AGRICULTURAL TVET COLLEGE

MODEL TTLM

SMALL SCALE IRRIGATION DEVELOPMENT LEVEL-III

Learning Guide- 11

Unit of competency: Measure troubleshoot irrigation and drainage System

Module Title: Measuring troubleshoot irrigation and drainage System

LG code: AGR SSI3M 11 LO1-LO5

TTLM Code: AGR SSI3 TTLM 1218V1

Nominal Duration: 40Hr

Instruction sheet	Learning guide- 11

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

- Plan job
- Determine access to irrigation and drainage lines
- Locate & identify faulty components and blockages
- Inspect site
- Shut down/isolate component

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 –

- Select and check equipment
- Select and use appropriate personal protective equipment's
- Determine plan of plumbing system and locating access points
- Carry out digging
- Determine irrigation system and component function
- Check and review monitoring and maintenance records
- Carry out operational tests
- Identify and document faulty components and blockages
- Inspect site to locate blocked section
- Determine work requirements and responsibility for repair
- Report and record repair activities
- Apply shut down sequence and isolation procedures
- Verify safe shut down or isolation
- Install safety/security lock off devices and signage

Learning Activities

1. Read the specific objectives of this Learning Guide.
2. Read the information written in the "Information Sheets.

3. Accomplish the “Self-check” at the end of each learning outcomes.
4. IfyouearnedasatisfactoryevaluationproceedtothenextInformationSheet”.However, if you acting is unsatisfactory, see your teacher for further instructions or go back to the Learning Activity.
5. Submit your accomplished Self-check. This will form part of your training portfolio
6. Follow the steps and procedure list on the operation sheet
7. Do the “LAP test” and Request your teacher to evaluate your performance

Information Sheet-1	**Plan job**

Introduction

Troubleshooting is a form of problem solving often applied to repair failed product or process. It is a logical, systematic search for the source of a problem in order to solve it and make the product or process operational again.

Troubleshoot irrigation system is a logical form of analyzing and solving the problem in irrigation system to replace or repair faulty components. It uses systematic procedures to identify and search for the source of problem and solve the problem (give solution).It uses system specification and technical /manual to solve the problem with clear understanding of the system.

Importance of trouble shoots irrigation system

- It made the system operational again because replace or repair faulty component.
- Is needed to identify the symptoms of problem and give possible solution.
- To prevent the unnecessary replacement of the component.

Job Plan is a systematic and structured action plan for conducting and documenting the results of the troubleshooting irrigation and drainage system analysis. The level of analysis conducted and effort expended for each phase should be scaled to meet the needs of each individual project. So that, we are expected to prepare an appropriate job plan before carrying troubleshooting irrigation and drainage system

1.1 Selecting and checking equipment

Equipment is an item that is primary prepared/manufactured to perform a specific task. Equipment must be selected, checked and maintained correctly to reduce the risk of accidents or damage to health and to meet health and safety requirements. Under health and safety law, employers have a duty to minimize risks to employees. Using personal protective equipment (PPE) is one of the safety measures, and is often regarded as the last resort, supplementary to control measures, in providing protection to the employees. Despite the use of PPE is often considered as a passive way to control risk, with thoughtful management, a very proactive PPE programmed can be developed.

Assess and reduce the risks of using workplace equipment. It covers the safeguards you need to put in place to prevent injury, the maintenance required and the rules that cover the disposal of equipment. Check if personal protective exemptions apply. The Personal Protective Equipment (PPE) at Work Regulations ordinary work clothes and uniforms which do not protect the health and safety of the wear equipment used .portable devices for detecting and signaling risks and nuisances

In establishing the appropriate safety measures, the primary consideration is always in the following in descending order of priority:

- ✓ Eliminate the risk, for example, by using other less dangerous chemicals or doing the job in a different way.
- ✓ Control the risk at source by various engineering control measures and systems of work, such as enclosure, exhaust ventilation.
- ✓ Only when the above measures cannot adequately control the risks, should the use of PPE be considered.

The PPE regulations also do not apply where separate legislation already obliges employers to provide personal protective equipment. These are the:

- ➢ Construction (Head Protection) Regulations
- ➢ Control of Noise at Work Regulations
- ➢ Control of Lead at Work Regulations
- ➢ Control of Asbestos Regulations
- ➢ Control of Substances Hazardous to Health Regulations

- Ionizing Radiations Regulations

Hazards from Work Equipment

Work equipment can cause injury in five main ways:-

Entrapment – where parts of the body could be caught in parts of equipment.

Impact – where the body could be crushed by moving parts or by items being processed.

Contact – where the body could touch sharp edges, hot surfaces or abrasive surfaces.

Entanglement – where hair, clothing or jewelers could get caught in parts of a machine.

Ejection – where parts of equipment or materials being worked on could fly off and hit the body.

- ✓ **Selecting and Purchasing Equipment**

The safest and most suitable work equipment should be selected for the work to be done.

Good design and construction can ensure the safety of machines by:

- Providing suitable operating controls which are easy to see and use and which prevent the equipment being turned on accidentally.
- Having a suitable emergency stop control.
- Failing to safe when something goes wrong.
- Minimizing risks during maintenance and cleaning as well as normal operation.

During the selection and purchase stage make sure that you obtain technical information and compare this to other equipment; check that the equipment has a CE mark (i. e complies with European standards for design and manufacture); that you satisfy yourself you have obtained all the relevant safety information and that you ensure that there will be

Measuring equipment may include:

- Tensiometers,
- Probe tubes,
- Flow meter,
- Catch cans and
- Pressure gauge,
- Test wells and
- Fault meter.

Mechanical Equipment may also include

- Mechanically operated drain clearing machines and attachments and

- Manually operated drain clearing tools and attachments.

1.2 Selecting and using appropriate personal protective equipment

PPE means equipment that is intended to be worn or otherwise used by a person at work and that protects the person against one or more risks arising from chemical or other operations to the person's safety or health. It includes any addition or accessory to the equipment designed to meet a similar objective.

Situations where use of suitable PPE may be necessary are:

- where it is not technically feasible to achieve adequate risk control by other means (in this case, exposure shall be reduced as far as practicable by other measures and
- Then, in addition, suitable PPE should be used to secure adequate risk control);
- where PPE is necessary to safeguard safety and health until such time as adequate
- Risk control is achieved by other means, for example, where urgent action is required
- Due to plant failure; or
- During routine maintenance operations where the infrequency and small number of people involved may make control measures not reasonably practicable.

Examples of PPE for use and handling of equipment or chemical uses PPE. They can be roughly classified into the following categories:

- Protective clothing;
- Hand and foot protective gears;
- Eye and face protective equipment; and
- Respiratory protective equipment.

PPE program is an integral part of a comprehensive safety management system. It is a systematic approach for selecting the appropriate PPE, as well as ensuring that the PPE is properly used and maintained. The basic components of a PPE program and the essential steps for developing the program include the following:

- PPE assessment and review
- Selection and provision of suitable PPE
- Provision of information, instruction and training to employees
- Monitoring the proper use of PPE and its effectiveness in controlling risks
- Maintenance and accommodation of PPE and

- Reviewing and revising the PPE program regularly and if there has been a significant change in the work to which it relates.

OHS Requirements may include

- Manual handling
- Outdoor work (including protection from solar radiation, dust and noise)
- Selection
- Use and maintenance of relevant personal protective clothing and equipment
- Care and safe use of hand tools and
- Safe systems for the prevention of electrical injury.

Record keeping

A PPE program cannot be effectively implemented and maintained in the absence of a good record keeping system. The benefits of record keeping are:

- Records facilitate more systematic and objective assessment.
- Keeping records of training, as well as distribution of PPE and instructions to employees enhance compliance with in-house safety rules regarding PPE.
- The rationales of the decision previously made on the PPE are traceable from the records. This greatly helps the subsequent review of the PPE program.

Self-Check-1	**Written Test**

Name: _____ Date: _____

Directions: Answer all the questions listed below.

1. What is equipment? (5 points)
2. What is PPE's? What is the objective of selecting and using PPE's(5 pt)
3. List and explain some of PPE's used for handling of equipment (5 pt)
4. List and explain benefit of keeping record? (5pts)
5. Identify and explain cause of injury in work? (4 pts)

Note: satisfactory Rating-12 and above pts. Unsatisfactory Rating-below 12 pts.

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

Information Sheet-2	Determine access to irrigation and drainage lines

2.1 locating plan of plumbing system

You should understand the scale of the plans and be able to read and understand the map legends, symbols and guideline notes. However, you should understand that plans may only give an indication of the location, configuration (how they are organized) and number of plumbing systems present. You cannot rely on plans for accurate distance measurement.

Assume there are more plumbing systems than you know about always assume that there are more buried plumbing systems present than you have located. You should understand that service.

Emergency plumbing problems don't always occur where they are easy to reach. Leaks, breaks, clogs and other troubles with underground lines have the potential to be as expensive to fix as they are difficult to find and reach**.**

Locating plumbing lines is key to repairing underground lines. Without a reliable way to find buried lines, your plumber may spend unnecessary time and energy digging and searching.

The best method for finding underground plumbing lines, drains and related fixtures is a two-step process using cameras and ground-penetrating sonar or radar.

- ✓ First, the plumber sends a camera on a wire or line into the pipe or drains system. He may start from a point inside your home or from a better access point outside. By noting which direction the wire travels, the plumber can get a general idea of the underground location of the pipes. The camera allows the plumber to see damage, rust, scale, foreign matter buildup, tree root penetrations or other problems. He can identify the issue causing the problem, such as a break or a crack.
- ✓ Once the problem has been found, the plumber can use a sonar device or ground-penetrating radar to locate the lines and map their layout and position. As the sonar or radar equipment is rolled along the ground, it sends signals into the earth that detect

where the pipes are buried. The device indicates the location on a mapping display, allowing the plumber to dig up the lines without wasting time.

- ✓ In some cases, the plumber may send an electronic transmitter into the pipes. This transmitter can be detected with electronic above-ground locators, which pinpoint the location of the plumbing lines.

2.2. Carrying out digging without damaging structure and existing fixtures

When working near underground cables, structures there are steps to follow which can help you reduce the risk of having an accident and damaging of structure. These steps are covered in detail in the 'Code of Practice for Avoiding Danger from Underground Services.

The main ways you can make sure that you will have a safe system of work. You must have to follow the following steps:

1. **Proceed with caution:** Treat all cables found anywhere as 'live'.
2. **Hand dig when possible**

   - ✓ Wherever possible, hand dig near buried cables.
   - ✓ Use insulated hand tools with wooden or fiberglass handles.

3. **Watch those picks and crowbars:** Take special care using picks or insulated crowbars.
4. **Protect yourself:** Wear gloves and eye protection.
5. **Keep handheld power tools away from cables:** Do not use hand held power tools within 0.5m of marked position of electricity cables
6. **Follow advice for handheld power tools over marked cable lines:**

   - ✓ Do not use handheld power tools directly over a marked line of a cable unless:
   - ✓ you have already found the cable at that position by careful hand digging beneath the surface; and
     - it is a safe depth (at least 300mm) below the bottom of the surface to be broken; or

- you have used a physical barrier to prevent the tool striking the cable.

7. **Keep using the cable locator right throughout the project**

   - When the surface has been broken out, use a cable locator again to reconfirm the position of services.
   - You should use the cable locator frequently and repeatedly during the work.

8. **Mechanical excavators**
   - ✓ Before using a mechanical excavator near electricity cables, you should excavate trial holes by careful hand-digging.
   - ✓ Confirm the depth of the cable(s) at the point of work.
   - ✓ You should not operate the excavator within a radial distance of 300mm (300mm in any direction) from the cable or cables.
   - ✓ When using a mechanical excavator near electricity cables keep everyone clear of the bucket and the excavator while it is digging.
9. **Watch out for concrete**
   - ✓ Where an electric cable is embedded in concrete, arrange for the cable to be disconnected before breaking off concrete.
10. **Protect exposed cables**
    - ✓ Where cables become exposed for any reason, you should take suitable precautions to prevent damage while other works are going ahead. For example, you could use physical ways to do this like using timber boarding or sand bags.
11. **Leave exposed cables alone**
    - ✓ Do not use exposed electricity cables as a convenient step or hand-hold.
12. **Don't move cables**
    - ✓ Do not handle or try to alter the position of exposed ESB electricity cables unless under the instruction of an authorized ESB person.
    - ✓ Take extreme care where joints in the cables have been exposed.

13. **Damaged cables, gas pipes or high pressure water mains**

Watch out for even slight damage, like a scrape to the outer surface, to:

- ✓ electricity cables,
- ✓ gas pipes, or
- ✓ High pressure water mains.

If they are even slightly damaged, you should tell the owner of the property immediately. People should be kept well clear of the area until it has been made safe by the owner.

14. **Keep contact numbers handy**

You should have the 24-hour emergency contact number for ESB and other relevant utilities readily available for immediate contact if damage occurs to an:

- ✓ electricity cable,
- ✓ gas pipe, or
- ✓ High pressure water mains.

Self-Check 2	**Written Test**

Name: _____ **Date:** _____

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

1. How can we locate plan of plumbing system?(5)
2. How can we carrying out digging without damaging structure and existing fixtures?(10)

Note: **Satisfactory rating –7.5points and above Unsatisfactory - below 7.5 points**

You can ask your teacher for the copy of the correct answer.

Information Sheet-3	Locate and identify faulty components and blockages

3.1 Determining irrigation system and component function

Irrigation system: The irrigation system consists of a (main) intake structure or (main) pumping station, a conveyance system, a distribution system, a field application system, and a drainage system. The (main) intake structure, or (main) pumping station, directs water from the source of supply, such as a reservoir or a river, into the irrigation system. Irrigation system and component function can be determined by reference to system specifications and technical manuals

Irrigation system component

The irrigation system component consists of

- ✓ Main intake structure or pumping station,
- ✓ A conveyance system
- ✓ a distribution system
- ✓ A field application system and a drainage system.

The (main) intake structure, or (main) pumping station, directs water from the source of supply, such as a reservoir or river, into the irrigation system.

The conveyance system assures the transport of water from the main intake structure or main pumping station up to the field ditches.

The distribution system assures the transport of water through field ditches to the irrigated fields.

The field application system assures the transport of water within the fields.

The drainage system removes the excess water (caused by rainfall and /or irrigation) from the fields.

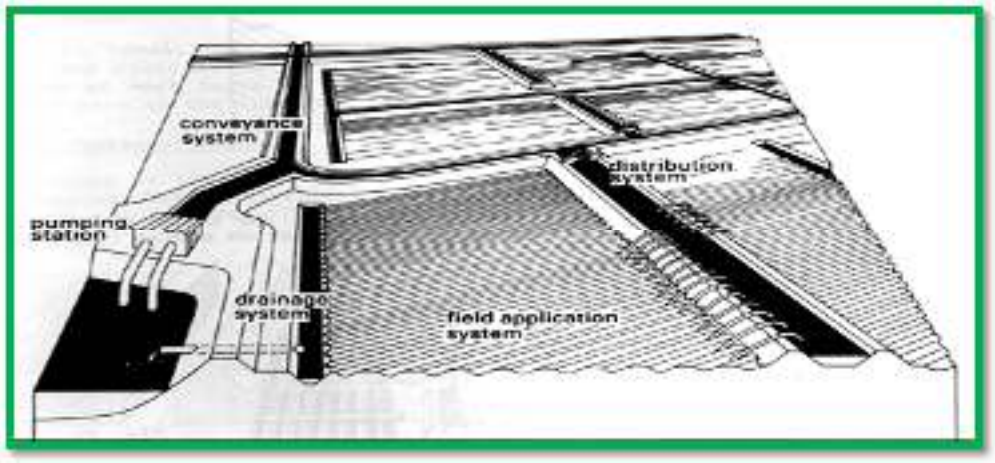

Fig.3.1.irrigation system components

Evaluation Irrigation System Performance

The installed irrigation system is evaluated as follows:

- Open the blocks as per the list of operations
- Check and correct, if necessary, the block pressures
- Note the pump operating parameters
- Note the pressures at nodes
- Perform a discharge test
- Repeat the procedure for all the operations
- Evaluate the data

The following is indicative of the system flow being higher than specified:

- Pump: Amp reading is higher than expected
- Pump: Pressure reading is the same or lower than expected
- Pump: Flow meter reading higher than expected
- Pressure at Nodes: Lower than expected
- Pressure at Blocks: Lower than expected
- CU/ Discharge Test: CU might be good, but the flow per emitter can be higher

The most probable cause is worn nozzles on the emitters, especially if the water has a high silt and sand content. The system pressure is lower due to the higher flow in each block. The pump is

trying to compensate by pumping more, which is why the amp reading will be higher. The uniformity should be acceptable, since wear and tear will occur on all the nozzles.

3.2 Checking and reviewing monitoring and maintenance records

Checking Your System

The first step in cleaning and maintaining your drip irrigation system is performing a visual inspection. You'll want to look carefully at your system and make sure that nothing is out of place or looking worn. Worn tubing could be leaking over areas you wouldn't want it to, resulting in a big waste of water.

Fig 3.1. Simple checking up of system

Tubing Lines

Fig 3.2 checks for tubing line

Of course, it may be easier to just run your hand along the tubing to identify any existing cracks or leaks. Once you find one, you'll either want to repair or replace that section of tubing. This decision will ultimately depend on the size of the leak, your particular setup, and your personal

preference. Keep in mind that even the smallest leaks can result in a large amount of water loss over time if left untreated.

You may find that your tubes are being slimed from algae and bacteria in your system. This can be rather annoying and can eventually create clogs in your lines. Luckily, there are commercial bacteria and algae control agents you can add to your system that will help you eliminate this issue. A daily rinse of chlorine is another good option, but you'll only want to use about two parts per million at the end of each irrigation cycle. Alternatively, you can add an automatic valve to your drip lines that flushes the entire system out at the end of each irrigation cycle and reduces the amount of slime buildup inside.

Filter

You'll also want to check your system's filter and clean it if necessary. If you currently have screen filters, and you're finding that they're clogging and hard to clean, it may be time to invest in some disc filters. Disc filters are better at filtering water, harder to clog, and can be back flushed for easy cleaning.

Emitters

3.3 showing emitter

Depending on your water supply (and anything you add to your water nutrient-wise), your emitters may be getting clogged with magnesium and calcium salts. Even if your emitters are only partially clogged, they can still create problems by unevenly distributing nutrients and water throughout the irrigation system. Rinse them out to the best of your ability, but bad build-up problems will usually require a more serious cleaning something you should usually do near the

end of the growing season. One helpful tip on clearing up emitters is to soak them in a vinegar-based solution.

End-of-the-Season System Flushing

Flushing the lines can help clear out the buildup of unwanted material in them like bacteria and residual calcium salts. Use an acid to flush your lines out at the end of the growing season. Flush the lines with your acid of choice for about an hour. Afterward, flush the lines with water to clear out any of the remaining acid solution. If you find that the lines still look rough with buildup, you can leave the acid solution in them overnight for an extra good soaking. This flushing should take care of all the microorganisms and particulate buildup in your system.

In case of an emergency, there must be some system for easy communication between the pump house operator and the officer in charge - either telephone or signal or runner.

A poorly maintained irrigation system means that much of this water never reaches its intended source and is lost to runoff, evaporation and deep watering below the root zone. Maintaining irrigation systems is one most effective ways to reduce wasted water, reduce pollution from run-off and over-irrigation, and improve plant health by applying the correct amount of water where it can be utilized by the landscape. At a minimum, a check of the irrigation system should be performed twice seasonally. Once at the beginning of the season, when the system is first turned on and again halfway through the season. Ideally, the system should be checked on a monthly basis.

The basics of irrigation maintenance are:

- Inspect the controller and make sure it's plugged in and functioning:
- Update the time and date
- Check the connection on all of the wires – make sure that rain, wind, or soil moisture sensors are connected
- Replace the back-up battery
- Change the schedule to reflect the current season and irrigation needs of the landscape
- Turn on each zone and look for system damage

3.3 Carrying out operational tests

Testing the Irrigation System the various components of the irrigation system are tested as they are installed and the performance of the entire system is tested once the installation is complete. As the pipes are laid and flushed, joints are inspected for leaks. Once the pipes are partially backfilled with the joints exposed, the system is brought up to working pressure. The blocks that are grouped in operations are opened. Pressure readings are taken in front of and after the valves. These are compared with the values noted on the irrigation design plan in the **Pressure and Flow at Nodes.** If the readings are not correct, it may be an indication of wrong pipe size, incorrect hydraulic valve settings, or pump or filter mal function. Hydraulic valves are calibrated at this time. The pressure gauge is inserted downstream, after the valve, and the valve is opened. Note the pressure reading. Once the block is filled, the valve is switched to automatic. If the pressure reading drops, the screw on the pilot is turned slowly in a clockwise direction. If the Pressure rises; the screw on the pilot is turned anticlockwise. The process is repeated by adjusting the pilot, checking the pressure again after a while, and adjusting the pilot again if necessary. Once the hydraulic valves have been calibrated, the pressures in the lateral lines can be checked. Check the pressure at the end of each lateral which should be close to the pressure that the valve is set at. Alternatively, each lateral can be assessed visually and the pressure of the laterals measured that appears to have a different distribution pattern than the other lines. Emitter delivery can also be checked to see if it corresponds with the irrigation plan. Place the emitter in a suitable container. After a specific time (this may be 1 minute up to 30 minutes), remove the container and measure the amount of water. Calculate the emitter delivery per hour. When this test is done with a representative sample for the whole block, the CU (Coefficient of Uniformity) could be calculated. At least 30 measurements, spread out over the block, need to be done for this test. A Cu of 90% or more is good. A qualified irrigation technician should carry out CU tests as it needs good judgment and statistical calculations. After this test is done and the system has been operating for a couple of days, the joints must be inspected for leaks. If no leaks are found, the trenches can be backfilled completely.

Pressures and flows

Incorrect pressures and flow rates are common causes of system inefficiency. If pressure is restricted then the flow will be reduced. Operating pressure can dramatically affect the

sprinkler/emitter pattern and output, and therefore the evenness of application. A variation in pressure between sprinklers/emitters of more than +/-10% is an indication that the system is not operating efficiently. Pressure compensating sprinklers/emitters are used in many systems to maintain the flow rate across a wide range of pressures along the spray line or due to differing positions in the paddock of travelling systems. Similarly, a flow variation of greater than ± 5% is unacceptable.

Reasons for pressure and flow variations include:

- wear and blockages in sprinklers/emitters
- system not designed correctly
- system not being used as designed
- system leakages
- pump not performing. (The pump may be worn or not being operated at best efficiency.)

When evaluating your system you must measure pressures and flows and compare these to the pump and sprinkler/emitter specifications. In table3. 1 you can compare some typical sprinkler/emitter pressures and flows.

Table 3.1. Common operating pressures and flows of various irrigation systems

Sprinkler/emitter type	Pressure range	Flow rate range
	(kPa)	(L/h)
Dripper	90–110	1.2–8
Micro-jet	100–150	25–200
Mini-sprinkler	130–200	35–350
Low-throw impact sprinkle	180–300	300–1200
Overhead impact sprinkle	240–400	700–3000
Centre pivot	100–400	100 000–200 000

It is important to run your system at the designed pressure. If a sprinkler/emitter is operated below its correct pressure, large droplets tend to be thrown further than small droplets, resulting in a 'doughnut ring' shaped output. If pressure is too high, more water falls close to the sprinkler/emitter, or fine droplets are caused, creating a fine mist, and excessive wind drift and evaporation.

- **Regular System Checks**

Several aspects of the irrigation system should be checked regularly to ensure correct operation. Performing these tasks regularly, say every 100 irrigation hours, allows the operator to identify, locate and rectify any problems across the irrigation system. Things to look at include:

- ✓ flow rate (meter readings)
- ✓ supply pressure
- ✓ end pressure
- ✓ checks for damaged or blocked sprinklers
- ✓ machine maintains alignment and tower drives engage and operate smoothly
- ✓ signs of uneven crop development due to poor irrigation uniformity (donut patterns)

- ✓ **Surface Irrigation operation test**

Surface irrigation performance testing will be considered in two subsystems: water delivery and field application efficiency.

Conveyance / Distribution

Conveyance losses in channels can be attributed to evaporation, seepage, operational losses and leakage; representing wasted effort and affecting irrigation performance by reducing inflow at the field inlet. Seepage often contributes the greatest proportion of distribution losses and can be measured by performing a bondage test in a representative section of the channel. Once seepage is calculated, the associated cost of water losses must be considered and plans for mitigation put into place.

The general procedure to conduct a poundage test is as follows:

- ✓ Water is held in the channel and the rate at which the water level drops is measured. All sources of inflow and outflow are minimized and measured wherever possible.
- ✓ The section of channel to be tested must be identified and isolated from other sections of channel. This is best done using existing control structures; but earth banks or tarpaulin stops can be used to hold water in a specific section of channel (ensure these are well sealed).
- ✓ The section of channel is filled to at least normal operating level before being sealed. Initial water level is recorded and then at regular intervals as the water level recedes. This

can be done using a staff, hook gauge or water level recorder. Measurement of water level may be made at a single point near the middle of the channel section or an average taken from each end of the channel. Taking an average removes the influence of wind on water level along the channel.

- ✓ Other measurements required and the formula used are as follows:

3.4 Identifying and documenting faulty components and blockages

- **Identifying system damage and problems**

Leaking valves or pipes

Leaks can occur as a result of weather damage (freezing and thawing), damage from shovels and other sharp tools, vandalism, tree roots, and normal aging of the system. Leaks from valves and pipes may be large and very obvious. Smaller leaks may not show up immediately and will require some detective work. Replace or repair damaged valves and pipes.

Broken or missing heads

Damage can occur to sprinkler heads from lawn mowers, vandalism, improperly installed heads, and normal wear and tear. Replace damaged or missing heads immediately. Installing heads on swing pipe allows the head to "float" in the soil and reduces the damage that can result from lawn mowers and other heavy objects.

Clogged nozzles

Clogged nozzles occur as a result of debris entering the irrigation system, a dirty water source, and normal wear and tear. Flush system at the beginning of the irrigation system, install screens on sprinkler heads, replace clogged nozzles, and improve system filtration.

Seal leaks

Over time, dirt and debris can wear out the wiper seal resulting in leaks around the top of the spray head. If the spray head consists of a single unit the entire head must be replaced; with some spray heads it is possible to screw off the top of the sprinkler head and replace.

Sunken heads

It is not uncommon for sprinkler heads to settle over time. Even when the soil is packed around them during, the weight of lawn mowers and other heavy equipment on wet turf can cause the heads to settle. Grass clipping, soil, and other debris can build up around heads resulting in a

head that doesn't clear the grass adequately and disrupts the spray pattern. Current best management practices call for higher mowing heights – older systems may have been designed for shorter turf. Heads can be raised by using taller sprinkler bodies, or installing risers. Cutting turf away from heads is another solution but must be seasonally.

Tilted heads

Lawn mowers and wet soil can cause newly installed sprinkler heads to tilt resulting in uneven coverage. If possible install the sprinkler head on swing pipe and move the head out of the line of mowers and other equipment that may cause the head to settle or shift. Otherwise reposition the head and pack the soil around it carefully.

Recording and reporting faulty components and blockages

Each irrigation worker shall maintain any records and make any reports. The activities required by the conditions or by the rules, regulations, and orders of the enterprise. Records which are required by the regulations in this part or by license conditions must be maintained for a period specified by the appropriate regulations or by license condition. Records which must be maintained pursuant may be the original or a reproduced copy or a microform if this reproduced copy or microform is capable of producing copy that is clear and legible at the end of the required retention period. The record may also be stored in electronic media: For producing legible, accurate, and Complete records during the required retention period. Records such as letters, drawings, specifications, must include all pertinent information such as stamps, initials, and signatures.

The reports shall include:

- specification of the quantity of each of the principal damage and blockage
- specification of the quantity of each of the principal location and the section of the system affected
- Jungle clearance and earthwork on canal berms, dowels and service road, etc.
- a summary of licensee disposal unit survey and maintenance activities,
- a summary, by waste class, of activities and quantities disposed off,
- Damaged or faulty pumps, valves, electrical components, etc. in irrigation systems should be recorded and reported to the supervisor.

- Maintenance and repair to these damaged parts should also be carried as soon as possible to avoid leakage and water losses.
- The reports on damaged or faulty pumps, valves, electrical components shall include:
- specification of the quantity of each of the principal damage and blockage
- specification of the quantity of each of the principal location and the section of the system affected
- a summary of maintenance activities,
- a summary, by waste class, of activities and quantities disposed of, any instances in which observed site characteristics were significantly different from those described in the application for a license; and any other information the commission may require

The quantities of work, unit costs and total costs should be cited in the report. The record on routine maintenance activities of irrigation system includes at least the following operations:

- a record on light deforestation on drainage
- a record weed control in the canal section
- a record on seeding grass in the canal section
- a record on maintenance of flow gauges and other measuring devices
- a record on removal of silt
- a record on maintenance of pumping stations where water cannot be evacuated by gravity.

Drains are subject to two main problems:

(a) Obstruction due to silting and plant roots, and

(b) Mineral deposits. The most common is the first. Mineral deposits of iron and manganese occur quite frequently in some irrigation schemes and the time necessary for such depositions varies widely from a few months to 30-40 years, depending on the mineral composition of the soil. Note: After completing the records, a report has to be submitted to authorize personnel for corrective measures. Presence of silt or clay inadequate filtration

Self-Check 3	**Written Test**

Name: _____ **Date:** _____

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

1. List the System Damage and Problems? (**5pts**)
2. What are the irrigation system component and irrigation maintenance activities ?(**5pt**)
3. Explain Reasons for pressure and flow variations in irrigation system**?(5pt)**
4. How to identify ,record and report the faulty components in irrigation system?(5pt)

Note: **Satisfactory rating –10 points and above Unsatisfactory - below 10 point**

Information Sheet-4	**Inspect site**

4.1 Inspecting site to locate blocked section

The quality of irrigation water has a large influence on the type of irrigation used and the potential for blockages. A chemical analysis of the water will help determine the design of the system and the type of treatment needed to prevent or control blockages. Generally, Irrigation water may treated by chemical, filter and flushing process.

- Chlorination is the most widely used chemical for irrigation water treatment to prevent biological emitter clogging /blockage.
- Filtration is the process of removing suspended soil particles in the water by settling the particles at the bottom.
- Flushing is simply washing the system by high water pressure flow through it.

Regular maintenance of the system is the best means of controlling blockages. A trickle system that was not maintained would be eventually blocked.

- ✓ **Arranging Access to faulty components and blockages**

Faulty components and blocked areas of the system should be accessed and be easier way to replace the components and clear blockages from the system. This may require specific approvals from property owners/managers and may involve excavation work.

- ✓ **Removing Faulty components from the system**

Faulty component removed from the system according to system specifications and technical manuals, and repairing or disposing of in an environmentally responsible way. Faulty components could be repaired or no repaired. No repaired components should be disposed of in an environmentally responsible way. The environmental effect of a given component and how to dispose it is given in its specification.

Selecting replaceable components from manufacturer's catalogues and procuring using enterprise procedures.

Replaceable components may be: Flexible pipes, valves, emitters, pump, sprinkler head and others. So, they should be selected and cured before replace them to faulty components. There are several important steps in replacing faulty components in an irrigation system. These include:

- Shutting down the system
- Isolation procedures
- Securing the area
- Replacing irrigation system components
- Installing replacement components
- Returning system to normal operating status
- Operational tests.
- Set up the system

Returning isolated or shut down component to service

The isolated or shutdown is returned to the service:-

- After faulty component have been replaced or repaired
- After blockage are cleared
- After winterization

Isolation system procedures

After the irrigation system has been shutdown, the part of the system containing the problem needs to be isolated. Procedures for this are found in system specifications and technical manuals. If a zone keeps running after its set to turn off, a component of the system is clearly not working properly. It could be as simple as a scheduling mistake with your sprinkler controller or as troublesome as a mechanical error that would require going in, performing a manual shut down, and locating the problem.

Winterization is the removing of water from the pipe, pump, valve and sprinkler head before freezing occurs. It is needed in order to minimize the risk of freezing damage internal part of the system and protect the corrosion of irrigation system during no-use of the system.

Winterizing irrigation system is start up by:-

- Turn off the water to the irrigation system at main valve
- Set the automatic irrigation controller to the rain setting
- Turn on each of the valve to release pressure in the pipe
- Drain all of the water out of any irrigation component that may freeze

Winterization techniques It is the best way to protect your irrigation investment from potentially serious damage with winter. You can choose from three winterization techniques:-

The manual valve methods i.e. are installed at lower point mainline or where water may collect.

The automatic drain valve methods i.e. is a spring-loaded device installed on Sprinkler heads or lateral pipes

The compressed air blow-out methods i.e. use compressed air to clear water from the mainline pipe, sprinkler control valves, lateral pipes and sprinkler heads.

- **Securing the area**

Once safe shutdown or isolation has been confirmed, safety or security lock-off devices and signings should be installed where appropriate.

- **Replacing irrigation system components**

The faulty components are removed from the system according to instructions in manufacturer's maintenance manuals. The specifications of the faulty component should be noted and determined from the system specifications. Suitable replacement parts should be obtained from storage or ordered in.

- **Installing replacement components**

Replacement parts should be installed in accordance with the system specifications and technical manuals. You will need to be able to identify the range of components that need to be replaced and demonstrate the correct replacement procedure for each component.

- **Returning system to normal operational set up.**

Once the faulty components have been replaced, the isolated or shutdown components are returned to service in accordance with system specifications and technical manuals.

4.2 Determining work requirements and responsibility for repair

Repair means responding to the breakdown of equipment and undertaking work to correct the problem in order to return the equipment to a working condition. Before equipment can be repaired, you need to be aware that there is a problem! Therefore, there should be a clearly understood **system for reporting faults and breakdowns** and equipment users should be encouraged to report faults and breakdowns as soon as possible. If there is no back-up equipment, a breakdown will mean that the service equipment was providing will come to a halt. Mainly repair activities can be classified in to two:

Simple repairs can be done by the in-house or external **maintenance and repair team**. If the equipment is repaired where it is used, it is important that the team is trained to work safely and that they don't create hazards for patients or staff.

More complex repairs will be carried out by **specialized maintenance personnel**; they might come to the eye care unit or you may have to send the equipment to them for repairs.

In all these situations, it is important to keep equipment users informed of how long their equipment will be unavailable.

Some items of equipment will be found to be damaged beyond repair. For others, spare parts may no longer be available as the equipment has become outdated. These will have reached the end of their lives and must be taken out of service (decommissioned or retired) and be replaced if the service they provide is to continue. Equipment that is being decommissioned should be disposed of safely and according to proper disposal procedures. Remember to update your records accordingly.

Tell someone if there is a problem

As a user, it is your responsibility to report any problems. You will most likely be the first person to know that something is not working as it should.

- Don't assume that someone else will report a fault-what if everyone thinks that someone else will report it? It may sound obvious, but a repair can't be attended to if nobody knows there is a problem. The longer you take to report it, the longer before the repair will take place.

- Don't wait for equipment to break down before reporting a fault. Even a small change in how the equipment moves or how it responds could indicate that something has gone wrong or that a part needs to be replaced soon. If left unchecked, a more serious fault may occur, which will be more expensive and time-consuming to repair.

4.3 Recording and reporting repair activities

All activities carried out throughout the process of troubleshooting irrigation and drainage system should be recorded and reported to supervisor. In order for an eye care unit to manage its equipment effectively, it needs good maintenance and repair records. It is very difficult to manage the unknown!

A **central maintenance and repair record** will help you to keep track of the maintenance and repair work done. Ideally, this system should correspond to the eye unit's equipment inventory this means that you will have maintenance and repair records for each of the items listed in the inventory.

- ✓ **Record-keeping for maintenance**

The preventative maintenance schedule for users can be accompanied by a weekly or monthly ‘tick sheet’ near the item of equipment, with a space for each day so that users can date and sign it, thereby showing that they have carried out the required tasks. This may include a space for users to indicate what spare parts, such as bulbs, were used. On a regular basis, the list of spare parts used should be noted in the central maintenance and repair record so that more spare parts can be ordered.

The central maintenance and repair record can be used to keep track of all other maintenance, including maintenance done by the in-house team, by vendors, or by service agents. The information captured should include the date, the equipment reference number, what was done, who did the work, and when next maintenance is due.

Figure4.1. Showing components that needs repair

One way of keeping track of regular maintenance tasks is to affix a tag to serviced or maintained equipment. This information should be reflected in the central maintenance record.

- ✓ **Record-keeping for repair**

Table Table11 shows what information about repairs should be recorded in the central maintenance and repair record, and what useful information this can provide.

Table 1

Record-keeping for repair

What should be recorded	This provides information about…
The details of repair work done on each machine (including cause/suspected cause, and who carried out the repair)	The history of each machine Common problems
The spare parts and materials used	The parts most frequently used What needs to be re-ordered
The date equipment has broken down, and the date it is repaired.	What still needs to be repaired (which allows you to prioritise the next week's tasks) The duration equipment is not in use (down-time)
The causes of any delays	What the most common causes of delays are (skill,

What should be recorded	This provides information about…
	labour, spare parts, transport, bureaucratic delays, money) and what additional resources may be needed to complete work on time

In addition to the practical benefits of a central maintenance and repair system, it also provides eye care unit administrators and the equipment maintenance team with valuable information and proof that they can use to ask for more resources.

How do I detect and repair a break in the mainline?

A break in a mainline normally will result in a high rate of water loss at the location of the break. Sometimes the breaks are not visible. What you should take notice of are wet areas that are present all the time. This may be an indication of a break or small leak. These problems should be taken care of immediately as they will eventually turn into the "high rate of water loss" mentioned earlier. Mainline breaks require that water be shut off at the POC.

Mainline Repair Checklist:

- Place locater flag at area of break.
- Turn off water at POC.
- Dig a trench to a depth exposing break. Most mainlines are 18 to 24 inches deep. Remove soil to provide adequate work space around and under the pipe and break. (See note in lateral repair section.)
- Allow any water in the trench to drain and clean any loose soil from around the break.
- Use an approved pipe repair device (see below).
- Check for any leaks and repeat the process if leaks are found.
- Back fill trench, compact the soil by puddling (applying water to the top of the backfill), jetting (injecting water below the surface of backfill) or tamping (compacting soil with some type of compaction device). This may have to be done in several lifts (layers), depending on the depth of excavation.

How do I detect and repair a break in the lateral line?

Breaks in a lateral will not be evident until the control valve of that zone is activated and water begins to flow through the lateral lines to the sprinkler heads. Many lateral line breaks occur at the connection to sprinkler heads. Laterals may be repaired any time the zone is not activated; or,

if actively running, the water can be temporarily shut off at the control valve by closing the flow control. Remember If the flow control is closed to make repair, return it to the proper position (adjusted to the flow demand of the zone) after the repair is complete. If the break is located between sprinkler heads, use the same procedures as for a broken mainline. Lateral Repair Checklist

- Locate the break.
- If the sprinklers are on, wait until they go off or close flow control on control valve.
- Excavate a hole large enough to have room to reach around the pipe in all directions (see note below) and around the break..
- Let glue set up and remove the nozzles on the sprinkler heads downstream from the break.
- Activate the zone from the controller or by using the manual bleed on the remote control valve.
- Let water flush from the open sprinkler heads for a few minutes to remove any debris from the lines.
- Check for leaks around the repair before turning water off and filling hole.
- Replace sprinkler nozzles and test the zone one more time.

Repair can take the form of restoring a non-functioning system to approved design specifications or it can include system modification or alteration (which is also referred to as re-rating).

Self-Check-4	**Written Test**

Name: _____ Date: _____

Directions: Answer all the questions listed below.

1. What is the objective of inspecting site to locate blocked section? How can we overcome it?(6 pt)
2. What is repair? List and explain the types of repairs(4pt)
3. What is the advantage and disadvantage of recording and reporting repair activities?(4 pt)
4. What is our responsibility regarding repair(4pt)

Note: satisfactory Rating-9 and above pts. Unsatisfactory Rating-below 9 pts.

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

Information Sheet-5	Shut down/isolate component

5.1. Applying shutdown sequence

Your first steps will be to shut off and drain the irrigation system. It only takes a few minutes and can save hundreds of dollars in repair costs and water bills.

A. Locate the main irrigation valve and drain - they may be in a vertical plastic pipe or in your green irrigation box.
   - ✓ First, use a sprinkler key to close the main irrigation valve by turning it to the right.
   - ✓ Then using the same key, open the drain by turning it to the left.

B. Locate the backflow device.
   - ✓ Turn both flat handles 90 degrees to the closed position.
   - ✓ Using a flat head screw driver, turn both "test cock" screws 90 degrees (in either direction) to drain the device.
   - ✓ Now turn both flat handles halfway back to original position so that they are at a 45 degree angle. This will prevent water from being trapped in the device.
   - ✓ It's a good idea to cover your backflow with a weatherproof cover, but this is not necessary.

C. Turn your irrigation controller to the "off" position. All your watering times and data will be saved.

D. It is always a good idea to check your water meter to make sure that everything has been shut off properly. If your meter shows usage, you should go back and check your work.

Some irrigation systems are easier to shut down than others, particularly if they are automated systems. Even fully automated systems may have a shutdown procedure. There're two sorts of shut downs to consider - at the end of the day and at the end of the season. Here are some general steps for the end of the day.

All valves, controllers and components should be reset to their original statuses: This ensures that the next person who operates the system is not left wondering what the status of the

system should be. Communication is important in maintaining smooth operations. For example, if the valves are shut when they are supposed to be open, damage to pumps could occur - particularly if the next operator isn't as conscientious as they should be..

Record activities and changes: Make a record of your activities and any changes made, should you be sick or unavailable at times.

Drainage: Some emitters will flood at the end of a watering cycle due to water within the system works draining at its lowest point. This is like to happen when an irrigation system is installed in an area which isn't completely flat. This is called low-head drainage and can lead to potential hazards such water pooling across a walkway.

Where there are excessive drainage flaws in system, flooding, erosion and blockages may result. Quick and appropriate action is required here.

At shut down, inspect the irrigated area for poor drainage. To prevent further low head drainage, check valves may need to be fitted to emitters or sometimes in the pipe works.

5.2. Verifying safe shutdown

You should have to use safe shut down of the irrigation system by using the following methods:-

- ✓ Shut off the main water supply and remove the faucet assembly (timer, filter, pressure regulator, etc.) at the start of the system. These components should be drained and brought indoors to protect them from freezing. Battery timers should have the batteries removed over winter to avoid damage and corrosion.
- ✓ Open all manual valves and remove all end fittings to drain the irrigation system. Poly mainline tubing is not damaged by freezing, but fittings may crack if water is left in them. When draining the lines, slightly elevate the fittings to make sure they are drained.
- ✓ Flush Valves can be installed at low points in the line to assist with draining the system. Flush valves will open every time the system shuts off, draining water trapped in the line. Emitters can also be installed at low points to assist with draining.

- ✓ **Blowing out the lines:** Another common method is to blow out the lines using compressed air. This is a time saving and effective method. Make sure to remove end fittings before blowing out the lines to avoid damaging the irrigation system.
- ✓ **Seal off the open lines:** After the lines have drained, make sure to replace all end fittings. Leave end caps loose to allow for draining throughout the winter. The beginning of the system where the faucet assembly was removed should be sealed off as well. Use a female hose plug to seal the female hose start fitting at the beginning of the system. A plastic bag or other barrier could also be used to cover the opening of the system. Never leave lines open; debris, insects and other creatures may take shelter in the open lines. To extend the growing season, Agribon(loop hoops frost protection) Row cover can be used to cover plants and protect them from frost damage.

- **We should have to shut down the irrigation system by following the steps of shut down**

For instance steps of shut down sprinkler

STEP 1: Valve should be located in your basement. Most valves are ball valves that have a handle. If the handle is running with the pipe, the water is turned on to the system. To shut the water turn

the handle 90 degrees until it stops. Typically, the handle has a "stopper" so that you cannot turn it too far.

STEP 2: Is will be on the outside of your house. device is small and made of metal. A pipe runs from the house into the back pre venter and another pipe runs out the back preventer and into the ground.

STEP 3: Turn the two valves handles about 45 degrees so that they are half open/half shut. You also will need to take a _at head screwdriver and open the two test ports on the side of the back device. NOTE: If your test ports have caps (usually black plastic) remove the caps before opening the ports.

STEP 4: if YES and they are near the back preventer on the outside of your

house, open them to drain the water out. If there are no drains on the outside of your house, there is probably a drain in the basement of your home near the valve. When opening the inside drain, have a bucket ready to catch the draining water. Leave all drains open during the winter.

For an inside drain, leave a bucket underneath. *Note: Most systems will have either drains on the outside or one on the inside, not both.*

STEP 5: Check it regularly completing Step #4 to make sure it stops dripping. If it is still dripping a couple days being opened, either the valve isn't closed all the way or the valve is going bad and needs to be replaced by a plumber.

STEP 6 & 7: We will use an air compressor to blow all of the water out of your lines. We will shut down your controller. If an unexpected freeze does happen, **completing steps 1-5 is NOT a guarantee that your pipes won't be damaged** by winter freezing. However, doing so will certainly improve the odds until we can get out to your home and remove the water from your lines with an air compressor.

5.3. Safety of shutdown

Caution: If you attempt this on your own, wear protective eye protection and never stand over irrigation pipes, sprinklers, or valves during this process. The manual drain valve or drain cap is pressurized and can cause injury if opened before the pressure is relieved. So you should have to shut down any irrigation system by following the steps of shutdown.

Self-Check 5	**Written Test**

Name: _____ **Date:** _____

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

1. What are the steps of shut down sprinkler irrigation system?(5)
2. What do you do to prevent yourself from injury during shut down of irrigation system?(5)

Note: **Satisfactory rating –5 points and above Unsatisfactory - below 5 points**

You can ask your teacher for the copy of the correct answer.

REFERENCE

- ✓ Rakesh H., S.N.Mundra, sewa r., (2002). Irrigation Drainage, International and National perspectives
- ✓ Dr.B.C.punmia and Dr.pande B.B., (2005). Irrigation and water power engineering
- ✓ Dr.A.K.B. and Dr. A.M.Michael, (2003). land Drainage principles, methods and Application