Aims of the Module

- To introduce the concept of best practice in environmental monitoring and performance assessment
- To discuss the following aspects
  - Guiding principles and standards
  - Purpose of environmental monitoring
  - Design of the environmental monitoring program
  - Environmental performance assessment

Some Definitions

- Environmental monitoring
  - The gathering and evaluation of information for assessment of performance
- Environmental performance
  - A measure of the success of strategies implemented, when compared with environmental objectives

Guiding Principles and Standards

- Sustainable development
- The precautionary approach
- Environment management systems (EMS)
- Environment management plans (EMP)

Environmental Management Plan

- Each issue identified using the environmental impact assessment will be covered by the environmental management plan.
- The EMP will also include a schedule of monitoring observations, measurements, analyses, sites and frequency of data collection.

Purpose of Environmental Monitoring

- Demonstrates **compliance** with regulatory requirements
- Provides **information** for periodic review and alteration (improvement) of environmental management
- BUT - monitoring by itself does not provide environmental protection!

Specific Objectives of Environmental Monitoring

- Measure impacts (or demonstrate lack of impacts)
- Check the accuracy of predicted impacts
- Detect long and short term trends
- Enable analysis of the causes of environmental changes or impacts
- Provide feedback to improve environmental protection and monitoring practices

Environmental Issues

- Identify key environmental issues.
  - What is being protected?
  - What are the potential hazards and impacts?
  - What is the level of acceptable change?
  - What is the level of risk?
  - What are the pathways and impact sites?

Design of the Environmental Monitoring Plan (EMP) (1)

- Specific monitoring requirements emerge from the EMP and include:
  - What to measure
  - Where to measure
  - When to measure
  - How to measure
  - Evaluation methods to be used

Design of the EMP (2)

- The environment monitoring program should be documented
  - Identify scope and list the programs corresponding to the environmental issues
  - Define objectives of each component
  - Set out details of what, where, when, how (methods), who (responsibility)
  - Define evaluation methods, frequency of reporting, circulation list

Typical Components of the Monitoring Program

- **Water:** streams, ponds, seawater, groundwater...
- **Land:** area of disturbance, fire, erosion, soil quality, rehabilitation progress, vibration...
- **Biology:** diversity, condition, populations; weeds, pests...
- **Air:** gases, dust, noise...
- **Process and waste:** waste rock, tailings, waste oil, used containers, garbage
- **Cultural aspects:** building condition, heritage sites, diet items, population movements

Data Collection, Evaluation and Presentation

- Appropriate techniques for each type of measurement
- Appropriate detection limits and quality control
- Data storage (data base)
- Graphs to examine trends in time-series data
- Diagrams and maps where helpful
- Both specialist and interdisciplinary (balanced) interpretation
- Interpretation to both look backwards and forwards
- Possible independent review or verification

Case Study: Hamersley Iron - Marandoo, Western Australia: Water

- Performance of aquifer and water quality
  - Depth to water measured in 5 production and 22 observation wells
    - Monitored and reviewed
  - Ground water quality measured in 5 production and 5 observation wells
    - Monitored and viewed six-monthly
  - Results compared with historical data
  - Reported in annual report

Case Study: Hamersley Iron - Marandoo, Western Australia: Rehabilitation

- Success of revegetation
  - Plant counts on transects in rehabilitated areas
  - Biannually or as required
  - Species density, diversity, percent cover
- Data are compared between sites and over time

Case Study: Hamersley Iron - Marandoo, Western Australia: Ecosystem health

- Biology: Pebble mound mouse
  - Quarterly
  - Monitor activity near and remote from mine
  - Results compared with historical data
  - Reviewed annually for annual report
- Biology: Plant growth
  - Area affected by aquifer draw-down
  - Biannually or as required
  - Plant transects, species density, diversity, % cover
  - Interpretation and review biannually or as required

Case Study: Hamersley Iron - Marandoo, Western Australia: Air

- Air
  - Environmental dust
  - 9 locations, collected monthly near and remote from mine
  - Results compared with historical data
  - Reviewed monthly, and annually as part of annual report

Case Study: Hamersley Iron - Marandoo, Western Australia: Waste

- Process and Waste
  - Waste water drainage from plate separators and waste water dam
  - Monthly, 3 locations
  - Analyse for hydrocarbons
  - Results compared with historical data
  - Reviewed monthly, and annually as part of annual report

Environmental Performance Assessment

- Environmental performance is measured against objectives set in the environmental management plan
- Progress towards meeting these objectives forms the basis for reporting on the state of the environment
- Areas that require more intensive study can be identified

Environmental Performance and Evaluation

- Environmental performance needs to be measured against its objectives
- Environmental monitoring and its interpretation (reporting) must permit clear conclusions
- Requirements for special investigations may be identified
- Areas of compliance or non compliance identified

Environmental Auditing

- Is a management tool
- Systematic assessment
- Periodic, e.g. annual
- Documented
- Highlights environmental risks
- Assesses compliance
- Is objective, preferably independent
- May be a licence requirement

Feedback to Environmental Monitoring and Protection Programs

- From the monitoring data:
  - Identify trends, information gaps, impacts and causes
  - Assess performance and compliance
- Use this information to:
  - Modify practices and procedures for environmental protection
  - Modify the monitoring program

Summary

Environmental Monitoring

- Addresses key environmental issues
- Provides relevant information
- Is interpreted and reported
- Demonstrates compliance

Environmental Performance Assessment

- May be audited
- Allows modification of environmental protection practices or monitoring programs
- Is part of continual improvement