Agricultural TVET College

Small Scale Irrigation Development

Level III

MODEL TTLM

Learning Guide #04

Unit of Competence: Measure Drainage System Performance

Module Title: Measuring Drainage System Performance

LG Code: AGR SSI3 M04 LO1-LO4

TTLM Code: AGR SSI3 TTLM04 1218V_1

Nominal Duration: 45 Hours

Instruction Sheet	Learning Guide 04

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- Assess drainage and collection systems
- Monitor supply of equipment and spare parts
- Monitor quality of work
- Record and report system performance status

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- ✓ Apply measuring and testing techniques
- ✓ Record and report system performance
- ✓ Identify adverse environmental impacts of drainage systems and appropriate remedial action
- ✓ Use computers for recording and reporting drainage system data
- ✓ Implement and follow relevant enterprise OHS and environmental policies and procedures.
- ✓ Communicate ideas and information on reporting drainage system performance status.
- ✓ Collect, analyze and organize information drainage system performance data.
- ✓ Plan and organize activities, supply of equipment and spare parts.
- ✓ Solving problems in identifying deviations in system performance.
- ✓ Use measuring instruments and computers for recording data

Learning Activities

1. **Read the specific objectives of this Learning Guide.**
2. **Read the information written in the "Information Sheet"**
3. **Accomplish the "Self-check".**
4. **If you earned a satisfactory evaluation proceed to the next "Information Sheet". However, if your rating is unsatisfactory, see your facilitator for further instructions or go back to Learning Activity.**
5. **Submit your accomplished Self-check. This will form part of your training portfolio.**
6. **Read and Practice "Operation Sheets".**

7. **If you think you are ready proceed to "Job Sheet".**
8. **Request you facilitator to observe your demonstration of the exercises and give you feedback.**

INFORMATION SHEET#1	**Assess drainage and collection systems**

1.1. Undertaking a visual inspection to determine damaged or broken components and recording results

The component of drainage system depends on the type of drainage system and the first step on assessing performance of drainage system is regular inspection of these parts and identifying irregularities. The sign for any malfunctioning of any component depends on brand of the system and we can get it from *specification*. After identifying the problem we have to *record* it properly and take an appropriate measure.
For the most part, identifying the other elements of a drainage system should be more straightforward. Simply walking an area and noting any features that are visible, including their state of repair, function etc, will be a useful step.

Visiting at the time of flood or high rainfall, may also highlight water *pathways, low spots, bund, banks etc* on a site. Identifying the low lying entry and exit points using *topographic surveys, Aerial photographs or Lidarmaps* may focus your investigations in to the most likely areas for water control structures and pumps, as will investigating the major water ways or drainage ditches than run through or adjacent to a site.

Although subsurface drainage systems do not require extensive maintenance, the maintenance that is required is extremely important. If the subsurface drains are working, water will stand in the field for only a short time after a heavy rain. *If water stands for a few days, the drain may be partly or completely blocked.* With drainage systems that have inspection wells or sediment traps, be sure to check the *amount and rate of flow* at these structures and at the outlets after a heavy rain. A change in flow may indicate that there is a blockage somewhere in the line. Regular inspection of the drainage system is essential. Prompt repair of any drain failure will keep the system in good working order and prevent permanent damage to it.

1.2. Inspecting areas being drained for signs of water pooling and recording problems

It is important that the drainage system is periodically inspected and maintained over its life span. *The ideal time to inspect the system is in the spring, late fall and after a significant rainfall* *event when the soil is wet and the drains are running*. Prompt repair of any noted issues will ensure that the system is always in good working order and will prevent a more serious issue from developing.

Remember to make records of any maintenance/repairs and changes to the system on the drainage plan. This will ensure that there is always an accurate plan of the system for future inspection and maintenance.

In the Field

Check for any signs of *erosion of the drainpipe trench* following rain events, especially in the first few years. Inspect the mains and laterals a couple of days after a heavy rainfall to look for any *signs of ponding or excessive wet spots* in your field. This may indicate that a blocked drain exists.

Uniformity of crop growth is another good indicator of a properly functioning drainage system. Ideally, the field should dry evenly and produce similar yields. Watch for changes in crop yield in different areas of the field annually to see if there is a slower developing problem in the drainage system that may need repair. Take periodic *aerial photographs* of the farm to get an overview of the drainage system and to identify potential drainage problems.

When drains get plugged, ***water rises*** to the surface at the point of the water stoppage. Dig up the drain at the wet spot and repair it. If the fields are wet, it may be better to wait for drier conditions to make the repairs to avoid damaging the soil structure.

If drains carry water for a prolonged period during the growing season, they can become plugged by tree roots. A good design will route the drains (both laterals and mains) at least 30 m from water-loving trees such as willow, soft maple, elm and poplar and at least 15 m from all other types of trees.

1.3.Taking measurements with appropriate equipment to determine drainage performance.

Once the drainage system has been operational for a number of years the performance of the system can be assessed to determine if the system is still functional and if not which measures have to be taken to correct the situation. The performance assessment can be done periodically (monitoring) or ad hoc if there are indications that the system is not functional.

The following periodic assessments are often carried out:

- A periodic assessment of the functionality of the system can be carried out to determine whether the system is functioning in accordance with the design. The assessment can give indications on the need of maintenance or rehabilitation and over time a knowledge base for the frequency and nature of maintenance can be built up.
- A periodic assessment of the *effect of the system*. The rationale behind this assessment is to determine if the system functions according to the design criteria, i.e. if the design groundwater tables and discharges are realized with the installed system, i.e. are the drain spacing, drain depth, drain envelope and dimensions of the drainage system correct. This assessment basically consists of the periodic, and according to pre-determined protocols, ***measuring of groundwater levels*** in between the drains and where relevant ***soil salinity levels;***
- A periodic assessment of the impact of the drainage system. This assessment is to check if the expected ***benefits*** of the drainage system are realized. This assessment will focus on increases of yields, farmer income and possibly effects on the environment.

Next to these periodic assessments, the following ad hoc assessments are often made:

- *Complaint based* ad hoc assessment. These assessments can be carried out if there are substantial complaints made by the beneficiaries of the system about the functionality of the system. These assessments will focus on those parts of the system that are subject of the complaints;

- Assessment to determine the need for rehabilitation. During this assessment the main indicators studied are the *frequency* and *cost of maintenance* and *repairs* and the impact of the malfunctioning of the system on yields and income. It may be rational if these costs and loss of incomes surpass a certain threshold to replace the system.

A performance assessment is based on a comprehensive list of indicators. An indicator is defined as a value derived from two or more parameters that describe conditions and changes in time and space. These changes cannot usually be explained by a single indicator but only in relationship with other indicators. Ideally, the monitoring program should contain a minimum of activities at the lowest possible cost, but resulting in a maximum insight in the performance of the system.

Depending on the objectives of the monitoring program, one or more of the following performance indicators should be measured:

- *Crop yield;*
- *Water ponding in the fields after heavy rainfall or irrigation;*
- *Depth of the groundwater midway between the drains;*
- *Discharge at the outlet;*

• *Discharges in some selected manholes;*
• *Water levels in manholes;*
• *Sedimentation in manholes.*

1.4. Measuring drainage/tail water quality

Water quality is relative and is defined as the characteristic of water that influences its suitability for a specific use. Quality is defined in terms of physical, chemical and biological characteristics. Drainage water is no different from any other water supply and is always usable for some purpose within certain quality ranges. Beyond these limits, drainage water must be disposed of in a manner that safeguards the usability or quality of the receiving water for present established and potential uses.
The management goal of agricultural drainage is to maintain a salt balance in the crop root zone in arid areas and proper soil water balance in humid areas. Drainage water from different locations and/or facilities will have different quality characteristics. Highly saline subsurface drainage water from arid areas, re-used for irrigation, could affect the growth of salt sensitive crops. In humid areas, most subsurface drainage water has the potential to be reused. There are several factors to consider when determining the constraints for the management of surface or subsurface agricultural drainage water. *The amount and quality of drainage water managed, changes in the rate of flow, and chemical concentrations need to be determined.*

Surface and subsurface drainage water from irrigated agriculture is normally degraded compared with the *quality of the original water supply*. *Drainage water that flows over or through the soil will pick up a variety of dissolved and suspended substances including salts, organic compounds and soil particles*. Management for safe *re-use and disposal* requires an understanding of the characteristics of the drainage water, and a matching of those characteristics to the environmental protection needs of the re-use or disposal area.

Water quality characteristics are: Toxic trace elements, Nutrients, Sediment , Bacteria ,Temperature, Salinity and major ions and Sulphurous compounds

There are several different ways the water quality can be impacted whether it is from non-point source or point source pollution. Nutrient loading (specifically phosphorus and nitrates) and sedimentation are two common types of non-point source pollution that affect water quality. Excess nutrients, typically found in fertilizers, are washed off of lawns, gardens, and farm fields during rain events, get into ditches, and eventually reach the water body. A second form of non-point source pollution is sedimentation. Sediments from road ditch, stream bank, and/or shoreline erosion, affect water quality by increasing turbidity, or cloudiness of the water, and decreasing water clarity. This inhibits respiratory capabilities of aquatic species, creates poor visibility conditions for fish, and affects spawning.

Agricultural run-off, including soil erosion from surface and sub-soil drainage. These processes transfer organic and inorganic soil particles, nutrients, pesticides and herbicides to adjacent water bodies.

Salinity of tail water: - is a major parameter that determines the effectiveness of drainage system. Salinity of water can be evaluated by its electrical conductivity (EC) which is expressed milli mho per centimeter (mmohs/cm) or by its salt content expressed in mg/l. Its measurement using ***electrical conductivity meter*** will be described in section 1.6.

Table1. Classification of irrigation water based on salt concentration

EC (mmhos/cm)	**Salinity(gm/lit)***	**Quality**	**Uses**
0-0.50	0-0.32	Good	Suitable for almost all crops. Not requires extensive leaching
0.50-2.20	0.32-1.40	Average to poor	Normal to high salt tolerant crops can be grown with good leaching
>2.20	>1.40	Unsuitable	Not suitable for irrigation purpose

*** 1gm/lit = 0.64EC**

Table2. Ranking of Irrigation water quality

Rank	**EC (mmhos/cm)**	**Na+(%)**	**SAR**	**Boron(mg/lit)**
1(Excellent)	0.5	40	3	0.5
2(very good)	1.0	60	6	1.0
3(Good)	2.0	70	9	2.0
4(Not good)	3.0	80	12	3.0
5(unsuitable)	4.0	90	15	4.0

If sampling water in a natural environment, take a representative sample. For flowing water, take the sample from a moving area away from junctions. For still water, take the sample from near the bottom of the water if possible

1.5. Measuring water table depth where required

Water table management requires periodic monitoring of the water table at the midpoint between *drain laterals or ditches*. It is best done by the farmer. One observation well per field is the minimum recommended. For a given soil and drain spacing, the frequency of observation and adjustment of the control structure depend mainly on the weather and crop development stage. For example, when crops are in their early stages of development, a shallow water table may impede proper root development, and this could make the crop more susceptible to drought later in the year.

The response of the water table to rainfall and control structure adjustments may be slow, depending on the soil properties and drain spacing. It may take several years to fully understand the response patterns and successfully operate the system. Accurate weather forecasts and the ability of the farmer to make use of climatic data could improve system operation.

Methods of measuring water table depth

Water-level measurements can be taken in various ways (Figure 1.):

- The **wetted tape method** (Figure 1. A): A steel tape (calibrated in millimeters), with a weight attached to it, is lowered into the pipe or borehole to below the water level. The lowered length of tape from the reference point is noted. The tape is then pulled up and the length of its wetted part is measured. (This is facilitated if the lower part of the tape is chalked.) When the wetted length is subtracted from the total lowered length, this gives the depth to the water level below the reference point;

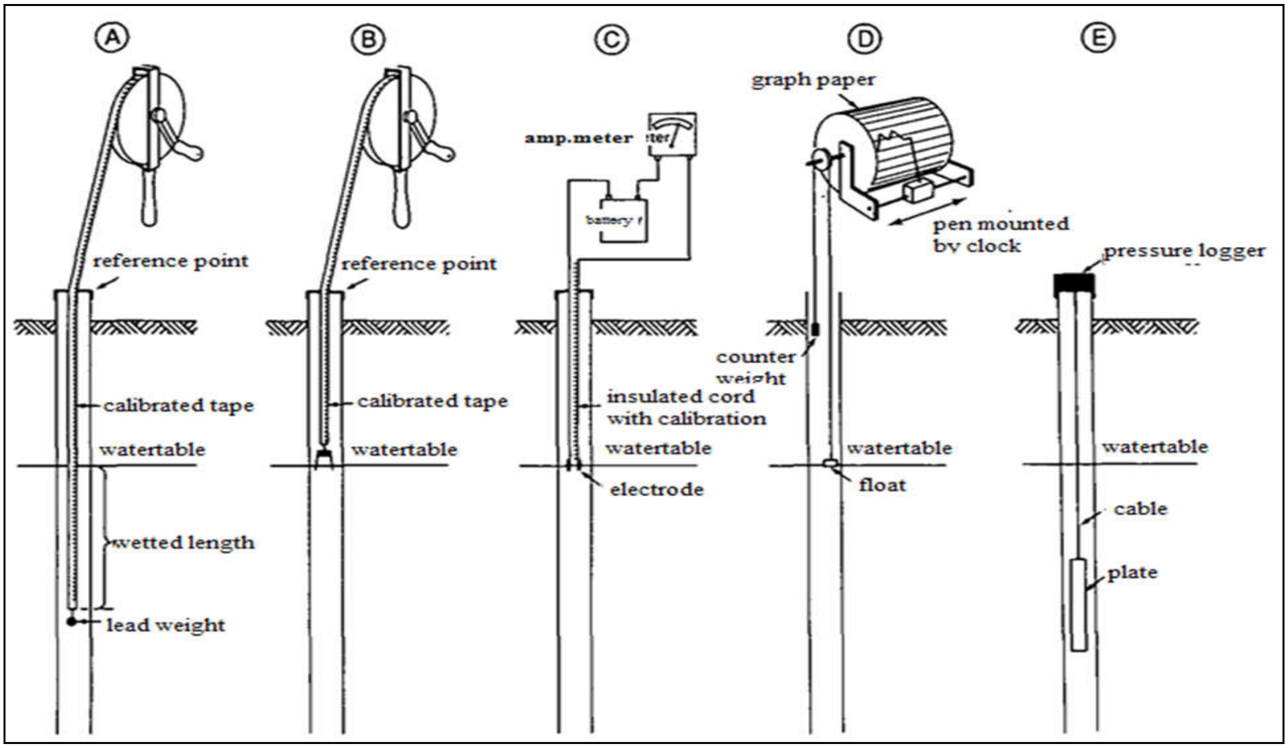

Figure 1. Various ways of measuring depth to water level in wells or piezometers

- With a **mechanical sounder** (Figure 1. B): This consists of a small steel or copper tube (10 to 20 mm in diameter and 50 to 70 mm long), which is closed at its upper end and connected to a calibrated steel tape. When lowered into the pipe, it produces a characteristic plopping sound upon hitting the water. The depth to the water level can be read directly from the steel tape;
- With an **electric water-level indicator** (Figure 1.C): This consists of a double electric wire with electrodes at their lower ends. The upper ends of the wire are connected to a battery and an indicator device (lamp, mA meter, and sounder). When the wire is lowered into the pipe and the electrodes touch the water, the electrical circuit closes, which is shown by the indicator. If the wire is attached to a calibrated steel tape, the depth to the water level can be read directly;
- With a **floating level indicator or recorder** (Figure 1.D): This consists of a float (60 to 150mm in diameter) and a counterweight attached to an indicator or recorder. Recorders can generally be set for different lengths of observation period. They require relatively large pipes. The water levels are either drawn on a rotating drum or punched in a paper tape;
- With a **pressure logger or electronic water-level logger** (Figure 1. E): This measures and records the water pressure at one-hour intervals over a year. The pressure recordings are controlled by a microcomputer and stored in an internal, removable memory block.

At the end of the observation period or when the memory block has reached capacity, it is removed and replaced. The recorded data are read by a personal computer.

Frequency of Measurements

The water table reacts to the various recharge and discharge components that characterize a groundwater system and is therefore constantly changing. Important in any drainage investigation are the (mean) highest and the (mean) lowest water table positions, as well as the mean water table of a hydrological year. For this reason, water- level measurements should be made at frequent intervals for at least a year. The interval between readings should not exceed one month, but a fortnight may be better. All measurements should, as far as possible, be made on the same day because this gives a complete picture of the water table.

Each time a water-level measurement is made, the data should be recorded in a notebook. It is advisable to use pre-printed forms for this purpose. Even better is to enter the data in a computerized database system. Recorded for each observation are: date of observation, observed depth of the water level below the reference point, calculated depth below ground surface (for free water tables only), and calculated water-level elevation (with respect to a general datum plane, e.g. mean sea level) an example is shown in Figure 2. Other particulars should also be noted (e.g. number of the well, its location, depth, surface elevation, reference point elevation).

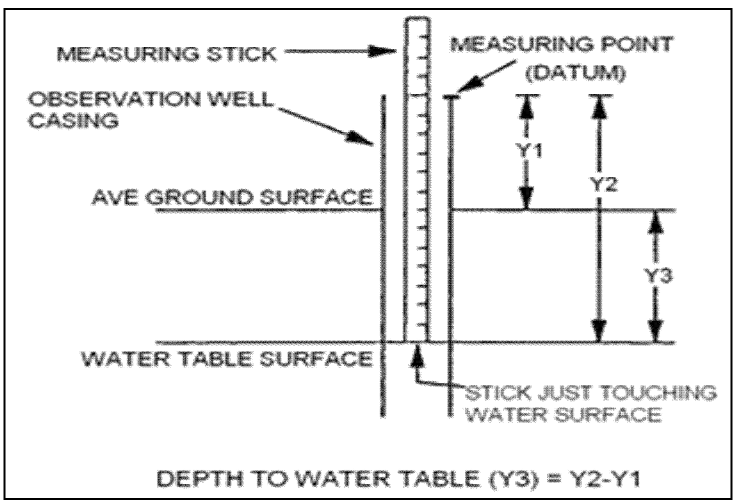

Figure 2. Calculation of the depth to water table from the ground surface

	Groundwater level			
Date	Metres below measuring point	Metres below ground	Metres AOD	Comments
1/8/00	1.85	0.95	2.85	Bottom of well = 2.7m below ground
8/8/00	1.15	0.25	3.55	Heavy rain last two days
15/8/00	1.90	1.0	2.80	Base of well 2.2m below ground. Clean well next visit
22/8/00	1.70	0.80	3.00	Cleaned well. Bottom 2.8m below ground
29/8/00	1.90	1.00	2.80	

Figure 3.Example of a form for recording water levels

1.6. Measuring soil salinity where required

The application of irrigation water means an input of salts. Irrigation water, even if of excellent quality, is a major source of soluble salts. If soil Stalinization is to be avoided, these salts have to be leached out of the root zone by water percolating to the subsoil. This percolation water will cause the water table to rise and has to be drained off because a second source of Stalinization in irrigated area is capillary rise from the water table.

As groundwater is often somewhat saline even a small amount of capillary rise can add greatly to the salinity of the root zone. Draining either natural or artificial is a necessary complement to irrigation.

Soil salinity is the oldest pollution problem. By far the most common cause of high soil salinity is Stalinization, i.e. the accumulation of salts in the upper layers of the soil from some outside source. Frequently, Stalinization involves a reverse of the leaching process, i.e. the return into the upper soil layers of the leached salts, usually carried by water - therefore often termed secondary salinity.

The severity of the salinity problem also depends on the quality of the irrigation water. In this context, the water quality problems can be seen into three (four) categories:

① The concentration of soluble salts – salinity problem also called osmotic problems,

② Relative concentration of sodium to other cations - sodicity problem,
③ Carbonate and bicarbonate concentration as related to the calcium and magnesium concentration – alkalinity problem
④ Concentration of elements that may be toxic to plant – toxicity hazard.

The most common method of measuring soil salinity is to first obtain soil samples (200 to 300 grams of material) at the desired locations and depths, and then dry and grind the samples. The ground-up soil is then placed into a container, and distilled water is added until a saturated paste is made. This condition occurs when all the pores in the soil are filled with water and the soil paste glistens from light reflection. The solution of the saturated paste is removed from the paste using a vacuum extraction procedure. The electrical conductivity and chemical constituents are determined using the extracted solution. This EC measurement is frequently called the salinity of the saturation extract (ECe).

Some laboratories may use dilutions of 1:1, 1:2, 1:5, or 1:10 soil/water ratios. The EC is measured on the extracts of these solutions.

Using a Conductivity Meter

1. Use this to measure salinity of soil or water. An electrical conductivity meter, or EC meter, is the only common device that can be used to measure the salinity of soil. It can also be used to measure the salinity of water.

2. Select an electrical conductivity meter. These devices send an electrical current through the material, and measure how much the material resists the flow of current. The more salts found in the water or soil, the higher the conductivity rating. In order to get an accurate reading for common water and soil types, select an EC meter that can measure up to at least 19.99 mS/cm (19.99 dS/m).

3. If measuring soil, mix it with distilled water. Mix one part soil with five parts distilled water, shaking them together thoroughly. Let the mixture settle for at least two minutes before continuing. Because distilled water has no electrolytes or salts in it, the measurement you get will reflect the quantity of these materials in the soil.

In laboratory conditions, you may be required to let the mixture settle for thirty minutes, or use a more accurate "saturated soil paste" method which can take over two hours.

4. With the cap off, dip the EC meter up to the required level. Remove the protective cap covering the thin end of the EC meter. Immerse this end to the level indicated on the meter, or just far enough that the thin prove is submerged, if no level is indicated. Most EC meters are not waterproof above a certain point, so do not drop the meter underwater.

5. Move the meter gently up and down. This motion removes any air bubbles that are trapped inside the probe. Do not shake vigorously, as this could drive the water out of the probe instead.

6. Adjust for temperature according to the EC meter's instructions. Some EC meters automatically correct for the temperature of the liquid, which can affect conductivity. Wait at least thirty seconds for the meter to make this adjustment, or longer if the water is unusually cold or hot. Other meters have a dial which can be manually adjusted to the correct temperature.

7. Read the display. The display is typically digital, and may give you a measurement in mS/cm (milli Siemens per centimeter), dS/m (deci Siemens per meter), or mmhos/cm (milli mho per centimeter). Fortunately, these three units are equal in size, so you do not need to convert between them.

8. Determine whether the soil salinity is appropriate for your plants. Using the method described here, EC readings of 4 or higher could indicate danger. Sensitive plants such as mango or banana may be affected at an EC as low as 2, while tolerant plants such as coconut may be fine with an EC as high as 8–10.

Note: Whenever looking up EC ranges for a particular plant, find out which method that source used to test the EC. If the soil is diluted with two parts water, or with just enough water to make a paste, instead of the 1:5 ratio used here, the numbers may be significantly different.

9. Periodically calibrate the EC meter. Between each use, calibrate the EC meter by using it to measure an "electrical conductivity calibration solution," purchased for this purpose.

1.7. Identifying and recording factors external to the system, which may cause interference

While rainfall induced erosion is a significant source of sediment, irrigated agriculture may also cause erosion directly through application of irrigation water, or indirectly through sub-optimal land management. Sediment contained in surface runoff from agricultural lands may carry P and certain pesticides to surface waters where they may contaminate the food chain or affect other beneficial uses of water. Excess sedimentation can also degrade the stream environment, diminish the health and diversity of fish and wildlife habitats, limit recreational uses and add to the costs of flood management and drinking water treatment.

Because subsurface drainage water is primarily groundwater, it is not expected to carry significant amounts of sediment. No data are readily available on sediment loads in subsurface drainage water, but sediment from subsurface drains is not normally expected to be a significant issue. However, from time to time a subsurface drain line will be poorly constructed, or a drain line will fail after construction and a significant amount of sediment will collect in the drains. This will then either plug the drains so they will not function or be discharged at the drain outlet. Moreover, in certain soils, drains with inadequate or improperly installed envelopes can accumulate fine sands and silts and these sediments will eventually either plug the drains or be discharged with the drainage water. In any event, the normally relatively sediment free water from subsurface drains might erode the banks of unlined surface drains and increase the sediment load of the drainage water.

Erosion is a natural geologic process. However, although sediment cannot be eliminated, its movement can be controlled to reasonable levels.

Factors external to the system that cause interference may include:

pests and vermin (tortoises, yabbies, ants, spiders, snails, rabbits, hares, foxes, wasps, rose weevil, earwigs, snakes, carp, pigs, wallabies, eels, rats, mice, kangaroos, dogs, cats, parrots), organic (leaves, slime, weeds, algae, sticks, crop residue), weather, channel regulators (if applicable), fire, mechanical damage (if applicable), power spikes, power failures, storm runoff/system breakage, thatch, runoff from adjacent areas and rising water tables.

Self-Check 1	**Written Test**

Name: _________________________ Date: _______________

Directions: Answer all the questions listed below.

1. Describe the Methods of water table measurement? (5 points)
2. Write at least five drainage performance indicators? (10points)
3. Why do we measure tail water quality? (3points)
4. Why do we measure soil salinity? (2points)

Note: satisfactory Rating-20 and above pts.   Unsatisfactory Rating-below 20 pts.

You can ask your teacher for the copy of the correct answers

INFORMATION SHEET#2	Monitor supply of equipment and spare parts

2.1. Recording supply and part usage

Recording Services & Supply is a full service retail business supplying the needs of the Recording, Industrial, Agricultural technology and Educational world.
When we are going to record supply and part usage we have to consider ourselves more than just a sales company. So we have to record all supply and parts used for a given drainage system.
This helps us to simplify our work when ordering some parts in case of damages in a given system. Though the supply and parts differs from system to system or brand to brand recording format can be same.

Table:-Sample recording format for supply and parts usage.

No	Item	Description	Quantity	Unit(in)
1.	Perforated pipe	150 mm in Ø	100	Meter
2.	Perforated pipe	100 mm in Ø	150	Meter
3.	Fitting	T, Y….	10	Number
4.	Fitting	90^{o}	12	Number
5.	Concrete pipe	semi circular	30	Number

Contemporary drainage materials

Contemporary drainage materials may be classified into drainpipes and their accessories, envelopes and auxiliary drain structures. Design criteria for drainpipes are now well established and unambiguous, both with respect to pipe size, geometry and perforation pattern, as well as to the pipe material.

- ✓ When a subsurface drain is installed, some soils may require measures to protect the drainpipe from soil particle entry.
- ✓ Due to the drag force of the water, soil particles or aggregates may be carried into the pipe through the perforations in the pipe wall.

- ✓ This process can never be prevented completely, but it may substantially be slowed down, or stopped by use of external porous material around the pipe.
- ✓ The porous device, designed to do this is called ‘drain envelope’, but has often erroneously been referred to as a ‘drain filter’. The functioning of a filter is such that it retains soil material as a result of which it may become blocked or clogged, or causing then surrounding soil to become clogged.
- ✓ A good ‘drain envelope’, on the contrary, restricts sediment inflow, provides material of high hydraulic conductivity and structural stability close to the drain, and does not clog with time.

Problems with drainage materials:-

Installing drains in the traditional way, which is by manual labor, cannot be easily done under adverse conditions such as shallow groundwater tables or general wetness. This restriction usually prevented poor drainage performance and ensured a long service life for manually installed systems. Since the introduction of mechanization the installation speed has risen drastically and control of the quality of the work (e.g. grade line accuracy) became more difficult, particularly after the introduction of the flexible corrugated pipe.

Installation under adverse conditions also became possible and proved hard to monitor, because contractors and constructing agencies try to keep their machines working as long as possible, due to the high fixed costs of installation machinery.

Some of these problems were introduced by drain installation in very wet soils, and by the introduction of new types of envelopes not suitable for use in all types of soils.

Application of a drain envelope largely depends on physical soil properties. In practice however, availability and cost strongly affect the selection process. Notably in arid areas, where drainage systems are installed for the control of water logging and salinization, the need to find affordable alternatives for potentially excellent yet expensive gravel envelopes has become increasingly urgent.

2.2 Checking purchases of spare parts and materials

Spare parts are system changeable parts, tools, equipment and supporting parts which are needed to keep the system reliability above the desired level.

<u>Points to remember while purchasing of system component parts are:-</u>

- ✓ Proper specification

- ✓ Invite quotations from reputed firms
- ✓ Comparison of offers based on basic price, freight & insurance, taxes and levies
- ✓ Quantity & payment discounts
- ✓ Payment terms
- ✓ Delivery period, guarantee
- ✓ Vendor reputation
  - o (reliability, technical capabilities, Convenience, Availability, after-sales service, sales assistance)
- ✓ Short listing for better negotiation terms
- ✓ Seek order acknowledgement

2.3 Reporting parts requirements outside of budget constraints

After determining the budget constraint we have to check weather our budget can buy ordered well or not we have to report parts and equipments outside the budget constraints for concerned body. This helps the management to take another alternative. Reporting could be done by using different formats.

2.4 Recording purchases and orders

Ordering includes the timing for make an order and purchase the right quantity of spare parts that reduces the cost. They make order when a specific spare part under the minimum level, where this minimum level depend on many factors which are divers from part to part.

Creating a Purchase Order

A purchase order serves a simple purpose: It tells some vendor that you want to purchase some item. In fact, a purchase order is a contract to purchase. Many small businesses don't use purchase orders. But when they grow to a certain size, many businesses decide to use them because purchase orders become permanent records of items that you have ordered. What's more, using purchase orders often formalizes the purchasing process in a company. For example, you may decide that nobody in your firm can purchase anything that costs more than $100 unless they get a purchase order. If only you can issue purchase orders, you've effectively controlled purchasing activities through this procedure. To create purchase orders, we have to follow the following steps :(this is only when we have soft ware access and for larger projects)

1. Tell Quick Books that you want to create a purchase order by choosing Vendors --> Create purchase order

Quick Books displays the Create Purchase Orders window.

Note that if the Vendors menu doesn't supply a Create Purchase Orders command, QuickBooks doesn't know that you want to create purchase orders.

2. Use the Vendors menu drop-down list box to identify the vendor from whom you want to purchase the item.
   The Vendor drop-down list box lists each of the vendors in your Vendor List.
3. (Optional) Classify the purchase using the Class drop-down list box.
4. (Optional) Provide a different Ship to address in the Ship to drop-down list box.

The Ship to drop-down list box displays a list of all your customers, vendors, and employees. You select the ship to address by selecting one of these other names. After you select an entry from the Ship To list, QuickBooks fills in the Ship To address box with the appropriate information.

The Create Purchase Orders window supplies some standard and, hopefully, familiar buttons and boxes: Previous, Next, Print, Find, Spelling, History, and Template.

5. Confirm the purchase order date.

Initially, QuickBooks puts the current system date into the Date box. You should, however, confirm that the date that QuickBooks enters as the purchase order date is correct. This is the contract date. Often, the date sets contractual terms — such as the number of days that the item needs to be shipped within.

6. Confirm the purchase order number.

The purchase order number, or P.O. number, uniquely identifies the purchase order document. QuickBooks sequentially numbers purchase orders for you and places the next number into the P.O. No. box. The guess that QuickBooks makes about the right purchase order number is usually correct, but if it isn’t correct, enters the replacement number.

7. Confirm the vendor and ship to information.

The Vendor block and the Ship to block identify the vendor from whom you are purchasing the item and the ship to address to which you want the vendor to send the shipment. This information should be correct if your vendor list is up-to-date and you have correctly used the Ship to drop-down list box to identify, if necessary, an alternative Ship to address. Nevertheless, confirm that the information shown in these two address blocks is correct. If the information isn't correct, of course, fix it. You can edit address block information by selecting the incorrect information and then retyping whatever should be shown.

8. Describe each item that you want to order.

You use the columns of the Create Purchase Orders window to describe in detail each item that you want to order as part of the purchase. Each item goes on its own row. To describe an item that you want to purchase from the vendor, you provide the following bits of information:

- ✓ ***Item***: The Item column lets you record the unique item number for the item that you want to buy. Remember that items need to be entered, or described, in the Item List. The main thing you need to know about the Item List is that anything that you want to show on the invoice — or, for that matter, on a purchase order — needs to be described in the item file.
- ✓ ***Description***: The Description column shows the description for the item that you select.

  You can also edit the Description field so that it makes sense to customers or vendors.

- ✓ ***Qty***: The Qty column lets you identify the quantity of the item that you want. You enter the number of items that you want in this field, obviously.
- ✓ ***Rate:*** The Rate column lets you enter the price per unit or rate per unit for the item. Note that QuickBooks uses different labels for this column depending on the type of business that you've set up.
- ✓ ***Customer***: The Customer column lets you identify the customer for whom the item is being purchased.
- ✓ ***Amount***: The Amount column shows the total expended for the item. QuickBooks will calculate the amount for you by multiplying the quantity by the rate (or price). You can also edit the column amount. In this case, QuickBooks adjusts the rate (or price) so that quantity times rate always equals the amount.

You need to enter a description of each item that should be included on the purchase order. This means, for example, that if you want to order six items from a vendor, your purchase order should include six lines of information.

9. Print the purchase order.

You will want to print the purchase order. The purpose of recording a purchase order into QuickBooks is to create a formal record of a purchase. You almost always will want to transmit this purchase order to the vendor. The purchase order tells the vendor exactly what you want to purchase and the price that you are willing to pay. To print the purchase order, you can click the Print button. You can also print purchase orders later in a batch; to do so, save all the purchase orders that you want to create, and then choose the File --> Print Forms --> Purchase Orders command.

10. Save the purchase order.

To save your purchase order, click either the Save & Close button or the Save & New button. If you click the Save & New button, QuickBooks saves that purchase order and redisplays an empty version of the Create Purchase Orders window so you can record another purchase order. But if we have no an access of soft ware and our project is small and if we can get the parts and equipments by local suppliers we may not follow the above steps. In this case simply we have to prepare table →list item →describe item →express the quantity → express the unit and we have to write the reference and day for the order. And by using this reference and day we have to record every and each order and in addition to this we should also record purchase done with respect to each order.

Self-Check 2	**Written Test**

Name: __________________________ **Date:** ________________

Directions: ***Answer all the questions listed below.***

1. Write the criteria to purchasing drainage materials?(5pt)
2. What is purchasing order means?(5pt)
3. Write the steps to follows to creates purchasing order?(5pt)
4. Describes each items that you want to Purchas the component parts of drainage materials?(5pt)

Note: **Satisfactory rating – 20 points** **Unsatisfactory – below 20 points**

Operation Sheet	**Record supply part system performance**

Objective: To identify the spar part of drainage materials and record and report the system performance to concerned body.

Materials, Tools and equipments used

- ✓ Paper
- ✓ Pencil
- ✓ Pen
- ✓ Flash
- ✓ CD
- ✓ Computer

Procedures

The following procedures should be taken into account to record supply parts and component part of drainage materials using the table below:

***Table:-Sample recording format for supply and parts usage*.**

No	Item	Description	Quantity	Unit(in)
1.				
2.				
3.				
4.				
5.				

LAP Test/ Job Sheet	Practical Demonstration

Name: ______________________________ Date: ________________

Time started: ________________________ Time finished: ________________

Instructions:

1. You are required to perform the following activity:

- Request your teacher to arrange materials, tools and equipments used in Record supply part system performance work, in order to handle materials and equipment.
- Request your teacher for evaluation and feedback.

INFORMATION SHEET#3	Monitor quality of work

3.1. Interpreting and checking instructions organizational standards of work.

Relevant: Relevant information applies to the interests of the individuals who use it for the decisions they are facing. It should reduce a person's uncertainties while facilitating choice and planning.

Organizational structure and processes

You may have a personnel or organizational chart, often available from the human resources department, which illustrates graphically the position titles and the names of the staff who hold those positions in your organization. These charts are a useful tool when you are first learning the names of the people with whom you work. It is also a useful tool for knowing who to contact for a specific query or problem.

3.2: Obtaining required clarification of work instructions

The following are some of the work instruction of the drainage used according to OHS requirements. Some of these work instruction may include: -

- Selection of hand tools and equipment to perform work.
- Process of assembling and using mechanical equipments according to manufacturer's instructions and OHS requirements.
- How to use manual lifting and handling techniques according to OHS requirements.
- Ways of obtaining access to drainage lines to allow blockage to be cleared.
- Methods of clearing blockage sections and replacing blocked according to enterprise, environmental and
- Ways of testing drainage line to confirm blockage is cleared from pipe system.
- How to repair/ reseal drainage line to permit normal use.
- Advising relevant persons/authorities that repairs have been completed and the drainage line has been commissioned for use.

3.3: Monitoring and adjusting work according to requirements

Understanding job roles and responsibilities

When you start work in an organization, it is likely you will have a job that requires you to work with other staff members. You may be part of a project where the team has a specific time frame to achieve a goal and each team member is responsible for completing specific tasks. Alternatively, you may find yourself working as part of a team where specific ongoing tasks need to be completed.

Most positions in an organization have an accompanying written position description, also known as a job description. The position description document outlines and explains a number of important points related to the role. It includes:

- General tasks to be performed
- Responsibilities of the position
- Who the position reports to
- Skills and competencies required for the position
- Qualifications required for the position
- Hours of work to complete the tasks
- Salary and entitlements of the position.

However, as the employee of an organization, you will also have duties and responsibilities that are over and above the general tasks associated with your role. These duties and responsibilities are designed to ensure the effectiveness, safety and protection of yourself, your organization and your fellow workers. Your general responsibilities will vary depending on the type of organization, but will include such things as:

- Following organizational policies and procedures
- Complying with the code of conduct
- Complying with occupational health and safety (OHS) guidelines
- Promoting good workplace relations.

INFORMATION SHEET#4	Record and report system performance status

4.1: Recording water quality in accordance with enterprise procedures.

There are several factors to consider when determining the opportunities for and constraints on the safe use, treatment and disposal of agricultural drainage water.

- Information and data desired at the site of drainage water production include: rate of drainage water production per unit area, chemical concentration of constituents of concern, and the rates of mass emission.
- Drainage water management requires additional information and data on drainage water quality and its suitability for the intended water uses as well as an understanding of environmental and health concerns.
- Upstream drainage water management affects the needs and water quality requirements of downstream water users.

Drainage water quality

The expected differences in quality in the return flow are described relative to the supply water because actual concentrations in supply waters vary. The operational spill waters (bypass water) from distribution conveyances are not expected to differ much from the quality of the supply water except for some pickup or deposition of sediments. In contrast, surface runoff or irrigation tail water tends to pick up considerable amounts of sediments and associated nutrients, phosphorus in particular, as well as water-applied agricultural chemicals such as demand (BOD).

Table_: ***Expected quality of characteristics of irrigation return flow as related to applied irrigation waters.***

Quality parameter	Optional spills	Irrigation tail water	Subsurface drainage
General quality	0	+	++
Salinity	0	0,+	++
Nitrogen	0	0,+,++	++,+
Oxygen demanding	0	+,0	0, -, --
Sediment	+, -	++	--

Pesticide residues	0	++	0, -, +
Phosphors	0	++	0, -, +

0 not expected to be much different than the supply water

+, - slight increase/pickup or decrease deposition expected

+ + expected to be significantly higher due to concentrating effects, applications of agricultural chemical, erosion losses, pick up of natural geochemical sources, e.t.c

-- expected to be significantly lower due to filtration, fixation, micro biological degradation, e.t.c

Subsurface drainage is enriched in soluble components such as dissolved mineral salts and nitrates, very low in sediments, whereas other quality parameters are similar to the irrigation water. These changes in water quality of irrigation return flow depend on a number of factors including irrigation application methods, soil properties and conditions, application of agricultural chemicals, hydrogeology, drainage system, climate, and farmers' water management.

In many regions of the world, municipalities and industries discharge wastewater into open drains initially intended for the conveyance of only agricultural drainage and storm water. In developing countries especially, municipal and industrial wastewater is often insufficiently treated before disposal into such open drains.

The result is a risk that agricultural drainage water quality might be seriously contaminated with microbes, pathogens, toxic organics and trace elements including heavy metals. Knowledge of the composition of the drainage effluent and the ability to predict changes in the composition as a result of changes in crop, irrigation or drainage water management practices are important in the planning and management of drainage water.

Characteristics of drainage water quality

Salts and major ions

The major cations and anions making up salinity are sodium, calcium, magnesium, potassium, bicarbonate, sulphate, chloride and nitrate. A lumped salinity parameter is frequently used such as EC in decisiemens per metre (dS/m) or TDS in milligrams per liter. The water quality of surface runoff typically deviates little from the composition of the irrigation water even if it flows over soils with visible salt crusts. On the other hand, deep percolation displaces salts accumulated in the soil profile from natural chemical weathering, blown in by salt dust, as well as evapoconcentrated salts derived from the applied irrigation water.

Thus, the salt content of the collected subsurface drainage water mainly reflects the salinity characteristics of the soil solution, which in turn is influenced by soil parent material, salinity of the shallow groundwater and salts brought into the soil with irrigation water. In many places, the drainage water composition is further influenced by the mineral composition of deep groundwater which is intercepted by the drains.

4.2 Recording water table depth, soil moisture and salinity.

- In previous chapters we have seen how to measure water table depth and salinity of soil so after measuring any parameter we have to record it.
- Soil moisture is always being subjected to pressure gradients and vapor pressure differences that cause water to move. Thus it cannot be constant at any pressure. But for particularly significance in agriculture, same soil moisture constants are used. These are;
  - Saturation capacity
  - Moisture equivalent
  - Available water
  - Field capacity
  - Permanent writing point

Measurement of soil moisture

Soil moisture Measurements are important in the suitable scheduling of irrigation and estimating the amount of water to be applied in each irrigation and to estimate evapo-transpiration.

There are also many experimental situations where careful measurement and control of soil moisture is necessary if the results of investigation on soil – plant - water relationships are to be interpreted properly and evaluate the performance of drainage system.

☞ The principal methods of expressing soil moisture are:-

I. By the amount of water in a given amount of soil and,

II. The stress or tension under which the water held by the soil.

Measurement of soil salinity

Salinity is a measure of the concentration of soluble salts in the soil. The most common salt is sodium chloride: however, others include bicarbonates, sulphates and carbonates of calcium, potassium and magnesium. Some salts are useful, e.g. many fertilizers are in a salt form, but too much salt of any kind is detrimental to plants and other organisms.

Equipment

Portable handheld EC meter, plastic jars with screw-on lids, distilled or rain water, thermometer, recording sheet and pen.

Timing

This measurement is best undertaken when soil sampling is conducted. Make sure any surface soil samples are taken within the irrigation wetting pattern, although it may also be a good idea to take some mid-row samples as well. Salinity in the root zone often comes from a saline water table; therefore the subsoil, and possibly a deeper level soil sample, should also be measured.

Method:

1. Take three surface soils and three subsoil samples from each site (as described in points 1-5 the Taking soil samples activity guide in this Vitinote series). Make sure surface soil and subsoil are not combined so that they can be analyzed separately.
2. Crush large aggregates and remove any gravel so that you have a fine mix to test.
3. Make sure to refer to instrument instructions and periodically calibrate your EC meter.
4. Unscrew jar lid and fill the lid level with soil. Do not compress the soil. Pour into jar*.
5. Add 5 jar lids of distilled water and screw lid on tight. Shake periodically over one hour.
6. Let the mixture stand undisturbed for half an hour or a little longer if the suspension is not clear. If the suspension cannot be clarified, the measurement can still be taken in the knowledge that EC will be slightly overestimated (0.01 to 0.03 dS/m). This error is acceptable for a field estimate that can be used to decide whether to submit samples for saturation extract analysis.
7. Rinse the EC meter electrodes in rain or distilled water and dry gently with a tissue.
8. Take a reading by immersing the electrode in the water above the settled soil as per manufacturer instructions. Make sure the electrodes are fully covered. Take care to minimize electrode contact with soil at the bottom of the jar.
9. Allow reading to stabilise. Record EC value.
10. Using thermometer record water temperature.

11. Rinse electrode on the EC meter between each reading.

Interpreting and recording results

If the soil water solution was not at 25°C at the time of measurement then an approximate correction has to be applied (unless the meter has an automatic correction— check the manufacturer's instructions):

- Increase the EC value by 2% for each degree above 25°C.
- Decrease the EC value by 2% for each degree below 25°C.

The tables below indicate the salinity hazard for grapevines measured as described above ($EC_{1:5}$) and also as recorded by laboratory soil-water saturation extract tests (EC_{se}).

Table_: Hazard rating of differing $EC_{1:5}$ levels at different soil types.

Salinity Hazard	Measured as $EC_{1:5}$ (dS/m)			Effect on vines
	Sandy Loam	Loam	Clay	
Non-saline	<0.15	<0.17	<0.4	None
Slightly saline	0.16-0.3	0.18-0.35	0.41-0.8	Own-rooted will be affected
Moderately saline	0.31-0.60	0.36-0.75	0.81-1.6	Some rootstocks may tolerate
Very saline	0.61-1.2	0.76-1.45	1.6-3.2	Growth greatly reduced
Highly saline	>1.2	>1.45	>3.2	Vines die

4.3 Documenting strategies of the drainage system.

While some of the world's most productive agriculture is on artificially drained soils, drainage is increasingly perceived as a major contributor to detrimental off□site environmental impacts.

However, the environmental impacts of artificial or improved agricultural drainage cannot be simply and clearly stated. The mechanisms governing the hydrology and loss of pollutants from artificially drained soils are complex and vary with conditions prior to drainage improvements and other factors: land use, management practices, soils, site conditions, and climate.

The purpose of documenting strategies is to present a review of research on the hydrologic and water quality effects of agricultural drainage and to discuss design and management strategies that reduce negative environmental impacts. Although research results are not totally consistent, a great majority of studies indicate that, compared to natural conditions, drainage improvements in combination with a change in land use to agriculture increase peak runoff rates, sediment losses, and nutrient losses.

Nevertheless, sediment and nutrient losses from artificially drained croplands are usually small compared to cropland on naturally well drained uplands. Increasing drainage intensity on lands already in agricultural production may have positive, as well as negative, impacts on hydrology and water quality. For example, increasing the intensity of subsurface drainage generally reduces loss of phosphorus and organic nitrogen, whereas it increases loss of nitrate nitrogen and soluble salts. Conversely, increasing surface drainage intensity tends to increase phosphorus loss and reduce nitrate nitrogen outflows.

Improved drainage is required on many irrigated, arid lands to prevent the rise of the water table, water logging, and salinity buildup in the soil. Although salt accumulation in receiving waters is the most prevalent problem affecting downstream users, the effect of irrigation and improved drainage on loss of trace elements to the environment has had the greatest impact in the U.S.

These detrimental effects often can be avoided by identifying a reliable drainage outlet prior to construction of irrigation projects. Research has shown that management strategies can be used to minimize pollutant loads from drained lands. These strategies range from the water table management practices of controlled drainage and sub irrigation, to cultural and structural measures. For example, controlled drainage has been found to reduce nitrate nitrogen and phosphorus losses by 45 and 35%, respectively, in North Carolina.

Self-check#3	**Written Test**

Name: ___________________________ Date: ________________

Directions: Answer questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Describe the principal methods of expressing soil moisture?(6 point)
2. Fill the quality criteria for the basic conditions of optional spills, irrigation tail water, and subsurface drainage? (14 point)

Quality parameter	**Optional spills**	**Irrigation tail water**	**Subsurface drainage**
General quality	__________	__________	__________
Salinity	__________	__________	__________
Nitrogen	__________	__________	__________
Oxygen demanding	__________	__________	__________
Sediment	__________	__________	__________

Pesticide residues	________	________	________
Phosphors	________	________	________

Note: **Satisfactory rating – 10 points** **Unsatisfactory – below 10 points**

Operation Sheet	Measuring and recording soil salinity

Objective:- To create basic candidates knowledge and skill on measuring, analysing, interpretation and recording soil salinity.

Materials, Tools and equipments used

- ✓ Portable handheld EC meter,
- ✓ Plastic jars with screw-on lids,
- ✓ Distilled or rain water,
- ✓ Thermometer,
- ✓ Recording sheet and pen.

Quality precautions':

- Use the appropriate PPE
- Betake care from damages and malfunctions of equipments

Procedures

The following procedures should be taken into account to:

1. Take three surface soils and three subsoil samples from each and crush large aggregates and remove any gravel so that you have a fine mix to test.
2. Unscrew jar lid and fill the lid level with soil. Do not compress the soil. Pour into jar*.
3. Add 5 jar lids of distilled water and screw lid on tight. Shake periodically over one hour.
4. Let the mixture stand undisturbed for half an hour or a little longer if the suspension is not clear. If the suspension cannot be clarified, the measurement can still be taken in the knowledge that EC will be slightly overestimated (0.01 to 0.03 dS/m).
5. Rinse the EC meter electrodes in rain or distilled water and dry gently with a tissue.

6. Take a reading by immersing the electrode in the water above the settled soil as per manufacturer instructions. Make sure the electrodes are fully covered. Take care to minimize electrode contact with soil at the bottom of the jar.
7. Allow reading to stabilise.
8. Record EC value, using thermometer record water temperature.
9. Interpret the result and categorize the hazard rating of the soil

Quality criteria

- Make sure to refer to instrument instructions and periodically calibrate your EC meter.
- Rinse electrode on the EC meter between each reading.