COURSE CODE:	Emt 520
COURSE TITLE:	Conservation Of Biological Diversity
NUMBER OF UNITS:	3 Units
COURSE DURATION:	3 Hours Per Week

COURSE DETAILS:

Course Coordinator:	Dr Clement Olabinjo Adeofun *B.Sc., M.Sc., PhD*
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COURSE CONTENT:

Definitions and uses of biodiversity, levels and types of biological diversity; strategies for conservation of biological resources – *in-situ* and *ex-situ* conservation; types, importance and limitation of both methods; threats and possible solutions for biodiversity conservation; biodiversity and climate change; relationships between biodiversity, culture and development; biodiversity and poverty reduction; indigenous knowledge in biodiversity conservation; legal and fiscal measures for biodiversity conservation; national organizations, national laws and legislation; international treaties; measurement of diversity indices and biodiversity similarity indices.

COURSE REQUIREMENTS:

This is a compulsory course for all students in Department of Aquaculture & Fisheries Management. In view of this, students are expected to participate in all the course activities and have minimum of 75% attendance to be eligible to write the final examination.

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READING LIST:

1. Arvind Kumar (2004). A textbook of Environmental Science pp 127-132.

2. Daniel B. Botkin & Edward A. Keller (1998) Environmental science Earth as a living planet pp 129-139.
3. Gareth Jones (2004). People and Environment, pp 208-220
4. Gtylermiller J.R. (2006) Miller Environment Science, pp 607 – 629
5. Jablonski, D (2004) Extinction: past and present. Nature, 427:589
6. Nick Middleton (2008). The Global Casino: An Introduction to Environmental Issues pp 296- 317
7. Rainforest facts (1996). Pp 1-23.
8. Thomas M. Smith and Robert Leo Smith (2006). Elements of Ecology, pp 602-629.
9. Williams P. Cunningham (2004). Principles of Environmental Science, pp 107-121

LECTURE NOTES

INTRODUCTION

Biodiversity, the variety of living things also makes the world a more beautiful and exciting place to live.

The convention on Biological Diversity defines biodiversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes in which they are a part; this includes diversity within species, between species and of ecosystems.

Genetic species – includes the variation between individuals and between populations within a species.

Species diversity – refers to the different types of animals, plants and other life forms within a region.

Ecosystem diversity - means the variety of habitats found in an area.

The 158 states that signed the convention on Biological Diversity at the UN Conference on Environment and Development in Rio de Janeiro in 1992 agreed that there was a general lack of information on and knowledge of biodiversity, and that there was an urgent need to develop

scientific, technical and institutional capacities to provide the basic understanding on which to plan and implement appropriate measure.

BIODIVERSITY HOT SPOTS

Most of the world biodiversity concentrations are near the equator, especially tropical rainforests and coral reefs. Only 10 to 15% live in N/America and Europe.

Ares isolated by water, deserts or mountains can also have high concentration of unique species and biodiversity.

Rainforests are experiencing biodiversity loss at rates greater than most other habitat types. The primary cause of rainforest loss is deforestation for timber, cattle grazing, and farming. Over 200,000 square miles of the Amazon rainforest have already been lost to deforestation, with another 7-10,000 square miles being destroyed each year. Scientists have only studied a fraction of the plants, animals, and insects that live in the rainforests, and estimate that there may be thousands of species not known to science at all. We have almost certainly driven to extinction already many species that we will never know about.

Another cause of rainforest biodiversity loss is climate change. Rainforests are delicately balanced ecosystems that can be substantially affected by even small changes in climate. The first documented victim of climate change in a rainforest was the Golden Toad (see below).

Wetlands are another habitat being lost at great pace. In the 1600s, the United States is estimated to have had approximately 220 million acres of wetland; in 1997, it had 105 million acres, less than half as many. The majority of those lost were drained, filled, and converted to other uses, such as farmland and later, parking lots.

Wetlands are very important to humans for a number of reasons, including storm mitigation and water filtration. Marshes and swamps serve as barriers when storms such as hurricanes come through, substantially decreasing wind speeds and absorbing storm surges. And all wetlands filter fresh water that runs through them, removing pollutants and making it safe for human consumption.

Coral reefs are extremely sensitive to changes in ocean temperature, and "coral bleaching" results when temperatures get too high; this phenomenon will eventually kill corals if the temperature does not return to suitable levels. As of 2004, 20% of the world's coral reefs were effectively dead, with no prospect of recovering. Research indicates that much of this destruction is due to human activity, including rising sea water temperatures.

HOW DO WE BENEFIT FROM BIODIVERSITY?

We benefit from other organization in many ways, some of which we don't appreciate until a particular species or community disappears. Even seemingly obscure and insignificant organisms can play irreplaceable roles in ecological systems or be the source of genes or drugs that someday may be indispensable. The benefits include:

Food

All of our food comes from other organisms. Many wild plant species could make important contributions to human food supplies either as they are or as a source of genetic material to improve domestic crops. Noted ecologist Norman Myers estimates that as many as 80,000 edible wild plant species could be utilized by humans.

Drugs and Medicines

Living organisms provide us with many useful drugs and medicines.

The United Nations Development Programme estimates the value of pharmaceutical products derived from developing world plants, animals and microbes to be more than $30 billion per year.

Table 2. *Some Natural Medicinal Products.*

Product	Source	Use
Penicillin	Fungus	Antibiotic
Bacitracin	Bacterium	Antibiotic
Tetracycline	Bacterium	Antibiotic
Erythromylin	Bacterium	Antibiotic
Quinine	Chincona bark	Malaria treatment
Diosgenin	Mexican yam	Birth-control drug
Cortisone	Mexican yam	Anti-inflammation treatment
Cytarabine	Sponge	Leukemia cure
Bee venom	Bee	Arthritis relief
Reserpine	Rauwolfia	Hypertension drug
Allantoin	Blowfly larva	Wound healer
Aspirin	Willow tree	Malaria drug
Vincristine	Periwinkle plant	Anticancer drugs

More than half of all prescriptions contain some natural products. The United Nations Development Program estimates the value of pharmaceutical products derived from developing world plants, animals, and microbes to be more than $30 billion per year. Consider the success story of vinblastine and vincristine. These anticancer alkaloids are derived from the Madagascar periwinkle (Catharanthus roseus). They inhibit the growth of cancer cells and are very effective in treating certain kind of cancer.

Ecological Benefits

Human life is inextricably linked to ecological services provided by other organisms. Soil formation, waste disposal, air and water purification, nutrient cycling, solar energy absorption, and food production all depend on biodiversity. Total value of these ecological services is at least $33 trillion per year, or more than double total world GNP. In many environments, high diversity may help biological communities withstand environmental stress better and recover more quickly than those with fewer species.

Aesthetic and Cultural Benefits

Millions of people enjoy hunting, fishing, camping, hiking, wildlife watching, and other nature-based activities. These activities provide invigorating physical exercise, and contact with nature can be psychologically and emotionally restorative. In many cultures, nature carries spiritual connotations, and a particular species or landscape may be inextricably linked to a sense of identity and meaning. Observing and protecting nature has religious or moral significance for

many people. Some religious organizations call for the protection of nature simply because it is God creation.

WHAT THREATENS BIODIVERSITY?

Extinction, the elimination of species, is a normal process of the natural world. Indeed, as one biologist puts it: extinction is a fundamental part of nature – more than 99 percent of all species that ever lived are now extinct (Jablonski, 2004: 589). In undisturbed ecosystems, the rate of extinction appears to be about one species lost every decade. Ecologist E. O. Wilson estimates that we are losing 10,000 species or subspecies a year. That makes more than 27 per day!

Natural Causes of Extinction

Studies of the fossil record suggest that more than 99 percent of all species that ever existed are now extinct. Most of the species were gone before humans came on scene. Periodically, mass extinctions have wiped out vast numbers of species and even whole families (Table 2).

The best studied of these events occurred at the end of the Cretaceous Period when dinosaurs disappeared, along with at least 50 percent of existing species. Current theories suggest that these catastrophes were caused by climate change, perhaps triggered when large asteroids struck the earth.

Table 2: Mass extinction

HISTORIC PERIOD	TIME BEFORE PRESENT	EFFECTS

Ordovician	444 million	25% of all families extinct
Devonian	370 million	19% of all families extinct
Permian	250 million	54% of families, 90% OF SPECIES EXTINCT
Triassic	210 million	23% of families, half species extinct
Cretaceous	65 million	17% of families, half of species extinct (Including dinosaurs but not mammals)
Quaternary	Present	1/3 to 2/3 of all species extinct if present trends continue.

Species Loss as Natural Process

New species are constantly being added to the planet through mutation and natural selection. This is a natural process that has been going on since the beginning of life on earth.

By the same process, species are constantly becoming extinct. There are a number of biological causes of species loss. Biological causes of extinctions can be thought of as changes in relationships; predator-prey relationships or relationships among competitors. Some examples of relationship changes include the following:

- Population fluctuations of predatory species leading to extinctions of prey species.
- New diseases resulting from genetic mutations of existing pathogens producing species extinctions.

- Existing competitors becoming more effective.
- New competitors emerge from existing species which were not competitors in the past, this can result from evolutionary changes in other organism.

HUMAN-CAUSED REDUCTIONS IN BIODIVERSITY

Habitat Destruction and Modification

Human disturbance of natural habitat is the largest single cause of loss of biological diversity. Over the past 10,000 years, billions of hectares of forests, woodlands, and grasslands have been converted to commercial forests, croplands, or grazing lands. Habitat loss and degradation was the most pervasive threat to birds, mammals and plants, according to the 2004 IUCN Red list, affecting 86 percent of all threatened birds, 86 percent of the threatened mammals assessed and 88 percent of threatened amphibians (IUCN, 2004).

Fragmentation

In addition to loss of absolute habitat area, a serious problem is habitat fragmentation - the reduction of habitat into smaller and smaller, more scattered patches. Fragmentation reduces biodiversity because many species, such as bears and large cats, require large territories to subsist. Other species, such as forest interior birds, reproduce successfully only in deep forest or other habitat far from edges and human settlement.

Fragmentation also divides populations into isolated groups. Small, isolated populations are vulnerable to catastrophic events, such as a single storm or disease outbreak. Very small populations may not have enough breeding adults to be viable even under normal circumstances.

Hunting and Fishing

Over harvesting is responsible for depletion or extinction of many species. A classic example is the extermination of the American passenger pigeon (Ectopistes migratorius). Even though it inhabited only eastern North America, 200 years ago, this was the world's most abundant bird with a population of between 3 and 5 billion. This species once accounted for about one-quarter of all birds in North America. In 1830, John James Audubon saw a single flock of passenger pigeons estimated to be ten miles wide, hundreds of miles long, and thought to contain perhaps a billion birds. In spite of this vast abundance, market hunting and habitat destruction caused the entire population to crash in only about 20 years between 1870 and 1890. The last known wild bird was shot in 1900, and the last existing passenger pigeon, a female named Martha, died in 1914 in the Cincinnati Zoo.

Fish stocks have been seriously depleted by over harvesting in many parts of the world, mostly because of a huge increase in fishing fleet size and efficiency in recent years. Defenders of wildlife estimates that poachers kill a million metric tons of game for the bush meat trade every year, helping to reduce chimpanzee populations by 95 percent and vastly reducing gorilla and orangutan populations.

Commercial Products and Live Specimens

Despite international bans on trade in products from endangered species, smuggling of furs, hides, horns, live specimens, and folk medicines amounts to millions of dollars each year. The trade in wild species for pets is an enormous business.

Predator and Pest Control

Some animal populations have been greatly reduced, or even deliberately exterminated, because they are regarded as dangerous to humans or livestock, or because they compete with our use of resources. Every year, U.S government animal control agents trap, poison, or shoot thousands of coyotes, bobcats, prairie dogs, and other species considered threats to people, domestic live stocks, or crops.

Exotic Species Introductions

Aliens introduced into habitats where they are not native are one of the greatest threats to biodiversity worldwide. Exotics can be thought of as biological pollution. Freed from the predators, parasites, pathogens, and competition that kept them in check in their native home, formerly mild-mannered species can turn into super-aggressive “weedy” invaders in a new habitat.

Accidental introductions of new species can present major problems, too. Mosquitoes were accidentally introduced into Hawaii in 1826 when they arrived on sailing ships. The mosquito carried several diseases of birds to which the native bird populations were particularly susceptible.

Pollution

We have known for a long time that toxic pollutants can have disastrous effects on local populations of organisms. A pesticide-linked decline of fish-eating birds and falcons was documented in the 1970s. Marine mammals, alligators, fish and other declining suggest complex interrelations between pollution and health.

Genetic Assimilation

Some rare and endangered species are threatened by genetic assimilation because the crossbreed with closely related species that are more numerous or more vigorously.

EFFECTS OF BIODIVERSITY LOSS

Biodiversity may not seem very important for humans, but it is! The living organisms of the world are critical to many aspects of human life, all of which will be affected as biodiversity is lost.

Energy

Wood and wood-based charcoal provide a large percentage of energy used for heating and cooking around the world, especially in rural or developing areas. Loss of biodiversity will reduce the amount of wood and the variety available for these purposes.

Food supply

Many communities rely on the biodiversity around them for food, especially when natural disasters strike. In many developing regions where drought or flooding are frequent dangers, it is important for people to have secondary food sources to turn to that are adapted to these conditions and are available when the need arises. In addition, having monoculture crops can be extremely dangerous when a pest or disease arises that affects that crop. The Irish potato famine, which was caused by a fungus that specifically infects potatoes, is a good example. It

killed between 500,000 and 1 million people and caused several million more to evacuate Ireland. For many of those people, potatoes were their sole source of food.

Environmental Buffers

Coral reefs and wetlands such as mangroves and marshes provide excellent barriers against storms and flooding. Coastal communities are especially vulnerable to the effects of these natural disasters, and removal and conversion of wetlands worldwide has worsened conditions during times of flood.

Medicines

Many important drugs are derived from biodiversity, and of these a large percentage cannot be manufactured artificially; they must come from the source organism. Examples include the antibiotic penicillin, which comes from a fungus, and digitalis, used to treat heart conditions, which comes from the foxglove plant. There are likely thousands of microorganisms and plants that have potential medical uses which have not yet been discovered.

Pest Control

Almost all species have natural predators, other organisms that eat them, infect them, and otherwise control their abundance. As we exterminate species, there is no way of knowing what other creatures we may be allowing to thrive in their absence.

Pollination

Plants require pollination to produce seeds and fruit, and many of the plant-based foods we enjoy consuming need to be pollinated by insects or birds. Pollinators are beginning to decline in abundance globally, resulting in fewer seeds or fruit, or seeds that are less viable to produce the next generation of plants.

Erosion Control

Plants are excellent at preventing erosion. Their roots hold soils in place and stabilize slopes and fields alike. As deforestation occurs, mudslides become more frequent and fresh water quality declines as soils are washed into rivers and lakes.

Livelihoods

Millions of people world-wide make their livings from biodiversity. People who farm, fish, or create crafts or furniture from natural sources will be in danger of losing their livelihoods if the species they depend on begin to decline. In some cases this is paradoxical, since over fishing and over hunting contribute to the very loss that will eventually make the fishers and hunters unable to support themselves.

Clean Water

Watershed destruction and deforestation lead to decreased quality of drinking water, which has greatest effects in rural and developing areas. Wetlands also serve water-filtering purposes that are lost when they are destroyed or converted.

Spiritual

Many people around the world value various ecosystem components in their religious and spiritual belief systems. As this biodiversity is lost, it will affect culture and quality of life of many.

Raw Materials

Many raw materials and resources come from the biological world, including wood for building, fabrics and fibers such as cotton, hemp, and raffia, dyes, resins, gums, rubbers, and oil.

PROTECTING BIODIVERSITY

1. Using Geographical Information System (GIS) to Protect Biodiversity

A GIS includes computer programs that map, manage, and analyze information about the environment together with environmental data when scientists overlay, integrate, or model information such as species distribution, habitat and land cover areas, or water resources, computer mapping software and data provide efficient tools for investigation. One of the most important conservation biology projects using GIS today is the Gap Analysis Program (GAP). The idea behind GAP is that many biologically diverse biomes and habitats are not sufficiently protected. They represent “gaps” in conservation programs. To preserve long term biodiversity, scientists in this program hope to fill as many of those gaps as possible by identifying and preserving important areas.

2. Hunting and Fishing Laws:

By the 1890s, most states had enacted some hunting and fishing restrictions. The general idea behind these laws was to conserve the resource for future human use rather than to preserve wildlife for its own sake. The wildlife regulations and refuges established since that time have been remarkably successful for many species.

3. The Endangered Species Act

Simply identifying species at risk can initiate protection. Globally, the World Conservation Union maintains a "Red List" of threatened species, and increasingly, countries are developing their own lists. In North America, the U.S Endangered Species Act (ESA) of 1973 and the committee on the status of endangered wildlife in Canada in 1976 represented powerful new approaches to wildlife protection.

Endangered Species: are those considered in imminent danger of extinction, while **Threatened Species** are those that are likely to become endangered – at least locally- within the foreseeable future. Bald eagles, gray wolves, brown bears, and sea otters, for instance, together with a number of native orchids and other rare plants, are considered locally threatened even though they remain abundant in other parts of their former range.

Vulnerable species: are naturally rare or have been locally depleted human activities to a level that puts them at risk.

The ESA regulates a wide range of activities involving endangered species, including "taking" (harassing, harming, pursuing, hunting, shooting, trapping, killing, capturing, or

collecting) species either accidentally or on purpose, and importing, exporting, selling, or possessing endangered species, parts, or products. Violators of the ESA are subject to fines up to $100,000 and one year imprisonment, as well as loss of vehicles and equipment used in the violation.

Table 3: Endangered and Threatened species, U.S and Foreign, listed by USFWS

Mammals	357
Birds	279
Reptiles	123
Amphibians	31
Fish	153
Invertebrates	203
Plants	746

Source: Data from U.S fish and wildlife service, 2002.

3. Recovery Plans:

Once a species is officially listed as endangered, the U.S fish and wildlife service must prepare a recovery plan detailing how populations will be rebuilt to sustainable levels. Negotiating the costs, politics, local economic interests, and biological species requirement can take years. Some recovery plans have been gratifyingly successful. The American alligator was listed as endangered in 1967 because hunting (for meat, skins, and sport) and habitat destruction

had reduced populations to precarious levels. Protection has been so effective that the species is now plentiful throughout its entire southern range.

4. Re-introduction

An endangered species can be restored by re-introducing it to its former habitat once the major threats to its survival have been removed. Re-introduction is expensive, so it has been attempted for only a few species. It usually requires raising animals in captivity and intensive management after release. For the falcon, re-introduced populations rebounded because the principal threat DDT had been removed from its food chain. In a major triumph for endangered species activists, the bird was removed from the endangered species list in 2001.

5. Private and Critical Habitat

Private land is essential in endangered species protection. Eighty percent of the habitat for more than half of all listed species is on non-public property. The U.S supreme court has ruled that destroying habitat is as harmful to endangered species as directly taking (taking) them. The US fish and wildlife service has been negotiating agreements called Habitat Conservation Plans (HCP) with private land owners. Under these plans, land-owners are allowed to harvest resources or build on part of their land as long as the species benefits overall. By improving habitat in some areas, funding conservation research, removing predators and competitors, or other steps that benefit the endangered species, developers are allowed to destroy habitat or even “take” endangered species.

6. Re-authorizing the endangered species acts:

The ESA officially expired in 1992. Since then, Congress has debated many alternative proposals, ranging from outright elimination to substantial strengthening of the act. Many people believe that the law puts the welfare of plants and animals above that of humans. On the other hand, much of the public also supports the ESA and the goal of protecting natural beauty and biodiversity.

7. International Wildlife Treaties:

The 1975 Convention on International Trade in Endangered Species (CITES) was a significant step toward worldwide protection of endangered flora and fauna. It regulates trade in living specimens, but has not been foolproof.

8. Imparting Environment Education:

Educating people from all walks of life regarding eco-friendly practices goes a long way in conservation of plant and genetic biodiversity.

9. Population Control

Effective population control measures have to be taken as a top-priority issue in the national agenda by involving people of all political parties, religious faiths and social organizations. Suitable incentives and disincentives should be in built into the strategies specially formulated for this purpose.

10. Reviewing the Agricultural Practice

We should refrain from temptation of high yields and making a fast buck at the cost of sustainable development. We should try to infuse diversity in our agricultural practices by

restoring to mixed cropping, polyculture and tolerance to wild, plants and other life forms around our agricultural fields.

11. Controlling Urbanization

Ever increasing urbanization and expansion of urban settlements should be controlled. Biological diversity should be infused into the urban localities.

12. Enacting, Strengthening and Enforcing Environmental Legislations

Existing environmental laws against ecologically unsound practices should be strengthened and enforced ruthlessly.

13. Conserving Biodiversity in Seed-Banks and Gene Banks

Most of the plants species form seeds with variable periods of dormancy after which they can be germinated to yield daughter plants. The seeds can be stored in seed-banks or gene banks or germ plasm banks. The germ plasm of a plant is any of its parts from which new plants can be generated.

14. Restoration of Biodiversity

By restoring both the extent and quality of important habitats, restoration programme provides refuge for species and genetics resources that might be lost otherwise. The techniques to restore ecosystem include; vegetation planting to control erosion, fertilization of existing vegetation to encourage growth, removal of contaminated soil etc.

15. Biodiversity Inventories

Current scientific understanding of ecological processes has to be strengthened by adequate research efforts aimed at improving methodologies, distributional and status information. Strategies based on sound information will ultimately provide the basis for pragmatic policies and management decisions.

16. Conserving Biodiversity in Protected Habitat

The two basic approaches to the wildlife conservation in protected habitats are as follows.

(a). Ex-situ conservation: It means the wildlife conservation in captivity under human care. In this, the endangered plant and animals are collected and bred under controlled conditions in gardens, zoos, sanctuaries etc.

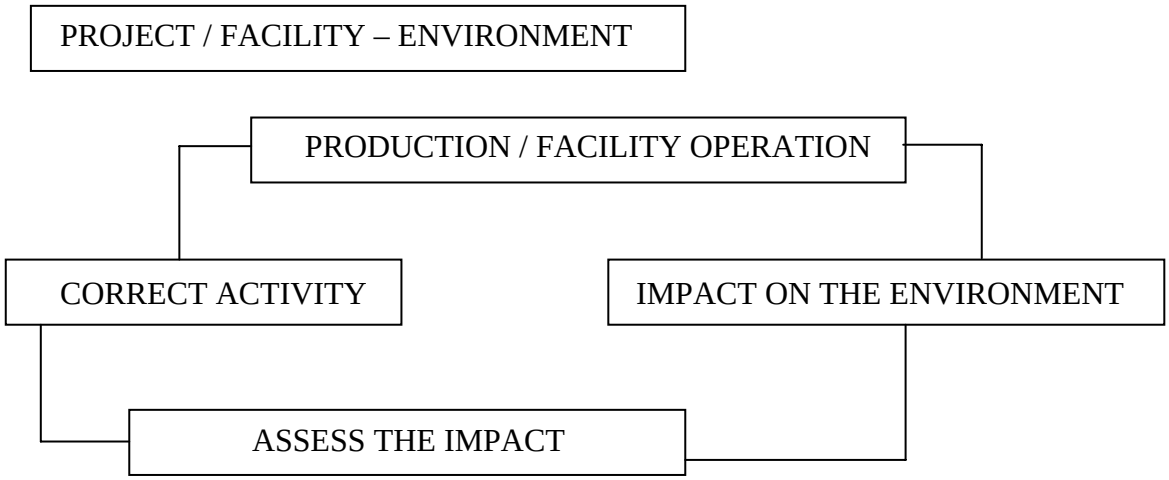
(b). In-situ conservation: This involves setting aside large portions of earth surface for wildlife. However, many protected habitats are used for logging, tourism and profitable activities.

AN APPROACH TO ENVIRONMENTAL AUDITING

Introduction and Objectives of Environmental Auditing

In ETA parlance, environmental "audit" is usually referred to as an account of the environmental consequences of operational developments. That is "after-the-fact" evaluation (see Figure 1). The data set used for audits are derived from monitoring programmes, and are used to identify and evaluate the effects of a project on the human and natural environments.

Fig. 1: ENVIRONMENTAL AUDITING SCHEME



The major value of auditing is as a management tool, which provides timely information on environmental performance in relation to goals and objectives. Also auditing provides independent verification that production/project systems are in place, to ensure continued compliance with the legislation(s) in force.

i. Provides timely information on environmental performance in relation to goals and objectives.

ii. Provides independent verification that project is in place to ensure continued compliance with the legislation in force.

A related advantage is reduced exposure to litigation and regulatory risk. Furthermore, environmental auditing has the following equally important benefits:

- Increasing awareness of environmental policies and responsibilities;
- Providing an opportunity for management to give credit for good environmental performance;
- Identifying potential cost savings, for example those which might arise from waste minimization;
- Providing an opportunity to determine the accuracy of E.I.A predictions earlier made;
- Providing an up-to-date environmental data base, which can be drawn on when making decisions in relation to plant/project modifications, etc. or for use in emergencies;
- Evaluating training programme and providing information for use in training staff.

Overview of the Approach

It must be emphasized that the requirements for environmental auditing could vary from one company/agency to another, depending on factors such as location, size, number, resources, type of employee and legislative requirements. Consequently, the basic principles and the general approach are common to all situations, the description of which follows:

- Developing an understanding of the plant's internal management systems and controls;
- Assessing the strengths and weaknesses of project;
- Gathering audit evidence through assessment and verification;
- Evaluating audit findings;
- Discussing findings with facility management;
- Preparing audit findings for the close out meeting;

- Preparing the draft audit report followed by the final version;
- Completing the action plan (by the audited facility); and
- Ensuring that the action plan has been implemented. This is accomplished by the Corporate Environmental Services Staff including the Manager regular and special visits to plant (see Figure 2)

Of vital importance to the audit process is the preparation of an audit process, response plans and the follow-up activities described in Figure 3.

The preparation and implementation of the action plan are essential for an effective audit programme.

Audit Types

International experience has shown the existence of about seven distinct types of environmental audit. These include the external environment, occupational health, industrial hygiene, emergency response, acquisition, divestiture and closure.

Audit Team

Under normal circumstances the audit team should consist of the following at the minimum:

(a) A production/project manager or a site manager from a similar site (as Team Leader);

(b) A qualified environmental health specialist (as experienced system Auditor and team Secretary);

(c) An Environmental and Safety Manager either from within and/or a similar site;

(d) A bio-chemical specialist;

(e) An Environmental Engineer having special knowledge of the operations under consideration;

(f) A Sociologist or Town Planner having special knowledge of the plant/project location and the citizenry.

Others e.g. FEPA staff or Staff from its state counterpart, could be invited to join the team, depending on available resources. It is quite important to invite experts from outside, to participate in the auditing process. This gives a good measure of legitimacy to the report thereafter produced.

CHAPTER TWO

TYPES OF ENVIRONMENTAL AUDITS

Environmental audits can be subdivided into various types according to the operations of the facility; the objectives of the audit; the requirements of the regulatory agencies and based on environmental performance gaps identified during inspections. Companies need to ensure they have carefully considered the scope of the audit (the systems to be evaluated) during the first phase of the auditing process, so as to ensure that every element required for effective audit is incorporated into the audit programme.

Systems to be checked can include corporate policy, systems analysis, operational procedures and practice, level of emissions, production of goods and waste, use and storage of energy and materials, transport systems, training procedures, facility maintenance and emergency procedures. The main types of environmental auditing are:

2.1. CORPORATE AUDIT

This type of audit specifically examines the efficiency and effectiveness of management in implementing corporate environmental policy of the company. According to BP environmental audit process, a corporate audit is essentially an audit of a division or unit authorized by the main board at the head office of the company. The corporate audit is mainly concerned with the organizational structure to ensure that the roles and responsibilities are understood by chief executives and to examine the organizational structure that deals with environmental programme management, line management responsibilities, technical and advisory support and the vertical and lateral communications, etc.

Typical corporate audit starts with interview of the chief executive, who is questioned on issues relating to policy, his understanding of it and the chief executive's view on how his

organization will implement the policy and its effectiveness. Other questions deal with communication awareness, issues relating to other company businesses, attitudes of divisions, staff and management to environmental matters, its customers and the public. Subsequently, line managers are interviewed followed by site visits of selected sample locations.

Information on site location is usually got from initial interviews of top management. While top management are primarily concerned with organization, policy implementation matters, awareness and communication channels, occasionally, site visits requires deeper investigation. In this way the strength and sense of urgency conveyed by management to the workforce and upward and downward efficiency of communication become apparent.

Corporate audits can involve looking at:

- A single site,
- A single company,
- An operating division,
- An environmental management system.

Specific audits within the operating divisions include:

- A purchasing audit, which analyses how the company sources and buys its raw materials and what impact the division has on the environment.
- A transport systems audit, which examines the effect of transportation system on the environment.

Classification of Corporate Audits

Issues Audit

Issues audit is concerned with how company deals with environmental issues of key concern. Issues audit involves evaluation of policy, operating procedures and other guidelines set against

actual operating practice within all the sectors of the business. Issues audit is important as it tends to reassure concerned corporate head office management that operating business division or plants are themselves environmentally concerned and responsible in all aspects of their business activities.

Compliance Audit

Compliance auditors check whether a company is complying with environmental legislation, industry standards, environmental regulations of the host state under which it operates daily and the company's internal policy.

Activity Audit

This is another form of corporate audit that evaluates the implementation of corporate policy on company's activities which cross business boundaries. For example, an audit of shipping operations of a group of companies is an activity audit. This may involve an audit of all vessels including barges and supply vessels. Such audit is directed at the company's environmental policy for the operation of vessels and the organizational structure required for ensuring effective implementation.

The audit activity of the shipping operations mentioned above can involve interview with shipping crew members, jetty and deck crews, examination of ship operating instructions and procedures and environmental requirements of chartered vessels and those operated by contractors. Corporate audits are conducted in a corporate manner, not with punitive intentions or to police anybody but to investigate and assist people in doing their work in an environmentally friendly manner. Corporate audits reveal, to an extent, the organizational

weaknesses of the company that require correction. These weaknesses can arise from a number of reasons, which may include:

- Failure of management to understand the strength and intents of corporate policy;
- Lack of environmental awareness due to poor communications and insufficient knowledge of overall complexity of the issues;
- Changes of personnel and inadequate job descriptions which fail to pin-point environmental responsibility of individuals;
- Organizational inadequacy and unclear lines of responsibilities;
- Organizational evolutionary drift in which changes in organizational structure are made without reference to the original role of people prior to changes;
- Changes in company objectives or development phases;
- Inadequacy of environmental policy.

Sometimes, line management has insufficient knowledge of systems operating under them. It is also a common occurrence whereby communication downward are clearly defined but with no feedback loops enabling grassroots environmental problems from being communicated back upwards to appropriate top management. This may result in serious blockage in communication.

2.2. LIABILITY (PRE-ACQUISITION) AUDIT

This is used to assess the potential environmental liabilities of a property, when a client is seeking to purchase a site or a company or to merge with another. It is a useful tool for reassuring the purchaser that he is not buying environmental liabilities or problems of potential liabilities.

Liability audit involves the assessment of the environmental status of properties such as houses, land, industrial site, etc. before purchase. When a company is about to buy a site, it needs to check out the past use to which the site and buildings had been put into such as landfill site for toxic wastes, solid waste dump and burial ground or other contaminants and hazardous substances. The audits usually try to ascertain the level of contamination that the properties had suffered which may be a source of future environmental liabilities.

The value of a site will vary according to the presence or absence of any contamination, and once this is established, the purchase price may change to reflect the cost of clean-up and remediation. This type of audit is used as a pre-acquisition assessment activity when somebody is seeking to purchase a site or a company. They can also be used prior to corporate merge process between companies. Typical example of a liability audits is shown in figure 2.1.

The case study in Figure 2.1 shows how a liability audit on the divestiture of an oil business could be carried out. The focus would be on contamination problems such as cost of cleaning contaminated lands or underground water body remediation.

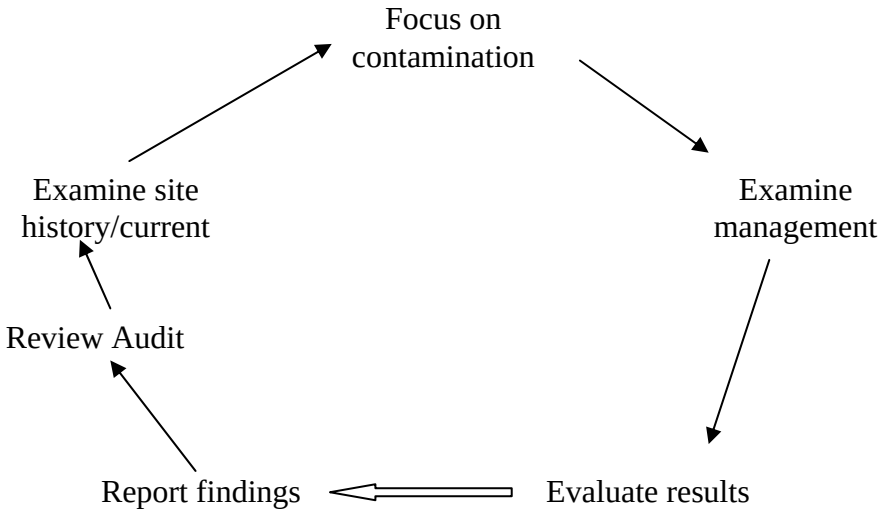


Figure 2.1: Case Study of Liability Audits of Oil Business

The auditor would need to look at site history, current usage and the past management practice in place. The better the management practice, the less likely the management would allow contamination of resources and the environment. Hence the management needs to be examined properly.

The liability audit looks at management structure, air, water and land pollution cases, waste disposal, material handling and storage and contingency plans to deal with accidents. The auditors will also look at construction works, land registry records, following previous ownership and try to establish what the site was used for previously. This will help determine probability of past contamination.

Spillage, use of underground tanks and types of chemicals used for production of goods need to be examined. The auditor can receive documentary evidence about the site. The auditor may be commissioned by either party involved in the sales of the property.

2.3. TECHNICAL AUDIT

Technical audit is carried out as a management tool to solve environmental and safety problems. Primarily, it is an in-house exercise but many companies use external consultants to introduce independent and objective check on their facilities or to train or supplement in-house staff expertise. With technical audit, company can look at its rate of compliance with environmental and safety legislations; internal, international and industry standards such as occupational safety standards, procedures, controls; and environmental management standards.

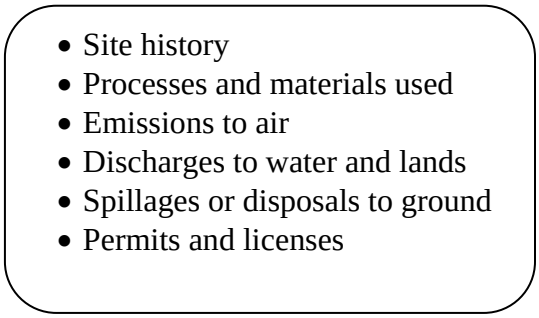


Figure 2.2: Scope of Technical Audits

The purpose of technical audit is to measure the environmental and safety performance of the facility and to develop an action plan to put things right. The emphasis is more on emissions to air, discharges to water and permits involved. With technical audit, a company can look at its rate of compliance with environmental and safety legislation or with its own standards.

2.4. COMPANY INTERNAL AUDITS

Internal audit involves the review of environmental management systems, procedures and company environmental performance using in-house or industry criteria. The purpose of internal audit is to enable facility management obtain objective view of the facility's overall environmental performance so as to develop corrective action plan for improvement.

Internal audit reports are restricted to internal use by facility and line management. There are many performance elements in every internal audit, which must be assessed, including:

- Understanding of the policy implementation of the process;
- Regulations and compliance;
- Plant design and operation;
- Operating procedures and practices;
- Maintenance practices;
- Emergency response plans and contingency measures;
- Source and receiving environment monitoring;
- Incident reports and corrective action measures;
- Environmental training and awareness;
- Internal and external communication.

2.5. PRODUCT AUDIT

Product audit involves looking at the extraction, supply, production and distribution processes involved in the life of a product. This may include quality assessment of the whole system, and can look onward to the marketing of the product.

The most commonly used form of environmental audit for products is the life-cycle analysis or cradle to grave assessment. This is well established in several national product-labeling schemes like Canada (Environmental Choice), Japan (Eco-Mark) and the EC, Eco-label of which the UK is a member. Companies operating under the Eco-Environmental scheme standards can only display Eco-label if their products meet certain pre-determined environmental standards.

The scope of the product audit defines clearly the product type and range, the key environmental criteria to be considered, and the product's fitness for purpose. The product audit areas include:

- Raw Material: The sources of the materials, the potential effects and availability of alternative choice.
- Production process: Significant effects of products come from the production processes. Product audit considers what can be done to reduce energy use, pollution, waste and transport of environmental problems. It also determines available, best environmental options that can reduce cost of impacts.
- Utilization: The effects of products use and how it compares with others products.
- Disposal: This aspect considers the effect of disposal and determines reusability and recyclability of the product.

2.6. ENERGY AUDIT

Energy audit involves the systematic assessment of energy inputs, outputs and general utilization of energy in the audited facility.

A detailed study of energy use can be used to reduce energy consumption by adopting a more efficient procedures and equipment. There is a double benefit to such a study. Not only can it be used to identify major cost savings areas to the company, it can also reduce a number of indirect environmental impacts ranging from transportation of fuel to the emission of CO_2, SO_2 and NO_2 from fuel use.

Like other audits, careful preparation, a rigorous methodology and effective follow-up remain the key elements to energy audit success. The audit should identify appropriate energy conservation measures.

Figure 2
BASIC STEPS OF AN ENVIRONMENTAL AUDIT

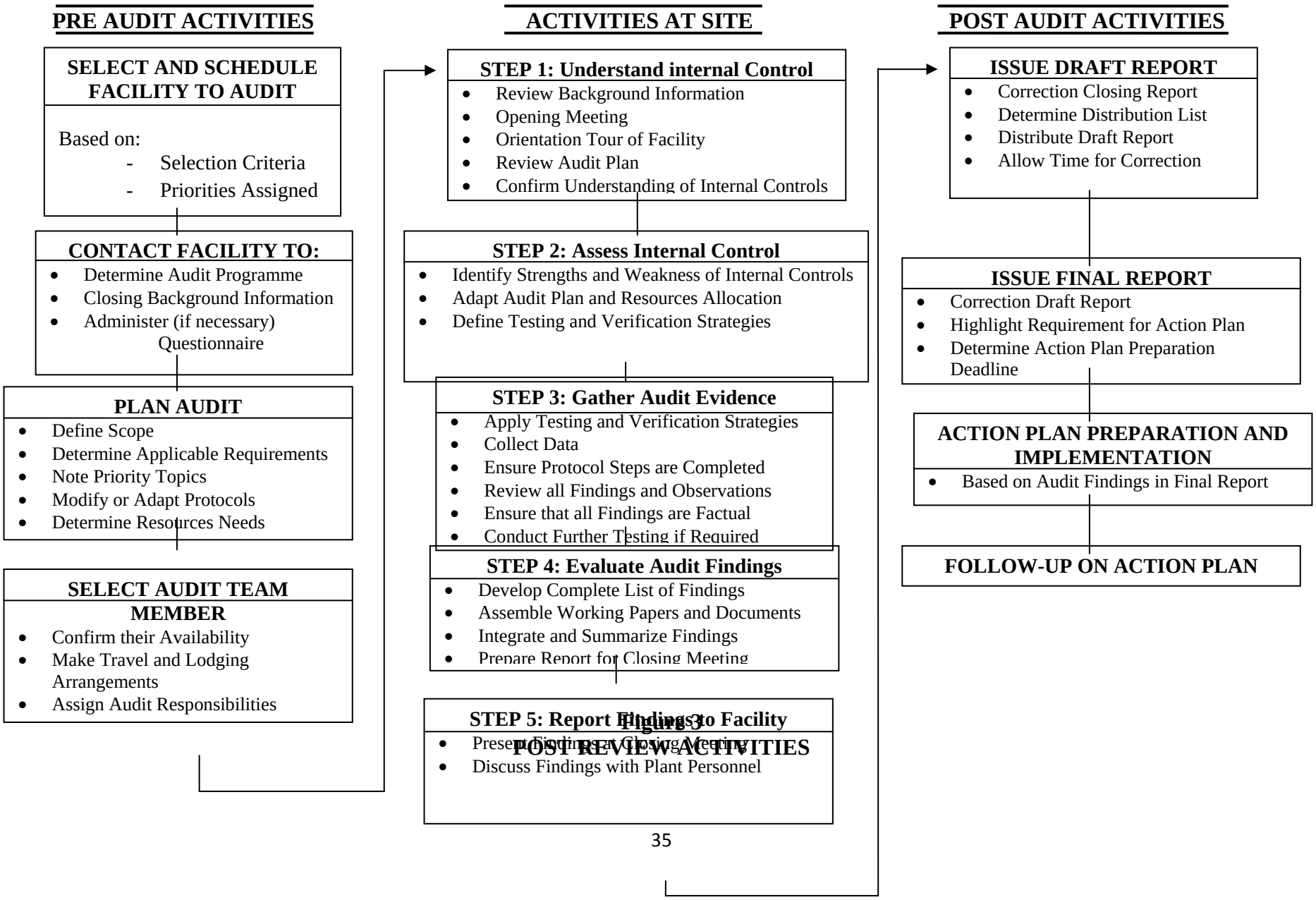
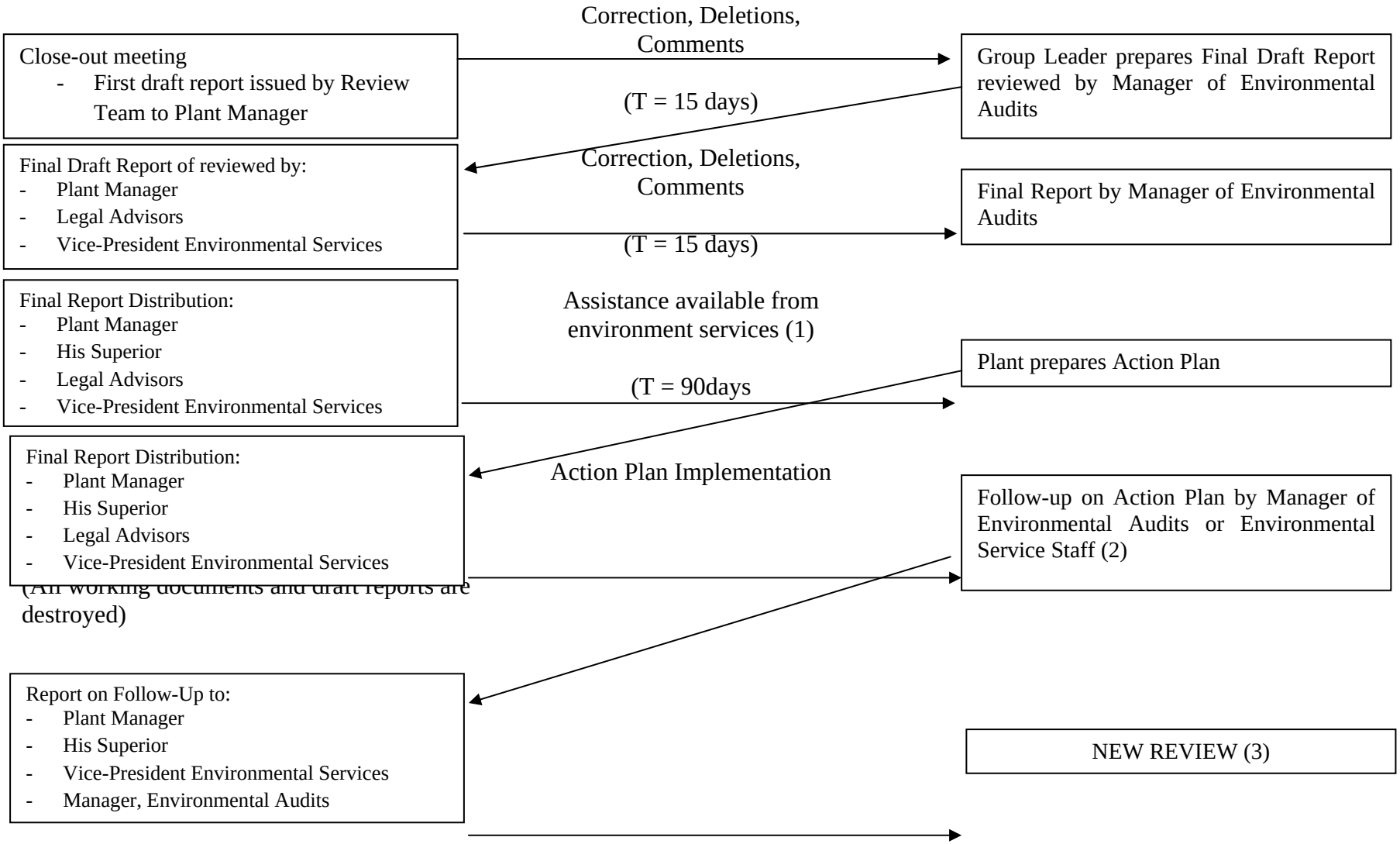


Figure 3
POST REVIEW ACTIVITIES


Close-out meeting
- First draft report issued by Review Team to Plant Manager
Correction, Deletions, Comments
(T = 15 days)
Group Leader prepares Final Draft Report reviewed by Manager of Environmental Audits
Final Draft Report of reviewed by:
- Plant Manager
- Legal Advisors
- Vice-President Environmental Services
Correction, Deletions, Comments
(T = 15 days)
Final Report by Manager of Environmental Audits
Final Report Distribution:
- Plant Manager
- His Superior
- Legal Advisors
- Vice-President Environmental Services
Assistance available from environment services (1)
(T = 90days
Plant prepares Action Plan
Final Report Distribution:
- Plant Manager
- His Superior
- Legal Advisors
- Vice-President Environmental Services
Action Plan Implementation
Follow-up on Action Plan by Manager of Environmental Audits or Environmental Service Staff (2)
(All working documents and draft reports are destroyed)
Report on Follow-Up to:
- Plant Manager
- His Superior
- Vice-President Environmental Services
- Manager, Environmental Audits
NEW REVIEW (3)

Scheduling of Audits

While there is no generally agreed time frame for audit scheduling, it is not out of place to suggest an audit exercise once in 3 -4 years. However, certain factors could lead to an increase in frequency of auditing. Such factors include

- new or modified legislation;
- the size of the facility;
- the processes carried out and the characteristics of the chemicals and raw materials used and the volumes stored.
- the employee exposure to in-plant chemicals and process by-products.
- the emission effluent and waste volumes and characteristics;
- the sensitivity of the environment surrounding the facility;
- the nature of the receiving environment; and
- the proximity of public residences to the plant.

Conclusion

As part of its mandate, the Federal Environmental Protection Agency has been carrying out some form of environmental audits of industrial establishments. It has been suggested by FEPA that auditing should be on schedules agreed to between it and the project management.