» **YOUTH ACTIVITIES** keep the fields booked non-stop from spring to early winter. Subsurface irrigation is often run while games are underway.

Sports complex finds water management solutions with dripline

Editor's note: *This article was supplied by Creative Services, Encinitas, CA.*

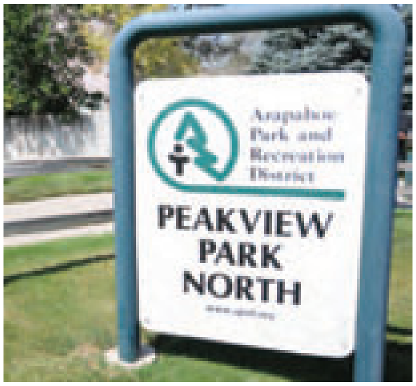
SPORTS FIELD DESIGNER DOUG ROCKNE likes to tell the story of the soccer mom who praised the grounds crew at the Arapahoe Park and Recreation District, just south of Denver, because the turf looked so good last summer, even though the fields were never irrigated.

Could they give her husband some tips?

"'Thanks,' said the crew, 'but we've got a professional secret. The turf is frequently irrigated, even when games are going on, but no one ever notices.

"'It's all underground . . . through driplines. We can irrigate any time of the day or night.'

"And that's one of the key reasons we've installed dripline on Arapahoe's sports fields over the last 10 years," said Rockne, ASLA, president of Rockne Corty Design of Centennial, CO. Located at the top of the nation's watershed, the 12.5 square-mile Arapahoe Park and Rec District has the majestic Rocky Mountains as a back-



>> Top left: NETAFIM DISTRICT SALES MANAGER KELLY KEICHER (LEFT) and project landscape architect Doug Rockne (right) review turf conditions during the dry summer months.

>> Bottom left: PEAKVIEW PARK NORTH is one of a series of community parks that comprise the 12.5-square mile Arapahoe Park and Rec District, just south of Denver.

>> Bottom Right: THE ARAPAHOE PARK AND REC DISTRICT has 100 acres of developed parks, including playgrounds alongside the sports fields.

drop. However, in this High Plains region where rivers are born, ground water is scarce. Lifeline water taps (the right to connect to water mains) and monthly water costs are pricey.

Rockne started working on this massive recreational project in the 1980s. He developed the District's original master plan and continues to function as lead designer and advisor to the board of directors. From the beginning, he knew he had to approach the site's water use with innovative thinking.

"With the Rockies nearby, you'd think we'd have plenty of water. But this is a semi-arid desert environment. We're at 6,000-foot elevation with 15 inches of precipitation a year, and heavy clay saline soils.

"A couple of our first fields were installed with traditional overhead sprinklers, but all the rest are dripline."

This high-use recreation area was designed to serve the fast-growing communities outside Denver and demand for sports fields grew exponentially during the housing boom.

"Local communities were clamoring for fields for all ages, all genders, all sports, and they are typically booked solid from March through November," said Rockne.

Today the Arapahoe complex is nearly 90% built out and has an envy of amenities: 100 acres of developed parks, 500 acres of open space, 14 miles of trails, 75,000 square-foot recreation center, gym, indoor skate park, and a multi-plex of natural turf sports fields.

"There's a reason Colorado is one of the healthiest states. Everyone's outdoors playing sports," said the field designer.

Over the past 6 years, the district has installed Netafim Techline CV dripline on three baseball fields, two softball fields, one football field, four soccer fields (two as large as three acres) and several multi-use fields. By specifying dripline systems, the planning team was able to maximize water use while minimizing costs.

"Our challenges included both fiscally-sound start-up costs and responsible management of water use per acre," said Rockne. "Dripline has helped us achieve those goals and the District has always been able to operate in the black."

WATER DIRECTLY TO THE ROOTZONES

"Dripline delivers a precise amount of water directly to the rootzones without wasting a drop," said Kelly Keicher, Netafim district sales manager for Colorado.

"This area has low humidity and dry mountain air. Overhead irrigation loses too much water to evaporation and wind drift in these conditions.

"We've shown that dripline is 90% efficient when compared to overhead irrigation, which is generally around 60% efficient," said Keicher.

The Arapahoe District management recently conducted a comparison of monthly water costs between a sports field with dripline and an older sports field with over-

>> **NETAFIM TECHLINE CV DRIPLINE** was run in lateral rows with approximately 14 inches between each line of tubing. The tubing was set in place with an automated Vermeer insertion plow.

head sprinklers. The comparison was done in May, a high usage month.

Arapahoe Sports Park A is a 4.7-acre site irrigated with a traditional overhead system. The field used 437,000 gallons of water or 92,979 gallons per acre in May.

Arapahoe Sports Park B, located nearby, is a 9.34-acre facility primarily irrigated with Netafim dripline (with overhead sprays in limited areas). During the same month Sports Park B used just 59,529 gallons per acre. Even though Sports Park B (with dripline) is twice the size of Sports Park A, it used just half the water.

The district found there were lower maintenance costs as well. Because the system is not visible, mower damage and vandalism are no longer problems and repair work is at a minimum, with no moving parts or heads to replace.

Wind was another area concern, but with dripline there is no water loss on gusty days.

"We've found that dripline also increases playability and safety on the fields. It softens the soil and eliminates compaction, which is problematic with clay. Overhead sprays often compact a field even more, making it tough on injuries," said Rockne.

INSTALLATION ON SPORTS FIELDS

Overseeing field conditions is landscape professional Chris Willis, president and founder of Colorado Total Maintenance, Inc., a landscape management firm based in Denver.

Willis has worked with Arapahoe Park and Rec for 10 years and currently handles maintenance for the entire district. He has installed more than a dozen multi-use and baseball fields with dripline and has become an authority on sports field subsurface irrigation. His expertise is well known and he has led regional seminars on dripline installation for designers and contractors. "Arapahoe's Piney Creek Hollow Park is one of our recent projects," he said.

"It's a 4-acre athletic field with 16 zones controlled by a Hunter IMMS Central Control system. We installed the dripline in an 'open excavation method' by removing the top four inches of the soil, laying down the pipe and placing the dirt back on top. We ran the main supply header in the middle of the field going east to west."

The 17mm-wide dripline laterals were spaced 15 inches apart in 150-foot runs heading north and south. The irrigation coverage per zone was 5,500 square feet.

Willis integrated a minimal nitrogen, plant-based organic compost into the soil to create a sandy/loamy surface.

"This amendment has excellent water-holding capabilities. With dripline, the soil needs to retain the water to its maximum capacity for efficient coverage, yet be able to drain," he said.

The site was then sodded with a hardy high-use athletic field mix from Graff Turf Farms.

SETTING UP THE IRRIGATION SCHEDULE

The important first step in setting up a dripline irrigation program is to initially saturate the field so that it's like a sponge, said Willis.

"We ran the irrigation for 24 hours straight until the field reached its saturation level.

"I have a tried-and-true method to determine when the right point is reached. I walk the field with shoes off and sink my heels in between the driplines to check the softness. Once we reach the right saturation point, we're good to go with the irrigation schedule."

The Piney Creek Hollow irrigation program runs three times a week using a cycle and soak schedule. Each of the 16 zones operates for 8 hours in 6- to 8-minute cycles at .4 gph (gallons per hour). At the end of the 8-hour program, each zone has had 45 to 55 minutes of precipitation.

Because the fields are so used and abused, the District has established ongoing rejuvenation programs. Overseeding and topdressing are scheduled spring, summer and fall and all fields are typically slice-aerated three times a season.

Among the site challenges have been slope irrigation and the occasional dripline repair.

"Even with built-in check valves, we've learned to adjust the scheduling to maintain even distribution from top to bottom in sloped areas," said Willis.

"As for repairs, sections of dripline have had to be replaced a few times, but it's been the coaches and parents at the 'root' of the problem. They'll pound volleyball net stakes or soccer goals into the ground, not knowing the irrigation lines are right beneath."

Lynn Cornell, manager of the Arapahoe Park and Recreation District, has been pleased with the success of the irrigation team.

"They demonstrated that sports fields could be irrigated very efficiently with dripline yet still maintain playability. The District has reported significant savings, based on water bills," he said.

"It's been a win-win for all teams involved in the project." ■

Water movement in turf: **the root of soil physics**

IN ITS MOST BASIC TERMS, soil physics is concerned with the delicate balance of water and oxygen in soil. Because this equilibrium is so vital to the health and appearance of turf, all sports turf managers are trained in managing soil water.

Water is released from soil three ways: through internal drainage, evaporation, and transpiration. If a field has poor drainage, it becomes more dependent on evapotranspiration to remove excess moisture. If a field remains saturated, the turf experiences stress typically referred to as “wet wilt.” While extended saturated conditions can cause roots to rot, most wet wilt stress is actually caused by an oxygen deficient environment. In essence, the roots are drowning.

When we consider the life processes of the grass plant, we typically focus on photosynthesis. The plant takes in carbon dioxide, water, nitrogen, and other nutrients while the chlorophyll captures photons and through the “miracle” of photosynthesis converts light into simple sugars such as glucose. The byproducts of photosynthesis are oxygen and water vapor.

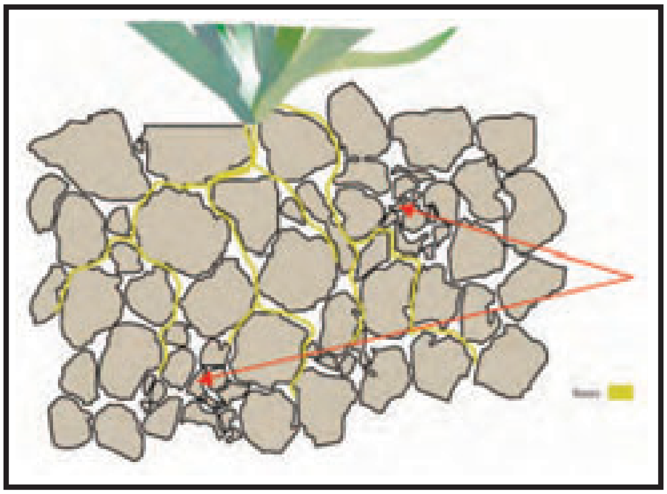
However, the life process does not end at glucose production. The sugar must be converted into energy at the cellular level in order for the organism to live. Oxygen is required to convert the glucose into energy and the byproducts of this ADP-ATP cycle at the cellular level are carbon dioxide and more water vapor. The roots are a primary gatherer of the needed oxygen but they also deposit water and carbon dioxide back into the soil.

THE IMPORTANCE OF OXYGEN IN THE SOIL

If soil is saturated or simply too dense, it will be oxygen deficient. In both cases there is insufficient space for oxygen diffusion, which compounds the challenges roots already face to survive. The roots are in constant competition with the microbial populations for soil oxygen. At this level, Oxygen is a depleting resource that must be constantly replenished from the atmosphere.

Bacteria and fungi need oxygen to break down—or decompose—their food, primarily organic matter. If there is insufficient free-floating O2 in the soil, the bacteria and other microbes will pull it off of other compounds in order to live. This is a simplistic way of describing the anaerobic processes. Carbon dioxide, methane, and hydrogen sulfide are common byproducts of this anaerobic decomposition. These three gases are toxic to the turf in low oxygen environments.

A release of toxic or potentially toxic soil gases coupled with the diffusion of oxygen from the atmosphere into the soil is the process we call aeration. The evaporation of water at the surface draws water and soil gases from the soil column up toward the surface. As water and soil gases are removed from the soil through aeration, space is created for oxygen. The efficiency of the aeration process is determined primarily by a soil’s physics. It is also supplemented by the turf’s access to direct sunlight, which is needed for transpiration, and surface airflow, which is needed for evaporation. [NOTE: We recognize that there are other factors that affect evapotranspiration. Ambient humidity is an example.]



SOIL COMPOSITION AFFECTS WATER MOVEMENT

The properties associated with soil physics are infiltration rate, total porosity (which is broken down into water porosity and air porosity), bulk density, and water holding. The composition of the soil (distribution of the sand, the gravel component, whether silt, clay, or organic matter is present) dictates the soil’s physical properties. The infiltration rate measures the gravitational flow of water. It is related to saturated hydraulic conductivity, which measures the capillary rise of water to the surface. As such, the infiltration rate is an indirect measurement of capillary rise and can also give clues to the level of aeration/oxygenation.

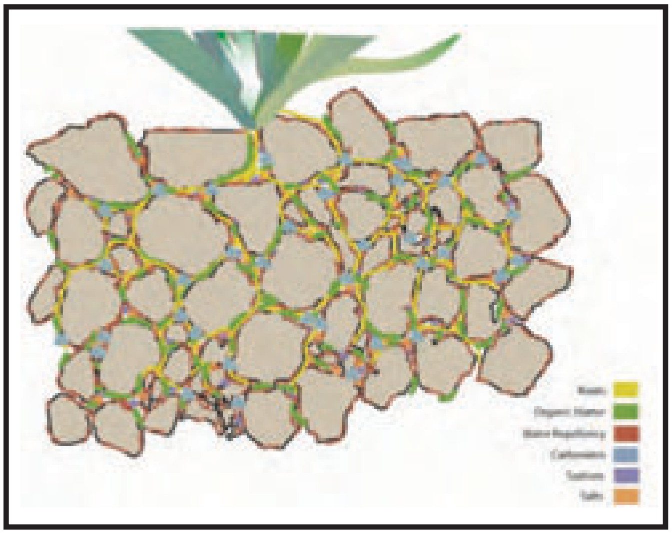
Water does not move freely through the small spaces classified as water pores. Rather, water molecules remain inside the pores due to the water’s adhesive and cohesive properties. Some pores are so small that the water is not plant available. The root hairs cannot overcome the water’s adhesion and cohesion properties in many of these smallest spaces.

Water does move through the larger air pores, both gravitationally and to the surface through capillary rise. The air pores also provide space for oxygen and for root growth.

This illustration shows how larger particles create air pores while smaller particles compress tightly to create water pores. As compaction tightens the soil, many of the air pores are converted into water pores. The soil loses total porosity and permeability, as measured by the infiltration rate.

Bulk density measures compaction, but it is a “relative” value in that one must know the relative weight of the material in the soil before evaluating soil density. Some products claim they reduce compaction because they lower bulk density. However, a decline in bulk density may not be a true indicator of reduced compaction. If the product weighs less than the material comprising the rootzone, bulk density will decline due to the fact that a lighter material has been introduced. It may or may not have truly reduced compaction.

It is helpful to think of a sports field as a dynamic organism. It is constantly changing through (a) compaction, (b) the deposit of water borne contaminants that are present even in potable water, (c) the byproducts of the organisms that live in the soil, and (d) the organic matter deposited by the turf. This second illustration shows how the air pores are gradually converted to water pores with the resultant loss of permeability. The roots will prune to the surface where they will be vulnerable to multiple stressors.



Whether the STM is managing a sand-based rootzone with internal drainage or a soil-based rootzone that is dependent on evapotranspiration, regular aerification is needed.

When it comes time to aerate, different tools are used to address different issues. Deep aeration, for instance, creates sand highways to move water from the surface but is generally ineffective in rehabilitating the soil in the second illustration. Why? Because of surface displacement. For instance, a 1-inch bit or tine on 7.5 x 7.5-inch center spacing, which is the spacing on a popular unit, displaces only 1.4% of a sports field's surface area. In contrast, 5/8 inch tines on 1.5 x 2-inch center spacing displace 10.2%.

The tighter spacing is available on a major manufacturer's walk-behind and tractor-mounted units. The smaller tines can gradually change the composition of a soil if the plugs are harvested and the holes filled with sand, but their effective depth is only 3 to 4 inches. Deep tines cannot change the soil, but they can be used to supplement the shallower tines. During the playing season, solid tines, deep slicers, and other forms of non-disruptive aeration should be used. They cannot change the composition of a rootzone but they aerate the soil and provide temporary space for water penetration, evaporation, and root growth.

An effective aerification program can address many deficiencies in a soil's physical properties but only if all of the variables are known. To use a hackneyed expression: "Knowledge is power." If you know the composition of a field's rootzone and its physical properties, you can choose the best cultural program to properly balance water and oxygen in your soil. ■

MANAGING PHYSICAL PROPERTIES

A soil turf manager is a grass farmer. His or her cousin, the row crop farmer, at least in the past, tilled the fields to: (a) relieve compaction, (b) oxygenate the soil, and (c) allow water to penetrate. Sports turf managers cannot use plows but he or she can use less disruptive tools to achieve the same results.

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