

In rare instances, bunkers have been known to achieve all three unconventional goals. A good example would be Desmond Muirhead's shark-teeth-shaped bunkers surrounding an island green at Stone Harbor Golf Club in New Jersey.

Maintenance considerations

Aside from design and usage, maintenance is another important aspect of bunkers. The perception of bunker-maintenance cost is often inflated because of golfers' constant complaints about sand conditions. Bunkers receive much attention, but a good percentage of that attention might be mental. The only way to determine the exact cost is to document all expenses associated with bunker maintenance. A complete assessment requires the following steps:

1. Document all maintenance costs, including grass surrounds.
2. Identify chronic problems that are adding to the annual maintenance costs. This includes washouts, sand contamination, poor drainage, sand quality and turfgrass quality around the bunker.
3. Determine the necessity of each bunker as it relates to economics, strategy and aesthetics. A golf course architect, working with a superintendent and green committee, should review the design and its impact on the maintenance budget.
4. Develop a long-range plan that includes bunker elimination and/or addition, rebuilding or renovation.

Chronic maintenance problems, which

usually can be traced to deficiencies in one or more areas, impact bunker costs, too. It's also important to understand why bunkers deteriorate to the point where rebuilding is wise economically. Knowing the cause will improve communication during the presentation of the renovation program. Here are four areas:

1. The second law of thermodynamics. All things left to themselves progress from a state of order to disorder. It's unreasonable to think bunkers will last forever.

2. Improper maintenance. Mechanical rakes have damaged thousands of bunkers to the point where renovation is required around the edges. Some bunkers aren't constructed to allow bunker rakes to enter or exit, or are too small.

3. Storms and disasters. Heavy rain and floods will wipe out even the best bunker, or at a minimum, remove the sand. In September 2003, Typhoon Maemi cut through Jeju Island on Korea with 120-mph winds and dumped four feet of rain in one day. At The Club at Nine Bridges, all 120 bunkers, which were constructed excellently, were damaged.

4. Chronic construction woes. This area can be the most troublesome and difficult to assess because it's a slow deterioration of a bunker and surrounding area. Deterioration is often a result of inferior construction methods. Chronic deterioration can be a result of:

- Improper irrigation design of grass surrounding a bunker;
- A lack of or faulty drainage;
- Contaminated sand from constant erosion;
- Atmospheric pollution from dust contaminating sand;
- Continually adding new sand, making a bunker too deep;
- The surrounding area channeling water into a bunker; and
- A wrong bunker design for the social, economic or climatic environment.

Rebuilding or renovation is the best course of action when chronic bunker disorders are identified. Continually treating symptoms is costly and is part of the annual maintenance cost for bunkers.

Superintendents also might need to prepare for partial or complete construction that will provide long-term benefits and reduce yearly maintenance costs. The table on page 43 shows some construction considerations.

Down the drain

Drainage is an aspect that impacts bunker maintenance considerably. Bunker design should include internal subsurface drainage, internal and surface drainage of water adjacent to a bunker, proper pipe size and drainage exit connections to overall golf course drainage.

Water flows through bunker sand at a high rate, so it's important to have internal drainage pipe that receives water and

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transports it at a rapid rate. One of the problems with slotted pipe with small openings is the inability to receive water through the openings. If water can't enter the openings, it will flow through the gravel surrounding the pipe, carrying fine particles that plug drainage gravel.

For a drainpipe to function properly, one must consider the total area of surface openings in the collector pipe, blockage at the available surface area and water pressure at the interface area. Responding to this, many companies have introduced more effective methods of draining bunkers. All of these work on the principle of having bigger holes to receive water. Examples include Drain-core2, ECS and EZFlow.

The landscape surrounding the bunker also is important for proper drainage. The area should be constructed so water is directed away from the sand. When surface or subsurface water can't be directed away from the bunker, an intercepting drain should be installed

Sand selection guidelines

Particle size	0.25 mm to 1.00 mm
Particle shape	Angular
Crusting potential	Silt and clay less than 5%
Chemical reaction, hardness	pH test, noncalcareous
Infiltration rate	20 inches per hour
Color	Matter of taste
Moisture holding capacity	As a percentage of water holding

Source: USGA

four feet from the bunker edge. Installing an intercepting drain too close to the bunker will destabilize the bunker wall's integrity.

Even with thoughtful design, most bunkers have a grass or sand side slope. During heavy rain or irrigation, erosion can occur on slope lengths of less than four feet of grass. Sand face erosion depends on precipitation volume, velocity, rate and sand texture.

Sand also affects drainage, and the best

sand is one that drains well, has a high angle of repose and has some tendency toward compaction. See the chart above for factors that should be considered when selecting sand. The USGA publication "How to Select the Best Sand for Your Bunkers" is an excellent source.

Construction sequence

Once it's determined a new bunker is required, advanced planning and attention to construction sequence is needed.



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Plugged drains, contaminated sand and damage to the golf course can result from out-of-order construction. The following is one recommended construction sequence:

1. Survey and stake according to a detailed drawing with written specifications. Determine cut, fill and soil need.
2. Prepare enough plywood or other material that will support traffic and minimize turfgrass damage.
3. Remove sod around the bunker.
4. Locate drainage exit and place a wire mesh over pipe opening.
5. Remove sand and old drainage. Stockpile contaminated sand for use surrounding the bunker.
6. Detail staking, shaping, and cut and fill as per the plan. Stockpile topsoil and import fill if necessary.
7. Install perimeter irrigation.
8. Stabilize bunker edge using plywood, sandbags or other materials.
9. Compact and smooth bunker base.
10. Install bunker liner following manufacturer's recommendations.
11. Install sand to a depth of five to six inches, then compact wet sand.

Subsurface preparation

Look at steps nine and 10 more closely. Before filling a bunker with sand, its

subsurface has to be compacted. If soils are rocky or compaction isn't possible, clay soil can be used as a base. For conventional bunkers with a flat bottom and a slim chance of erosion, compacted clay should suffice. Combined with good drainage, a compacted clay bottom should maintain its integrity for many years. For bunkers in moderate to high rainfall areas with expansive or partial sand faces, additional subsurface treatments can prevent future sand contamination.

Another method of stabilizing the base is applying synthetic polymers, such as liquid polyurethane, which are sprayed on the subsoil to help stabilize soils and prevent sand contamination.

Once the base is established, liners are installed. Liners have been used in bunkers for many years. Early liners were plastic or woven materials that gave way to nonwoven geotextile liners such as Trevira Spunbound, a porous polyethylene fabric. Nonwoven, needle-punched fabrics have questionable long-term performance qualities, especially in the area of water permeability. Another disadvantage of nonwoven liners is their potential to be snagged by bunker rakes. Older liners helped prevent contamination but did little to prevent erosion or

sand slipping.

Recently, a number of geosynthetic bunker liners have been introduced. The liners come in various thicknesses, from about 0.25 of an inch to thicker than 1 inch, and are manufactured from man-made materials. Bunker liners serve two important purposes:

1. To prevent contamination from underlying soils by forming a physical barrier between the sand and subsoil; and
2. To reduce erosion on steep sand faces. Water flows through the liner, to the subsoil, reducing sand slipping/erosion. Liners provide a rough surface, increasing the sand's angle of repose, allowing a steeper sand face without erosion.

All sands have an angle of repose. When sand is piled on the ground, there's a maximum angle of the pile that can't be exceeded. One factor that affects the angle of repose is the coefficient of friction at the base. Sand piled on glass will achieve a lower angle than sand piled on a rough surface. Another factor is moisture. Sand with the correct moisture-holding capacity will achieve a higher angle than very dry or very wet sand. Angular sand will also achieve a higher angle.

Get control

It would be nice if we could return to the days of yesteryear when bunkers were primitive and feared greatly. Nowadays, bunkers are tame and domesticated, and superintendents are expected to groom and care for them. As a result, bunkers require money. This year, superintendents should make it their goal to reduce mental stress by getting control of those costly bunkers. GCN

Jim Connolly is president of JCC, Ltd. A former USGA agronomist, he's a consultant and can be reached at jim@jccurf.com.

Bunker construction considerations

Area of concern	Action
Drainage and water issues	Diversion of surface flow area from sand
Irrigation	Install perimeter irrigation to maintain turfgrass health
Sand selection	Color, texture, particle size distribution
Surrounding grass areas	Reduce slopes and need for hand mowing
Sand slope stabilization and protection from contamination	Install geotextile bunker liner
Bunker rake access	Modify surrounds to allow for easy entry/exit of mechanical rakes

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Making the switch

SOUTH CAROLINA SUPERINTENDENT GRADUALLY CHANGES UTILITY VEHICLE FLEET

by JOHN WALSH

A fairly new trend regarding utility vehicles has been to convert them from gas to electric, mainly because of noise and gasoline prices. However, that trend wasn't what drove Mike Fabrizio, GCCS, director of grounds and golf maintenance at Daniel Island Golf Club in Charleston, S.C., to change his utility vehicle fleet. Instead, Fabrizio is gradually switching his fleet from Jacobsen to Club Car.

Daniel Island, which has about 500 members, is a sizable 12-month operation. The facility features two 18-hole golf courses: the Tom Fazio-designed Beresford Creek Course (7,293 yards), which opened in 2000, and the Rees Jones-designed Ralston Creek Course (7,446 yards), which opened in 2006.

Fabrizio has more than \$2.5 million to spend to maintain the golf courses and grounds – 230 acres of irrigated Bermudagrass and 500 total acres, including low-maintained and no-maintained areas. He says the club tries to keep the capital expenditures budget between \$100,000 and \$200,000 a year.

Along with his budget, Fabrizio has 45 full-time employees and three to five seasonal employees during the summer to help him maintain the courses and grounds.

Generally, Fabrizio purchases most of the equipment he and his staff use, with one exception – the Toro Reelmaster

5500 D series fairway mowers, which he leases for a 36-month period.

"Fairway mowers are the lifeblood of the operation," he says. "They are high-tech pieces of machinery, and I don't want to get into replacing reels and other parts. I don't want to rebuild them. I like the philosophy of getting a new fleet every three years. A reasonable life span for everything else is five years or more."

With utility vehicles, Fabrizio is in the midst of slowly changing the fleet from Jacobsen to Club Car's Carryall Turf 2, which is primarily used to move people and tow greens mowers across the course. This change has been an ongoing process that started about three years ago. The 36-vehicle fleet consists of 19 lightweight vehicles (Jacobsen and Club Car), 10 mid-weight vehicles (Cushman, Toro and Club Car), five heavy-duty vehicles (Toro and Cushman) and two sprayers (Toro).

"Throughout the past three years, we've been switching three to five vehicles a year, costing between \$20,000 and \$30,000 a year," Fabrizio says.

The reason Fabrizio is making the switch is partly because Jacobsen hasn't had a stable distribution system in the eastern part South Carolina, he says.

"They have had several different distributors during the seven years I've been here," he says. "But now Vereens seems to be making a dedicated effort for the long haul."

The other reason Fabrizio is making the switch is because Daniel Island's general manager, Greg Keating, decided to switch from E-Z-GO golf carts to Club Car models, and he would like to see all vehicles at the facility be Club Car branded. Club Car also gave Daniel Island an incentive to switch.

"I like trying to stick with the most economic and simplistic utility vehicle

when they're just used for moving people or towing greens mowers," says Fabrizio, who's been at Daniel Island since April of 1999. "You need to have heavy-duty vehicles, but there's no need for an \$11,000 utility vehicle to be pulling a greens mower across the course."

Fabrizio considers his maintenance operation to be normal and utility vehicles should last five to eight years. He says the Jacobsen utility vehicles he's been phasing out didn't last that long and had engine failure because they were used during the construction and grow-in of the courses and took more abuse than normal.

Fabrizio also says utility vehicles generally take a beating because they tend to be used by younger workers who are less responsible than older workers and by people who turn over quickly.

But before Fabrizio makes a purchasing decision about equipment, such as utility vehicles, he receives input from the mechanic, the general manager and his maintenance staff.

"The service of the distributor and the timing of the delivery of the parts are important," Fabrizio says. "The service aspect is the No. 1 consideration. The general manager provides input because he would like to see Club Car carry over to the maintenance side of the operation."

Overall, purchasing utility vehicles nowadays is much different than 30 years ago.

"There are definitely a lot more choices than there used to be," Fabrizio says. "Back then, your choices were Cushman, Red Rider or modifying a golf cart. Now, because there are so many choices, you can make a better educated decision." GCN

Mike Fabrizio can be reached at m_fabrizio@danielisland.com.



Mike Fabrizio, CGCS, receives input from the mechanic, general manager and maintenance staff before purchasing equipment. He's in the midst of switching his fleet from Jacobsen to Club Car.



Around for a while

SUPERINTENDENT IN OREGON USES EQUIPMENT LONGER THAN MOST

Bud Lisac doesn't have a nice fat budget to work with while maintaining the 18-hole Sah-Ha-Lee Golf Course in Clackamas, Ore. In fact, Lisac doesn't have a set budget at all.

"We run on a shoestring budget," Lisac says. "We buy what we need when we need it."

Because of this limitation, Lisac uses his golf course maintenance equipment, including utility vehicles, much longer than most golf course superintendents.

Lisac and his brother, Steve, own Sah-Ha-Lee. They own a total of 65 acres, 35 of which comprise a par-3 golf course and 15 of which comprise a driving range. Lisac and his brother built the public golf course, which is located in an urban area on the outskirts of Portland, and opened it in 1990.

Lisac considers the course a learning center that caters to family and seniors, yet accommodates everybody from scratch golfers to those with a 36 handicap. The seniors and ladies leagues are the biggest at the course. Green fees range from \$7.50 for seniors to play nine holes up to \$19 for golfers to play 18 holes on weekends and holidays.

The course's maintenance staff, in addition to Lisac, consists of two full-time workers and three part-timers.

Because of his shoestring budget, Lisac doesn't lease any equipment – he purchases everything.

"I keep equipment a lot longer than most," he says. "For example, we had our first two greensmowers for 10 years. Other superintendents will typically lease some equipment for three years. Because our green fees are so low, I need to keep my equipment a lot longer than the big boys."

The utility vehicle fleet consists of four John Deere vehicles, enough for everybody to run around the course during the summer, Lisac says. He has

two lightweight 4x2 Turf Gators and two heavy-duty ProGators. The two lightweight Gators are gas powered, and the two ProGators are diesel powered. Lisac says he'll stick with the gas-powered vehicles because he's not keen on the electric-powered ones. He has an electric golf car that he uses as a beverage cart, but he's not happy with the maintenance it requires.

"You get more years out of the diesel engine with the big stuff," he says, referring to the heavy-duty utility vehicles.

Lisac purchased his Gators separately. He says he and his brother will review the course's inventory at year's end and determine what needs to be purchased, if anything. Lisac's newest Gator was purchased this year, replacing an old Toro Workman that he had for 10 years. Lisac says the main reason for the switch is because Sah-Ha-Lee is eight city blocks away from a John Deere distributor and because he doesn't have a full-time mechanic, he needs to take equipment to a nearby dealer when a major repair is needed.

"This is something I take into consideration when purchasing equipment," he says. "I look at every type of equipment the same way. We own everything. We've got Toro greensmowers, four Ford tractors and a Bush Hog tow-behind rotary deck for mowing the rough."

Lisac says utility vehicles are just as imported to maintain as mowers.

"You can't throw shovels and buckets on the backs of your employees and expect them to walk all over the course," he says.

Flexibility is an important quality of utility vehicles as well, Lisac says. One of the Gators he uses has a hitch on it so a golf ball picker can be attached to clean up the driving range.

Durability is another important qual-

ity of utility vehicles because they take more abuse than other types of equipment, Lisac says. In the past, he has had issues with employees treating a utility vehicle like a race car.

"But I still paid \$8,000 for it," he says. "Sometimes employees don't treat utility vehicles as their own, but they tend to treat mowers differently because they're cutting grass at an eighth of an inch and realize mowers are more technical pieces of equipment."

Overall, Lisac says the Gators have held up well and he's pleased with their performance. GCN

by JOHN WALSH



Bud Lisac (sitting in the driver's seat) has just enough utility vehicles for him and everybody on his staff to run around the course during the summer.

travels with  **TERRY**



Terry Buchen, CGCS, MG, is president of Golf Agronomy International. He's a 35-year member of the GCSAA and can be reached at terrybuchen@earthlink.net.

Globetrotting consulting agronomist Terry Buchen visits many golf courses annually with his digital camera in-hand. He will share helpful ideas relating to maintenance equipment from the golf course superintendents he visits – as well as a few ideas of his own – with timely photos and captions that explore the changing world of golf course management.

Easy come, E-Z-GO

In the midst of replacing the golf cart fleet at Congress Lake Club in Hartville, Ohio, Scott Frase, CGCS, and Mike Florea, equipment manager, kept one – a 1989 gasoline-model E-Z-GO with a 2-cycle, oil-injection 1-cylinder engine – and turned it into a functional mechanic's cart.

Florea made no modifications to the cart's engine, but he removed the bag rack and built a 1/4-inch-thick angle iron frame to support the aluminum diamond-plate bed he built using a local fabrication shop. Two aluminum tool boxes were placed on either side of the bed. A hinged aluminum tailgate is held in place on the top end with a flat piece of aluminum and removable lynch pins.

At the bottom of the cart, where the bag rack used to be, Florea installed a 5-gallon air tank for use on the course. The tank is protected with an aluminum cover, which is bolted to the back panel. The back panel houses a pressure gauge and male and female air-hose quick connects.

A 2-inch receiver hitch was welded in place to pull utility trailers, which have turf tires. The windshield that came with the golf cart was reduced to 6-inches high to act as a wind deflector. The vinyl seats were painted with a charcoal-gray, automotive metallic enamel paint. The oversize wheels and tires were acquired from Cart Parts (www.cartparts.com), and a lift kit was made in-house and installed to raise the cart's height by 3 inches so the cart wouldn't be centered too high.

Florea even took a piece of aluminum, put his first name on it and put it next to the ignition switch.



Material list	
Aluminum tool boxes (2)	\$100
Aluminum bed (local fabrication shop)	\$180
Lift kit (built in-house)	\$30
Tires and wheels	\$300
Air tank (5 gal.)	\$35
Fittings	\$35
Paint (supplies)	\$55
Total cost	\$735



A heavy-duty hauler

The trailer pictured transports sod pallets throughout the course at The Old Collier Golf Club in Naples, Fla. It was conceived and designed by Todd Draffen, golf course superintendent; Mike Koopman, equipment manager; and J.W. Stidham, assistant equipment manager, under the auspices of Tim Hiers, CGCS, director of golf course operations.

Koopman ordered a 4,000-pound-capacity utility wagon that had a solid axle, no suspension, wheels with no brakes and 35-psi tires from Northern Tool & Equipment Co. (www.northerntool.com) for about \$500.

Four 8-foot-long pieces of 2-inch-square tubing 1/4-inch thick (\$110) was welded and bolted in place and spaced equally on top of the running gear, which has a telescoping rod connecting the front and rear axles set on the shortest setting. The tie rods were beefed up to handle the weight of the steel plate and about 2,000 pounds of sod. A 4-foot-by-8-foot steel plate (\$200) 1/4-inch thick was purchased locally and cut to fit where the front wheels articulate back and forth by the tongue. The steel plate was painted with a rust protector (\$20).

The trailer is pulled by a Toro Workman utility vehicle to prevent cracking or damaging the cart paths.

Instead of placing a pallet on the ground in one location, the trailer can be moved anywhere the sod is being laid. The trailer also can be retrofitted with 5-foot-high wooden side boards to haul bales of pine straw or other supplies. GCN

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Are you a predator or prey?

A couple of months ago, I experienced one of those gorgeous Indian Summer days that helps carry me through the cold, nasty winters up here on the North Coast. I was visiting a course outside Dallas and playing a fun but mediocre round. I had my feet propped up on the dash of a golf car and was nursing a warm beer while killing time waiting for the group in front of us to clear a nasty little par 3. The moment didn't suck.

As our foursome chatted, I spotted a huge red-tailed hawk turning lazy circles in the azure Texas sky above us. It was an incredibly peaceful scene that made me feel slightly better about being forced to sit behind some boneheads who were convinced they each needed 10 minutes to line up their critical double-bogey putts.

Suddenly, the majestic bird broke its slow, smooth glide and rocketed straight down toward the native area to our right. At the last second, she spread her wings and slowed just enough to lower her talons and expertly snag something small, brown and furry that had – up to that moment – been minding its own business in the tall grass. She screamed that cool hawk victory cry and slowly flapped off into the distance to enjoy her snack.

It was a very bad day for that pitiful little varmint, but just another fast-food meal for one of Mother Nature's kick-ass predators.

That moment got me thinking: In the great outdoors, every day is life or death for that deadly killer hawk and for the cute little ground squirrel that had the misfortune of twitching a muscle at exactly the wrong moment and catching her attention. In the circle of life, you're either the predator or the prey.

Is our industry any different?

We have 16,300 golf courses each trying to get their share of a revenue pie that just doesn't seem to grow from the 500-million-round plateau it's been stuck at for a decade. Every course is different, but each has to hit a number that makes it economically viable to survive or even prosper. When it comes to hitting that number, are you the sharp-eyed, hungry hawk or the unsuspecting little fuzzy mammal? Are you the predator or the prey?

Take this quiz

Here's a quiz based on Jeff Foxworthy's "You know you're a redneck if ..." routine to help you gauge which category you fit in.

- You know you're a predator if you have a well-thought-out player development plan to attract and retain golfers at your facility.

- You know you're prey if you just assume people will show up and plop down money to play at your place.

- You know you're a predator if you're almost 100 percent focused on the golf course as your primary source of business.

- You know you're prey if you're spending all your time worried about choosing a new wallpaper design for the clubhouse or hiring a new pastry chef for the kitchen.

- You know you're a predator if you're aggressively finding ways to improve the golf course and keep up with modern club and ball technology and offer something new to players.

- You know you're prey if you think the course is just fine as it is and there's no need to consider any upgrades or improvements.

- You know you're a predator if you show up for work every day feeling like Conan the Barbarian, with a strong desire to crush your enemies, see them driven out before you and hear their women lament.

- You know you're prey if you think your competitors are pretty nice guys and you wish them the best of luck.

- You know you're a predator if you're driving around every Saturday morning to check how full the parking lots are at other courses in the area.

- You know you're prey if you're happy to fill half the tee sheet every Saturday.

- You know you're a predator if you've brought your management team together to do a SWOT (strengths, weaknesses, threats and opportunities) analysis of your facility.

- You know you're prey if you're just working off a bunch of unexamined assumptions about your course and your competition.

- You know you're a predator if you have a carefully developed marketing strategy that sets you apart from everyone else based on a unique selling proposition.

- You know you're prey if you think your course speaks for itself.

- You know you're a predator if you're investing in radio, print, TV and online advertising to bring new customers to your course.

- You know you're prey if you think word of mouth is all you need.

- You know you're a predator if you understand player retention programs, like coupons and frequent-player cards, are a cheap way to generate revenue.

- You know you're prey if you're not making attempts to keep players coming back for more.

- You know you're a predator if you're convinced a great superintendent is the most critical member of your staff and you're doing everything you can to find and keep a world-class professional for the job.

- You know you're prey if you think a new food-and-beverage manager will solve all your problems by lowering food cost or creating a new menu.

- You know you're a predator if you walk or ride your course at least once a week and critically analyze conditions based on how golfers perceive the course.

- You know you're prey if you think green is good enough and have fairways full of clover.

- You know you're a predator if you have an Internet site that compels Web-savvy golfers to give you a try and makes it easy to find directions to your facility.

- You know you're prey if you still believe Web sites are a silly waste of money.

So, how did you score? Is your facility a razor-clawed raptor or just another item on the appetizer menu? If you're a true predator, congratulations. You're likely to survive the tough business challenges during the next few years. If you're merely prey, you might as well go lie down and find a nice comfortable place to wait in the tall grass because that big red-tailed hawk is coming. GCN

EVERY COURSE IS DIFFERENT, BUT EACH HAS TO HIT A NUMBER THAT MAKES IT ECONOMICALLY VIABLE TO SURVIVE OR EVEN PROSPER.

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