CONTENTS	Page	Slide
Introduction	1	2
1.1 Hydrologic cycle	4	re and T
1.2 Ground water in rocks		
1.3 Types of interstices	6	12
1.4 Types of ground water	7	13
1. Pores and ground water - Flow in pores	9	fanousm17
2.1 Porosity (P)		18
2.2 Void ratio (e)		19
2.3 Effective porosity (P _e = specific yield),		
Capillary porosity (P _k)	10	20
2.4 Degree of saturation (D _s)		21
	12	23
2.6 Flow of water through a porous rock	13	25
2.7 Laminar flow		
2.8 Saturated flow – Darcy's law		
		34
2.10 Saturated hydraulic conductivity (K)		36
2.11 Transmissivity (T)		38
3. Determination of hydraulic conductivity (K)	nar sunice of	
and permeability (K _p)	20	40
3.1 Constant head apparatus	21	41
3.2 Falling head apparatus	21	
4. Unsteady ground water flow		44
4.1 Equations of unsteady saturated flow		
4.2 Three-dimensional saturated flow		
5. Flow to wells and boreholes		
5.1 Steady flow, well penetrates unconfined aquifer		
5.1.1 Calculations of steady flow,		
well penetrates unconfined aquifer		
5.2 Steady flow, well penetrates confined aquifer		
5.2.1 Calculations of steady flow,		
well penetrates confined aquifer mollsout		
5.3 Unsteady flow to a well – Theis solution	29	58
5.3.1 Equation of Theis for unsteady flow to a well	30	60
5.3.2 Equation of Jacob	23	65
5.4 Pumping tests – summary	35	70
5.5 Ground water investigations	36	72
5.6 Drilling methods	37	74
5.7 Examination of drill cuttings	41	d aid 81
6. Fractures and ground water	42	83
6.1 Primary fractures	43	85
6.2 Secondary fractures - in solid rocks	45	89
6.3 Spatial distribution and orientation of fractures	48	95
6.4 Flow of liquid in fractures	48	96
6.5 Faults – development	49	98

7.2 Volcanic areas – lava tubes 7.3 Geology and ground water flow 8. Hydrogeological characteristics of rocks 8.1 Ground water in igneous rocks 8.1.1 Plutonic (abyssal) rocks 8.1.2 Volcanic (effusive) rocks 8.1.3 Dyke (hypabyssal) rocks 8.2 Ground water in metamorphic rocks 8.2.1 Crystalline schists katazonally and mesozonally metamorphosed 8.2.2 Crystalline schists epizonally metamorphosed 8.2.3 Crystalline limestones 8.2.4 Quartzities 8.2.5 Final comments on ground water in metamorphic rocks 8.3 Ground water in sedimentary rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure	50	90
7.3 Geology and ground water flow 8. Hydrogeological characteristics of rocks 8. 1.1 Plutonic (abyssal) rocks 8.1.2 Volcanic (effusive) rocks 8.1.3 Dyke (hypabyssal) rocks 8.2.1 Crystalline schists katazonally and mesozonally metamorphosed 8.2.2 Crystalline schists epizonally metamorphosed 8.2.3 Crystalline limestones 8.2.4 Quartzities 8.2.5 Final comments on ground water in metamorphic rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.3.3 Disposal of waste saline water 10.4 Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	50	1053
7.3 Geology and ground water flow 8. Hydrogeological characteristics of rocks 8. 1.1 Plutonic (abyssal) rocks 8.1.2 Volcanic (effusive) rocks 8.1.3 Dyke (hypabyssal) rocks 8.2.1 Crystalline schists katazonally and mesozonally metamorphosed 8.2.2 Crystalline schists epizonally metamorphosed 8.2.3 Crystalline limestones 8.2.4 Quartzities 8.2.5 Final comments on ground water in metamorphic rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.3.3 Disposal of waste saline water 10.4 Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	52	10
8. Hydrogeological characteristics of rocks 8.1 Ground water in igneous rocks 8.1.1 Plutonic (abyssal) rocks 8.1.2 Volcanic (effusive) rocks 8.1.3 Dyke (hypabyssal) rocks 8.2 Ground water in metamorphic rocks 8.2.1 Crystalline schists katazonally and mesozonally metamorphosed 8.2.2 Crystalline schists epizonally metamorphosed 8.2.3 Crystalline limestones 8.2.4 Quartzities 8.2.5 Final comments on ground water in metamorphic rocks 8.3 Ground water in sedimentary rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4 Discharge of ground water 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.3.3 Disposal of waste saline water 10.4 Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	53	1001
8.1.1 Ground water in igneous rocks 8.1.1 Plutonic (abyssal) rocks 8.1.2.Volcanic (effusive) rocks 8.1.3 Dyke (hypabyssal) rocks 8.2.2 Ground water in metamorphic rocks 8.2.1 Crystalline schists katazonally and mesozonally metamorphosed 8.2.2 Crystalline schists epizonally metamorphosed 8.2.3 Crystalline limestones 8.2.4 Quartzities 8.2.5 Final comments on ground water in metamorphic rocks 8.3 Ground water in sedimentary rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.4 Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	54	1
8.1.1 Plutonic (abyssal) rocks 8.1.2 Volcanic (effusive) rocks 8.1.3 Dyke (hypabyssal) rocks 8.2.1 Crystalline schists katazonally and mesozonally metamorphosed 8.2.2 Crystalline schists epizonally metamorphosed 8.2.3 Crystalline limestones 8.2.4 Quartzities 8.2.5 Final comments on ground water in metamorphic rocks 8.3 Ground water in sedimentary rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.3.3 Disposal of waste saline water 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	56	1.7.01
8.1.2.Volcanic (effusive) rocks 8.1.3 Dyke (hypabyssal) rocks 8.2.1 Ground water in metamorphic rocks 8.2.1 Crystalline schists katazonally and mesozonally metamorphosed 8.2.2 Crystalline schists epizonally metamorphosed 8.2.3 Crystalline limestones 8.2.4 Quartzities 8.2.5 Final comments on ground water in metamorphic rocks 8.3 Ground water in sedimentary rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	56	0 8 0 1
8.1.3 Dyke (hypabyssal) rocks 8.2 Ground water in metamorphic rocks 8.2.1 Crystalline schists katazonally and mesozonally metamorphosed 8.2.2 Crystalline schists epizonally metamorphosed 8.2.3 Crystalline limestones 8.2.4 Quartzities 8.2.5 Final comments on ground water in metamorphic rocks 8.3 Ground water in sedimentary rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	59	1
8.2 Ground water in metamorphic rocks 8.2.1 Crystalline schists katazonally and mesozonally metamorphosed 8.2.2 Crystalline schists epizonally metamorphosed 8.2.3 Crystalline limestones 8.2.4 Quartzities 8.2.5 Final comments on ground water in metamorphic rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.3. Organism of maste saline water 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	62	deo 1
8.2.1 Crystalline schists katazonally and mesozonally metamorphosed 8.2.2 Crystalline schists epizonally metamorphosed 8.2.3 Crystalline limestones 8.2.4 Quartzities 8.2.5 Final comments on ground water in metamorphic rocks 8.3 Ground water in sedimentary rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.3.3 Disposal of waste saline water 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	62	a or or
and mesozonally metamorphosed 8.2.2 Crystalline schists epizonally metamorphosed 8.2.3 Crystalline limestones 8.2.4 Quartzities 8.2.5 Final comments on ground water in metamorphic rocks 8.3 Ground water in sedimentary rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.3.3 Disposal of waste saline water 10.4 Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	02	1.01.01
8.2.2 Crystalline schists epizonally metamorphosed 8.2.3 Crystalline limestones 8.2.4 Quartzities 8.2.5 Final comments on ground water in metamorphic rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4 Discharge of ground water 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion 10.2.2 Intrusion into inland aquifer 10.3. Orgound water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	64	10.10.2
8.2.3 Crystalline limestones 8.2.4 Quartzities 8.2.5 Final comments on ground water in metamorphic rocks 8.3.6 Ground water in sedimentary rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.3.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	65	8.01.01
8.2.4 Quartzities 8.2.5 Final comments on ground water in metamorphic rocks 8.3 Ground water in sedimentary rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution		
8.2.5 Final comments on ground water in metamorphic rocks 8.3 Ground water in sedimentary rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	66	1
in metamorphic rocks 8.3 Ground water in sedimentary rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.3.3 Disposal of waste saline water 10.4 Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	66	1
8.3 Ground water in sedimentary rocks 8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.3. Organic sedimentary 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	(7	MOTOR STATE
8.3.1 Consolidated psephitic and psammitic sediments 8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4 Discharge of ground water 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.3. Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	67	1
8.3.2 Consolidated pelitic sediments (clays) 8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4 Discharge of ground water 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.3.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	67	1
8.3.3 Rhythmically alternating consolidated sediments 8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	67	negg A1
8.3.4 Carbonate sediments 8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4 Discharge of ground water 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	70	19191971
8.3.5 Evaporites (readily soluble chemical sediments) 8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4 Discharge of ground water 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.3. Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	71	1
8.3.6 Organic sediments of biological origin (organisms) 8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4 Discharge of ground water 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	72	1
8.3.7 Unconsolidated and incoherent sediments 9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4 Discharge of ground water 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	74	1
9. Hydrogeological structures and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4 Discharge of ground water 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	75	1
and discharge of ground water 9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4 Discharge of ground water 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	76	1
9.1 Hydrogeological structure 9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4 Discharge of ground water 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution		
9.2 Ground water regime 9.3 Types of hydrogeological structures 9.4 Discharge of ground water 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	78	1
9.3 Types of hydrogeological structures 9.4 Discharge of ground water 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	78	1
9.4 Discharge of ground water 9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	79	1
9.4.1 Effluent flow in ground water 9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	79	1
9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	80	1
9.4.2 Springs 9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	80	1
9.4.3 Classification of springs 10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	81	1
10. Environmental aspects of hydrogeology 10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	81	1
10.1 Land subsidence due to various human activities 10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	83	1
10.2 Saltwater intrusion 10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	83	1
10.2.1 Seawater intrusion into coastal aquifers 10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	84	1
10.2.2 Intrusion into inland aquifer 10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	84	1
10.2.3 Disposal of waste saline water 10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	85	1
10.3 Ground water contamination – sources 10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	85	1
10.4. Most important sources of ground water pollution 10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	86	1
10.4.1 Underground storage tanks 10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	88	1
10.4.2 Septic tank – sewage system of village residences 10.4.3 Agriculture and ground water pollution	89	1
10.4.3 Agriculture and ground water pollution	89	
	90	
10.4.4 Landfills		
	92	1
10.4.5 Surface impoundments 10.5 Ground water contaminants	93	1

10.5.1 Inorganic elements and compounds	93	185	
10.5.2 Biological agents	94	187	
10.5.3 Organic chemicals	94	188	
10.6 Non – aqueous phase liquids (NAPLs)	95	189	
10.6.1 Movement of LNAPL and DNAPL	97	194	
10.7 Transport of contaminants	98	195	
10.7.1 Advection – dispersion Equation (ADE)	100	199	
10.8 Ground water contamination, its chemistry			
and biology	101	201	
10.9 Decontamination	103	205	
10.10 Remediation methods	103	206	
10.10.1 Pump-and-Treat Method	103	206	
10.10.2 Funnel-and-Gate Method	104	208	
10.10.3 Natural Attenuation	106	211	
Literature 1518W bouring no ains	107		
Appendix I - Geologic Environment and Ground Water Appendix II - Glossary References to Glossary	109 128 139		