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**Examining Ways to Promote Water Conservation at Golf Courses in
Bloomington-Normal, Illinois**

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Abstract

The purpose of this study was to examine ways for golf courses in Bloomington-Normal, Illinois, to promote water conservation. As the demand for freshwater exponentially increases around the United States, it becomes necessary to examine current freshwater uses, especially those for recreational purposes. Golf courses are one of the largest freshwater users, with a typical course consuming hundreds of thousands of gallons every day for grass maintenance. With water shortages and insecure future water supplies, golf courses around the United States are urgently looking for ways to promote water conservation. This includes golf courses in Bloomington-Normal, Illinois. The severe drought in the summer of 2012 amplified the importance of promoting water conservation at golf courses in Bloomington-Normal. My research focused on examining ways for these golf courses to conserve water. Through extensive archival research, observations of five selected golf courses, and in-depth interviews with local golf course superintendents, local water resource personnel, local golfers, and other knowledgeable community members, I have determined that there is substantial room for Bloomington-Normal, Illinois, golf courses to use water more wisely. The current average water use for each of the five selected Bloomington-Normal golf courses -- of around 300,000 gallons per day -- could be dramatically lowered with both maintenance updates and by changing the average golfer's perceptions about how a golf course should look and be maintained. Unfortunately, I have also determined that some significant barriers exist for promoting golf course water conservation. I recommend extensive further research into changing the average golfer's perception about how the typical American golf course should look and be maintained.

Introduction

On October 31, 2011, the world reached a major milestone. It was on this day, according to the United Nations, that the population of Earth exceeded seven billion people. Never before have so many people occupied the Earth at once. Improvements such as improved sanitation, increased food production, immunizations and other medical advances, and overall technological progress have allowed humans to exceed the Earth's carrying capacity and reach this milestone (Kremer 1993). As reported by the United States Census Bureau, it took only 43 years, from 1968 to 2011, for the world population to double from 3.5 to 7 billion people. At our current growth rate, the United Nations forecasts that the world will be home to more than 10 billion people by 2100.

This exploding population is a significant reason the Earth's natural resources are in such high demand. Arguably the most important resource, and the resource currently most in demand globally, is clean freshwater. Clean freshwater is necessary for the ecological health of all Earth's ecosystems and the organisms that live in them. Without it, life on land would not be possible. While the global supply of freshwater is constant, its demand for it is rapidly increasing. Owing to multiple factors, including exploding global population, the demand for freshwater is greater than the supply. It has thus become necessary to examine current freshwater uses, especially those for recreational purposes. Golf courses are one of the largest recreational freshwater users, with the average course consuming 300,000 gallons of freshwater every day for proper maintenance of the grasses (Napton and Laingen 2008). The World Watch Institute estimated that, globally, golf courses consume 2.5 billion gallons of water every day. This extremely high water usage is not sustainable and will need to fall to create a more sustainable planet.

Access to clean freshwater is an escalating problem for many cities in the United States. Insecurities over future freshwater supplies are high, especially in the Western United States. At least 36 states are anticipating local, regional, or statewide water shortages by 2013, even under non-drought conditions (US EPA 2012). In response to this, cities across the country are developing drought plans as a precautionary measure for when freshwater supplies are low (US EPA 2012). Bloomington-Normal, Illinois, is one of the metropolitan areas in the United States facing future water-supply insecurities. The severe drought in the summer of 2012 amplified the importance of promoting water conservation. In July 2012, Lake Bloomington and Lake Evergreen, the two freshwater suppliers for Bloomington, were a combined eight feet below normal level (The Pantagraph 2012). The 2011 Illinois State Water Analysis stated: "If eight years from now the city faces a worst-case scenario drought, scientists give Bloomington's current water supply a 50 percent chance of drying up beyond use." (The Pantagraph 2012). With predictions like this, insecurity over the future water supply is high.

Researching ways to reduce recreational water usage at golf courses is thus urgent for Bloomington-Normal, Illinois. Asking "In what ways can golf courses in Bloomington-Normal, Illinois, promote water conservation?" will become increasingly important as the demand for freshwater increases. In order to answer the stated research question, multiple qualitative research methods were utilized, including extensive

archival research, observations of the local golf courses, and in-depth interviews with local golf course superintendents, local water resource personnel, local golfers, and other knowledgeable community members. Each of these methods provided different information necessary to fully answer the stated research question. Archival research provided important information regarding environmental benefits and damages golf courses could cause, current water-conservation “best practices” at non-local golf courses, and also examples of model courses from around the United States. In-depth interviews with water resource personnel were used to understand the current water situation in both the City of Bloomington and the Town of Normal, and interviews with a variety of golfers in Bloomington-Normal were utilized to determine the average golfer’s perceptions about how a golf course should look and be maintained. The ultimate goal of this research was to combine all of the above qualitative research methods, analyze the results, and provide water conservation recommendations to golf courses in Bloomington-Normal, Illinois.

Literature Review

On the roughly 18,000 courses in the United States, 25 million Americans play golf each year (Napton and Laingen 2008). Very few other sports are as popular and as widely played as golf is in the United States. And golf’s popularity is not limited to the United States. Globally, golf is played by some 60 million people on 35,000 courses (Napton and Laingen 2008).

Golf is one of the few sports with an inherent tie to the environment. Golf courses are sculpted from the land, with nature playing a key role. Because the popularity of the game is growing worldwide and because golf and the environment inherently go hand in hand, a further analysis of golf’s effect on the environment is necessary. Determining ways for golf courses to be more sustainable is becoming increasingly important as the human impact on the Earth rises. While many parts of golf course environmental sustainability could, and should, be addressed, this literature review and report will focus mainly on freshwater conservation.

Golf Courses and Environmental Benefits

Golf courses in the United States are frequently criticized in environmental terms. The modification of natural habitats during construction of the courses and excessive chemical and water use for maintenance of the turf are the most commonly discussed topics by those concerned with golf course sustainability (Colding and Folke 2009). While these are legitimate concerns, golf courses are not entirely detrimental to the environment. In fact, golf courses can serve some essential environmental functions -- two of the most significant of which are to provide “green spaces” for communities (with multiple related benefits) and to serve as native areas in which biological diversity of plants and animals is preserved (Colding and Folke 2009; Colding et al. 2006; Burgin and Wotherspoon 2009; Tanner and Gange 2005).

In many communities around the United States, “green space” is disappearing. Rapid development and growth, especially suburban sprawl, have eliminated many urban

green spaces around the nation (Haq 2011). Benefits such as a reduction of the urban heat-island effect, air quality regulation, groundwater supply recharge, filtering of polluted water, and reduction in soil erosion can all be provided by urban green spaces (Colding and Folke 2009). When urban green spaces are destroyed, these benefits disappear. Consequently, the people and ecosystems of urban areas suffer. Fortunately, golf courses have the potential to partially fill the void left by these vanishing urban green spaces. While a golf course cannot fill all of the voids left by a removed green space, it can provide significant benefits.

Golf courses around the United States and the world are, in fact, providing urban areas with much-needed green space. Disappearing types of greenery (native grasses, shrubs, and trees) and aquatic ecosystems (ponds and rivers) are all commonplace at golf courses. They provide benefits to the urban ecosystem that are increasingly needed and also difficult to find. The most significant benefits are improvements in water and air quality, creating or re-creating native flora areas, carbon sequestration, and reduction in soil erosion (Beard and Green 1994). Without golf courses, many cities in the United States would not receive these necessary benefits and thus would have unhealthy ecosystems. Wynn Golf Course in downtown Las Vegas, Harding Park Golf Course in San Francisco, Rancho Park Golf Course in Los Angeles, and Van Cortlandt Golf Course in New York City are just a few examples of golf courses in highly populated areas providing green space and significant ecosystem benefits (Forbes 2010).

Golf courses are also useful in conserving biodiversity and providing habitat to many animal species. Biodiversity is important for all of the Earth's species. The Earth is a complex interrelated system in which species, and their survival, are connected to one another. What happens to one species will more than likely affect what happens to other species, and humans are no exception (Burgin and Wotherspoon 2009). One of the major threats to biodiversity is lack of habitat (Burgin and Wotherspoon 2009). Whether due to agriculture, resource extraction, global climate change, or development, habitat for almost all of the Earth's species is being degraded or destroyed (Colding and Folke 2009). Wildlife habitat is being lost at an increased rate. This fact only increases the importance of golf course land and its potential ability to help preserve biodiversity. Golf course size alone is an important factor in protecting biodiversity. The average American golf course is 54 hectares in size (about 133.5 acres), much larger than many protected nature reserves (Colding and Folke 2009). The larger the area, the more likely it will be able to support a healthy ecosystem with high species diversity (Colding and Folke 2009). Forests, ponds, rivers, and prairies are all commonly found on golf courses and often provide native habitat for animals (Tanner and Gange 2005). Golf courses are able to provide habitat for mammals, birds, amphibians, insects, aquatic life, and plants (Colding and Folke 2009). Very few other public places are capable of preserving biodiversity so effectively. This fact should not be overlooked when analyzing golf course sustainability.

Golf Courses and Environmental Damage

While golf courses do play some important beneficial environmental roles, they also lead to environmental degradation. Groundwater contamination, native habitat destruction, excessive nutrient runoff (nitrogen and phosphorus specifically, from fertilizers), and extreme freshwater usage are just a few of the numerous environmental problems that a golf course can cause. While some golf courses, and the people who run them, are committed to making golf more sustainable, it has historically been a challenge.

Chemical Use on Golf Courses

The use of chemicals constitutes a major part of the challenge of creating more sustainable golf courses. Pesticides (including herbicides) and fertilizers are used because players expect high-quality turf and because the turf must withstand frequent low-mowing and heavy traffic (Metcalf et al. 2008). To get those desired results, golf course superintendents must use chemicals. The types of grass currently used at many golf courses would not survive the mowing and traffic without pesticides and fertilizers. Superintendents, who are responsible for turf maintenance, are more likely to apply excessive pesticide and fertilizer than to apply not enough and have the grass die. Replanting grass in dead areas is a very expensive, difficult, and time-consuming process, and is not ideal for a high-traffic golf course (Metcalf et al. 2008). A few of the more serious environmental consequences of excessive chemical use are groundwater contamination, eutrophication of nearby ponds (i.e., a lack of oxygen in the water as a result of algae growth and decomposition that is caused by excessive fertilizer nutrient runoff), soil acidification, and biodiversity loss (Metcalf et al. 2008; Ma et al. 1999; Cohen et al. 1990).

In addition to the many environmental consequences of chemicals at golf courses, they also have the potential to harm human health. Pesticide exposure has been associated with birth defects, mutations, reproductive defects, kidney and liver damage, nervous system damage, brain tumors, and many different types of cancer in lab rats (Hernke and Podein 2011). While chronic effects caused by pesticides are difficult to report and analyze, groups such as gardeners, farmers, and golf course superintendents, who are in frequent contact with pesticides, are more vulnerable to these health hazards (Ayra 2005). According to the World Health Organization, pesticides poison 3,000,000 people each year and are responsible for 200,000 deaths (Ayra 2005). A major concern with human health and pesticides on golf courses is the potential for them to leach into the groundwater. This could contaminate the drinking water for thousands of individuals and lead to widespread exposure to these dangerous chemicals (Gaus 2000).

Arguably, water contamination is the most environmentally concerning unintended consequence of chemical use at golf courses. While every golf course uses different chemicals and amounts of chemicals, runoff of pesticides and fertilizers into adjacent aquatic ecosystems after they are applied to the turf is virtually impossible to avoid (Moss et al. 2006). Ideally, all of the applied pesticide and fertilizer will be taken up by the turf, but sudden heavy rain or irrigation can cause nutrient runoff (Moss et al.

2006). Nitrogen and phosphorus, the two most common ingredients in fertilizer, damage aquatic ecosystems when they are added in large amounts, and pesticides can contain compounds called “persistent organic pollutants” that are not decomposed by natural means and can stay toxic in water for many years (Moss et al. 2006). The death of native species, groundwater contamination, and increased algae growth (and subsequent eutrophication) can all result from pesticide and fertilizer runoff (Ma et al. 1999). In order to increase sustainability at golf courses, this chemical use needs to be addressed. While this is an extremely important issue, and one that deserves research, this paper will focus on promoting water conservation.

Importance of Water Conservation

The importance of promoting water conservation at golf courses is at an all-time high. Water demand in the United States is higher than ever before. Cheap and reliable supplies of freshwater have led to carelessness and wastefulness in the past, and have created a current problem. Simply put, there is not enough freshwater to meet the demand. This fact cements the importance of examining large, recreational freshwater users. Golf courses are one of the largest recreational freshwater users. When it comes to water use, golf courses are not at all sustainable. Hundreds of thousands of gallons of freshwater are used every day for turf maintenance at almost every golf course in the country. The average American golf course uses 312,000 gallons daily, but in arid regions, such as Arizona, California, and Southern Florida, golf courses can use more than 1,000,000 gallons every day (Napton and Laingen 2008; Schmidt 2006). That is, a golf course in these arid regions uses the same amount of water in one day that an entire family of four would use in four years (Deford 2012). If the 18,000 golf courses in America were laid out together, they would encompass an area the size of Delaware (Deford 2012). And all of this area is irrigated on a daily basis. According to the United Nations, it would take the same number of gallons to support 5.2 billion people as it would to irrigate all of the golf courses in the world combined. This extremely high rate of water consumption is not at all sustainable, especially since it is for recreational purposes, and will need to be lowered as the demand for freshwater increases.

Overview of Golf Course Irrigation

Golf courses may look like picture-perfect pieces of nature, but they are actually highly designed pieces of land with a complicated web of irrigation system underneath the surface. Thousands of feet of piping are on every golf course, with pop-up sprayers supplying water to much of the turf (see Appendix D). While each golf course’s water needs are different based on climate, type of turf grass, drainage capabilities, soil composition, etc., every golf course must water its grass daily (Batsug and Buyuktas 2003). The greens on a golf course, the tightly mown areas where the holes are located, need the most frequent irrigation. They have the shortest grass and also the most foot traffic. Without water, the greens would die in only a few days (Batsug and Buyuktas 2003). Fairways and tee boxes (the middle of the playing area and the starting location for every hole) have the second-shortest grass and need frequent irrigation, but not so frequent as the greens. They have a much higher threshold for drought and thus can

survive for about a week with no water (Gilhuly 2010). The roughs (the long grass on the edge of every hole) do not need frequent irrigation. While they do need some watering, it does not have to be frequent. The grass species common to rough can enter dormancy and withstand drought (Gilhuly 2010). See Appendix D for explanation of the different golf course parts.

The water used for irrigation at golf courses in the United States comes from a variety of sources. Golf courses at one end of the spectrum use only rainwater or surface water collected in retention ponds and lakes, and golf courses at the other end use only municipal, treated water. Many golf courses use a combination of the two (Gilhuly 2010). Which type of water a golf courses decides to irrigate with is dependent on multiple economic factors, with each one having positives and negatives. While using purely rainwater and surface water is very economical, it can be risky. If there is an unexpected drought and water is unavailable, the grass will die. Municipal treated water, while more readily available to some extent, is very expensive. Treating the water to human consumption standards is an expensive process and thus makes the water expensive to the customer (Gilhuly 2010).

Water Conservation Best Practices

Owing to the increased demand and constant supply of freshwater, golf courses in many parts of the world have been forced to explore new techniques for watering that require less water to produce the same results. Many different methods have been proposed and researched, with varying degrees of success. The most successful of these methods are the use of native plant areas, the use of non-potable water sources, the use of newly created, genetically modified grass species, and the push for the idea that brown grass on a golf course is acceptable.

Native Plant Areas

Native plant areas have increased in both size and number at golf courses over the past few decades (U of Illinois 2008). Because they require no watering, mowing, or pesticide and fertilizer application, native plant areas are saving golf courses maintenance time, water, and money (U of Illinois 2008). These native plants have evolved in the local climate and thus have fewer insect and disease problems, and are more heat and drought resistant (U of Illinois 2008).

More than just saving golf courses on labor and pesticide and fertilizer costs, native grass areas also save water. Irrigation of native plants is unnecessary (Wanessa 2002). Without irrigation, native plants enter dormancy, which is completely natural and healthy for the plants. Dormant plants stop growing, and thus stop needing water. The plants will break dormancy when water is available (Wanessa 2002). The deep root system of many native plants also allows them to survive without watering. Extending multiple feet into the ground, the roots of native plants can reach and store significantly more water than their exotic counterparts (Wanessa 2002). With such substantial benefits, it is no wonder that more and more golf courses are utilizing native plant areas.

While these native plant areas cannot be used for the tees, fairways, or greens on a golf course because of their growing inconsistencies, they can be used in the roughs and also in non-playable areas (U of Illinois 2008). Forest Hills Country Club in St. Louis, Missouri, is just one of these courses. With the support from both the Head Superintendent and the members of the club, Forest Hills Country Club added more than 15,000 native forb plants and 15 pounds per acre of native grass seed. In total, more than 20 species of native plants were added. They saw drastic cuts in pesticide and fertilizer applications and also irrigation (Weston 1990).

A few other courses that have successfully introduced or expanded native plant areas are Stone Tree Golf Course in Petaluma, California; The Sagamore Club in Noblesville, Indiana; Cantigny Golf Club in Wheaton, Illinois; Edgewood Golf Club in River Vale, New Jersey; South Hills Country Club in Franksville, Wisconsin; The Prairie Club in Valentine, Nebraska; and Cog Hill Golf Course in Lemont, Illinois (Torsiello 2010). These, though, are just a few of the thousands of golf courses around the United States obtaining benefits from native plant areas.

Alternative Water Sources

The use of alternative water (non-potable) sources is not a new concept. Recycled wastewater and stormwater have been used for many years in a variety of ways, but only recently has the idea of using alternative water sources for golf course irrigation taken off. This idea has gained popularity in large part because of the vast quantity of available non-potable water. Whereas potable water is in high demand, non-potable water is in low demand. Potable water is highly treated and purified with multiple chemicals and monitored by appropriate authorities so as to be safe for human consumption. Non-potable water is not monitored or treated with chemicals, and thus is typically not safe for human consumption (Schwecke et al. 2007). Non-potable water can be classified as stormwater, dam and creek water, recycled water (water that has been used at least once and then supplied for reuse, either treated or untreated), or rainwater collected in tanks (Schwecke et al. 2007). In some highly developed cities where hard surfaces coat the ground surface, up to 90% of rainfall ends up as stormwater (Schwecke et al. 2007). And the amount of wastewater produced by the city of San Diego in one day alone tops 175 million gallons (Martorana 2012).

Because these water sources are not suitable for consumption, their usefulness is limited. Historically these water sources have been used for cropland irrigation, landscape irrigation, and power generation (Martorana 2012). And recently, they have also been used successfully at golf courses. This success can mainly be attributed to the lower cost of non-potable water. Municipalities often sell reclaimed water at a lower cost than potable water (Martorana 2012). For example, in 2005 recycled water sold for an average price of \$1.00 for 748 gallons, while potable water sold for an average price of \$1.25 for the same amount of water (Martorana 2012). For golf courses, which use millions of gallons of water every year, this small price difference adds up to big yearly savings. Golf courses that use free sources of water -- stormwater, dam and creek water,

and rainwater collected in tanks -- save even more money. And beyond their money savings, non-potable water sources have shown to be just as beneficial as potable water, if not more beneficial, to the grasses (Devitt et al. 2007). The fluoridation and chlorination of potable water specifically has raised some environmental concerns. While there is some conflicting research and opinions about the benefits of these chemicals, both fluoride and chlorine have shown to harm some organisms and plants (Alonso and Camargo 2011; Olmez and Kretzschmar 2009). More research is needed to fully assess the ecological impacts of water fluoridation and chlorination.

Newly Developed Grasses

The campaign for golf course water conservation has been waged not only on the golf courses, but also in the laboratory. One of the newest techniques used to reduce water consumption at golf courses is the use of hybrid grass species. Scientists have been working to develop high-quality turf grasses that require substantially less water for irrigation. Buffalograss, Texan bluegrass, Kentucky bluegrass, annual bluegrass and bermudagrass are just a few examples of grasses that have been developed to be very drought-resistant and also able to hold up to the high traffic of golf courses (Zhang et al. 2006). Some other recently developed grass species, like seashore paspalum and seagreen, can survive with saltwater irrigation (Koch and Bonos 2010). Both of these groups of grasses have changed the way some golf courses are looking at irrigation. At some golf courses, 50-60% water consumption savings have been reported from the use of drought-resistant grasses (Zhang et al. 2006). A few examples of these golf courses are Sonoma Ranch Golf Course in New Mexico, Mediterra Golf Club in Florida, and Merion Golf Club in Ardmore, Pennsylvania (Duncan 1997). And at some other golf courses, mainly those directly bordering the ocean, grass irrigation has been entirely from seawater (Koch and Bonos 2010). The Ocean Course on Kiawah Island, South Carolina; Sea Island Golf Course on St. Simons Island, Georgia; Fairbank Golf Course in San Diego, California; and Honolulu International Country Club in Hawaii are just a few examples (Duncan 1997). Given such outstanding freshwater savings, more research into developing new grass species has the potential to save billions of gallons every year.

Golfer Perceptions

A final way golf courses are working to promote water conservation is through changing golfers' view of what a well-maintained golf course should look like. When one pictures a typical American golf course, the picture in most people's heads is a lush green landscape with one type of grass all cut to the same height, and absolutely no weeds – as at Augusta National Golf Club, home of the annual Masters tournament. This lush green monoculture turf is not environmentally sustainable. The amount of water necessary to keep the turf grasses so green is extraordinarily high, and also unnecessary. Turf grass, while it does require some irrigation, does not need near the amount of water that is applied on American golf courses to survive (Bastug and Buyuktas 2003). Dull green patches, or even brown patches to some extent, are normal for turf (Bastug and Buyuktas 2003). While golf course superintendents are aware of this fact, many are not willing to compromise on grass color. They fear that fewer golfers will play a course

with brown patches than will play a lush green course, and thus they over-irrigate the turf (Bastug and Buyuktas 2003). Superintendents would much rather over-irrigate the course and pay a slightly higher water bill than under-irrigate the course and lose potential business (and their jobs). Changing the way the American golfer views a well-manicured golf course has enormous potential to conserve freshwater. If the average golfer's perception of an attractive golf course could be changed to one with dull green turf with possible brown patches, the irrigation requirements of golf courses would drastically decrease. While this research did not identify scientific, peer-reviewed journal articles into the perceptions of the American golfer, many members of the golf business, including head superintendents, architects, and head golf professionals, agree that changing the golfers' perceptions about how a golf course should look could make golf courses more sustainable (How Green is Golf 2012). In order to fully understand the possible benefits of this method, further research is necessary.

Examples of Model Courses

With the increasing awareness of anthropogenic (human-caused) impact on the environment, some golf courses around the United States have taken the initiative to become more sustainable. While many of these golf courses were financially motivated to observe more sustainable practices, the steps were nevertheless taken. Improvements in the amounts of pesticide and fertilizer applications, variety of both native and drought-resistant grasses grown, efficiency of irrigation technologies, amounts of irrigation, and types of irrigation water have all been seen at golf courses around the United States.

Audubon International

An important program currently supporting golf course sustainability in the United States is Audubon International. The mission of the organization is, "To work with others to deliver high-quality environmental education and to facilitate the sustainable management of land, water, wildlife, and other natural resources in all places people live, work, and play" (Audubon International 2012). For golf courses specifically, Audubon International created the Audubon Cooperative Sanctuary Program for Golf, an educational and certification program that helps golf courses protect the environment. By providing information and guidance, the program helps golf courses implement environmental management plans that improve efficiency, conserve resources, and promote conservation efforts. These plans focus on six categories: environmental planning, wildlife and habitat management, chemical use reduction and safety, water conservation, water quality management, and education. To date, more than 500 golf courses in the United States have successfully implemented the program (Audubon International 2012). Three of these Audubon-certified golf courses are discussed below.

Vineyard Golf Club – Edgartown, Massachusetts

Located just off the coast of Cape Cod, Massachusetts, on the island of Martha's Vineyard, Vineyard Golf Club is known for both the beauty and challenge it provides players. Located on 235 acres of naturally sloping protected land, it is no wonder people from all across the United States come to play it. It is also one of the most sustainable

golf courses in the world. Because of their great concern for the fragile island ecosystem, residents of Martha's Vineyard demanded – during its development – that the course be maintained in a completely organic way. They insisted that no synthetic pesticides be used and only natural fertilizers be applied. Many educated golf course superintendents thought that it was simply impossible for a golf course to meet these demands and still produce a high-quality course that people would pay to play. But, through a combination of hand-weeding, biostimulants (which have replaced pesticides), and composted fertilizers, the golf course has been able to provide excellent golf while remaining sustainable. Vineyard Golf Club has replaced the toxic pesticides and fertilizers used at most American golf courses with all-natural ones, and in doing so, the club has been able to avoid damaging the surrounding environment (The Vineyard Golf Club 2012).

While Vineyard Golf Club has been successful in its mission to be entirely organically maintained, it was not an easy process. The course went through lots of trial and error to find what worked well for maintenance and what did not work so well. Keeping disease, fungus, and pests off the grass proved to be the most difficult task. The club has seen success not only in utilizing unusual maintenance techniques, but also in educating its players. Having them understand and accept that the golf course at some times may not be in “pristine” condition has been a major accomplishment (The Vineyard Golf Club 2012).

Old Collier Golf Club – Naples, Florida

Located in one of the most beautiful places in the United States, Old Collier Golf Club in Naples, Florida, sits on 267 acres of sculpted land, ideal for world-class golf. The course provides players with a stunning natural landscape full of native plants and animals. It is only minutes from the Gulf of Mexico. Old Collier Golf Club was the first golf course in the United States to plant Seashore Paspalum, a salt-tolerant grass species capable of being irrigated with brackish water, from tee through green. Having the ability to irrigate with brackish water and not potable water drastically reduced the course's environmental impact. But more than just having sustainable turf, the golf course also focused on preserving wildlife. Of the 267 acres the golf course sits on, 50 acres have been set aside as mangrove and wetland habitat and 109 acres are continuous native habitat corridors. Foxes, gopher tortoises, and more than 100 bird species have been observed at the golf course. Less significant, but still important to note, Old Collier uses 100% recycled plastics for its benches, trashcans, and bridges. It has also successfully launched a program of Integrated Pest Management. This has drastically reduced its pesticide needs by combining several methods for long-term prevention and management of pests in the most economical fashion (Environment-Old Collier Golf Club 2012).

Pebble Beach Golf Links – Pebble Beach, California

One of the best and most famous golf courses in the entire United States, Pebble Beach Golf Links is the peak of perfection for golfers. Located on the cliffs of Pebble Beach, California, the golf course has breathtaking views of the Pacific Ocean, with hole

after hole fit for the front of a post card. People from all around the world travel to play the course. But what most people do not know about the golf course is the leadership role it has played in golf course sustainability, especially in water conservation. Pebble Beach Company, a non-profit organization that owns and operates Pebble Beach Golf Course, has sponsored a \$67 million Wastewater Reclamation Project that converts locally produced wastewater into high-quality recycled water perfect for irrigating the golf turf. All seven golf courses on Pebble Beach Resort property are 100% irrigated with this non-potable water. To date, this project has saved more than four billion gallons of potable water that would otherwise have been used for irrigation. State-of-the-art irrigation technology has also been utilized to make turf irrigation more efficient, and to further the water conservation initiative (Green Initiatives at Pebble Beach Golf Resorts, California 2012). In addition to promoting water conservation, Pebble Beach has reduced energy consumption by updating to more efficient golf carts, reduced waste by composting its grass clippings, etc. (which total 2500 tons annually), reduced pesticide applications through an Integrated Pest Management program, and been designated a Certified Audubon Cooperative Sanctuary by Audubon International (Green Initiatives at Pebble Beach Golf Resorts, California 2012).

Other Golf Courses

While the three golf courses described above are leaders in sustainability efforts, thousands of other golf courses in the United States have made significant strides toward sustainability. Glendale Country Club in Bellevue, Washington; Bald Peak Colony Club in Moultonborough, New Hampshire; Maple Leaf Golf and Country Club in Port Charlotte, Florida; Hudson Hills Golf Course in Ossining, New York; Currituck Golf Club in Corolla, North Carolina; and Greate Bay Country Club in Somers Point, New Jersey, are just a few examples (Audubon International 2012).

Conclusion

As the demand for freshwater increases in the United States, the importance of examining large, recreational freshwater users only increases. Golf courses are one of the largest freshwater users, with the average course consuming hundreds of thousands of gallons for turf irrigation every day. It is apparent from the literature review that golf courses can take numerous steps to promote water conservation. Whether it be planting different types of drought-resistant grasses, using different forms of irrigation water, or changing the public's opinion about how a golf course should look and be maintained, golf courses around the United States are beginning to understand the importance of water conservation and are making positive changes. Vineyard Golf Club, Old Collier Golf Club, and Pebble Beach Golf Links are just a few of the thousands of golf courses in the United States making a difference in promoting sustainability generally and water conservation specifically.

Research Design and Methodology

Overview of Research Purpose and Question

The primary purpose of this research was to examine ways golf courses in Bloomington-Normal, Illinois, could promote water conservation. The objective of this research was to answer the question, “How can golf courses in Bloomington-Normal, Illinois, promote water conservation while still maintaining the golf course to the satisfaction of the players?” In order to answer this question, I used qualitative research methods including archival research, observations of the local golf courses, and in-depth interviews with local golf course superintendents, local water resource personnel, local golfers, and other local knowledgeable community members. The ultimate goal of my research was to provide recommendations for water conservation to golf courses in Bloomington-Normal, Illinois, so they could become more sustainable.

Overview of Bloomington-Normal, Illinois, and its Golf Courses

Located in the heart of Central Illinois in McLean County, Bloomington-Normal is a lively community with more than 125,000 residents. Big businesses like State Farm, Country Financial, and Mitsubishi Motors, two highly accredited universities (Illinois State University and Illinois Wesleyan University), and a thriving family community are all found in Bloomington-Normal.

Bloomington-Normal is home to thousands of golfers. In the city limits alone, there are five championship, 18-hole public golf courses: Ironwood Golf Course, The Den at Fox Creek, Highland Park Golf Course, Prairie Vista Golf Course, and The Weibring Golf Club at Illinois State University. In addition, there are two 9-hole golf courses: The Links at Ireland Grove and Lakeside Country Club. There are also two championship, 18-hole private golf courses: Bloomington Country Club and Crestwicke Country Club. The wide variety of golf courses, each looking and playing very differently, makes Bloomington-Normal a great place for golfers to live and visit.

But Bloomington-Normal can be a difficult place to maintain a golf course. Periods of slight drought are not uncommon. The drought in the summer of 2012 was the most recent example of drought, and it was very severe. Months of intense drought greatly affected the entire city, including the golf courses. Golf courses were urgently looking for ways to conserve water while still properly maintaining the grasses. Because water had been much more plentiful in past years, promoting water conservation had rarely, if ever, been so imperative. With insecurity over the future water supply, the importance of promoting water conservation at golf courses in Bloomington-Normal has never been higher.

Description of Research Design

To answer the stated research question on local golf course water conservation possibilities, qualitative research was conducted in the form of a detailed literature review, observations of five local golf courses, and in-depth interviews conducted in October through November 2012. In-depth interviews were held with three different groups of people: local golf course superintendents, local water resource personnel, and local golfers. Each group was asked different questions to fully extrapolate any information that would be useful for the research.

Local Golf Course Superintendents

The purpose of interviewing local golf course superintendents was to understand the current irrigation practices at five of Bloomington-Normal's golf courses, so as to recommend improvements. In-depth interviews were conducted with three local golf course superintendents: Tyler Bain, head superintendent at Ironwood Golf Course; Jason Wingate, head superintendent at The Den at Fox Creek, Highland Park, and Prairie Vista golf courses; and Danny Rieger, head superintendent at Bloomington Country Club. While time limitations prevented sampling all of the golf courses in Bloomington-Normal, the five selected golf courses were chosen because of their variety. Ironwood Golf Course was chosen for research because it is owned by the Town of Normal; the Den at Fox Creek, Highland Park, and Prairie Vista golf courses were chosen because they are all owned by the City of Bloomington; and Bloomington Country Club was chosen because it is a private country club. The goal was to survey a wide variety of golf courses in order to have a wide variety of data. In further research, the other golf courses in Bloomington-Normal – The Weibring Golf Course, Lakeside Country Club, The Links at Ireland Grove, and Crestwicke Country Club – should be included. The three superintendents interviewed were vital resources for their knowledge about current freshwater use at golf courses. They knew how much water was used for irrigation on the average day, what kinds of grasses were used for turf, what the golf course was doing to conserve water, and many other pieces of information vital for my research. Topic guides for my interviews with the local golf course superintendents can be seen in Appendix A.

Local Water Resource Personnel

The purpose of interviewing local water resource personnel was to understand the current water situation for Bloomington-Normal, Illinois. I was looking for information about the security or insecurity of the water supply for both the City of Bloomington and the Town of Normal. Steve Gerdes, the Water Director for the Town of Normal, and Rick Twait, the Water Purification Superintendent for the City of Bloomington, were interviewed for their comprehensive knowledge. This information was vital for my research. Understanding the current water situation for both Bloomington and Normal was key to justifying the promotion of water conservation at the city's golf courses. Topic guides for my interviews with the local water resource personnel can be seen in Appendix A.

Local Golfers

In addition to holding in-depth interviews with local golf course superintendents and local water resource personnel in Bloomington-Normal, Illinois, I interviewed 10 local golfers. The goal of these interviews was to better understand the average Bloomington-Normal golfer and his or her perceptions about, and reactions to, how a golf course should be maintained. The 10 interviewees were both male and female, ranged in age from 19 to 53 years old, and, due to time limitations, were a convenience sample, which included acquaintances of this researcher. In further research, more, randomly selected golfers in Bloomington-Normal should be interviewed. The research conducted for this report about local golfers' perceptions was preliminary. Understanding the opinions of local golfers about proper maintenance of local golf courses, specifically maintenance regarding irrigation levels and turf quality, is a vital piece of my research. This information was gathered with the intention of sharing it with the local golf course superintendents. Golf course superintendents maintain their courses to the liking of their players, so giving the superintendents some information about course conditioning – e.g., what must be watered, in their view, and what could be dry (and possibly go brown) – has the potential to affect water consumption at golf courses and really promote water conservation. Topic guides for my interviews with local golfers can be seen in Appendix A.

Research Findings

Current Golf Course Maintenance

I gained a great deal of information through in-depth interviews with local golf course superintendents. Superintendents from Ironwood Golf Course, Prairie Vista Golf Course, Highland Park Golf Course, The Den at Fox Creek, and Bloomington Country Club were interviewed. In future research, other golf courses in Bloomington-Normal could be consulted for valuable information. The interviewed superintendents were very knowledgeable about golf course maintenance, and were able to answer all of my questions about the current water usage for each course.

Ironwood Golf Course -- Normal, Illinois

Ironwood Golf Course is a public, 18-hole golf course located in, and owned by, the Town of Normal, Illinois (see Appendix C). The head superintendent at Ironwood Golf Course, Tyler Bain, provided me information on the maintenance requirements and water usage at Ironwood Golf Course. On an average summer day, Ironwood Golf Course uses 200,000 gallons of water for irrigation of its grasses, with the water mainly coming from a 23-acre pond on the north side of the golf course. There is also a 6-acre pond that can be used for irrigation, but this option is used only when the water level of the 23-acre pond is low. There is no option to supplement this water with municipal water because there is no existing piping from the Town of Normal's water system. Because of the high cost of installation, there are no immediate plans to irrigate the golf

course with potable water. Daily irrigation of the course, especially greens, tees, and fairways, is necessary to keep the grass growing and healthy. Because the greens are cut so short and are made of bentgrass, if they were to go without water they would quickly die. The rest of the course, while it is still cut to a short height, is more drought-tolerant because it is a mixture of bluegrass and ryegrass. Instead of immediate death, this type of grass would go dormant and likely come back at a future date when water is more abundant.

The summer of 2012 was a difficult one for the golf course. During the peak of the drought, the main irrigation source, the 23-acre pond on the north side of the course, had such low water levels that water from the 6-acre pond had to be pumped into the main pond. This action was unprecedented. The water level in the main pond was so low that the piping leading to the golf course wasn't submerged in the lake's water. The golf course, without the additional water from the second pond, had no way to irrigate its turf. This water shortage forced Ironwood to change some of its usual irrigation techniques. Hand watering of the greens and chemical applications were increased to reduce water consumption. Hand watering saved a lot of irrigation water because it is a very efficient technique. Water can be applied to specific spots on the green where water is needed instead of widespread irrigation of the whole green. Chemical applications were increased to help the turf take water up into its system more quickly. This reduced the amount of runoff and thus lowered the irrigation requirements. The golf course was also forced to not water its rough and fairways for close to a month.

In response to this water shortage, the golf course has increased its no-mow, no-water areas around the course. It has considered using newly developed drought-resistant grasses, but has at this point decided not to use them because of the time it would take to switch over from the current grass. Tyler Bain has also considered watering the grass only to the minimum level required to keep the grass alive, and not striving for that lush green color that many players expect, but he has, at this point, decided against it. He believes that brown grass on the course would cause Ironwood to lose business. He, as the superintendent, would be able to water less if local golfers accepted dull green grass with possible brown patches, but as of now, he is not comfortable with irrigating less.

Prairie Vista, Highland Park, and The Den at Fox Creek Golf Courses – Bloomington, Illinois

The head superintendent at Prairie Vista, Highland Park, and The Den at Fox Creek Golf Courses (see Appendix C), Jason Wingate, was instrumental in providing me information about three local golf courses and their maintenance requirements. The three courses mentioned above are all owned and operated by the City of Bloomington, with Jason Wingate responsible for the maintenance of each. On average, the three courses combined use 800,000 gallons of water a day in the summer months. The Den at Fox Creek and Prairie Vista both irrigate with surface water from ponds on each course, and Highland Park uses municipal water supplied by the City of Bloomington. These courses have never had instances of low water supply, even during the 2012 summer drought. Highland Park has never had irrigation-level restrictions placed upon it by the City of

Bloomington. All three courses have bentgrass greens, fairways, and tees, and a mixture of bluegrass and fescue roughs. This means that the greens, fairways, and tees require daily watering and the roughs can survive without irrigation.

While there has been thought about employing water conservation techniques, few have been utilized to date. New drought-resistant grasses and recycled water (specifically at Highland Park) have not been used because of their high costs, but an increase in no-mow, no-water areas has been seen at all three courses. Twelve acres of no-mow area has been added at Prairie Vista alone in the last few years. In regard to golfer perceptions, Jason Wingate's personal opinion is that he feels pressure from the players to keep the course looking lush green. He would be open to watering less if he knew there would be no backlash from the players about the look of the courses, but in this economy, he is not willing to take that chance. He thus waters to achieve the lush green look that many golfers expect.

Bloomington Country Club – Bloomington, Illinois

Bloomington Country Club is a private, 18-hole golf course located in the City of Bloomington, Illinois (see Appendix C). It is owned and operated by a private party, with members of the club paying yearly dues in order to play the course. Danny Rieger is the Head Superintendent of the course and was very helpful in answering my questions about the water use at Bloomington Country Club. On the average summer day, the course uses 350,000 gallons of water for irrigation of the grasses. This water comes from a variety of places. Part of it comes from a 2.5-acre retention pond that is filled with run-off water from nearby roads and parking lots, part of it comes from an on-course well, and part of it is municipal water supplied by the City of Bloomington. The course, with the ability to irrigate with municipal water, has never had instances of low water supply. It has never had restrictions placed on its municipal water usage by the City of Bloomington. The greens, fairways, and tee boxes are all bentgrass, and the rough is bluegrass. This means that the greens, fairways, and tee boxes require daily irrigation, while the rough can withstand drought and little irrigation.

To date, Bloomington Country Club has not seriously considered promoting water conservation. While it uses as little irrigation water as possible for financial reasons, it has not taken many measures to reduce its daily irrigation requirements. It has not considered increasing its no-mow grass areas or using newly created, drought-resistant grasses. In regard to pressure from the members to keep the course looking lush green, Danny Rieger said he does feel pressure. He said that he must keep the course maintained to a high standard, but he also said that the members do somewhat understand the grass looking dull green during times of drought.

Current Water Situation for Bloomington and Normal, Illinois

Research into the current water situation for Bloomington-Normal revealed that the water situation for the two communities is very different. Bloomington, which uses surface water from Lake Bloomington and Lake Evergreen, has a much greater insecurity

over the water supply than does Normal, which uses 15 wells to draw its water from the Mahomet Aquifer (see Appendix D).

Steve Gerdes, the Water Director for the Town of Normal, provided me with significant information regarding the water supply for the Town of Normal. Overall, the Town of Normal does not currently have any water supply issues. There has never been a water supply shortage in Normal, not even during the severe drought of the summer of 2012. Because it has never had low water supply, the Town of Normal has never had to impose water use restrictions on its residents. The aquifer is large enough that fluctuations in rainfall have little to no effect on the water supply for Normal. When I asked Steve Gerdes his educated opinion, he said he had no major concerns about the future water supply for the Town of Normal.

Rick Twait, the Water Purification Superintendent for the City of Bloomington, provided me with information about the water supply for the City of Bloomington. Whereas Normal had little to no concern over the future water supply, Bloomington has greater concern – because the city uses surface water to meet its water needs. Surface water in general is much more susceptible to low supply levels because of rainfall fluctuations than is water from an aquifer. On October 13, 2012, Lake Bloomington and Lake Evergreen were a combined 10 feet below normal levels (see Appendix D). According to Rick Twait, this deficit is unusual but not unprecedented. Deficits have been even greater in years past. Rick Twait's educated opinion is that there is some concern over the future water supply for the City of Bloomington. But even with this opinion, there are no water conservation ordinances in place for golf courses that use municipal water from the City of Bloomington.

Golfer Perceptions

After conducting multiple in-depth interviews with local Bloomington-Normal golfers, I have a much better understanding of how the average golfer perceives a golf course. I was able to interview 10 Bloomington-Normal golfers. The interviewees were both male and female, ranged in age from 19 to 53 years old, and because of time limitations, were not randomly selected, but were instead a convenience sample of acquaintances of the researcher. Even with the time limitation, a variety of interviewees was desired, for a variety of opinions.

Overall, there was a broad consensus among local golfers about acceptable and unacceptable golf course maintenance. Every golfer interviewed responded that their overall reaction to a golf course with brown patches of turf would be negative. Many felt that brown patches indicated a lower-quality golf course with a maintenance crew that was not doing an adequate job. Many indicated that they would play a golf course with brown patches of grass much less frequently than a course with lush green grass, and would also pay considerably less money to play a course with brown patches of grass than they would to play a course with lush green grass. When asked about what parts of the golf course they would find acceptable going brown, a common sentiment was voiced. All of the golfers interviewed agreed that greens should never be brown. Even in

times of drought, the interviewees indicated that they would not accept a golf course with brown greens. They explained how the greens were so important to the game of golf and how having them be anything but lush green would not be acceptable. While the local golfers indicated that brown greens were never tolerable, a majority of the interviewees stated that they would accept brown tees and rough. Brown fairways, like brown greens, were intolerable in these golfers' views.

Interviewed golfers expressed a common sentiment about their experience with golf courses advertised as "sustainable." The common sentiment was that they all had very little experience with these types of golf courses. Most of the local golfers had no previous experience with golf courses advertising their commitment to sustainability or any environmentally friendly practices. A few of the interviewees had played a golf course in Florida irrigated with reclaimed water, but none had experienced any golf course in the local area committed to becoming more sustainable. While most had no previous experience (to their knowledge) with sustainable golf courses, most of the respondents indicated that they would be drawn to play an environmentally friendly golf course. Support for the "green" movement and curiosity about the course were the two most common reasons for their desire to play a sustainable golf course. When asked for their guess as to how many gallons of water the local golf courses use on an average day, only one of the respondents was close to the actual water usage for golf courses in Bloomington-Normal. All of the other guesses were drastically lower than what the golf courses actually use for irrigation. And when asked if they were concerned about the amount of water used for irrigation at the local golf courses, about half said they were concerned and about half said they had no concerns.

Discussion of Findings

After collecting and analyzing my research findings, I have determined that Bloomington-Normal, Illinois, golf courses have the ability to improve water conservation. Overall, there are two main ways in which this water conservation could take place. The first way is changing how the golf courses are designed and maintained. Utilizing newer and more efficient irrigation techniques has the potential to conserve a lot of water for the local courses. The second way is altering Bloomington-Normal golfers' opinions about a golf course with brown patches of grass. If the average local golfer were to accept dull-green or brown patches of grass instead of the lush-green grass that is currently at the golf courses, considerably less irrigation would be required, and could thus save millions of gallons of water every year for the community of Bloomington-Normal, Illinois.

After speaking with three local golf course superintendents, I have learned that promoting water conservation at some courses is more important than at other courses. While all of the golf courses in Bloomington-Normal use roughly the same number of gallons per day, some of the courses' irrigation water sources are more sustainable than others. Because Ironwood, Prairie Vista, and The Den at Fox Creek do not use, and do not even have access to, potable municipal water, they are much less in need of urgent water conservation. They irrigate their grasses with pond water instead of treated potable

water. While using this pond water may have some negative impacts on the aquatic ecosystem, it is generally more sustainable than using treated, potable water. They are not using water that has been treated and purified and that could have been supplied for human use, but instead are using rainwater and runoff. Bloomington Country Club and Highland Park Golf Course, on the other hand, use treated City of Bloomington water for irrigation. The fact that Bloomington specifically is struggling with insecurity over the future freshwater supply only makes water conservation for these two courses more imperative.

The golf course superintendents showed me how the local golf courses are already trying to conserve water. While the golf courses still use large amounts of water, the superintendents are doing their best to use as little water as possible. For the local golf courses that use their own surface water for irrigation (Ironwood, Prairie Vista, and The Den at Fox Creek) the motivation for conserving water is to have as much water on hand as possible. The motivation for conserving water at the local golf courses that use city water for irrigation, Bloomington Country Club and Highland Park Golf Course, is to keep maintenance costs as low as possible. Golf courses without any access to municipal water must keep as much water in their irrigation ponds as possible, to be prepared for worst-case scenarios. If something were to happen, such as a severe drought, these courses must have enough stored water to keep the grass alive. This fact propels golf course superintendents at these golf courses to conserve water. Golf courses with access to city water, by contrast, try to use as little water as possible for financial reasons. The more water they use, the higher water bill they will have, and thus a lower profit. The amount of water used is not the only water conservation decision where money is a key aspect. Planting newly developed drought-resistant grass seed and the use of reclaimed or recycled water for irrigation are options local golf courses have thought about, but ultimately decided against them owing to high costs of implementation. While local golf course superintendents may not be promoting water conservation for environmental reasons, they are nevertheless taking some strides toward sustainability.

After analyzing the information provided by the local golf course superintendents, I believe that the way to conserve the most water on golf courses is to change the perceptions of local golfers. Bottom line, golf courses use extraordinarily large amounts of water for irrigation because golfers expect lush green grass to cover the entire course. When one thinks of a typical American golf course, one thinks of bright green expanses of grass, not dry, dull-green grass. American golfers expect every golf course to be in pristine condition, and if it's not, they will choose to play at another course. To reach this pristine condition, golf course superintendents are forced to use excessive amounts of irrigation. Superintendents could irrigate less and still have very healthy, dull-green colored grass, but many will not take the risk of losing potential business. The economic situation for golf courses is unstable, and to lose golfers to another golf course because they do not have lush-green grass is a risk superintendents are not willing to take. If a widespread change of opinion by golfers were to take place, every golf course in the Bloomington-Normal community could reduce its water consumption. If the general opinion of local golfers was that a golf course with dull-green grass, or even brown patches, was just as high-quality as a golf course with entirely lush-green grass,

superintendents could irrigate less and not worry about losing business to other golf courses.

Recommendations

Information gathered through archival research, observations, and in-depth interviews have allowed me to provide golf courses in Bloomington-Normal, Illinois, several recommendations for promoting water conservation. My recommendations are divided into two categories. One section of my recommendations surrounds updating irrigation techniques and course design to be more water-efficient, and the other section focuses on changing the average Bloomington-Normal golfer's picture about how a typical golf course should look to a more sustainable picture.

Golf Course Maintenance

Changing the way local golf courses are designed and maintained has great potential to promote water conservation. The first (and arguably easiest) of my recommendations for golf courses in Bloomington-Normal to promote water conservation is to increase the no-mow, no-water areas on the courses. Native grass areas and fescue areas not only do not require irrigation and chemical applications of pesticide and fertilizer, but also have the potential to increase biodiversity of both plants and animals on the courses. Because transitioning to no-mow, no-water areas is simple, and because it can provide so many benefits, I recommend increasing the acreage of these areas at all of the local golf courses.

Further recommendations would be to use newly developed drought-resistant grass seed – for example, buffalograss, Texan bluegrass, and Kentucky bluegrass – when reseeding is necessary, to mow less frequently, and to irrigate tee boxes and rough much less frequently. Owing to the high cost and labor-intensive process of tearing up current grass, I am recommending using these newly developed grasses only when old grass dies or when general reseeding is required. Mowing less frequently, and thus allowing grass heights to increase, allows the grass to retain more moisture, and subsequently reduces the necessary irrigation level. And finally, based on my in-depth interviews with local golfers, I recommend reducing the amount of irrigation on both tee boxes and rough. All of the local golfers I interviewed were accepting of brown patches of grass on these two areas. The superintendents can thus save water without any potential drawbacks from the players. While this is my recommendation, I also recommend more in-depth research into the perceptions of golfers in Bloomington-Normal.

My last recommendation having to do with the maintenance of local golf courses is to research the possibility of using recycled or reclaimed water for irrigation. This recommendation applies only to Highland Park Golf Course and Bloomington Country Club, because they irrigate with municipal water. The switch from city water to reclaimed water at these two golf courses has the potential to save millions of gallons of potable water for the City of Bloomington every year. If potable water already used once was treated, but not to human consumption standards, and used for irrigation, the potable

water that would have been used to irrigate could be saved. In order to make this switch, much more research needs to be completed. It would need to be proven a feasible and cost-effective strategy before it could be instituted by the City of Bloomington. This research has not been completed to date. My recommendation is to complete this research and, if it proves to be a promising option, to implement this water conservation strategy.

Golfer Perceptions

While changing the way golf courses are maintained has the potential to conserve large amounts of freshwater for the community of Bloomington-Normal, changing golfer perceptions about how a golf course should look and be maintained could have a much larger impact. In general, golf course superintendents maintain golf courses to please the players, and currently what is pleasing to golfers is lush-green grass. In order to keep grass lush-green, large amounts of irrigation are required. The potential to save millions of gallons of water could come from changing what golfers want out of grass. If they no longer want lush-green grass, and will accept dull-green grass, huge amounts of water could be saved. My recommendation would be to research this idea, and promote as much public education as possible. The more golfers know about how much water is being used to irrigate, and the subsequent consequences of this high water use, the more people will want to save water at golf courses. Advertisement of sustainable practices – for example, signs around the golf course and informational flyers given to the golfers – could be effective strategies to promote public education. If dull-green becomes the new standard, and the average golfer did not demand lush-green grass, golf courses in Bloomington-Normal could conserve significant amounts of water.

Conclusions

As the demand for freshwater steadily increases in Bloomington-Normal, Illinois, it becomes necessary to examine current freshwater uses, especially those for recreational purposes. Golf courses are one of the largest recreational freshwater users, with each course consuming hundreds of thousands of gallons every day for maintenance of the grasses. As a result of the incredibly dry summer of 2012, golf courses in Bloomington-Normal, Illinois are urgently looking for ways to decrease their water consumption. The major research question that needs to be addressed is simply, “In what ways can golf courses in Bloomington-Normal, Illinois promote water conservation while still maintaining the golf course to the satisfaction of the golfers?” Using an average of 300,000 gallons of freshwater every day at each golf course in Bloomington-Normal is not sustainable and will need to be changed in order to create a more sustainable society. In order to answer the stated research question, archival research was performed, observations of the local golf courses were taken, and in-depth interviews with local golf course superintendents, local water resource personnel, local golfers, and other knowledgeable community members were completed. The information provided by all of the qualitative research methods described above cemented the fact that golf courses in Bloomington-Normal, Illinois can promote water conservation in multiple ways. While some water conservation methods at this time require much more research before they

could be implemented at golf courses in Bloomington-Normal, such as utilizing reclaimed water, there are a few that can immediately be used to conserve water. Increasing the size of no-mow, no-water areas and using newly developed drought-resistant grass species are two simple water conservation recommendations. Another is to change the perception of local golfers. If the average Bloomington-Normal golfer learns to accept dull-green or brown grass instead of the lush-green grass that is currently at golf courses, drastically less irrigation would be required, and thus saving millions of gallons of water every year for the community of Bloomington-Normal, Illinois.

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Appendix A – Interview Guides

Local Golf Course Superintendents

1. Where are you currently getting your irrigation water? How much are you using on average each day in the summer?
2. Do you have any regulations on the amount of water you may use to irrigate? Did you have any restrictions placed on you during the drought this summer?
3. What is the minimum amount of water you would need to keep the course in good shape?
4. Have you ever had instances of low water supply? If so, how did you change your irrigation practices? In what ways did you conserve water?
5. Did you have to change any irrigation techniques this summer due to the drought? What did you change?
6. What type of grasses do you use for the turf? Are the grass types different for the fairway, rough, and greens?
7. Do you have any native grass (or no water) areas on the course? If so, have you considered increasing their size? If not, have you considered installing them?
8. Have you ever considered using recycled water for irrigation? If so, why did you consider it? If not, what are your barriers to entry?
9. Are you currently doing anything to conserve water? For example, using different irrigation techniques, aerifying more often, watering only at night, etc.?
10. Have you considered using newly developed drought resistant grasses for your turf? If so, why? If not, why?
11. Do you feel pressure by the golfers to keep the course looking lush green? Do you think fewer golfers would play your course if the grasses were not lush-green?
12. Would you feel comfortable using less water for irrigation if you knew that the players would accept them as normal?

Local Water Resource Personnel

1. What is the current water supply situation? Have the water levels in Lake Bloomington and Lake Evergreen rebounded any after the especially harsh drought this summer?
2. What are the current irrigation regulations for the Bloomington-Normal during times of drought? Are their regulations on homeowners, businesses, etc.? How bad does the water situation need to be before regulations are imposed?
3. Are there any golf courses in Bloomington-Normal that currently irrigate with Bloomington-Normal's municipal water? Are there any current water regulations on those golf courses? For example, a limit to the number of gallons used, or time of day allowed for irrigation, etc.?
4. Do you have any concerns about the amount of water golf courses are using in regard to the future water supply of Bloomington-Normal? If so, what would you like to see done to improve the situation?
5. Are there any concerns about next summer and the possibility of another drought occurring? Could it be even worse than this summer?
6. Do you have any further recommendations to aid my project? People I should talk to?

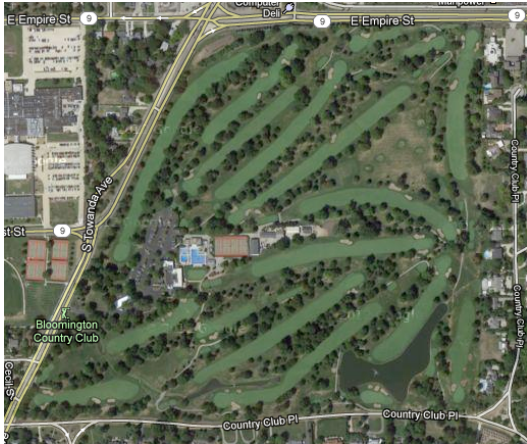
Local Golfers

1. As a golfer, how would you respond to a golf course with brown patches of grass? Would it change your opinion about the quality of the course? Would it cause you to play the course more or less frequently? Would you pay less to play a course with brown patches of grass?
2. As a golfer, what parts of the golf course would you find acceptable going brown during times of drought? Tees, fairways, rough, greens, fringes, etc.? If you would not accept any of the turf going brown, please state so.
3. As a golfer, what would be your response to a golf course that advertises as being “sustainable”? Would it change your opinion about the quality of the course? Would it cause you to play the course more or less frequently?
4. Have you had any previous experience on golf courses that promoted their sustainability? If so, what were your experiences with the course, and how were you told about the sustainable practices (signage on the course, website advertising, on scorecard, etc.)?
5. Are you personally concerned about the amount of water golf courses use for irrigation? Do you have any idea how many gallons a golf course in Bloomington-Normal uses on an average summer day for irrigation?

Appendix B – Research Timeline

Task	Date Completed (2012)
Golf Course Observations	10/2-10/19
Interview Tyler Bain	10/25
Interview Jason Wingate	10/24
Interview Steve Gerdes	10/29
Interview Rick Twait	11/1
Interviews with local golfers	11/1-11/6
Interview with Danny Rieger	11/20

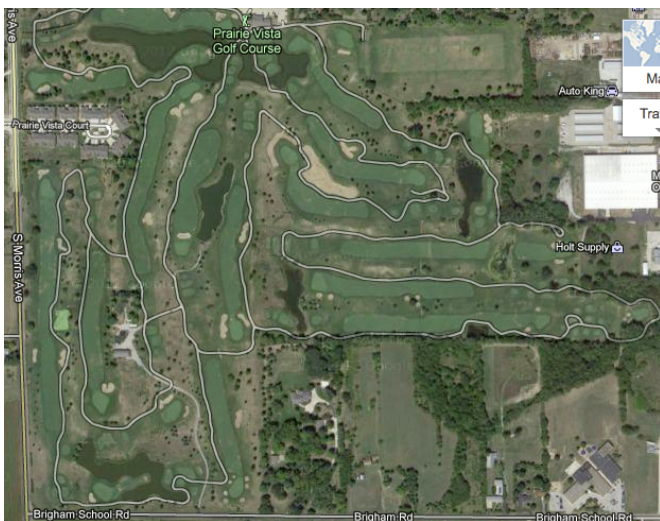
Appendix C – Maps of Local Golf Courses



❖ Bloomington Country Club, Bloomington, Illinois

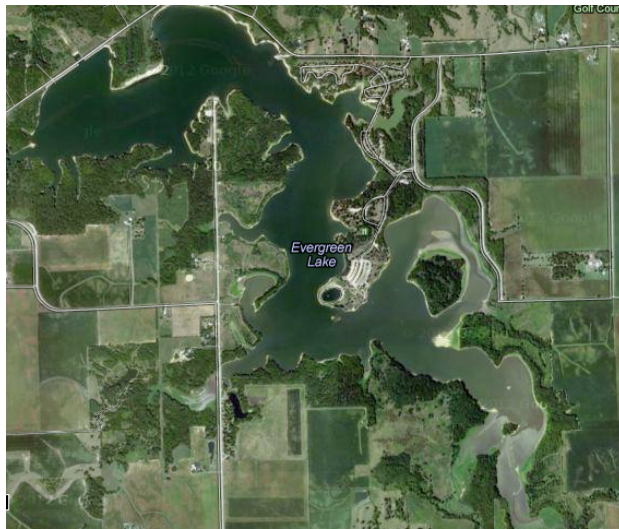


❖ Ironwood Golf Course, Normal, Illinois

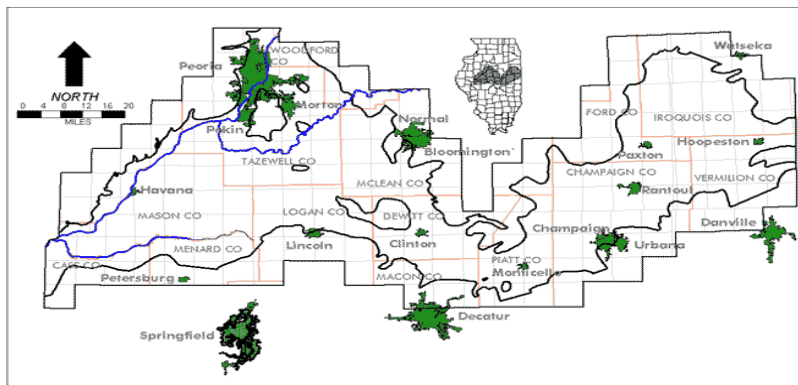


❖ Prairie Vista Golf Course, Bloomington, Illinois

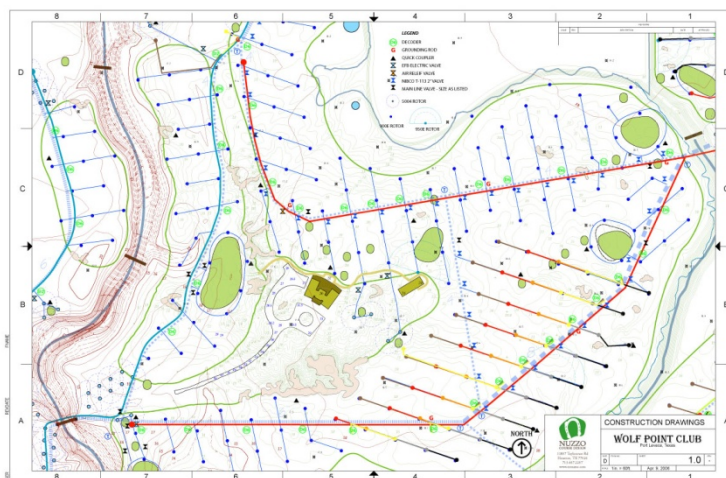
Appendix D – Important Figures



- ❖ Lake Bloomington and Lake Evergreen (two fresh water suppliers for Bloomington, Illinois)



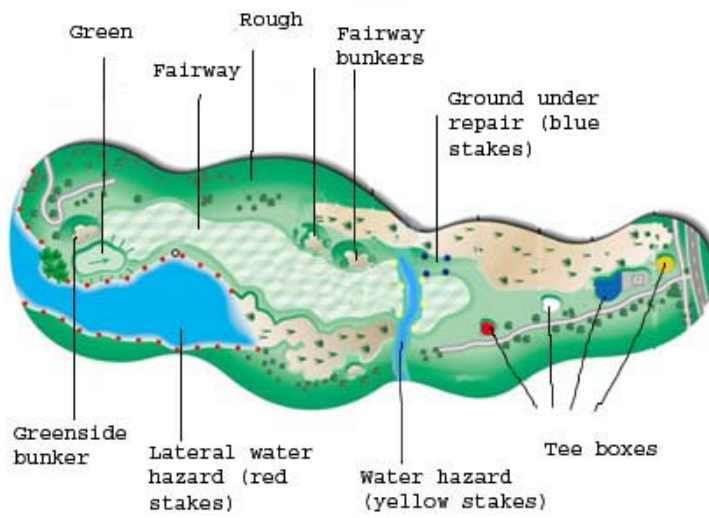
- ❖ Mahomet Aquifer of Central Illinois



- ❖ Example of Irrigation System



❖ Example of pop-up sprayer



❖ Parts of the Golf Course Explained