Survey of reclaimed water (wastewater) use in the Alabama turf industry

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Abstract: Grey water, which is reclaimed or directly discharged wastewater effluent, is used throughout the United States as an irrigation and nutrient source for pasture crops. In many municipalities reclaimed water application is required in golf course management, and plans for the safe storage and delivery of reclaimed water to golf course turf are mandatory. This study seeks to quantify the amount of reclaimed water currently applied to Alabama golf courses. The study covers two areas: 1) a survey of golf course superintendents to determine reclaimed water use, and to evaluate why they do or do not use reclaimed water, and, 2) an environmental survey with three cooperating golf course superintendents, including soil and water sampling to evaluate nutrient loading from areas to which reclaimed water has been applied. The goal of the study is to provide preliminary data for future research on the environmental impact of reclaimed water reuse.

Introduction: Nationally, the USDA has identified the green industry as one of the largest and fastest-growing segments of U.S. agriculture. According to a recent Auburn University study conducted by the Alabama Agricultural Experiment Station (2005), the green industry in Alabama has emerged as the largest cash crop in the stat,. This clearly illustrates the tremendous and far-reaching impact of the green industry in Alabama. Data ranks Alabama third in the nation in turfgrass and sod production and sixteenth in nursery and greenhouse production, confirming the state, regional, and national significance of Alabama's green industry. Alabama's green industry has been classified in four sectors, including 767 nurseries and commercial greenhouses, 69 turfgrass and sod operations, 1029 state-licensed lawn and landscape operators and 727 retail establishments. This paper focuses on an initial survey of golf course turf in the state.

The environmental impact of reclaimed water application to golf courses is largely unknown and unstudied. This is remarkable, given that such areas receive human foot-traffic, and that fairways are often located near environmentally sensitive areas such as water or wetlands. This survey seeks to quantify the amount of reclaimed water currently applied to Alabama golf courses. The work will include a survey of golf course superintendents and an environmental survey including soil and water sampling to evaluate nutrient flux and loading from areas to which reclaimed water has been applied. This combination of a background survey coupled with initial data collection will provide direction for follow-up research.

Reclaimed wastewater effluent, which is the liquid byproduct of sewage disposal, is a waste product requiring land or water disposal. Increasing concerns about direct water disposal of reclaimed water have led to land application; and reclaimed water has long been applied to agricultural land, where it provides both water and nutrients (Sumner, 2000). As supplies of potable water become more scarce, there is an increasing need to reuse waste water efficiently, especially as direct application of potable water to agricultural and recreational areas becomes less financially and environmental sustainable.

Golf courses are an excellent potential location for the disposal of wastewater effluent (Graves, 1982). Golf courses are a desirable location for waste water application because: 1) they are comprised of large areas of maintained turf (each course averages around 250 acres), 2) there are no crops to be harvested for food (nutrient uptake by food crops can pose secondary issues about health and safety), 3) warm-season turfgrasses are large users of nutrients and water, and, 4) there are no periods in which bare ground is exposed, which limits nutrient runoff concerns. However, there is little research that examines the effect of long-term effluent application on turfgrass quality, and its' impacts on the surrounding environment.

The limited research which has examined effluent use in turf systems has been regional in nature, relegated to the arid southwest United States. That research showed that three

years of effluent irrigation increased soil salinity, phosphorus (P), and potassium (K) content (Mancino and Pepper, 1992). In another study effluent application reduced seed emergence of perennial ryegrass (*Lolium perenne*), and there were signs of overfertilization due to nutrients contained in the effluent (Hayes et al., 1990a). Last, there were increases in leachate salinity and leachate sodium due to effluent application, but the increases did not exceed current recommended limits for drinking water quality (Hayes et al., 1990b). However, the arid climate, regional nature of this research and other work (Harivandi, 1991) limits its applicability to the humid southeastern United States. In our region, soil salinity and sodium is less of a concern, while nitrate and P movement through soil and to water sources is a greater issue.

Objectives and significance of research: The objective of this research project is to: 1) assay the extent of current reclaimed water use on Alabama golf courses, 2) determine the limitations that prevent golf course superintendents from adopting reclaimed water use into their irrigation plans, and, 3) collect background soil and water nutrient data from three golf courses that are currently using reclaimed water in their management programs. This research is significant because there is currently no data available on the magnitude of reclaimed water use on Alabama golf courses. Such a survey is under way in Georgia, but Alabama needs this data as well. Such data will help the golf courses industry better manage its' waste water, and help the Alabama environment as a whole. Anecdotal information exists that several of Alabama's coastal courses use reclaimed water, and they have agreed to participate in the soil and water sampling part of this project. We need the complete statewide survey and additional cooperating golf courses to complete a statistically significant database, allowing us to complete for competitive grants.

Figure 1 shows the location of the 162 golf courses surveyed, ranging from the states' largest four cities, Montgomery, Huntsville, Birmingham, and Mobile, to a large number of rural towns and cities distributed across the state.

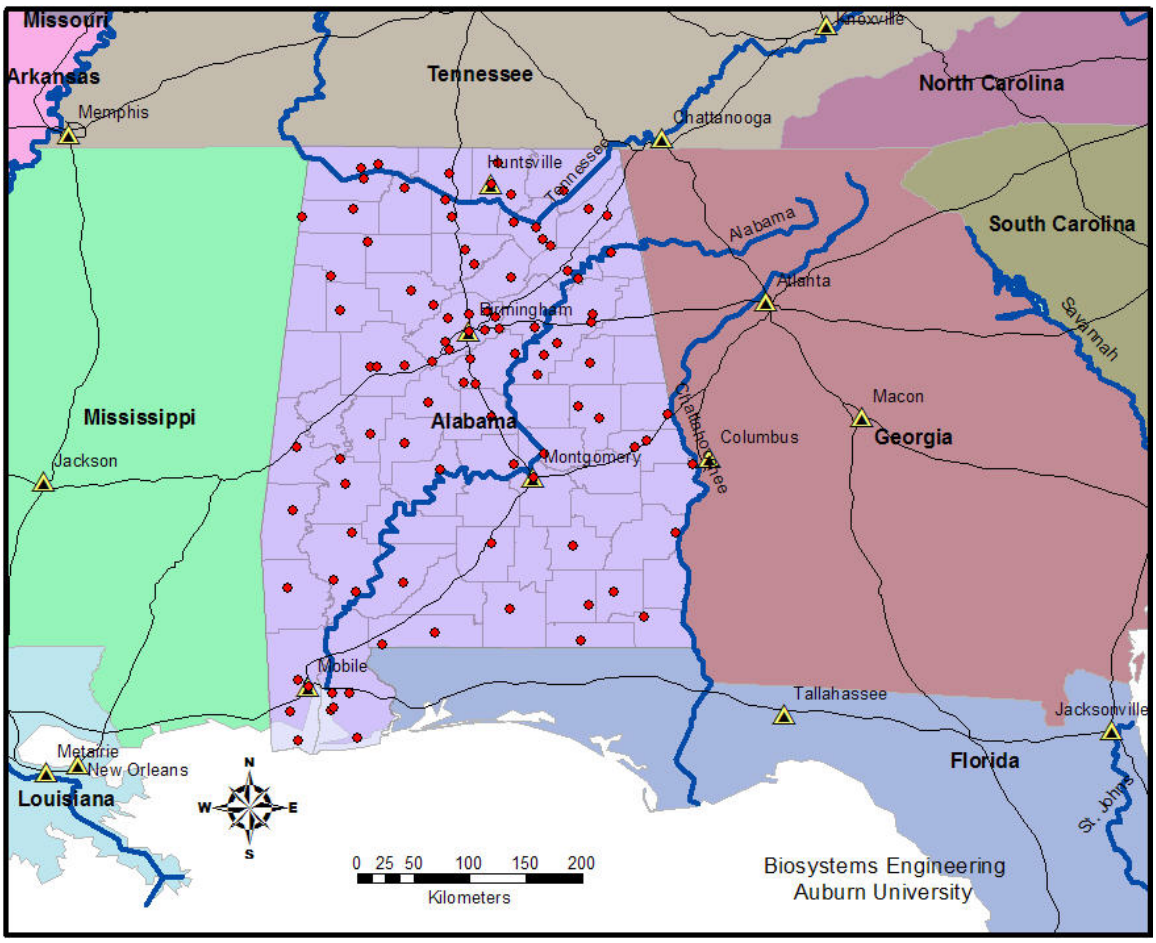


Figure 1. Location of 162 Alabama golf courses surveyed.

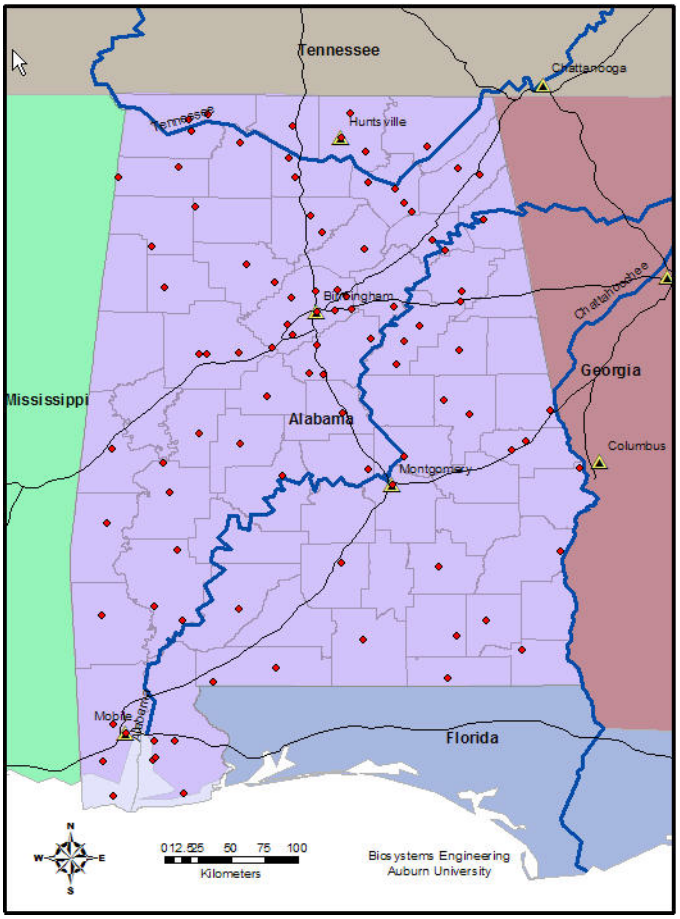
Methods: The survey is a short, one-page evaluation sent to every golf course in Alabama. The data base will ask if superintendents are using reclaimed water, and will follow-up with four to five related questions. The database of course names and addresses already exists, and previous experience in sampling this group has shown that superintendents are very willing to share agronomic information, and will do so without requiring anonymity. Thus, we can contact superintendents for follow-up discussion. These surveys are a success because: 1) they are short, and, 2) we offer a service. In this case the service is that we might use the course as a part of our monthly sampling study, and the superintendent will get detailed soil and water nutrient data as a byproduct.

Once participating courses have been identified, monthly soil and water sampling (for one year) will commence. At each course three replicate fairways that receive effluent

will be used, and three replicate fairways that do not receive effluent will be studied. Fairways will be selected based on uniformity of soil type and other related factors (slope, etc.). Fairways will be sampled randomly in incremental depths (0-3, 3-6, and 6-12 inches) using a Giddings hydraulic soil probe, with approximately 10 samples removed from each fairway. Each soil sample will be analyzed separately, with all samples analyzed for pH, nitrate, ammonium, total N, P and K. Appropriate wet digestion techniques will be used for each analyte.

Bodies of water (ponds, streams or lakes) lying next to the selected fairways will also be sampled using a grab sample technique of 10 randomly collected samples. These samples will also be analyzed for nitrate, soluble phosphorus and dissolved oxygen. At minimum, over the 12 month sampling period approximately 6500 soil samples will be collected from participating courses (3 courses x 6 fairways x 10 samples x 3 depth increments x 12 months = 6,480). The number of water samples will likely be less.

Importance of findings to Alabama: Reclaimed water utilization by turfgrass in Alabama is both timely and environmentally responsible. This study is important to Alabama simply because there is currently no data available on the magnitude of reclaimed water use on Alabama golf courses. Such a survey is under way in Georgia, but there is no comparable effort underway in Alabama. This type of data will help the golf courses industry better manage its' waste water,



and help the Alabama environment as a whole. Additionally, a complete statewide survey incorporated into a statistically significant database, will allow us to compete for externally funded research grants promoting the wise reuse of this otherwise wasted resource. Surveys were sent out in mid-summer 2005. Results are currently being compiled

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