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Air Pollution

Introduction of chemicals, particulate matter or biological matter that cause harm or discomfort to humans or other living organisms or damages the natural environment, into the atmosphere.

Above Background Level

Source : Anthropogenic & natural

Mexico Valley, 1930

Los Angeles Smog

Cleveland Gas Explosion

Donosa Smog

Mexico, Puerto Rico

Bhopal Disaster

2-3 Dec 1984

A poisonous vapour burst from the Union Carbide Pesticide Plant

8000 died immediately

300000 injured

7000 animals affected

1000 animals died

40 tons of toxic gas had leaked from Carbide's Bhopal Plant & spread throughout the city

Source & Classification

Natural

Man-made or Anthropogenic

- ① Natural pollen grains
- ② Volcanic eruptions
- ③ Forest Fires
- ④ Dust Storms
- ⑤ Spores
- ⑥ Bacteria & other microorganisms

- ① Man made Industrial Units
- ② Thermal power plants
- ③ Automobile exhausts
- ④ Fossil Fuel Burning Mining
- ⑤ Nuclear Explosions

Stationary

Mobile

Point Source - Large Stationary Source

Area Source ~ Small Stationary Source

Line Source - Mobile Source

Air Pollutants

- (1) Substance degrading temop or perm in the air.
- (2) A pollutant can be solid, liquid or gas.
- (3) It may originate from both natural or anthropogenic source.
- (4) Affect the environment by interfering with health, comfort, food chain, property values of people.
- (5) It is estimated that anthropogenic sources have changed the composition of global air by less than 0.01%.

Classification of Pollutants

- (1) Primary Pollutants which are emitted directly from identifiable sources.
- (2) Secondary Pollutants which are produced in the atmosphere when certain chemical reaction takes place.

Major Primary Pollutants

Particulate Matter (PM)

Sulfur Dioxide

Nitrogen Oxides

Volatile Organic Comp (VOCs)

Carbon monoxide

Lead

Secondary Pollutants

HNO_3

H_2SO_4

SO_3

H_2O_2

O_3

Meteorology and Transport of air pollution

Layer Nomenclature	Major Subdivision of Atmosphere
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Exosphere

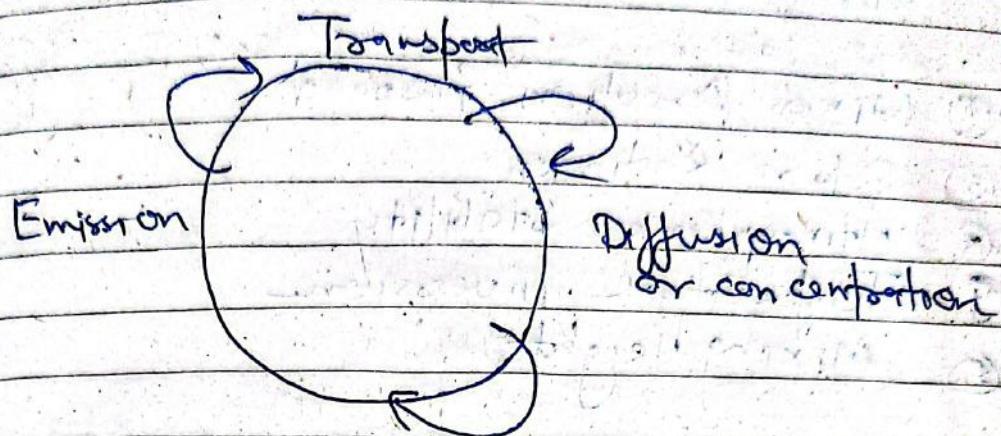
Thermosphere

Mesosphere

Stratosphere

Troposphere

Air Pollutant Cycle



Transport

Pollutants moved from source
May undergo physical & chemical exchange

Concentration & Dispersion

Dispersion based on meteorological & topographic conditions

Concentration - Stagnant cond

Pollutants disperse over geographic area

Any location receives pollutants from diff sources in diff amounts

Prediction

Mathematical Model of local atmosphere
determine transport & dispersion patterns

Meteorological factors influencing air pollution

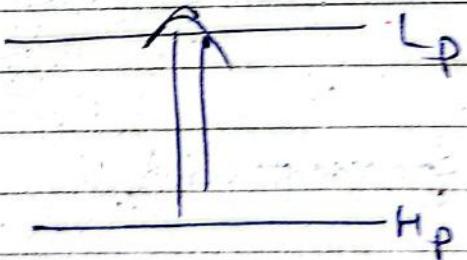
- (1) Wind Direction & Speed
- (2) Solar Radiation
- (3) Atmosphere Stability
- (4) Temperature Inversion
- (5) Mixing Height

Wind Direction & speed

Air moves in response to differences without rotation

Wind Circulation

Air flows directly from high to low pressure



Rising Air cools & produces rain

Sinking Air is heated & becomes dry.

Lapse Rate

Imp char of atmosphere is ability to resist vertical motion: stability

Lapse rate is the negative of temp grad.

Adiabatic Expansion

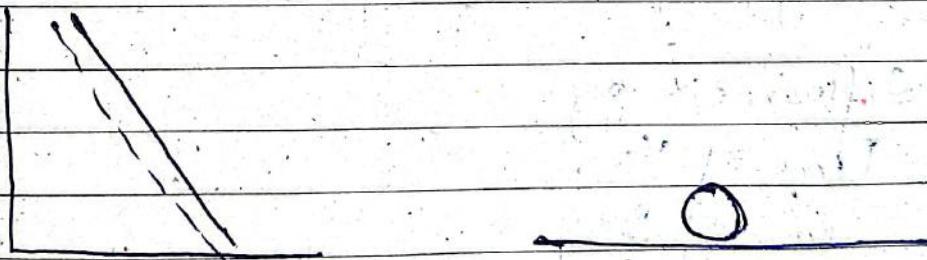
$$\frac{dT}{dz} = - \frac{\gamma pg}{C_p}$$

Atmospheric Stability

Affects dispersion of pollutants

① Neutral

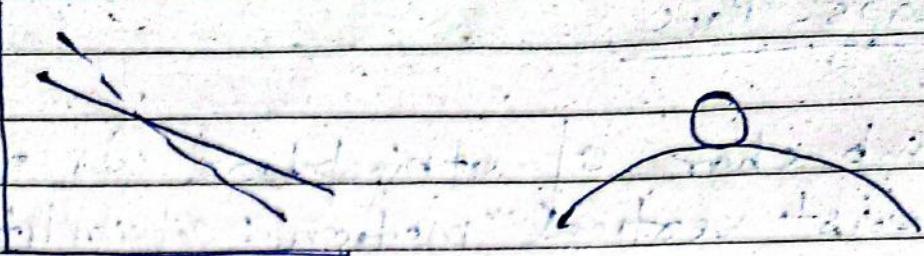
$$\text{Env Lapse Rate} = \text{Dry Adiabatic Lapse Rate}$$



② Superadiabatic

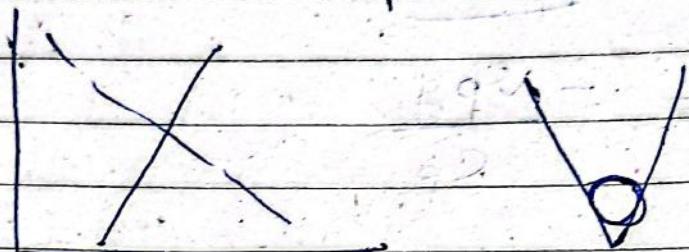
$$\text{Env Lapse Rate} > T$$

Unstable



③ Subadiabatic

Environmental Lapse Rate (Γ_e)



Stable

Inversion

Stability lessens exchange of wind energy b/w air layers

Influenced by
Time of Year
Time of Day
Topography
Presence of water or ice

Two types of Inversion

- ① Radiation Inversion
- ② Subsidence Inversion

Two more types

Cold Air Flowing Under
Warm Air Flowing Over

Stability Classes

Developed for use in dispersion models

Stability classified into 6 classes

- A strongly unstable
- B moderately unstable
- C slightly unstable
- D neutral
- E slightly stable
- F moderately stable

Wind Velocity Profile

Friction Retards Wind Movement
Wind Speed varies by height

Power law of Deacon

$$\frac{U}{U_1} = \left(\frac{z}{z_1} \right)^p$$

$U \rightarrow$ wind speed at elev 2

$z \rightarrow$ elevation

$p \rightarrow$ exponent based

Collection Mech.

Impingement

Interception

Diffusion

Condensation

Types of Scrubbers

Spray Towers

Venturi Scrubbers

Cyclone Scrubbers

Packed

Mechanical

Land Pollution

Land Poll is the destruction of earth's land surfaces often directly or indirectly, as a result of human activities & their misuse of land resources.

It occurs when waste is not disposed off properly or can occur when humans throw chemicals onto the soil.

Causes of Land Pollution

- ① Deforestation & soil erosion
- ② Mining Activities
- ③ Overcrowded Landfills
- ④ Industrialization
- ⑤ Construction Activities
- ⑥ Nuclear Waste

Effects of Land Pollution

- ① Soil Pollution
- ② Change in climate Patterns
- ③ Environmental Impact
- ④ Effect of Human Health
- ⑤ Cause Air Pollution
- ⑥ Distraction for Tourism
- ⑦ Effect on Wildlife

Solutions For Land Pollution

- ① Make people aware about the concept of Reduce, Recycle & Reuse.
- ② Reduce the use of pesticides & fertilizers in agriculture activities.
- ③ Avoid buying packaged item.
- ④ Buy biodegradable products.
- ⑤ Create Dumping Ground away from Residential Areas.

No Dumping

Reduce, Reuse, Recycle & Compost

Noise Pollution

- Unwanted sound that penetrates the environment.
- any noise irritating to one's ears which comes from an external source.

Source of Noise Pollution

Street Traffic

Rail Traffic

Road Traffic

Airplanes

Construction

Indoor Source (Radio, TV, AC)

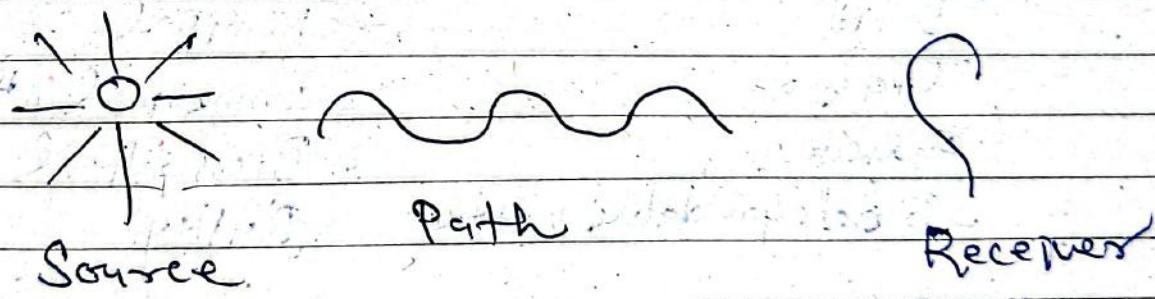
Effects of Noise Pollution

- ① Loss of Hearing
- ② Annoyance
- ③ Health Effects
- ④ Interference with communication
- ⑤ Working Efficiency
- ⑥ Sleep Interference

Control of Noise Pollution

Can never be eliminated completely but it can be controlled

Can be controlled by paying attention to one or all of the 3 elements



Source

Transmission Path

Receiver

Other steps to control noise poll

- Noise Pollution Rules 2000.
- Vehical noise can be controlled by proper maintenance.
- By controlling sound of loudspeakers
- Aerodrome should be located away from the city.

Waste

Rubbish, Trash, Garbage, Junk

Waste is any unwanted or useless materials

Types of Waste

Solid

Chemical

Liquid

Commercial | Business

Gaseous

Biomedical

Biodegradable waste

Bulky

Solid Waste

non liquid, non soluble materials ranging from municipal garbage to industrial wastes

If include

Garbage, Rubbish, Dead Animals,

Source

Agriculture

Fisheries

Household

Commerce & Industry

Types.

Household

Industrial

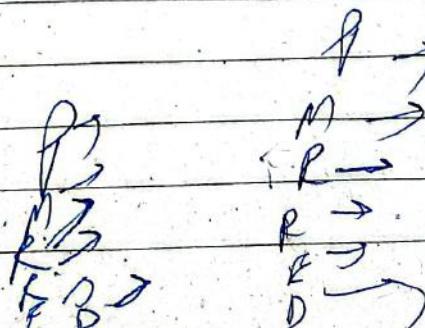
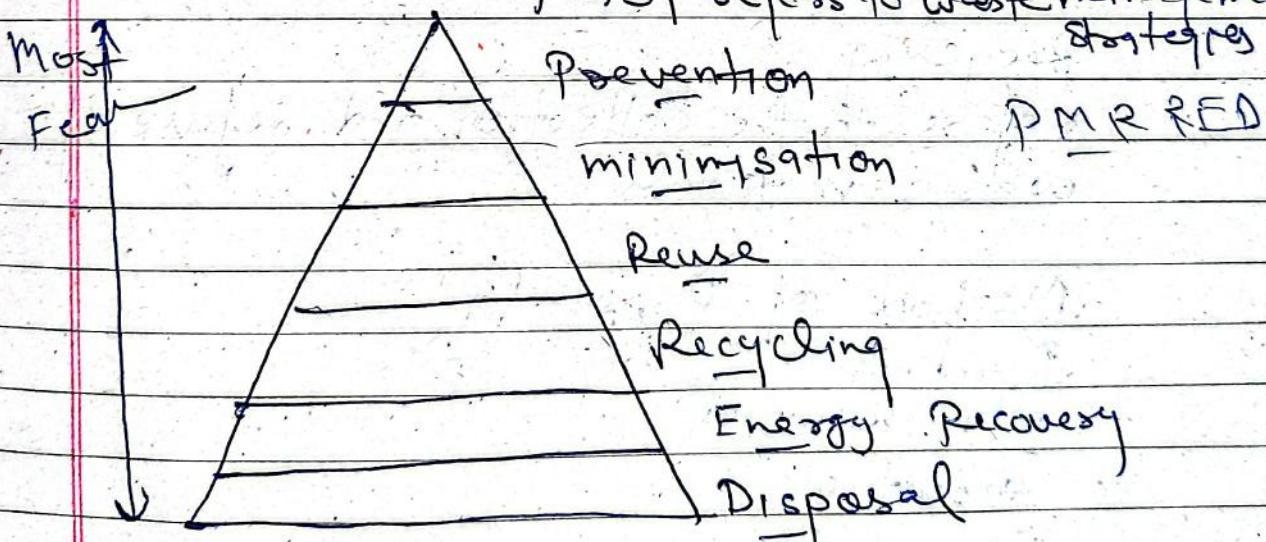
Biomedical

Waste Management Concept

Reduce, Reuse, Recycle

Waste Management Hierarchy

↳ It refers to waste management strategies



Solid Waste Management

- ① Storage
- ② Collection
- ③ Transport & Handling
- ④ Recycling
- ⑤ Disposal & monitoring of waste materials

Storage

- Galvanized steel dust bin
- Paper sack
- Public bins

Collection

- House to House Coll.
- Coll from the public bins

Recycling

refers to the collection and refuse of waste materials

Method of Disposal

- Dumping
- Incineration
- Composting
- Burying

Impact of Human on Environment

- ① Overpopulation
- ② Pollution
- ③ Global Warming
- ④ Climate Change
- ⑤ Ocean Acidification
- ⑥ Deforestation
- ⑦ Acid Rain
- ⑧ Ozone Depletion

Consequences of Population Growth

- ① Overuse of Resources
- ② Unemployment
- ③ Standard of Living
- ④ Decrease of Forest / Agriculture Area
- ⑤ Environmental Pollution

Energy Problems

The environmental problems directly related to energy production & consumption include air poll, water poll, thermal poll, solid waste disposal, climate change

Environmental Issues

- Climate Change
- Global Warming
- Ozone Depletion
- Water Poll

Solid Waste Mgmt
Deforestation

EIA

Environment Impact Assessment refers to the evaluation of impacts likely to arise from major project significantly affecting the environment.

Impact

The impact of an activity is a deviation (change) from baseline situation that is caused by the activity.

The baseline situation is the existing environmental situation or condition without presence of activity.

Types of Impacts

① Ecological Impacts

- Fisheries, Forests, Plantation

② Physico Chemical Impact

- Erosion & Siltation, Water logging, Dust / noise pollution, Flooding

③ Impact on Human Interest

- Loss of agricultural lands, generation of employment opps, industrial area

Historical Background of EIA

first developed in US as result of NEPA (National Environmental Policy Act) of 1969 for considering possible impacts to a decision being taken on whether or not a proposal should be given approval to proceed.

Purpose of EIA

- ① Identification, estimation & assessment of important effects that the planned project may have on the environment
- ② Presentation of data on impacts in the report for the authorities responsible for approving the realization of the project, as well as for the public
- ③ Encouragement of authorities responsible for approving the planned projects to include ecological elements in their decision making process

Process of EIA

Screening

Which projects need a full or partial assessment study is decided in this stage.

Scoping

Which impacts are necessary to be assessed is decided in this stage. While doing so legal requirements, expert knowledge & public engagement are also considered.

Alternative solutions that avoid or at least reduce the adverse impacts of project are also studied in this stage.

Assessment & Evaluation of Impacts & Development of Alternative

Environmental impacts of the proposed project are analyzed & light is thrown upon the alternatives present to such proj.

EIA Report also called EIS

An environmental management plan is also a non-technical summary of project's impact is prepared for general public ~~and~~ on this stage.

Decision Making

Whether the project is to be given approval or not if it is to be given, under what conditions.

Monitoring, Compliance, Enforcement & Environmental Auditing

Monitoring whether the predicted impacts of the mitigation efforts happen as per EIA.

Objectives of EIA

- ① Identifying, Predicting, Evaluating economic, environmental & social impacts of development activities.

Water Pollution

Water Poll is caused when water bodies such as rivers, lakes, oceans, groundwater contaminated with industrial & agricultural effluents.

Sources

Physical - flow, temperature, electrical conductivity etc.

Chemical - ~~Bio-degradable organics~~, Bio-degradable organics, dissolved oxygen and sediment demand (SOD), nutrients (N + P), toxic pollutants, salinity (dissolved solids), pH, BOD, COD etc.

Biological - ~~Chlorophyll, BOD~~

Coliform Bacteria, Indicator Parameters like Chlorophyll

Eutrophication - It is a process in which water receives excess nutrients like N + P that stimulate excessive plant growth (algal bloom). It causes hypoxia (oxygen shortage condition)

Causes

① Chemical Fertilizers

② Detergents

③ Poor Sewage Treatment

Toxicic State

Oligotrophic

Mesotrophic

Eutoophic

Hyper-Eutrophic

- ① Oligotrophic - (i) Lowest Productivity (Limited Growth),
(ii) highly well oxygenated,
(iii) found in the cold area,
(iv) quality drinking water is highly available
 - ② Mesotrophic - (i) Intermediate state b/w oligotrophic & eutrophic
(ii) Clear water with some merge plants
 - ③ Eutrophic - Biological Productivity increases
 - ④ Hyper Eutrophic - Dense Algal Growth

>100 microgram/litre P

> 40 microgram / litre Chlorophyll

BOD - Amount of free O in water required for biological oxidation of organic matter under Aerobic Conditions at 20°C for period of 5 days.

+ large amount of decomposable ~~solid~~ matter
greater is BOD & more pollutant water

COD - Amount of oxygen required for chemical oxidation of organic matter in sewage.

- * get completed in comparatively less time (3 hrs) than BOD (5 days)
- * on basis of COD value, approx BOD value can be estimated.
- * It is a quickly measured parameter for stream, sewage & industrial waste sample to determine their pollution strength.
- * COD is higher than BOD

$$\text{COD of sample water} = \frac{(V_B - V_s) \cdot N \times 8000}{X}$$

V_B = Volume of FAS sol given down in blank titration

V_s = Vol sample test titration

N = Normality of FAS

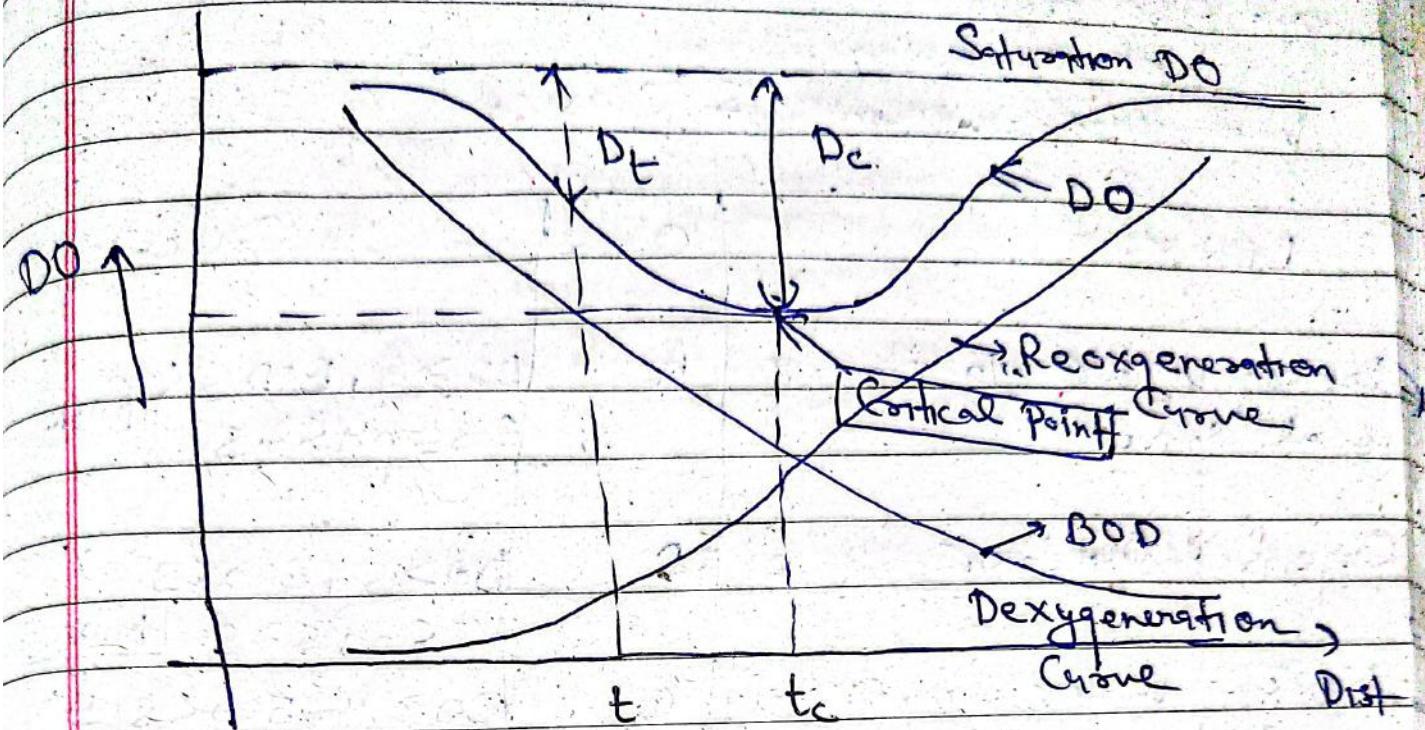
X = Volume of Test Sample

FAS \rightarrow Ferric Ammonium Sulphate.

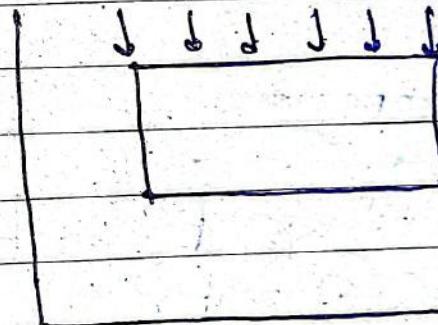
$$\begin{aligned} \text{BOD of Sample water} &= (DO_b - DO_d) \times \text{Dilution Factor} \\ &= (DO_b - DO_d) \times \frac{\text{ml of sample after dilution}}{\text{ml of sample before dilution}} \end{aligned}$$

DO_b = Dissolved Oxygen present in sample before dilution.

Longitudinal profile of Dissolved Oxygen



$$L = L_0 e^{-xt}$$



Self Purification Capacity of Stream

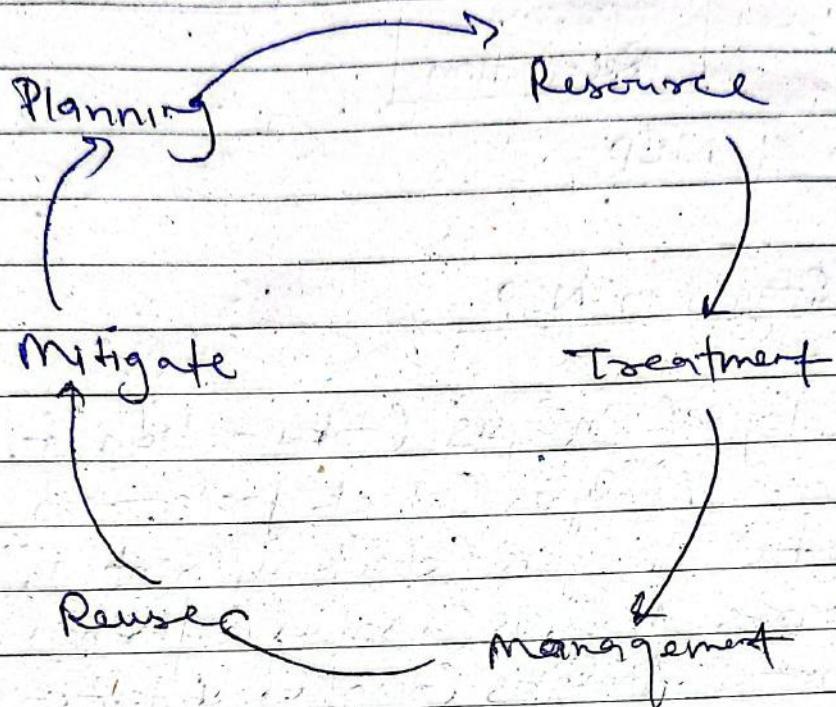
Classification of SWR based on Designated Best and Use order

Water Bodies in 5 Classes

DBU	Class	Category
Drinking water w/o convergent natural source	A	$DO \geq 6, BOD \leq 6$ $6.5 \leq pH \leq 8.5$ [MPN 55]
Organised Outdoor	B	$DO \geq 5, BOD \leq 3$ $6.5 \leq pH \leq 8.5$ [MPN 555]
Drinking water with convergent natural source	C	$DO \geq 4, BOD \leq 5.5$ $6 < pH < 9$ [MPN 55500]
Wildlife Propagation	D	$DO \geq 4, BOD \leq 2$ $6.5 \leq pH \leq 8.5, N \leq 12$
Irrigation Industry + Contro lled Disposal of water	E	$6 \leq pH \leq 8.5$ $EC = 2-25$ [SAR ≤ 25]

Environmental Audits

EA are intended to quantify environmental performance & environmental position of an industry / organization



Types

Compliance

Env Management

Liability Definition

Supplier

Programme

Single Issue

Risk Definition or Hazard Identification