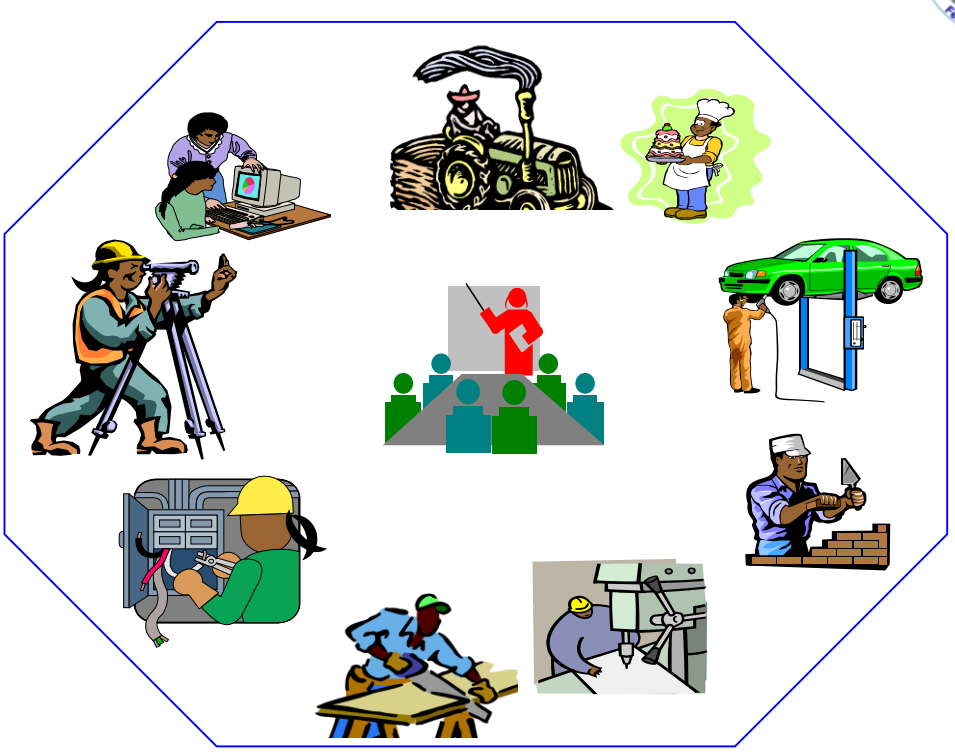

Natural Resources Conservation and Development Level IV
Based on March 2018, Version 3 Occupational standards

Module Title: Coordinating Natural Area Restoration Program
LG Code: AGR NRC4 M08 LO (1-4) LG (38-41)
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THE WORLD BANK
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East Africa Skills for Transformation and Regional Integration Project (EASTRIP)

Table of Contents

LG #38	LO #1- Inspect and assess site conditions

Instruction sheet

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

- Preparing a vegetation assessment checklist/format
- Identifying site conditions, level of degradation and potential
- Assessing threats to existing ecosystem, flora, fauna
- Assessing range of likely operating conditions, hazards and difficult
- Preparing vegetation assessment report

Identifying appropriate mechanisms for infrastructures development
This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Prepare a vegetation assessment checklist/format
- Identify Site conditions, level of degradation and potential for natural area restoration
- Assesse threats to existing ecosystem, flora, fauna and property from natural area restoration works
- Assesse range of likely operating conditions, hazards and difficult/sensitive environments for impact on natural area restoration works.
- Prepare a vegetation assessment report is in standard format

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide,
7. If you earned a satisfactory evaluation proceed to “Operation sheets
8. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
9. If your performance is satisfactory proceed to the next learning guide,
10. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1- Preparing a vegetation assessment checklist/format

1.1. Vegetation assessment

Conducting a comprehensive site analysis is the first step in evaluating a specific site. A site analysis should include the following steps:

- **Learn about the biological history of the site**. Refer to The Natural Vegetation of area at the Time of Survey:
  - ✓ Survey and evaluate existing vegetation on the site
  - ✓ Determine whether any listed plant or animal species are present.
  - ✓ Analyze soil types and characteristics. (Conduct a soil sampling onsite, Determine soil compaction or disturbance, Determine content of organic matter and nutrient levels and Determine pH factor)
- **Determine soil moisture** gauged on a gradient from dry to mesic to wet. Determine drainage patterns. For example, sandy soils and hilltops are dry, and depressions and clay soils hold water and therefore are more moist.
- **Consider topographic** features, such as slope and aspect. Determine whether the site is hilly or level; identify degree of exposure to the sun (south, north, east or west).
- **Consider the microclimatic conditions of the site**, within the regional context.
- **Select the appropriate plant species** according to site conditions and the specific landscape unit

1.2. Assessment Checklist

Checklists are assessment tools that set out specific criteria, which educators and students may use to gauge skill development or progress.

Evaluation checklist include

- Title Page.
- Table of Contents and Other Sections That Preface the Report
- Executive Summary.
- Summary, Conclusion, and Recommendations.

- Introduction and Background. Comments
- Methodology.
- Results Chapters
- References and Appendices

Each team member will document field activities in a water-resistant field logbook with an indelible ink pen. Each site will be named using the following nomenclature: Date (yy.mm.dd).

The site ID, time, and date of assessment will be recorded on each datasheet and in field logbooks. At each site location, GPS coordinates will be collected and recorded in decimal degrees (dd.ddddd°) in the logbook and on the datasheets. In addition, photographs will be taken to document each site, the surrounding habitat, and any other notable features. The GPS track log function will be turned on and the camera operator will photograph the GPS unit once daily. A site sketch will be completed on the back of the Site Inventory Datasheet. The only remaining evidence of surveying at each site will be the wooden stake with its appropriate label and the blue flagging tape to help identify the site location as the wooden stake ages. Care will be taken to minimize trampling of the sites. No vegetation samples will be collected. If positive field identification is impossible, plants will be photographed at close range to facilitate identification at a later time but no sample will be collected.

Date:_____ Site ID:_____

Sample Point: A B C

Assessment Data Sheet

Centroid Latitude: _____ Team Members: _____

Centroid Longitude: _____ _____

Total % cover: _____ _____

Fill out one data sheet per sample point (3 sample points per study site). Percent cover is measured by species in each stratum. For stem height, estimate the approximate average stem height by species. Stem height is measured in herbaceous and shrub stratum plots only. Stem density is measured by the number of stems that are rooted within the plot. Record relevant information regarding plant health of individual species in the Notes column. If positive field ID is not possible, plants will be photographed at close range, but no sample will be collected.

Table1.1. Checklist format for assessment of wood (herbaceous) plant

Herbaceous Stratum (woody or herbaceous plants <1 m in height)

Species	*% cover*	*Approximate Stem Height*			*Notes*
		<0.5 m	*0.5-1 m*	*1+ m*	

Table 1.2. Checklist format for assessment of shrub

Shrub Stratum (woody species <20 feet in height OR >20 feet in height, but <3 inches in diameter)

Species	*% cover*	*Approximate Stem Height*			*Stem Density*	*Notes*
		<1 m	*1-2 m*	*2+ m*		

Table 1.3. Checklist format for assessment of trees

Tree Stratum (woody species >3 inches in diameter and >20 feet in height)

Species	*% cover*	*Stem Density*	*Notes*

Self-Check -1	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. List the steps in site analysis? (5points)
2. Develop chick list for vegetation assessment?(5points)

Note: **Satisfactory rating >5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information sheet 2- Identifying site conditions, level of degradation and potential

2.1. Site conditions

A natural plant community is **never static**. It changes its form and composition continually. This constant change is called **succession.** Consideration of successional principles must guide all restoration and management decisions.

Under natural conditions, a new forest is usually initiated as the result of a catastrophic disturbance.

The five recognized stages in the natural development of a forest are:

Stage 1: Herb, shrub and seedling stage

Stage 2: Young forest (pioneer trees)

Stage 3: Mature forest

Stage 4: Subclimax old-growth forest

Stage 5: Climax old-growth forest

If uninterrupted by disturbances (either natural or induced by human activities), a forest will eventually become a climax forest. Small-scale and large-scale disturbances, such as windfalls, disease, forest fires or clear cuts, assure constant change in the composition of a forest, displaying various successional stages within the forest. Each successional stage is characterized by specific tree species: pioneer species, gap phase species, subclimax and climax species. Pioneer species establish first after a catastrophic disturbance (natural or artificial). They dominate in the early stages of succession, providing shade and shelter to gap phase species.

Pioneer species originates after forest fires and is less shade tolerant. Pioneer species have a shorter life span than successional species,

A mature forest is a stand that has reached its potential height, is even-aged, is capable of sexual reproduction, and has harvestable timber.

Gap phase species is more shade tolerant than pioneer species, gap phase species fill in when a gap appears in the canopy, such as dying individual pioneer species.

Subclimax species they are not shade tolerant and often persist in climax old growth forests. **Climax species** reproduce and persist under low light conditions. They are more sensitive to moisture stress and less resilient toward fire and animal damage.

2.2. Level of degradation and potential

Restoring the ecological functionality of degraded and deforested landscapes is cruial while enhancing the well-being of people who coexist with these places. A means of regaining, improving, and maintaining are vital ecological and social functions, in the long-term leading to more resilient and sustainable landscapes. Restoring is a whole landscape to meet present and future needs and to offer multiple benefits and land uses over time. The practice of renewing and restoring degraded, damaged or destroyed ecosystems and habitats by human intervention.

Figure 2.1. Degraded land

Before doing Restoration Disturbance analysis

• Assess the type of disturbance

- ✓ Natural
- ✓ Anthropogenic

• Frequency

- ✓ More frequent
- ✓ Less frequent

• Intensity

- ✓ Non-lethal
- ✓ Lethal

- Erosion condition
  - ✓ Level of soil erosion -the silent crisis
  - ✓ Soil is the vital but missing link in the global Conventions and the national strategies
  - ✓ A key to Global Sustainability

Figure 2.2 restoration program

- Vegetation analysis
  - ✓ Existing vegetation (inventory)
  - ✓ Historical trend in vegetation
  - ✓ Environmental reconstruction-markers
  - ✓ Reproductive biology

R

Figure 2.3 vegetation analysis Source: Tefera, 2021

Self-Check -2	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. List the five recognized stages in the natural development of a forest.(5points)

Part II Match column "B" with Clomun "A" (2 pts for each)

A	B
1. Pioneer species	A. reproduce and persist under low light conditions
2. A mature forest	B. they are not shade tolerant
3. Gap phase species	C. more shade tolerant than pioneer species
4. Subclimax species	D. a stand that has reached its potential height
5. Climax species	E. originates after forest fires

Note: **Satisfactory rating >7.5 points** **Unsatisfactory - below 7.5 points**

Answer Sheet

Score = _____

Rating: _____

Information sheet 3- Assessing threats to existing ecosystem, flora, fauna

3.1. Threats to existing ecosystem flora and fauna

Threats may affect the initial establishment phase for regenerated or re-vegetated plants and the long-term viability of target species or the restored habitat. Vigilant monitoring and control of threats is important at all sites to ensure that weed competition and feral predation does not cause the restored habitat to become a 'population sink' for some native species. A population sink is a site that some species may be initially attracted to, but due to sub-optimal habitat or the presence of predators, for example, their individual survival rate is low.

Coordinated threat control throughout the immediate district is often warranted to achieve longer term results. A comprehensive threat assessment process that goes beyond project boundaries is therefore a primary key to success. Involve all stakeholders in and adjoining the project area wherever possible.

On-site indicators of threats (Table 3.1) only signal present issues; future threats should also be taken into account by observing the surrounding landscape and talking to land managers in the area about any likely future changes in management or known seasonal problems (e.g. grasshoppers).

Where the restoration scenario calls for increased plant establishment through regeneration or re-vegetation, the site should initially be managed to reduce threats that are a problem for the early establishment phase of seedlings. These include competitive weeds, disease (e.g. Phytophthora sp) and grazers (including insects, slugs, snails, stock, rabbits, deer and goats).

Weeds must be assessed by criteria that will allow the determination of appropriate methods of control. For example, perennial or summer-growing weeds will have different control methods and timing than annual or winter-growing weeds. All threats should be assessed in the context of the restoration goal and with the possible impacts of threat abatement actions on other species in mind. Some invasive plant species

provide habitat to endangered native fauna. Where threatened fauna are likely to rely on weeds as habitat, the weeds should have a staged plan for gradual removal and replacement with other suitable habitat.

Table 3.1. On-site indicators of threats

Threat	Potential on-site indicators
Predation, grazing, trampling	Presence of livestock or pest animals (e.g. foxes, rabbits, hares, deer, goats); also invertebrates such as grasshoppers, red-legged earth mite, snails. Presence of dung/scats, diggings, fur, grazed vegetation, animal tracks.
Competition	Presence and size/extent/type of weeds. Presence of exotic animals that may occupy niches of desired fauna (e.g. feral bees in hollows).
Inappropriate fire regime	Requires assessment by a professional fire ecologist. Some indicators of a lack of fire may be senescent vegetation and lack of regeneration; lack of under storey diversity in mature vegetation and a lack of fauna species that require diverse understorey.
Changed hydrological regime	Dieback/death of plants. Invasion of sites by plants usually found in either drier or wetter environments.
Disease.	Yellowing or unhealthy plants, dieback
Pollution	Rubbish dumping, unhealthy plants, dieback.
Soil erosion	Lack of cover; unstable soil; tracks and vehicle damage; soil cultivation.
Potential damage or removal of habitat features (e.g. rocks, logs, wood).	Signs of human visitation and use of site; recently cut stumps.

The term ‘ecosystem function’ covers a wide range of processes and interactions between biota and their environment. Desirable processes that enable ecosystem function include:

- nutrient cycling
- water filtration and cycling
- energy flow (production, consumption and decomposition)
- soil formation, pollination and carbon cycling

Habitat types, structures and compositions are influenced by the physical elements at a site such as soil fertility, topography, geology and hydrology. Restoration planners should be aware that the composition and structural formations of restored habitats should differ within sites according to changes in the physical environment. The density of vegetation (both horizontally and vertically) can influence how plants grow and which fauna can make use of the vegetation. Different fauna species are associated with dense vegetation compared to open vegetation. Open space with few or no trees or shrubs provides important habitat that is often overlooked. Areas that were once native grasslands, sedge lands or wetlands) may be difficult to recognize if the site is now a cleared open pasture paddock. If restoration of these vegetation types is an important part of the habitat for the restoration target species then these areas should be identified and managed for appropriate openness, taking into account weed management issues.

Ecosystem services include: provision of food, water, products and energy; carbon sequestration; waste decomposition; purification of water and air; crop pollination; pest and disease control; nutrient dispersal and cycling; seed dispersal; and the provision of cultural, intellectual and spiritual inspiration through, for example, recreational experiences and scientific discovery

Many factors have caused habitat loss and degradation in Ethiopia systems. Key primary causes include:

- past native vegetation clearance (removing all or selected plant species)

- soil cultivation
- inappropriate grazing and browsing pressure from livestock, introduced pests, and over-abundant native animals
- chemical use/pollution (e.g. herbicides, fertilizer application)
- competition and other effects of plant and animal pests
- inappropriate burns
- spread of disease
- drainage
- mining
- collection of firewood, specimens and rocks
- Re-vegetation with inappropriate species or inappropriate seed sources.

Biologists estimate there are between 5 and 15 million species of plants, animals, and micro-organisms existing on Earth today, of which only about 1.5 million have been described and named. The estimated total includes around 300,000 plant species, between 4 and 8 million insects, and about 50,000 vertebrate species (of which about 10,000 are birds and 4,000 are mammals).

Today, about 23% (1,130 species) of mammals and 12% (1,194 species) of birds are considered as threatened

Global biodiversity is being lost much faster than natural extinction due to changes in land use, unsustainable use of natural resources, invasive alien species, climate change and pollution among others.

Land conversion by humans, resulting in natural habitat loss, is most evident in tropical forests and is less intensive in temperate, boreal and arctic regions. Pollution from atmospheric nitrogen deposition is most severe in northern temperate areas close to urban centres; and the introduction of damaging alien species is usually brought about through patterns of human activity.

Species loss is also compounded by:

- the ongoing growth of human populations and unsustainable consumer lifestyles
- increasing production of waste and pollutants

- urban development
- international conflict.

3.2. Sensitive environmental impacts

Environmental impact assessment (EIA) is an evaluation procedure that helps decision-makers and planners to understand the environmental impacts of a proposed project or activity in a systematic, holistic, multidisciplinary way. A method has been developed in the present study to characterize the sensitivity of an area, with respect to transportation line projects. Environmental and socio-economical factors, such as ecology, land productivity and aesthetics, have been considered and analysed together with the main impacts mostly caused by a transportation system on them. This analysis has generated a set of sensitivity maps, which have been subsequently integrated through a spatial decision support system, to obtain synthetic sensitivity maps to be used for EIA.

Environmental impact assessment (EIA) aims at identifying, predicting and assessing the environmental impacts related to a development (or project). The EIA procedure differs from country to country, being regulated by the legislation in force at the location of the proposed development. Nevertheless, it tends to have a similar structure that, according to Beinat et al. (1999), can be broken down into the eight stages, shown as follows:

1. **Screening.** It represents the first logical activity of a EIA, being aimed at determining whether the EIA procedure itself is necessary for the proposed development;
2. **Scoping**. It is the process of identifying the most significant issues (environmental components, impacts) that need to be addressed during the EIA;
3. **Baseline study**. It represents the result of the collection of all the relevant data concerning the status of the environment likely to be affected by the developments;
4. **Impact prediction.** It involves the description of the forecasted changes in the environment caused by the presence of the development;
5. **Impact evaluation.** It provides an interpretation of the forecasted impacts in terms of their significance and their relative importance, so that indications can be

drawn on the acceptability of the development and on the most suitable alternative to be selected;

6. **Mitigation and compensation**. It requires the analysis of possible measures that can reduce or remove environmental impacts, alleviating the overall damage of the development on the environment;
7. **Review**. It is performed by the competent authority to assess whether the submitted environmental impact statement (EIS) is adequate and conformed to the current regulations;
8. **Monitoring.** It takes place during and after the construction of the development, to check whether the impact predictions were accurate

Sound environmental management of tourism facilities and especially hotels can increase the benefits to natural areas. But this requires careful planning for controlled development, based on analysis of the environmental resources of the area. Planning helps to make choices between conflicting uses, or to find ways to make them compatible. By planning early for tourism development, damaging and expensive mistakes can be prevented, avoiding the gradual deterioration of environmental assets significant to tourism.

Cleaner production techniques can be important tools for planning and operating tourism facilities in a way that minimizes their environmental impacts. For example, green building (using energy-efficient and non-polluting construction materials, sewage systems and energy sources) is an increasingly important way for the tourism industry to decrease its impact on the environment. And because waste treatment and disposal are often major, long-term environmental problems in the tourism industry, pollution prevention and waste minimization techniques are especially important for the tourism industry. A guide to sources of information on cleaner production (free) is available here.

Self-Check -3	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. What are threat to existing ecosystem flora and fauna? (5points)
2. What is components ecosystem services?(5points)
3. List factors that cause habitat loss and degradation in Ethiopia (5points)

Note: **Satisfactory rating >7.5 points** **Unsatisfactory - below 7.5 points**

Answer Sheet

Score = _____

Rating: _____

Operation Sheet 1	Identify On-site indicators of threats of flora and fauna

Objective to assess On-site indicators of threats of flora and fauna

Procedures

Presence of livestock or pest animals

Presence and size/extent/type of weeds

Requires assessment by a professional fire ecologist

Dieback/death of plants.

Disease

Pollution

Soil erosion

Signs of human visitation and use of site; recently cut stumps.

Information sheet 4- Assessing range of likely operating conditions, hazards and difficult

4.1. Hazards and Difficult

Areas where response actions occurred or are ongoing may contain potentially hazardous materials and should be treated with caution to minimize exposure to field personnel. Additional hazards include slips, trips, and falls; heat stress; insects; poison sunburn; and boating hazards. Wear will comply with the site-specific Health and Safety Plan and may include waterproof clothing (e.g., waders/heavy rubber boots), safety glasses, and a personal flotation device as appropriate. In addition, all field staff are required to be in compliance with the safety requirements.

The site-specific Health and Safety Plan must be reviewed to identify further hazards, precautions, and safety procedures. A daily tailgate safety meeting will be held prior to beginning any field work. A written record of the daily tailgate safety meeting, including signatures of all personnel present, will be maintained and provided to the study manager at the close of each field day when data are transferred.

4.2. Operating conditions

Operating conditions are a set of conditions for operating a particular system or process. Operating conditions are a set of conditions for operating a particular system or process.

To carry out this restoration, there are operations like:

- Treatment of invasive species.
- Placement of clean sand and sediment.
- Seeding and planting.
- Constructing physical structure
- Maintenance and monitoring.

Planting vegetation such as seedlings, trees and/or shrubs is a very popular method of erosion control. The root systems of vegetation help re-stabilize eroding river banks. Other fish habitat restoration methods used to stabilize river banks are fascines and deflectors.

Self-Check -4	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. What are contain potentially hazardous? (5points)
2. What is Operating conditions in restoration assessment?(5points)

Note: **Satisfactory rating >5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information sheet 5- Preparing vegetation assessment report

5.1. Developing a report/correspondence format, plan and structure

Report is needed to give information about the situation in logical order or to inform relevant personnel in authority about vegetation assessment.

5.2. Format of the report

To meet the needs of these different users of the report, it has frequently been found useful to divide the plan into the following sections:

- *Executive summary*: a summary of the land situation, its problems, the opportunities and the recommendations for action, i.e. the focal point. Reasons for decisions taken are given, but only briefly. Clear, concise writing is of the highest importance. This section should include at least one key map, the (master) restoration program and possibly other maps at small scales.
- *Main report*: Explains the methods, findings and factual basis of the plan. Written for technical and planning staff who wants to know details, including reasons for decisions taken. Often five to ten times as long as the executive summary.
- *Maps volume*: An integral part of the main report, presented separately for convenience of binding with Appendixes. Give the technical data that support the main report. These may run to several volumes. They include the results from original surveys conducted as part of the plan, e.g. soil surveys, forest inventories, records of river flow.

Example of headings for a report

Title

Summary

- *Highlight problems, recommendations and the main reasons for these recommendations.*

Introduction

- *The long-term goals for the planning area and the purpose of the plan*

- *Relationship with other documents. Briefly describe legislation and any higher-level plans as well as local plans that are related to this plan.*
- *Description of the planning area. A brief overview of location, area, population, land resources, current land use and production*

Management problems and opportunities

- *Degraded land problems and opportunities.*
- *Rationale for the selected option.*
- *Summary of the changes the plan will bring about, by subject area or geographic area.*

Direction

- List land-use types and standards that apply to the whole planning area and to individual planning units.
- Identify projects. Illustrate with maps and diagrams.
- Time scale for action.

Monitoring and revision

- Describe the procedure for reviewing progress and revising the plan.

Work plan for implementation

- List individual projects with details of location, time, resources required and responsibility for implementation.

Appendixes

- Supporting information:.- physical environment, planning units, agroclimate and soil data;
    - ✓ Population, settlement, infrastructure, tenure;
    - ✓ Present land use; land degradation
    - ✓ restoration techniques;
    - ✓ economic projections.

Public relations material

Relatively few people will read the full planning document, a larger number will read the executive summary, but a lot of people need to be informed about the plan. Equally important is a range of public information documents, posters and press releases which

are needed to inform the people about the plan, its relevance, the benefits to the community as a whole and the participation needed from different sections of the community. This additional material will draw on the main report but should be specially prepared and well illustrated to secure the most effective participation of all parties.

Writing a report/correspondence

After deciding the format of the report the next step is to write a report or account of something from notes made earlier and making communication by means of exchanged written messages such as letters

Formatting a report/correspondence according to enterprise policies and procedures.

Revising and updating of the report up to date by writing additional entries according to enterprise policies and procedures.

Checking report/correspondence for accuracy

Regularly check the report for updates and correctness with the tangible situation as of comparing with the changes of the local situation.

Finalizing report/correspondence

Arranging review and sign off of report/correspondence

Forwarding report/correspondence to client

Self-Check -5	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. What are reporting format ? (5points)
2. List content of reporting (5points)

Note: **Satisfactory rating >5 points** **Unsatisfactory – below 5 points**

Answer Sheet

Score = _____

Rating: _____

LAP Test	**Practical Demonstration**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within4 hour.

Task 1. Identify On-site indicators of threats of flora and fauna

LG #39	LO #2- Plan natural area restoration program

Instruction sheet

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

- Preparing plans and specifications for natural area restoration works
- Selecting natural area restoration techniques
- Following Steps of strategy
- Planning protective structures
- Selecting and transporting appropriate personnel
- Obtaining appropriate permits/licenses and authorizations
- Equipment and materials

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, **you will be able to**:

- Prepare plans and specifications for natural area restoration works according to program/management aims and objectives.
- Select natural area restoration techniques to meet management plans and enterprise requirements.
- Follow Steps of strategy for works that are outlined.
- Plan protective structures to ensure compliance with OHS and relevant legislation.
- Select and transport appropriate personnel to natural area restoration sites according to enterprise procedures.
- Obtain appropriate permits/licenses and authorizations according to legislative and enterprise requirements.
- Source equipment and materials required for natural area restoration work according to enterprise procedures.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If your performance is satisfactory proceed to the next learning guide,

2.1 Plan and specifications

Restoring woodland/forest communities and interpreting the process will help recreational users understand the beneficial beauty of natural areas and re-establish basic function to these communities, thereby enhancing their ecological quality. Restorations serve three purposes:

a. **Restoring ecological function**: While human intervention can not recreate complex natural ecosystems, basic functionality can be re-established.
b. **Preserving landscape integrity**: Restoration of disturbed plant communities helps preserve overall landscape integrity and continuity.
c. **Providing opportunities for user education**: Management and restoration, coupled with interpretation, build awareness and appreciation of native plant communities without impacting rare habitats.

Native species nursery production plan

The production of native species will be supervised by a flora and native species reproduction expert. The aim of this plan is to reproduce the native species of the vegetation formations affected by the Project, focusing particularly on conservation-dependent species. These will be planted in a larger number than originally found in the area. As already mentioned, the Project considers setting up a nursery. The nursery will have a storage room for supplies and materials, an area to prepare substrata, and a greenhouse to develop vegetative and seed reproduction programs. The nursery will be equipped with an irrigation system for the dry season.

Table1.1 Native Species Reproduction and physical measure Plan

Activity	Timing	Methodology
Preparatory studies	Prior to construction works	Identification of the land occupancy map units subject to intervention, and assessment of the dominant native species and species included in a conservation category.
Seed collection	Prior to construction works	Collection of seeds from all the native species existing in the unit, particularly dominant and conservation dependent species. In lower areas, seeds are collected from November to March, depending on the species; and in upper areas, from January to April.
Nursery production	During works	Production at the site agreed to by the Project Owner and competent authorities, which will begin operating during the autumn of seed collection. The plants will remain in the nursery for at least 2 years in order to ensure a good survival rate.
Reproduction and development study	During nursery production	Development of a reproduction and development study on species included in conservation categories.
Planting	During and after works	Planting activities carried out by qualified company staff from April to July. The first plantation phase (pioneer species) will take place upon completion of the Project's construction phase, and the second phase (late species) two years after the first plantation.
Construction of structural measures	Off production season	Construction of structural measures during off season.
Monitoring of replaced nursery plants for up to 5 years after completion of the Project's construction phase	After the construction phase	Monitoring of plants produced in the nursery and then transplanted for re-vegetation purposes for up to 5 years after completion of the Project's construction phase.

Self-Check -1	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. What are three purposes restorations serve? (5points)
2. Why do you plan for native species nursery production (5points)

Note: **Satisfactory rating >5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information sheet 2- Selecting natural area restoration techniques

2.1. Natural area restoration techniques

Natural area restoration provides the solution to re-establish and maintain the structure and function of a disturbed ecosystem. This is achieved by assisting the natural regeneration of endemic plant species to increase the resilience of a system so it is able to cope with normal periodic stress. A planned and integrated approach allows for the germination and growth of native flora by reducing competition pressures.

Natural area restoration techniques are:

- natural regeneration
- hand planting,
- mechanical planting,
- direct seeding and
- mechanical sowing

2.2. Ecological restoration theory and techniques

Wetlands are the lands transitional between terrestrial and aquatic ecosystems. They provide humanity many services and commodities, are the habitats of wildlife, can control the water cycling and the biogeochemical cycling of nitrogen and carbon, and can filter and decompose the pollutants. The wetlands suffer loss and degradation because of reclamation and human disturbance. Some theories, such as self-design versus design theory, succession theory, invasion theory, flood pulsing theory, edge effect theory, and intermediate disturbance hypothesis, can be used to direct the restoration of wetlands. Techniques of wetland restoration include to restore the natural hydrologic conditions, to rehabilitate suitable vegetation types, to control human disturbance, to meliorate the soil or landscape, to construct the buffer region, and so on.

“Ecological restoration is an intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability.” Restoration typically begins with practical questions, such as “Which sites are available?” “How

have they been degraded?" and "Which targets are feasible?" Additional questions develop from cultural and socio-economic perspectives, including "Which targets are most desirable?" "Who gets to decide?" "How much effort can be expended to achieve targets?" and "How can local communities become involved?" The latter questions are extremely important, and I look to other experts to seek answers from local activists, politicians, and those with traditional ecological knowledge. From the ecological perspective, restoration is an opportunistic arena. A landowner or local entity might decide to restore a degraded site, or a developer might be required to restore a site to mitigate damages that are permitted elsewhere.

Virtually every ecological theory has some application in restoration practice, since all the components of ecosystems need to be in place and functioning naturally for a project to be considered ecologically complete. My aim is to highlight theories with high utility in guiding restoration. For practitioners, the stages of the restoration process suggest an order; thus, we consider theories that guide goal setting, site prioritization, manipulations of abiotic processes and biota, and maintenance of the resulting ecosystem

Self-Check -2	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. What are Natural area restoration techniques? (5points)
2. What is the difference between mechanical planting and direct seeding? (5points)

Note: **Satisfactory rating >5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

3.1. Strategy

Strategies are made as a **blueprint** and action plan is the step by step process of how to go about that blueprint. Strategy is the mental part of reaching a goal, action plan is the physical part of reaching a goal.

An effective strategy **brings together vision and execution**. Strategies are much more specific than an organization's vision, mission, and objectives. Strategies should map long-term plans to objectives and actionable steps, foster innovative thinking, as well as anticipate and mitigate potential pitfalls.

In a perfect world **the strategy always comes before a plan** and shapes the details of the plan. A strategy is the overarching wisdom that coordinates all of the plans in order to effectively reach the goals. Remember, having a plan is essential, but developing a strategy should always come first.

Strategic planning is a framework providing a systematic approach to planning for future development and allocating needed resources for anticipated changes. Ordinary planning and goal setting usually looks at the past and bases the future on historic trends. Strategic planning considers possible future events and trends, and then bases planning and resource allocation on anticipated changes. Simple planning often falls short of implementation because the plan fails to be linked with resources and action

3.2. A strategic action plan

By extension, a strategic action plan explains how you're going to make your strategy a reality. It takes the purpose and goals you've outlined and adds the details needed to turn thought into action.

Short-term planning looks at the characteristics of the company in the present and develops strategies for improving them. Examples are the skills of the employees and their attitudes. The conditions of production equipment or product quality problems are also short-term concerns.

The six steps to the strategic planning process include:

- Identifying your strategic position.
- Gathering people and information.
- Performing a SWOT analysis.
- Formulating a strategic plan.
- Executing a strategic plan.
- Constantly monitoring performance.

Self-Check -3	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. Define strategic planning. (5points)
2. What is the difference between short term and long term planning? (3points)

Note: **Satisfactory rating >4 points** **Unsatisfactory - below 4 points**

Answer Sheet

Score = _____

Rating: _____

4.1. Introduction

A protective structure is defined as any structure designed to modify the environment in which restoration program undertaken. Protective structures, such as Signs, fences, barriers, clothes, stakes and mulches, are known worldwide as protection for high-quality restoration. After restoration activities were implemented, the team should plan how to protect from animal and human.

4.2. Protective signs

Protective signs are symbols to be used during an armed conflict to mark persons and objects under the protection of various treaties. One method that is being used to make the public aware of the sources of their water is the use of signs that mark the watershed boundaries and label the rivers and reservoirs within the watershed.

Figure 4.2 protective signs

4.3. Fences and Barriers

A fence is a structure that encloses an area, typically outdoors, and is usually constructed from posts that are connected by boards, wire, rails or netting. A fence differs from a wall in not having a solid foundation along its whole length. A fence acts as a deterrent for trespassers and intruders and keeps unwanted wild animals off your property as well. Fences are not just designed to keep people and animals out, but they also keep things in, like children.

A barrier is anything that blocks or separates something. Walls, fences, and bars are examples of barriers. Construction barriers are fences, signs, and other devices used on constructions sites for: Preventing unnecessary, unauthorized, or inadvertent

access by people, vehicles, and equipment, to structural natural area or other prohibited areas of the restoration site.

Figure 4.3. Fences and barriers

Self-Check -4	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. What are protective structures in restoration program? (5points)
2. What is the difference between fences and barriers? (3points)

Note: **Satisfactory rating >4 points** **Unsatisfactory - below 4 points**

Answer Sheet

Score = _____

Rating: _____

Information sheet 5- Selecting and transporting appropriate personnel

As the responsibilities of the department have evolved, the term human resources is the term that is used for departments that manage personnel and the resources to develop talent. Personnel refer to the actual human beings, while resources are all the tools to recruit, manage and train people to be better employees.

Arranging appropriate transport for staff and equipment for site access as required for erosion assessment and measurement purpose. Arranging transport by providing vehicles, spares, fuel, servicing equipment, etc.

To apply the assessment transport:

- Identify the type of materials to be transported.
- Identify and select the type of vehicle used in relation to the suitability of the materials, equipment and machinery to be transported
- Identify and select safe driver
- Identify the safest direction and routs of driving
- Follow basic safety procedures in handling and transporting materials, equipment and machinery

Safe vehicle

- Vehicles, machines and hand handling equipment are; capable of safely performing the jobs to be done and inspected daily and faults repaired promptly and properly maintained, paying particular attention to braking system;
- Drivers of material handlers and loaders are protected from falling objects and loads are stable;
- The vehicles used to transport equipped with lamps ,brakes ,horns, mirrors, wind shields and turn signals, are good in repair;
- The vehicles for it is fully charged with fire extinguisher;
- Cutting tools are carried on transport vehicles are placed in a box.

Safe driver:

- Drivers; are licensed and medically fit to drive and are properly trained and un authorized people are not allowed to drive

Follow basic safety procedures:

- Secured packages, including palletized ,against shifting within vehicle during transportation.(tying, blocks and bracing the load)
- Load packages with orientation marks so that the marks remain pointed up.
- Do not allow any smoking near the vehicle when loading / un loading flammable.

Transport:

- Vehicle fleets should be standardized (same makes and models);
- Ensure there are sufficient drivers, fuel, lubricants, spare parts, tyres, maintenance personnel and facilities;
- It may be necessary to improve access roads, bridges, airport, or other infrastructure;
- The substantial margin of spare transport capacity (10-20%) must be provided;
- With health and community services, assess particular requirements for transporting refugees in a repatriation operation, and/or distribution for vulnerable groups.

Kind of transport

- International Transport (Air & Sea)
- National Transport (Transport Networks & Road Transport)

Accident rates increase markedly with tired drivers.

A system must be established to monitor and control vehicle use. In some situations, urgent action may be necessary in order to improve access roads. Technical advice will be of paramount importance in deciding how improvements should be made (seek advice through Programmed and Technical Support Section at Headquarters).

These improvements could be undertaken by the ministry of transport .In some situations, careful briefing will be required about alternative routes in case usual roads

are impassable. Vehicles, bicycles, or animal or hand carts could be used for final distribution. Observe how local movement of supplies normally takes place.

Transport Capacities

If a commodity is to be transported by truck, the number of trucks needed should be calculated from the following information:

i. The quantity of goods to be transported in weight and volume;

ii. Type of truck available and its capacity in weight and volume;

iii. How long a round trip takes (including loading and offloading);

iv. Time allowed for routine maintenance capacity or time allowed for other known factors (driver breaks);

v. A margin for unpredictable events (such as breakdowns, accidents, bad weather, road and bridge repairs). In difficult conditions, the theoretical capacity might need to be increased by 25% or more.

Transporting staff by road

Logistical support will be necessary when transporting technical staff for erosion site assessment and measurement work will be under way.

Self-Check -5	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What does arranging transport mean?(3points)

2. Why caring for staff and equipment during transport?(5points)

Note: **Satisfactory rating >4 points** **Unsatisfactory - below 4 points**

Answer Sheet

Score = _____

Rating: _____

Information sheet 6- Obtaining appropriate permits/licenses and authorizations

Authorization is the function of specifying access rights/privileges to resources, which is related to general information security and computer security, and to access control in particular. More formally, "to authorize" is to define an access policy. Restoration team should take permits/licenses on cover fire, vehicle operation (including heavy vehicles), access to specific places, working near threatened species, and for herbicide application.

Site access and site clearance /permit are important for the security condition and unnecessary conflicts occurrence. Over and above, site access and site clearance /permit protect life cost (death) to workers and property damage. Check and arrange security clearances for staff and equipment, e.g. for the purchase and use of maps, air photographs and computers. So, arranging site access and site clearance /permit from the following personnel for erosion assessment and measurement are important. Those personnel are the following but may not limited to

- Community elders,
- Farmers association leaders
- Local administrators

Site accessibility

To determine accessibility of a given site there are two constraints.

A. Natural constraints

   May be unfavorable climate (extremely cold or hot, heavy shower of rainfall, etc)

B. Technical & socio-economical constraints

   May be road damage, lack of permit from personnel to access site for staff and equipment, Security case, etc

Self-Check -6	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Why site access and site clearance /permit is needed for erosion assessment and measurement?(5points)

2. Who are personnel those give site access and site clearance /permit? (3points)

3. To determine accessibility of a given site there are **two** constraints. What are?(2points)

Answer Sheet

Score = _____

Rating: _____

Note: **Satisfactory rating >5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 7- Equipment and materials

7.1. Introduction

Sustainable agriculture: Meeting the requirements for food production while maintaining profitability and preserving the environment.

There is a whole range of tools and equipment you might need for re-vegetation. Many of these will be covered in the various other learning guides. Make a list in your project natural resource of all the tools and equipment you think you will need. Below are some examples. Tape measures Paper, pencils, ruler and compass for plan Calculator Spray pack Herbicide Buckets Auger Mattock Trowel Rakes Wheelbarrow Shovel and spade Hammers Pliers Irrigation punches Steel post driver, GPS, clinometer, water level, Arial photo, topographic map,

Assembling, checking & arranging tools and equipment, safety equipment weather fitting for erosion assessment and measurement purpose. Tools and equipment required for erosion assessment and measurement include, but not limited to be:

- Tape measure, rulers, micrometers callipers, water level indicators
- GPS, pegs, string, hammer, Knives, trowels, spades, forks, rakes, hoes, shovels, buckets, stationery, spades
- Sensitive balances
- Oven dry (for soil bulk density measurement)
- Meter/probe systems (for example, Dissolved Oxygen (DO), Electrical Conductivity (EC))
- Analogue and digital meters (for example, voltage, current, resistance, pressure,
- Temperature, barometers, anemometers, hygrometers)
- Dipsticks or spot test kits
- Clocks, timing devices.

Safety practices may include, but not limited to:

- Use of Material Safety Data Sheets (MSDSs)

- Use PPE, such as; hard hats, hearing protection, gloves, safety glasses, goggles, face-guards, overalls, gown, body suits, respirators, safety boots
- Correct labelling of hazardous materials
- Handling and storing hazardous material and equipment in accordance with labels, MSDS, manufacturer's instructions, enterprise procedures and regulations
- Regular cleaning and/or decontaminating of equipment
- Fitting machinery guards
- Signage, barriers, service isolation tags, traffic control, flashing lights
- Lockout and tag out procedures

Self-Check -7	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. List equipment and materials used for restoration program? (8points)

Note: **Satisfactory rating >4 points** **Unsatisfactory - below 4 points**

Answer Sheet

Score = _____

Rating: _____

LG #40	LO #3- Monitor natural area restoration works

Instruction sheet

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

- Conforming OHS management
- Making Observations of o natural area restoration plans
- Making site specifications
- Checking plant materials, machinery and equipment
- Performing natural area restoration works
- Monitoring Work and undertaking remedial action

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**:

- Conform OHS management
- Make Observations of o natural area restoration plans
- Make site specifications
- Check plant materials, machinery and equipment
- Perform natural area restoration works
- Monitor Work and undertaking remedial action

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed.
4. Ask your trainer for assistance if you have hard time understanding them.
5. Accomplish the “Self-checks” which are placed following all information sheets.
6. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
7. If you earned a satisfactory evaluation proceed to “Operation sheets
8. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
9. If your performance is satisfactory proceed to the next learning guide,
10. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

1.1. Application of OHS

Occupational safety and health, also commonly referred to as occupational health and safety, occupational health, or workplace health and safety, is a multidisciplinary field concerned with the safety, health, and welfare of people at work.

A health and safety program is a definite plan of action designed to prevent accidents and occupational diseases. Some form of a program is required under occupational health and safety legislation in most Canadian jurisdictions. A health and safety program must include the elements required by the health and safety legislation as a minimum.

Because organizations differ, a program developed for one organization cannot necessarily be expected to meet the needs of another. This document summarizes the general elements of a health and safety program. This approach should help smaller organizations to develop programs to deal with their specific needs.

1.2. Program elements

While organizations will have different needs and scope for specific elements required in their health and safety program, the following basic items should be considered in each case:

- Individual responsibility.
- Joint occupational health and safety committee.
- Health and safety rules.
- Correct work procedures.
- Employee orientation.
- Training.
- Workplace inspections.
- Reporting and investigating accidents/incidents.
- Emergency procedures.
- Medical and first aid.
- Health and safety promotion.
- Workplace specific items.

Self-Check -1	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. While organizations will have different needs and scope for specific elements required in their health and safety program. What are basic items should be considered in restoration program? (10points)

Note: **Satisfactory rating >5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information sheet 2- Making Observations of o natural area restoration plans

2.1. Observations

Observation is the active acquisition of information from a primary source. In living beings, observation employs the senses. In science, observation can also involve the recording of data via the use of instruments.

Observation is the action or process of closely observing or monitoring something or someone.

2.2. Plant materials, machinery and equipment

Specifications: drawings, schedules, method statements, Standard Operating Procedures (SOPs), manufacturers guidelines, customer requirements

Set equipment for output:

- plants/ha
- kg/ha

Planting material:

- seeds
- plants
- tubers etc
- fertilisers
- treatments

Position planting material:

- density
- depth
- orientation

Timing:

- seasonality
- soil conditions
- weather conditions

- environmental conditions

Relevant factors:

- soil type and condition
- topography
- climate
- weather and ground conditions
- previous treatments
- existing structures and systems (e.g. fences, hedges, drainage)
- access

2.3. Monitoring natural area restoration works

Restoration in the context of nature conservation includes a range of management activities, some of them ill-defined. For the purpose of this study, ecological restoration is defined as management that aims to restore particular biotic communities to a condition more like that of a selected time period in the past. It is concerned with both animals and plants as parts of self-maintaining communities and is therefore system orientated rather than species-oriented. However, attention to the ecological requirements of individual species, both the dominant plants and animals, and other less common species, is essential for success with restoration. Furthermore, improving the chances of survival for some threatened species often requires re-establishment of suitable habitats. Here, the goals of community and species management coincide.

How does restoration differ from protection? Control of mammalian browsers and predators, or of problem weeds, is often necessary to prevent degradation of ecological systems we value. This is an example of protection with the expected outcome that natural restorative processes, such as plant and animal succession, will be sufficient to halt or reverse the degradation. However many systems are so altered, particularly by loss of species or changed physical conditions, that no amount of control work will restore these species or conditions. If sufficient value is attached to restoring a particular system to something more like its former condition, then active intervention to reinstate the lost species or lost physical conditions (e.g. a former water-table regime) will be needed. It is this additional kind of intervention that distinguishes ecological restoration from protection. When the distinction is made, it focuses attention on the

goals of the programme and enables funding for restoring something of the past to be separated from that required to maintain the status quo.

Both protection and restoration can be labour-intensive but some kinds of protection can be applied to large areas. With ecological restoration there are needs for continuing intervention over a considerable period of time and for regular monitoring of progress. Much of this work must be conducted in a site-specific manner. These needs place substantial constraints on the size and kind of place than can be used for restoration. Restoration without human intervention is widespread. It results from normal regeneration and successional processes in which, with the passing of time, species of both native and alien plants and animals replace each other at a site. Restoration programmes should always aim to complement whatever natural regeneration of plants and animals is taking place rather than attempt to substitute for it.

In most conservancies there are no formal procedures for monitoring restoration programmes. A great deal of informal monitoring as well as some systematic monitoring (particularly of threatened species dependent on restoration programmes) is taking place. It is apparent from the questionnaire returns that in most programmes only one or two parameters are being monitored.

Rehabilitation activities are preceded by stakeholder consultation to enhance awareness of the causes and consequences of land degradation and of the available techniques for rehabilitation and their benefits.

Rehabilitation efforts must be preceded by the collection of baseline data on biophysical and socioeconomic conditions, followed by monitoring of these aspects during the rehabilitation process.

The Environmental Rehabilitation process should form an integral part of site and construction activities. The rehabilitation specialist should therefore be appointed, and on-site at the project construction inception. The Rehabilitation Specialist would form an integral part of the project team, attending regular project site meetings, receiving project meeting Minutes and being kept fully updated regarding the Construction Programme timeframes and Construction Works sites.

Self-Check -2	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. _____ is the active acquisition of information from a primary source. In living beings, observation employs the senses. (2points)
2. List planting material. (5points)
3. How do you monitor restoration program? (2points)

Note: **Satisfactory rating >4 points** **Unsatisfactory - below 4 points**

Answer Sheet

Score = _____

Rating: _____

3.1. specifications

The site specification is the planning team's concise statement of core goals, values, and intent, to provide the ultimate policy direction for everything that comes next.

Designing a substantial restoration site is a costly and time-consuming process. When you're up to your neck in the daily challenges of building the site, it can be surprisingly easy to forget why you are doing what you are, to lose sight of your original priorities, and to not know on any given day whether the detailed decisions you are making actually support those overall goals and objectives. A well-written site specification is a powerful daily tool for judging the effectiveness of a development effort. It provides the team with a compass to keep the development process focused on the ultimate purposes of the site. As such, it quickly becomes a daily reference point to settle disputes, to judge the potential utility of new ideas as they arise, to measure progress, and to keep the development team focused on the ultimate goals.

At minimum, a good site specification should define the content scope, budget, schedule, and technical aspects of the Web site. The best site specifications are very short and to the point, and are often just outlines or bullet lists of the major design or technical features planned. The finished site specification should contain the goals statement from the planning phase, as well as the structural details of the site.

3.2. Goals and strategies

- What is the mission of your organization?
- How will creating a Web site support your mission?
- What are your two or three most important goals for the site?
- Who is the primary audience for the Web site?
- What do you want the audience to think or do after having visited your site?
- What Web-related strategies will you use to achieve those goals?
- How will you measure the success of your site?
- How will you adequately maintain the finished site?

3.3. Production issues

- How many pages will the site contain? What is the maximum acceptable count under this budget?
- What special technical or functional requirements are needed?
- What is the budget for the site?
- What is the production schedule for the site, including intermediate milestones and dates?
- Who are the people or vendors on the development team and what are their responsibilities?

These are big questions, and the broad conceptual issues are too often dismissed as committees push toward starting the "real work" of designing and building a restoration site. However, if you cannot confidently answer all of these questions, then no amount of design or production effort can guarantee a useful result.

3.4. Avoiding "scope creep"

The site specification defines the scope of your project — that is, what and how much you need to do, the budget, and the development schedule. "Scope creep" is the most prevalent cause of restoration project failures. In badly planned projects, scope creep is the gradual but inexorable process by which previously unplanned "features" are added, content and features are padded to mollify each stakeholder group, major changes in content or site structure during site construction are made, and more content or interactive functionality than you originally agreed to create is stuffed in. No single over commitment is fatal, but the slow, steady accumulation of additions and changes is often enough to blow budgets, ruin schedules, and bury what might have been an elegant original plan under megabytes of muddle and confusion.

Don't jump into building a restoration site before you understand what you want to accomplish and before you have developed a solid and realistic site specification for creating your restoration site. The more carefully you plan, the better off you will be when you begin to build your site.

One excellent way to keep a tight rein on the overall scope of the site content is to specify a maximum page count in the site specification. Although a page count is hardly infallible as a guide, it serves as a constant reminder to everyone involved of the project's intended scope. If the page count goes up, make it a rule to revisit the budget implications automatically — the cold realities of budgets and schedules will often cool the enthusiasm to stuff in "just one more page." A good way to keep a lid on scope creep is to treat the page count as a "zero sum game."

Changes and refinements can be a good thing, as long as everyone is realistic about the impact of potential changes on the budget and schedule of a project. Any substantial change to the planned content, design, or technical aspects of a site must be tightly coupled with a revision of the budget and schedule of the project. People are often reluctant to discuss budgets or deadlines frankly and will often agree to substantial changes or additions to a development plan rather than face an awkward conversation with a client or fellow team member. But this acquiescence merely postpones the inevitable damage of not dealing with scope changes rationally.

The firm integration of schedule, budget, and scope is the only way to keep a restoration project from becoming disturbed from the real constraints of time, money, and the ultimate quality of the result. A little bravery and honesty up front can save you much grief later. Make the plan carefully, and then stick to it.

Self-Check -3	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. What should a good site specification define?(5points)
2. Changes and refinements can be a good thing, as long as everyone is realistic about the impact of potential changes on the budget and schedule of a project. ?(3points) True/ false

Note: **Satisfactory rating >4 points** **Unsatisfactory - below 4 points**

Answer Sheet

Score = _____

Rating: _____

4.1 Routine inspections and maintenance

Routine inspections and maintenance are normally based on usage. Routine inspections should be undertaken in accordance with manufacturer's recommendations but at least every three months.

Hazards associated with working near or on machinery vary depending on the exact machine used but can include exposure to: moving parts (e.g., risk of injuries from entanglement, friction, abrasion, cutting, severing, shearing, stabbing, puncturing, impact, crushing, drawing-in or trapping, etc.)

One unavoidable aspect of running a business is dealing with regular maintenance of your assets, equipment, and property. Within these groupings, we'll cover several specific types of maintenance, including preventive, predictive, planned, condition-based, reactive, emergency, and corrective maintenance. Four general types of maintenance philosophies can be identified, namely corrective, preventive, risk-based and condition-based maintenance.

The objective of plant maintenance is to achieve minimum breakdown and to keep the plant in good working condition at the lowest possible cost. Machines and other facilities should be kept in such a condition which permits them to be used at their optimum (profit making) capacity without any interruption or hindrance.

Self-Check -4	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. What is the objective of maintenances?(6points)

Note: **Satisfactory rating >3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Information sheet 5- Performing natural area restoration works

5.1. Introduction

Rehabilitation The original ("Latin") meanings of rehabilitation and restoration are identical. However the emphasis in rehabilitation work has been to replace lost vegetation, often with something generally similar, but with no particular aim of re-instating a system from a former time period. Where eradication of a pest species is possible, such as on an island or fenced-off mainland peninsula, natural regeneration of plants may be sufficient to rehabilitate the area without further intervention.

Re-vegetation Because ecological restoration sometimes requires planting, there can be confusion between re-vegetation and restoration. Re-vegetation involves re-establishing a plant cover of some kind: indigenous, exotic, or mixed. It may be done for a variety of purposes, such as erosion control, stabilising batters along roadsides or canals, reestablishing plants on mining sites, or beautifying an unattractive area. There may be no particular need to restore the plant cover to a former state. I n one respect, ecological restoration is a specialised kind of re-vegetation; in another, it goes beyond re-vegetation because of the interest in animals. Soil restoration emphasises soils; land restoration emphasises physiography, vegetation and soils; ecological restoration includes animals as well as physiography, vegetation, and soils.

Recovery Recovery has also been used in an ecological context. The term has in recent years become particularly associated with species recovery plans. A recovery programme for a threatened species is something that can stand on its own, but it may often involve restoration of a biotic community as habitat essential for the species.

Enhancement The term enhancement is often used loosely, but in an ecological context it refers to an increase in the quality or quantity of some characteristic of a site or area. Whether this results in an improvement on the previous condition can be a subjective judgement.

Ecological engineering It i s possible to establish new combinations of plants and animals, both native and exotic, as biotic communities for conservation purposes; for

example, as habitat for a threatened species. The extent to which some pine forests have been used by kiwi highlights the potential of this kind of management which I have elsewhere called ecological engineering (Atkinson 1990:85).

5.2. Techniques for rehabilitation of degraded lands

This section reviews rehabilitation techniques which are being used in the agricultural and forest sectors.

- **Natural Regeneration**

Natural regeneration involves deliberately protecting degraded land to enhance and accelerate the natural processes of forest succession in order to re-establish a healthy and resilient productive – generally a forest – ecosystem. Where land is suited to direct human use and has not been stripped of topsoil, substantial recovery may be achieved in as few as 3 to 5 years but more typically may take 20 years.

This technique is simple and cheap.

Disadvantages:

- ✓ Uncontrolled grazing can have a major influence.
- ✓ When land has been degraded for a long period, natural processes are often disturbed and barriers are formed which block the natural pathways of forest succession. These barriers include: low availability of native seeds and other propagules on-site, seed and seedling predation, seasonal drought, root competition, and poor soil conditions. Natural regeneration can be used in all ecological zones. However, as earlier mentioned, the degree of success depends on the ecological characteristics of each specific site.

- **Assisted Natural Regeneration**

An alternative approach to the restoration of degraded lands is to accelerate regeneration by assisting the natural processes of succession. Assisted natural regeneration (ANR) involves: cutting or pressing down the weeds around existing naturally established seedlings, protecting the area from fire, area closures etc. ANR differs from 'natural regeneration', as it allows some human intervention but generally precludes tree planting.

As with natural regeneration, ANR is also simple and cheap to implement. However, it is important to know what specific factors limit the rate of regeneration of trees in deforested areas, so that minimum input strategies may be devised to overcome them.

- ***Area closure***
  - ✓ Area closure is a very low input conservation measure because the only thing that is practice is to prohibit livestock & human interference.
  - ✓ It is a passive restoration when no action is taken except to cease environmental stressors such as agriculture or grazing.
  - ✓ The main objective is to improve the ground vegetation cover of degraded land by natural regeneration
  - ✓ There is no tree plantation what is done is to close the area from 3 to 5 years until 80% of the natural vegetation attain.
  - ✓ In need a very tight willingness of the community for its effectiveness.
  - ✓ After the natural vegetation attain 80% it is possible to use with proper management.
  - ✓ If the enclosure diversity is very low enrichment plantation is possible but the species should be more of local rather than exotic.
  - ✓ Mostly this is a good conservation for marginal lands.

- **Enrichment Planting**

Enrichment planting is defined as the introduction of valuable species to degraded forests without the elimination of valuable individuals already present. The technique includes: line-, strip-, gap- and under- planting. Enrichment planting practice is intermediate in intensity between natural regeneration and plantations. This technique has been suggested for restoration of over-exploited primary and secondary forests as it can increase total tree volume and the economic value of forests. In addition, there are biological, environmental and economic arguments in favour of enrichment planting.

When compared to other artificial regeneration systems, enrichment planting has the advantages of mimicking natural gap dynamics and protecting the soil by maintaining vegetative cover on site. Although enrichment planting is mainly used in the humid zone for production of timber, it has potential for application in other ecological zones.

The main constraints for the application of this technique include: difficulty in selection of appropriate species and/or a lack of adherence to sound planting and tending practices. Others include: insufficient over storey opening prior to planting, insufficient follow-up tending, pest attacks, labour demand and high costs of establishment and maintenance of planting in the initial years.

- **Plantations**
  - ✓ **Direct seeding and**
  - ✓ **Seedling planting**

This technique involves planting trees and/or shrubs as single or mixed species on degraded lands. There is increasing evidence that mixed-species plantations are more effective for rehabilitation than the use of single-species plantations due to their high potential for biomass production and attraction to animal seed dispersers as well as increased soil fertility and soil microbiological activity (Vanclay 1994, Parotta 1999). The inclusion of promising indigenous tree species along with exotic species would further improve the ecological stability and sustainability of forest plantations (Yirdaw 2002). Mixed forest plantations, therefore, should be given serious consideration in the planning and establishment of rehabilitation programmes.

Major considerations in the use of plantations for rehabilitation include:

- Careful and accurate species/site matching.
- Choice of complementary species in case of mixed species plantations.
- Critical timing of forest management interventions.
- Provision of adequate protection against fire and grazing especially in the savannah and drylands.

Land Rehabilitation Using Agroforestry

Trees may be grown in farmer's field while crops are grown in the under storey. The trees might be dispersed widely or spaced systematically. The practice of raising trees dispersed on cropland may be based on protection and management of existing trees or it may involve planting of new trees.

In many drier parts of Ethiopia this kind of agroforestry is common. Species commonly used for this purpose is *Acacia albida, Balanites aegyptica* and *Croton machrostachys* in higher altitudes and rainfall areas. Even exotic species such as *Leucocephala,*

Sesbania sesban, *Grevillae robusta* and *Calliandra calothyrsus* can be used for this purpose in the higher rainfall areas. An advantage of this system is that, these trees produce leaves during dry season, which can be used as livestock fodder. In addition they pump up nutrients such as phosphorus from deeper layers of the soil. Through their nitrogen fixation capacity they improve the soil fertility and growth performance of most crop species especially that of sorghum and maize. However it is important that the trees are regularly managed through pruning, lopping, pollarding or coppicing before the growth season of the crops.

Reclamation agroforestry involves two stages. In the first stage, tree and/or shrub species are introduced on to degraded forestland together with any necessary mycorrhizal or rhizobial symbionts, with the objective of checking erosion and restoring soil organic matter and fertility status.

In the second stage, the cover may be selectively removed and agricultural production introduced. However, time is needed to build-up the enlarged plant-litter-soil nutrient cycle, a period during which exploitation of the vegetative biomass should be kept low with necessary protection from grazing etc. The initial tree removal can be along contour aligned strips, with belts of trees remaining in between, leading by stages towards hedgerow intercropping (Young, 1989, 1995). Other options include fodder incorporation along strips or multi-storey systems (Young, 1989, 1995).

- **Soil and Water Conservation**

Soil and water conservation techniques entail creating structures which improve the retention of water for plant growth. These techniques are more suitable for the dry sub-humid and dry land areas, which experience severe moisture deficits. The techniques are, however, generally labour-intensive.

- **Directing ecological successions**

Ecological succession is the process by which the component species of a community changes over time. Following a disturbance, an ecosystem generally progresses from a simple level of organization (i.e. few dominant species) to a more complex community (i.e. many interdependent species) over a few generations. Depending on the severity

of the disturbance, restoration often consists of initiating, assisting or accelerating ecological succession processes.

In many ecosystems, communities tend to recover following mild to moderate natural and anthropogenic disturbances. Restoration in these systems involves hastening natural successional trajectories. However, a system that has experienced a more severe disturbance (i.e. physical or chemical alteration of the environment) may require intensive restorative efforts to recreate environmental conditions that favor natural succession processes.

Analyzing sample soil

The first consideration for any information involving environmental analytical data is whether the samples adequately represent the site being investigated. The purpose of environmental sampling and analysis is to obtain a small but informative portion of the sampling site media being investigated. Seldom is the entire site collected for analysis. There are almost infinite soil samples that could be taken in most situations. Therefore, soil samples that are intended to be “representative” of a site are analyzed and conclusions about that entire site are made based on the data obtained from them. It is now clear that most of the important and large costs involving decisions are based on the sampling data, making it essential that these data accurately characterize the conditions of the actual site.

The primary aim of representative soil sampling is to get accurate data about the soil quality of a specific site but the ultimate objective is to know the soil characteristics of the area and implement rehabilitation and restoration.

5.3. Selection of species to restore the degraded area

Indigenous or other selected species is used in the demarcated area to rehabilitate degraded woodlands and provide alternative sources of fuel wood and income for the communities.

Biological intervention refers to the use of versatile plant species (Single/combination of species) such that it can overcome many if not most of the problems confronting the restoration of degraded areas. The species must have the following characteristics:

- Ability to survive, adapt and grow normally under harsh condition;

- Ability to grow at extremely low/high pH levels;
- Potential to grow fast/ increase its biomass;
- Tolerate drought and fire;
- nitrogen-fixing and/or mycorrhizal associations (bioremediation potential);
- Resistance to pests and diseases;
- Potential to reproduce even under adverse environment;
- Ability to phytoremediate (remove toxic heavy metals from the mine waste areas).

The species should also possess other environmental functions. The so-called bio-engineering strategy combines vegetative and engineering schemes i.e. planting of certain species or mix of different plant forms in a methodical manner to provide structural cover for erosion control, slope stabilization and enhanced drainage system.

Vegetative measures are first choice because they are rather cheap materials, i.e more or less four times cheaper engineering structures.The basic considerations in the selection of tree species as bio-engineering measure against soil erosion and landslides are as follows:

- Plants must grow quickly to establish ground cover, have dense rooting systems and canopies.
- Roots and aboveground parts should grow rapidly in order to provide the required protection as soon as possible (rapid lateral growth of stems, leaves and roots for erosion control)
- Plant should possess deep and wide root system for good anchorage in the subsoil. A dense shallow root system can also be used because of the matting effect
- Rapid and dense growth of roots vertically for shallow-seated slope stabilization
- High root tensile strength and surface roughness for soil reinforcement
- Plant should produce a large volume of litter to improve the site. Legumes, in particular, can add considerable amount of nitrogen to the soil through symbiosis with nitrogen-fixing bacteria
- Prevent or minimize further transport of eroding materials

- Plant should form dense and wide spreading crowns or interlocking canopy as early as possible.
- Ability to be propagated vegetatively/asexually as large section cuttings as used in brush layering and as large diameter live poles.

Potential key plant species for restoration or rehabilitation

1. native species: to enhance biodiversity
2. rare or threatened species: to increase their populations
3. fast-growing species: to occupy site and exclude weeds
4. species tolerant of poor soils: to facilitate rehabilitation
5. nitrogen-fixing species: to improve soil fertility
6. fire tolerant trees: to use in fire-prone landscapes, create new forests or form buffers around a restored forests

Factors motivating the need for land rehabilitation

- Accelerating degradation - soil erosion
- Decreasing productive capacity/soil
- Decreasing water table
- Sedimentation of lakes / Eutrophication / Water hyacinth
- High % of food insecure households
- Erratic rainfall
- Over grazing
- Exhausted soil,
- Low organic mater

Physical Rehabilitation Measures is a process of returning the land in a given area to some degree of its productivity through physical structures involving bunds, terraces and basins.

- Micro-basins - The most common measure in land rehabilitation on slopes

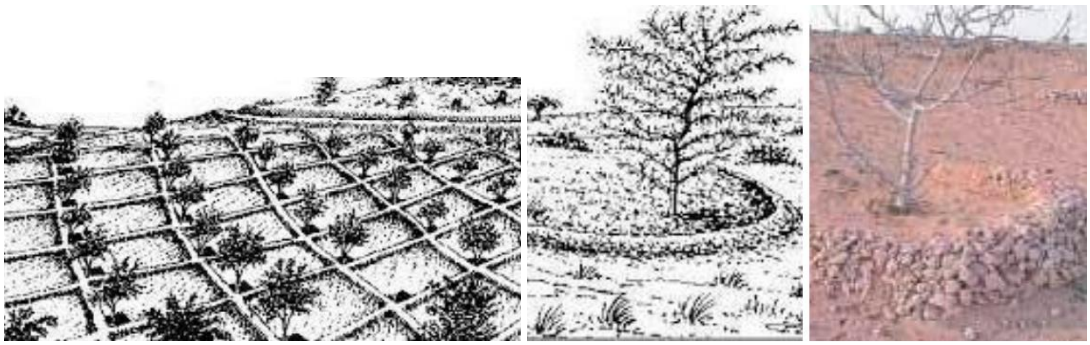

Figure 5.1 Micro basins

- Stone bunds - Effective in fields with excess stones

Figure 5.2. stone bunds

- Check dams
  - ✓ Important in waterways
  - ✓ Can also be used to control gully formation

Figure 5.3. Check dam

- Hillside terraces
  - ✓ Very labor demanding
  - ✓ Good control of erosion
  - ✓ Good infiltration

Figure 5.4. Hillside terraces

- Biological rehabilitation measures
  - ✓ A process of returning the land in a given area to some degree of its productivity through tree/grass planting and related bio-based efforts.
- Contour grass-strips
  - ✓ Easily established
  - ✓ Give fodder for livestock

- ✓ Give forage for apiculture
- ✓ Can be combined with trees and legumes

- Contour hedge-rows
  - ✓ Easily established if suitable spp are used
  - ✓ Give fodder for livestock
  - ✓ Can be combined with trees

Self-Check -5	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. What is area closure? (5points)
2. **List factors motivating the need for land rehabilitation. (10points)**

Part II Match column "A" with Column "B"

A	B
1. native species	A. to facilitate rehabilitation
2. rare or threatened species	B. to improve soil fertility
3. fast-growing species	C. to occupy site and exclude weeds
4. species tolerant of poor soils	D. to enhance biodiversity
5. nitrogen-fixing species	E. to increase their populations
6. fire tolerant trees	F. to use in fire-prone landscapes, create new forests

Note: **Satisfactory rating >7.5 points** **Unsatisfactory - below 7.5 points**

Answer Sheet

Score = _____

Rating: _____

Operation Sheet 1 – Rehabilitate Degraded Natural Areas

Objective:

To enhance and rehabilitate degraded natural areas.

Procedures:

- Improves the habitat values of an area
- Reduces longer term management inputs
- Increases other values such as amenity and passive recreational use, and
- Assists in reducing the risk of fire by reducing the prevalence of weeds.

Operation Sheet 2 – Measurement of gully and erosion

Objectives

To measure gully erosion

Procedures:

For an area where the average dimensions of many measured gullies or ravines estimate soil loss in ton/ha/yr using the following steps:

1. Measure the average cross-sectional area (width at lip = ____ m, width at base = _____ m, depth = _____m of the gully/rill in a study area, assuming a trapezoidal cross-section
2. Measure the gully length in the study area, and then compute the volume of soil lost from an average gully or ravine.
3. Delineate and determine the catchment area of the gully
4. Convert volume of soil lost in step 2 to a volume per catchment area (square meter).
5. Estimate soil bulk density value of the area using oven dry method in your local soil laboratory or use secondary data of the area available.
6. Convert the volume per square meter soil lost in step 4 to tonnes per hectare
7. Interview the indigenous people about the age of the gully in year(s).
8. Convert tonnes per hectare by dividing by the age of the gully to tonnes per hectare per year (t/ha/yr)

Hint: Using the average measurements of width at lip and width at base, and depth, calculate the average cross-sectional area of the gully or ravine (considering the cross-sectional shape is trapezoid); using the formula:

(width at lip (m) + width at base (m) / 2) * depth (m)

Operation Sheet 3 – plant seedling

Objectives

- ✓ To enrichment of bare land

Procedures:

- Choose a container.
- Start with quality soil. Sow seeds in sterile, seed-starting mix or potting soil available in nurseries and garden centers
- Plant at the proper depth
- Water wisely
- Maintain consistent moisture
- Keep soil warm
- Fertilize
- Give seedlings enough light
- Circulate the air
- Harden off seedlings before transplanting outdoors.

Information sheet 6- Monitoring Work and undertaking remedial action

6.1. Monitoring

Monitoring is the continuous collection and analysis of information used by management and partners to assess performance (progress on implementation of activities, delivery of outputs, achievement of results and impacts and use of resources).

Monitoring and Evaluation (M&E) is a continuous management function to assess if progress is made in achieving expected results, to spot bottlenecks in implementation and to highlight whether there are any unintended effects (positive or negative) from an investment plan, programme or project ("project/plan").

As an Action Plan for a solution to a problem is being implemented it is important to monitor its progress. Once the plan has been implemented, you need to evaluate the success of the solution. Monitoring the plan helps to ensure that the solution is being implemented as expected.

Five Steps to Successful Monitoring

1) Define a Monitoring Project Plan.
2) Review Capabilities & Requirements.
3) Create a Data Collection Plan.
4) Develop a Deployment Strategy.
5) Go Live with Install & Evaluation.

6.2. Basic Principles of Ecological Restoration

- Health: Functional processes such as water filtration, sequestration of carbon dioxide, etc.,
- Integrity: Species composition and community structure,
- Sustainability: Resistance and resilience to disturbance.
- Disturbance is a change of environmental conditions.

Restoration activities may be designed to replicate a pre-disturbance ecosystem or to create a new ecosystem where it had not previously occurred. Restoration ecology is the scientific study of repairing disturbed ecosystems through human intervention

The assessment is performed by measuring the attributes correlated with the ecosystem structure and function. The success or failure of a project can be determined by examining the similarity of the plantings to naturally regenerating forests and the resilience of the restored sites.

Successful ecosystem restoration projects have included:

- Repairing and replanting wetlands, creek beds, forestland, and other habitats.
- Eradicating invasive species.
- Replacing turf grass with native species.
- Planting rain gardens to absorb rainwater running off roofs or asphalt

A useful way to evaluate restoration success is by comparing the trajec- tory of recovery of different variables through time with reference sites. Compare with the baseline information on restoration area.

6.3. Remedial action

Remedial action is an action taken to effect long-term restoration of environmental quality (as under the Comprehensive Environmental Response, Compensation, and Liability Act) - compare removal action.

Rework and repair are generally the remedial actions taken on products, while services usually require additional services to be performed to ensure satisfaction. In some settings, corrective action is used as an encompassing term that includes remedial actions, corrective actions and preventive actions.

Taking prompt, effective remedial action to stop inappropriate conduct helps to prevent conduct from interfering with an employee's ability to do his or her job and from rising to the level of creating a hostile work environment.

Self-Check -6	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. What are basic Principles of Ecological Restoration? (10points)
2. What is remedial action in restoration program (5points)

Note: **Satisfactory rating >7.5 points** **Unsatisfactory - below 7.5 points**

Answer Sheet

Score = _____

Rating: _____

LAP TEST	Performance Test

Name……. ID……..
Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **1** hour for each task. The project is expected from each student to do it.

Task 1- Rehabilitate Degraded Natural Areas

Task 2- Measure gully erosion

Task 3- plant seedling on bare land

LG #41	LO #4- Review natural area restoration program

Instruction sheet

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

- Monitoring site maintenance program
- Assessing site of natural area restoration works
- Reporting changes to natural area restoration techniques

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**:

- Monitor site maintenance program
- Assess site of natural area restoration works
- Report changes to natural area restoration techniques

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed.
4. Ask your trainer for assistance if you have hard time understanding them.
5. Accomplish the “Self-checks” which are placed following all information sheets.
6. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

Information sheet 1- Monitoring site maintenance program

1.1. Site maintenance

Monitoring is a process to be aware about change of parameters but maintenance is a process to stay them in a certain amount. Condition based monitoring in maintenance is focused on preventing restoration failures, downtime, and unnecessary practices by monitoring restoration health to determine what maintenance needs to be completed and when. It can be considered essential to any predictive maintenance strategy.

Inspection and maintenance is vital to the performance of erosion and sedimentation control measures. If not properly maintained, some practices may cause more damage than they prevent. Always evaluate the consequences of a measure failing when considering which control measure to use, since failure of a practice may be hazardous or damaging to both people and property. For example, a large sediment basin failure can have disastrous results; low points in dikes can cause major gullies to form on a fill slope. It is essential to inspect all practices to determine that they are working properly and to ensure that problems are corrected as soon as they develop. Assign an individual responsibility for routine checks of operating erosion and sedimentation control practices in restoration program.

Removing the vegetative cover and altering the soil structure by clearing, grading, and compacting the surface is increases an area's susceptibility to erosion. Apply stabilizing measures as soon as possible after the land is disturbed. Plan and implement temporary or permanent vegetation, mulches, or other protective practices to correspond with construction activities. Protect channels from erosive forces by using protective linings and the appropriate channel design. Consider possible future repairs and maintenance of these practices in the design.

Monitoring can be linked to points in time ('milestones') when a significant output is expected to be completed or a certain interim outcome obtained. Milestones are benchmarks for success, and indicators to prompt changes in management if they are not reached in appropriate timeframes. Such project milestones can be hypothesized in advance by using a process which identifies the rationale behind goals, strategies,

outputs and activities (this is sometimes referred to as a 'program logic' process). Collecting monitoring data scientifically will allow objective scrutiny through statistical analysis. It is therefore helpful if project milestone statements are specific, measurable, realistic and time-bound and formulated with the restoration goal in mind. Monitoring questions or hypotheses about outcomes can then be more easily devised to guide the collection of data and link to management decision making.

Understanding wider regional dynamics through monitoring of reference sites is important to aid in evaluating the effects of restoration actions compared to other influencing factors. Species diversity should ideally be evaluated by comparing the species composition and abundance relative to reference sites that represent desired goal states. An increase in bird numbers at the restoration site may indicate that the restoration actions have resulted in better habitat. If however, control sites and/or reference sites also show a similar increase in bird numbers at the same time period, it could predominantly be the result of good seasonal conditions. A drop in bird abundance observed over time at the restoration site could indicate a decrease in habitat quality, that predation is occurring or that a few aggressive species are becoming dominant (e.g. Noisy Miner birds can occupy re-vegetation sites and aggressively chase smaller birds species out of the area). A similar drop in bird abundance at the same time in reference sites would indicate that the response is more likely to be related to environmental conditions (e.g. drought) or seasonal migrations. The appearance of new species over time at the restoration site may be in response to restored habitat quality and natural regeneration processes. Alternatively, if the same species are turning up as new species in reference sites, it may indicate wider environmental changes, such as species dispersal due to climate change.

Self-Check -1	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I write True if statement is correct, False if statement is incorrect (2pt each)

1. Monitoring is a process to be aware about change of parameters but maintenance is a process to stay them in a certain amount. _____
2. Inspection and maintenance is vital to the performance of erosion and sedimentation control measures. _____
3. Removing the vegetative cover and altering the soil structure by clearing, grading, and compacting the surface is increases an area's susceptibility to erosion._____
4. An increase in bird numbers at the restoration site may indicate that the restoration actions have resulted in better habitat. _____
5. Collecting monitoring data scientifically will allow objective scrutiny through statistical analysis.

Note: **Satisfactory rating >5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Information sheet 2- Assessing site of natural area restoration works

2.1 Natural area restoration works

Site is assessed to determine whether natural area restoration works are addressing factors and issues consistent with management plans. When land is disturbed at a construction site, the erosion rate accelerates dramatically. Since ground cover on an undisturbed site protects the surface, removal of that cover increases the site's susceptibility to erosion. Disturbed land may have an erosion rate 1,000 times greater than the pre-construction rate. Even though construction requires that land be disturbed and left bare for periods of time, proper planning and use of control measures can reduce the impact of man-induced accelerated erosion.

Measurement points are accessed by removing covers and locks as appropriate. Why measurement points accessed are to have ground truth and conducting measurement for quantifying soil loss. Measurement points' located mark on topographic map is sometimes inaccessible and obstruct. Those points obstructed by covers and locks can be maintained by removing the covers and locks. But those points inaccessible due to topographic features and other natural phenomena have to be reported to the supervisor.

Identifying erosion problems at the planning stage and noting highly erodible areas, helps in selecting effective erosion control practices and estimating storage volumes for sediment traps and basins. This manual focuses primarily on the prevention of sedimentation problems associated with water-generated soil erosion.

2.2 Review and consider all existing conditions

Review and consider all existing conditions in the initial site selection for the project. Select a site that is suitable rather than force the terrain to conform to development needs. Ensure that development features follow natural contours. Steep slopes, areas subject to flooding, and highly erodible soils severely limit a site's use, while level, well-drained areas offer few restrictions. Any modification of a site's drainage features or topography requires protection from erosion and sedimentation.

The site assessment aims to show the current state of the site and any current or future threats that may impact on site condition. The data collected would indicate a site's immediate suitability or its potential suitability for restoration as well as the time period required to direct the desired change. The site assessment process also aims to reveal information that will allow predictions of possible outcomes under different management scenarios, as discussed in 'Restoring Towards a Goal State'. For large sites, the assessment should also aim to give enough information about the site to determine and map the boundaries of appropriate units for management The key factors to assess include: soils and landforms; infrastructure; habitat attributes; landscape context; threats; land-use history and regeneration potential.

Note all physical features and infrastructure at the site that may influence the design of restoration or access to the site. These include: power lines/underground cables , drainage channels, roads/tracks fence lines/gates, stockyards , water points/windmills, property boundaries.

Self-Check -2	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer (2pt each)

1. List some physical features and infrastructure at the site that may influence the design of restoration or access to the site.
2. What is the aims site assessment?

Note: **Satisfactory rating >2 points** **Unsatisfactory - below 2points**

Answer Sheet

Score = _____

Rating: _____

Information sheet 3- Reporting changes to natural area restoration techniques

3.1. Recording changes

Recording environmental/Site conditions and any other observations with appropriate accuracy, precision and units is mandatory unless which may impact on data quality.

Conditions affecting quality of data

- Human resources.
- Lack of Institutional problems.
- Inadequate sector coordination.
- Insufficient community involvement.
- Inadequate operation and maintenance.
- Insufficient information and communication.
- Financial difficulties

Environmental condition affecting quality of data:

- Climate
- Land form/topography

3.2. Accuracy of data

Contents should be based on scientific facts, on exact, verified information and free from errors. If information has to be selected or filtered, then the most essential data must be retained.

Precision of data

- Contents should not be presented in an incomplete or an ambiguous fashion. If content is rather complex, then it should be explained and remain totally comprehensible.
  - ✓ It means that the data have to be understandable for another reader.

help us:

- To have definite and accurate reading
- To make data handling simple

- To document data for a long time
- To make it understandable

Self-Check -3	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Part I Give short answer

1. What are environmental condition affecting qualities of data? **(**5pt each)
2. What is the importance of recording data with its unit? (5pt each)

Note: **Satisfactory rating >5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

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WEB ADDRESSES

https://webstyleguide.com/wsg2/process/specify.html

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