



NQF Level: 2 US No: 116077

Assessment Guide

Primary Agriculture

Monitor Water Quality



Assessor:

Workplace / Company:

Commodity: Date:

Before we start...

This assessment guide contains all necessary activities and instructions that will enable the assessor and learner to gather evidence of the learner's competence as required by the unit standard. This guide was designed to be used by a trained and accredited assessor whom is registered to assess this specific unit standard as per the requirements of the AgriSETA ETQA.

Prior to the delivery of the program the facilitator and assessor must familiarise themselves with content of this guide, as well as the content of the relevant Learner Workbook.

The assessor, facilitator and learner must plan the assessment process together, in order to offer the learner the maximum support, and the opportunity to reflect competence.

The policies and procedures that are required during the application of this assessment are available on the website of the AgriSETA and should be strictly adhered to. The assessor must familiarise him/herself with this document before proceeding.

This guide provides step-by-step instructions for the assessment process of:

Title: Water quality		
US No: 116077	NQF Level: 2	Credits: 3

This unit standard is one of the building blocks in the qualification listed below. Please mark the qualification you are currently assessing, because that will be determined by the context of application:

Title	ID Number	NQF Level	Credits	Mark
National Certificate in Animal Production	48976	2	120	<input type="checkbox"/>
National Certificate in Mixed Farming Systems	48977	2	120	<input type="checkbox"/>
National Certificate in Plant Production	48975	2	120	<input type="checkbox"/>

Please mark the learning program you are enrolled in:

Are you enrolled in a:	Y	N
Learnership?	<input type="checkbox"/>	<input type="checkbox"/>
Skills Program?	<input type="checkbox"/>	<input type="checkbox"/>
Short Course?	<input type="checkbox"/>	<input type="checkbox"/>

Note to Assessor:

If you are assessing this module as part of a full qualification or learnership, please ensure that you have familiarized yourself with the content of the qualification.

Class discussion and brainstorming**Learner Guide: Page 10****Facilitator Guide: Page 13**

Complete the worksheet below.

1. What does water quality mean to you?

Model Answer(s):

All natural waters contain "foreign" material. The type and concentration of these "foreign" materials determine the quality of the water. These foreign materials are grouped into physical, chemical and biological components dissolved or suspended in water.

2. Why is water quality important?

Model Answer(s):

Poor quality water has a negative influence not on the plant alone but also on the soil and irrigation system. Using poor quality water increases the input costs, and has a negative influence on the environment without greater profits.

3. What do you think are the major methods to maintain water quality?

Model Answer(s):

The basic principle is to avoid the addition of unnecessary foreign material during any stage of the production process that will decrease the quality of the water that leaves the farm, to underground water or water stored on the farm.

4. How do you think you can contribute on a daily basis to maintaining water quality on your farm and in your area?

Model Answer(s):

By using the minimum chemicals and fertilisers according to prescription, protect open water sources from contamination and following the cleaning procedures for all equipment handling chemicals and fertilisers.

Individual Exercise: Please complete the worksheet.

Learner Guide: Page 14 **Facilitator Guide: Page 13**

Complete the worksheet below.

- List the six critical water quality control points of water quality management.

Model Answer(s):

- The quality of the water received on the farm.
- Knowing what causes the said quality.
- The quality standards of water for crop production.
- What can be done to improve the quality?
- Which water quality factors cannot be changed and need to be managed.
- Managing the quality of the water leaving the farm/property.

- List the materials that play a role in physical water quality factors and indicate which can be controlled with proper measures.

Model Answer(s):

PWQF	Control Measure
Inorganic materials like clay, silt and sand.	Controlled by reducing erosion of soil surfaces, sedimentation and/or filtration.
Organic debris like remnants of plants, seeds, animals, aquatic fauna and flora.	Filtration
Living aquatic plants and animals like algae and snails.	Filtration
Plastic cuttings from the irrigation pipes and equipment.	Clean the working area after a repair job is done and filtration.
Lubricant residues.	Lubricate according to prescription, clean after the job is done, filtration.

3. List the chemical water quality factors and indicate which aspect (the plant, irrigation system or the soil) of crop production might be influenced.

Model Answer(s):

CWQF	Factor Affected
Total soluble salts and pH	The plant, soil and irrigation system
Iron, manganese and sulphides	The irrigation system
Sodium	The plant and soil
Chloride	The plant
Bicarbonate	The plant
Boron	The plant

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Experiment: Using a Pilot Plant

Learner Guide: Page 14

Facilitator Guide: Page 16

1. Follow the instructions below and complete the experiment.
 - a. Fill a 20-litre drum with the water to be used for pest control sprays.
 - b. Measure the pH of the water with a pH meter or pH paper strips. If the pH is higher than the optimal pH for the pesticide, continue with step 3. Otherwise no acidification is required.
 - c. Add acid in small volumes of 1ml at a time.
 - d. Stir the water with a paddle in a vertical motion – not a horizontal motion – which will mix the water, and acid in an up-down movement. Do this after every addition of acid.
 - e. Measure the pH again with a pH meter or pH paper strips.
 - f. Repeat the addition of acids and mixing until the pH reaches the desired level.
 - g. Record the volume of acid used to reach the desired pH.
 - h. Calculate the volume of acid required to bring the pH of the desired volume of water down to the required level.

2. Record your observations and conclusions:

Model Answer(s):

List of equipment required to perform the experiment:

20-litre drum, pH meter or pH paper strips, pH standard buffer solutions, measuring cylinder, pipette or burette to measure the acid, paddle, calculator.

Model Answer(s): (Continued)

Model procedure for the correct use and preparation of the equipment:

1. Calibrate the pH-meter according to the instructions by the manufacturer before it is use to measure the pH.
2. Store the pH-electrode as prescribed by the manufacturer.
3. Measure the pH. If it is higher than the required pH, proceed with step 6. If not, proceed with step 4.
4. Add the chemical at the correct concentration and mix with the paddle.
5. Measure the pH. If it is higher than the required pH, proceed with step 6. If not the mix is ready for use.
6. Add 10ml of the acid and stir the water with the paddle for 5 to 10 strokes.
7. Note the volume acid added.
8. Measure the pH. If it is higher than the required pH, repeat step 6. If not proceed with steps 4 and 5.
9. Calculate the volume acid required per spray tank.

Important adherence points for health and safety:

1. Always add the acid to the water. Wear protective eyeglasses, gloves and apron when handling acids.
2. Never fill the pipette by sucking with your mouth. Use the rubber bulb design for this purpose.

To reduce the risk of injury, use diluted acid for the pilot. Remember to consider the dilution when calculating the volume acid required for the spray tank.

Accuracy of measurement and recording of values observations:

The volume of acid required to reach the prescribed pH is determined on a small volume of water. Usually a spray tank has a capacity of 2,000 litres. Therefore the volume of acid needs to be calculated as follows: Millilitre acid required = volume of spray tank ÷ volume of the pilot container x ml acid added to reach the desired pH. If the accuracy is substandard the error will be aggravated by a huge factor. In the example it will be $2000 \div 20 = 100$.

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In pairs: Discuss the questions and write down your answers.

Learner Guide: Page 23

Facilitator Guide: Page 16

Complete the worksheet below.

- List four direct and four indirect effects of water quality on crop production.

Model Answer(s):

Direct Effects

- The concentration of salts dissolved in the water.
- Concentration of magnesium (Mg), chloride (Cl) and nitrogen (NO₃ and NH₄).
- Bicarbonate.
- High concentration of chlorides.

Indirect Effects

- Sodium adsorption ratio (SAR).
- For foliar sprays to supplement nutrients the pH has an effect.
- Foliar sprays to control pest and diseases.
- Blocking of emitters.

- How can PWQF be improved?

Model Answer(s):

Sedimentation.
Filtration.

- How can CWQF be improved?

Model Answer(s):

Correcting the pH.
Oxidation.

- How can the quality of water leaving the farm be improved?

Model Answer(s):

The only practical method to improve the quality of the water leaving the farm is to minimise the chemicals and fertilisers used and to prevent any contamination of the water sources.

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Demonstration

Learner Guide: Page 26 Facilitator Guide: Page 19

1. Take turns to demonstrate the preparation for and taking of water samples. Let the assessor or facilitator sign that you can demonstrate the correct techniques.

Model Answer(s):

Key Notes:			
<ol style="list-style-type: none"> 1. Obtain a suitable sample container. Glass or plastic. 2. Clean the sample container and the lid or cap. 3. Rinse the sample container with the water to be sampled three times. 4. Take the sample by filling the container away from the side and below the surface. 5. Fill the bottle to the rim. 6. Close tightly. 7. Tie the label with the appropriate information to the container. 			
Learner's Signature		Date:	
Assessor's Signature		Date:	

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Job Description

Learner Guide: Page 29

Facilitator Guide: Page 19

1. Write a job card for someone to take a water sample and to perform basic water quality tests. Instruct the person to perform the following tests:

- ◆ pH Testing
- ◆ Electrical Conductivity

Model Answer(s):

Job Description – pH Testing:

Using pH test paper strips:

1. Utensils required are a small beaker or cup holding 25 to 100ml water.
2. Ensure that the glassware is clean.
3. Pour a small volume of the water to be tested into the beaker and rinse the beaker.
4. Discard the rinse water and repeat step 3.
5. Fill the beaker 50% with the water to be tested.
6. Insert 25% of the test paper strip into the water and keep it submerged for the period specified by the manufacturer.
7. Compare the colour developed on the paper strip with that of the colour chart.
8. Note the pH. If in doubt when the colour is developed is not clear, repeat steps 6 and 7.

Using a pH-meter:

1. Utensils require are glass beakers for the buffer solutions and the water to be tested as well as a thermometer if the pH meter requires temperature adjustments.
2. Calibrate the instrument according to the specifications of the manufacturer.
3. Ensure that the glassware is clean.
4. Pour a small volume of the water to be tested into the beaker and rinse the beaker.
5. Discard the rinse water and repeat step 3.
6. Fill the beaker 50% with the water to be tested.
7. Insert the pH electrode into the water.
8. Follow the instructions of the manufacturer as to the time required to reach a reading.
9. Note the pH reading.
10. Take a measurement of the temperature of the water.
11. Care for the pH electrode and pH meter as per the instructions of the manufacturer, after the measurements are completed.

Model Answer(s): (Continued)

Job Description – Electrical Conductivity:

1. Utensils require are glass beakers for the calibration solutions and the water to be tested as well as a thermometer if temperature corrections are required for the specific instrument.
2. Calibrate the EC instrument according to the specifications of the manufacturer.
3. Ensure that the glassware is clean.
4. Pour a small volume of the water to be tested into the beaker and rinse the beaker.
5. Discard the rinse water and repeat step 3.
6. Fill the beaker 50% with the water to be tested.
7. Insert the EC probe into the water.
8. Follow the instructions of the manufacturer as to the time required to reach a reading.
9. Note the EC reading.
10. Note the temperature of the water.
11. Care for the EC probe and EC meter as per the instructions of the manufacturer, after the measurements are completed.

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Experiment: Water Tests**Learner Guide: Page 32****Facilitator Guide: Page 19**

1. Follow the instructions below and complete the experiment.

Working in groups or as individuals, locate at least three different water sources close by and take samples in the prescribed manner. At the same time, assess the physical quality factors of the water sources.

Under the supervision of the facilitator, perform pH and EC tests on the water according to the procedures described above.

2. Record the procedures followed in taking the water samples and performing the tests described above.

Model Answer(s):

See model answers to activities 5 and 6.

3. Based on the results of the pH tests performed in the practical, discuss methods that can be used to improve the pH of the water.

Model Answer(s):

No model answer provided, depends on results of tests. See previous model answers.

4. Based on observations made at the water sources when samples were taken, discuss means by which the physical quality factors of the water can be improved.

Model Answer(s):

No model answer provided, depends on results of tests. See previous model answers.

Class discussion**Learner Guide: Page 40****Facilitator Guide: Page 22**

Have a class discussion and make notes for yourself.

1. Suggest methods to manage the physical conditions of water to maintain water quality.

Model Answer(s):

Soil particles; Prevent water entering the natural water sources and storage dams to flow at high speed unprotected soil surfaces. This could mean erosion control of newly planted areas, construction and maintenance of waterways, planting on contours, reducing the precipitation rate of irrigation systems especially systems like central pivots, high volume sprinklers and flood irrigation.

Reducing pollution by nitrogen and phosphorus will reduce the growth of algae in the water storage systems.

During repairs, take care to prevent soil and plastic cuttings to enter the irrigation system.

2. Suggest methods to manage the chemical conditions of water to maintain water quality.

Model Answer(s):

Acidify water for pesticide and foliar nutrition sprays.

Get expert help to manage saline or alkaline water to minimize the effect on the soil, trees and environment.

Mix waters of different chemical quality to improve the overall quality and volume available after mixing.

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Write a report

Learner Guide: Page 41 Facilitator Guide: Page 22

1. Write a report about the reporting system related to water quality management and maintenance on your farm. Include what has to be reported, when it has to be reported, who has to report what and to whom it has to be reported.

Model Answer(s):

Model criteria for report writing:

1. State the current situation in terms of WQ parameters measured.
2. State the historic situation of these parameters.
3. Explain all deviations
4. Compile an action plan to address the deviations.

Model key points to appear in the report:

1. Current situation in respect of measurements like suspended solids, pH and EC.
2. Events like rainfall, spillage during the preceding 2 to 3 months that could have influence the current quality.
3. Comparisons with the quality parameters the previous year during the same time.
4. Evaluate the deviation from the average in respect of the parameters but also those climatic factors that have an impact on water quality.
5. Evaluate these deviations in terms of their impact on production, soil and environment.
6. Review of action plans in place.

My Notes ...

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Assessment Feedback Form

Comments / Remarks	
Feedback to learner on assessment:	
Feedback from learner to assessor:	
Learner's Signature:	Date:
Assessor's Signature:	Date:

Summative Test and Attitude & Attribute Evaluation

Before the knowledge test is undertaken, the learner must be reminded of what is expected from him / her in terms of summative and reflexive competence. Read and explain to the learner, the **Preparation for Your Final Assessment** section in the learner workbook. Learners and assessor should sign off this section to acknowledge that this step was completed.

Please set up a knowledge test from the questions given as a guideline to learners and supply each learner with a test sheet.

Supply each report with the following heading:

Unit Standard:	116077	NQF Level:	2
Learner Name:			

Questions	Model Answers
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. These characteristics are controlled or 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 ".
2. Why is water quality important for crop production?	
3. How is water quality managed and maintained on your farm?	
4. What affects water quality chemically?	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: <ul style="list-style-type: none"> • Crop production;

Questions	Model Answers
	<ul style="list-style-type: none"> • Sustainability of the productivity of the soil; and • The effective operation of the irrigation system.
<p>5. How should these chemical factors be controlled to assist in optimum water quality?</p>	<p>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.</p> <p>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.</p>
<p>6. What affects water quality physically?</p>	<p>They should be removed by screening and filtering and if necessary chemically removed to protect irrigation systems from damage.</p>
<p>7. How should these physical factors be controlled to assist in optimum water quality?</p>	<p>Regular sampling helps the producer to ascertain the quality of the water on his farm and to improve it if necessary. If producers have a database of water sampling results they can use it to compare the quality of their water in the future.</p>
<p>8. How should water sampling be done??</p>	<p>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.</p> <p>Select place in the water source that is frequently used.</p> <p>Allow the water to flow full force 3-5 minutes.</p> <p>Please print or type all information requested on the enclosed report form.</p>
<p>9. What happens to the water samples?</p>	<p>A goes to a laboratory for analysis. The result is then send back.</p>
<p>10. Why is water quality important for agriculture?</p>	<p>Water quality can impact agricultural productivity. Agricultural producers are realizing that improved</p>

Assessment Feedback Form

Comments / Remarks	
Feedback to learner on assessment and / or overall recommendations and action plan for competence:	
Feedback from learner to assessor:	
<p>Assessment Judgement You have been found:</p> <p><input type="radio"/> Competent</p> <p><input type="radio"/> Not yet competent in this unit standard</p>	<p>Actions to follow:</p> <p><input type="radio"/> Assessor report to ETQA</p> <p><input type="radio"/> Learner results and attendance certification issued</p>
<p>Learner's Signature:</p>	<p>Date:</p>
<p>Assessor's Signature:</p>	<p>Date:</p>
<p>Moderator's Signature:</p>	<p>Date:</p>