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New Zealand Piped Irrigation System Performance Assessment Code of Practice

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Contents

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Background

WHY SHOULD WE HAVE A CODE?

Good, well managed irrigation is beneficial for agriculture, the wider economy and to our communities. Poor irrigation can have negative economic and environmental impacts through reduced yields and wasted water, nutrients and energy.

As the largest user of water in New Zealand, the irrigation industry understands its obligation to manage water and to recognise the rights of other users. Implementing the Code will ensure irrigation is sustainably managed, accountable, responsible and trusted.

Adoption of this Code will enable cost effective, defensible assessments of irrigation systems and management, and identify opportunities for improvement. This will directly benefit irrigators, the environment and the community.

WHAT IS THE CODE?

The *New Zealand Piped Irrigation System Performance Assessment Code of Practice* provides standardised guidelines to measure and benchmark performance of irrigation. This code applies to assessments of pressurised irrigation systems, performed on-site under prevailing conditions typical for that system. The level of implicit statistical error resulting from selected methodologies must be noted.

The Code uses performance indicators that are common with the *New Zealand Piped Irrigation Systems Design Standards*, allowing benchmarking while recognising the unique character of individual farms, their irrigation requirements and constraints.

WHAT IS NOT IN THE CODE?

The Code does not cover testing to validate an original equipment manufacturer's (OEM) design or construction of a particular make or model of irrigation machine nor assessments of that equipment for the purposes of supplying generic design or sales information. OEMs should follow relevant standards for equipment manufacture such as those published by the International Organisation for Standardisation.

WHO SHOULD USE THE CODE?

The code Is written for those performing calibrations and evaluations to ensure consistency in testing and reporting across the range of service providers. As such it is written from the perspective of an evaluator. This does not mean that the code can not be used by irrigation system owners/operators; they can and should use this code as required.

REGULATION AND THE COP

While the Code was not written for regulatory purposes, performance assessment of irrigation systems is now becoming a regulatory requirement. Regulators should become familiar with the benefits of the information provided from a performance assessment and the limitations of both a system calibration and a full assessment. As these two methodologies provide different levels of system performance information IrrigationNZ recommends that assessments for regulatory purposes should follow the calibration methodology.

OTHER RELEVANT GUIDANCE DOCUMENTS

- New Zealand Irrigation Technical Glossary
- New Zealand Piped Irrigation Systems Design Code of Practice
- New Zealand Piped Irrigation Systems Design Standards
- New Zealand Piped Irrigation Systems Installation Code of Practice
- New Zealand Water Measurement Code of Practice
- NZ Electrical (Safety) Regs

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References

RELATED CODES AND STANDARDS

International Organisation for Standardisation (ISO)

ISO 7749-2: 1990 Irrigation equipment – Rotating sprinklers – Part 2: Uniformity of distribution and test methods

ISO 8026 Agricultural irrigation equipment – Sprayers – General requirements and test methods

ISO 8026:1995/Amd.1:2000 Agricultural irrigation equipment – Sprayers – General requirements and test methods AMENDMENT 1

ISO 8224/1 – 1985 Traveller irrigation machines – Part 1: Laboratory and field test methods

ISO/FDIS 8224-1:2002 Traveller irrigation machines – Part 1: Operational characteristics and laboratory and field test methods (FDIS)

ISO 9261: 1991 Agricultural irrigation equipment – Emitting-pipe systems – Specifications and test methods

ISO 11545: 2001 Agricultural irrigation equipment – Centre-pivot and moving lateral irrigation machines with sprayer or sprinkler nozzles – Determination of uniformity of water distribution

ISO 14050: 2002 Environmental management – Vocabulary

American Association of Agricultural Engineers (ASAE)

ANSI/ASAE S436.1 DEC01 Test procedure for determining the uniformity of water distribution of center pivot and lateral move irrigation machines equipped with spray or sprinkler nozzles (ANSI)

ASAE EP405.1:2001 Design and installation of micro-irrigation systems

ASAE EP 458: 1995 Field evaluation of micro-irrigation systems [Withdrawn]

Other

ITRC Irrigation Evaluation: Drip micro 2000 [de facto standard]

Bloomer, D. and Goodier, C. 2003-2005. *IRRIG8 Software for Irrigation Evaluation*. (Support software for evaluations conducted according to guidelines established in the Code of Practice for Irrigation Evaluation 2005.)

TECHNICAL REFERENCES

Allen, R.G., J. Keller and D. Martin. 2000. *Center Pivot System Design*. The Irrigation Association. Falls Church, VA.

Anon. 2001. The New Zealand Irrigation Manual: A practical guide to profitable and sustainable irrigation. Malvern Landcare/Environment Canterbury. Canterbury, New Zealand.

Anon. 2002. *Principles of Irrigation*. The Irrigation Association. Falls Church, VA.

Burt, C.M., A.J. Clemmens, T.S. Strelkoff, K.H. Solomon, R.D. Bliesner, L.A. Hardy, T.A. Howell, Members, ASCE, and D.E. Eisenhauer. 1997. "Irrigation Performance Measures: Efficiency and Uniformity". *Journal of Irrigation and Drainage Engineering*. Nov/Dec. 1997. Pp 423–442.

Burt, C.M and S.W. Styles. 1994. *Drip and Micro-irrigation for Trees, Vines and Row Crops.* Irrigation Training and Research Center, California Polytechnic State University, San Luis Obispo, CA.

Burt, C.M., R. Walker, S.W. Styles and J. Parrish. 2000. *Irrigation Evaluation*. Irrigation Training and Research Center, California Polytechnic State University, San Luis Obispo, CA.

Buttrose, D. and M. Skewes. 1998 Irr-E-Pack Irrigation Evaluation Package – System Evaluation Field Reference Manual Primary Industries and Resources South Australia/Murray Darling Basin Commission

Davoren, A. (2002) *Planning and monitoring irrigation rotations*. Report for LandWISE Inc. Via internet: www.landwise.org.nz/pdf/l_notes_planning.pdf

Doak, M., I. Parminter, G. Horgan, R. Monk, G. Elliot. (2004) *The Economic Value of Irrigation in New Zealand.* MAF Technical Paper No: 04/01. Ministry of Agriculture and Forestry. Wellington.

Goodier, C. and Bloomer, D. 2004. *IRRIG8 Software for Irrigation Evaluation*. (Support software for evaluations conducted according to guidelines established in this Code of Practice.

New, L. and G. Fipps. 2002. Center Pivot Irrigation. Bulletin B-6096. 4.00. Texas Agricultural Extension Service. The Texas A&M University System. via internet: http://amarillo.tamu.edu/amaweb/Programs/EnviroSys-NatRes/IrrigaWtrQlty/publications/B-6096-CtrPivIrri.pdf

Rout, R. (2004) *Key Performance Indicators for Irrigation Design.* Irrigation New Zealand (unpublished draft)

Smajstrla, A.G., B.J. Boman, D.Z. Haman, D.J.Pitts, and F.S.Zazueta. 1998. *Field evaluation of micro-irrigation water application uniformity*. Bulletin 265, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida.

Sparrow, D. and M. Skewes. 1998. *Irr-E-Pack: Irrigation Evaluation Package, User Manual.* Primary Industries and Resources, SA. Murray Darling Basin Commission.

How to use this code

THIS CODE CONTAINS EQUATIONS AND ABBREVIATIONS, DEFINITIONS OF THESE CAN BE FOUND IN THE NEW ZEALAND IRRIGATION TECHNICAL GLOSSARY, AS SUCH BOTH THESE DOCUMENTS SHOULD BE READ TOGETHER.

PART A AND B MUST BE READ BEFORE MOVING ON TO PARTS C–H.

PART A

Introduces the process and requirements in order to carry out checks, calibrations and performance assessments. Outlines how to report your findings.

PART B

Initial checklists for compliance and water supply

PARTS C–H

Parts C–H are system specific processes for measuring system performance.

The Code recognises different levels of system performance assessment depending on purpose. In increasing level of complexity, system performance assessment includes:

1. Operational checks
2. System calibration
3. Full system performance assessment.

PART I

Part I contains additional assessments for energy efficiency and seasonal irrigation efficiency

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PART A: An Introduction to Performance Assessment

Note: This is Part A of a series of nine (Parts A–I).

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Part A: Contents

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The Code is presented as a series of booklets, each with a defined purpose.

Part A: An Introduction to Performance Assessment
(This booklet)
Part A provides an overview of performance assessment, explains the broad philosophy behind assessment approaches taken throughout the Performance Assessment series, and contains specific formulae and reporting standards.

Part B: Compliance and Water Supply Checklists
Part B relates to all system types. It contains recommendations for checks to ensure compliance with regulations, rules and consent conditions, safe effective operation of water supply systems.

Parts C–H: System Performance Assessments
Parts C–H contain guidelines and recommendations for Operational Checks, System Calibrations and In-field Performance Assessments specific to a range of irrigation system types.

Part I: Conducting Energy Efficiency Assessments and Seasonal Irrigation Efficiency

IrrigationNZ Technical Glossary
The Glossary and Calculations are common with the NZPIS Design Code of Practice.

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1. Conducting operational checks

The operational checks are a base set of observations to be made regularly to ensure the system is operating efficiently. Intended for use by suitable farm staff, they ensure there are no obvious performance issues or faults, and that the system is safe to operate.

Additional checks, that apply to all system types, can be found in *Part B: Compliance and Water Supply Checklists.*

See Parts C–H for system specific operational checklists:

- *Part C: Micro-irrigation*
- *Part D: Solid-set irrigation*
- *Part E: Sprayline irrigation*
- *Part F: Travelling irrigators*
- *Part G: Linear move irrigators*
- *Part H: Centre pivot irrigators*

2. Conducting system calibrations

This section presents protocols for irrigation system calibrations to be undertaken by irrigation managers and operators efficiently with minimum equipment.

Calibration involves checking irrigation system performance and making adjustments to ensure performance is as intended. Standard procedures described cover most irrigation system types used in New Zealand agriculture.

WHERE CALIBRATION FITS

These Calibration Protocols collect a minimum amount of information for a basic assessment of system performance to be completed. Only some of the potential performance indicators are determined, albeit they are key ones, and causes of poor performance are only generally identified and reported.

These protocols should be used as a relatively quick and regular check of system performance to maximise irrigation efficiency and minimise any adverse impacts. They inform irrigation managers and can be adopted as part of audited self-management programmes.

NOTE:
A calibration will normally include Operational Checks of system pressure and flow, combined with visual observations that the system is working.

NOTE:
If a more detailed assessment of performance or determination of causes of poor performance are required, a full In-field Performance Assessment should be considered.

CALIBRATION OVERVIEW

Calibration is a four step process:

1. Gathering information about the system (such as the KPIs documented in the system commissioning report and any as-built drawings) and measure in field data, make basic system observations
2. Calculate the current performance values
3. Comparing results with the original KPI expectations and report the differences
4. Make recommendations to the operator to make adjustments to irrigation system settings required to achieve intended performance.

Gathering information

Calibration begins with a simple field test which can be completed during the course of a normal irrigation event. The key measurements include determining:

- the amount of irrigation applied at specified points AND
- irrigator speed of moving systems OR
- the duration of each irrigation event of stationary systems.

The protocols are based on measurements at multiple points specified according to the type of system, and calculations to determine generic performance values.

Different irrigation system types require different data collection processes. Follow placement instructions carefully and ensure readings are as accurate as possible.

Performance indicators

Performance indicators cover key aspects of the system's operation. They are calculated from data collected during the field test.

Generic indicators that apply to all systems include:

- the depth of irrigation applied during an irrigation event
- the intensity of application and
- how uniformly the irrigation is distributed to the land surface..

Applied depth is the rainfall equivalent amount of irrigation applied, measured as depth, typically millimetres. It is an average across the irrigated area where the calibration test is performed. Applied depth is calculated by dividing measured irrigation volumes by the area to which they are applied.

Application Intensity is a measure of how quickly the water is applied and is compared to the soil's ability to absorb water as it lands. Excessive intensity can cause surface ponding and runoff, and reduce irrigation efficiency and effectiveness

Distribution Uniformity (DU) describes the evenness of application across the irrigated area. The higher the DU, the better the system is performing.

Other performance indicators specific to system type may be determined.

Adjusting settings

Comparing calculated with intended performance exposes any deficiencies. Adjustment recommendations can be made to correct or allow for performance differences.

Example:
Travelling irrigators may be sped up to apply less irrigation, or slowed down to apply more. If this is not possible, the return interval might be adjusted.

Example:
Solid set systems, including spraylines and micro systems with multiple blocks can be run for different times to achieve intended irrigation depths.

NOTES:

- Irrigation Calibration provides information for the system operating only where the test is completed (i.e. only the sampling points taken or the position of the irrigator machine in the field), running at the pressure and weather conditions on the day.
- Calibration should be undertaken on a regular basis to ensure performance is maintained. An annual calibration is recommended.
- Where a number of significantly different blocks are involved in an overall system, calibration of each separately managed block should be considered.
- If findings are unexpected, or suggest low performance, the performance assessor could make additional field observations of system issues or failing that seek additional advice from the operator or the supplier company.
- Low distribution uniformity may indicate poor sprinkler or emitter condition, or may indicate insufficient pressure in the system. Adjustments can be recommended to the operator and a new field test completed.

NOTE:
It is not normally the role of the performance assessor to correct system failings unless they are qualified to do so and have the authorisation from the system owner/operator.

CALIBRATION PROTOCOLS

All calibrations report on the same critical performance indicators. However, the methods for collecting data in the field and the details of calculations vary between system types. Therefore a series of Calibration Protocols covering different system types are provided.

See Parts C–H for system specific calibration protocols:

- *Part C: Micro-irrigation*
- *Part D: Solid-set irrigation*
- *Part E: Sprayline irrigation*
- *Part F: Travelling irrigators*
- *Part G: Linear move irrigators*
- *Part H: Centre pivot irrigators*

3. Conducting full system performance assessments

This section presents procedures for efficient and reliable full system performance assessments conducted in the field. Procedures for planning, conducting, analysing and reporting system performance are described.

The following procedures were developed as guidelines for full system performance assessments of irrigation systems. While the field testing is still a 'snapshot' taken under prevailing field conditions, the more extensive evaluations are intended to provide informative reporting that promote good system management and maintenance, supports efficient irrigations scheduling practices and can assist In comparison of systems during development.

WHERE FULL SYSTEM PERFORMANCE ASSESSMENT FITS

A full system performance assessment seeks objective information for analysing performance. More detailed than a simple calibration, it collects a broader suite of KPI information to identify departures from the design KPI arising from problems and their causes, enhance performance, or demonstrate compliance with regulatory or market requirements.

The Parts C–H take into account international practices and standards, which prescribe different procedures and sampling methods but are not necessarily equivalent to these international practices and standards. Parts C–H attempt to encompass thorough testing requirements but ensure that procedures are cost effective and practical which is why they can stray from the international practices and standards at times.

FULL ASSESSMENT OVERVIEW

Irrigation full system performance assessment procedures objectively check an irrigation system and management practices, and allow a system to be benchmarked against the original design KPIs and in some cases established design standards. Irrigation maintenance and management plans can be drawn up to improve the system use of water, energy and labour.

In addition to in field measurements and calculations of depth, rate and uniformity from test results for determination of water application efficiency, a full irrigation performance assessment may include:

1. Visual inspection
2. Assessment of pump, pipe and filter performance including energy use
3. Seasonal irrigation efficiency estimation.

Each process involves evaluating the system in its current state as per a calibration assessment but in addition takes into account an assessment of current or historic management practices. Analysis and reporting compares these results to the design KPIs, specified standards or benchmarks, and makes recommendations for improvement.

NOTE:

Like a calibration level assessment, that is the start of the improvement process, a full performance assessment is further part of the process towards irrigation "best practice". It is important that managers use the generated information to develop irrigation management and maintenance programmes that continuously improve the irrigation system and practice.

ASSESSMENT VALIDITY AND RELIABILITY

Selected measurements are taken of the system at a given time and place. Actual in-field measurements are preferred wherever possible over and above assumed data. This ensures that the generated results describe what is happening, not what is supposed to happen.

By following the assessment procedures diligently the full assessment will provide satisfactory accuracy and identify causes of non-performance as well as their effect on overall performance. They provide irrigator owners, regulators and other stakeholders with confidence that findings are valid, repeatable and comparable.

Technical note regarding reliance on the assessment outcomes: Some parameters, in particular distribution uniformity, are determined using stratified or targeted sampling approaches in preference to strict randomised sampling. This helps identify the factors contributing to non-performance. In practice, this has been shown to give similar performance results to randomised sampling, but in any case, limitations and confidence levels should be recognised.

KEY PERFORMANCE INDICATORS

Key performance indicators are presented in the *New Zealand Piped Irrigation System Design Code of Practice*. They include:

Water use efficiency

- Crop irrigation demand
- Management allowable deficit
- Return interval
- Application uniformity
- Application intensity
- Application depth
- Adequacy of irrigation
- Application efficiency
- Distribution efficiency
- Headwork efficiency
- Supply reliability
- System capacity.

Other efficiency indicators

- Energy
- Labour
- Capital
- Capital cost
- Operating cost
- Effectiveness
- Productivity
- Returns
- Environment
- Average system efficiency
- Drainage
- Runoff.

Indicators selected for this Code relate to estimates of efficiency across an irrigated growing season or year. They provide information relating to economic or environmental implications of inefficient irrigation systems or management.

APPLICATION OF PARTS A–H

These Parts are stand-alone guidelines to determine irrigation system performance in the field. They provide information for inclusion in assessments of irrigation efficiency, and can be combined with other assessments such as energy efficiency and pump performance.

The guidelines describe procedures that ensure:

- evaluations are representative of normal operating conditions
- key in-field system performance observations are recorded
- sampling is undertaken in a way that permits extrapolation and comparison
- key performance indicators are assessed and calculated accurately and correctly
- results are reported in standard units and formats so that comparisons may be made.

Planning an assessment

Appropriate preparations should be made prior to visiting the field. These preparations include collection of relevant data about the system and its management, ensuring all required equipment is available, and that the system will be ready for testing when the evaluator arrives at the field.

NOTE:
Basic system checks should be completed before the performance assessment is undertaken.

VISIT PLANNING

There are benefits in the usual system operator being involved in the assessment, to operate the equipment safely and in the usual way, and to understand the assessment process. A performance assessor should consider halting testing if the operator is not available at the initial system start up and should expect not to conduct the testing alone (which is also sensible for safety considerations).

Agreements to be obtained prior to the visit include:

Assessment date(s)

1. Setting a date, time and meeting place
2. Any site specific safety briefing or farm management protocols (e.g. emergency points of contact, stock movements, gate positions, system lock outs and operator instructions during the test period)
3. **Ensuring any required support staff will be present and available**

Service and fees

4. Confirming assessment(s) to be conducted
5. Establishing how results will be reported
6. Establishing fee for service

System availability

7. Ensuring the system will be available for assessment
8. Ensuring any system maintenance has been completed
9. Ensuring access to irrigation system, equipment and suitable position in the field.

Conducting an assessment

The following is a series of checklists that provide guidance for steps to be undertaken during a system calibration or full system performance assessment.

PROJECT NAME: ____________________

DATE: ____________________

PRE-SITE VISIT INFORMATION CHECKLIST

Much required information can be obtained through a general questionnaire completed by the irrigation manager. The minimum expected information that should be sought by a performance assessor prior to conducting an assessment includes:

General property information

- ☐ Owner/Contact name and details
- ☐ Property location and address
- ☐ Property plan, aerial photos, contour map
- ☐ Enterprises

Climate information

- ☐ Long term rainfall data
- ☐ Long term ET data
- ☐ Current or Last Season rainfall
- ☐ Current or Last Season ET

Soils information

- ☐ District/property soil maps
- ☐ Soil texture
- ☐ Soil water holding capacity data
- ☐ Soil limitations

Farm water supply information

- ☐ Water source and quality
- ☐ Resource consent limits and conditions
- ☐ Overall system layout
- ☐ Total flows
- ☐ Filtration type

Irrigation system information

- ☐ Permanent system layout
- ☐ Movable system positions
- ☐ Age and condition
- ☐ Connection to farm water supply
- ☐ Irrigation machine type
- ☐ Motive power and operating speed
- ☐ Controller location
- ☐ Operating instructions
- ☐ Design flow
- ☐ Operating pressure
- ☐ Sprinkler package
- ☐ Whether other water takes influence the system

Irrigation management information

- ☐ Irrigation need monitoring
- ☐ Irrigation interval (rotation length)
- ☐ Irrigation duration
- ☐ Target application depth

MEET THE IRRIGATOR

The owner/manager should:

- ☐ Be present during the assessment, to ensure the equipment is operated correctly, consistent with usual practice
- ☐ Make adjustments or alterations to the machine, and provide assistance if required
- ☐ **Take responsibility for any jobs that involve tampering with the irrigation system, such as fitting pressure gauges or flow meters**

CONFIRM QUESTIONNAIRE RESPONSES

In consultation with owner/manager:

- ☐ Review pre-visit questionnaire responses
- ☐ Further Investigate missing details as required
- ☐ Review or draft property and system plans

CONFIRM ASSESSMENT DETAILS

In consultation with owner/manager:

- ☐ Confirm purpose of assessment
- ☐ Confirm normal and test operating conditions
- ☐ Locate key features and components in the field
- ☐ Select test locations and type of test to be conducted

CONDUCT PRE-TEST INSPECTION

- ☐ Observe crop growth patterns and record abnormalities
- ☐ Assess soil condition, root depth and estimate water holding capacity
- ☐ Assess wheel track condition on moving systems
- ☐ Familiarise with system layout and components
- ☐ Measure and record topography if variable, focusing on key system points

SET-UP TEST EQUIPMENT

- ☐ Install temporary flow meter if used
- ☐ Fit pressure test points as required
- ☐ Determine location for, and set out collectors
- ☐ Set out speed test markers
- ☐ Establish weather monitoring location and equipment

PRE-START CHECKS

- ☐ Take water meter readings
- ☐ Take power meter readings if possible and specific to the system being tested
- ☐ Check headworks components and layout as prescribed
- ☐ Assess filter condition and record contaminant type and amount
- ☐ Assess sprinklers or emitters for blockages or wear

OPERATING CHECKS

The owner/manager should operate the system, including automatic controllers and motor starting.

WITH SYSTEM OPERATING

- ☐ Check flow rates measured by water meter
- ☐ Check for correct equipment functioning
- ☐ Measure un-irrigated machine or boom lengths
- ☐ Record system pressures at prescribed locations
- ☐ Assess surface ponding
- ☐ Assess for crop interference
- ☐ Assess leakages and off-target applications
- ☐ Conduct machine speed tests as required

SPRINKLER/OUTLET CHECKS

- ☐ Check sprinkler or other outlet operation and record abnormalities
- ☐ Measure outlet flows as prescribed
- ☐ Determine wetting radius of sprinkler package and/or end-guns etc.

UNIFORMITY TESTING

- ☐ Record key weather conditions throughout test period
- ☐ Lay-out uniformity collectors according to test arrangement
- ☐ Collect applied water in collectors
- ☐ Set up evaporation collectors as soon as collector volume measurement begins and record volume and time
- ☐ As collectors stop receiving water, begin recording measurements, including the time for each reading
- ☐ At completion, record evaporation collector volumes and the time.

SPECIFIC TESTS

Conduct any tests specific to the irrigation system type or assessment. Examples may include:

- ☐ Alternative pressure/flow tests for micro-irrigation systems
- ☐ Specific span tests on pivot or linear systems
- ☐ Alternative gun-angle tests on travellers

POST-TEST CHECKS

- ☐ Take flow meter readings
- ☐ Take power meter readings, if possible and relevant
- ☐ Observe system drainage patterns
- ☐ Nozzle and regulator checks against design sprinkler chart documented at time of commissioning
- ☐ Ensure all data readings have been made and recorded

PRE-LEAVING CHECKS

(Ideally in the presence of the owner/manager)

- ☐ Ensure test and temporary equipment is recovered
- ☐ Ensure the system is returned to pre-test condition
- ☐ Ensure system is closed down or returned to automatic settings as required

Data analysis

Much of the data analysis requires repetitive and relatively complex calculation. The use of prepared software is recommended.

SOFTWARE

Supporting software packages are available from a variety of sources but an assessor should understand the limitations of software tools and the degree of accuracy they will provide. Software should not be a substitute for understanding of the necessary calculations that can be made manually. Software often prompt evaluators to make and record particular measurements or assessments, assist with the calculations, and generate reports and recommendations based on inputted values.

The various software packages may not use the same units as those prescribed in these guidelines, and may be based on different procedures of sampling methods. If these factors are noted, most can be adapted to the requirements outlined in this section of the code.

Current software options Include:

- Bucket Test (App for calibrations)
- IRRIG8Lite (free software for calibrations)
- Irrig8 (restricted software for full system performance evaluations)
- DairyNZ's "bucket test calculator" (Excel sheet available to download from their website).

DETERMINE SYSTEM PERFORMANCE

1. Process collected data as prescribed to calculate the key performance indicators for the system as tested
2. Complete other system analyses as required
3. Compare results to benchmark values
4. Identify key causes of non-performance
5. Assess the contribution of factors to overall performance
6. Estimate cost savings that may be achieved from system and/or management improvements.

Equipment specifications

COLLECTORS FOR SPRAYER AND SPRINKLER IRRIGATION

These guidelines apply to collectors (catch cans) used to intercept irrigation water under sprayer or sprinkler irrigation systems where only a part of the flow from one or more sprayers or sprinklers is captured.

NOTE:
The guidelines for collector design and dimensions established in this Code are based on specifications for collectors established in ISO 7749-2:1990, and in ISO 11545:2001(E).

NOTE:
Where a performance assessment is conducted according to specifications in any recognised standard, the collectors must meet the specification established in that standard.

Minimum requirements for collectors

Ensure that all collectors used for a test are identical and shaped such that water does not splash in or out.

Ensure that the lip of the collector is sharp, symmetric and without depressions or deformities.

Ensure the entrance diameter (mouth) of the collector is half to one times its height, but not less than 75mm.

Ensure that the height of the collector is at least twice the average depth of water collected during the test, but not less than 150mm.

NOTE:
Collectors that are intended for collecting water for transfer to a measuring device, will have a sharp edged round opening as described above. They may be cylindrical or conical, with sidewalls inclined to at least 45° from the horizontal.

NOTE:
Other types of collectors may be used, provided that their accuracy is not less than the accuracy of the collectors described above.

Minimising error

To minimise measurement error, testers are encouraged to use collectors that are as large as possible (ISO). A 10 litre bucket with a mouth opening of 250–300mm is generally practical.

NOTE:
Many buckets have a widened lip/rim, in which case the best estimate for diameter is to measure to the centre of the rim. Set collectors level, and so their mouth is the same height as, and not affected by, the canopy.

COLLECTORS FOR MICRO-SPRINKLER IRRIGATION

The guidelines for collectors established in this part of the Code apply to micro-sprayers and sprinklers where the entire flow from an individual emitter is collected for measurement. There is currently no international specification for this test.

Special consideration must be given to in-field measurements in orchards where one sprayer or sprinkler is used to apply water to two young plants with small root systems. Careful observation will identify whether plants are receiving applied water.

Minimum requirements for collectors

The minimum requirement for collectors is that all water emitted is collected without affecting the flow rate of the sprayer or sprinkler by blocking flow or causing pressure changes. This will involve shrouding the sprayer or sprinkler with a vented cover in such a way that normal operating pressures and flows are maintained.

Minimising error

To minimise measurement error, testers must ensure that normal operating pressures and flows are maintained. Either of two alternative approaches may be used:

1. Place a shroud over the sprayer or sprinkler in-situ and direct the captured flow to a second vessel for collection (Figure 1.1)

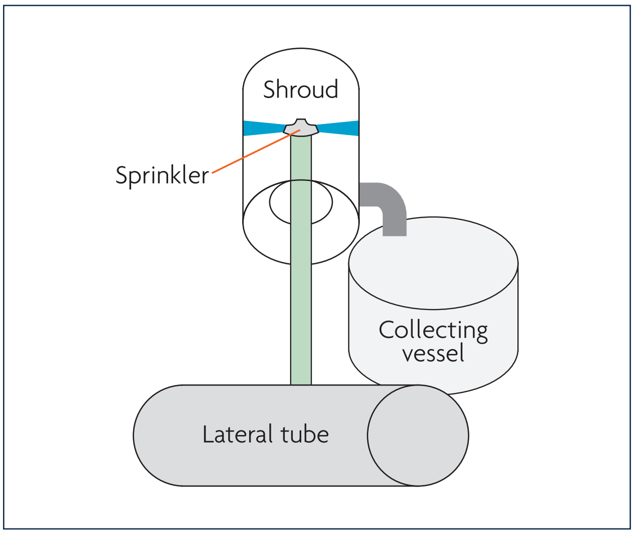

Figure 1.1. Shroud for sprayer discharge collection

2. Place the sprayer or sprinkler in a container ensuring the sprayer or sprinkler outlet is not flooded and is at the same elevation as in the field. For sprinklers that are above the canopy, these should be tested at their usual height and not lowered to the ground. This will impact pressure and therefore performance.

COLLECTORS FOR DRIPLINE IRRIGATION

The guidelines for collectors established in this Code recognise the specifications for collectors established in ISO 9261:1991(E) *Agricultural irrigation equipment – Emitting pipe systems –* Specification and test methods apply only to new pipe and emitting devices measured in laboratory conditions.

In-field measurements, especially of buried dripline, require special consideration. Pressure measurements along the laterals become a key test where water cannot be collected from drippers.

Minimum requirements for collectors

The system of collection used must capture all the flow from the section of pipe or emitters being assessed without affecting the flow rate of the sprayer or sprinkler by blocking flow or causing pressure changes.

Minimising error

To minimise measurement error, testers must ensure that all flow is captured and normal operating pressures and flows are maintained. Practically, this can be done by placing stopper rings around the pipe at the end of the section being measured, and a collection tray underneath the pipe or emitter in situ ensuring the outlet is not flooded and is at the same elevation as in the field (Fig 1.2). The captured flow should be transferred to a second vessel for measurement.

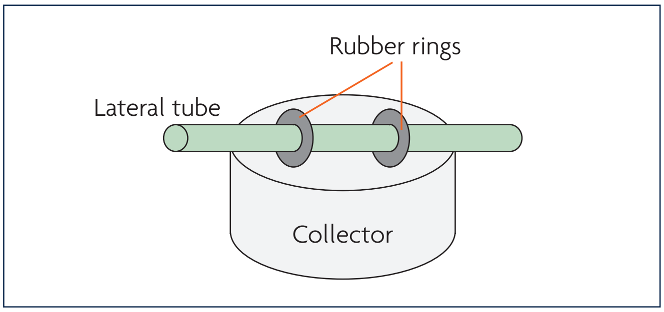

Figure 1.2. Drip-line collector

MEASURING DEVICES

Measuring devices should be cylindrical (rather than conical) and graduated with marks at no less than 10% of the volume being measured to avoid interpolation errors in reading.

Ideally the measuring device capacity will exceed the volume to be measured. This avoids error and time involved in splitting collected volumes into multiple readings.

Standard plastic measuring cylinders of a range of volumes (100–2,000mL) are suitable for field use.

PRESSURE GAUGES

Meet specifications in adopted standards

Where an audit is conducted according to specifications in any recognised standard, the pressure gauges and sampling methods must meet the specification established in that standard.

Existing accuracy standards

ISO Standards 7749-2:1990, 11545:2001, and 9261:1991 specify that pressure gauges shall have an error not exceeding ± 2% of actual values.

ISO 8224/1:1985 Travelling irrigation machines establishes that pressure gauges shall have an error of less than ± 10 kPa.

For practical purposes, gauges with error of less than ± 2% of actual values should be used.

Gauge reading range

The pressure gauge used should have a reading range that is centred on the pressure value being taken.

Measurement techniques

A variety of pressure measurement techniques and positions are specified in standards and other guidelines. The critical factor is to ensure the same method is used for all similar measurements in any evaluation exercise.

Micro-irrigation laterals

Unless pressure test points are fitted to a micro-irrigation system, pressure measurements in the field are made using a pressure gauge with a pitot tube. The pitot is inserted into a hole punched in the lateral tubing, and the pitot directed to face into the flow (Fig 1.3).

The measurement is made with the lateral in its normal position, and the hole is sealed with a 'goof plug' once the reading is completed.

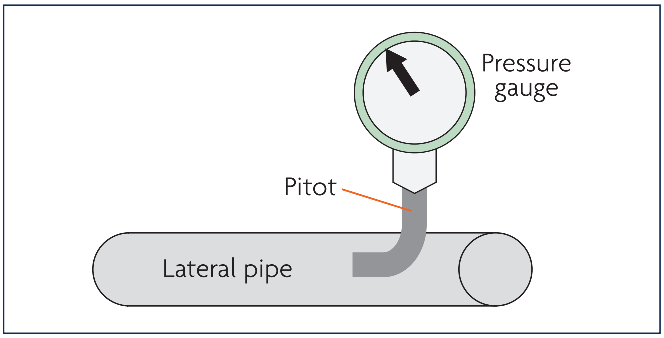

Figure 1.3. Pitot tube to measure soft lateral in-line pressure

Sprinklers, rotators or multi-outlet sprayers

See Fig 1.4. The test pressure shall be measured at the height of the main nozzle of the test sprinkler. The point at which pressure is measured shall be located at least 20cm upstream of the sprinkler so that the pressure measured is not affected by any local variation. No fitting or device which may cause a drop in pressure shall be installed between the point of pressure measurement and the sprinkler.

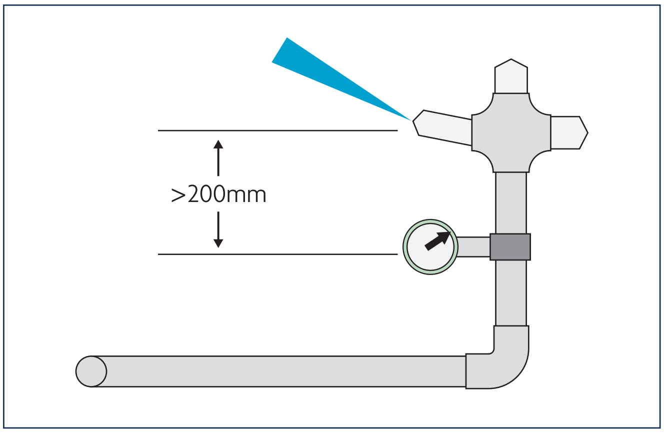

Figure 1.4. Measurement of sprinkler pressure

Sprayer or sprinkler orifice

For in-field pressure measurement on existing systems the simplest method is usually to take pressure readings at the nozzle outlet or orifice. This technique may not be possible with some designs, or where the orifice diameter is very small.

A pressure gauge fitted with a pitot is used, with the pitot inlet positioned in the centre of the flow stream just outside the orifice (Fig 1.5 Measurement of sprinkler pressure).

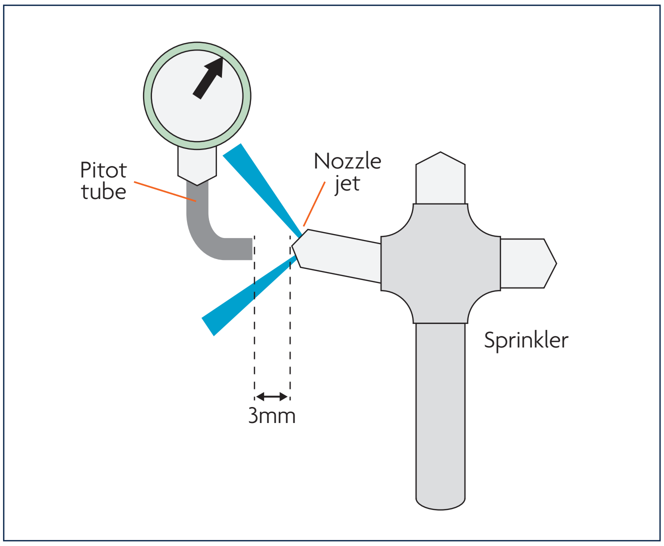

Figure 1.5. Measurement of sprinkler pressure

In-field sprinkler pressure measurement

It is difficult to obtain satisfactory pressure measurements from moving irrigators, and from irrigation systems such as centre pivots where very high discharge rates are common.

It is possible to install tees fitted with pressure test points upstream of the sprinkler in many instances. The pressure can then be measured using a gauge fitted with a long flexible hose and pressure test needle.

FLOW METERS: RANGE AND ACCURACY

Meet specifications in regulations

Flow meters must comply with the Resource Management (Measurement and Reporting of Water Takes) Regulations 2020 or with conditions specified in a Resource Consent, whichever is more stringent. The accuracy of flow meters is required to be ± 5% by law. The flow meter shall be verified as accurate at a maximum interval of 5 years, with the test conducted by a suitably qualified person as determined by the consenting authority.

For more information on flow meters, please read the *New Zealand Water Measurement Code of Practice*.

No water meter installed

Where no meter is fitted but a flow rate is deemed to be required to conduct a test, a range of external flow metering technologies is available. Care must be taken to install and operate any such device correctly in accordance with manufacturers' instructions. These should only be used by trained operators as they will give poor results to users who are unfamiliar with their operation.

WEATHER MONITORING

Most standards require monitoring of prevailing weather conditions throughout the period of system testing.

The main purpose of weather records during the test period is to assist post-test analyses. This may include identification of possible causes of non-uniformity (wind), or confirmation of measured evaporation rates (temperature and humidity).

Wind speed

Wind effects in particular can greatly affect system performance and should be monitored carefully.

Equipment used to measure wind speed should be accurate to better than ± 5%. Many small handheld meters are available with adequate performance.

> Many standards specify a maximum wind speed for reliable uniformity evaluations of 3m/s. If wind speed is greater than this, the system owner should be consulted and made aware of the potential limitations of results from testing.

Wind speed should be recorded at least once every 15 minutes throughout the test period. A logging meter simplifies this task. The average and maximum speeds should be presented in the report.

Wind direction

The direction of wind, and any significant variations, occurring during the test period should be recorded. Generally the direction relative to the irrigation system, particularly for system irrigating strips, is of significance.

Temperature

The ambient temperature, and the range of temperatures, during the test period should be recorded. Readings should be taken at no more than 15 minute intervals with equipment accurate to ± 1° Celsius.

Humidity

Equipment used to measure relative humidity should allow monitoring to ± 5%. A range of small handheld devices are available that meet this specification.

ELEVATION

System pressure is sensitive to changes in elevation. Systems that operate at very low pressures may be particularly affected by terrain and elevation determination can be critical in identifying factors contributing to non-uniformity.

Survey plans or topographical maps

Irrigation system design plans should provide topographical data to a satisfactory resolution.

Use such plans if available, and apply some in-field checks to verify accuracy.

Standard topographical maps (e.g. NZMS 1 1:50,000 series) do not provide enough resolution. They may however be useful in establishing benchmark elevations.

Benchmark elevation

It is not necessary to present elevations as metres altitude about mean sea level (m ASL). Reduced levels relative to a benchmark established on site are sufficient.

Suitable benchmarks will have a clearly defined point of measurement. They will be stable and enable repeated measurements, even at a later date. Examples include a defined point on a solid concrete pad (pump foundation) or similar.

Equipment lists for field work

MISCELLANEOUS EQUIPMENT

- Road map
- Farm location / physical address
- Contact details
- Contact phone number
- Data collection sheets
- Field book
- Pens, pencils
- Cell phone
- Camera
- Magnetic compass – identify North etc
- Angle finder
- Wind speed meter
- Thermometer / Humidity meter
- Altimeter
- Stop watch
- Shovel
- Soil probe / auger
- Thread tape
- Pouch – to hold tools, misc items
- Nylon stockings – to sieve flushing water

CLOTHING

- Gumboots
- Parka
- Overtrousers
- Long rubber gloves
- Towel
- Change of clothes

MISCELLANEOUS TOOLS

- Vice grips
- Spanner – 20cm adjustable
- Open end spanner set
- Wrench – 35cm adjustable
- Pliers – to insert goof plugs
- Secateurs
- Knife snap blade – cut emitters, drippers
- Wire cutters

LENGTH MEASUREMENT

- 100m and 10m tape measure
- Measuring wheel
- Fibre glass poles 1.5m – to mark speed test runs

PRESSURE MEASUREMENTS

- Pressure Gauges
  - 0–250kPa
  - 0–400kPa
  - 0–1000kPa
- Spare threaded pressure test points
- Flexible hose extension – to connect to gauges
- Pressure test needles – to connect to gauges
- Pitot tubes – to connect to gauges

Micro irrigation

- Pressure test points
- Clamps – to close off lateral tubing
- Lateral punch – to allow pitot insertion
- Goof plugs – to repair holes

Pivot/linear

- Threaded tee pressure test points – between dropper and pressure regulator
- Bayonet pressure test point – between pressure regulator and spray head

FLOW MEASUREMENT

- Measuring cylinders (depend on collector size)
- 100mL
- 250mL
- 1,000mL
- 2,000mL
- 5L Measuring jug

Micro irrigation

- Collection vessels
- Sprinkler shroud for uprights
- Jiffy clips – attached to lateral to prevent dribbling passed collector

Other systems

- Container of known volume (~ 20L)
- Shroud and pipe or hose – to divert sprinkler water to container
- Flexible hose 25–30mm, 1m long – to divert sprinkler flow to large container
- Collection vessels
- Clothes pegs – to stop sprinkler movement.

Field assessment of system performance by system type

Parts C–H provide guidelines for the assessment of both individual irrigation system performance and overall seasonal irrigation efficiency. These are intended to allow irrigators and other stakeholders to determine and benchmark performance, and to identify problem areas and the contribution these make to overall system in-efficiency.

These Parts are available as a series of additional documents specific to irrigation system type. They present guidelines for measuring irrigation system performance on-site under prevailing crop and weather conditions. Their primary focus is to determine Applied Depth, Distribution Uniformity and Application Intensity, and identify the proportional contribution key factors make, to non-uniformity. Other performance indicators include pump efficiency, headworks and mainline velocities and energy efficiencies.

Parts C–H schedules cover:

- *Part C: Micro-irrigation*
- *Part D: Solid-set irrigation*
- *Part E: Sprayline irrigation*
- *Part F: Travelling irrigators*
- *Part G: Linear move irrigators*
- *Part H: Centre pivot irrigators*

4. Reporting format

The purpose of reports is to provide the system owner/ manager with information to help improve performance.

- Present key performance indicators as prescribed
- Present conclusions and comparisons with established performance benchmarks
- Present recommendations
- Present performance data graphically where appropriate
- Include base data and calculations in appendices.

SYSTEM LAYOUT

1. Provide a map of the irrigation area with North indicated
2. Identify water supply and mainline locations, access track, hydrants and any segment excluded from irrigation
3. Identify the area(s) watered outside the target area
4. Identify the location of sprinklers used in testing
5. Identify the location of the traveller at the start and end of the strip
6. Identify the wind direction during the test

Ground profiles

7. If the irrigated area contains significant elevation variation, provide a diagram and mark locations of ground profiles measured
8. Present maps of ground profiles with distance and reduced levels in metres.

TEST DESIGN

Present a plan showing the location of critical test elements as below:

Micro irrigation

1. Pressure test point locations
2. Flow test locations

Spraylines/multiple spraylines

3. Sprayline position in field
4. Grid test location
5. Collector placement
6. Irrigation strip width
7. Wetted radii and locations measured
8. Identify wind direction during testing

Travellers

9. Delivery tube laid position
10. Transverse test line locations
11. Collector placement
12. Irrigation strip width
13. Wetted radii and locations measured
14. Gun sector angle if relevant
15. Wind direction during testing for each transverse line

Lateral moves

16. Lateral position in field
17. Wetted length
18. Lateral uniformity test position
19. Collector placement
20. Wind direction during each test

Centre pivots

21. Pivot lateral position in field
22. Wetted radii
23. Radial uniformity test position
24. Collector placement
25. Wind direction during each test.

GENERAL OBSERVATIONS

Surface ponding

1. Note any observed surface ponding
2. Identify implications of soil water ponding or runoff on actual distribution uniformity.

PERFORMANCE INDICATORS

Pressure

1. Present pressure measurements made at headworks, hydrants and the machine (report in consistent units)
2. Note range of elevations identified in the field including minimum and maximum variations from a mean or mode elevation

Applied depth

3. Present a graph or graphs of collector volumes (corrected for evaporation) along each transverse line. Use shading to distinguish between collector rows
4. Present a graph or graphs of applied depths (corrected for evaporation and for overlap) across the irrigated strip width at each transverse line. Use shading to distinguish between collector rows

Application intensity

5. Present calculated instantaneous application intensity and assessed soil infiltration rate
6. Interpret the result:

   For example: The soil is a clay loam with signs of compaction. The calculated application intensity of 60mm/hr is high for this soil type.

   For example: Field observations found ponding and minor runoff under the wetting area. This indicates excessive application intensity, redistribution of water at the soil surface and high risk of by-pass flow. It will reduce the actual distribution uniformity.

Distribution uniformity

7. State the method used to determine uniformity, present the result and give an interpretation based on expectations for the type of system
8. Present low quarter Distribution Uniformity (DU_{lq}) as a decimal. Do not present it as a percentage

   For example: Lateral DU_{lq} = 0.83.

   Interpretation: This is considered “good” for a linear move irrigator on level ground.

CAUSES OF NON-UNIFORMITY

Identify the contribution to non-uniformity that can be attributed to key causes.

Inappropriate strip width

1. From transverse line and overlap calculations, determine the optimum strip width for highest distribution uniformity at the prevailing conditions and machine settings tested

Wind effects

2. From transverse line and overlap calculations, determine the effect of wind on distribution patterns if possible

Incorrect components

3. Report any components that do not meet specifications. Note number and proportion of sprinklers or other components represented

Boom distribution systems

4. Compare the result of the discharge (sprinkler) and collector distribution uniformity results:

   For example: Low quarter discharge uniformity was calculated based on measurements from 16 sprinklers. DU_d = 0.65.

   Interpretation: This is considered ‘poor’ for a travelling irrigator fitted with a boom distribution system.

Sprinkler condition

5. Report possible interference if sprayers not horizontally staggered
6. Report on nature of wear, damage or blockage, number and proportion of instances, and any possible causes
7. Present an overall interpretation.

IRRIGATION NEW ZEALAND
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New Zealand Piped Irrigation System Performance Assessment Code of Practice

PART B: Compliance and Water Supply Checklists

Note: This is Part B of a series of nine (Parts A–I).

IRRIGATION NEW ZEALAND

Part B: Contents

Date of Issue: January 2023

The Code is presented as a series of booklets, each with a defined purpose.

Part A: An Introduction to Performance Assessment
Part A provides an overview of performance assessment, explains the broad philosophy behind assessment approaches taken throughout the Performance Assessment series, and contains specific formulae and reporting standards.

Part B: Compliance and Water Supply Checklists
(This booklet)
Part B relates to all system types. It contains recommendations for checks to ensure compliance with regulations, rules and consent conditions, safe effective operation of water supply systems.

Parts C–H: System Performance Assessments
Parts C–H contain guidelines and recommendations for Operational Checks, System Calibrations and In-field Performance Assessments specific to a range of irrigation system types.

Part I: Conducting Energy Efficiency Assessments and Seasonal Irrigation Efficiency

IrrigationNZ Technical Glossary
The Glossary and Calculations are common with the NZPIS Design Code of Practice.

Ministry for Primary Industries
Manatū Ahu Matua

Supported by Sustainable Farming Fund

1. Compliance checklist

This is a minimum list of checks to ensure safe operation and regulatory compliance. Checks should be made before the irrigation season starts.

These include checks of the physical system and performance checks of water flow, pressure, and emitter delivery. It can be helpful if two people work together to perform checks.

NOTE:
Ensure all legal requirements are known and understood before operating the system.

NOTE:
Documentation such as Resource Consents and Operation Manuals will give more detail than this checklist, including information specific to the system.

Additional documents covering specific types of irrigation system contain Operational Checklists for:

- Micro-irrigation systems
- Solid-set irrigation systems
- Sprayline irrigation systems
- Travelling irrigators
- Linear move irrigators
- Centre pivot irrigators.

Management system

Safety

1. Ensure Health and Safety protocols in place
   - Protocols documented
   - Record of staff training

Regional plan rules

2. Ensure all rules governing water takes, irrigation and other relevant activities are documented
   - Read and understand all rules and their implications
3. Ensure compliance processes are defined and readily accessed
   - Ensure information is documented and accessible
   - Ensure processes are in place to inform all staff of requirements
   - Put critical dates in diary

Resource consent conditions

4. Collate copies of all Resource Consents
   - Read them and understand all conditions
5. Ensure compliance processes are defined and readily accessed
   - Ensure information is documented and accessible
   - Ensure processes are in place to inform all staff of requirements
   - Put critical dates in diary

Irrigation scheme and market/supply contract conditions

6. Ensure copies of current scheme rules/supply requirements and contracts are available
   - Read them and understand all conditions
7. Ensure compliance processes are defined and readily accessed
   - Ensure information is documented and accessible
   - Ensure processes are in place to inform all staff of requirements
   - Put critical dates in diary.

Irrigation system

Safety

1. Ensure appropriate system checks have been completed
    - See additional documents covering different system types (as mentioned on page B3)

Water supply

2. Check the supply intake meets Rule and Consent conditions

Water measurement

3. Confirm the water meter is installed to standards

    NOTE: Obtain documentation from an accredited installation company – see IrrigationNZ accreditation website for a list of companies in your region.

4. Ensure the water meter has been verified.

    NOTE: Obtain documentation from an accredited verification company – see IrrigationNZ accreditation website for a list of companies in your region.

5. Confirm any data logging and telemetry equipment has been tested and is functioning
6. Monitor the maximum take rate. Check against Consent Conditions

    NOTE: Check flow rate during irrigator fill and other potentially high flow periods.

Fertigation/chemigation

7. Check all required non-return valves are fitted – however testing of most non-return values requires a suitably qualified person. Where irrigation is connected to a potable supply testing of non-return valve may need to be conducted by a registered plumber. You would need to check local regulations before implementing any changes to these fittings.

2. Water supply checklist

This is a minimum list of checks that focuses on the system water supply: wells, surface intakes, pumps and mainlines. These checks should be made before the irrigation season starts. This Is usually the responsibility of the owner/manager or their irrigation service company.

Checks include structural and mechanical checks of the structure, and performance checks of water flow, pressure and nozzle delivery. It can be helpful if two people work together to perform checks.

NOTE:
Be safety conscious – pressure, electrical and mechanical hazards present.

NOTE:
Every system should be supplied with a System Operation Manual. Read it and follow instructions. The manual may include extra checks not listed here. It will give more detail than this checklist including information specific to your system.

Begin the checks with the system turned off.

- Tag/lock electrical isolator or motor switches to prevent accidental starting
- Observe the state of all equipment, looking for damage or wear and tear
- Tighten, adjust, maintain or replace components as required
- Lubricate all parts as specified in manuals.

Make checks with the system running.

- Consider which aspects required qualified expert (e.g. electrical)
- Ensure the irrigator travel path is clear before starting moving machines
- Check the operation of intake, pump, motor, headworks, valves and hydrants.

Check drawdown, flows and pressures

- Ensure the depth to water and system operating points are as expected.

NOTE:
Many items can be fixed on-farm. Others require specialist skills or equipment.

SYSTEM-OFF CHECKS

NOTE:
Completed with the system NOT running.

WARNING:
Ensure electrical isolator and motor switches are tagged/locked.

Well/bore

1. Check the ground water level after recovery and before irrigation
   - Measure water depth below the top of the casing
   - Compare depth to measurements from previous years

   NOTE: Consider well test to check for deterioration in performance

Surface takes

2. Check intake structures for damage
   - Check strainers are secure, not damaged, not blocked

Pump system

NOTE: Complete basic shed maintenance

3. Check bearings and shafts not worn
   - Lubricate as required
4. Check belt condition and tension
   - Replace if worn

Headworks

5. Check filter for damage and cleanliness
   - Clean and replace strainers/elements/discs if necessary
6. Check pressure gauges are fitted and in good condition
   - Fit or replace if required

Mainline and off takes

7. Check visible mainline and fittings for any obvious damage
   - Make any repairs as required
8. Check off-take valves or hydrants for any obvious damage
   - Make any repairs as required

Power supply

NOTE: Exercise caution

9. Check for any obvious problems, worn cables or fuel lines

NOTE: Get expert assistance if required.

Control unit

10. Check electronic controls and ensure battery is charged.

PREPARE TO START

WARNING: CHECK IT IS SAFE TO START THE SYSTEM

- Before continuing consider completing the System-off Irrigation System checks. This is particularly significant for moving machines such as travelling guns or booms, linear/lateral moves and centre pivots
- Ensure nothing is parked in the irrigator travel path
- Remove tags or locks from isolator switches.

SYSTEM-ON CHECKS

NOTE:
Completed WITH the system running.

Well/bore

1. Check dynamic water level depth
    - Measure water depth below the top of the casing
    - Compare depth to measurements from previous years

Pump system

2. Complete visual inspection
    - Check there are no new noises or unusual vibrations
    - Ensure no leaks – repair as necessary
3. Measure and record inlet pressure
    - Compare to previous records
4. Measure and record outlet pressure
    - Compare to previous records
5. Measure and record flow rate
    - Compare to previous records
6. Measure and record energy consumption
    - Compare to previous records

Headworks

7. Complete visual inspection
    - Check there are no new noises or unusual vibrations
    - Ensure no leaks – repair as necessary
8. Check the water meter is functioning
    - Compare measurements to expected values.
9. Check the main control valve operation
10. Measure and record outlet pressure
    - Repeat for different irrigation blocks or zones
    - Compare to previous records

Mainline and off-takes

11. Pressure test mainline
    - Fill and pressurise mainline
    - Close all valves on mainline
    - Monitor pressure drop
12. Complete visual check for leaks in mainline, off-takes or hydrants
13. Measure pressure at furthest hydrant or off-take
    - Compare measurements to expected values

Control unit

14. Ensure the control valves are functioning correctly.