimizing the threat to wildlife if a golf course is sited in the vicinity of congregation areas. These measures are described in the next section.

**Reducing the Impact of an Existing Golf Course**

1. A combination of physical, chemical, and biological monitoring techniques should be employed to determine if the course is causing an impact and, if so, to identify the probable causes.

2. The **maintenance personne**l responsible for identifying and controlling pests **should become proficient** in the use of Integrated Pest Management (IPM), but IPM alone will not eliminate the potential for contamination of ground and surface waters with pesticides.

3. If any area of a fairway, green, or tee is located on coarse-textured soils or the **depth to bedrock or the water table is less than four feet**, then one or more of the following measures should be employed.

a. The area should be fitted with an under drain system to collect leachate so it can be treated through application to suitable soils or with a sand-peat filter.
b. The area should be filled with material which will increase the clay and organic matter content, reduce soil permeability, and increase the depth to groundwater, or
c. The area should be replanted with a grass species requiring minimal fertilizers, pesticides, and irrigation.
d. The area should be converted to a use requiring minimal maintenance, such as a rough.

4. **Fertilizers with a low leaching potential** should be applied at the lowest acceptable rate and applied during periods when grass is actively growing.
5. **Irrigation should be performed on the basis of evaporative demand (evapotranspiration rates), rather then on a set schedule**. If irrigation water is drawn from a well, a stream, or a river, then an analysis of the impact upon low-flows and aquatic organisms should be conducted. An analysis should also be conducted of the effects upon well-yields in the area. If either analysis indicates a problem, then the following options should be considered.
a. The construction of an upland pond to capture and store stormwater runoff. If this option is used then the ponds must be designed and sited to avoid either a significant increase or decrease in floodflows.
b. Relocate production wells to several groundwater drainage basins to reduce the impact upon individual streams or rivers and to lower the impact upon other groundwater users.
c. Relocate a surface water intake to utilize a stream, river, or lake which can meet irrigation needs without a negative impact upon aquatic communities or other water users.
d. Reduce or terminate water withdraws during critical periods, such as low-flow periods.
e. Replant the course with grass species having a higher drought-tolerance.

6. The first inch of stormwater runoff from all impervious surfaces should be delivered to an infiltration device or a peat/sand filter.

7. A **75 to 150-foot buffer** should be established along all wetlands, streams, rivers, tidal waters, ponds, or lakes.

8. The **use of chemical measures for managing ponds and lakes should be reduced or eliminated.** Rather than using chemical substances to control algae, techniques with fewer long-term impacts should be used, such as reducing nutrient inputs, dredging, and so forth.

9. Wherever possible, the **number of trees and shrubs** on the course should be increased.

10. Pesticides, fertilizers, fuels, and other toxic substances should be stored in a location where a spill will not result in rapid, uncontrollable entry into ground or surface waters.

11. If the golf course existed prior to 1980, then soils on the greens, tees, and fairways should be analyzed for organochlorine and metallic pesticide residues. If residues are present, then measures should be taken to minimize movement to ground or surface waters, such as increasing the organic matter content of soil.