Innovations in Subsurface Turf Irrigation

Southern Region Water Quality Conference
Lexington, KY
October 25, 2005

Bernd Leinauer
New Mexico State University
Las Cruces, NM

Problem

- Water is the biggest concern in turf management not only in the Southwest, but also in many parts of the world
- Quantity and quality can rarely be maximized for optimum growth and maintenance

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COOPERATIVE EXTENSION SE

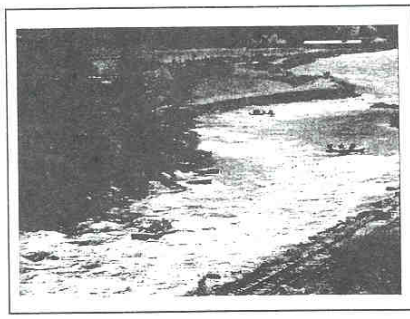
PLANT SCIE
NEWS

VOLUME 20, NO. 04

How Bad Is The Drought

Craig Runyan
Water Quality Coordinator

Areas throughout the country are experiencing drought conditions. The situation is particularly disturbing to residents east of the Mississippi, where drought is generally no considered a threat. Some state and local



New Mexico State University is an equal
NMSU and the U.S. De

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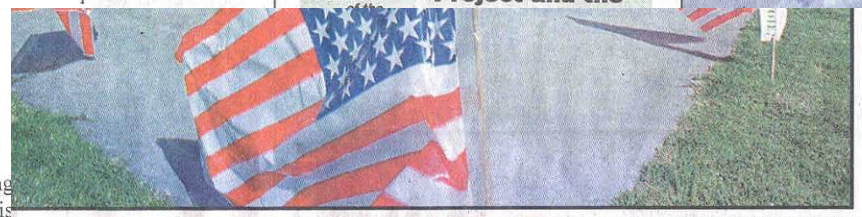
Water War Enters New Stage

San Juan-Chama Project and the

Headwaters



Sun-News photo by Vladimir Chaloupka

Corps League El Perro Diablo detachment, including Jesse Rodriguez, left, stand at attention at Veterans Park dur-
ay commemorating Victory over Japan Day. The featured speakers were Pearl Harbor survivor Stanley Kotovsky and
versity Army ROTC professor Lt. Col. Frank Sherman.

Chairman Gilbert Apodaca wanted to add Picacho Hills to Garza's district. Because Garza is a Democrat, and Picacho Hills is heavily Republican, Garza suggested such a change would hurt his chances for re-election in 2002. Garza will be the only commissioner running for re-election next year.

Apodaca did not respond to Garza's accusations during the questioning of Sharp, but earlier in the meeting he said he had no input into the proposed plans.

Sharp said his company did meet with a commissioner. But when Garza asked Sharp to reveal the name of the commissioner, Sharp declined to answer, citing confidentiality rules. Garza did not pursue the question any further.

He asked Sharp if he was aware that when Research and Polling Inc. entered its contract with the county, the firm presented a time line for meeting with all the commissioners to get input into the

See Redistricting, Page A-7

SON/JOURNAL

SHORT ON WATER: A federal judge's ruling will keep the Rio Grande, seen here looking north from the Montaño Bridge in Albuquerque, flowing for the endangered silvery minnow

Officials grapple with limited water

By Christopher Schurtz
Sun-News

Debated and fought over for decades, the complex issues surrounding water rights in the Texas, New Mexico and Mexico region are far from being resolved.

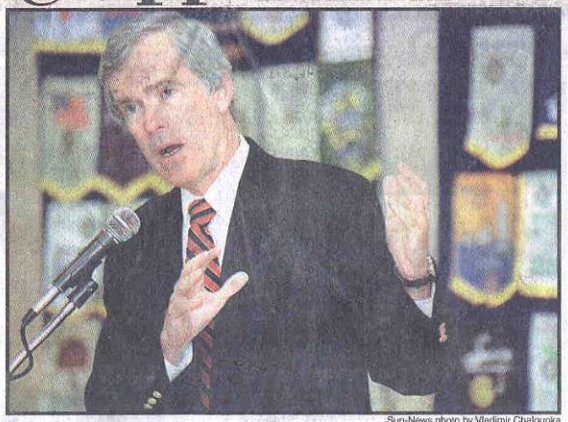
And the rapid population growth of the region will likely exacerbate tensions over water rights in the coming years if a more coordinated e..ort at settlement is not made.

This is one sentiment agreed on by a panel of area water experts Tuesday during a hearing of the Senate Energy and Natural Resources Committee at New Mexico State University, hosted by committee chairman Sen. Jeff Bingaman, D-N.M.

Bingaman said the population of the region, according to the most recent census figures, has grown at a rate exceeding other areas of the country.

Combined with an already scarce supply of clean, available water in most areas in the region, he said, the increased demand that will come with the population boom will further strain the water supply.

"This growth not only increases the



Sun-News photo by Vladimir Chaloupka

Sen. Jeff Bingaman, D-N.M., speaks before members of the Mesilla Valley Economic Alliance and the Rotary Club on Tuesday at the Mesilla Valley Best Western Inn.

water rights to lease water to water- la Bolson. About 40 percent of El Paso's

Bingaman says alternative fuels, research needed

By Christopher Schurtz
Sun-News

Sen. Jeff Bingaman, D-N.M., criticized several energy policy decisions made by President George W. Bush, saying more must be done in pursuing "enlightened policies" concerning energy production and conservation.

In town Tuesday to host a hearing of the committee concerning water issues, Bingaman spoke of his energy plan to a packed room before area political and social leaders and members of the Mesilla Valley Economic Alliance and the Rotary Club.

The chairman of the U.S. Senate Committee on Energy and Natural Resources, Bingaman said he disagrees with the Bush administration's proposals to drill for oil in the Alaskan National Wildlife Refuge Alaska.

opardy

Problem

1. Availability
2. Quality
3. Distribution

Approximately 50% of domestic water use during the summer in the Southwest is used for landscape irrigation
(Kjelgreen et al., 2000)

Strategies to reduce (irrigation) water use for turf

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STRATEGIES TO REDUCE (POTABLE) WATER CONSUMPTION ON TURF

1. Use of adapted low-water use (turf)grass species
2. Irrigation with non-potable water
3. Increase irrigation efficiency

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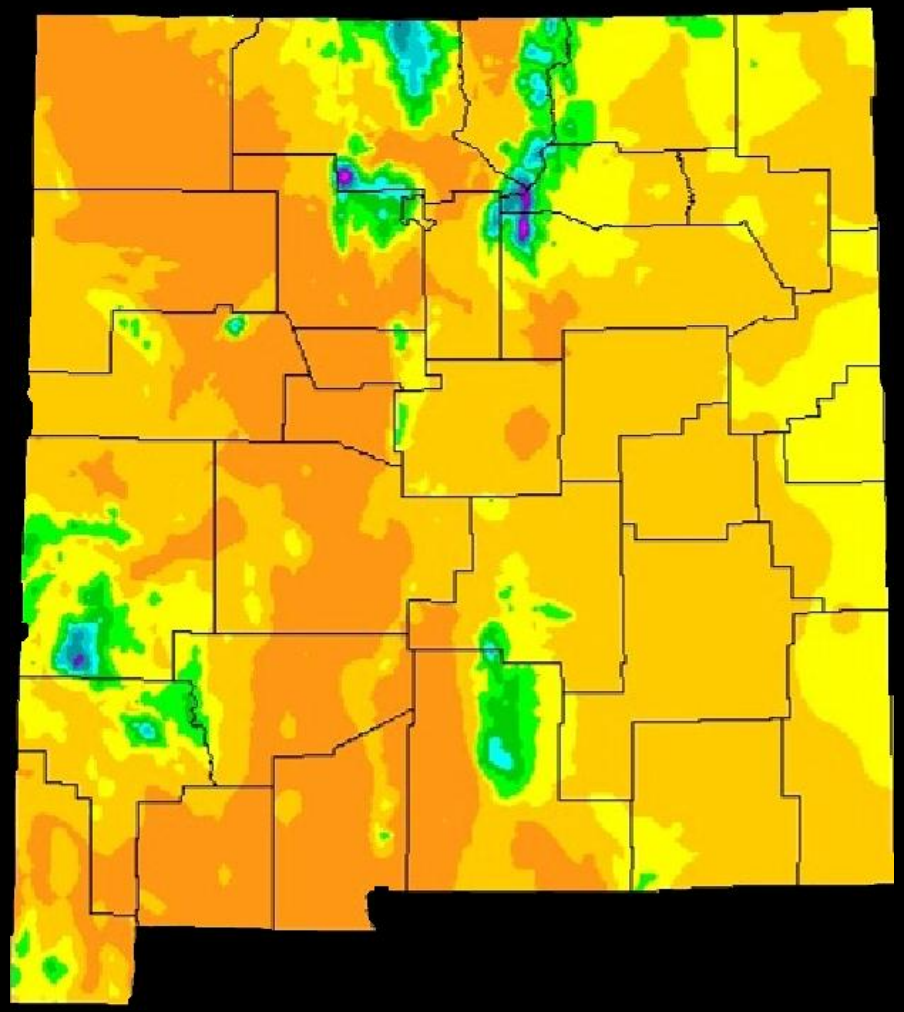
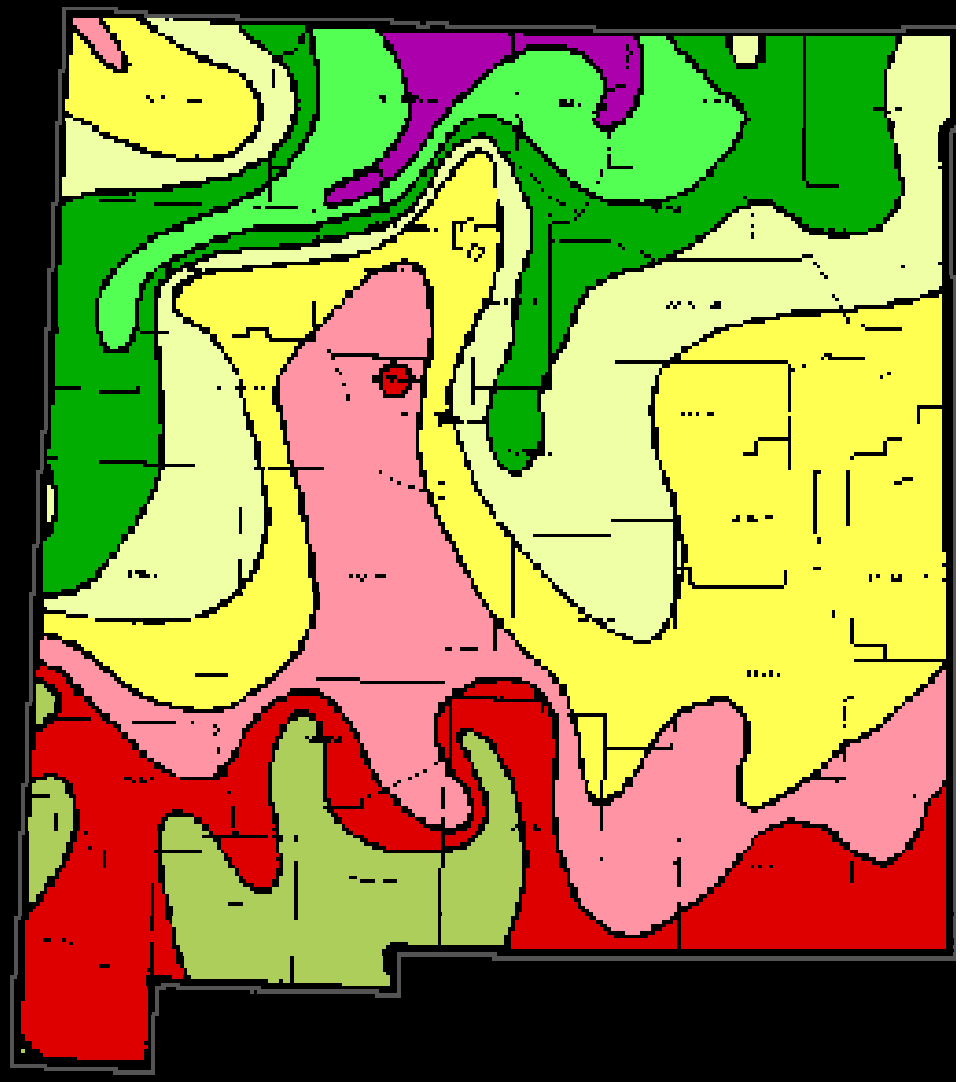


Annual precipitation
New Mexico



USDA Plant Hardiness
Zone Map for New Mexico

New (alternative) turfgrasses

Poa compressa

Koeleria macrantha

Festuca longifolia

(Festuca ovina duriuscula)

Poa arachnifera x Poa pratensis

Deschampsia cespitosa

Puccinella distans

Cynodon dactylon

Zoysia japonica

Paspalum vaginatum

Disticlis spicata

Buffalo dactyloides

Bouteloua gracilis

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Irrigation with non-potable water

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STRATEGIES TO REDUCE (POTABLE) WATER CONSUMPTION ON TURF

3. Increase irrigation efficiency
    1. Scheduling, maintenance and troubleshooting
    2. Irrigation based on plant and/or soil water status
    3. Improve Water Distribution
        1. External (Irrigation)
        2. Internal (Root zone, Drainage, Amendment, Irrigation, Construction)

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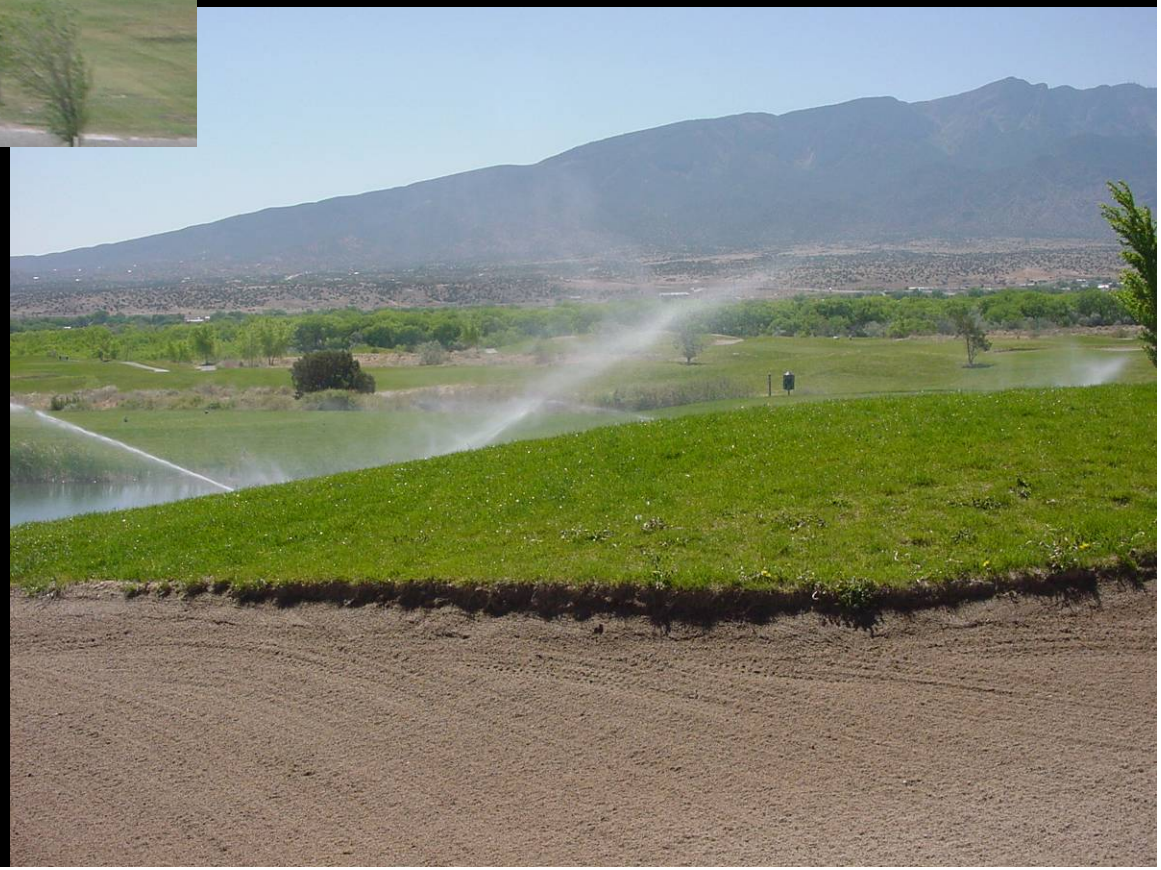
Sprinkler Problems



LOT #102
ALL PERMITS
NOTE
LOT CLOSED
ON DAYS OF
EVENTS

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Microirrigation

- Above ground
  - Drip irrigation (Trickle irrigation)
- Below ground
  - Drip Irrigation
  - Subirrigation

(ASAE Standards, 1996)

Microirrigation

Drip Irrigation

- Line source (Precision porous pipe)
- Point source (Netafim, Toro)

Subirrigation

- Cellsystem
- ECS
- Pat System, Purr-Wick System

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SUBIRRIGATION (SBI)

- ✓ Line source system
- ✓ Irrigate and drain through <u>one</u> pipe system
- ✓ Subgrade sealed by plastic barrier (optional) – "bath tub" analogy
- ✓ Sand or sandy root zone mix
- ✓ 30 - 40 cm (12" - 16") deep
- ✓ PAT-System, Cellsystem, ECS

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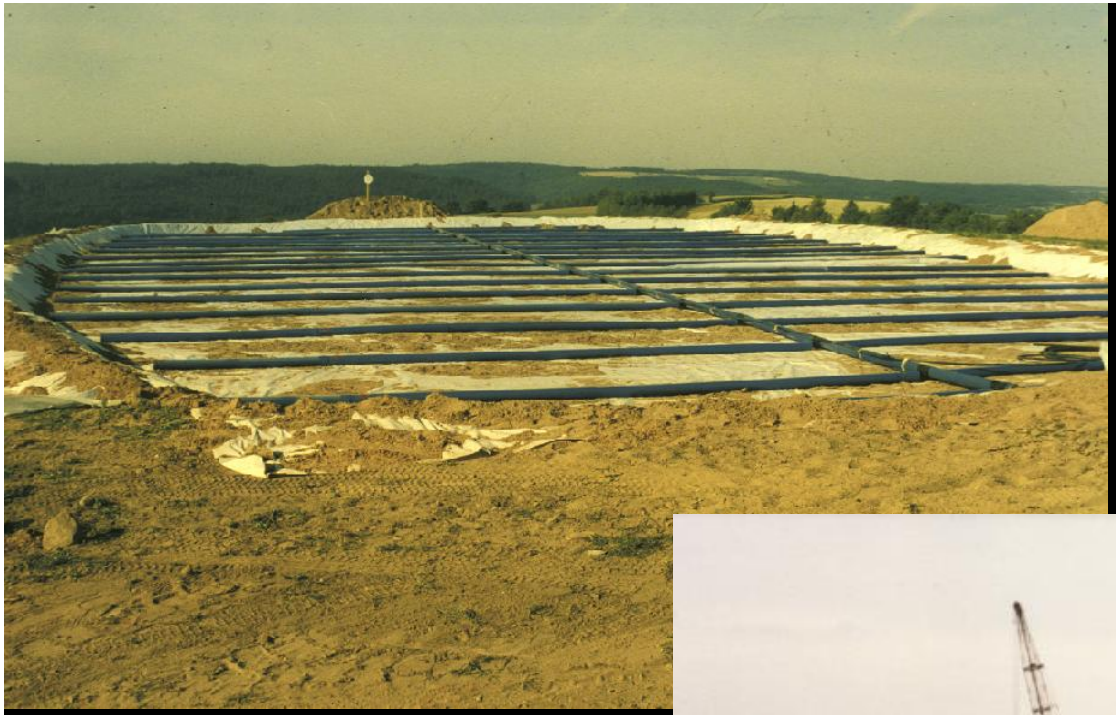

Cellsystem

Cellsystem

- ✓ Prater Stadium, Vienna
- ✓ San Siro Stadium, Milan
- ✓ 3 stadiums in Saudi Arabia
- ✓ Golf courses and 20+ stadiums in Germany, Austria, Switzerland

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PAT-System

Pat-System

- ✓ Pro Player Stadium, Miami
- ✓ Turner Field, Atlanta
- ✓ Dodger Stadium, Los Angeles
- ✓ University of Texas, Austin
- ✓ Ohio State Buckeyes

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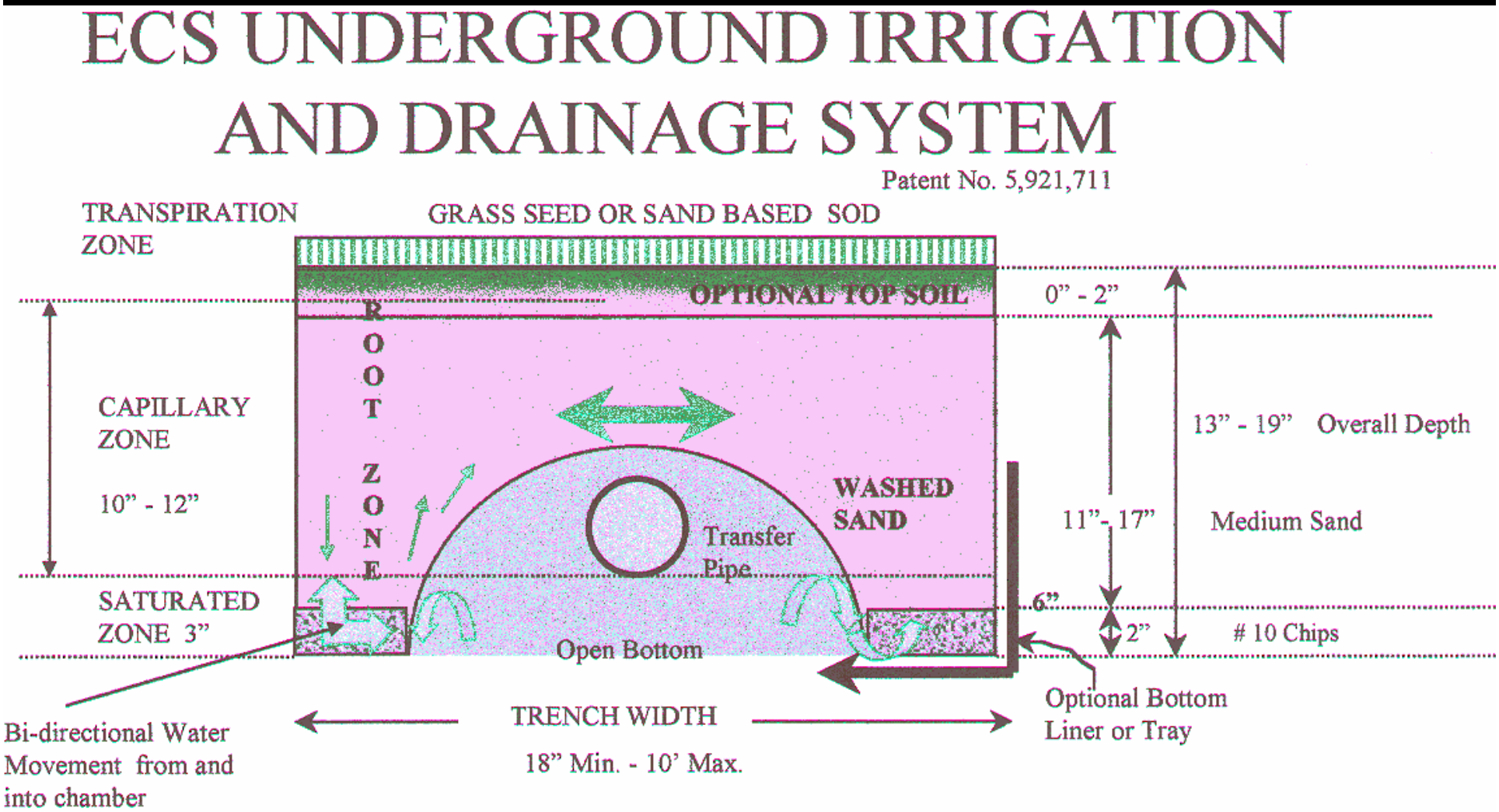
Evaporative Control System

Evaporative Control System

Evaporative Control System



Turf Construction
Structural cross section Details

Evaporative Control System

Evaporative Control System

Microirrigation

Drip Irrigation

- Line source (Precision porous pipe)
- Point source (Netafim, Toro)

Subirrigation

- Cellsystem
- ECS
- Pat System, Purr-Wick System

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DRIP IRRIGATION (SDI)

Point source systems:

- Toro (DL 2000)
- Netafim (Techline, Landline)
- Eurodrip

✓ Line source systems:

- Leaky Pipe
- Porous Pipe

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SUBSURFACE DRIP IRRIGATION (SDI)

Emitter spacing - depth

- ✓ Soil type
- ✓ Grass type (rooting depth)
- ✓ Water pressure
- ✓ Elevation changes

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fits all shapes

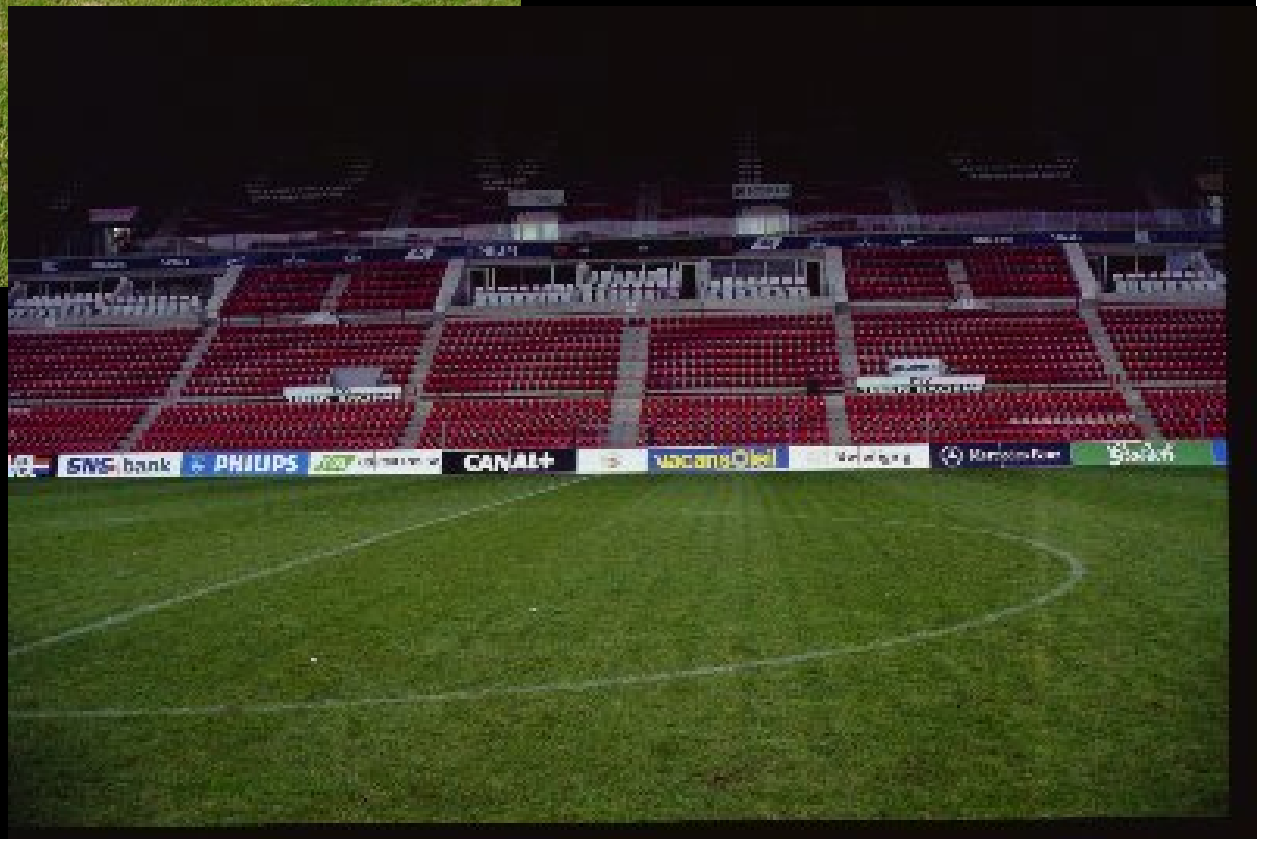
Home lawns

Park Area

Fresno State

Golf courses

Athletic Fields



Installation

Santa Fe
High School

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System Design

Information

1. Water quality
2. Pressure
   - preferably between 15 and 30 psi
3. Flow rate
   - important to determine maximum lateral length of drip lines

System Design

Calculation of maximum lateral length:

- ✓ Supply flow rate S_f: 20 gpm
- ✓ Emitter flow rate E_f: 0.5 gph
- ✓ Emitter spacing E_s: 12″

$$MLL = \frac{S_f(gph)}{E_f(gph)} \bullet E_s(ft) = \frac{20 \bullet 60gph}{0.5gph} \bullet 1ft = 2400ft$$

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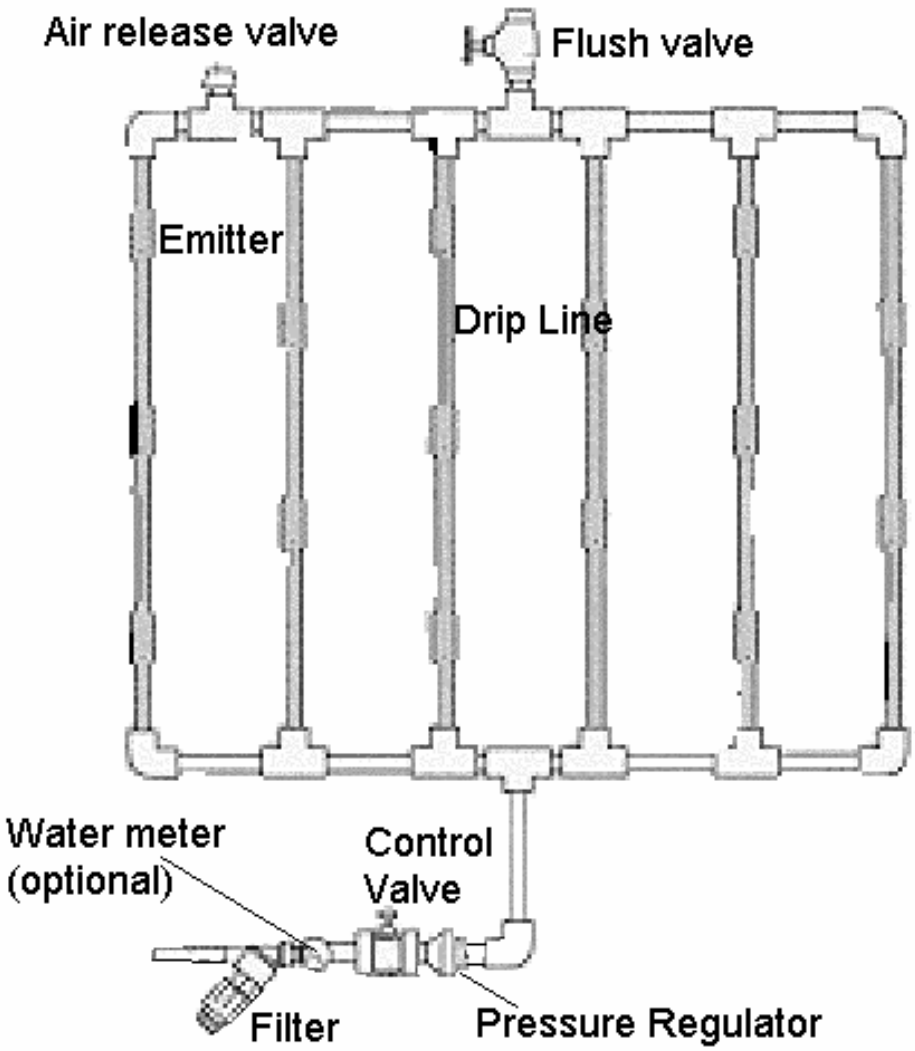
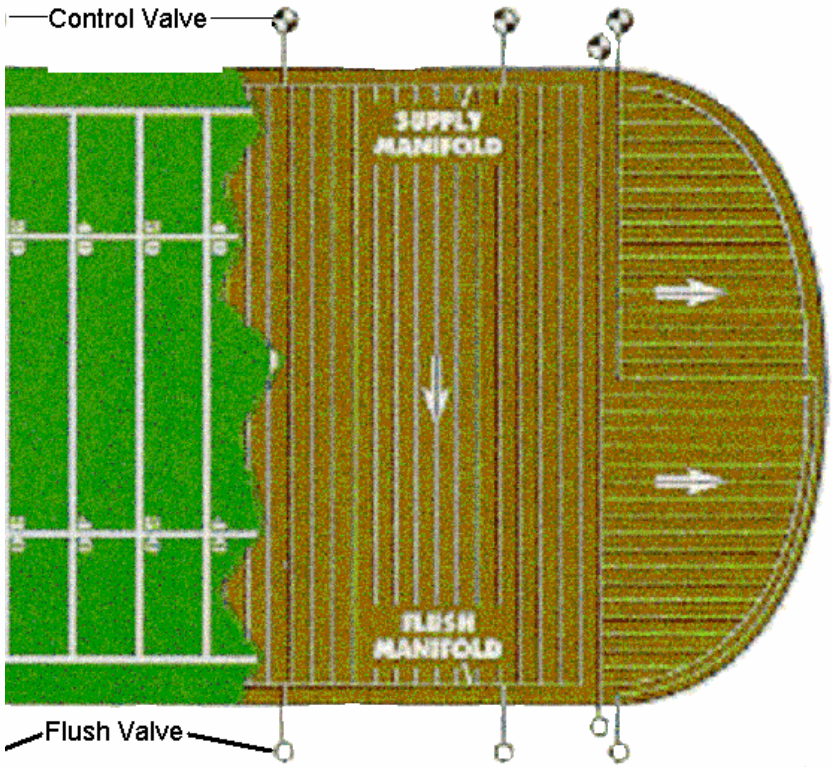
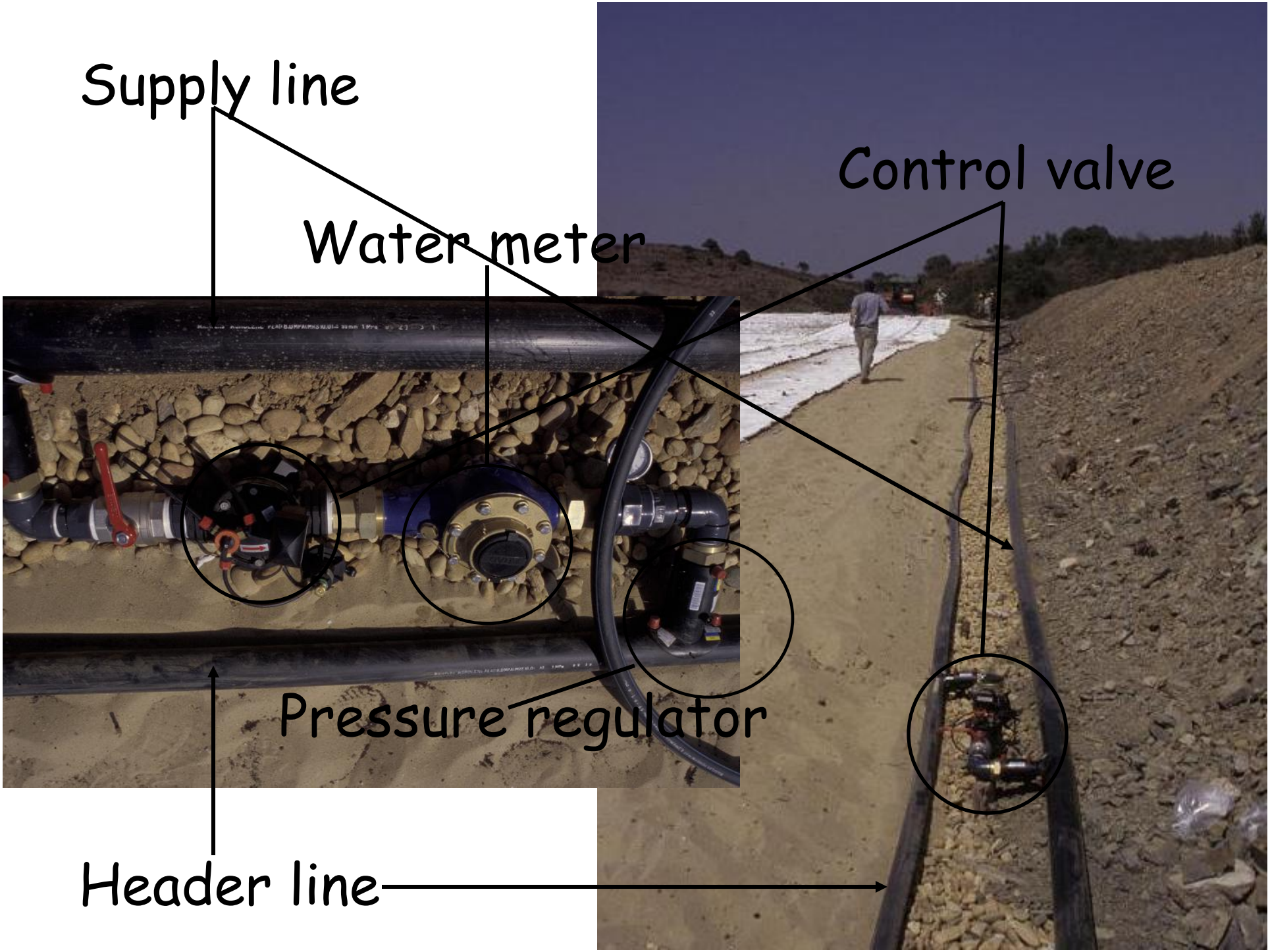
DRIP IRRIGATION (SDI)






Supply line
Water meter
Control valve
Pressure regulator
Header line

DRIP IRRIGATION (SDI)

Technical Details

Flush Valve and
Air Release Valve

Installation

Installation

Installation

Irrigation Water Use

- ✓ Irrigated Area: 60′ x 40′ = 2400 ft^2
- ✓ 1 ft spacing: 2400 emitters
  18″ spacing: 1800 emitters
  24″ spacing: 1200 emitters
- ✓ Emitter delivery rate: 0.5 gph
- ✓ System delivery rate:
  2400 x 0.5 gph = 1200 gallons/hour

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Irrigation Water Use

- ✓ Delivery rate: 1200 gph
- ✓ Irrigated Area: 60′ x 40′ = 2400 ft^2
- ✓ 1″ = 1520 gallons
  1 acre inch = 27154 gallons
  27154 x 0.056 = 1520
- ✓ System run time to apply 1″ of water:
  1520/1200 =1.27 hours
  <u>1 hour 20 minutes</u>

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Does sub-irrigation make a difference ?

1. Turf quality
2. Irrigation water use

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Does Sub-Irrigation make a Quality Difference ?

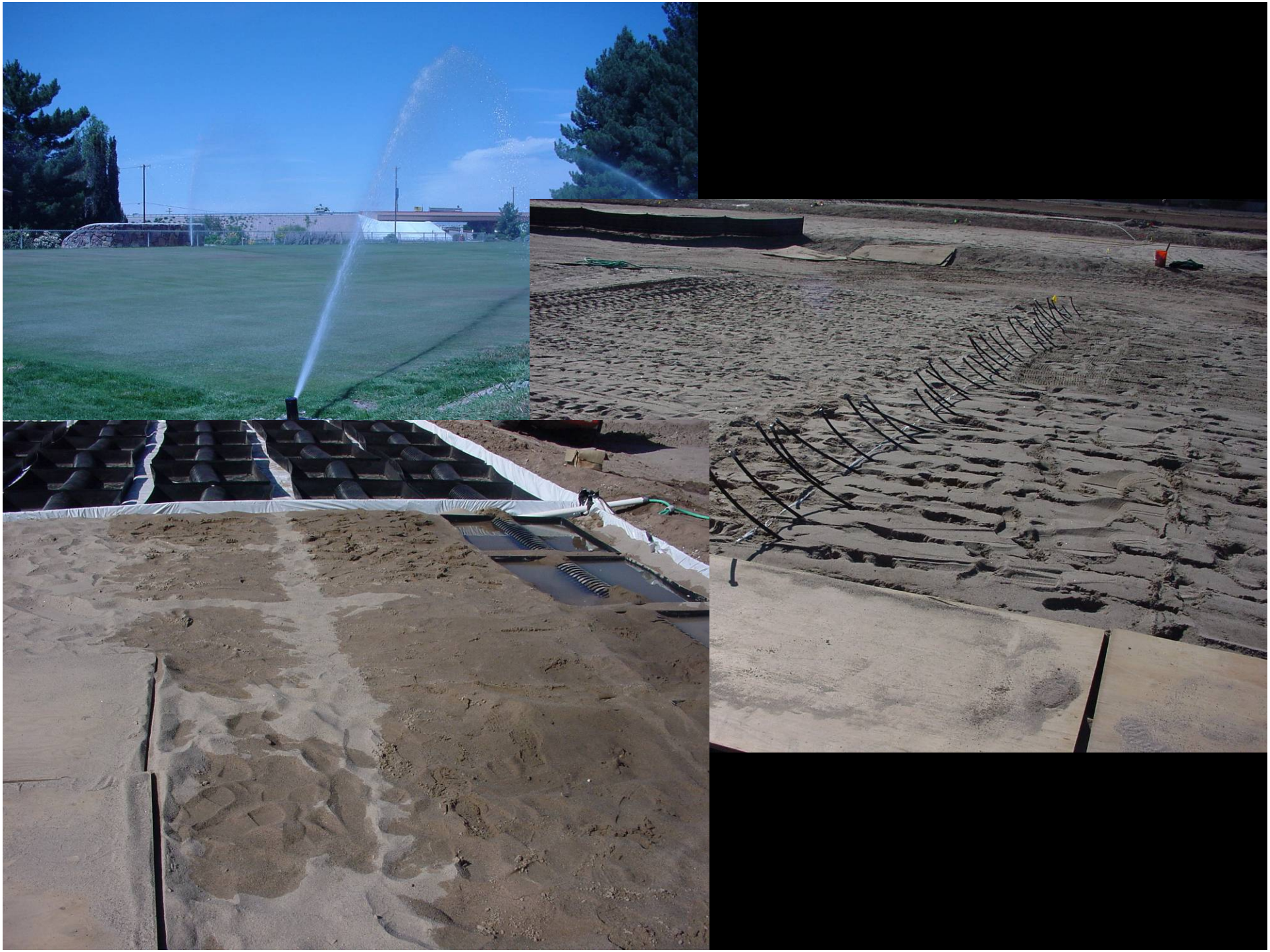
Sprinkler, maintained by Association

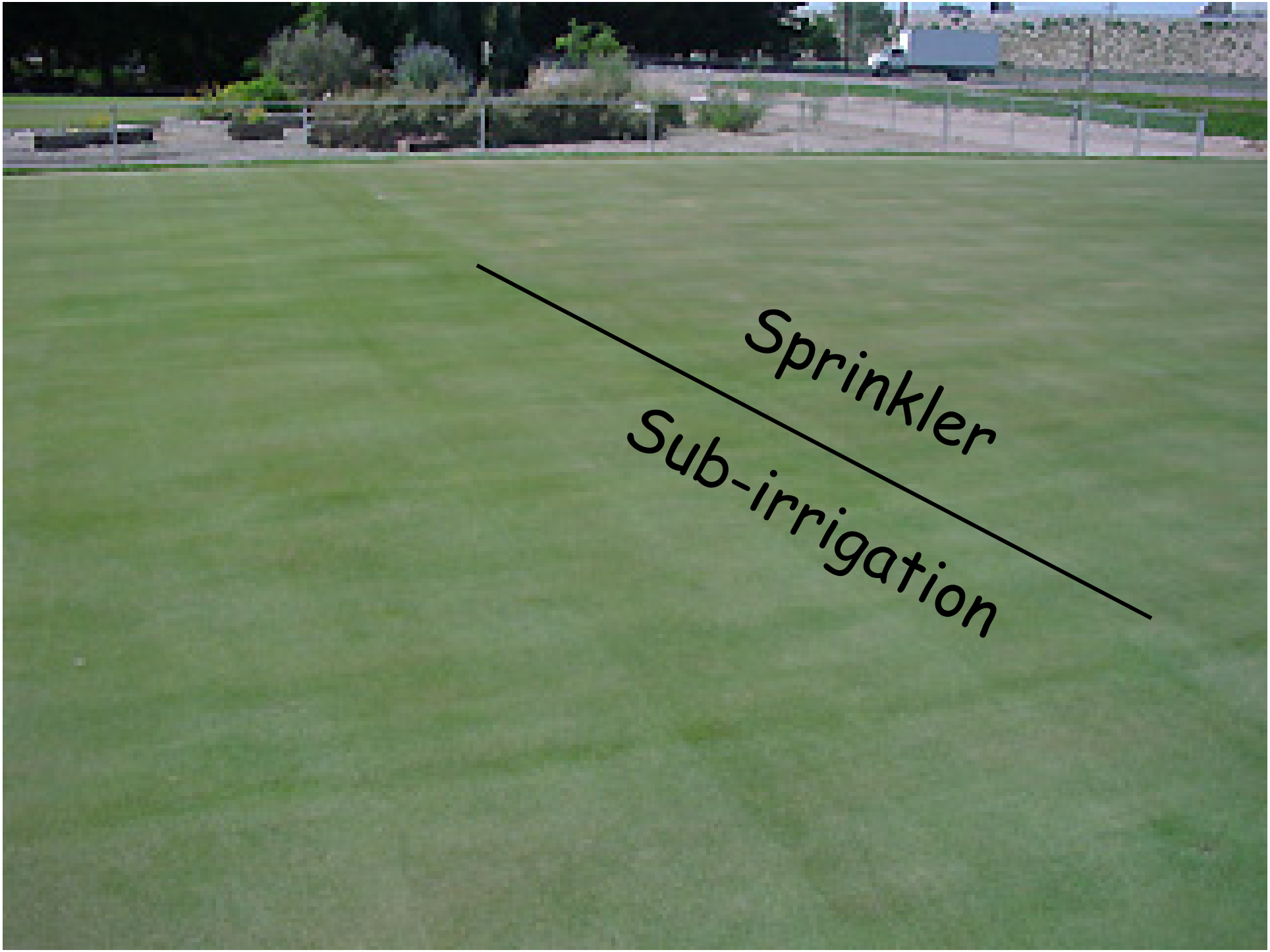
Sprinkler, maintained by meticulous homeowner

Two year old KB turf

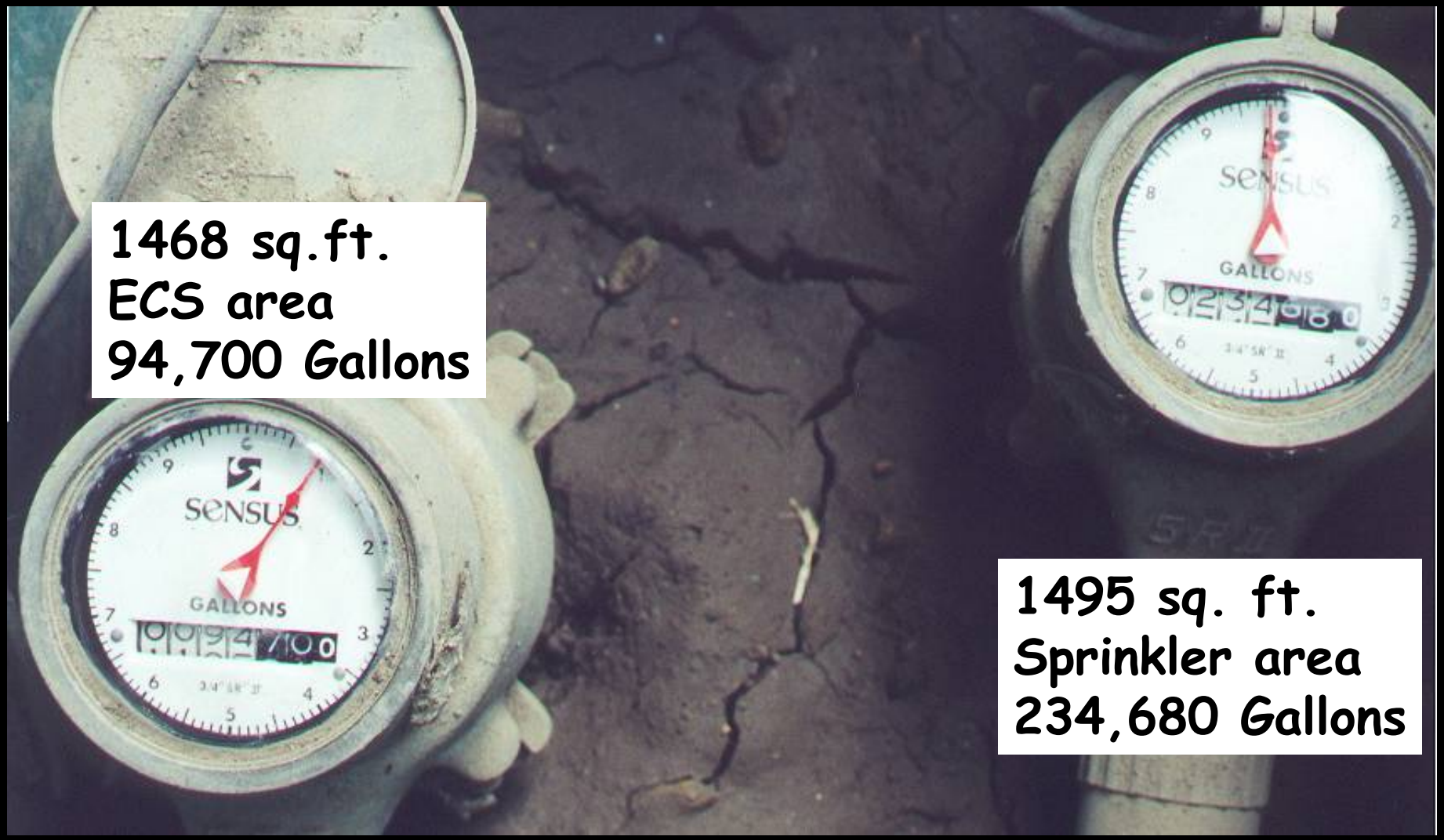
ECS

Sprinkler, (same as upper left)



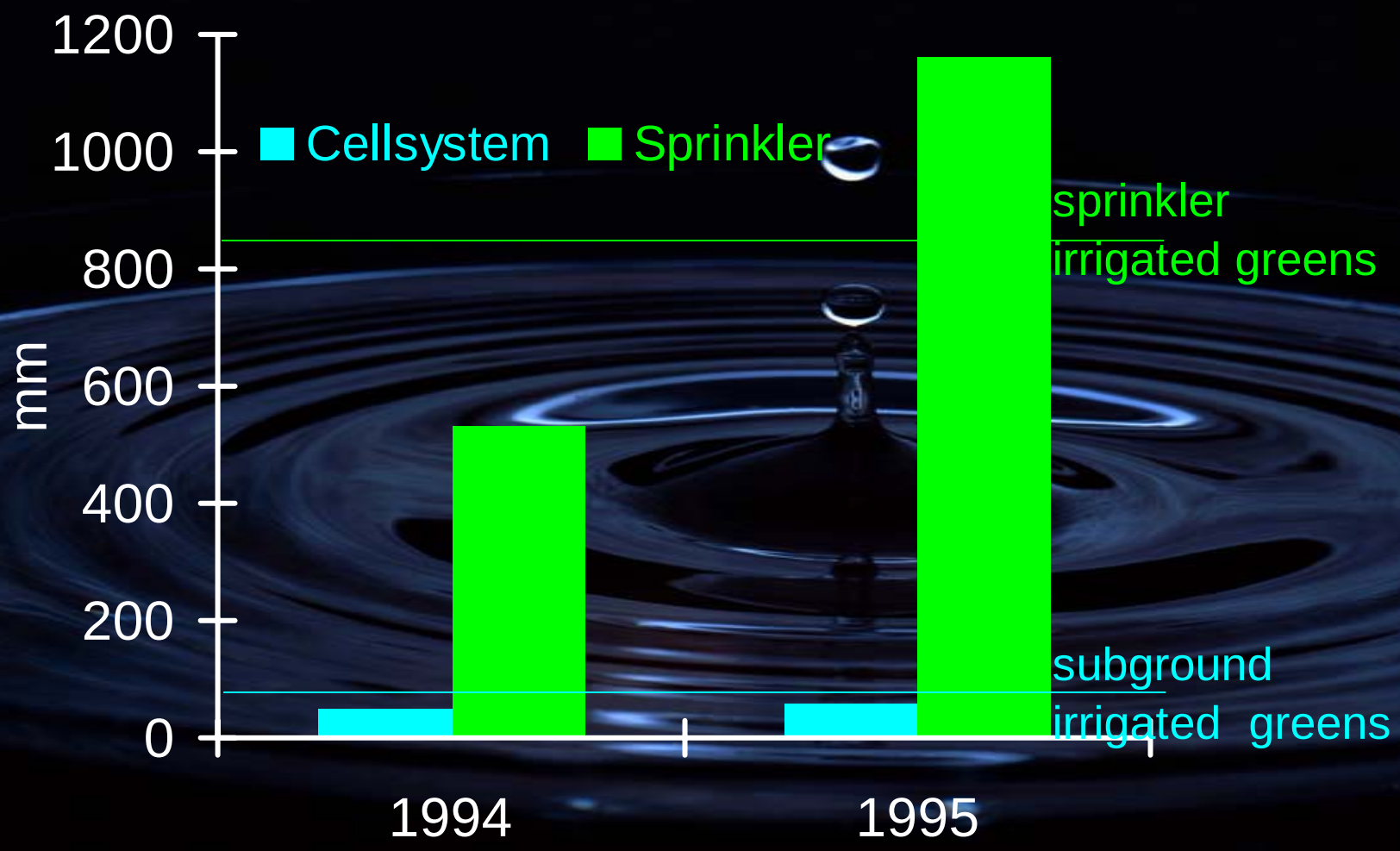

Sprinkler
Sub-irrigation

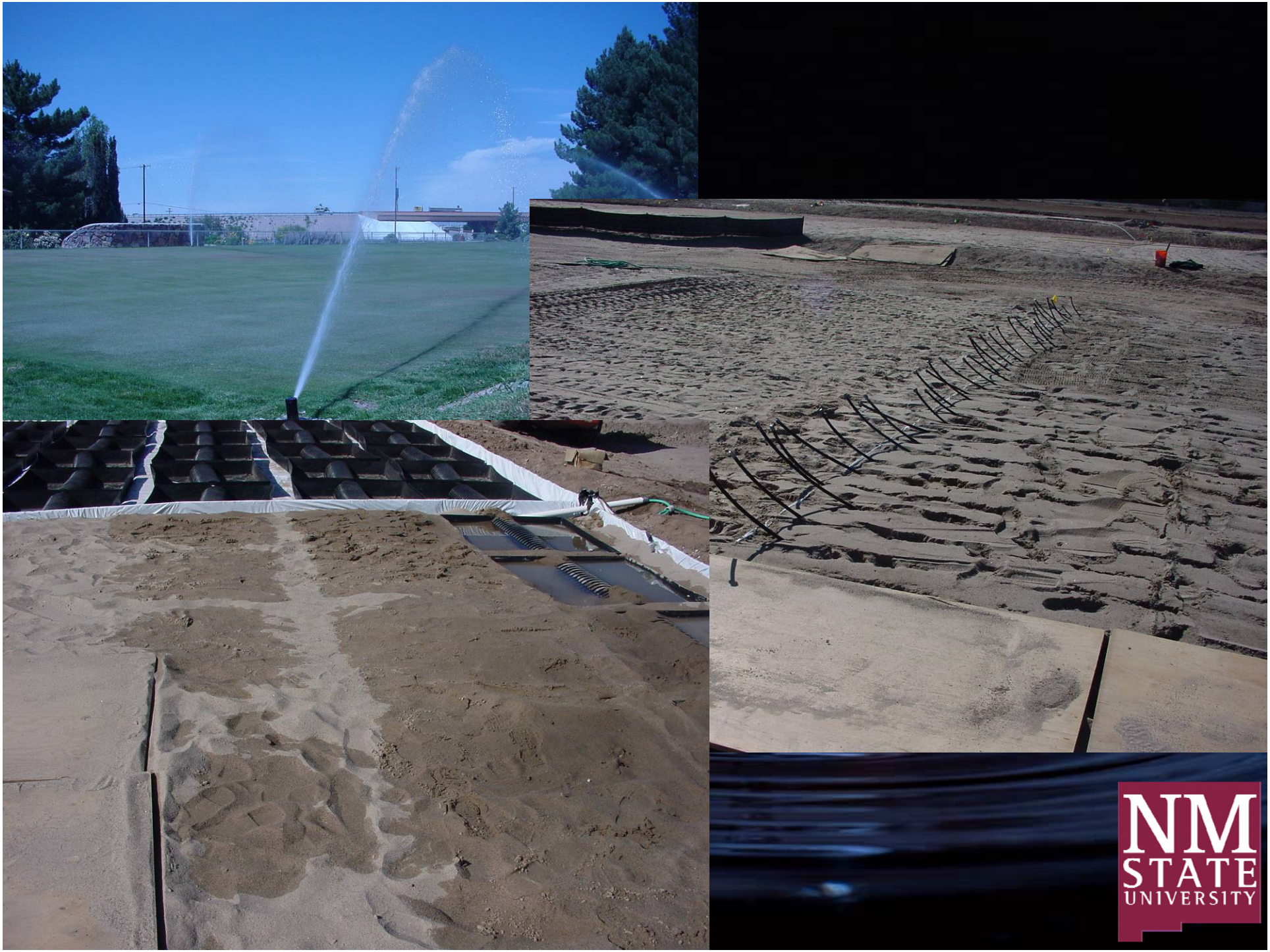
WATER SAVINGS AFTER TWO SEASONS



105″ 254″

Water consumption on differently irrigated greens

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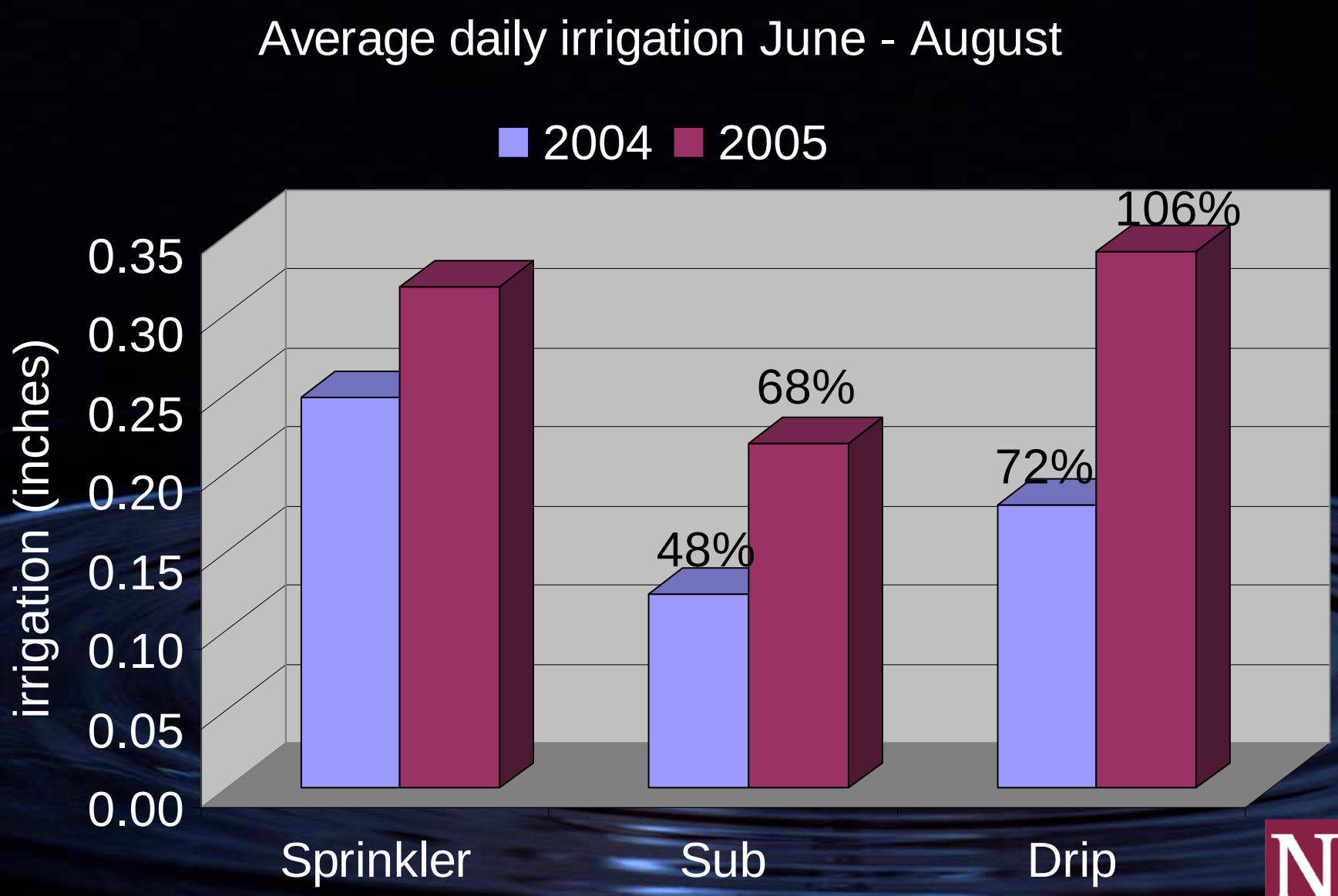
2003 Irrigation Water Use

May 16 – September 14:

ECS	7.52 mm day^{-1} (0.3″)	61%
Drip	15.22 mm day^{-1} (0.6″)	123%
Sprinkler	12.32 mm day^{-1} (0.5″)	100%


Average daily irrigation June - August
2004
2005
irrigation (inches)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
48%
68%
72%
106%
Sprinkler
Sub
Drip

Subsurface or Sprinkler?

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12001521
AGRIFIM
AGRIFIM
DRIP AND MICRO
IRRIGATION PRODUCTS

Water Quality (Salinity)

- ✓ Geothermal / saline
  - EC = 3.1-5.0 dS/m
  - SAR = 10.5
  - Total Dissolved Solids = 2050-3220
- ✓ Potable
  - EC = 0.6-1.2
  - SAR = 1.61
  - Total Dissolved Solids = 413-750

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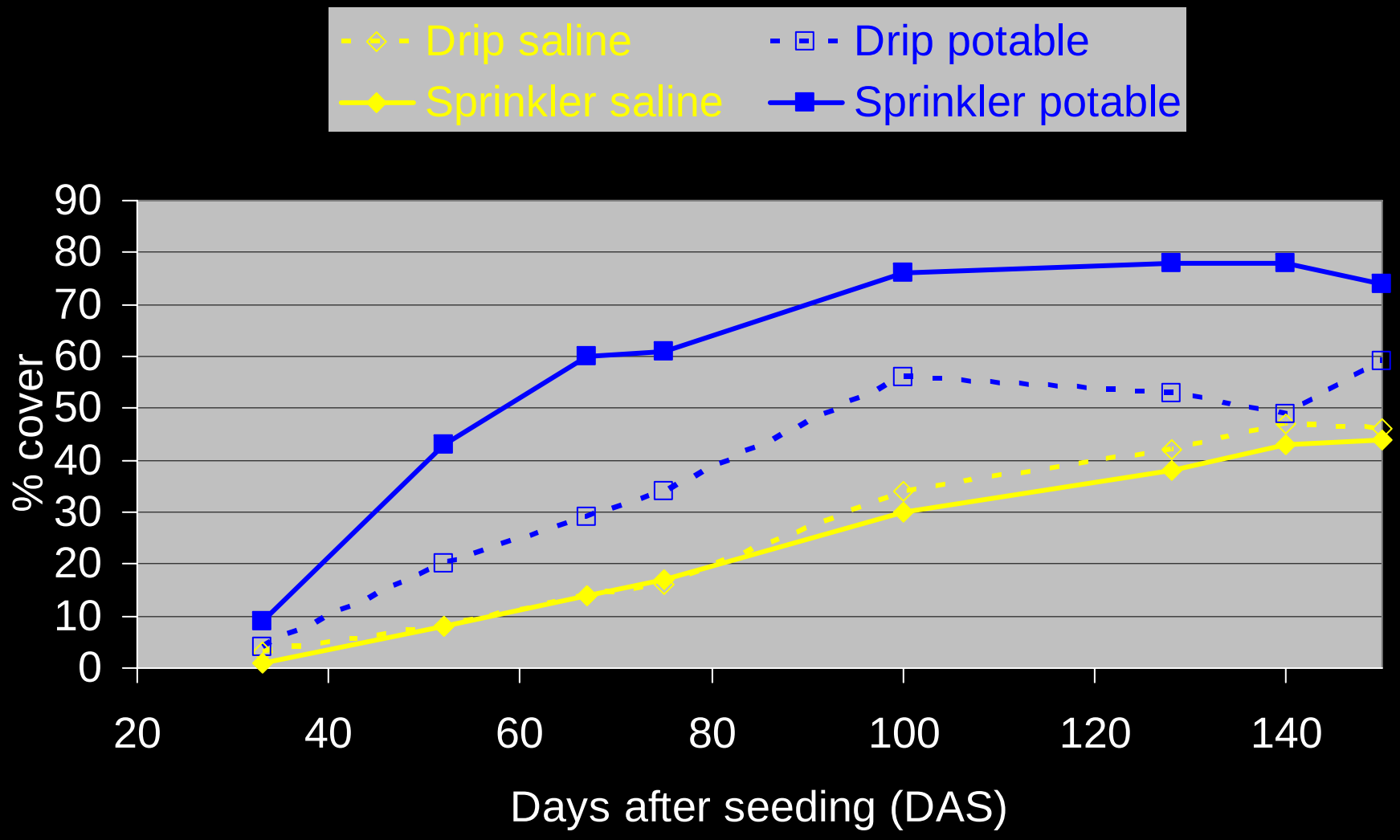
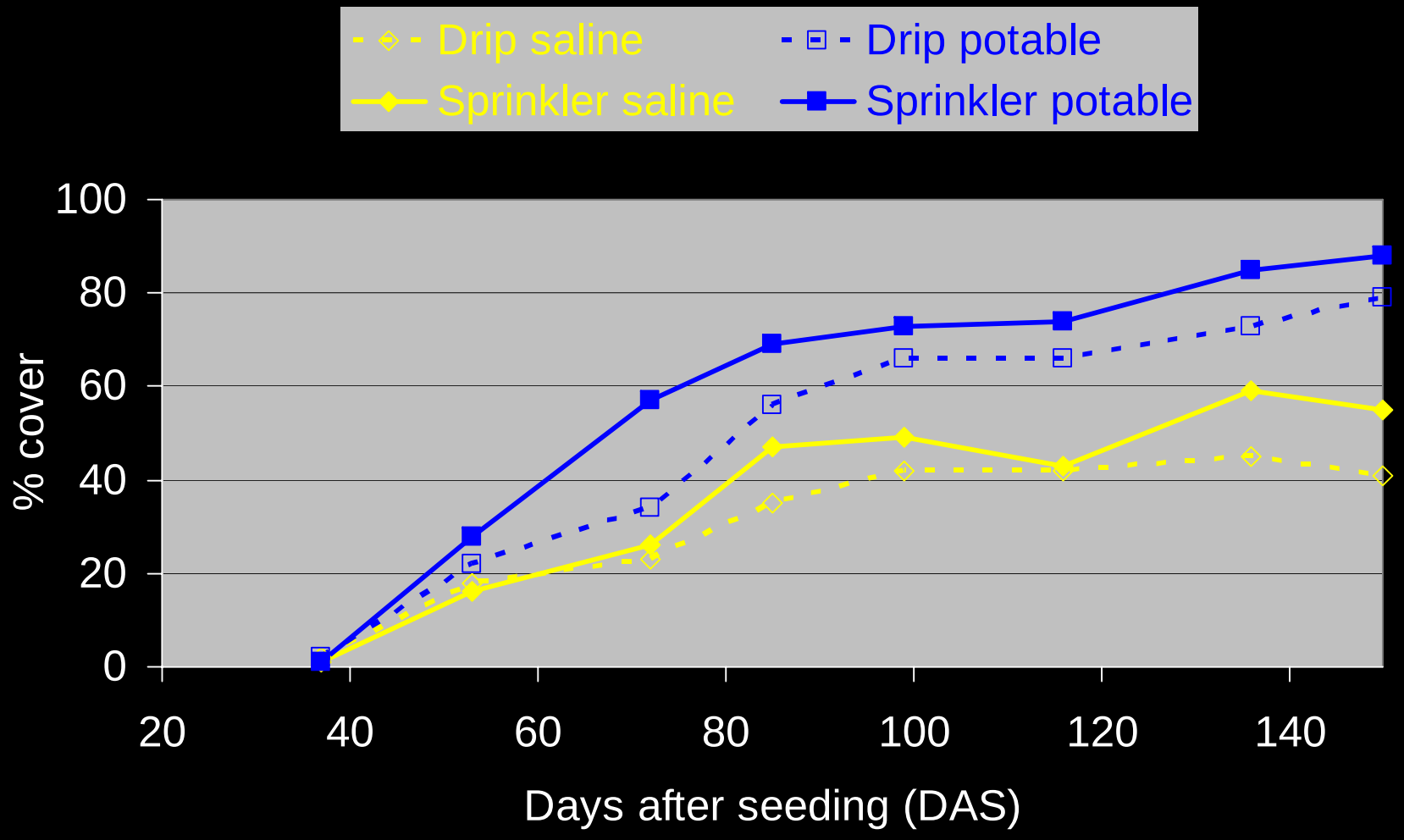

Establishment warm season grasses
Drip saline
Drip potable
Sprinkler saline
Sprinkler potable
% cover
90
80
70
60
50
40
30
20
10
0
20
40
60
80
100
120
140
Days after seeding (DAS)


Establishment cool season grasses
Drip saline
Drip potable
Sprinkler saline
Sprinkler potable
100
80
60
40
20
0
% cover
20
40
60
80
100
120
140
Days after seeding (DAS)

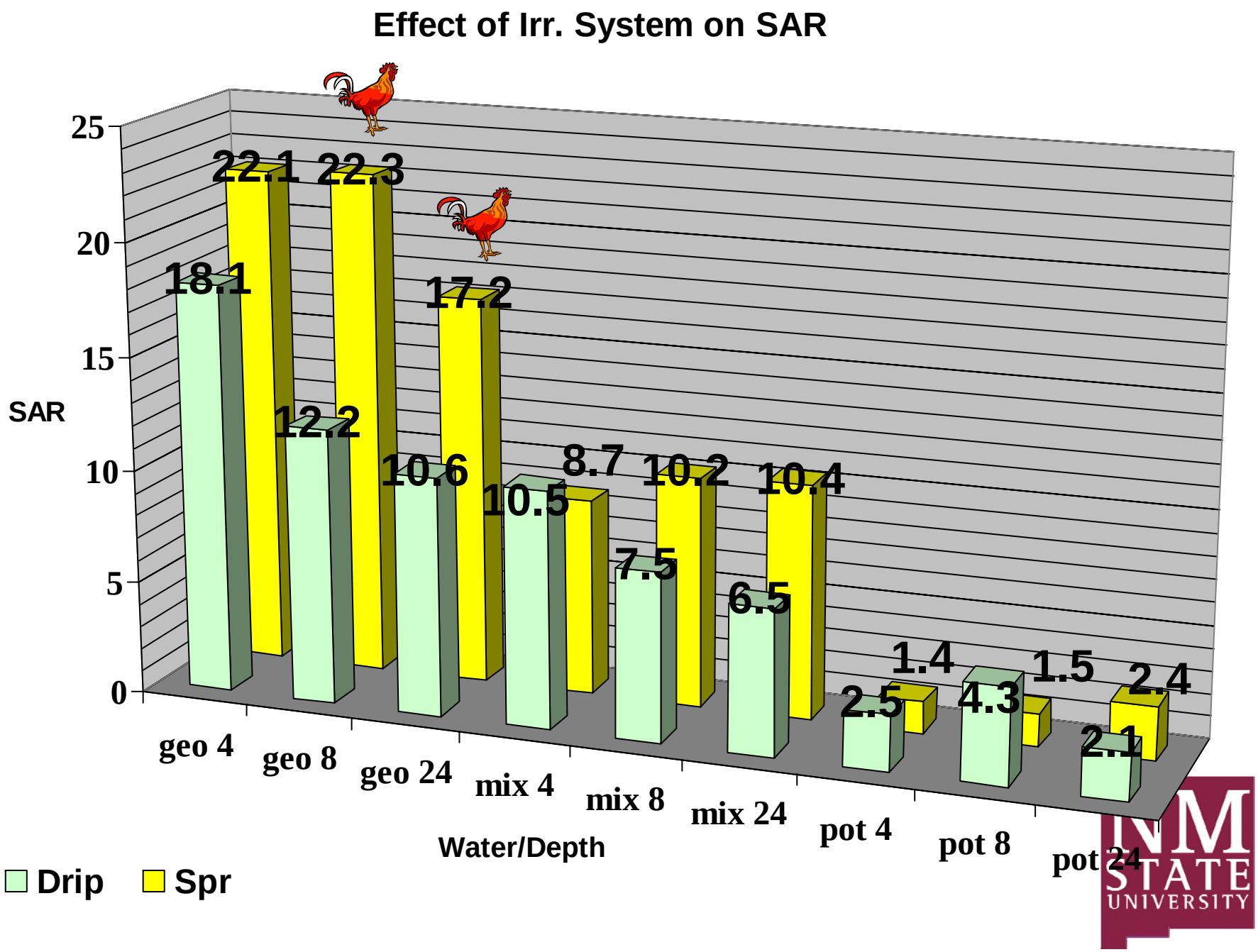
Establishment with saline water 150 DAS

Princess Bermudagrass

Seaspray Seashore

SWI 2000 Buffalograss

Salinity Effects on Root Zone


Effect of Irr. System on SAR
SAR
25
20
15
10
5
0
18.1
22.1
12.2
22.3
10.6
17.2
10.5
8.7
7.5
10.2
6.5
10.4
2.5
1.4
4.3
1.5
2.1
2.4
geo 4
geo 8
geo 24
mix 4
mix 8
mix 24
pot 4
pot 8
pot 24
Water/Depth
Drip
Spr

Summary

- SI turf is more drought resistant than sprinkler irrigated turf, it uses water more efficiently, thereby needing less water
- SI turf shows higher quality
- SI can lead to (significant) water savings

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Summary

- If SI is economically feasible depends entirely on the amount of water used and on the price of the water

Acknowledgements

NMSU Agricultural Experiment Station
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The Toro Co.
United States Golf Association

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Questions?

leinauer@nmsu.edu

http://turf.nmsu.edu