SealIsle 1, a new salt-tolerant (halophytic), drought-resistant, warm-season turfgrass, is now available as "certified" sod or sprigs. After seven years of extensive research at the University of Georgia's Griffin Experiment Station, combined with careful evaluation of 35 small-plot golf course locations, SealIsle 1 was released in 1999 by plant geneticist Dr. R.R. Duncan. Unlike Adalayd, Futurf and other earlier medium and coarse-bladed paspalum cultivars, SealIsle 1 is similar in texture and wear tolerance to the hybrid bermuds. And SealIsle 1 has a number of other advantages, especially under difficult environmental scenarios. First and foremost, it can handle multiple stresses: prolonged drought, high salt levels, low light intensity, waterlogging and extremely high or low soil pH levels. Secondly, SealIsle 1 can tolerate most types of alternate water sources, including wastewater, effluent, ocean water, gray water and brackish water. It also requires less irrigating, less fertilizer and only minimal pesticide applications when compared to other warm-season cultivars. As water quality and water conservation become even more critical in the days ahead, SealIsle 1 may be the best choice for fairways, tees, roughs and transition areas. SealIsle 1 not only thrives in difficult environments, it also gets very high marks for turf quality, cold-hardiness, turf density and turf strength, disease and pest resistance, and rapid recovery from normal wear and injury. On top of that, SealIsle 1 has the most attractive, rich dark green color of any of the warm season grasses. See for yourself. Schedule a trip to see SealIsle 1 at one of these quality-conscious producers licensed to grow and sell certified SealIsle 1 seashore paspalum.

To Order Your Certified SealIsle 1 Seashore Paspalum
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South Florida Grassing Hobe Sound FL 561 546-4191
The Turfgrass Group Marshallville GA 678-642-0915
Rapid Turf, Inc. Rincon GA 912 826-2454
Phillip Jennings Turf Farms, LLC Norristown GA 478 668-3729
Emerald Island Turf, Inc. Punta Gorda FL 941 637-4770
Southern Turf Nurseries, Inc. Punta Gorda FL 800 841-6413
Table 3. Turfgrass varieties used by Florida golf courses, 2000.

<table>
<thead>
<tr>
<th>Turfgrass Variety</th>
<th>Respondents</th>
<th>Number</th>
<th>Percent</th>
<th>Mean Acres</th>
<th>Standard Error</th>
<th>Share of Total</th>
<th>Expanded Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Acres</td>
<td></td>
<td></td>
<td>Total Acres</td>
</tr>
<tr>
<td>Bermudagrass</td>
<td>214</td>
<td>96.0%</td>
<td>102</td>
<td>5</td>
<td>92.5%</td>
<td>136,773</td>
<td></td>
</tr>
<tr>
<td>Bahiagrass</td>
<td>67</td>
<td>30.0%</td>
<td>4</td>
<td>2</td>
<td>3.5%</td>
<td>5,251</td>
<td></td>
</tr>
<tr>
<td>St. Augustinegrass</td>
<td>89</td>
<td>39.9%</td>
<td>3</td>
<td>1</td>
<td>2.7%</td>
<td>3,996</td>
<td></td>
</tr>
<tr>
<td>Mixed/other grasses</td>
<td>25</td>
<td>11.2%</td>
<td>1</td>
<td>1</td>
<td>0.9%</td>
<td>1,351</td>
<td></td>
</tr>
<tr>
<td>Zoysiagrass</td>
<td>25</td>
<td>11.2%</td>
<td>0</td>
<td>0</td>
<td>0.2%</td>
<td>257</td>
<td></td>
</tr>
<tr>
<td>Centipedegrass</td>
<td>6</td>
<td>2.7%</td>
<td>0</td>
<td>1</td>
<td>0.2%</td>
<td>299</td>
<td></td>
</tr>
<tr>
<td>Specific other type(s)</td>
<td>26</td>
<td>11.7%</td>
<td>0</td>
<td>1</td>
<td>0.2%</td>
<td>147,927</td>
<td></td>
</tr>
</tbody>
</table>

the list in second place was bahiagrass with 5,251 acres, representing 3.5 percent of the total, or 4 acres per course. Bahiagrass is typically limited to the golf course rough. St. Augustinegrass was the only other turf variety that was of significance, with 2.7 percent of the total acreage planted. Each of the remaining varieties constituted less than 1 percent, and are generally limited to the special tee and greens areas.

This study examined three aspects of water use by golf courses - sources of irrigation water, changes in water use per acre, and changes in fertilizer use per acre, and whether or not the golf course had installed an automated irrigation control system. Total water use by Florida golf courses in 2000 was estimated at 172 billion gallons. Information related to water sources is shown in Figure 1. Nearly 85 billion gallons of water came from recycled water, compared to 49 billion for surface water, 35 billion from wells, and 1.5 billion from municipal sources.

Taking total irrigated acres and dividing it into the total amount consumed from all water sources, average consumption by Florida golf courses was 1.23 million gallons per acre, or 3.75 acre feet applied in 2000. The use of recycled water was the primary source for almost half of all golf facilities and has grown from 8 percent in 1974 to 21 percent in 1994 and to 49 percent in 2000. The second most common source was surface water such as canals and lakes (29 percent), followed by groundwater (21 percent) from wells. Use of surface water rose from 23 percent of golf courses in 1974 to 37 percent in 1994, but then declined to 29 percent in 2000. Groundwater as a source declined from 61 percent in 1974 to 41 percent in 1994, falling further to 21 percent in 2000. Clearly, much of the shift from surface and groundwater has been replaced by the dramatic growth in the use of recycled water to irrigate Florida’s golf courses.

Survey data on changes in water and fertilizer use indicate that Florida golf courses have markedly reduced (60 percent) consumption of fertilizers and pesticides on a per-acre basis and were increasingly shifting sources of water from ground to recycled. From a water-policy and efficiency standpoint, perhaps even more important than total consumption per acre are changes in water-use patterns over time. To address this issue, golf course superintendents were asked whether irrigation water use per acre over the past five years had increased, decreased or remained the same. The results are shown in Figure 2.

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- **Reduces damage to plant root in the following ways:**
  - Disrupts the ability of plant parasitic nematodes to locate plant roots, thereby restricting penetration, feeding and reproduction
  - Reduced nematode feeding activity reduces the opportunities for invasion by pathogenic fungi
Table 4. Changes in Florida golf course consumption of water and fertilizer use, 2000.

<table>
<thead>
<tr>
<th>Change Variable</th>
<th>Respondents Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation water use per acre over past 5 years</td>
<td>Increased 20 9.0%</td>
<td>Decreased 94 42.2%</td>
</tr>
<tr>
<td>Fertilizer use per acre over past 5 years</td>
<td>Increased 64 28.7%</td>
<td>Decreased 39 17.5%</td>
</tr>
</tbody>
</table>

remained the same (Table 4). If it increased or decreased, respondents were asked to specify how much it had changed. By a slim margin, the majority (42.2 percent) indicated that their water consumption had decreased and the reduction in water use by this group averaged 37 percent. Slightly fewer (41.7 percent) said per-acre use remained the same. Nine percent of respondents indicated water use increased over the past five years and that it increased by roughly 8 percent. A similar set of questions was asked about per-acre fertilizer use patterns over the past five years. Nearly half (46 percent) of all respondents stated that fertilizer use remained the same.

Table 5. Geographic origin of golfers playing golf in Florida, 2000.

<table>
<thead>
<tr>
<th>Geographic Origin</th>
<th>Respondents Number</th>
<th>Mean Rounds</th>
<th>Standard Error</th>
<th>Share of Total Percent</th>
<th>Expanded Total Million Rounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local (county) residents</td>
<td>184</td>
<td>20,372</td>
<td>1,315</td>
<td>53.7%</td>
<td>31.47</td>
</tr>
<tr>
<td>International visitors</td>
<td>133</td>
<td>2,049</td>
<td>347</td>
<td>5.4%</td>
<td>3.16</td>
</tr>
<tr>
<td>US residents outside Florida</td>
<td>175</td>
<td>10,277</td>
<td>989</td>
<td>27.1%</td>
<td>15.88</td>
</tr>
<tr>
<td>Non-local Florida residents</td>
<td>146</td>
<td>5,209</td>
<td>663</td>
<td>13.7%</td>
<td>8.05</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>31,47</td>
<td></td>
<td>100.0%</td>
<td>58.56</td>
</tr>
</tbody>
</table>

More than a quarter (29 percent) indicated that it had increased and that the average percentage increase was 28 percent. Almost a fifth (18 percent) stated fertilizer use had declined, with the magnitude of reduction a similar percentage (18). Finally, respondents were asked whether the golf course had automated irrigation systems installed, and whether they were original or retrofitted from a manual system. Nearly all (94 percent) stated that their course had an automated system and more than half (53 percent) indicated it was installed at the time of original construction.

Visitor Originations
Florida is well known for its large influx of winter visitors from many northern states as well as international locations, particularly Europe and South America. The geographic origin of golfers in general tends to be associated with distance to the course. At 54 percent or 31.4 million rounds, local county residents were the group most frequently playing golf (Table 5). The second-most-common group comprised U.S. residents from outside Florida, representing 27 percent of total rounds played. Nonlocal Florida residents were the third-ranked group with 14 percent or 8 million rounds, followed finally by international visitors who accounted for just over 5 percent or 3.2 million rounds of golf. A total of over 19 million rounds (32 percent) were played by out-of-state visitors to Florida.

Florida Golf Visitors and Expenditure Impacts
One of the objectives of this research was to estimate the total economic impact of golf visitors to the state of Florida. The tourism industry publishes information regarding the impact of tourism to the state, but estimates of the impact of golf-related recreation specifically have not been made. Information was obtained from the National Golf Foundation on golf traveler characteristics in

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the United States, such as the average number of rounds played per day and per year, the number of days spent annually in golf-related travel, the average number of golf trips per year, and average expenditures per trip.

The typical U.S. golf traveler makes 6.6 golf-related trips per year with an average of 3.95 days per trip, or a total of 26 days each year in golf-related travel, and spends an average of $1,114 per trip or $282 per day on lodging, local transportation, food, entertainment, golf lessons, gifts, and miscellaneous other expenses, but excluding transportation to the destination (Table 6).

This study assumed that U.S. average golf travel data are representative of golf travelers to Florida since this state is the largest golf travel market in the United States. The U.S. travel data were used together with the survey data on total rounds of golf played in Florida by out-of-state visitors (19,046,060) to estimate a total of 3.12 million golf-playing visitors to Florida in 2000, who made 20.6 million golf-related trips and spent a total of 81.5 million visitor days in Florida.

Based on the U.S. average golf-travel expenses per day and the estimated number of golf-visitor days in Florida, total golf-travel expenditures by Florida visitors amounted to nearly $23 billion (Table 6). Based on the number of travel days and number of rounds of golf played, we estimate that 23.4 percent of the total trip expenditures, or $5.4Bn, may be attributed to golf.

As noted earlier, visitors to Florida impact the economy at three levels - directly on expenditures such as food, recreation, lodging and entertainment, indirectly by the receiving industries of those dollars as they in turn spend money to purchase goods and services to operate their businesses, and induced impacts from personal consumption expenditures by the employees of these companies and their allied suppliers.

The cross-section of industries influenced by tourist dollars, for the major sectors of the Florida economy, and the three levels of economic impact are shown in Table 7. These impacts (direct, indirect and induced) are extrapolated and classified into three types of impacts - output, value added, and employment.

- Output impact is a gross figure that represents total revenues generated from the three levels of economic activity.
- Total value-added impact is a net figure that removes all purchased inputs used by the respective industry to generate their goods and services. This is similar to net income after cost of goods sold (COGS) have been subtracted from total income.
- Finally, the employment impact represents the jobs that are generated from all the activity across

Table 6. Travel expenditures by Florida golf visitors, 2000.

<table>
<thead>
<tr>
<th>Type of Expenditure</th>
<th>Average Per Trip (1)</th>
<th>Average Per Day (2)</th>
<th>Estimated Total Expenses (3)</th>
<th>Estimated Expenses Attributable to Golf (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lodging</td>
<td>403</td>
<td>102</td>
<td>8,303</td>
<td>1,941</td>
</tr>
<tr>
<td>Transportation</td>
<td>87</td>
<td>22</td>
<td>1,793</td>
<td>419</td>
</tr>
<tr>
<td>Food</td>
<td>203</td>
<td>51</td>
<td>4,183</td>
<td>978</td>
</tr>
<tr>
<td>Entertainment</td>
<td>113</td>
<td>29</td>
<td>2,328</td>
<td>544</td>
</tr>
<tr>
<td>Golf lessons</td>
<td>106</td>
<td>27</td>
<td>2,184</td>
<td>510</td>
</tr>
<tr>
<td>Gifts</td>
<td>87</td>
<td>22</td>
<td>1,793</td>
<td>419</td>
</tr>
<tr>
<td>Other</td>
<td>115</td>
<td>29</td>
<td>2,369</td>
<td>554</td>
</tr>
<tr>
<td>Total expenses (5)</td>
<td>1,114</td>
<td>282</td>
<td>22,953</td>
<td>5,364</td>
</tr>
</tbody>
</table>

2 Average per trip divided by average number travel days per trip.
3 Average expenditure per day multiplied by estimated number of traveler-days.
4 Share of trip expenses attributable to golf (23%).
5 Excludes transportation expenses to destination of $227 per trip.
the economy due to golf.

The output impact from golf tourism spending totaled $12.86Bn. It was dominated by three sectors—services, which accounted for $5.06Bn, or 39 percent of the total; trade with $3.05Bn, or 24 percent of the total; and finance, insurance, and real estate, which comprised 10 percent or $1.36Bn. Combined, these three sectors represented more than four-fifths of the total output impact.

A similar dominance by these sectors occurred for total value-added impact, with services accounting for $3.27Bn (39 percent), trade for $2.14Bn (25 percent), and finance, insurance and real estate comprising $984M (12 percent) of the $8.46Bn total. Value-added impacts also included an impact on labor income of $5.58Bn and impact on indirect business taxes paid to local, state, and federal governments of $792M.

Finally, the number of jobs generated by golf tourism, measured as an employment impact, was 215,873 in 2000. The component responsible for the majority of employment was the service sector with 96,000 jobs, followed by trade with 72,000 jobs, and third was the government, which accounted for nearly 17,000 jobs.

<table>
<thead>
<tr>
<th>Industry Sector</th>
<th>Total Output Impact (Smillion)</th>
<th>Total Value Added Impact (Smillion)</th>
<th>Total Employment Impact (jobs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Services</td>
<td>5,060</td>
<td>3,268</td>
<td>95,641</td>
</tr>
<tr>
<td>Trade</td>
<td>3,049</td>
<td>2,144</td>
<td>71,574</td>
</tr>
<tr>
<td>Finance, Insurance, Real Estate</td>
<td>1,355</td>
<td>984</td>
<td>7,092</td>
</tr>
<tr>
<td>Transportation, Communication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Utilities</td>
<td>1,031</td>
<td>649</td>
<td>11,229</td>
</tr>
<tr>
<td>Government</td>
<td>971</td>
<td>886</td>
<td>17,109</td>
</tr>
<tr>
<td>Construction</td>
<td>779</td>
<td>282</td>
<td>7,209</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>534</td>
<td>192</td>
<td>3,321</td>
</tr>
<tr>
<td>Agriculture</td>
<td>63</td>
<td>36</td>
<td>1,385</td>
</tr>
<tr>
<td>Other</td>
<td>11</td>
<td>11</td>
<td>958</td>
</tr>
<tr>
<td>Mining</td>
<td>6</td>
<td>3</td>
<td>55</td>
</tr>
<tr>
<td>Total</td>
<td>12,860</td>
<td>8,455</td>
<td>215,873</td>
</tr>
</tbody>
</table>

Golf Course Employment

Employment is a vital indicator of an industry’s contribution to a local, regional, or national economy. Wages stimulate an economy when they are spent locally in the purchase of other goods and services. In 2000, Florida’s golf-course industry employed a total of 72,038 people, including 51,375 full-time workers and 20,663 part-time workers (Table 8). Almost one-third (32.7 percent) of these full- and part-time employees worked on golf course maintenance activities, while the remaining two-thirds (67.3 percent) worked for the golf course clubhouse and/or related food service or recreational concerns.

The average golf course employed 16 full-time and three part-time people for its highly intensive maintenance work, which includes both the care of the course and the equipment used to maintain the turfgrass. On a per-acre basis, this translates into roughly one person for every 5 acres of maintained grass. At two-thirds of the total, the clubhouse component of the golf facility utilizes the larger share of total employment, due primarily to the larger number of separate business activities. For example, depending on the size of the facility, services may include hotel operations, restaurant management and service, and recreational services such as golf and tennis instruction. The average golf course employed 27 full-time people and 19 part-time or seasonal labor for clubhouse-related activities.

On average, total facility employment translates into one employee for every $150,000 of financial assets - land, vehicles and equipment, irrigation systems, and golf-owned buildings and installations.

These figures attest to the substantial employment impact Florida’s golf course industry has on the state’s economy. Put in different perspective, the golf course industry employment was close to the 80,000 people that work for all the theme and amusement parks in the state and greatly exceeded the 50,000 wage and salaried employees in agriculture (Florida Statistical Abstract 2000).

Summary

Economic impacts of the Florida golf industry were estimated for year 2000 based upon a survey of golf course owners, together with other published data and regional economic models. Respondent golf courses were classified as private (50%), semi-private (27%), public (14%), municipal (9%), resort (5%), and military (1%). Total annual revenues amounted to $4.44 billion (Bn), including membership and initiation fees (38%), playing fees (27%), food and beverage services (18%), retail sales (6%), lodging (4%), and miscellaneous other activities (9%). The revenues for year 2000 were 49 percent higher than a previous estimate of $3.0Bn in 1991-92, representing an average annual growth rate of 5 percent in nominal dollar terms.

Total industry employment was 73,000 persons, including clubhouse personnel (68%), and golf course maintenance personnel (32%), with 71 percent as full-time and 29 percent as part-time, temporary or seasonal employees.

Water used for irrigation amounted to 173 billion gallons, of which surface waters were the dominant source (90%), with lesser amounts from recycled water sources (7%) and wells (3%). Compared to 5 years ago, water use per acre increased by 9 percent of firms, decreased by 42 percent, and remained the same for 42 percent. Water use per acre was increased by 29 percent of firms, decreased by 18 percent, and remained the same for 47 percent. The irrigation control system was automated by 94 percent of courses.

Acknowledgments

This study was made possible by a sponsored research project funded by the Florida Turfgrass Association, WCI Communities, Inc., Florida Golf Alliance, Florida Golf Course Superintendents Association, Everglades Golf Course Superintendents Association, Taylor Woodrow, and Bonita Bay Group. Guidance on the study objectives and survey design was provided by golf industry professionals including Ken Flora and Lou Conzuelan, WCI Communities; Roy Bates, Florida Turfgrass Association; Ron Garl, Florida Golf Alliance; Geoff Coggins and Joel Jackson, Florida Golf Course Superintendents Association; Michael Fiddelke, Florida Club Managers Association; Ken Hylkema, FPCA; Jack Brennan, Palmad Golf Marketing; Amy Courson, PGA Tour; Stephanie Gordon, Florida Golf Course Owners Association; Matt Taylor, Royal Poinciana Golf Club; and Bill Wert Turo-green Chemlawn. Survey data entry was performed by Effie Philippakos, University of Florida.
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Alternative Water Sources

Editor's Note: Water quality and availability remains the number-one issue facing golf today and the near future. The following articles discuss how two clubs sought solutions to those challenges.

'Horizontal Well' Taps Surficial Aquifer, Returns Investment

By Tom Trammell, CGCS

In August of 2000, I was facing quite a dilemma at Hawks Nest in Vero Beach. My charge was maintaining one of the top golf courses in Florida, we were already in a drought, we were going into the dry season (and the busy season) and my water supply was terribly inadequate. My two conventional vertical wells were yielding approximately 40 gallons per minute and the effluent that I had been promised by the county was not arriving. Even though the two existing wells were running 24 hours a day, the course was still short 400,000 to 500,000 gallons per day.

Some effluent arrived, but not nearly enough. Fortunately, I remembered a presentation that I had attended in 1990. The subject was “horizontal wells” that tap the surficial aquifer a few feet below the surface.

In my files were the brochures that I had stored away from the presentation with the appropriate phone numbers. To make a long story short, I called and received a “re-education” on horizontal wells and decided that they may be the answer for our golf course. My green committee was a little suspect at first, because no one had heard of a “horizontal well.”

I asked the company to come in and give a presentation to the committee. The company presented a short video, made a presentation, answered questions, and the committee said, “Go ahead.” I was a little nervous, because it was all on my recommendation, but I plunged forward and had the well installed.

I am writing this article in March of 2002 and, here in Florida, we were still in the midst of a drought. The horizontal well not only has provided ample, good quality water (and continues to do so), I am using less electricity because the well is only 18 feet deep. Additionally, I am applying fewer soil supplements because of the quality of the water, and I am recycling anything that is unused. I was able to make a presentation to my green committee that demonstrated our horizontal well would pay for itself in 10 years.

The horizontal well taps the water that lies near the surface and directly beneath the golf course in a surficial water zone. This technology has the ability to recover water from this resource and deliver it in sufficient quantity to satisfy irrigation and lake augmentation needs. Surplus water that is not used in actual irrigation is returned to the surficial aquifer to be reused later. The system can be permitted to be used as a stand-alone water supply source or to supplement existing water supplies.

The horizontal wells are site specific. However, they work in most places in Florida. To determine if a horizontal well will work at your golf course, you need to spend approximately $2,500 to $3,000 for a 25- to 30-foot boring and have a hydrologist run computer models. The report will be pretty accurate and give you a much better idea of what you will get with the horizontal well than you will ever have when you drill a conventional vertical well.

This is a technology whose day has come. If your site will accommodate a horizontal well, then chances are you will not only have a more-than-adamant supply of good quality water; you will also have a return on your investment.

Club Taps Surficial, Floridan Aquifers, Processes in Own RO Plant

By Michael Caglioni, PG and Peter Brooks, CGCS

The Everglades Club is located in the Town of Palm Beach, which is located on an elongated barrier island, the Island of Palm Beach, bounded to the west by the man-made estuary of Lake Worth/Intracoastal Waterway, to the east by the Atlantic Ocean, and to the north and south by man-made inlets. The Everglades Club is a private, par 70, 18-hole golf club that covers 70 acres.

The original irrigation water supply was potable drinking water purchased from the Town of Palm Beach Utilities, which purchases its bulk water from the City of West Palm Beach. The City of West Palm Beach obtains its raw water from a surface water body, Clear Lake, and is treated mainly through green sand filtration. The Everglades Club irrigation water was supplied by transferring a drinking water source to the barrier island and then to the golf course. When using potable water purchased from the Town of Palm Beach, The Everglades Club Golf Course had an average monthly water bill of $20,000.

Alternative Water Source No. 1: Surficial Aquifer

In order to reduce the irrigation costs to the golf course, the Everglades Club investigated the potential of installing its own well field for irrigation purposes. Hydrogeologic investigations indicated that the Everglades Club could install a shallow, surficial aquifer well field that would supply brackish raw water with a total dissolved solids range of 2,000 to 6,000 milligrams per liter to an on-site, reverse osmosis plant for treatment. The finished water is to be utilized for irrigation of the golf course. The Everglades Club received a permit from the South Florida Water Management District to withdraw 146 million gallons per year total from both surface water and ground water (surficial aquifer) sources.

Topography plays an important part in the surficial hydraulic regime of a barrier island and, therefore, the Everglades Club. Normally, the water table will approximate the topography (contours) of the land surface. The height of the water table above mean sea level is a function of the elevation of the land surface, the nature of the hydrogeology (aquifer characteristics), and the amount of rainfall. The topography of the Everglades Club golf course is relatively low, approximately six feet above mean sea level at the eastern edge of the property. To the east of the golf course is a topographic high (consolidated and unconsolidated sand dune to ±15 feet MSL) on which housing and roadways have been
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The top of the Floridan Aquifer is more than 1000 feet below the surface of the Everglades Club. Developed. This topographic high increases the height of the freshwater head between the golf course and the Atlantic Ocean and impedes the potential of lateral saltwater movement from the Atlantic Ocean to the golf course.

The hydrogeologic investigation (which included the drilling of a test well and collection of lithologic and water quality samples) indicated the presence of a really extensive, clay unit, approximately 1-2 feet thick, from a depth of approximately 29 feet to 31 feet below MSL. The clay unit impedes the upward movement of saline water. As is expected on a barrier island, the water increased in salinity (conductivity) with depth. Below the clay unit, the water quality decreased significantly (more saline).

Twelve irrigation wells were constructed along the eastern edge of the golf course and withdraw water from approximately 19 to 29 feet MSL. This water is pumped and treated through a reverse osmosis membrane plant designed to treat brackish ground water with TDS levels of 2,000 to 6,000 mg/L.

The average TDS concentration of the production wells is 1,500 mg/L. This treated water is pumped into lakes for storage and is then pumped from the lakes to the irrigation system for distribution.

The brackish water lens and the well field are monitored by six saltwater monitor wells. The RO water treatment plant at the Everglades Club is designed to output (permeate) 75% of the raw water intake. Each RO plant must consider the raw water quality for proper design and efficiency.

In addition, the disposal method of the reject water (concentrate) must also be considered. The Everglades Club currently discharges its concentrate water to a pond for percolation and evaporation near the Intracoastal Waterway. This pond naturally has a higher salinity than the concentrate water. This disposal option is available to the Everglades Club because of its proximity to saltwater bodies. Other options for concentrate disposal in South Florida include infiltration trenches, injection wells, and discharge to a sanitary sewer system. Each option has its associated regulations and costs. Each of these options should be investigated prior to installation of an RO plant.

The surficial aquifer has limitations of use during drought conditions because of upconing and lateral saltwater encroachment. Computer groundwater modeling was performed to assess the limitations of the surficial aquifer. The model predicted that lateral saltwater encroachment would occur after 10 days of continuous pumping with no recharge.

The Everglades Club is able to minimize the potential for the lateral encroachment of saltwater.

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