Assessing Environmental Impacts

Which aspects of the environment are most likely to suffer adverse effects as a result of a project or program?

- This is the most critical part of environmental impact analysis – 4-step process:
  - Determine activities necessary to complete the proposed project
  - Which environmental attributes will reflect the impacts associated with project activities: water, air, aesthetics, etc.?
  - Determine/predict magnitudes of environmental impacts
  - Report findings in a way that is usable by decision-makers and comprehensible by stakeholders and the public

How to determine project activities?

- Develop comprehensive list of all actions needed for implementation, construction, and operation that may impact the environment
  - Site access/supply delivery: roads, railways, utilities, water, etc.
  - Support facilities: asphalt, concrete, sewer, construction shops, etc.
  - Site preparation: clearing, excavation, critical habitat loss, endangered spp., etc.
  - Construction activities: traffic, dust, waste disposal, noise, etc.
  - Impacts of large, transient labor force on public services (schools, utilities, hospitals, etc.)
  - Operational activities: traffic, waste disposal, impacts of permanent labor force on public services, etc.
  - Secondary impacts: cumulative effects, changes in economic/tax base, disruption of ecosystem function, etc.

Which environmental attributes will be affected by the project?

- Variables that represent characteristics of the environment are 'attributes'
  - Changes in attributes provide indications of changes in the environment
    - E.g., water, air, noise, aesthetics, etc.
  - EIAs/EISs are prepared to characterize potential changes in environmental attributes = impacts
    - Attributes may be biophysical or socioeconomic
- Lists of environmental attributes (i.e., SEQR checklists) often used to provide a short-hand characterization of the environment
  - Limited value due to environmental complexity
  - Must understand existing complex environmental relationships to be able to predict future/complex changes in attributes

Specific steps used to assess anticipated environmental impacts

- Not all steps will apply to all types of environmental impacts
- In many cases, relevant data may not exist
- Air pollution example: sulfur oxides from a proposed coal-fired power plant
  - Define the environmental attribute: fossil fuel combustion produces sulfur oxides; e.g., $S + O_2 \rightarrow SO_2 + H_2O \rightarrow H_2SO_3$ and H_2SO_4
- Determine relevant laws and regulations
  - Clean Air Act of 1970 and subsequent Amendments
    - Set AQ standards by which project impacts can be measured
    - EPA sets ambient air quality standards (AAQSs)
  - Primary standards protect public health

- For sulfur oxides, standards are 0.03 ppm annual mean and 0.14 ppm/d
- Secondary standards protect public welfare, including the natural environment, from adverse effects of air pollutants
  - For sulfur oxides, standards are 0.02 ppm annual mean, 0.10 ppm for 24 h once per year, and 0.5 ppm for 3 h once per year (lethal to humans)

What project activities affect the air quality attribute?
- Burning fossil fuels for electrical power production

What types of effects can be expected?
- Morbidity (respiration problems); mortality (smog episodes)
- Materials damage (stone, paints, metals, etc.)
- Ecosystem damage (acid precipitation effects on aquatic/land biota)

Which variables = attributes should be measured?
- Annual, 24 h, 3 h means (see AAQSs above)
- Be sure to consider ambient conditions plus projected additions
- Also examine interacting factors (e.g., typical humidity vs. effects on materials)

How to measure the attribute?
- Standard EPA method is pararosaniline method for sulfur oxides followed by colorimetric analysis to determine ppm
  - Be sure to check latest guidelines

How to collect data?
- Do it yourself or collect it from somewhere else (e.g., federal, state, local AQ monitoring stations; web sites)

What skills are required?
- Technician to run analyses or gather information

Evaluation and interpretation of the data: review literature
- For sulfur oxides, 0.03 ppm damages plants, 0.2 ppm kills humans
- AQ regions are classified as high, moderate or low quality
  - Projects creating a 0 step change in classification legally have no significant impact
  - 1 and 2 step changes = moderate and major impacts, respectively
- EPA rule is not to permit any new facility that will lower regional AQ
  - Be sure to analyze local as well as regional changes before concluding no impact

Consider geographic and temporal limits
- Collect data or use models to predict spatial and temporal impacts
  - E.g., where will sulfur oxides go from source and in what concentrations (e.g., acid precip in northeast from taller smokestacks in midwest was not predicted)

How can impacts be mitigated?
- E.g., reduce consumption of fossil fuels; use technology to trap emissions at source, then landfill; remove receptors from polluted area; create protected, controlled environments (gas masks, sealed buildings)

Are secondary effects likely re: economic, resource, environmental or other losses from damage to materials, water, aesthetics, general welfare, altered land use patterns, etc.?

Consider other relevant, attribute specific, factors
- E.g., odor/aesthetic problems of sulfur oxides

Other attributes and their characteristics to consider in an EIS process

Water

- High quality is essential to humans and their ecosystems
  - E.g., agriculture, industry, recreation, potable
- Many federal and state laws regulate (e.g., Clean Water Act and Amendments)
- Most construction projects have potential to damage water quality or quantity (e.g., Great Lakes diversions)
  - May affect run-off, surface waters, ground water
  - Pollution in any of these hydrologically connected parts can spread rapidly (e.g., Niagara escarpment mirex to Lake Ontario)
- Physical attributes of water: depth, velocity, discharge, color, clarity, turbidity, temp.
  - All can be influenced by impacts of projects and affect critters
- Chemical/biological attributes: pH, nutrients, metals, BOD, pathogens, toxic chemicals
- Many interactions and secondary effects in aquatic systems (e.g., buffering capacity vs. acid precipitation)
  - Focus of analysis determined by type of project

Land: many terrestrial features can be impacted by human activities

- Soils: interface among atmosphere (temperature, moisture, wind), geosphere (rock, minerals) and hydrosphere (erosion, nutrients)
- Climate, weather, local landforms, constituent materials, etc. all influence project impacts
- Consider local environmental cycles to evaluate long-term project impacts
- Modifying land attributes has great potential to change environmental and social attributes, especially when alterations are permanent
  - E.g., should land be used renewably for forests, farms, wildlife, etc. or permanently for roads, buildings, etc.?

Ecology: evaluating the potential for changing relationships among organisms and humans is the main purpose of environmental analysis

- Damage to living organisms by toxic chemicals was a major impetus for the environmental movement that led to the EIS process (DDT, R. Carson)
- Aesthetically pleasing environments mean abundant plants, animals, natural ecosystems
  - Natural vs. developed environments provide individual/social benefits
- Humans have two major interests relative to biota
  - Maintaining species diversity as an indicator of environmental health/provider of resources
    - E.g., medicines, products, fish/wildlife, minimizing endangered species
  - Maintaining stable ecosystems that ultimately sustain all human activity
  - These critically important values are very difficult to quantify, especially to the satisfaction of engineers and economists
- Millions of potential ecological interactions as a result of a project make it very difficult to predict impacts
  - But, decreased species diversity and loss of habitat destabilizes ecosystems and enhances probabilities of extreme system fluctuations (e.g., GL fisheries)
- Very few human activities have no significant ecological impact and difficult to predict, secondary ecological effects are the rule
  - E.g., CFCs and stratospheric ozone
  - E.g., Land clearing ---> stream turbidity ---> temperature extremes, blocked photosynthesis, benthos smothering, gill damage ---> morbidity, mortality,

aesthetic, economic effects (e.g., salmon)

Understanding and predicting these kinds of effects before they happen is essential for long-term ecosystem health and human prosperity

Noise: a pervasive problem in modern society

80-100 million people impacted adversely; 40 million may suffer adverse health effects (e.g., green chain, radiotracking)

Must consider noise control/mitigations for many construction projects

Occupational hearing loss for workers; structural damage

Temporary disturbance of surrounding community re: sleep loss, impaired creativity (e.g., build noise barrier near urban roads)

Land-use incompatibility (e.g., concrete plant next to nature center)

Consider noise impacts during construction and for project duration

Lots of post-project court battles over this impact

Human aspects: quality of life is just as important to consider in environmental analysis as technical and environmental considerations

Must consider human ecology in relation to projects

The environment is surroundings and includes other people and their jobs, property, associations and heritage

Project impacts must be evaluated in these terms

To assess total impacts of a proposed project, must know the social and political environment of the project area (neighborhoods, villages, cities, cultural values, etc.)

Determine current conditions: local community goals/lifestyle, land uses

How will the project affect these values? (e.g., fishing marinas fit well in Great Lakes harbors)

Scientists, engineers and bureaucrats are notoriously poor at judging the social and political ramifications of project decisions

E.g., toxic waste incinerators in communities; venting radioactive gases at nuclear power plants

Political power is vested in organizations with stakes in the community (stakeholders) who will support or oppose a project according to how their interests will be affected

Therefore, community status and needs will influence the relative positive/negative impacts of a proposed project

E.g., is further economic development desired; are more schools, hospitals, etc. needed?

Economic attributes usually examined on two levels

Impact on Conditions (income, employment, etc.)

Impact on Structure (output by sector, employment by sector)

Key categories are: assets, employment, income, output

Assets: value may change due to a project

E.g., mined coal can't be replaced, roads destroy soil below for agriculture; converting farmland to residential development increases local tax base (is there a fundamental flaw here?)

To what extent are irreplaceable resources consumed (CEQ guidelines)?

Employment: levels indicate economic health of a region

Projects often provide short-term boost to jobs, income and taxes

- Often a long-term decline for those left behind after construction workers leave
- Income and Output are not much affected by individual projects unless the project is large relative to the regional economy
- Communities can be left with high inventories, underused facilities, high taxes and high unemployment
- Other economic factors to consider are income distribution, government expenditures to stimulate local economies, taxes, etc.

Natural resources: environmental quality is linked directly to the use of energy and material resources that may be in short supply or vulnerable to unstable foreign politics

- Resource development projects greatly impact the environment (e.g., strip mining, oil pipelines/ocean transport, offshore oil, smelters, etc.)
- In an era of limits, projects must be evaluated in terms of their ability to minimize resource use, promote reuse and recycling, and reduce emissions to levels below those that damage the environment

Don't forget the environmental value of aesthetics

- Hard to quantify, but important