Physical Environment

- ◆ Geology
- ♦ Soils
- ◆ Groundwater
- ◆ Surface Water Resources



Assessing Impacts to Geology

- Identify Source of Potential Impacts
 - Overpumping Groundwater
 - Construction of Steep Slopes
 - Logging on Steep Slopes
 - Construction of Jetties
 - Reservoirs
 - Hazard Zone Issues Affect Project
 - Mineral Takings
- ◆ Determine Study Area
 - Generally area of direct impact
 - Zone of Influence pumping groundwater
 - Down slope
- **♦** Determine Existing Conditions
 - USGS Geological Atlases
 - Bureau of Mines
 - DOGAMI
 - State/Local Planning Studies (Hazard Areas/Seismic)



Geology (cont.)

- Identify Standard
 - State
 - Local
- ◆ Impact Prediction
 - Engineering Studies
 - Similar Projects in Area
- ◆ Assess Significance of Impacts
 - Percentage
 - State/Local Policies
 - Human and Ecological Down-slope Affects
 - Impacts on Project
- Mitigation
 - Limit Groundwater Use
 - Move Project from Hazard Areas
 - Seismic Reinforcement

Hazard Zone Issues







Seismic

Volcanic

Tsunami



Coastal Sloughing



Mass Wasting

Assessing Impacts to Soils

- ◆ Identify Source of Potential Impacts
 - Site Clearing
 - Compaction
 - Change in Land Use
 - Hazardous Materials
 - Change Nutrients
- ◆ Determine Study Area
 - Generally area of direct impact
- **◆ Determine Existing Conditions**
 - Soil Survey (NRCS county surveys)
 - Field Testing
- ◆ Identify Standard
 - State
 - Local



Soils (cont.)

◆ Impact Prediction

- Erosion (Universal Soil Loss Equation)
- Compaction (Engineering Studies)
- Change in Chemistry (Mass-balance Calculations)

◆ Assess Significance of Impacts

- Percentage
- State/Local Policies
- Ecological (e.g. sedimentation of salmon bearing streams)

Mitigation

- Re-Vegetate Area
- Limit Time of Year
- Barriers
- Best Management Practices
- Line Disposal Area

Universal Soil Loss Equation (USLE)

 \bullet A = R x K x LS x C x P

where:

A = long term average annual soil loss in tons per acre per year

R = rainfall and runoff factor

K = soil erodibility factor

LS = slope length-gradient factor

C = crop/vegetation and management factor

P = support practice factor

Assessing Impacts to Groundwater

Identify Source of Potential Impacts

Quantity

Withdrawal

Change Recharge Source

Draw Down

Quality

Subsurface Percolation

Injection Wells

Land Application of Wastes

Land Application of Pollutants

Storage Tank Leakage

Burial

Transport of Wastes/Nonwastes (pipelines and overland)

♦ Determine Study Area

- Zone of influence
- Zone of contribution
- Direct impact

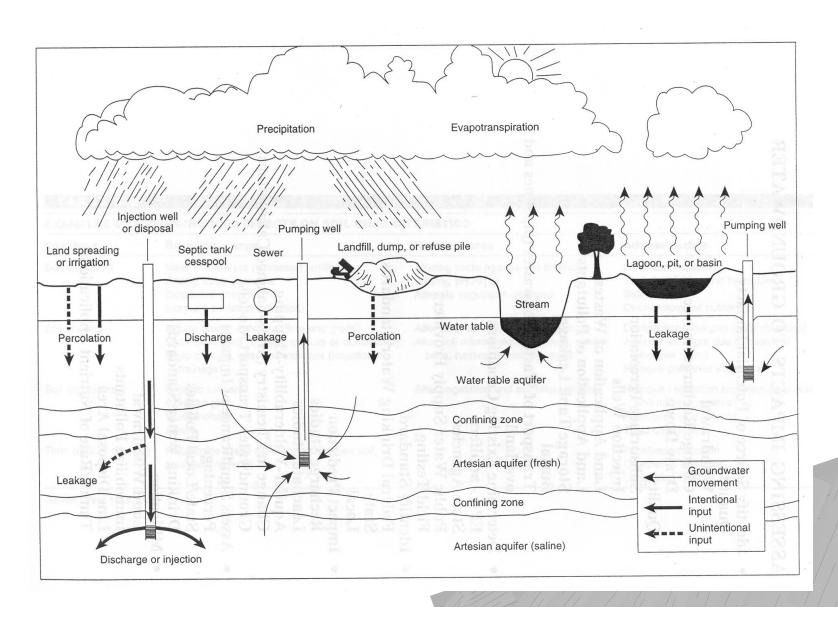
Groundwater (cont.)

- Determine Existing Conditions
 - EPA aquifers
 - State Agencies
 - Public Water Supply Providers
 - Field Testing
- Identify Standard
 - Federal Drinking Water Standards
 - State
 - Local
- ◆ Impact Prediction
 - Recharge Studies
 - Leachate Studies
 - Aquifer-Vulnerability-Mapping
 - Change in Chemistry (Mass-balance Calculations)
 - Groundwater Transport Models

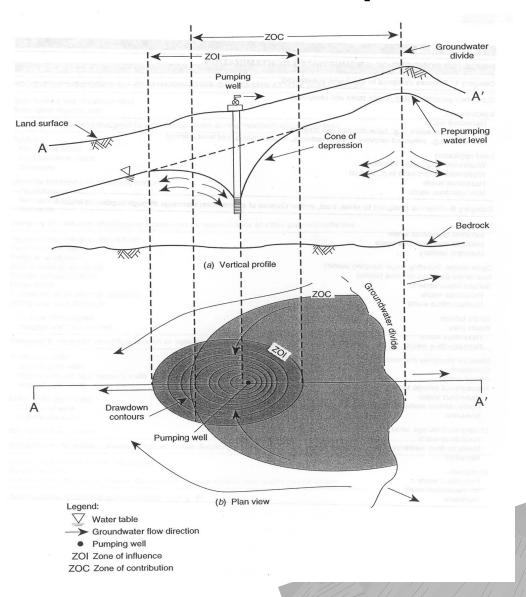
Groundwater (cont.)

- ◆ Assess Significance of Impacts
 - Percentage
 - State/Local Policies
 - Drinking Water Standards
- ◆ Mitigation
 - -Limit Withdrawal
 - Immobilize Pollutants
 - Line Disposal Area
 - Timing/Rate of Nutrient Applications

Sources of Groundwater Contamination



Wellhead Impacts



Assessing Impacts to Surface Water

Identify Source of Potential Impacts

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Quantity
Withdrawal
Diversion
Quality
Point Source
Non-Point Source
Fill
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Determine Study Area

Direct impact Mixing zone

Determine Existing Conditions

EPA (STORET)
State Agencies (DEQ, Water Resources Dept.)
Public Water Supply Providers
USGS - Flow Gauge
Field Testing

Identify Standard

Federal Standards
State Standards
New Source Performance Standards

Surface Water (cont.)

◆ Impact Prediction

Change in Chemistry (Mass-balance Calculations)

Dispersion Models

Ecological Models

◆ Assess Significance of Impacts

Water Standards

Percentage

Ecologically - Sensitive Species

State/Local Policies

Mitigation

Limit Use of Surface Water

Limit Erosion

Treat Point and Non-Point Sources

Construct Wetlands for Treatment

Timing/Rate of Nutrient Applications

Operate Project to Minimize Impacts

Potential Impacts to Surface Water

						7		Activity			
Type of effect						Modification of land cover	Construction		Water supply	Waste disposal	Channel modification
			itive/ ease	Negative/ decrease		or landform	W			ater	nels
On	site	Major	Minor	Major	Minor	over		actories	nts oply	aste w	nt orks in chai ge irs
Down- stream						plant of land action tion	works bads ls	ng ings s and fa	ls rrages undmer ater sup rells	s ems eated w aste wa	rts alignme ction w debris debris n of rive
						Removal of plant cover Bulldozing of land Gravel extraction Clay extraction Cut and till Terracing	Foundation works Unsealed roads Paved roads Curbing Guttering Isolated buildings	Gardens Mass housing Car parks Office buildings Warehouses and factories Storage yards Airports	Sinking wells Surface storages Major impoundments Allogenic water supply Municipal wells	Sanitary fill Septic tanks Sewer systems Return of treated waste water Industrial waste water	Road culverts Bridges Channel realignment Flood protection works Dumping of debris in channels Stormwater drainage Canalization of rivers
Hydrological parameter		Precipitation Interception Throughfall Surface runoff Infiltration Throughflow Water-table level Flood height Flood duration Base flow				0000	ш	•••••			
	ntity						••••		00		•
	Water quantity						0 0	• 00 0 0 00	0.0.0	•	
	Wat										
		Ev	Evaporation Transpiration			00000			•••		0 00
	1950	Sediment concentration Solute concentration Organic concentration Trace elements			STATE OF THE	•••••	••••				• •
Hydro	Water quality				tion	• • • • • •	••••		• • • •	0000	• • •
			Dissolved oxygen Groundwater quality			000000	0000	000000	00000		0
	Fluvial geomorphology	Channel stability Bank erosion Channel extension Gully erosion Channel aggradation Silt deposition				00000					
	Flu					*****	8				

State Water Quality Standards (Beneficial Uses)

- ◆ Public domestic water supply
- Private domestic water supply
- Industrial water supply
- ◆ Irrigation
- ◆ Livestock watering
- Anadromous fish passage

- ◆ Salmonid rearing
- ◆ Salmonid spawning
- ◆ Resident fish
- Wildlife/Hunting
- ◆ Fishing
- ◆ Boating
- Water contact rec.
- ◆ Aesthetic quality
- ◆ Hydro power
- ◆ Navigation

Pollutant Discharges

◆ Point Discharge

$$C_{avg} = SC_iQ_i/SQ_i$$

C_i = concentration of constituent i

$$Q_i = flow$$

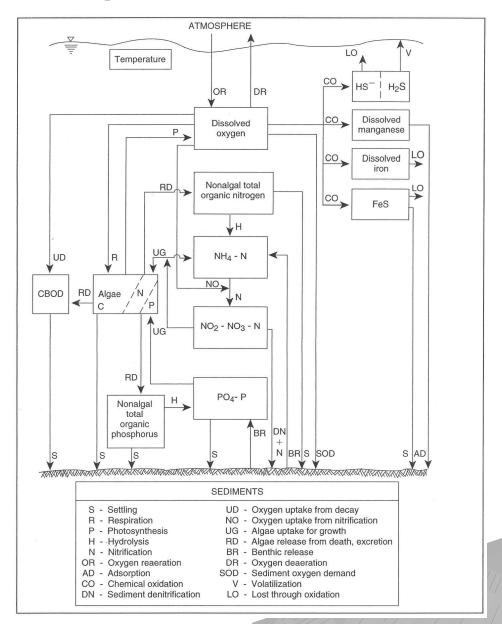
◆ Non Point Discharge Loadings from activities

Models

- ◆ Dispersion
- ◆ Compartment
- ◆ Ecological
- ◆ Instream Flow Incremental Method



Compartment Model



Best Management Practices

- ◆ Agriculture
 - FertilizerManagement
 - PesticideManagement
 - Conservation Tillage
 - IrrigationManagement
 - ManureManagement
 - Livestock Exclusion

- ◆ Silviculture
 - Buffer Strips
 - Haul RoadMaintenance
 - Selective Forest