Tracking Every Drop: Irrigation Audits and Troubleshooting for Success

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Goals for this presentation

- How to conduct an irrigation audit
- How to troubleshoot an irrigation system based on audit results
- How to irrigate using audit results

Each Field is Unique!!!

The answer is not the same for every field
Be flexible
Don’t be afraid to ask for help
NETWORK!!!

Cultural practices matter!

What Type of Watering System Do You Have?

- Portable Systems
  - Pros
  - Can be moved
  - Cons
  - Time
  - Labor
- In-Ground Systems
  - Pros
  - Less time and labor to operate
  - Cons
  - Maintenance

Uniform Irrigation is a MUST
An efficient irrigation system has 4 components:

- The correct hardware
- Proper installation
- Long-term maintenance
- Management of the system

Before conducting an audit... fix the obvious.

- Broken sprinkler heads
- Mismatched nozzles
- Full-circles and part-circles matched
- Leaking heads or pipe
- Sunken heads
- Clogged nozzles
- Heads not level with grade

Improved irrigation efficiency:

- Reduced water use
- Fewer dry and wet spots
- Less water wasted
- Less need for fertilizer or chemicals
- Save money

What is an irrigation audit?

The method of inspecting and measuring how effective the sprinklers are working together to apply the water within each individual zone or test area.

The results are compiled and used in combination with observations to facilitate irrigation management.

Tools of the Trade
Steps for the irrigation audit

- Site evaluation
- Irrigation system tune-up
- Catch-can test
- Calculations
- Report of findings
- Make decisions

Steps for the site evaluation

- Make notes about the system design
- Activate each zone and visually inspect for problems
- If available, gain access to the water meter during the audit
- Determine sprinkler spacing and type

Key Outcomes of a Catch Can Test

- Average precipitation rate
- Distribution uniformity coefficient
A few definitions

- **Distribution Uniformity**
  A measure of how uniformly water is being applied to the plants in a measured area.

- **Lower Quarter Distribution Uniformity (DU_{0.25})**
  Average water applied in 25% of driest areas divided by the average water applied over the total area.

- **Scheduling Multiplier**
  Equation used to adjust run time based on distribution uniformity.

- **Precipitation Rate**
  Rate of water applied to the turf, usually in units of inches per hour.

The Catch Can

- Commercial products available from irrigation suppliers, universities etc. Some measure in mL and others convert to inches.

- But any straight-sided and short container can work (think tuna can).

A few questions before we start the test

- **How many cups do I need?**
- **How should the cups be spaced?**
- **How long do I need to run the zone?**
- **Do I need to test every zone?**

Guidelines for the Catch Can Test

- 5 mph wind or less
- “Normal” operating conditions (especially pressure)
- Uniform catch cans
- At least 24 cans per zone and use appropriate run times
- Cups near edge of zone should be 12 to 24-inches from edge
- Cans should be spaced within 2 to 3 feet of corner head and every one-third of the distance between the heads (or one-quarter for >40-ft spacing)

How long do I run the test?

- Amount of water should be 1.5 times the throat area of the cup
- Spray heads \( \rightarrow 5 – 10 \) minutes
- Rotors \( \rightarrow 10 – 20 \) minutes
- At least 5 full rotations for large rotors

STMA Audit Worksheet #1
STMA Audit Worksheet #2

Calculating Precipitation Rate Using mL:

Measure catch volume: ________ mL (1 mL = 1 cm³)
Calculate area of catch device opening: ________ cm²
Area (ft²) = ________ ft²

cm = ________ cm

inches of water in catch device = ________ in

PR = ________ inches of water in catch device

inches x 60

minutes run time

PRECIPITATION RATE = ________ in/hr

STMA Audit Worksheet #3

Calculating Precipitation Rate Using inches:

If using catch cans with parallel sides, inches per hour can be found by measuring the depth of water cups for rain.

Calculating Precipitation Rate Using inches:

PR = ________ inches x 60

PRECIPITATION RATE = ________ in/hr

Calculating Distribution Uniformity:
The most common measure of distribution uniformity is the Low Quarter Distribution Uniformity. This is computed as the average of the lowest quarter of catchment samples, divided by the average of all catchment samples. A higher distribution uniformity indicates more uniformity in the distribution of water. The distribution uniformity of 1.0 indicates perfect uniformity, whereas a ratio less than 1.0 is considered acceptable. The lower the distribution uniformity, the less uniform the distribution, which means more water must be applied to meet the minimum requirement.

DU (of lowest quarter) = ________ in

Avg Catch Overall = ________ in

Calculation: ________ in

Distribution Uniformity (DU) = ________ in

Run Time per Irrigation Cycle = ________ min

Run Time = ________ minutes

Zone Precipitation Rate = ________ inches x 60

Run Time per Irrigation Cycle = ________ in

Run Time = ________ min x 60

Inches

Inches
What does it mean?

Average application rate for the fields were:

<table>
<thead>
<tr>
<th></th>
<th>In/Hr</th>
<th>Uniformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Houston</td>
<td>3.11</td>
<td>34%</td>
</tr>
<tr>
<td>TAMU Kyle Field</td>
<td>0.54</td>
<td>52%</td>
</tr>
<tr>
<td>TAMU Soccer Field</td>
<td>0.54</td>
<td>43%</td>
</tr>
</tbody>
</table>

80% ideal!

Troubleshooting based on your audit results

Head to Head Coverage is IDEAL
Poor Coverage Creates Problems
Square spacing is very common but can be tough if rectangles are not quite square.

Triangular spacing is better but difficult on a rectangular field.

Uniformity of coverage is often related to low pressure.

There are 2 types of pressure:

- **Static pressure**: water is at rest (not moving)
- **Dynamic pressure**: water is in motion (working pressure)

Elevation affects pressure:

Expect ~0.433 PSI of loss for every 1-ft rise (or gain for going downhill).

From OSU Factsheet HLA-6617

<table>
<thead>
<tr>
<th>Irrigation Component</th>
<th>Pressure Loss</th>
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<tbody>
<tr>
<td>Water meter</td>
<td>5 psi</td>
</tr>
<tr>
<td>Backflow preventer</td>
<td>4 psi</td>
</tr>
<tr>
<td>Control valve (one per zone)</td>
<td>3 psi</td>
</tr>
<tr>
<td>Water mainline</td>
<td>2 psi</td>
</tr>
<tr>
<td>Water lateral lines</td>
<td>1 psi</td>
</tr>
</tbody>
</table>

Don’t overlook the obvious:

- Is the isolation valve partially closed?
- Is there a backflow prevention device that is partially closed?
- Pressure regulation or flow control on valve adjusted properly?
- Is there debris in the heads, filters, or valves?
Bigger problems can be tough to address

- Are pipes adequately sized?
- Were sprinkler heads or nozzles changed since original design?
- Shrinking to low flow nozzles or increasing the number of heads might be an option.
- Booster pumps are available but consult an expert when evaluating the best fit for an under-engineered system.

Pressure regulation comes in several options

- Pressure regulator at the source (near pump or meter)
  - Need to confirm adequate pressure remains between install site and field
- Pressure-regulated valves
  - Can be simple and economical – seek a local distributor for options on retro.
- Pressure-regulated heads
  - Might be expensive depending on number of heads

What’s missing from the picture?

How much water do we need?

- Use estimates of ET to calculate a plant water requirement
- Convert PWR to a run time using the irrigation audit
Texas ET Network
www.texaset.tamu.edu

For Water Budgets, We Like to Use Long-term Weather Data

<table>
<thead>
<tr>
<th>Month</th>
<th>Average Irrigation Needed</th>
<th>Average Irrigation Used</th>
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</thead>
<tbody>
<tr>
<td>April</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>May</td>
<td>3.6</td>
<td>3.6</td>
</tr>
<tr>
<td>June</td>
<td>4.9</td>
<td>4.9</td>
</tr>
<tr>
<td>July</td>
<td>4.7</td>
<td>4.7</td>
</tr>
<tr>
<td>August</td>
<td>4.1</td>
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<tr>
<td>September</td>
<td>3.8</td>
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<tr>
<td>October</td>
<td>3.0</td>
<td>3.0</td>
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Modified from OSU Factsheet 1-64

ET Irrigation Recommendations

<table>
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<tr>
<th>Grass</th>
<th>High Maintenance</th>
<th>Moderate Maintenance</th>
<th>Low Maintenance</th>
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<tbody>
<tr>
<td>Bermuda</td>
<td>-0.5</td>
<td>-1.0</td>
<td>-1.5</td>
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<tr>
<td>Zoysia</td>
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<td>-1.0</td>
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<tr>
<td>Tall Fescue</td>
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<td>-0.75</td>
<td>-1.0</td>
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<tr>
<td>Kentucky Blue Grass</td>
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<td>-0.75</td>
<td>-1.0</td>
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<td>Perennial Rye</td>
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<td>-0.75</td>
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Modified from OSU Factsheet 4-34

From IA CLIA-CGIA Audit Guidelines

Table 4-2 Conversion table from DI_L to scheduling method

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<td>0.56</td>
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<td>1.40</td>
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<td>0.84</td>
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<td>1.30</td>
<td>0.42</td>
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<tr>
<td>0.80</td>
<td>0.78</td>
<td>0.60</td>
<td>1.33</td>
<td>0.40</td>
<td>1.56</td>
</tr>
</tbody>
</table>

Fix the sprinkler problems below G.00

What else Can We do?

GCSAA EIFG Golf Course Env. Profile (2009)
All plots in this putting green experimental area received the same amount of irrigation (very little). Can you pick out the only three plots that received monthly wetting agent applications?

Tifway bermudagrass on 8" sandcap
Wetting agent applied monthly

1" H2O/week
0.5" H2O/week
0.5" H2O/week + wetting agent

PGR’s resulted in 5-7 day delay in firing. Suggests that irrigation could be applied less frequently if Primo is used.

Don’t forget the basics

• Early in the morning
• Wind is calm
• Adequate time for leaves to dry
• At least 24-48 hours before game time
• After practice or a game?
• Why?

Summary
1. Use your eyes to observe problems
2. Audit the system to confirm performance
3. Make adjustments and repeat Steps 1 and 2
4. Implement BMP’s to conserve water and maintain player safety