
**NQF Level: 1** **US No: 116202 & 116168**

# Learner Guide

## Primary Agriculture

# Water Quality & Irrigation Systems


My name: . . . . . .

Company: . . . . . .

Commodity: . . . . . Date: . . . . . .

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agriculture
Department:
Agriculture
REPUBLIC OF SOUTH AFRICA

AgriSETA

# Before we start...

Dear Learner - This Learner Guide contains all the information to acquire all the knowledge and skills leading to the unit standard:

| | | | | | |
|---|---|---|---|---|---|
| **Title:** | Operate and maintain irrigation systems | | | | |
| **US No:** | **116202** | **NQF Level:** | 1 | **Credits:** | 2 |
| **Title:** | Maintain basic water quality | | | | |
| **US No:** | **116168** | **NQF Level:** | 1 | **Credits:** | 1 |

The full unit standard will be handed to you by your facilitator. Please read the unit standard at your own time. Whilst reading the unit standard, make a note of your questions and aspects that you do not understand, and discuss it with your facilitator.

This unit standard is one of the building blocks in the qualifications listed below. Please mark the qualification you are currently doing:

| Title | ID Number | NQF Level | Credits | Mark |
|---|---|---|---|---|
| National Certificate in Animal Production | 48970 | 1 | 120 | ❒ |
| National Certificate in Mixed Farming Systems | 48971 | 1 | 120 | ❒ |
| National Certificate in Plant Production | 48972 | 1 | 120 | ❒ |

Please mark the learning program you are enrolled in:

Your facilitator should explain the above concepts to you.

| Are you enrolled in a: | Y | N |
|---|---|---|
| Learnership? | ❒ | ❒ |
| Skills Program? | ❒ | ❒ |
| Short Course? | ❒ | ❒ |

You will also be handed a Learner Workbook. This Learner Workbook should be used in conjunction with this Learner Guide. The Learner Workbook contains the activities that you will be expected to do during the course of your study. Please keep the activities that you have completed as part of your Portfolio of Evidence, which will be required during your final assessment.

You will be assessed during the course of your study. This is called *formative assessment*. You will also be assessed on completion of this unit standard. This is called *summative assessment*. Before your assessment, your assessor will discuss the unit standard with you.

**Enjoy this learning experience!**

# How to use this guide ...

Throughout this guide, you will come across certain re-occurring "boxes". These boxes each represent a certain aspect of the learning process, containing information, which would help you with the identification and understanding of these aspects. The following is a list of these boxes and what they represent:


**What does it mean?** Each learning field is characterized by unique terms and **definitions** – it is important to know and use these terms and definitions correctly. These terms and definitions are highlighted throughout the guide in this manner.


You will be requested to complete **activities**, which could be group activities, or individual activities. Please remember to complete the activities, as the facilitator will assess it and these will become part of your portfolio of evidence. Activities, whether group or individual activities, will be described in this box.


**Examples** of certain concepts or principles to help you contextualise them easier, will be shown in this box.


The following box indicates a **summary** of concepts that we have covered, and offers you an opportunity to ask questions to your facilitator if you are still feeling unsure of the concepts listed.

## My Notes ...

You can use this box to jot down questions you might have, words that you do not understand, instructions given by the facilitator or explanations given by the facilitator or any other remarks that will help you to understand the work better.

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# What are we going to learn?

# What will I be able to do?

**When you have achieved this unit standard, you will be able to:**

- Carry out basic irrigation system and equipment maintenance; operate an irrigation system according to set procedures; identify the basic factors affecting crop growth under irrigation.
- Gain specific knowledge and skills in plant production and will be able to operate in a plant production environment implementing sustainable and economically viable production principles.
- Be capacitated to gain access to the mainstream agricultural sector, in plant production, impacting directly on the sustainability of the sub-sector. The improvement in production technology will also have a direct impact on the improvement of agricultural productivity of the sector.
- Observe and maintain basic water quality.
- Work with the technical systems that control certain quality factors in water.
- Sample and observe water quality.
- Perform maintenance tasks on certain operational technical systems.
- Handle systems to maintain water quality.
- Record basic observations and applications regarding water quality.

# Learning Outcomes

**When you have achieved this unit standard, you will have a basic knowledge and understanding of:**

- Names and functions of tools and equipment used during irrigation.
- Function of protective clothing.
- Attributes of basic parts of the implemented irrigation system e.g. nozzles, quick-coupling pipes, etc.
- Sensory cues such as visual perceptions of dry and wet spots, too high/low pressure, etc.
- Purpose of irrigation Implications of defective irrigation systems.
- Implications of not reporting non-conformance of irrigation systems.
- The names and terms related to water quality.
- Attributes and properties of water related to its quality.
- Sensory cues related to water quality and water quality maintenance systems.

- The purpose of sampling water and maintaining water quality.
- Implications related to water quality on the operation.
- Rules related to the sampling of water quality measurements.
- Recording techniques.
- Basic reporting skills.

# Learning Assumed to be in Place

**On attempting this unit standard, you will show competence against the following unit standard:**

- NQF1: Collect Agricultural Data

## My Notes ...

# Session 1 Sample and observe water quality

*After completing this session, you should be able to:*
**SO 1: Demonstrate a basic ability to sample and observe water quality**

**In this session we explore the following concepts:**

- a basic ability to sample and observe water quality
- ability to perform maintenance tasks on certain operational technical systems
- handle systems to maintain water quality
- record basic observations and applications regarding water quality.

## 1.1 What is water quality?


***Water Quality:*** . Is a term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for an intended purpose.

Water quality is a term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for an intended purpose. These characteristics are controlled and influenced by substances, which are either dissolved or suspended in water.

Although scientific measurements are used to define the quality of water, it's not a simple thing to say that " this water is good," or " this water is bad ". The quality of water that is required to wash a car is not the same quality that is required for drinking water.

Therefore, when we speak of water quality, we usually want to know if the water is good enough for its intended use, be it for domestic, farming, mining or industrial purposes, or its suitability to maintain a healthy ecosystem.

Water quality is changed and affected by both natural processes and human activities.

Generally natural water quality varies from place to place, depending on seasonal changes, climatic changes and with the types of soils, rocks and surfaces through which it moves.

A variety of human activities can potentially significantly alter the quality of natural waters, e.g:

- agricultural activities,
- urban and industrial development,
- mining and
- recreation,

It can also change the water use potential.

The key to sustainable water resources is, therefore to ensure that the quality of water resources are suitable for their intended uses, while at the same allowing them to be used and developed to a certain extent.

## 1.2 Why do we need to manage water quality?

The effects of **polluted water** on human health, on the aquatic ecosystem and on various sectors of the economy, including agriculture, industry and recreation, can be disastrous.

Deteriorating water quality leads to increased treatment costs of potable and industrial process water, and decreased agricultural yields due to increased salinity of irrigation water.

On the other hand not all health, productivity and ecological problems associated with deteriorating water quality are ascribed to man's activities. Much water quality related problems are inherent in the geological characteristics of the source area.

■ **Water Quality is affected by:**

♦ **Salination**: Accumulation of salts in water. A persistent water quality problem is salination, which has two major causes, natural and anthropogenic. The origin of natural salination of river water is geological. Man-made causes are multiple. A wide variety of man's activities are associated with increased releases of salts, some in the short and others in the long term.

- **Eutrophication**: Another major water quality problem is eutrophication, which is the enrichment of water with the plant nutrients nitrate and phosphate. These encourage the growth of microscopic green plants termed algae – causing dams and rivers to become silted in, causes a lack of oxygen for water plants & -animals. As nutrients are present in sewage effluent, the problem is accentuated wherever there is a concentration of humans or animals.
- **Micro-pollutants**: A water quality issue, which is receiving increasing attention among industrialized nations, is pollution by metals and man-made organic compounds, such as pesticides. Serious incidents of health impacts to man and animals have occurred at places throughout the world through uncontrolled exposure to these micro-pollutants.
- **Microbiological pollutants**: Water contamination by fecal matter is the medium for the spread of diseases such as dysentery, cholera and typhoid.
- **Erosion and sedimentation**: Average sediment yields for South African catchments range from less than 10 to more than 1 000 tonnes/km$^2$/annum. In some parts of the country erosion has increased by as much as tenfold as a result of human impacts. Apart from the loss of fertile agricultural soil, off-site damage like loss of valuable reservoir storage, sediment damage during floods and increased water treatment costs, have been largely ignored even though these are estimated to be in excess of R 100 million per year.


| | |
|---|---|
| **Salination**: | Accumulation of salts in water. |
| **Eutrophication**: - | the enrichment of water with the plant nutrients nitrate and phosphate. |
| **Micro-pollutants**: - | pollution by metals and man-made organic compounds, such as pesticides. |
| **Microbiological pollutants**: | contamination by fecal matter. |
| **Erosion and sedimentation**: - | foreign materials that do not dissolve in the water, and that can usually be seen with the naked eye. |

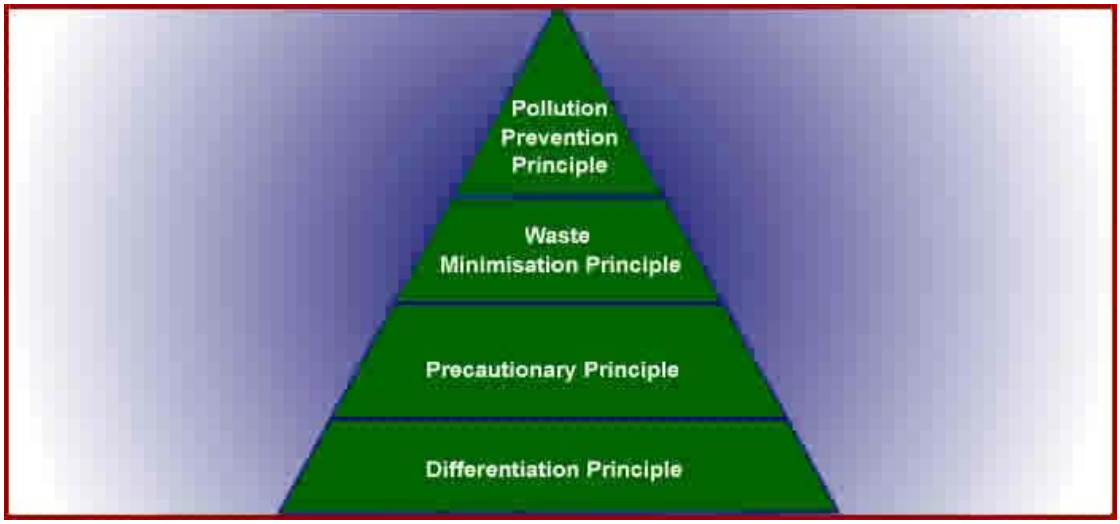
# 1.3 The underlying principles of water quality management

Sustainability, equity and efficiency are recognized as the central guiding principles in the protection, use, development, conservation, management and control of water resources; are inherent to the management of water quality.

- **Important principles from management policies and practices in South Africa:**

The management of water quality must be carried out in an integrated and holistic manner, acknowledging that all elements of the environment are interrelated.

The precautionary approach to water quality management applies, in which active measures are taken to avert or minimize potential risk of undesirable impacts on the environment.



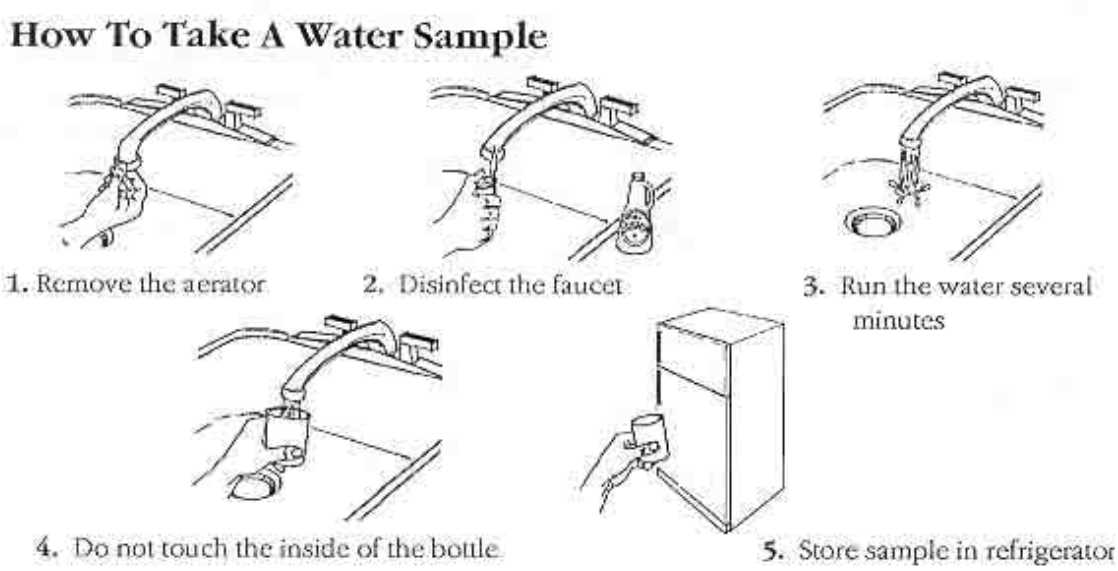

# 1.4 Taking water samples

There are various sources of water. The water quality of each of these sources should be determined by taking water samples. These sources are:

- A tap;
- Well, river, dam or stream

## ■ Taking water samples from a tap:

The diagram below shows the steps that should be taken when taking a water sample from a tap:




## ■ Taking water samples from a well / river / dam / stream:

The results of analysis on water samples can only be as good as the sample submitted to the lab. Care must be exercised to ensure that the sample is as representative as possible and that it is properly cared for prior to reaching the lab. Keep the following in mind:

- ♦ Do not remove the cap from bottle until ready to fill. Do not rinse the sample container. There is a small amount of powdered chemical inside.
- ♦ Select place in the water source that is frequently used.
- ♦ Allow the water to flow full force 3-5 minutes.
- ♦ Please print or type all information requested on the enclosed report form.
- ♦ Enclose the completed paperwork in the tube and return sample to the lab.

# 1.5 The quality of water on the farm is largely determine by the following factors and processes:

## Physical water quality factors:

Physical water quality factors (PWQF) are influenced by all the foreign materials that do not dissolve in the water, and that can usually be seen with the naked eye. These materials pose problems primarily to the irrigation system.

Micro-sprayers and drippers have very narrow openings (0.25mm to 2.50mm diameter) and are blocked by any material that is too large to pass through, or that accumulates in this narrow pathway. When partly or totally blocked, the micro-sprayer or dripper cannot deliver the required volume of water to the trees.

The following materials influence the physical quality factors and are often responsible in clogging the drippers or micro-sprayers:

- Inorganic materials, such as clay, silt and sand;
- Organic debris, such as remnants of plants, seeds, animals, aquatic fauna and flora;
- Living aquatic plants and animals, such as algae and snails;
- Plastic cuttings from the irrigation pipes and equipment; and
- Lubricant residues

While the first three contaminants can usually not be controlled and must be managed, the last two contaminants can be controlled by taking the necessary steps to prevent contamination by plastic cuttings and lubricant residues.

Sprinklers do not block as easy as micro sprayers but also do block causing uneven distribution of water.

## Chemical water quality factors:

The chemical water quality factors (CWQF) refer to the non-visible components in water. Instruments are used to determine their presence and concentration. CWQF are very important, because they determine the short- and long-term potential and sustainability of the entire plant production system. Chemical quality factors affect:

- Crop production;
- Sustainability of the productivity of the soil; and
- The effective operation of the irrigation system.

♦ The most important CWQF and their impact on each of these areas are shown in the table below, with the following classifications:

**Y** = This factor has an impact
**Y/N** = This factor may have an impact depending on other factors
**N** = This factor seldom has an impact

| ***CWQF*** | ***Crop Production*** | ***Soil Productivity*** | ***Irrigation System Efficacy*** |
|---|---|---|---|
| Total soluble salts | Y | Y | Y |
| pH | Y | Y | Y |
| Calcium | Y | Y | Y/N |
| Magnesium | Y | Y/N | Y/N |
| Sodium | Y | Y | N |
| Chloride | Y | Y/N | N |
| Bicarbonate | Y | Y/N | Y/N |
| Boron | Y | Y/N | N |
| Iron, manganese and sulphides | N | N | Y |

# 1.6 Reporting on data

The accuracy and integrity of data should be maintained. This means that data should be correct and updated at the prescribed and scheduled dates and in some cases specific time of day. Should the data not be collected and recorded correctly, the integrity of the data is corrupted.

Data should be reported on by using required reporting formats. This should be available at the farm.

Basic deviances in data should be recorded and reported on. (Please refer to the Unit Standard and module: Collect Agricultural Data; SAQA ID 116156 for more information and activities).

■ **Methods to improve water quality:**

- ♦ **Filtration** – Filtration is the process where water is passed through a structure with very small openings which allow the water to pass through, but trap insoluble suspended particles. **Filtration does not remove dissolved salts.** The small openings are created by a container filled with sand (a sand filter), with a series of plastic discs containing narrow spleens on their flat surfaces that are fitted together (a disc filter), or with a series of steel plates with small holes in or mesh wire (screen filter).
- ♦ **Oxidation** – When water gets in contact with air, dissolved metals like iron and manganese are oxidised to their insoluble form and settles to the bottom of the water. Oxidation can be accelerated through spraying the water through the air into a storage dam. The practice of ensuring maximum airflow over water to ensure oxidation is called **aeration.**
- ♦ **Screening:**- The first part of the purification system is normally a screening for larger physical particles in the water, this is achieved by putting a mesh of the correct perforation in the water flow and in collecting the unwanted material therein.
- ♦ **Degassing-** To ensure lower microbiological activity the water is degassed and the oxygen etc. is physically or chemically removed from the water.

# 1.7 Managing agricultural Inputs

■ **Controlling fertilizers, manures and pesticides:**

Managing agricultural inputs is an important element of pollution prevention. Proper handling and use of fertilizers, manures and pesticides will prevent or limit the impact on the environment.

Nutrient management is the practice of applying fertilizers and manures only in the amounts that can be taken up by the crop. Over-applications increases the risk of contaminating surface and groundwater supplies.

The use of pesticides can be minimized through "Integrated Pest Management". This refers to a management strategy that includes an understanding of the target pest and use of a combination of physical, chemical, biological and cultural controls.

Proper storage, mixing and handling are also essential in minimizing risk to the environment.

Another practice includes livestock watering at sites well away from natural water courses (including wells or sensitive aquifers) in order to keep manure out of the water and building fences to prevent cattle access to watercourses.

■ **Controlling erosion and runoff:**

Controlling erosion and runoff is an important beneficial management strategy. Runoff from fields to which pesticides, fertilizer and manure are applied, as well as runoff from livestock operations can contaminate water. Practices such as the use of cover crops prevent erosion and reduce the movement of nutrients and pesticides from agricultural land.

# 1.8 Best management practices for agriculture

Sustainable agriculture requires that soil and water quality be maintained. Some farm practices have the potential to cause environmental harm.

Many of the potential negative impacts of farming can be greatly reduced by the use of Best Management Practices. These are agricultural practices that reflect current knowledge about conserving soil and water without sacrificing productivity.

Remember…Water is continually cycling.

The water that we use has been used before. Producers and consumers, rural and urban people and the public and private sectors, are all responsible for using water wisely and ensuring that the resource is maintained for others.

Although pesticide concentrations in water may be very low, concentrations may increase with each step in the food chain. Contaminated water is incorporated in algae cells, which are eaten by water fleas, which are eaten by minnows, which are in turn eaten by larger fish, and so forth…

Pesticides tend to be very soluble and can easily move with water.

■ **Alternatives to Direct Access Livestock Watering:**

♦ **What is Direct Access Watering?**

Clean water is a key factor in a healthy livestock production system. There is a direct relationship between water intake and feed intake. Animals that drink more are likely to feed more, which of course improves production.

♦ **Problems Associated with Direct Watering:**

Livestock are often watered by allowing them direct access to streams, lakes, reservoirs or dugouts. This is particularly true for range cattle.

Direct access raises a number of questions and concerns about negative impacts on water quality. Poor water quality can be a concern both in

terms of downstream water users, as well as animal health, safety and productivity.

Over-grazing and trampling of stream banks by cattle can increase runoff of sediment into water bodies.

Direct access watering can cause infections and diseases for herds. Cattle lingering in water tend to develop foot-rot. Excrement in the water may expose animals to pathogens, which can have significant impacts on health and weight gain.

♦ **Limited Access or Total Exclusion?**

A number of strategies will minimize stream bank damage without completely excluding the animals. Low flow crossings and hard surface ramps give animals the opportunity to cross streams and drink without entering deep water or disturbing sediment.

Pasture management programs can be designed to allow time for recovery of riparian areas or to prevent animal access to the riparian zone in spring and early summer when stream banks are most susceptible to damage.

In many cases, the preferred way to protect water quality is the total separation of the animals and the water source with fencing. When this is the chosen alternative, a remote watering system is necessary.

# 1.9 Quality water for Agricultural Productivity

Water quality can impact on agricultural productivity. Agricultural producers are realizing that improved water quality can increase productivity and reduce costs of maintenance of water distribution systems.

Results of applied research have found that there is a benefit from using quality water suited to the agricultural demand. For example, it has been shown that cattle drinking water of poor quality gain less weight or may have poor health, so an adequate supply of good quality water is crucial to the livestock industry.


Please complete Activity **1,** in your learner workbook

**My Notes ...**

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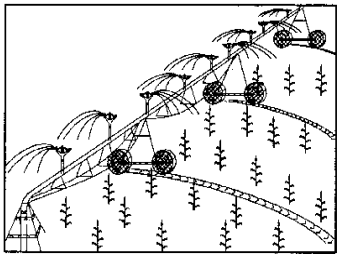
| Concept | I understand this concept | Questions that I still would like to ask |
|---|---|---|
| The use of the recalling of tasks associated with the control of water quality is demonstrated. | | |
| Water quality sampling techniques is demonstrated. | | |
| The maintenance of water sampling equipment is demonstrated. | | |
| Information on the sampling of water quality is recorded and provided. | | |
| An ability to perform basic maintenance tasks on certain operational technical systems that control and maintain specific water quality is demonstrated. | | |
| The ability to identify the need for the maintenance work to be done is demonstrated. | | |
| Information regarding the maintenance task being performed on water quality systems is recorded and provided. | | |
| Tasks associated with the maintenance of systems that control water quality are demonstrated. | | |
| Water systems maintenance is demonstrated. | | |
| Information on the maintenance of water quality control systems is recorded and provided. | | |
| The ability to record all necessary data regarding water quality management is demonstrated. | | |
| The ability to report on the recording of water quality observations and data is demonstrated. | | |
| An understanding for the need to record and report data on water quality is demonstrated. | | |

# Session 2 Irrigation – An introduction



In order to understand irrigation systems and the need for irrigation systems, we need a clear understanding of the irrigation process. What follows is a summary of the processes that occur once water is applied to soil and the various systems designed to deliver irrigation water.

These processes are independent of the irrigation system because they are the result of the interaction between soil – plant – water – air – heat and nutritional elements.

One could ask why should we know what happens with water after it landed on the soil? Is it important? Is our job, as irrigators not finished when we put the water on the soil?

Once water is applied to soil either as rain or as irrigation, it may either infiltrate the soil or run off the surface into streams. Over irrigation of from either rain or irrigation systems cause water logging or erosion, or a combination of all three. Under-irrigation leads to crop stress and a reduction in yield.


***Irrigation:***
Artificial application of water to soil in order to supply water to crops.

In irrigation farming one of the most common problems is over irrigation. We need to be aware how it affects our crop, our soil and thus our farming profits.

When water reaches the soil surface and infiltrates it, the water will move down into the soil, Water can move in any direction in soil and this flow is caused by the adhesion and cohesion forces in soil. This movement of water explains why the water will reach plant roots and also the movement away from a dripping tap, mainly because of the "sucking power" of the soil. The dryer the soil is the more is this "sucking power" of the soil. This is also why water moves sideways in soil and not only downward.

As water enters the soil it displaces (pushes out) the air trapped in the soil. Just after irrigation or rain the soil is **wet**. As time progresses the soil becomes **damp** and may even become **dry.** This occurs because plants use the soil water for growth. In addition much of the water evaporates. The ideal irrigated condition for soil is a damp soil, which means some of the openings in the soil are filled with water and some with air. Damp soil allows plants to take up soil water.

When the soil is damp like this the plant roots can easily "drink water" and "breathe air". When soil is dry, plants cannot get any water from it. Irrigation events should take place while the plant can still take up water, but water logging must not occur. Irrigate before the soil is too dry and do not over irrigate and cause water logged soil.

# Irrigation systems

What follows is a definition of the major irrigation systems that are being used on irrigation farms. Also provided is a summary of the advantages and disadvantages of individual systems.

Irrigation systems can be divided into three groups of systems:

- Flood irrigation
- Static irrigation
- Mobile irrigation

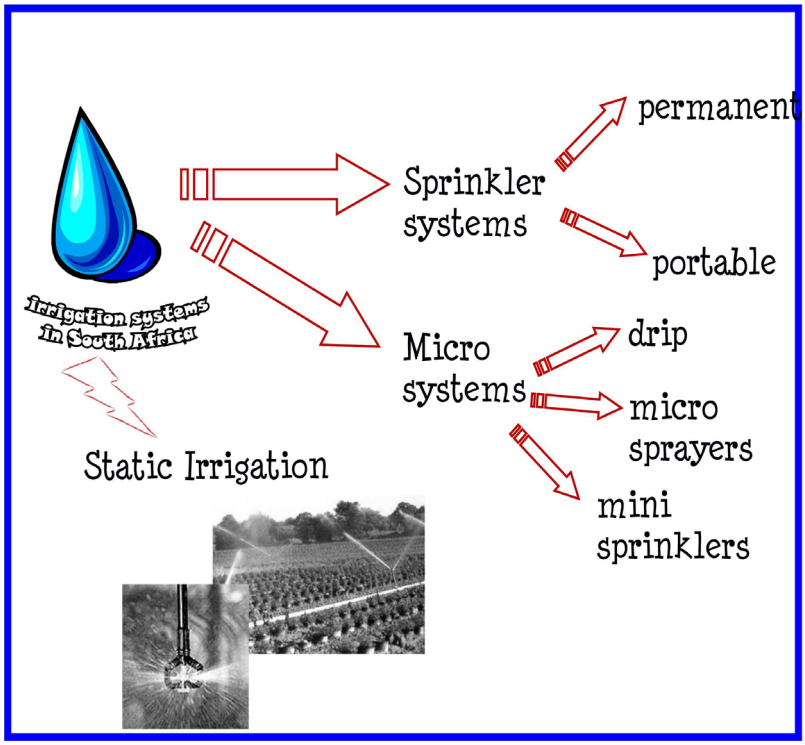
## Flood irrigation systems


***Flood Irrigation:*** Water flows over the ground in a furrow and infiltrates the surface. Borders made with spades guide the direction of flow.

| Advantages | Disadvantages |
|---|---|
| Lower capital costs than other systems in most cases. | Water losses may occur if the system is not well managed and maintained. |
| Wetting limited to the root zone in furrow irrigation thus reduces losses. | Furrow systems suitable primarily for row crops. The area must be levelled. |
| Can be used to leach brackish soils. | These systems can be very labour intensive. |
| With most systems the crop produce is not wetted at all, thus reducing diseases. | These systems could cause environmental damage due to erosion, compaction, leaching and secondary effects on water quality. |
| Ideal for soils that are prone to crusting. | Mechanised cultivation on short furrow systems is difficult. |

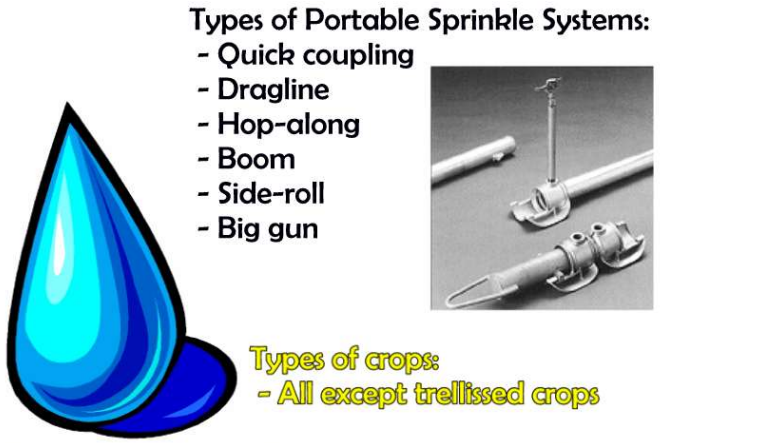
## Static irrigation systems


***Static Irrigation Systems:*** Normally these types of systems refer to overhead sprinkler systems. The whole plant gets wet.




The above diagram gives and overview of the different types of irrigation systems.

**Portable** systems remain static while operating and are moved when shut down.




**Micro-irrigation** Systems are mainly used for high value permanent crops.


This type focuses on the root systems of the crop and water is directed to the surface area above the effective root-zone.

| Advantages | Disadvantages |
|---|---|
| Easy Operation. | Most of these systems are very expensive to install and require specialised maintenance. |
| The distribution of the water is uniform if the system is well maintained and managed. | These systems could cause compaction, leaching and similar effects on soils. |
| Lower capital costs for portable sprinkle systems compared to other pressurised systems. | The water applied through micro systems has to be filtered (filter systems add cost and increases the need for maintenance). |
| Labour requirements are lower. | These systems need good management and maintenance to maintain efficiency. |
| May be automated with ease. | Water losses may occur if the system is not well managed and maintained – especially wind losses. |
| Good control of application depth possible. | Micro systems suitable primarily for row crops. |
| Can be used to leach salts from brackish soils. | |
| Can be very efficient with regard to water use. | |

## Mobile irrigation systems


***Mobile Irrigation Systems:*** These systems move while they are irrigating.

Names of the systems:
- Center pivot
- Linear move
- Travelling gun

Types of crops:
- Lucern
- Maize
- Grains
- Vegetables

Mobile Irrigation

| Advantages | Disadvantages |
|---|---|
| Low labour costs. | Outfall areas of the crop might not be wetted sufficiently. |
| Some of the systems have low energy costs. | Some of these types of systems are very expensive and maintenance is very sophisticated. |
| Chemigation and fertigation is possible through this system. | Water supply to linear systems may be problematic. |
| | Some of these systems – like the travelling gun is very wind sensitive and has high pumping costs. |

## My Notes ...

# Session 3 Tools for basic maintenance of irrigation systems

*After completing this session, you should be able to:*
**SO 1: Identify and obtain appropriate tools for basic maintenance of irrigation systems.**

**In this session we explore the following concepts:**

In this session we explore the concept of "routine maintenance" and its importance and look at a number of specific routine maintenance tasks:

- The appropriate tools for basic maintenance of irrigation systems, and what they are used for.
- The appropriate clothing to wear when performing maintenance on an irrigation system.
- Using, maintaining, cleaning and storing of tools.
- Reporting problems of faulty tools and equipment.
- Dealing with problems that might be encountered during maintenance of an irrigation system.

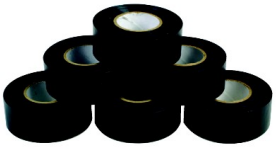
## 3.1 Tools used in basic maintenance of irrigation systems

This diagram includes a selection of tools that are used during maintenance of irrigation systems.

The table below is a selection of the tools that could be used for the maintenance of an irrigation system. Also provided are the uses of the tool and maintenance tips.

| Type of tool or equipment | How is it used in irrigation? | Tips for correct use, cleaning and maintenance |
|---|---|---|
| **Spanners sizes 6-24**  | • Various pump bolts and irrigation-system bolts can be fastened or loosened with this. | • Use the correct size for the correct sized bolt.<br>• Remember-clockwise turning fastens; while anti-clockwise turning loosens.<br>• Never over-tighten-it will strip the bolts.<br>• Prevent rusting.<br>• Store in designated areas.<br>• Never store above head-height. |
| **Pipe wrench**  | • Used to tighten and loosen pipe couplings.<br>• It is also used to grip round edges to enable other turning / loosening / tightening actions. | • Open the spanner before placing it on the area and then close it to size.<br>• Regularly oil or grease the wheel allowing opening and closing.<br>• Prevent rusting.<br>• Store in designated areas.<br>• Never store above head-height. |
| **Shifting spanner**  | • Very similar to regular spanners, except that it provides you the option to use one tool instead of many different sized ones. | • Open the spanner before placing it on the area and then close it to size.<br>• Regularly oil or grease the wheel allowing opening and closing.<br>• Prevent rusting.<br>• Store in designated areas.<br>• Never store above head-height. |
| **Pliers**  | • Cutting wire and stripping outer coatings off electrical cable.<br>• It is also used to grip screws or pipes etc to enable other turning / loosening / tightening actions. | • Place the wire between the cutting edges where it has to be cut and close the tool to cut through the wire.<br>• Some pliers have ridges on the front of the blades that allow stripping of outer electrical cable.<br>• Prevent rusting.<br>• Store in designated areas.<br>• Never store above head-height. |

| Type of tool or equipment | How is it used in irrigation? | Tips for correct use, cleaning and maintenance |
|---|---|---|
| **Binding wire – thick and thin**<br>  | • Used to fix couplers onto polyethylene pips.<br>• Also used to fix polyethylene pipes to trellis systems. | • Use wire cutters to cut the wire and pliers to twist it tight around the couplers.<br>• Flatten any pieces of wire that stand upright to avoid injury. |
| **Wire cutters**<br>  | • Cut wire and sometimes equipped with wire stripping areas to remove the outside of electrical wiring. | • Cut through wire of the correct thickness and grade with the correct wire cutter. |
| **Stanley knife**<br>  | • Cutting plastic pipe. | • Retract the blade when it is not in use. |
| **Hammers**<br>  | • To nail nails or hooks into walls or wood (small hammers).<br>• To level tiles (rubber hammers).<br>• To break down walls and concrete structures (sledge hammers). | • Hammer in nails by looking at the nail and not focusing on the hammer head.<br>• It is essential to use the correct hammer for the correct job.<br>• Even though small hammers are provided with an end that can remove nails, it is discouraged to use the tool for this purpose because it often damages or breaks the head and can cause injury. |

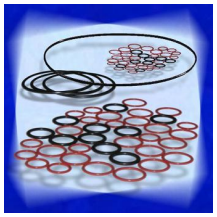
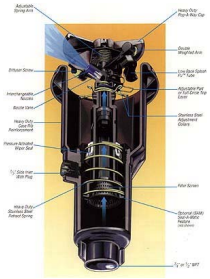
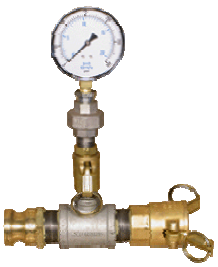
| Type of tool or equipment | How is it used in irrigation? | Tips for correct use, cleaning and maintenance |
|---|---|---|
| **Teflon tape**  | • Secure the seal where the pipe and the couplings meet. | • Wind the tape around the thread of the coupling area and then fix the pipe to it. |
| **Screwdriver flat tip + Phillips**  | • Tighten or loosen screws of different sizes. | • Straight screwdrivers tighten or loosen screws with a straight edge while Philips screwdrivers ("star") tightens screws with cross-sections.<br>• Some screwdrivers are magnetic and will hold the screw to the tip of the screwdriver. |
| **Insulation tape**  | • Insulating electrical wiring. | • Wind the insulation tape around areas where electrical cables have been fixed or extended.<br>• Don't handle electrical cord while there is electricity running through it! |

| Type of tool or equipment | How is it used in irrigation? | Tips for correct use, cleaning and maintenance |
|---|---|---|
| **Shovel**<br>  | • Shovels are used for digging and lifting loose soil or other materials.<br>• If you have a large amount of lightweight material to move, a wide scoop shovel works best. | • Take care not to put a spade or fork through your foot. Take care to keep your back straight when digging.<br>• Store a spade or fork flat on the ground - with the blade/prongs pointing down - or leaning against a tree.<br>• Do not leave a spade or fork sticking into the ground.<br>• Carry a spade or fork down by your side, at its point of balance and with the blade where you can see it.<br>• Do not use a spade or fork to lever stones out of the ground.<br>• Try to use your heel or the ball of your foot rather than your instep when digging. |
| **Spade**<br>  | • Spades are useful for cutting and digging heavy soil, digging straight-sided flat bottomed trenches, or removing a layer of sod. | • Take care not to put a spade or fork through your foot. Take care to keep your back straight when digging.<br>• Store a spade or fork flat on the ground - with the blade/prongs pointing down - or leaning against a tree.<br>• Do not leave a spade or fork sticking into the ground.<br>• Carry a spade or fork down by your side, at its point of balance and with the blade where you can see it.<br>• Do not use a spade or fork to lever stones out of the ground.<br>• Try to use your heel or the ball of your foot rather than your instep when digging. |

| Type of tool or equipment | How is it used in irrigation? | Tips for correct use, cleaning and maintenance |
|---|---|---|
| **Fork**<br>  | • Garden forks have thick tines and are used for turning soil and breaking up soil clods.<br>• Pitchforks have longer tines, which are useful for moving light, loose material eg. Hay or lucerne. | • Take care not to put a spade or fork through your foot. Take care to keep your back straight when digging.<br>• Store a spade or fork flat on the ground - with the blade/prongs pointing down - or leaning against a tree.<br>• Do not leave a spade or fork sticking into the ground.<br>• Carry a spade or fork down by your side, at its point of balance and with the blade where you can see it.<br>• Do not use a spade or fork to lever stones out of the ground.<br>• Try to use your heel or the ball of your foot rather than your instep when digging. |
| **Hose**<br>  | • Watering manually. | • Coil hoses after use.<br>• Don't leave hoses lying around and near vehicle traffic that can damage it. |
| **Water Filter**<br>  | • Filter irrigation water and drinking water. | • Regularly clean and replace filters.<br>• Properly prime pumps before switching the irrigation system on.<br>• Frequently check that the pump is running at the correct pressure settings. |

| Type of tool or equipment | How is it used in irrigation? | Tips for correct use, cleaning and maintenance |
|---|---|---|
| **Bucket**<br>  | • Mixing chemicals.<br>• Transporting liquids.<br>• Holding ingredients. | • Use buckets for a specific purpose only. Do not use waste buckets for storage.<br>• Use specific buckets for mixing specific chemicals. |
| **Chemicals**<br>  | • Agro-chemicals are used as herbicides, pesticides and fertilizers and some soluble kinds can be applied through the irrigation system.<br>• Cleaning chemicals are used to clean areas, surfaces and the inside of irrigation lines. | • Store chemicals separately and never use or mix chemicals that you are not trained for.<br>• Wear the correct safety clothing while working with agro-chemicals.<br>• Mix accurately and according to manufacturer's instructions.<br>• Discard excess chemicals according to manufacturer's instructions and avoid pollution of water sources or poisoning of animals and humans. |
| **Grease (pictures of different grades)**<br>  | • Apply to moving parts and bolts to prevent wear on machinery and moving parts. | • Grease parts correctly and according to a maintenance schedule.<br>• Avoid getting grease on or inside parts or pipes of the irrigation system.<br>• Never apply grease while a machine is running. |
| **Grease gun**<br>  | • Apply grease to specific bolts or parts of equipment and moving parts of pumps. | • Fill the gun with the appropriate amount of grease and clean it out after use. |

| Type of tool or equipment | How is it used in irrigation? | Tips for correct use, cleaning and maintenance |
|---|---|---|
| **Specialised irrigation equipment** | | |
| **Hose Clamps**  | • Tighten parts, couplings onto irrigation lines. | • The clamp is designed with a screw that is tightened.<br>• Be careful not to over tighten the clamp to prevent it cutting into the pipes underneath or damaging the coupling. |
| **T-connector**  | • Join 3 irrigation pipe sections together.<br>• Usually used to split irrigation lines. | • First cut the pipe open and then join the 3 parts to the connector. Tighten with wire or hose clamp after inserting it.<br>• Check the integrity of the join when the irrigation system is running. |
| **L-connector**  | • Join 2 irrigation pipe sections on the corners of a permanent system. | • Use is similar to a t-couplers. |
| **Brass fittings and reducers**  | • Join 2 pipes together of different sizes. | • Gradually reduce the diameter of lines and be careful of creating too much pressure in the system-the narrower the pipes, the higher the pressure build-up.<br>• Secure reducers to the pipes as per instruction. |

| Type of tool or equipment | How is it used in irrigation? | Tips for correct use, cleaning and maintenance |
|---|---|---|
| **O-rings**<br>  | • Acts as a seal between screw in sections of a tap, reducer piece etc. | • Use the correct sized o-ring for the tap or valve-too small o-rings will be useless, while too large o-rings will prevent the seal from sealing and cause leaks. |
| **Sprinkler nozzles (jets) – green / blue**<br>  | • A method of applying water through an irrigation system.<br>• Designed to deliver a specific amount of water through a specific system in a specific manner. | • Ensure that nozzles are frequently checked for blockages.<br>• Check the delivery rate of nozzles.<br>• Ensure that nozzles are in the correct position and haven't fallen over. |
| **Potato ridger**<br>  | • It is used to make furrows for furrow irrigation.<br>• It can only be used after soil preparation is completed.<br>• Furrows have to be at least 300 mm deep -this is controlled with the hydraulic system of the tractor.<br>• Furrows made on too dry soil will powder the soil, while too wet soil will cause smearing and compaction. | • It is important that the instrument sits level on the tractor to ensure that all furrows are even.<br>• After operation, the soil has to be rinsed off.<br>Inspect the instrument and the parts for cracks and damage.<br>• Ensure that the bolts are tight before working with the instrument. |
| **Pressure gauge**<br>  | • Check water pressure in irrigation system pressure. | • These are specialized instruments that have to be professionally calibrated.<br>• The reading on the gauge is the pressure that is experienced inside the pipes.<br>• Place gauges away from human, animal and vehicle traffic and prevent them getting wet. |

Tools require regular maintenance to work properly. Clean all tools after each use with water and a penetrating oil to prevent rust. Sharp tools are safer and more efficient to use.

- Various sharpening methods are used depending upon the tool. It is important to become familiar with the various methods so tools are sharpened properly.
- Check tools regularly for loose nuts and screws and tighten as needed.
- Sand rough handles and repair cracks as soon as possible to prevent injury.
- Store tools in a dry location away from the elements. Hanging them on a wall is an ideal way to organize the store or shed.
- Proper tool selection and care will extend the life of your purchase for many years to come.

# 3.2 Select task appropriate equipment


Please complete Activity **2, 3 and 4** in your learner workbook

**My Notes ...**

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**My Notes ...**

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# 3.3 Usage, cleaning, storage and maintenance of tools

## Shovels and Trowels

The general principles involved in safe lifting and handling are:

- Think of the ergonomics of the situation and plan what you are going to do first.
- Seek alternatives to the manual handling of loads e.g. use of machinery, change of process etc.
- Be aware of your own and other people's physical limitations.
- Get help to move heavy objects.
- If you think you cannot cope with a situation, do not even try.
- Do not bend or twist your back, keep it as straight as possible and don't make it do the work as it damages very easily.
- Make use of your strong muscles in arms, legs and thighs.
- Make sure you have a good grip, not just with fingertips.
- Check that the handles are smooth and free from splinters and that the blade or tines are not split.
- When digging or shovelling avoid back strain by using your leg muscles as much as possible, e.g. push a shovel handle against your thigh muscle, keeping your back straight.
- Make sure that there is at least two handle-lengths' distance between you and anybody else to avoid striking them with tool or materials.
- Never leave a spade, fork or shovel upright as others may trip over it. Always lay it flat with the blade or tines pointing downwards.
- Carry these tools at their point of balance, down by your side and with the blade or tines pointing forward.

1. Do not dig with a shovel - use a spade.
2. Position yourself to avoid twisting movements.
3. Keep you back straight. Squat down, and then lift the load using your leg muscles.

- Stout boots should be worn especially when digging in hard ground.
- There are boots available with striking plates built into the soles to protect the feet, a very worthwhile consideration if a lot of digging is to be done by hand.
- To dig with a spade, stand up straight holding the handle with both hands.
- Using whichever foot suits you, place it on the tread and push the blade into the ground.
- Cut the soil into square lumps that are as large as possible but still comfortable to move (trial and error).
- Hold the spade with one hand on the handle and the other halfway down the shaft.
- Placing the blade behind the lump you have cut, lever and then lift it clear it to wherever the spoil is being deposited.
- Shovels should be held by the handle and with the other hand halfway along the shaft.
- It is very important proper stance is used while shovelling, or backache and even injury can result.
- Ensure you have a sound footing, for example if working on a bank cut a small step for each foot.
- When loading the shovel do not fill it beyond your ability to lift and control it comfortably.
- You should position yourself such that the minimum amount of twisting is done while moving the spoil.
- Turning while holding a heavy load on the end of a shovel is not good for your back.
- A slip while holding a loaded shovel can easily lead to a sprain and as we often work in wet, slippery conditions be sure of your footing at all times.
- It is often easier to work as a team; one person breaking the material up while the other shovels it away.

## Spades and Forks

The general principles involved in safe lifting and handling are:

- Take care not to put a spade or fork through your foot.
- Take care to keep your back straight when digging.
- Store a spade or fork flat on the ground - with the blade / prongs pointing down - or leaning against a tree.

- Do not leave a spade or fork sticking into the ground.
- Carry a spade or fork down by your side, at its point of balance and with the blade where you can see it.
- Do not use a spade or fork to lever stones out of the ground.
- Try to use your heel or the ball of your foot rather than your instep when digging.

## Picks and Mattocks

The general principles involved in safe lifting and handling are:

- Although innocent looking tools, a pick or a mattock can inflict serious personal or third party injury.
- **It is imperative anyone using a pick or mattock is fully aware of how to use the tool and the potential dangers to both themselves and those around them!**
- Picks and Mattocks are constructed in a similar fashion with a hickory shaft and a steel head.
- The type of steel used and the shape of the head distinguish between the two.
- Picks have a hardened steel head that gives them the strength to withstand being used to break up hard and stony ground.
- They can also be used to lever rocks out of the ground (but should not be used as wrecking bars!).
- Mattock heads are made of much softer steel than a pick head, and so will burr if used on hard ground and bend if used to lever things.

### Technique for use

- The art to using a mattock as with any tool you lift is to let gravity do the work for you.
- Hold the tool with one hand at the end of the shaft and your other hand near the tool head.
- If using a pick or the cutting end of a mattock lift the tool over your shoulder until the hand at the head end of the shaft is alongside your own head.
- Bring the tool down in front of you by simply guiding it and letting it fall under gravity.
- As the tool descends slide your far hand nearest the head along the shaft back towards your other hand.

- As the tool nears the floor you should bend over with it.
- **Do not** use your own weight or strength while bringing the tool down, as you will only prematurely tire yourself and possibly damage the tool itself.
- With practice it becomes possible to place where the blade lands very accurately, especially useful when cutting roots.
- The flat end of a mattock is not as strong as a pick or the cutting end of a mattock, and if swung from head height will be damaged.
- It should instead be used with half swings, holding the shaft with one hand at the end and the other halfway along. This technique should also be used with picks and cutting mattocks if the ground is very stony or a root particularly hard otherwise the tool could bounce back and hit you. If a large lump of stone is encountered it should be dug round to loosen it, and then prized out with a bar instead of trying to smash it with a pick.
- You *must* ensure the blade is secure on the handle. The handle should extend beyond the blade by at least 3cm.
- You *must* wear a hardhat and steel toecap boots.
- You *must wear gloves.*
- You *must* wear safety goggles if working in stony ground.
- You m*u*st ensure a safe working distance of at least 5 metres is maintained.
- You *must* keep your back straight when using these tools.
- You *must not* use the handle to pack material around fence posts. This causes serious damage to the end of the handle.
- To tighten a loose blade hit the blade end of the handle on the ground several times.
- To release a blade, hold the blade in your hand and hit the narrow end of the handle on the ground until the blade is worked free.
- Keep the ground around your feet clear of loose material to avoid tripping
- Carry the tool in two separate pieces
- Check that shafts are smooth.
- Check that the shaft fits snugly in the socket without rocking and that it stands slightly proud of the tool head.
- Do not use shafts for packing loose material around straining posts when fencing as it causes dangerous damage to the shaft end.
- Make sure other people are well away from you before using.
- Keep the ground around your feet clear of loose material to avoid slipping or tripping.

- When removing the head from the shaft, make sure that you tap the bottom of the shaft on a firm surface and that you are positioned so that the haft cannot damage you should it come free unexpectedly.
- Carry the tools in separate pieces as heads can otherwise slide down hafts and trap fingers.

## Hammers

The general principles involved in safe lifting and handling are:

- When replacing hammer handles, make sure they fit the hammer head.
- Wedge the handle securely in the head and make sure that it is free of splinters and cracks. Never strike hardened steel surfaces with a steel hammer.
- Use a soft metal hammer or one with a plastic, wood or rawhide head when striking steel surfaces. Always wear safety glasses to protect your eyes from flying objects.
- Inspect sledgehammers carefully before each use. Use the right type of hammer for the specific job.

## Spanners

The general principles involved in safe lifting and handling are:

- Use the correct size for the correct sized bolt.
- Remember-clockwise turning fastens; while anti-clockwise turning loosens.
- Never over-tighten-it will strip the bolts.
- Prevent rusting.
- Store in designated areas.
- Never store above head-height.

## Pliers

The general principles involved in safe lifting and handling are:

- Never substitute pliers for another tool such as a wrench to complete the task. It may cause the bolt heads to become chewed.
- Pliers cannot grip nuts and bolts securely and will slip.
- If working with electricity use hand insulated grips.
- Make sure the protective coverings are free from cracks or holes. Use a vise when cutting wire with the pliers.

- Hold the open end of the wire with your free hand to prevent the cut-off piece from flying through the air. If a vice is not available, use your foot to secure the wire and always use safety glasses.

## Pipe wrench

The general principles involved in safe lifting and handling are:

- Open the spanner before placing it on the area and then close it to size.
- Regularly oil or grease the wheel allowing opening and closing.
- Prevent rusting.
- Store in designated areas.
- Never store above head-height.

## Shifting spanner

The general principles involved in safe lifting and handling are:

- Open the spanner before placing it on the area and then close it to size.
- Regularly oil or grease the wheel allowing opening and closing.
- Prevent rusting.
- Store in designated areas.
- Never store above head-height.

## Wire cutters

The general principles involved in safe lifting and handling are:

- Do not try to cut nails or hard steel as this can damage the wire cutters.
- Place the wire between the cutting edges where it has to be cut and close the tool to cut through the wire.
- Prevent rusting.
- Store in designated areas.
- Never store above head-height.

# 3.4 Reporting problems with faulty tools and equipment

Broken or damaged tools can cause injury or accidents in the workplace.

Broken or damaged tools also add cost to the business in the long run.

The faster problems with tools are reported, the quicker the tool can be fixed or replaced and the less the chance of risk or injury to employees or added cost to the company.


Please complete Activity **5** in your learner workbook

**My Notes ...**

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# 3.5 Dealing with problems encountered during maintenance of an irrigation system

Each farm will have unique procedures and will install unique systems that place people in charge of organizing, issuing and controlling tool stock. There might be different people in charge of different things to do with tools. It is important that you find out who is responsible for what and who you have to report faults or problems with the tools to.

It is essential that problems and faults with tools immediately be reported to the correct person to prevent risk of accident or injury through the use of the tools.

It is important to respect the roles of the people placed in charge of organizing and maintaining tools because this also protects your safety.

Never attempt to fix or maintain or use a tool that you do not have training or authority for.


| Concept | I understand this concept | Questions that I still would like to ask |
|---|---|---|
| Appropriate clothing is worn. | | |
| The ability to identify and select task appropriate equipment is demonstrated. | | |
| The correct usage of equipment is demonstrated. | | |
| Problems encountered with the use of equipment are identified and corrected. | | |
| Tools are appropriately cleaned and stored after use. | | |
| Tools are appropriately cleaned and stored after use. | | |

**My Notes ...**

# Session 4 Operate an irrigation system

*After completing this session, you should be able to:*
**SO 2: Operate an irrigation system according to set procedures.**

**In this session we explore the following concepts:**

- The basics of operating and irrigation system.
- Definitions of the concepts:
  - Flow and pressure regulation.
  - Cleaning filters.
  - Pipeline maintenance.
  - Cleaning of blocked sprinklers.
  - Shifting of pipes.
- The relevance of measuring equipment to irrigation, and how to use it correctly.
- Pipeline maintenance on a static irrigation system.
- The correct method and procedure for shifting pipes on a static sprinkler system.

## 4.1 Operating an irrigation system

**How do I know when and how much to irrigate?**

The easiest way to determine this is to dig a hole in the land and determine the wetness of the soil. Determine if the depth of moist earth includes the effective root zone of the crop. Sensors that measure soil moisture (sensitometers) are also available.

**Water pressure and irrigation systems.**

One of the most important aspects to understand before implementing an irrigation system is pressure!

# 4.2 Determining maximum available flow

Pressure is the energy that moves the water through the irrigation pipes, flow is the measurement of the volume of water that is moved (via pressure) in a given amount of time. Flow is measured in litres per minute or (lpm) / litre per hour (lph).

Flow must be measured because the higher the flow, the greater the loss of pressure. If the flow is too high and the resulting pressure loss will lead to the sprinklers malfunctioning. In order to increase the flow without increasing the pressure loss, the size of the pipe can be increased. To change piping on a permanent system is time consuming and expensive. It is therefore important that the system is designed in such a way that the correct piping and pumps are put in place.

Pressure can also be lost in the system due to to friction.

It is possible however to calculate the pressure loss so that the maximum available flow can be calculated. This will help to determine the type of sprinklers required as well as the number that can be used on one zone during one irrigation interval.

Keep in mind that changes in elevation will also cause changes in pressure. Water travelling uphill in an irrigation system will lose pressure and, conversely, water travelling downhill gains pressure.

Finally an irrigation schedule must be developed which takes into account the volume of irrigation required, the volume available and the volume that can be delivered with the system in place.

## Irrigation scheduling

The easiest way to determine scheduling is to base it on actual soil moisture.

- To determine soil moisture, dig a hole in the field and to feel how wet the soil is.
- Alternatively a soil-moisture sensor (tensiometer) can be installed that provides a more scientific measurement of soil moisture.
- Two tensiometers are installed, one in the soil root zone (soil area to a depth where roots are located).
- This meter indicates when it is necessary to irrigate.
- The second tensiometer is planted just below the roots and indicates whether the farmer is over- or under-irrigating, and can be used to determine the shut off time for irrigation.

To obtain further information on the operation and installation of tensiometers, contact your nearest agricultural extension officer.

The operating pressure of the system must match the irrigation system used, in order to avoid uneven distribution of the water as well as damage to the system. It is thus important that pressure in the system is checked regularly and corrected if necessary. Nighttime irrigation is more effective than irrigation during the day, because the evaporation is less at night.

- **Flow and pressure regulation**

  Flow and pressure regulation is important to ensure uniform distribution of water.

  It is done by:

  - Using the correct pump
  - Using the correct diameter of pipe
  - Using flow and/or pressure regulating valves
  - Regular checks of the system pressure.

- **Cleaning filters**

  The measurement of system pressure difference in front of and behind the filter system can be used to determine when to clean filters.

  Ensure that filtered debris does not pass the filter point while cleaning the filters.

  Filter specific procedures for cleaning must be followed when cleaning filters. What follows are broad guidelines to cleaning different filter systems.

  **Disk filters:**

  - Loosen disks and clean off all debris (frequency depends on the quality of water).
  - Tighten and re-assemble.

  **Sand filters:**

  - The only cleaning action on these filters is to backwash and rinse the system.
  - It is important to regularly check that the filter hasn't formed a shaft and the remainder of the filter is ineffective.
  - Replace filter sand at regular intervals.
  - Make sure that the secondary (disk) filter is also cleaned.

  **Mesh filters:**

  - Remove the mesh and clean it carefully with a soft brush (preventing damage to the mesh).
  - Assemble correctly.

- **Pipeline maintenance**

It is important to check for leaks and repair these as soon as they are observed.

Remember to also check the suction pipe of the pump for leaks that aren't apparent.

The rated operating pressure of pipes should never be exceeded.

Regular flushing out of pipelines must be done to remove sediments than may cause blockage.

**Quick-coupling pipes:**

- Check integrity of rubber seals (make sure the rubber is in place and that it is still flexible).
- Check the connections between the stand pipe (one with sprinkler) and the coupling pipe is flush as the pies often leak at the joins.
- Move pipes away from vehicle traffic and prevent that vehicles damage the pipes.

**Poly-ethylene pipes:**

- Check for damage on pipes due weeding/cultivation.
- After cultivation actions, ensure that the pipes are replaced in their correct positions.
- Drip and micro-lines should be flushed regularly and treated with the required cleaning chemicals.

**Permanent installed underground pipelines:**

- Fill the lines very slowly, allowing air to escape and prevent bursting of pipes.
- Check for visible signs of sub-surface leaks.
- Flush and scour the pipes a few times each year.

**Drag lines:**

- Check for cracks and replace if damaged.
- Prevent pipes from kinking during moving.

**Metal pipes:**

- Check for rust and treat immediately.
- Make sure that anchors are secure and intact.

**Hydrants:**

- Protect them from vehicle damage by proper demarcation.
- Check the operational status of hydrant valves.

♦ **Cleaning sprinklers**

- If sprinklers often clogged, a screen or filter should be installed after the pump station.
- Do not use wire or sharp instruments to clean sprinklers because nozzles are easily damaged.
- Clean nozzles by removing it. Follow the manufacturers guidelines for cleaning.

♦ **Moving pipes**

- Shut off the system.
- Drain all water from pipes before they are moved.
- Move pipes to the new position.
- Take care to prevent crop damage during the movement of pipes.
- Check that all rubbers remain in place.
- Check for leaks when the water is opened.

# 4.3 The use of measuring equipment in irrigation

There are three ways to decide when to irrigate:

♦ Measure soil-water.

♦ Estimate soil-water using an accounting approach (the check-book method).

♦ Measure crop stress.

## ■ Measuring soil-water

There are many different methods or devices for measuring soil water. These include the feel method, gravitational method, tensiometers, electrical resistance blocks, neutron probe, Phenecell, and time domain reflectometer. These methods differ in reliability, cost, and labour intensity.

Tensiometers and electrical resistance blocks are the most cost-efficient and reliable devices for measuring soil-water for irrigation. Tensiometers are best suited for sandy, sandy loam, and loamy soil textures, while electrical resistance blocks work best in silt or clay soils. You should be aware that the calibration curves and

recommendations supplied by the manufacturer for these devices were developed for general conditions and are not adequate for specific soil conditions and fields. For best results, all soil-water measuring devices should be calibrated for the major soils in each field being irrigated.

**Check book Method.**

The checkbook method is an accounting approach for estimating how much soil-water remains in the effective root zone based on water inputs and outputs. This is similar to a daily balance on a bank account based on deposits and withdrawals. Irrigation is scheduled when the soil-water content in the effective root zone is near the allowable depletion volume. Some of the simpler checkbook methods keep track of rainfall, evapotranspiration, and irrigation volumes. More sophisticated methods require periodic measurements of the soil-water status and moisture-use rates of the crop. Some methods may even require inputs of daily temperature, wind speed, and solar radiation amounts.

Check book methods require detailed daily record keeping, which can become time consuming for the more complex methods. One of the advantages of the check book approach is that it can be programmed on a computer. Computer programs have been developed to handle the accounting and provide timely and sometimes precise scheduling recommendations. Some of the more advanced programs can predict the effect of an irrigation or irrigation delay at a given growth stage on crop yield and maturity date. Computer programs can be very reliable tools for scheduling irrigation; however, it is very important to remember that the computer recommendations are only as good as the data you supply.

# 4.4 Pipeline maintenance on a static irrigation system

The maintenance of an irrigation system is important because it is designed to last for at least as long as the crop will be cultivated.

Some of the essential tasks to be carried out are:

- Fixing of leaking taps,
- Replacement of rubbers for quick-couple piping,
- Regular rinsing of polyethylene lines of microsystems.


Please complete Activity **6** in your learner workbook

**My Notes ...**

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| Concept | I understand this concept | Questions that I still would like to ask |
|---|---|---|
| Flow and pressure regulation, cleaning filters, pipeline maintenance, cleaning of blocked sprinklers, shifting of pipes, etc. | | |
| The correct usage of measuring equipment is demonstrated. | | |
| The ability to service and clean equipment is demonstrated. | | |
| The ability to carry out pipeline maintenance is demonstrated. | | |
| The correct method of shifting pipes is demonstrated. | | |

**My Notes ...**

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Session 5

# Identify the basic factors affecting crop growth under irrigation

*After completing this session, you should be able to:*
**SO 3: Identify the basic factors affecting crop growth under irrigation.**

**In this session we explore the following concepts:**

- Factors affecting crop growth.
- Consequences for the crop of lack of irrigation
- Consequences to soil fertility of over irrigation.
- The importance of irrigation scheduling and consequences of starting and stopping at the times when irrigation is scheduled.
- The consequences for crops if pipes are moved too early / late.
- The consequences for crops if the pipeline spacing is incorrect.
- Consequences of the lack of system maintenance.
- Consequences of incorrect pressure or flow rate.

## 5.1 Factors affecting crop growth

**Plants need the following for growth:**

- **Room to Grow:** Plants cannot expand their roots or vegetative parts without space. Too many plants in a close proximity to each other are in competition for nutrients and space and the plants will eventually push some of the other plants out.
- **Temperature:** Different plants grow and produce a crop at different temperatures. Some plants need low temperatures to enter a time of dormancy. Some plants need specific temperature conditions to germinate from seed.
- **Light:** All plants require light to photosynthesise.

- **Water:** All plants require water to photosynthesise. Water is also a solvent for minerals that the plant absorbs from the soil and is a transportation medium inside the plant for the products of photosynthesis. Water keeps plant cells in shape and prevents the plant from wilting.
- **Air:** All plants require Carbon Dioxide from air to photosynthesise.
- **Nutrients:** Plants have to absorb minerals from the soil to photosynthesise and grow. Excess nutrients can prevent crop formation or even cause death of the plant through toxicity. Too few nutrients can do the same.
- **Time:** Plants need time to mature and go through their various growth cycles.

# 5.2 Consequences of the lack of irrigation

Irrigation is designed to supply a plant with one of its needs, namely water. Irrigation systems can also supply plants with dissolved nutrients. The growth stages of the plant can be manipulated through the irrigation schedule.

Lack of irrigation will lead to:

- Under irrigating at vital times during the growth cycle of the plant could lead to plants wilting and dying or specific physiological stages of the plant suffering and then later leading to a reduced crop or lower crop quality.
- Some of the nutrients will become out of balance and the plant could experience an oversupply of some nutrients and a shortage of other nutrients. This will affect the growth of the plant and its ability to produce a crop.

# 5.3 Consequences of over irrigation on soil fertility

Over irrigation flushes nutrients out of the soil and the plant experiences an imbalanced supply of nutrients. Some of the nutrients are more difficult to flush out of the soil and will become toxic to the plant, while others flush out quickly and the plant will have a lack of these nutrients.

- Therefore the importance of irrigation scheduling and consequences of starting and stopping at the times when irrigation is scheduled is emphasised.
- Irrigation scheduling is a very precise and scientific task. Over irrigating will result in leaching of minerals from soil causing imbalanced mineral supply to the plant. Over irrigating clay soils also cause water-logging, compaction and could lead to fungal root diseases or root drowning.

- Irrigation is designed to supply plants with the correct amount of water for a specific physiological stage of the plant and it thus vital that we start and stop irrigation at the correct times.
- Irrigating at the wrong time of day or under the wrong wind conditions will lead to water being wasted or blown away and can affect the break-out of diseases.

## 5.4 The consequences for crops if pipes are moved too early / late

Shifting pipes too early or too late is the same as over or under irrigating and will have the same consequences as over or under irrigating.

## 5.5 The consequences for crops if the pipeline spacing is incorrect

Incorrect pipeline spacing will lead to over irrigation or under irrigation. It usually leads to a combination of the two, where some plants receive excessive water and others receive none at all or too little water. The result will be that some plants might die and become diseased, while the crop will not be of uniform quality or size throughout a block or orchard.

## 5.6 Consequences of the lack of system maintenance

- A lack of irrigation maintenance will lead to a combination of certain plants being over irrigated and others being under irrigated or not irrigated at all because some emitters will be non-functional or parts of the irrigation system doesn't work.
- Insufficient maintenance will lead to parts of the irrigation system being over-taxed and eventually also breaking.
- It is highly likely that large portions of the irrigation system or the entire irrigation system have to be replaced completely due to a lack of proper maintenance.
- The cost in eventually replacing an entire irrigation system is massive compared to fixing and maintaining throughout!

# 5.7 Consequences of incorrect pressure or flow rate

- Too low irrigation pressure leads to under irrigation and an insufficient supply of water to plants. Water standing in pipes for a period of time allows the clogging of emitters and the growth of algae.
- Too high pressure leads to over supply of water to plants at best, and is likely to cause bursting of pipes, damaging of valves, rupturing of seals and filters and breakdown of pumps.


Please complete Activity **7 and 8** in your learner workbook

**My Notes ...**

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| Concept | I understand this concept | Questions that I still would like to ask |
|---|---|---|
| The effect of lack of water and fertilizer, irrigation not started / stopped as per schedule, effect of lack of maintenance, effect of incorrect pressure / flow rate, etc. | | |
| The basic factors affecting crop growth are described. | | |
| The consequences of the pressure / flow rate too low / high are described. | | |
| The consequences if pipes are shifted too early / late are described. | | |
| The consequences if the pipeline spacing is incorrect are described. | | |

# Bibliography


## Books:

Irrigation design manual revised edition June 2003, ARC

Water Research commission's manual

Glossary of Soil Science 2nd Edition, HVH van der Watt, Theo H van Rooyen

People's farming workbook, 2nd edition

## World Wide Web:

http://www.bae.ncsu.edu/programs/extension/evans/ag452-4.html

enchantedlearning.com

## Subject Matter Experts:

C Stimie (B Eng Agric)


# Terms & Conditions

# Acknowledgements


## Project Management:

- M H Chalken Consulting
- IMPETUS Consulting and Skills Development

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- Ms P van Dalen

**SOUTH AFRICAN QUALIFICATIONS AUTHORITY**

**REGISTERED UNIT STANDARD:**

# Operate and maintain irrigation systems

| SAQA US ID | UNIT STANDARD TITLE | | |
|---|---|---|---|
| 116202 | Operate and maintain irrigation systems | | |
| **SGB NAME** | | **REGISTERING PROVIDER** | |
| SGB Primary Agriculture | | | |
| **FIELD** | | **SUBFIELD** | |
| Field 01 - Agriculture and Nature Conservation | | Primary Agriculture | |
| **ABET BAND** | **UNIT STANDARD TYPE** | **NQF LEVEL** | **CREDITS** |
| Undefined | Regular | Level 1 | 2 |
| **REGISTRATION STATUS** | **REGISTRATION START DATE** | **REGISTRATION END DATE** | **SAQA DECISION NUMBER** |
| Registered | 2004-10-13 | 2007-10-13 | SAQA 0156/04 |

## PURPOSE OF THE UNIT STANDARD

A Learner achieving this Unit Standard will be able to, inter alia: Carry out basic irrigation system and equipment maintenance; operate an irrigation system according to set procedures; identify the basic factors affecting crop growth under irrigation.

Learners will gain specific knowledge and skills in plant production and will be able to operate in a plant production environment implementing sustainable and economically viable production principles.

They will be capacitated to gain access to the mainstream agricultural sector, in plant production, impacting directly on the sustainability of the sub-sector. The improvement in production technology will also have a direct impact on the improvement of agricultural productivity of the sector.

## LEARNING ASSUMED TO BE IN PLACE AND RECOGNITION OF PRIOR LEARNING

No learning is assumed to be in place.

## UNIT STANDARD RANGE

Whilst range statements have been defined generically to include as wide a set of alternatives as possible, all range statements should be interpreted within the specific context of application.

Range statements are neither comprehensive nor necessarily appropriate to all contexts. Alternatives must however be comparable in scope and complexity. These are only as a general guide to scope and complexity of what is required.

## UNIT STANDARD OUTCOME HEADER

N/A

# Specific Outcomes and Assessment Criteria:

**SPECIFIC OUTCOME 1**

Identify and obtain appropriate tools for basic maintenance of irrigation systems.

**OUTCOME RANGE**

Includes but not limited to: Spade, pliers, binding wire, hose-clamps couplings, ties, joints, reducers, etc.

**ASSESSMENT CRITERIA**

**ASSESSMENT CRITERION 1**

Appropriate clothing is worn.

**ASSESSMENT CRITERION RANGE**

Overall, gumboots, hat, etc.

**ASSESSMENT CRITERION 2**

The ability to identify and select task appropriate equipment is demonstrated.

**ASSESSMENT CRITERION 3**

The correct usage of equipment is demonstrated.

**ASSESSMENT CRITERION 4**

Problems encountered with the use of equipment are identified and corrected.

**ASSESSMENT CRITERION RANGE**

Spade needs sharpening, wrong gauge binding wire, couplings not suited to specific pipe type, etc.

**ASSESSMENT CRITERION 5**

Tools are appropriately cleaned and stored after use.

**ASSESSMENT CRITERION RANGE**

Washing, greasing, oiling, etc.

**ASSESSMENT CRITERION 6**

Faulty equipment is reported to Supervisor.

**SPECIFIC OUTCOME 2**

Operate an irrigation system according to set procedures.

**OUTCOME RANGE**

Includes but is not limited to: flow and pressure regulation, cleaning filters, pipeline maintenance, cleaning of blocked sprinklers, shifting of pipes, etc.

**ASSESSMENT CRITERIA**

**ASSESSMENT CRITERION 1**

The correct usage of measuring equipment is demonstrated.

**ASSESSMENT CRITERION RANGE**

Pressure and flow gauges, etc.

**ASSESSMENT CRITERION 2**

The ability to service and clean equipment is demonstrated.

**ASSESSMENT CRITERION RANGE**

Filters, pipes, sprinklers, etc.

**ASSESSMENT CRITERION 3**

The ability to carry out pipeline maintenance is demonstrated.

**ASSESSMENT CRITERION RANGE**

Repairs, replacement, flushing, etc.

**ASSESSMENT CRITERION 4**

The correct method of shifting pipes is demonstrated.

**ASSESSMENT CRITERION RANGE**

Pipes, draglines, spacing, avoidance of crop damage, etc.

**SPECIFIC OUTCOME 3**

Identify the basic factors affecting crop growth under irrigation.

**OUTCOME RANGE**

Includes but is not limited to effect of lack of water and fertilizer, irrigation not started/stopped as per schedule, effect of lack of maintenance, effect of incorrect pressure/flow rate, etc.

**ASSESSMENT CRITERIA**

**ASSESSMENT CRITERION 1**

The basic factors affecting crop growth are described.

**ASSESSMENT CRITERION RANGE**

Sunshine, water, fertilizer, good soil, etc.

**ASSESSMENT CRITERION 2**

The consequences of the pressure/flow rate too low/ high are described.

**ASSESSMENT CRITERION 3**

The consequences if pipes are shifted too early/late are described.

**ASSESSMENT CRITERION 4**

The consequences if the pipeline spacing is incorrect are described.

**UNIT STANDARD ACCREDITATION AND MODERATION OPTIONS**

The assessment of qualifying learners against this standard should meet the requirements of established assessment principles.

It will be necessary to develop assessment activities and tools, which are appropriate to the contexts in which the qualifying learners are working. These activities and tools may include an appropriate combination of self-assessment and peer assessment, formative and summative assessment, portfolios and observations etc.

The assessment should ensure that all the specific outcomes, critical cross-field outcomes and essential embedded knowledge are assessed.

The specific outcomes must be assessed through observation of performance. Supporting evidence should be used to prove competence of specific outcomes only when they are not clearly seen in the actual performance.

Essential embedded knowledge must be assessed in its own right, through oral or written evidence and cannot be assessed only by being observed.

The specific outcomes and essential embedded knowledge must be assessed in relation to each other. If a qualifying learner is able to explain the essential embedded knowledge but is unable to perform the specific outcomes, they should not be assessed as competent. Similarly, if a qualifying learner is able to perform the specific outcomes but is unable to explain or justify their performance in terms of the essential embedded knowledge, then thy should not be assessed as competent.

Evidence of the specified critical cross-field outcomes should be found both in performance and in the essential embedded knowledge.

Performance of specific outcomes must actively affirm target groups of qualifying learners, not unfairly discriminate against them. Qualifying learners should be able to justify their performance in terms of these values.

- Anyone assessing a learner against this unit standard must be registered as an assessor with the relevant ETQA.

- Any institution offering learning that will enable achievement of this unit standard or assessing this unit standard must be accredited as a provider with the relevant ETQA.

- Moderation of assessment will be overseen by the relevant ETQA according to the moderation guidelines in the relevant qualification and the agreed ETQA procedures.

**UNIT STANDARD ESSENTIAL EMBEDDED KNOWLEDGE**

The person is able to demonstrate a basic knowledge of:

- Names and functions of tools and equipment used during irrigation.
- Function of protective clothing.
- Attributes of basic parts of the implemented irrigation system e.g. nozzles, quick-coupling pipes, etc.
- Sensory cues such as visual perceptions of dry and wet spots, too high/low pressure, etc.
- Purpose of irrigation Implications of defective irrigation systems.
- Implications of not reporting non-conformance of irrigation systems.

**UNIT STANDARD DEVELOPMENTAL OUTCOME**

N/A

**UNIT STANDARD LINKAGES**

N/A

# Critical Cross-field Outcomes (CCFO):

**UNIT STANDARD CCFO IDENTIFYING**

Problem solving relates to all specific outcomes.

**UNIT STANDARD CCFO WORKING**

Teamwork relates to all specific outcomes.

**UNIT STANDARD CCFO ORGANIZING**

Self-organisation and management relates to all specific outcomes.

**UNIT STANDARD CCFO COLLECTING**

Information evaluation relates to all specific outcomes.

**UNIT STANDARD CCFO COMMUNICATING**

Communication relates to all specific outcomes.

**UNIT STANDARD CCFO SCIENCE**

Use science and technology relates to all specific outcomes.

**UNIT STANDARD CCFO DEMONSTRATING**

Inter-relatedness of systems relates to all specific outcomes.

**UNIT STANDARD CCFO CONTRIBUTING**

Self-development relates to all specific outcomes.

**UNIT STANDARD ASSESSOR CRITERIA**

N/A

**UNIT STANDARD NOTES**

N/A

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**SOUTH AFRICAN QUALIFICATIONS AUTHORITY**

**REGISTERED UNIT STANDARD:**

# Maintain basic water quality

| SAQA US ID | UNIT STANDARD TITLE | | |
|---|---|---|---|
| 116168 | Maintain basic water quality | | |
| **SGB NAME** | | **REGISTERING PROVIDER** | |
| SGB Primary Agriculture | | | |
| **FIELD** | | **SUBFIELD** | |
| Field 01 - Agriculture and Nature Conservation | | Primary Agriculture | |
| **ABET BAND** | **UNIT STANDARD TYPE** | **NQF LEVEL** | **CREDITS** |
| Undefined | Regular | Level 1 | 1 |
| **REGISTRATION STATUS** | **REGISTRATION START DATE** | **REGISTRATION END DATE** | **SAQA DECISION NUMBER** |
| Registered | 2004-10-13 | 2007-10-13 | SAQA 0156/04 |

## PURPOSE OF THE UNIT STANDARD

Learner must demonstrate an ability to observe and maintain basic water quality and the ability to work with the technical systems that control certain quality factors in water. In addition they will be well positioned to extend their learning and practice into other areas of water management and agriculture.

Learners will gain an understanding of sustainable agricultural practices as applied in the animal-, plant and mixed farming sub fields. This unit standard focuses on the application of water quality practices in primary agriculture.

They will be able to participate in, undertake and plan farming practices with knowledge of their environment. This unit standard will instill a culture of maintenance and care for both the environment as well as towards farming infrastructure and operations.

## LEARNING ASSUMED TO BE IN PLACE AND RECOGNITION OF PRIOR LEARNING

It is assumed that a learner attempting this unit standard will show competence against the following unit standards or equivalent:

- NQF 1: Collect Agricultural Data.

## UNIT STANDARD RANGE

Whilst range statements have been defined generically to include as wide a set of alternatives as possible, all range statements should be interpreted within the specific context of application.

Range statements are neither comprehensive nor necessarily appropriate to all contexts. Alternatives must however be comparable in scope and complexity. These are only as a general guide to scope and complexity of what is required.

**UNIT STANDARD OUTCOME HEADER**

N/A

# Specific Outcomes and Assessment Criteria:

**SPECIFIC OUTCOME 1**

Demonstrate a basic ability to sample and observe water quality.

**OUTCOME RANGE**

Quality factors for water include but are not limited to temperature, dissolved gasses such as oxygen and carbon dioxide, COD, water insoluble solids and dissolved minerals and organic load.

**ASSESSMENT CRITERIA**

**ASSESSMENT CRITERION 1**

The use of the recalling of tasks associated with the control of water quality is demonstrated.

**ASSESSMENT CRITERION 2**

Water quality sampling techniques is demonstrated.

**ASSESSMENT CRITERION 3**

The maintenance of water sampling equipment is demonstrated.

**ASSESSMENT CRITERION 4**

Information on the sampling of water quality is recorded and provided.

**SPECIFIC OUTCOME 2**

An ability to perform maintenance tasks on certain operational technical systems is demonstrated.

**OUTCOME RANGE**

Including but not limited to water aeration, inlet and outlet screening, inlet and outlet level and flow control, degassing and filtration and temperature.

**ASSESSMENT CRITERIA**

**ASSESSMENT CRITERION 1**

An ability to perform basic maintenance tasks on certain operational technical systems that control and maintain specific water quality is demonstrated.

**ASSESSMENT CRITERION 2**

The ability to identify the need for the maintenance work to be done is demonstrated.

**ASSESSMENT CRITERION 3**

Information regarding the maintenance task being performed on water quality systems is recorded and provided.

**SPECIFIC OUTCOME 3**

The ability to handle systems to maintain water quality is demonstrated.

**OUTCOME RANGE**

Quality factors for water include but are not limited to temperature, dissolved gasses such as oxygen and

carbon dioxide, COD, water insoluble solids and dissolved minerals and organic load.

**ASSESSMENT CRITERIA**

**ASSESSMENT CRITERION 1**

Tasks associated with the maintenance of systems that control water quality are demonstrated.

**ASSESSMENT CRITERION 2**

Water systems maintenance is demonstrated.

**ASSESSMENT CRITERION 3**

Information on the maintenance of water quality control systems is recorded and provided.

**SPECIFIC OUTCOME 4**

Record basic observations and applications regarding water quality.

**OUTCOME RANGE**

Including but not limited to water aeration, inlet and outlet screening, inlet and outlet level and flow control, degassing and filtration and temperature.

**ASSESSMENT CRITERIA**

**ASSESSMENT CRITERION 1**

The ability to record all necessary data regarding water quality management is demonstrated.

**ASSESSMENT CRITERION 2**

The ability to report on the recording of water quality observations and data is demonstrated.

**ASSESSMENT CRITERION 3**

An understanding for the need to record and report data on water quality is demonstrated.

**UNIT STANDARD ACCREDITATION AND MODERATION OPTIONS**

The assessment of qualifying learners against this standard should meet the requirements of established assessment principles.

It will be necessary to develop assessment activities and tools, which are appropriate to the contexts in which the qualifying learners are working. These activities and tools may include an appropriate combination of self-assessment and peer assessment, formative and summative assessment, portfolios and observations etc.

The assessment should ensure that all the specific outcomes; critical cross-field outcomes and essential embedded knowledge are assessed.

The specific outcomes must be assessed through observation of performance. Supporting evidence should be used to prove competence of specific outcomes only when they are not clearly seen in the actual performance.

Essential embedded knowledge must be assessed in its own right, through oral or written evidence and cannot be assessed only by being observed.

The specific outcomes and essential embedded knowledge must be assessed in relation to each other. If a qualifying learner is able to explain the essential embedded knowledge but is unable to perform the specific outcomes, they should not be assessed as competent. Similarly, if a qualifying learner is able to perform

the specific outcomes but is unable to explain or justify their performance in terms of the essential embedded knowledge, then they should not be assessed as competent.

Evidence of the specified critical cross-field outcomes should be found both in performance and in the essential embedded knowledge.

Performance of specific outcomes must actively affirm target groups of qualifying learners, not unfairly discriminate against them. Qualifying learners should be able to justify their performance in terms of these values.

- Anyone assessing a learner against this unit standard must be registered as an assessor with the relevant ETQA.
- Any institution offering learning that will enable achievement of this unit standard or assessing this unit standard must be accredited as a provider with the relevant ETQA.
- Moderation of assessment will be overseen by the relevant ETQA according to the moderation guidelines in the relevant qualification and the agreed ETQA procedures.

**UNIT STANDARD ESSENTIAL EMBEDDED KNOWLEDGE**

The person is able to demonstrate a basic knowledge of:

- The names and terms related to water quality.
- Attributes and properties of water related to its quality.
- Sensory cues related to water quality and water quality maintenance systems.
- The purpose of sampling water and maintaining water quality.
- Implications related to water quality on the operation.
- Rules related to the sampling of water quality measurements.
- Recording techniques.
- Basic reporting skills.

**UNIT STANDARD DEVELOPMENTAL OUTCOME**

N/A

**UNIT STANDARD LINKAGES**

N/A

# Critical Cross-field Outcomes (CCFO):

**UNIT STANDARD CCFO IDENTIFYING**

Problem Solving refers to specific outcome:
- Record basic observations and applications regarding water quality.

**UNIT STANDARD CCFO WORKING**

Team Work refers to specific outcome:
- Record basic observations and applications regarding water quality.

**UNIT STANDARD CCFO ORGANIZING**

Self Management refers to all specific outcomes.

**UNIT STANDARD CCFO COLLECTING**

Information evaluation refers to specific outcomes:
- Demonstrate an ability to perform maintenance tasks on certain operational technical systems.
- Demonstrate the ability to handle systems to maintain water quality.
- Record basic observations and applications regarding water quality.

**UNIT STANDARD CCFO COMMUNICATING**

Communication refers to specific outcome:
- Record basic observations and applications regarding water quality.

**UNIT STANDARD CCFO SCIENCE**

Science and Technology refers to all specific outcomes.

**UNIT STANDARD CCFO DEMONSTRATING**

Inter relatedness refers to all specific outcomes.

**UNIT STANDARD CCFO CONTRIBUTING**

Self development refers to specific outcomes:
- Demonstrate the ability to handle systems to maintain water quality.
- Record basic observations and applications regarding water quality.

**UNIT STANDARD ASSESSOR CRITERIA**

N/A

**UNIT STANDARD NOTES**

N/A

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