#### FEATURE ARTICLE Jon Jennings, CGCS Chicago Golf Club

# Time to Run

Given the time demands that managing a golf course requires, why would you consider taking on an activity that would consume upward of five to eight more hours a week of time you don't even have? It has been hot, dry; you and your staff are tired of each other. Your family remembers you only by a photograph hung on the refrigerator, and when neighbors invite you over in the evening, chances are your head is slumping in the southward position by 8:30 p.m.

My introduction to running began in high school. Not on a track team, but with the sports that used it as punishment. Football and lacrosse used running as conditioning. They also used it as a way to discipline players if the team was not performing satisfactorily.

Considering that, why would anyone in their right mind ever want to run a marathon? The marathon distance is 26.2 miles, that is 26 miles, 385 yards. A friend of mine once said, "I can't even drive 26 miles without getting edgy." I have observed running t-shirts of college track teams that read, "Our sport is your sport's punishment." Given the overall negative sentiment toward running, I'd wager that most people would rather have bamboo shoots inserted under their fingernails than start a running regime.

The first event to be called a marathon was held in 1896 at the first modern Olympic Games in Athens, Greece. For a dozen years, the official marathon distance was approximately 25 miles. That was the distance run in the 1900 Olympic Games in Paris and the 1904 Games in St. Louis. Then in 1908, in London, the British designed a marathon course that started at Windsor Castle and finished at the Olympic Stadium.

Nobody challenged the British course design, which was reportedly laid out so that the royal family could see the start of the race. The distance from start to finish for that marathon was precisely 26 miles and 385 yards. For whatever reason, that distance became the standard for future marathons.

#### **Absolute Beginner**

My introduction to running began in high school. Not on a track team, but with the sports that used it as punishment. Football and lacrosse used running as conditioning. They also used it as a way to discipline players if the team was not performing satisfactorily. I never really liked running. My close high school friend had parents that were very much into distance-running. They were my first exposure to running for a reason other than what a coach yelled out for you to do.

In the early '80s, there were not nearly as many people distance-running as there are today. Chuck and Barbara Kipp were very athletic. They had both run many distance races and numerous marathons. Both in their late 40s at this time, they were not like other parents, or at least like mine. They ran everyday before work. They ran in the heat, cold, rain, snow, whatever. At first I thought it was bizarre. However, the more I was around them with my friend Cliff, I accepted that it was just what they did. Eventually I became intrigued and asked questions.

I began running in small increments around our neighborhood. A while later, I extended the run to a few miles. I finally built up the stamina and endurance to enter a race. On St. Patrick's Day, 1982, I ran my first competitive road race. The distance was 10 kilometers or 6.2 miles. I was exhausted by the finish, but satisfied in my accomplishment. The Kipps encouraged me to pursue a marathon and I entered the lottery for New York City. As luck would have it, I was accepted.

I was off to college that fall and played rugby—again, a sport that punishes with running. Making the transition to college was not as easy as I had figured. The amount of studying was overwhelming. Mid-October rolled around and I had not put in any miles toward the marathon, which was the first (continued on page 12) Sunday in November. Needless to say, I did not run.

Ed Acton, my college roommate, participated in triathlons. He was from Barnstable, Massachusetts, a short distance from Boston. He told me of how great the Boston Marathon was and suggested we train for it and run the following spring.

We began our training in February. Having no guidance, and not being smart enough at the time to look up the information, we would run upward of 15 to 20 miles, six days a week. This distance was getting easier each week. By late March, we were nearing the marathon distance with our training. During a run, I felt a sharp pain radiate from the top of my leg all the way down to my calf. Something was wrong.

I did not run over the next couple of days and figured I had pulled a hamstring. The problem was, it was uncomfortable to sit, stand and walk. I saw a doctor and was diagnosed with sciatica. Sciatica is when a disk in your back shifts outward, pressing into the sciatic nerve. Because of the injury, I did not run the Boston Marathon. The Boston Marathon requires you to complete another marathon within a given time in order to qualify for the event. We would not have been officially entered anyway.

Moving forward to 1998, I was engulfed with a career and a young family. Finding the time to do anything outside of that was unheard of and in my mind, unrealistic. My running had been reduced to a couple times a month and I participated in two or three races a year. Pat Sisk, CGCS at the Country Club of Fairfield (now, Milwaukee Country Club) and a close friend of mine, had recently run the New York City Marathon and earlier in the year, had completed the Jersey Shore Marathon. I asked him about his experiences and how he trained. He then suggested that I attempt to train for one. I told him of my injury when I was training in 1986.

He said that training was different now. The experts had moved away from the day-after-day, longmileage runs and were now mixing long runs with short runs. He later gave me the book that he had used for his training, *Making the Marathon Your Event* by Richard Benyo. I read it with interest. I figured that I could do this and mailed in my entry for the New York City Marathon. My name, and Pat's, were drawn from the lottery in May. I was now in, and was pretty excited about it.

The problem, however, was now it was summer and I was consumed at the golf course. I would have to be creative, especially on the long-run days. Shorter runs, ranging anywhere from five to 12 miles, were relatively easy to squeeze in. The longer runs, 13 to 20 miles, took a greater amount of time. I lived 11 miles from the golf course. Saturday and Sunday mornings, I usually worked from 5:00 a.m. to approximately noon. I found that by bringing my running gear to work, I could run home, get some water and run back to check the golf course later in the afternoon. Normally, it was about a 20-minute drive. I could run the distance in about an hour and 20 minutes. This worked well in regard to time management.



Marathon week arrived. Living near metropolitan New York, marathon excitement was spreading throughout the area. The Thursday morning prior to the marathon, Pat and I traveled into Manhattan to pick up our race numbers and information. We drove to the marathon exposition on the west side of the city and waited for our turn to enter the building. Inside, we received our race number, a t-shirt, a packet of information and a race chip.



Thousands of runners crowd the starting line at large races such as the New York City and Chicago marathons.

The race chip is an electronic device that attaches to your shoe laces. Measuring about an inch-anda-half in diameter, the chip registers when you start the race as you cross a mat with a receiver in it. It also keeps track of your progress on the race course. The best part of the chip is that it formulates a net running time for each person. In large races such as marathons, there can be anywhere from 10,000 to 40,000 runners.



A sea of runners waits for the starting gun.

The time it can take to get to the starting line may be as little as a minute to more than 15. The chip starts your race time as it crosses the starting pad and stops when you cross a finish pad. The gun time is the time from when the start of the race officially occurs. Your chip time is the period of time in which you as an individual actually completed the race.

Pat and I stayed in New York instead of driving in from Connecticut. The night before a marathon, sleeping is a challenge as you think about the next morning's event. With that said, the night prior to the night before becomes essential for you to properly rest for the race. The New York City Marathon is a point-topoint race. This means you start in one spot and finish in another. (Whereas, the Chicago Marathon has a start and finish point approximately in the same place.)

#### The First Race Remembered

The logistics of New York are a nightmare. Organizers have to transport 35,000 runners to Staten Island in the morning for an 11:05 race start. On race day, we begin our trek to the New York City Library, where buses will carry us to the staging area. As we walk south from 76th and Lexington at 5:30 in the morning, we begin to see other runners pouring out into the streets, joining us from all directions.

At the New York City Library, a long line of tour buses is being loaded and moving out toward Staten Island. We listen to the directions being broadcast and board our bus. The sun is just starting to light the sky as we leave Manhattan. The mornings of fall marathons can be cold. You do not want to overdress for the run: however, you will be outside for three to four hours. This is where old clothing or inexpensive; fashion faux pas clothing comes in handy. How you look is not as important as staying warm. Color schemes can be thrown out the window. I usually anticipate a marathon in advance by a few months and start looking for old clothing I don't care about. This will include a work jacket with a tear, old sweatshirts, winter gloves, wool hats and clothing that otherwise would have been thrown away. I have also gone to discount department stores and purchased really ugly sweatpants for \$8 that I will wear that morning and cast away before I start the race.

Bathrooms, or to be honest, port-a-johns are very popular race morning. Anticipate a long wait to access to one. Although there are The night before a marathon, sleeping is a challenge as you think about the next morning's event. With that said, the night prior to the night before becomes essential for you to properly rest for the race.

many scattered around the staging area, thousands of other people have the same idea. The lines start early and become very long. Your wait may be upward of 15 minutes.

As the start of the race nears, runners are directed to begin heading toward their designated starting pens based on race bib numbers and colors. I can barely see the start from my position. We move up a long ramp and make our way into place. There are more announcements and the national anthem is sung. A sea of clothing being cast off in all directions is seen from every part of the starting area as the runners prepare to make the journey through New York's five Burroughs, finishing in Central Park.



Runners at the N.Y. City marathon shed their warm-up clothes before the race begins.

<sup>(</sup>continued on page 14)

#### Time to Run (continued from page 13)

Above the Verrazano Narrows Bridge that links Staten Island to Brooklyn, at least a dozen helicopters hover, providing an apocalyptic setting. A word of caution that I take to heart is, stay near the center of the bridge if starting on the lower deck. The reason for this is runners on the upper deck are urinating off the side as they start. During the race, all pride and humility are gone. Both men and women are utilizing everything from trees, street signs and anything else that may be deemed appropriate at the moment for use as a toilet.

The start of the race occurs with a short word from then-Mayor Giuliani and a cannon firing. I stand in place for five minutes before the mass of people I am surrounded by even begins to lurch forward. Nine minutes later, I cross the starting line, walking. A few hundred more yards and my walk turns into a gentle run. The sea of people crossing the bridge is absolutely amazing. Never before have I been surrounded by so many runners. Below, fire boats spray plumes of water into the air. The race start is exhilarating, although there is no place to go as the roadway is littered with runners. My first mile is over 11 minutes. I was hoping to be closer to 8.



Running a marathon affords a scenic tour of the host city and its landmarks.

I am surprised at how quickly the miles go by. Ten, 11, 12, each one feels a little faster than the one prior. As I cross the halfway mark, I feel very good. I am running a little off the pace I was hoping for with my overall goal to finish in less than four hours.

There are times on the course where spectators are spread a little thin and your mind begins to wander. After all, I have been running for more than two hours. At other points during the race, there are bands and deejays playing loud music for motivation.

Mile 19 is unbelievable; coming off the bridge onto First Avenue, more than a million spectators are assembled and the roar of their cheers can be heard from over a mile away. Their enthusiasm pumps new life into my body. This lasts for a couple of miles as the course heads north into Harlem. The crowds diminish at this point, not to return until mile 22, and Fifth Avenue.

Most experienced marathoners will tell you that the marathon begins at mile 20. If you have not run one before, it doesn't really make sense. Your body at mile 20 suddenly feels very tired as all of the glycogen in your muscles is gone and your body begins to burn fat, which is not as efficient with respect to being an energy source. You are thirsty and now, the miles feel longer. In fact, each mile feels incrementally longer than the one before. The course becomes hilly as I enter Central Park and slightly rolling hills feel like





www.dryject.com

mountains. I cross the 24-mile mark and realize that I have 2.2 miles to go. I think about how far 2.2 miles is from my house and tell myself, I can do that. The south end of Central Park is electric with cheering spectators. I feel energy spark within me and pick up my pace. As I climb the last hill toward the finish line, I run as fast as I can, mustering every bit of determination for the last stretch.

There are banners, cameras and people everywhere as I cross the finish line with a time of 3 hours, 46 minutes and 13 seconds, placing 6,414 out of 31,785 finishers. I had met my goal. As I walk away from the finish line, north through the park, a volunteer places a finisher's medal around my neck. I am offered a Mylar blanket for warmth and wrap myself in it. The exit out of the park is about a half-mile north of the finish. At this point, I am overwhelmed with thoughts of what I have just accomplished. Running 26.2 miles under four hours and having enough strength to kick at the end is amazing in my mind.



The author, a little dazed upon completion of the 2002 N.Y. City Marathon. Note the finisher's medal around Jon's neck.

#### My Life as a Runner

My training has changed since 1999. I have utilized information from Hal Higdon, senior writer for *Runner's World Magazine*. His book, *Marathon*, The Ultimate Training Guide, outlines specifically rigid steps for safely and effectively training for and completing a marathon. Beginning 18 weeks from the start of the race, my official marathon training begins. Prior to starting, I have a base mileage of about 25 to 30 miles a week.

The training program consists of running five days a week. Tuesday, Wednesday, Thursday, cross-train Friday, run Saturday, Sunday, cross-train Monday. I alter this schedule to fit my life. I run Wednesday, Thursday and Friday, take Saturday off, run Sunday and Monday, then Tuesday off. The reason for this is, we start work at 5:00 a.m. Friday, Saturday and Sunday. 6:00 a.m. is the starting time the rest of the week. Mondays are when I do the long runs before work, so I am able to sleep an extra hour before I run.

The thing that startles most people is the early hour that I run. I found that if I waited to run after work, I would end up not running. I would leave work in the summer at 5:00 or 6:00 p.m., get home, have dinner and it would be time to go to bed-and I did not run. By getting up earlier and running before work, I was guaranteed to have the run out of the way before my day began. For shorter distances, this equates to getting up an extra hour before work. As the program progresses, the first three days have you running five, 10, five miles. The last two days of the week are 10 and 20 miles respectively. For the 20-mile runs, I allow two hours and 40 minutes of actual running time. For a 6:00 a.m. start at work, this means leaving the house running at 2:20 in the morning.

Running at this time of day has pluses and minuses. The advantages include the fact that not very many cars are on the road. You are able to run without having to wait for traffic lights or cars to get out of your way. The night temperature is much cooler than the day. Without the sun, you can focus on running and not how hot your body is becoming.

But there are some negatives to running in the early morning when it is dark. Although traffic is much lighter between 2:30 and 5:00 a.m., some cars are on the road and the people driving are not even close to thinking about runners. I wear a reflective vest when I run in the dark The thing that startles most people is the early hour that I run . . . For the 20-mile runs, I allow two hours and 40 minutes of actual running time. For a 6:00 a.m. start at work, this means leaving the house running at 2:20 in the morning.

and my running shoes have reflective material on them. In the suburbs, the cars that are most troubling are those of the newspaper delivery people. Careening from side to side, throwing newspapers into the driveways, they are paying attention to their deliveries, not someone running. Still, my biggest concern is when I run early Sunday morning. People are heading home from parties or bars when I am running and not thinking about runners. I always run against traffic when running on roads and have jumped up on the grass a few times when cars appeared to be heading directly at me.

My favorite anecdote was one time when I was running on Ogden Avenue around 3:00 a.m. and saw a car drifting toward me. I immediately jumped up on the grass to get out of the way. As the car passed me, I saw it was a Naperville police car. I think I startled him as much as he startled me. I glanced back and saw the car's brake lights.

The car immediately turned around in the middle of the road and came back over toward me as I was still running. He pulled in front of me with the car and cut me off. I paused the time on my watch and approached the car. The officer (continued on page 16) looked at me, puzzled, and asked me what I was doing. I explained that I had to be at work by 6:00 a.m. and was training for a marathon and this was the only time I had to train. This stopped him dead in his tracks; he replied, "Be careful," and drove off.

Other hazards are the occasional early-morning skunk encounter. Skunks are more active in the late summer and early fall. Joel Purpur of the River Forest Country Club once told me that skunks cannot spray as long as they are running. If they stop, they can lift their tail and spray. I always give wandering skunks a wide berth, allowing them to get wherever they desire.

To break up the monotony while I train, I wear a Walkman. I use one I purchased in 1988 that still works great and has probably been on 6,000 miles of running with me. I listen to the news, weather, sports or music. Most days, I jump around on the dial and listen to a little of everything. I have tried other models, but keep coming back to the old one. I received an Apple iPod last Christmas, which I used for a while. At first it was great. I would have songs that I wanted to listen to and it had 40 MB of storage, plenty of room for all my favorite music. The downfall I found with the iPod was that the controls on the front are heat-sensitive. The touch of your finger changes the track you are listening to or the volume. During very cold days, I could not generate enough heat to activate the controls. As the weather began to warm, too much heat would build in my hands and overtake the controls. Songs would skip or jump, making for a very frustrating run. For now, I continue to run with my old Walkman. Its reception is good, and as long as it keeps working, I see no reason to change.

#### Advice for Would-Be Runners

As far as what clothing to wear when running, a good guide is to be a little cold at the start. If you are comfortable standing outside in the winter prior to the run, you are wearing too much. Even on the coldest days, the most clothing I wear are running pants, a synthetic running shirt that wicks moisture away from the body, a nylon running jacket, a hat and gloves. The jacket is worn if it is below  $30^{\circ}$ . I wear a face-covering hat if it is below zero.

The coldest weather in which I have endured running is -15°. The nylon jacket becomes stiff at that temperature and the front of your face and corners of your eyes freeze up wherever there is any moisture. I have skied in colder weather, so running in it did not faze me. A little trick to use in the winter before heading out on a cold morning is to toss your running gear in the dryer right before you put it on for the run. The added warmth of the clothing will keep vou a little warmer until vour body has an opportunity to heat up from the first mile.

The shoes you wear are critical to your health and the way your body feels while you run. If you are just starting out, visit a running store and ask a lot of questions. Be upfront with the salesperson and discuss the type of running in which you wish to participate. Expect to wear a larger shoe size in running shoes than in street shoes. A larger toe area is necessary with running shoes than with street shoes in order to prevent your toes from banging in the front of the shoe. Wear your running shoes only for running. The reason for this is so they do not break down faster than they need to.

The cushion on the shoe bottom is the part of the shoe that protects your feet from the punishing blows inflicted upon them from pounding the asphalt mile after mile. Shoes commonly last between 250 to 400 miles before the cushioning has been compromised and your body begins to take notice. In my case, I can tell when a shoe's life is just about over when my knee, hip or lower back begin to develop a nagging ache. The pain may be different for different individuals.

I think that cross-training is important in order to balance your body. I run between 1,000 and 1,500 miles a year. When I train for a marathon, I have little time for any other exercise. However, once the marathon is over, I lift weights, Stairmaster and do other things I was unable to do while training.

Diet is also important. You can lose a substantial amount of weight while training for a marathon. If you are already near your goal weight, you will need to increase your caloric intake. For every mile you run, your body burns 100 extra calories. On the high-mileage weeks, this is upward of 5,000 extra calories that are expended. I eat like a horse while I am training, consuming as much as and anything I want. The problem lies in the two to three weeks leading up to the marathon when you reduce miles and begin your taper for the race. At this point, I am not burning as many calories and it is even worse the couple of weeks following when I am not logging very many miles. Traditionally, I have gained 10 to 15 pounds following a marathon, which I am sure sounds hard to believe. As the miles are reduced, your caloric intake must also be reduced.

When training with your daily runs, do not expect improvement everyday. You will have good days and bad days. Some days, it will feel as though your body just doesn't want to get in gear and it is a laborious effort to get moving. Other days, it will feel as though you do not want to stop with each mile getting easier to finish. "Runner's high" is a description used when the endorphins within your body make you feel energized and excited about what you are doing. Depending upon your fitness level, this may kick in at various times. I personally do not always feel it; however, I have from time to time. Usually it is around the five- to sixmile mark, after my body has loosened up and I am moving and breathing comfortably.

I have run five marathons since that first one in 1999. Four of those five have been the LaSalle Bank Chicago Marathon and the other was New York, again. I prefer marathons that are close to where I live. I find it much easier to travel to them and sleep better in my own bed. I actually ran the Chicago race in October 2002 and New York three weeks later. This, I will tell you, is not advisable. Your body requires a long period of time to recover following a marathon with three weeks not being nearly enough.



The author crosses the finish line at the 2001 Chicago Marathon.

During the New York race, I was exhausted from mile 19 through 26.2. I have never walked during a marathon prior to this. As I approached each water stop, which is at every mile mark, I would grab a cup of water and drink it while walking. When the cup was empty, I would roll into a run. At mile 24, a woman who was also walking and limping looked at me and said, "Come on, you run and I'll run." This was the inspiration I needed, and I started to run again. We ran together for about a mile when the pain in her knee was too excruciating. As she slowed to a walk, she yelled at me, "Keep going," which I did to the finish.

This is just one example of the support you will encounter on the marathon course. People who are watching are enthusiastic to see you finish, other runners want to see you finish, and most of all, deep down inside, you want to finish. Having family members watch and support you while you run is great. Some of my best memories during the marathons I have run are seeing my children jumping up and down with excitement, holding signs as I run by and give them high-fives.

A popular thing for runners to do is inscribe their names somewhere upon them. Most of the time it will be on the front, back or both sides of their shirts. The reason for this is to attract spectator participation. For instance, I was running next to a man named Frank this past fall. Frank and I maintained the same pace for about three miles before drifting apart. Frank had "Frank" written in large block letters on the front and rear of his shirt. As he ran by the crowds, people would shout, "Go Frank, keep it up Frank, good work Frank," and it went on and on. These people had no idea who Frank was, nor had they ever met him before. However, by virtue of having his name spelled out his shirt, people were able to identify and cheer for Frank.



Runners with their names emblazoned on their shirts draw plenty of enthusiastic support from spectators, who shout encouragement.

A popular goal for many marathoners is to qualify for the Boston Marathon. There is a sliding scale of qualifying times for Boston that adds more time as you get older. Qualifying for Boston is the runner's equivalent to qualifying for the U.S. Open in golf. The qualifying time for men age 35 to 40 is 3:15. My prior times in Chicago ranged between 3:17 and 3:21. I did not run a marathon the year of my 40th birthday. The qualifying time for men age 40 to 45 is 3:20. Knowing that my three previous starts in Chicago had yielded a time within this range, I felt relatively confident that I could meet my goal this year.

I ran the first half of the marathon ahead of schedule, building up a threeminute reserve toward my goal time of 3:20. As I mentioned earlier, the race really began at mile 20. My pace began to slow and I was about 20 to 30 seconds per mile off my intended pace. I finished the race in 3:19.20, with a net chip time of 3:18.45. I had finally qualified for Boston.

There are many different approaches to training for a marathon. Many marathons are available throughout the country and the world during "Runner's high" is a description used when the endorphins within your body make you feel energized and excited about what you are doing. Depending upon your fitness level, this may kick in at various times.

any season you wish. Find the training program that fits you best and a marathon that will inspire you to train and finish. Not everyone will want to run a marathon. But once you have, that is a memory you can savor for the rest of your life.



Weary but triumphant, Jon poses in front of Buckingham Fountain after running the 2002 Chicago Marathon.

#### References

Benyo, Richard. Making the Marathon Your Event. Higdon, Hal. Marathon, the Ultimate Training Guide.





#### COMMENTARY Dan Glitto Prime Turf

## Another Helping of Alphabet Soup

Editor's Note: This is the third of a series of articles discussing water quality. Parts one and two appeared in the September and October 2004 issues of On Course.

The highly negative effects of sodium displacement of calcium and magnesium at the cation-exchange sites has lead to a number of indices designed to help predict and determine the potential effects water quality has on your soil and turf. The following review should be helpful in understanding these indices and how to work through them.

Here in the Midwest, we rarely encounter natural waters with high sodium levels, but we can suffer from induced sodium problems when high pH and high bicarbonates "tie up" calcium and magnesium, making them unavailable for exchange.

## Sodium Adsorption Ratio (SAR)

One index we see with regularity is the SAR. This has been used to rate the permeability hazard, but really gives a limited view of our Midwestern waters because it neglects to incorporate considerations for pH and bicarbonate alkalinity. However, we should review it for background.

We know that high sodium levels are problematic because the sodium adsorbs onto the soil cationexchange sites. This causes sealing of the soil and a corresponding reduction in the permeability of water and air flow. The potential for sodium to replace other cations (Ca & Mg) on the cation-exchange sites is calculated with the SAR, which looks at the ratio of sodium levels to calcium-plus-magnesium levels in the water. This is called the Sodium Adsorption Ratio.

The SAR is determined by the following formula:

$$SAR = \frac{Na}{\sqrt{(Ca + Mg) \div 2}}$$

These values are expressed in meq/l. (Refer to the second piece in this series, October 2004, for important equivalent weights and conversion calculation.)

The SAR does not account for well-documented chemical reactions between alkalinity and water hardness (Ca & Mg). Water hardness is the natural result of rock weathering. Calcium usually is higher than magnesium. These elements are the main ones causing the scale-forming properties of waters. In general terms, as water hardness increases, the tendency for sodium to become toxic decreases. However, where pH and alkalinity are high (< 7.0 and < 120 ppm), the hardness is tied up with bicarbonates and therefore, the sodium can displace them at the exchange sites.

#### Adjusted Sodium Adsorption Ratio (adj.SAR)

The Adjusted Sodium Adsorption Ratio (adj.SAR) is more complex than the SAR but should be used when the carbonates or bicarbonates are high. If bicarbonates are less than 2.0 meq/l (120 ppm) and carbonates are less than 0.5 meq/l (15 ppm), use SAR.

In many of your waters, the bicarbonates are higher than the levels shown above. These waters should be evaluated by the adj.SAR.

Adjusted Sodium Adsorption Ratio = SAR [9.4-pHc]

Determining pHc is necessary to calculate adjusted SAR. Make sure that the SAR and adjusted SAR are included on your water-analysis reports.

#### The pHc

- Theoretical calculated pH of water when it is in contact with lime.
- Indicator of dissolution (> 8.4) or precipitation (< 8.4) of lime in soil.</li>
- Saturation Index = pHa-pHc
- If positive—precipitation likely referred to as a "depositor."
- If negative—dissolution likely referred to as a "stripper."

The pHc adds consideration for pH and alkalinity to the mix.

pHc=(pK'2-pK'C)+p(Ca+Mg)+p(Alk) (continued on page 20)

#### Another Helping of Alphabet Soup (continued from page 19)

- (pK'- pK'C) obtained from the sum total of Ca/Mg/Na from a table.
- p (Ca + Mg) obtained from sum of Ca and Mg in table as well.
- P(Alk) is sum of HCO<sub>3</sub> and CO<sub>3</sub> from table.

#### **Recommended Guidelines**

- SAR (Sodium Adsorption Ratio) .....< 3\*</li>
- pHc (Calculated).....>8.4
- \*meq/l

## Residual Sodium Carbonate (RSC)

In addition to the pHc and Adj. SAR, the use of the Residual Sodium Carbonate (RSC) is very useful for evaluating sodium hazard in water applied directly to the soil. In these calculations, the potential for precipitation of calcium, magnesium bicarbonates and carbonates is considered. If these constituents precipitate out of the water, relative amounts of sodium will increase in the soil solution. This fits Midwestern waters nicely. The RSC:

 Forecasts the accumulation of sodium in the soil based on the potential precipitation of calcium and magnesium with bicarbonates and carbonates.

• Should be ZERO or less. Anything above that should be considered for treatment. Above 2.5 is not suitable for irrigation.

If HCO<sub>3</sub> and Ca are high (10 meq/1), the RSC will be low but will still precipitate CaCO<sub>3</sub> and cause a problem. This requires further analysis.

RSC=(CO<sub>3</sub>+HCO<sub>3</sub>)-(Ca+Mg)

The RSC equals the sum of the bicarbonate and carbonate ion concentrations minus the sum of the calcium and magnesium ion concentrations, where the ions are expressed in meq/l. Where excess or "residual" carbonates are in the water, calcium will be stripped from the soil exchange sites. These unoccupied exchange sites then become available for sodium to dominate. A reduction of carbonates and bicarbonates will leave the calcium and magnesium in solution.

A negative RSC indicates that sodium build-up is unlikely since sufficient calcium and magnesium are in excess of what can be precipitated as carbonates. A positive RSC indicates that sodium build-up in the soil is possible. The degree of sodium hazard is as shown in the table below.

Next time, we'll review various techniques to reduce the negative impacts of poor water quality. Happy New Year!

-Vestavel

RSC	HAZARD	
< 0	None.	
0-1.25	Low, with some removal of calcium and magnesium from irrigation water.	
1.25-2.50	Medium, with appreciable removal of calcium and magnesium from irrigation water.	
> 2.50	High, with most calcium and magnesium removed leaving sodium to accumulate. Unacceptable.	

