Recommended Audit Guidelines

The Irrigation Association has developed a set of minimum guidelines to create a standardized procedure to perform an audit of a landscape irrigation system. ASABE standards have been reviewed and incorporated wherever possible. Consultation and review of the guidelines has been conducted with many irrigation auditors, contractors, statisticians, educators, irrigation consultants and the Irrigation Association Certification Board. The usage and application of these guidelines is at the discretion of others. The Irrigation Association offers the guidelines without warranty or obligation.

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Irrigation Audit Guidelines

The guidelines were developed by the Irrigation Association and are intended to function as recommendations in the auditing of landscape irrigation systems. They have been designed to aid irrigation professionals in fieldwork procedures, techniques and performance calculations.

Recommendations and projections from the guidelines and their accuracy depend upon the quality of measurements and data provided by the individual user. The Irrigation Association makes no warranty, implied or expressed, as to the results obtained from these procedures.

Step #1 Pre-audit inspection

- Irrigation system should be in optimal working condition prior to performing a test.
  Verify that the irrigation system complies with local codes.
  Identify operational defects or deficiencies.
  Assure that corrections have been made.

Step #2 Auditing procedures

- Maximum wind allowable during audit = 5 mph or less (ASAE S398.1). Wind speed should be monitored and recorded every five minutes during the audit test.
- Audit should reflect normal operating conditions. If normal operating conditions occur at odd hours, some assessment of the impact of these conditions should be made on the tested conditions
- Pressure tests should be conducted at normal operating conditions at the sprinkler using the appropriate pressure testing device at the beginning and end of each zone audited.
- All catch devices must be uniform in size and shape. Larger collectors give better repeatable results.
- Catchments for a test area should be documented to facilitate repeatability.
- A minimum of 24 catch devices should be used. Research (Vinchesi, et al., Irrigation Show 2007 and 2008 proceedings.) shows that smaller sprinkler spacing may require more catch devices to improve statistical accuracy.
- The catchments along the edge of the zones should be placed 12 to 24 inches in from the edge.
- Minimum catchment device spacing
  - For fixed spray sprinklers – near a head (within two to three feet) and half-way between the heads.
  - For rotor sprinkler heads spaced less than 40 feet on center – near a head (within two to three feet) and every one-third of the distance between the heads.
  - Rotor heads spaced greater than 40 feet on center – near a head (within two to three feet) and every one-fourth of the distance between the heads.
  - Unusual or irregularly shaped areas:
    - For rotor sprinklers – uniform grid of catch devices, 10 to 20 feet on center spacing (i.e., baseball infield, golf green).
    - For spray sprinklers – uniform grid of catch devices, 5 to 8 feet on center spacing (i.e., curvilinear areas without defined rows of sprinklers).
- Test run times must be consistent and appropriate for the sprinkler type and arc.
- When the test area contains multiple stations, the test run times for each station or zone must be adjusted to achieve a matched precipitation rate across the test area.

- The volume in milliliters should be approximately one and one-half times the throat area of the catch device in square inches. For example if the throat area of the catch device is 20 square inches the average volume of water should be 30 ml (20 x 1.5 = 30).
- "Linking" (using information from one station or zone and applying to another) may be used when there are a large number of sprinkler zones that are identical, i.e. the same sprinkler head, nozzle, spacing, operating pressure and irrigating similar soil and plant types. The auditor may elect to perform catch device tests on one-third to one-half of the sprinkler zones to get an average value that could be applied to all sprinkler zones that are identical.
- The following data should be documented and recorded:
  Sprinkler head locations
  Sprinkler head spacing
  Sprinkler make, model and nozzle size
  Approximate catch device locations
  Catchment readings
  Test run time
  Meter readings if available
  Pressure readings with locations
  Wind speed readings
  Soil types and root zone depths
  Date and time of testing

Step #3   Performance calculations

To calculate the precipitation rate using milliliter readings:

$$PR_{net} = \frac{3.66 \times V_{avg}}{t_R \times A_{CD}}$$

PR_{net} = station precipitation rate {in./h},
V_{avg} = average catch volume for station {ml},
t_R = testing run time {min},
A_{CD} = catch device throat area {in.^{2}}.

To calculate the low-quarter distribution uniformity:

DU_{LQ} = Low-quarter distribution uniformity {decimal}.

$$DU_{LQ} = \frac{\text{Average Catch of Lower Quarter}}{\text{Average Catch Overall}}$$

When calculating the base irrigation schedule it is recommended to use IA scheduling methodology and procedures as presented in the Golf Irrigation Auditor and Landscape Irrigation Auditor manuals.

stressed areas and achieve an acceptable appearance. When additional minutes of run time become excessive, runoff potential increases, and it becomes more difficult to do proper maintenance if the sprinkler system is operating beyond its desired or designated water window.

Table 4-2 is a quick reference for the SM that corresponds to the measured DU_{lq} for a particular sprinkler zone or area. The SM is a quick way to determine how much extra water could be applied. For example, a DU_{lq} of 0.60 has an SM of 1.32, which indicates that about one-third more water would be applied.

Table 4-2
Conversion table from DU_{lq} to scheduling multiplier

DU_{lq}	SM	DU_{lq}	SM	DU_{lq}	SM
1.00	1.00	0.78	1.15	0.58	1.34
0.98	1.01	0.76	1.17	0.56	1.36
0.96	1.02	0.74	1.18	0.54	1.38
0.94	1.04	0.72	1.20	0.52	1.40
0.92	1.05	0.70	1.22	0.50	1.43
0.90	1.06	0.68	1.24	0.48	1.45
0.88	1.08	0.66	1.26	0.46	1.48
0.86	1.09	0.64	1.28	0.44	1.51
0.84	1.11	0.62	1.30	0.42	1.53
0.82	1.12	0.60	1.32	0.40	1.56
0.80	1.14	Fix the sprinkler problems if below 0.40			

Precipitation Rate

Precipitation rate [PR] is the rate at which irrigation water is applied per unit of time. PR is usually measured in inches of water per hour {in./h}. It is calculated as an average within a given area. Precipitation rate (also referred to as the application rate) is a critical factor in design, because sprinkler systems can easily apply water at rates greater than the soil's intake rate. Depending on the pressure, spacing, and type of sprinkler selected, each individual station may have a different precipitation rate. At many sites, it is possible to use a water meter to measure the flow into an irrigation area or zone. If the flow rate of a station and the area covered by the sprinklers are known, it is possible to estimate the average gross precipitation rate. Variations depending on sprinkler spacing and configuration are given, but all are based on the same general equation used for the gross or theoretical precipitation rate in equation 4-3a. In each example, the area is calculated based upon the data available for the site.

Run Time Multiplier (RTM)

The Run Time Multiplier is used to increase the number of minutes that would be required to apply a given amount of water depending upon the precipitation rate of the sprinkler and to compensate for the lack of perfect uniformity in the distribution of water. The RTM also accounts for the lateral movement of water in the soil. The RTM is based upon the following equation:

$$RTM = \frac{1}{0.4 + (0.60 \times DU_{LQ})} \qquad \textbf{Equation 3-11}$$

Where:

RTM = Run Time Multiplier

DU_{LQ} = Lower Quarter Distribution Uniformity

The RTM can also be determined from the following table:

Table 3-8: Conversion Table from DU_{LQ} to RTM

DU_{LQ}	RTM	DU_{LQ}	RTM	DU_{LQ}	RTM
1.00	1.00	0.70	1.22	0.40	1.56
0.98	1.01	0.68	1.24	0.39	1.58
0.96	1.02	0.66	1.26	0.36	1.62
0.94	1.04	0.64	1.28	0.33	1.67
0.92	1.05	0.62	1.30	0.30	1.72
0.90	1.06	0.60	1.32	0.27	1.78
0.88	1.08	0.58	1.34	0.24	1.84
0.86	1.09	0.56	1.36	0.21	1.90
0.84	1.11	0.54	1.38	0.18	1.97
0.82	1.12	0.52	1.40	0.15	2.04
0.80	1.14	0.50	1.43	0.12	2.12
0.78	1.15	0.48	1.45	0.09	2.20
0.76	1.17	0.46	1.48	0.06	2.29
0.74	1.18	0.44	1.51	0.03	2.39
0.72	1.20	0.42	1.53	0.00	2.50