Effluent Irrigation Quick Calibration

Guidelines for Travelling Effluent Irrigators 0 - 15% overlap V2.1

What is the Effluent Calibration about?

The purpose of the Effluent Calibration Quick Test is to determine the depth of effluent and amount of nutrient applied during an irrigation event, and how uniformly the effluent and nutrients are distributed.

It is designed so farmers and staff can do the testing and calculations themselves. As well as this guideline, a worksheet is available to assist. If findings are unexpected, or suggest low performance, consider getting professional advice.

Why you should check your system?

Profitability – effective effluent irrigation captures nutrients and avoids animal health problems. A well setup system saves money!

Sustainability – efficient irrigation minimises energy use, leaching and water contamination.

It is essential for effluent managers to know how much effluent is being applied. It is an important input into any nutrient budgeting or scheduling process. It is particularly important to manage the risk of adverse impacts and non-compliance.

The uniformity of effluent irrigation determines whether all areas are receiving the same amount of nutrient. As uniformity decreases, some areas will be more over-fed while some are more under-fed. This applies to all the major nutrients, N P & K

What is involved?

The Effluent Calibration Quick Test method is based on measurements of effluent collected in twenty two identical buckets. Follow bucket placement instructions carefully and read volumes as accurately as possible to be sure of best results.

Determine the speed of the irrigator as it passes over the collector buckets. You can redo this at different locations along the run length to check the speed (and thus depth applied) is constant.

To complete the nutrient application calculations, you need to determine the concentration of nutrients in the effluent. Send a sample to your soil testing lab and use the results to complete your calculations. Nitrogen is the example used in this protocol, but you can repeat for all nutrients.

Be aware: the concentration will vary with pasture quality, extra feed and wash down water. It may pay to do several tests over a full season.

What will the testing tell you?

The main things the Quick Test will tell you are:

Applied Depth – the depth of effluent the irrigator is applying. Comparing the measured applied depth to your target application is a main point of this calibration exercise.

Distribution Uniformity – DU describes the evenness with which nutrients are applied. The closer to 1.0 the DU the better the system is performing. And the more confident you can be that your measurements are truly representative of your system's performance.

Nutrient Loading – The average and peak amount of nutrient applied to the field given the sample concentration and applied depth as measured. If lab test units are kg/m^3, multiply depth by concentration times 10. If lab test units are mg/L multiply depth by concentration divided by 100.

What do you need to do?

- Gather information about your system
- Get an effluent sample tested
- Record the data on the worksheet
- Work out the answers using the worksheet

When should you do it?

Choose test conditions that are typical for your farm. Performance is likely to change along the length of each run, and at different hydrants on a long mainline or on rolling country.

It may be useful to test in different wind conditions and when effluent make-up changes significantly.

What are the Quick Test's limitations?

The depth of effluent applied will change if the speed of the irrigator changes. A faster speed puts on less.

The uniformity will change with machine pressure, lane spacing, topography and wind.

The Effluent Calibration Quick Test will only provide information for a given machine running at a given position at a given speed and pressure on a given day. As any of these change so will effluent application.

Measurement Procedure

What equipment will you need?

This guide and the worksheet

22 Collectors of the same diameter (at least 150 mm) – 9 Litre plastic buckets are good
1 Measuring cylinder (about 1 Litre)
1 20m measuring tape
2 Electric fence standards
1 Stop watch
1 Pen or pencil

Dealing with overlap

If irrigation from adjacent runs overlaps, this must be taken into account. To account for overlap, buckets are placed in the overlap zone and measured depths combined. The effective depth and evenness is the combined effect of both runs.

1. Place a marker half way between two hydrants. This is the edge of the "Lane".
2. Mark the extent of obvious wetting when the irrigator runs. This is the "Wetted Width".
3. If the wetted width is more than 5% greater than the lane width, you need to consider overlap. If overlap is less than 5%, ignore it.
4. If the overlap is 5 - 15%: Place one bucket half way between the edge of the lane and the edge of the wetted width [see **'L11'** in Diag 2].

   Mirror this inside the edge of the lane, setting another bucket at the same spacing from the edge of the lane [see '**L10** in Diagram 2].
5. Arrange nine more buckets at even spacing to cover the area back to the centre line (the hose or cable) [see '**L9-L1**' in Diagram 2]. The spacing may be different to overlap buckets.
6. If the overlap is more than 15%: Use two buckets between the edge of the lane and the edge of the wetted width.

   [There is another Guide and Worksheet for systems with more than 15% overlap.]
7. Repeat 4, 5 & 6 on the right hand side.

Application test

1 Set your 22 buckets in a row across the direction of irrigator travel [**T1** in Diagram 1]
2 Start the irrigator away from (before any water can reach) the line of buckets
3 Run the irrigator until it is well past wetting the buckets. Measure the irrigator speed as it passes over the test buckets
4 Measure the volume of water caught in each bucket and record on the Record Sheet

Speed test

1 Set two markers (e.g. fence standards) 5.0m apart along the hose or cable
2 The markers should cross the line of collectors
3 Measure the time for the irrigator to travel between markers.

Field test layout

Ideally do tests in various places to check the same depth is applied along the length of irrigator runs and off different hydrants.

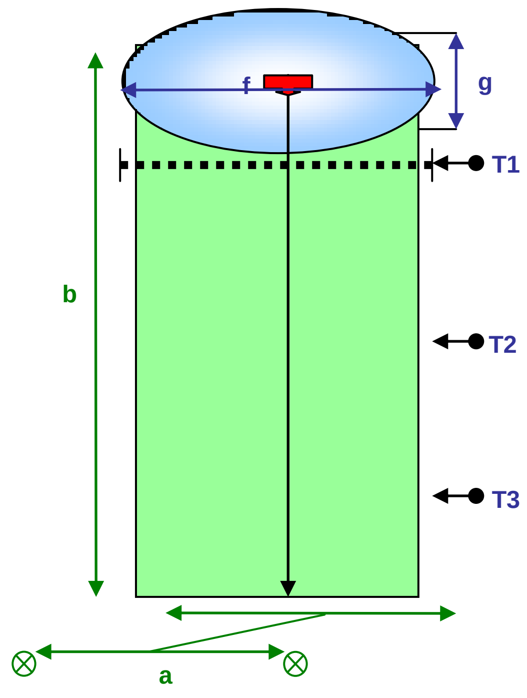


Diagram 1. Key Dimensions

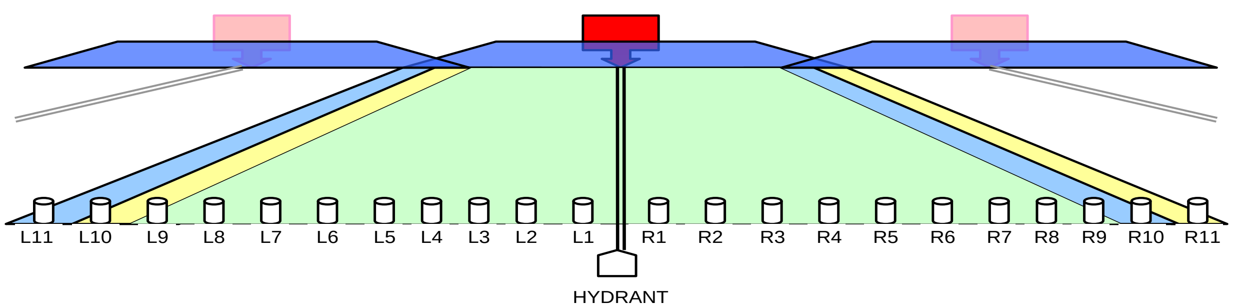


Diagram 2. Collector bucket positions relative to irrigation lane and wetted width (5-15% overlap)

Why does performance change?

Machine travel speed determines how long any area receives water. The travel speed often varies along the length of an irrigation run. Some machines slow down in windier conditions. Many machines slow down as more hose has to be dragged along the ground. It is useful to test irrigators at the beginning and end of typical runs and in different wind conditions.

Lane spacing is the distance between the centre of side-by-side irrigation runs. How far sideways do you shift the irrigator? Changing spacing has very significant effects on uniformity and average applied depths.

Irrigator wetting width is the spread of water both sides away from the centre line (the hose position). It varies with wind direction and speed.

Wetting pattern width is the other dimension of the wetting pattern. It is the average width of the area being wetted at any time, measured parallel to the direction of travel.

For most booms, the wetting pattern width is fairly constant. For circle or half circle patterns, the width of wetting measured two thirds of the way from the hose to the wetted edge is a good estimate.

What is acceptable?

Applied Depth

The measured Average Applied Depth should be within 10% of target depth. A result within 5% is better. Note: One eighth of the area receives even more than the High Quartile depth you calculate.

Distribution Uniformity (High Quartile)

The following interpretations assume the test represents the whole farm; no speed variation and stable effluent concentration.

DU < 1.10	Uniformity is excellent - the system is performing very well. You can be confident of this result.
1.10 – 1.25	Uniformity is good - performance better than average. You can be confident of this result.
1.25 – 1.43	Uniformity is adequate - performance could still be improved. The result is likely to be a good indication of system performance.
1.43 – 1.67	Uniformity is fair - system should be investigated. Results may be less reliable – redo the testing to check.
DU > 1.67	Uniformity is poor - system must be investigated. Results are less reliable – redo the testing to check.

Example Recording Sheet for Travelling Irrigator Calibration Test

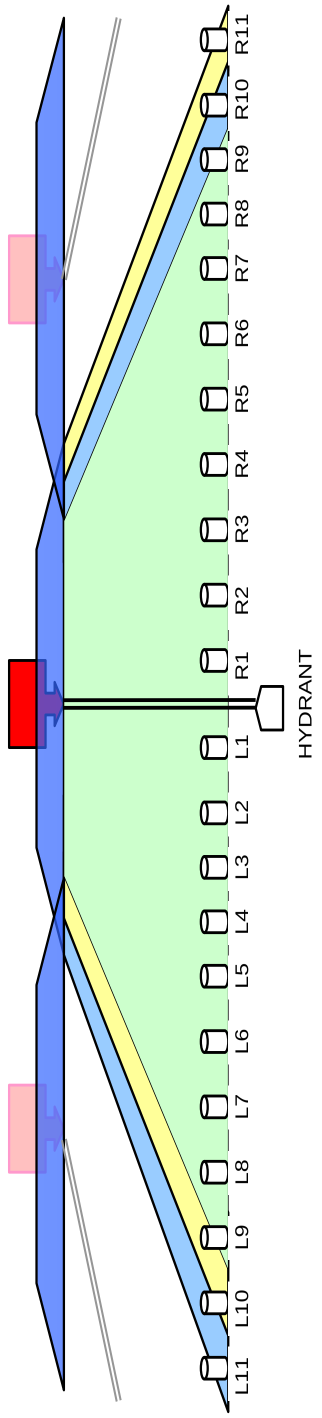
Use the Sheet to record details from the field and to complete some extra calculations. Take care to enter information using the same measurement units (e.g. millimetres or metres) as specified in the Recording Sheet. This will ensure your calculated answers have the correct units too.

Test Details	
Farm Name	Drylands
Tester's Name	Jimmy
Test Date	20 Nov 09
Test Machine	Effy
Test Field/Run	Paddock B3
Target Irrig Depth [mm]	25
Test distance [m]	5
Test time [min]	12
Speed [m/min]	0.42
Test Flow [L/min]	210
Test Pressure at pump [kPa]	350
Test Pressure at irrigator [kPa]	210
Wind conditions	Light from North
Nutrient test N [kg/m^3 or mg/L]	0.40 kg/m^3
Nutrient test K [kg/m^3 or mg/L]	0.36 kg/m^3

Field Details			
a	Run spacing (Diag. 1)	[m]	30
b	Run length (Diag. 1)	[m]	200
c	Area Irrigated (**a** x **b** / 10,000)	[ha]	0.6
d	Number of runs		8
e	Total Area (**c** x **d**)	[ha]	4.8
f	Irrigator wetting width (Diag. 1)	[m]	35
g	Wetting pattern width (Diag. 1)	[m]	17
h	Wetting area (**f** x **g**)	[m^2]	595
i	Bucket diameter (measure)	[mm]	260
j	Open area (**i** / 2000)^2 x 3.14	[m^2]	0.053
k	Applied Depth (from next page)	[mm]	16.0
m	High Quartile Depth (k x DU_{hq})	[mm]	18.7
n	Speed (from Test Details)	[m/min]	0.42
p	Flow Rate (**a** x **k** x **m**)	[L/min]	202
q	Application Rate (**p** / **h** x 60)	[mm/hr]	20.4

Recording Sheet for Travelling Effluent Irrigator Calibration

Enter your field measurements from buckets in Column 1.
Complete the overlap adjustments in Column 2.
Complete the calculations in Column 3.



Column 1	
Collected Volumes	
R11	1 200
R10	2 400
R9	500
R8	760
R7	900
R6	1020
R5	940
R4	860
R3	700
R2	900
R1	1000
L1	1000
L2	920
L3	780
L4	900
L5	880
L6	1000
L7	980
L8	940
L9	820
L10	1 360
L11	2 300

Column 2	
Overlapped Volumes	
Add Boxes R11 and L10 from Collected Volumes and enter in L10 Below. Repeat for R10 and L11	
R10	2 700
R9	500
R8	760
R7	900
R6	1020
R5	940
R4	860
R3	700
R2	900
R1	1000
L1	1000
L2	920
L3	780
L4	900
L5	880
L6	1000
L7	980
L8	940
L9	820
L10	1 560
SUM of 20	17060
AVG of 20	853

Column 3	
Calculations	
Enter the highest five volumes in boxes 1 – 5	
1	1020
2	1000
3	1000
4	1000
5	980
SUM of 5	5000
AVG of 5	1000
Calculate DU: Divide average of highest five by average of all twenty	
AVG of 5	1000
AVG of 20	853
DU_{HQ}	1.17
Calculate average applied depth: Average volume ÷ Bucket Area ÷ 1000	
AVG of 20	853
Area m^2	0.053
Depth mm	16.0
Calculate Nitrogen Loading kg.ha (Depth x Conc ÷ 100	
Depth	16.0
N|K mg/L	0.40 | 0.36
N|K kg/ha	64.0 | 57.6