extra sunscreen that day or is the UV level fairly low. This also changes based on the time of year. June is vastly different from September in terms of sun strength and the amount of daylight."-Larry Divito, Minnesota Twins

"The first thing I do every day is to wake up and check the latest weather reports and discussions. Weather impacts all parts of our operation and planning. This goes on 24/7/365 as the grass does not know what a weekend or holiday is. I read the latest National Weather Service weather discussion and forecast every day at 6 am and 4 pm (when the updates come out). We also contract with a local weather consultant and they issue daily reports every morning. Our weather consultant also offers a lightning and severe weather notification service that we use for events at the stadium."-Ross Kurcab, Invesco Field at Mile High, Denver Broncos

"The weather is not just confined to temperature, precipitation and wind; sun angles play a big part as well. Do we plow snow? Is the sun going to melt the snow/frost? Do we syringe the fields? Do we put on the Evergreen blankets? This is just the tip of the iceberg as there are so many other decisions based upon the weather forecast that it makes it a necessity to be on top of the weather not only on daily but also a week ahead of time. It is also useful to know what the climatic averages are for your particular area."-Troy Smith, Denver Broncos Practice Facility

Websites are excellent resources for current weather information. The National Weather Service has an excellent website loaded with information at www.weather.gov. In addition to the standard reports of current conditions, forecast and maps they also provide links to items like their forecast discussions prepared by staff meteorologists (it's listed under their Additional Forecasts and Information Section). These discussions can provide additional insight as to why they are making a particular forecast.

Also, there are weather consultant services available online that can provide the sports turf manager with forecasts and real-time storm and lightning information. This information can be relayed directly to your cell phone to help you make game-time decisions regarding severe weather, etc. These services are fee-based, but each program is tailored to the particular needs of each facility's situation.

Weather affects nearly every aspect of a sports turf manager's job. Having a better understanding of current weather conditions and using forecast information to your advantage can make your life much easier which may save you time, labor, and money now and in the future. ■

Brad Jakubowski is an instructor at Doane College in Lincoln, NE. He would like to thank those who contributed to this article.

Cracked earth image courtesy of istockphoto.com

By Thomas Serensits

Field management during a drought

Editor's note: This article originally was commissioned by the Sports Turf Managers Association as part of its "Resources" library.

MANAGING TURF DURING DROUGHT CONDITIONS can be one of the most frustrating times for an athletic field manager. You may have perfectly groomed your field during the spring, but if you don't have an irrigation system or water restrictions are put into place, your field is at the mercy of Mother Nature. As water-use restrictions become more common across much of the country, turf areas like athletic fields are often the first to feel the ramifications.

It is important to prepare your field and have a management plan for drought conditions before the weather turns dry. Once you are in a drought, there are still some management techniques that you can use to increase the chance that your turf will green-up and start growing once it starts raining again. Here are some tips to get you through drought conditions.

Properly preparing your field to take on the stresses of a drought gives your turf the best chance for survival.

• Become aware of local and state drought regulations well in advance of drought conditions.

• Monitor your water use throughout the year so you can provide information to drought regulators during a drought emergency. In some cases, this information is required to allow you to water your fields during a drought.

• Develop a written document that outlines your plans for watering during a drought. You can then share the plan with water regulators, administrators, athletes, parents, and community.

• Establish a Best Management Practices (BMP) document for your facility. An outline/template can be found at http://commodities.caes.uga.edu/turfgrass/georgiaturf/Publicat/BMP/BMP_06.pdf

• Identify high priority areas that must be watered regularly such as a stadium field, infield, or the center of a practice field.

• Show how many gallons of water you can save by following your plan.

• Developing these documents will show that you are being proactive and have already planned out what you are going to do if a drought occurs.

Fertilization

• Take a soil sample and send it to your local testing facility (most universities can test your soil). You will get a report back with fertilizer recommendations that you can use to set up your fertilizer program. Proper nutrient levels in your soil promote healthy turf heading into drought stress.

• Avoid applying quick release nitrogen (urea, ammonium sulfate) late in the spring. These fertilizers decrease your turf's ability to handle dry conditions.

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Promote Deep Roots

• Aerify with hollow tines to relieve soil compaction, reduce thatch, and increase oxygen levels in the soil during the spring and fall.

• Raise your mowing height if drought conditions are expected. Don't wait until the drought hits to raise your mowing height, it will be too late to help.

• Alternate your mowing pattern to reduce soil compaction from mower tires.

• Water efficiently in the spring. Deep, infrequent irrigation promotes deeper rooting. Water enough to wet 6 to 8 inches deep (check with a soil probe), and then wait to irrigate again until the turf begins to turn a dull, blue color, the first sign of moisture stress.

Prepare the Irrigation System

• Perform an irrigation system audit. Place catchcans of equal size in a grid pattern about 15 feet apart around each sprinkler and run each sprinkler for 15 minutes. You can then determine the distribution uniformity. Make adjustments to nozzles, arcs, and pressure regulators if needed.

• Make sure sprinklers are all rotating properly and are not leaking.

• Replace worn-out nozzles. You can get a water savings of up to 6% just by replacing worn-out nozzles.

What to do during a drought

Once the weather turns dry, do everything you can to reduce the stress on your turf. You also must be prepared to communicate the condition of your field and your watering practices to interested parties.

Communication

• Hopefully you already have a written document explaining your plan and best management practices (BMPs) for watering during a drought (see above section on writing a contingency plan). You can use this document as the basis for your communication with administrators, coaches, parents, and athletes.

• Explain the consequences of playing on non-watered fields. These include injuries because of hard surfaces and worn-out turf that is unable to recover.

Maintenance Practices

• Do not perform any cultural practices such as aerification or vertical mowing during drought conditions; the turf will not be able to recover.

• Only mow when needed. Your turf's growth rate will be much slower during dry weather. Mowing when it is not needed only puts more stress on the turf plants.

• Do not apply growth regulators or pesticides.

• Herbicides can be especially damaging during hot, dry conditions.

• Applying a wetting agent will help to disperse water into water-repellent soil. Be aware that wetting agents actually lower the soil's water holding capacity.

• Avoid applying fertilizer until wet weather returns.

Irrigation Practices

• Water during the early morning hours (4:00 – 9:00 AM). This is the most efficient time to water because the evaporation rate is low and wind speed is minimal.

• Eliminate overspray onto sidewalks, parking lots, etc. where possible. This not only eliminates wasted water, but it is also important for public perception. You do not want to anger the public by visibly wasting large amounts of water at any time, especially during drought conditions.

• Focus on irrigating high priority areas like the centers of your field.

Managing Water Use During Water Restrictions

• Be aware of your local water restrictions and be sure to follow them. You are breaking the law if you don't abide by them and you can be fined.

• Be prepared to report your weekly water usage to your local water authority.

• Be ready to close the field during extreme conditions in order to avoid complete turf loss and reduce the chance for athlete injury (and subsequent liability).

Alternative Water Sources

The use of alternative water sources such as effluent (reclaimed) water is gaining popularity on golf courses. Explore the possibility of using effluent water as an irrigation source. Because this water is not safe for drinking, you will not face the same water restrictions you do using potable (drinking) water.

Monitoring Drought Conditions

Monitoring drought conditions and forecasts will help you plan your field management schedule and keep you up-to-date on drought conditions in your area. Here are some useful websites for drought information.

• http://www.drought.gov/

• http://www.cpc.noaa.gov/products/expert_assessment/drought_assessment.shtml

• http://www.drought.unl.edu/

Your state may also have its own drought-monitoring website.

Few things can be as stressful for a turf manager as watching your turf wilt and die and not being able to do anything about it. Drought conditions often bring about water restrictions for turfgrass areas including athletic fields. By properly preparing your turf before a drought occurs, you can increase your turf's chances for survival once water is scarce. Also, remember to outline your plans for watering during a drought before it occurs and be sure to communicate those plans. You can never win the battle against Mother Nature, but you can do your best to deal with her effects. ■

Thomas Serensits is a graduate student in Penn State's turfgrass program.

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Long-term follow-up:
how well did that soil amendment work?

Above: "WOW!" is what most turf professionals say when shown these pictures of a soccer field built in 1997. Big Finn Hill Park, Soccer Field, King County Parks, Juanita, WA, designed by The Berger Partnership. Constructed in 1997 with 10% CDE tilled into the top 6 inches of USGA sand blended with organic.
9 Years After Construction – 2006
12 Years After Construction - 2009

Below: BOTHELL HIGH SCHOOL, Baseball & Softball Fields, Bothell, WA, designed by D.A. Hogan & Associates. Constructed in 1998 with 5% CDE blended offsite with USGA sand and organic 6 inches deep over 6 inches of sand mix.
8 Years Past Construction – 2006
11 Years Past Construction - 2009
Healthy root systems are evident here in not just root length, but in root density, which again, for the turfgrass manager translates into better wear resistance.

Editor's note: This article was written by the vice president of EnviroTech Soil Solutions, which makes soil amendment products.

LIKE ANYTHING ELSE OVER TIME, natural grass sports fields can deteriorate into poor playing surfaces. It is also true that sports fields have a better chance of holding up over time if they are constructed well. One way to improve long-term performance is to improve the rootzone with porous amendments that work long-term.

In an exercise to provide post-construction feedback to some prominent physical engineers and landscape architects in the Pacific Northwest, who specified our calcined diatomaceous earth (CDE) soil amendment (AXIS), we created a pictorial history to show how several sand-based fields are holding up as many as 12 years after installation.

Sports turf managers understand that healthy roots are a good measure of plant health and are essential for stable playing surfaces and good wear resistance. All of the fields pictured were originally seeded with cool-season blends of rye, blue, and fescue. There may be some added significance to these extensive root systems since they are inevitably susceptible to *poa annua*, which is notoriously shallow rooted.

According to Mike Crandell, Natural Resource Coordinator for King County Parks, who manages Big Finn Hill Park, "This field holds up particularly well compared to the other fields we have in our system, especially when you consider the volume of scheduled uses this field receives vs. the amount of maintenance that we can perform. This field is generally aerated only once per year, with three applications of fertilizer and one overseed application every year."

Healthy root systems are evident here in not just root length but in root density, which translates into better wear resistance. Significant rooting is the result of an environment with adequate air, air exchange and hydraulic conductivity. In other words, good rootzone mixes have the capacity to move more air and more water into, out of, and throughout the soil. Plants don't compensate for good or bad soil environments, they reflect their environments. These are rich root environments, and the currency is efficient air and water movement and availability, along with good nutrition and proper maintenance practices. These roots are consistent with original research by Dr. Ed McCoy of Ohio State where dry weight rootmass was found to be 4 times greater with CDE than the control in USGA sand.

Spin Martin, former head groundskeeper of the Indianapolis

John Mascaro's Photo Quiz

John Mascaro is President of Turf-Tec International

Can you identify this sports turf problem?

Problem: Large brown circular area
Turfgrass Area: Civic center mall
Location: Scottsdale, Arizona
Grass Variety: Bermudagrass overseeded with perennial rye

Answer to John Mascaro's Photo Quiz on Page 49

Colts, claimed phenomenal rooting in the practice field he rebuilt last year for the Colts with CDE. "I had 14-inch roots in 6 weeks, and after 12 solid weeks of NFL players practicing on my fields I noticed less compaction, and not a single bare spot at the end of the season. This was the best field I ever installed or worked on, and my irrigation was reduced by about 60%, according to irrigation records.

» **Above:** Redmond High School, Baseball & Softball Fields, Redmond, WA, designed by The Berger Partnership. Constructed with 10% CDE tilled into the top 6 inches of USGA sand and organic in 2002.
4 Years After Construction, 2006
7 Years After Construction, 2009

» **Below:** PCC Rock Creek/ Tualatin Hills Park & Recreation District Athletic Fields, designed by WHPacific. Constructed in 2006 with 10% CDE with USGA sand and organic. Infield mixes contain 10% CDE Play Ball!
1 Year After Construction, 2007
2 Years After Construction, 2008

"There's also a healthy increase in oxygen content all the way down to the roots. I did the lab comparisons, due diligence, and my own bench tests. Every step of the process confirmed this was the best material to use and made it a no-brainer," Martin said.

It is widely recognized that soil should be about 25% air space, and 25% water pore space. What may not be as readily recognized is that porosity influences everything else. It reduces compaction while increasing infiltration, air and water pore space, water holding capacity and plant available water. Studies show that CDE increases water holding capacity and plant available water significantly enough to reduce irrigation. As water is released from their structures it is replaced with air, and likely contains residual air permanently.

When comparing porous inorganics, pore size matters, as larger pores absorb and *release* more water per wetting and drying cycle. As these cycles repeat within the soil, the cumulative difference of air and water availability over time is substantially greater with CDE. Testing by Micromeritics Instrument Corporation reported median pore size for CDE is 9 times larger than calcined clay (CC)—(.36 microns vs. .045). The impact of this is that CDE requires approximately 4 times less energy to release water than CC.

Using university water savings research and irrigation data, it is possible to estimate the water conserved, the water cost savings, an estimated return on your investment, and the time required for CDE to pay for itself. Depending on your location, water resources can be limited by cost, or a simple lack of available resources for sufficient irrigation. Water resource stewardship is less of a choice now than a necessity. For Big Finn Hill Park's soccer field, the original cost of the CDE averaged over 12 years of service is $2,500 per year, or less than three cents a square foot per year.

Any conversation of the long-term contribution of porous amendments needs to include what we know about their life expectancy. There are two forms of breakdown concern, weathering and crushing. The USGA recommends a sulfate soundness test of under 12 to determine suitable resistance to weathering. Sulfate soundness tests for CDE are 3.1 and calcined clay (CC) are 2.9. From this test, two manufacturers of CDE and CC, EP Minerals and Profile Products respectively, both estimate a 3% breakdown from weathering over 20 years.

While calcined diatomaceous earth can crush at slightly lower pressures than calcined clays, when the products have been satu-

Field [over] use pressure amplifies the importance of 'hardwiring in' the best opportunity for resilient and productive service.

rated, they crush within 7 psi of each other. Crushing potential barely exists on grass fields where grass blades, plant crowns, and thatch can insulate these products from wear, and since soil pressures reduce quadratically with soil depth. Crushing potential is higher on infield surfaces and can crush all but the hardest (and abrasive) products. Essentially, in turf and landscape applications, these products are marketed as permanent amendments.

One surprising observation common among all the fields pictured was the degree to which the original grades were preserved. The grades are almost identical to original condition even after several years of use in the Northwest's frequently rainy weather due to increased drainage, less puddling, and increased rootmass. Because the fields are saturated less, they have increased wear resistance and are less vulnerable to that bad combination of aggressive cleat traffic, shallow roots, and saturated conditions.

Sports turf managers are not always afforded proper resources and time to properly manage their facilities. In many areas, there are not enough athletic fields to accommodate the scheduled uses. This field use pressure amplifies the importance of "hardwiring in" the best opportunity for resilient and productive service. To the extent these fields require less work to maintain, there may also be some maintenance cost savings in addition to improved soil and turf quality.

Designing in healthy, proven, soil performance from construction resources is less expensive, more effective, and requires less effort than engaging in soil modification after construction. For soil modification of existing turf, topdressing porous amendments with sand after aerifying is much more effective than sand alone, but requires repeat applications to reach recommended rates and best results.

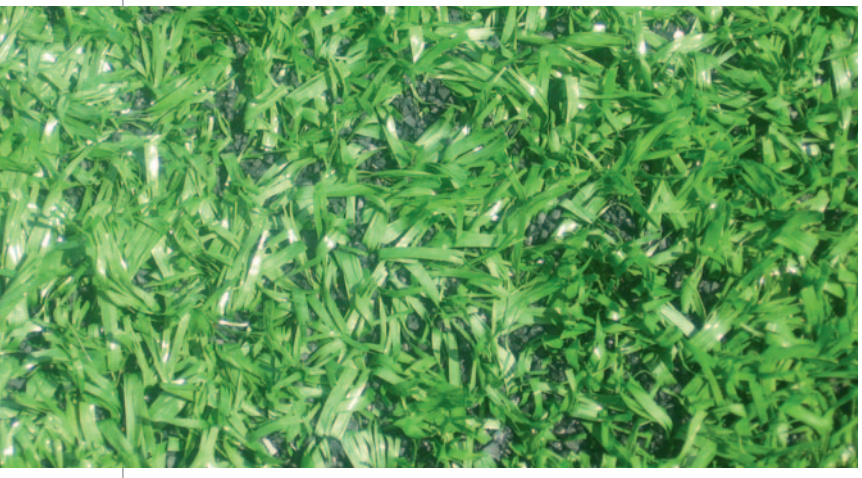
All photos by George Serrill, Vice President, EnviroTech Soil Solutions; Serrill is a member of the Pacific Northwest STMA Chapter and can be reached at gserrill@axis-playball.com

By Eric Schroder

Just the facts:
update on science and synthetic systems

DESPITE THE HEADSHAKES displayed by many sports turf managers around the country when synthetic playing surfaces come up in conversation, it is a fact that professionals should view synthetics as valuable assets in providing safe playing surfaces for their athletes.

As Bob Campbell, CSFM, former president of the Sports Turf Managers Association, said in a recent interview in this magazine, "We have to adapt and accept changes to survive and grow as a profession. We have to be part of it or be left behind."



For those readers currently maintaining synthetic fields or who are anticipating doing so in the near future, *SportsTurf* here attempts to provide summaries of the latest scientific information available on several topics of interest. Simply reading headlines might give you the impression that athletes on synthetic fields can spontaneously combust from high temperatures, contract a killer disease from a turf burn, or poison themselves with a face full of recycled rubber. Many media reports are driven by environmental and parent groups; we will provide info from the latest research and hear from some of the major players in the synthetic industry regarding three issues: high field temperatures, MRSA infections, and toxicity. [Editor's note: Later this year we will address the actual installation process, what problems are being encountered, and best practices to avoid them.]

Heat

In conditions of high humidity and high heat, synthetic turf surface temperatures can become hot. While manufacturers of new infill materials are touting the reduced temperatures their products produce versus crumb rubber, there is nothing in the research literature that suggests much can be done about these temps. Anecdotally, plenty of sports turf managers are irrigating their surfaces before play (and hearing about it from taxpayers who expected no water use on synthetic grass), while others recommend misting the athletes on hot days.

The latest science on the topic comes from the International Society for Horticultural Science's 2nd International Conference on Turfgrass Science and Management for Sports Fields, held in Beijing last year. Dr. Andy McNitt, grad student Tom Serensits, and Penn State's go-to turf assistant, Dianne Petrunak, produced "Temperature Amelioration of Synthetic Turf Surfaces Through Irrigation" (http://www.actahort.org/books/783/783_59.htm). Here's the abstract:

"Researchers have found that the surface temperatures of synthetic turf are significantly higher than natural turfgrass surfaces when exposed to sunlight. Reports indicate the surface temperatures of traditional synthetic turf can be as much as 35-60°C higher than natural turfgrass surface temperatures. Surface temperatures of infill synthetic turf systems have been reported to be as high as 93°C on a day when air temperatures were 37°C. Researchers have concluded that the heat transfer from the surface to the sole of an athlete's foot is significant enough to contribute to greater physiological stress that may result in serious heat related health problems.

"The objective of this study was to evaluate various methods of reducing the surface temperature of synthetic turf surfaces. Various irrigation and tarping regimes were used in an effort to reduce surface temperature. Infill was also amended with calcined clay in an effort to increase the water holding capacity and potential evaporative cooling of the infill media. Many of the regimes tested were initially very successful in lowering surface temperature to that of natural turfgrass; however, these low temperatures could not be maintained for periods of time equal to the length of standard sporting events, although synthetic turf surfaces receiving irrigation did measure lower in surface temperature after 3 hours compared to unirrigated synthetic turf surfaces."

Another study, published last December, "Environmental Effects of Synthetic Turf Athletic Fields," by the engineering, landscape architecture and environmental science firm Milone & MacBroom, found that "On hot sunny days, surface temp of the fibers was 40-50 degrees hotter than ambient [means "surrounding"] temp; air temp at 2 inches above surface or under cloud cover was near ambient. Crumb rubber was only a few degrees