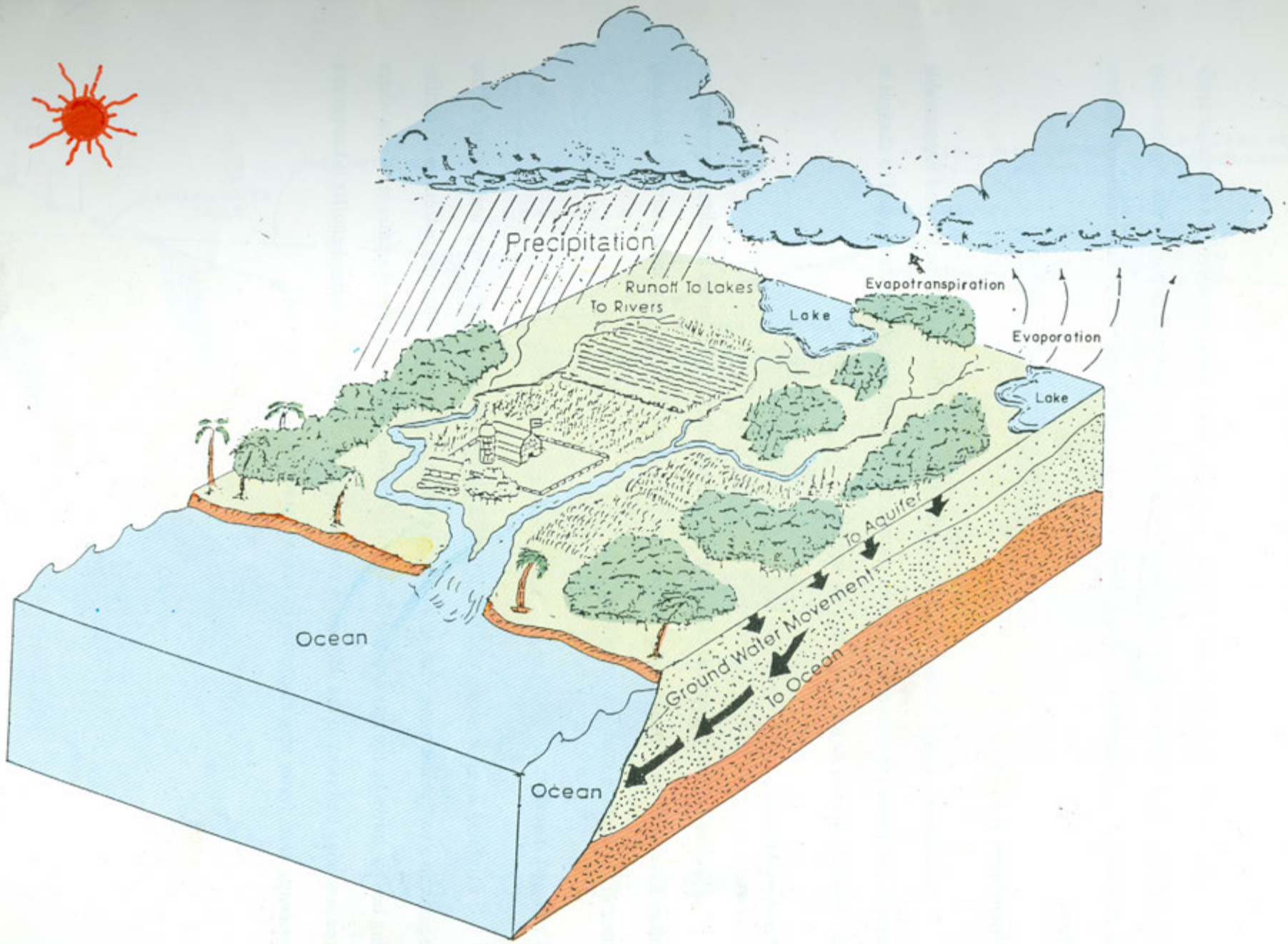
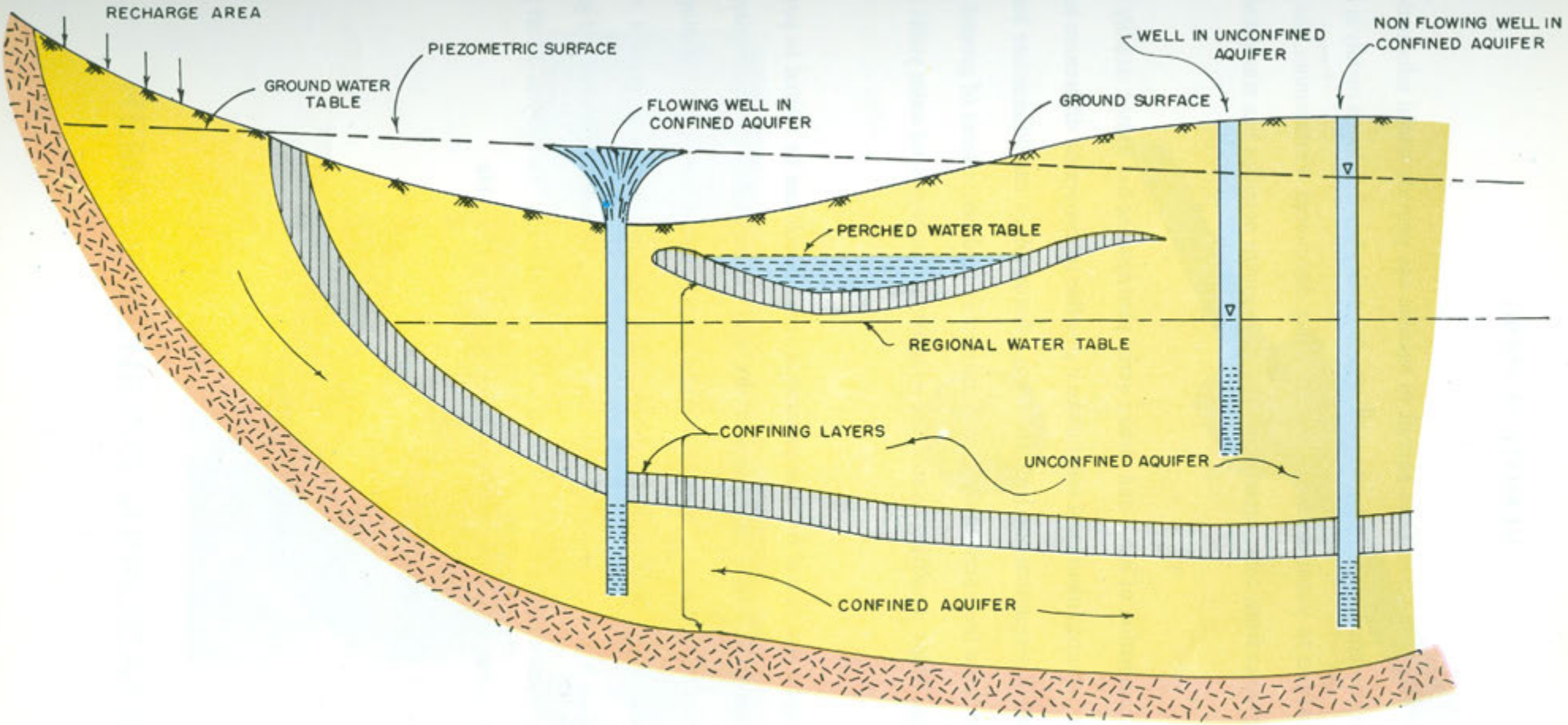
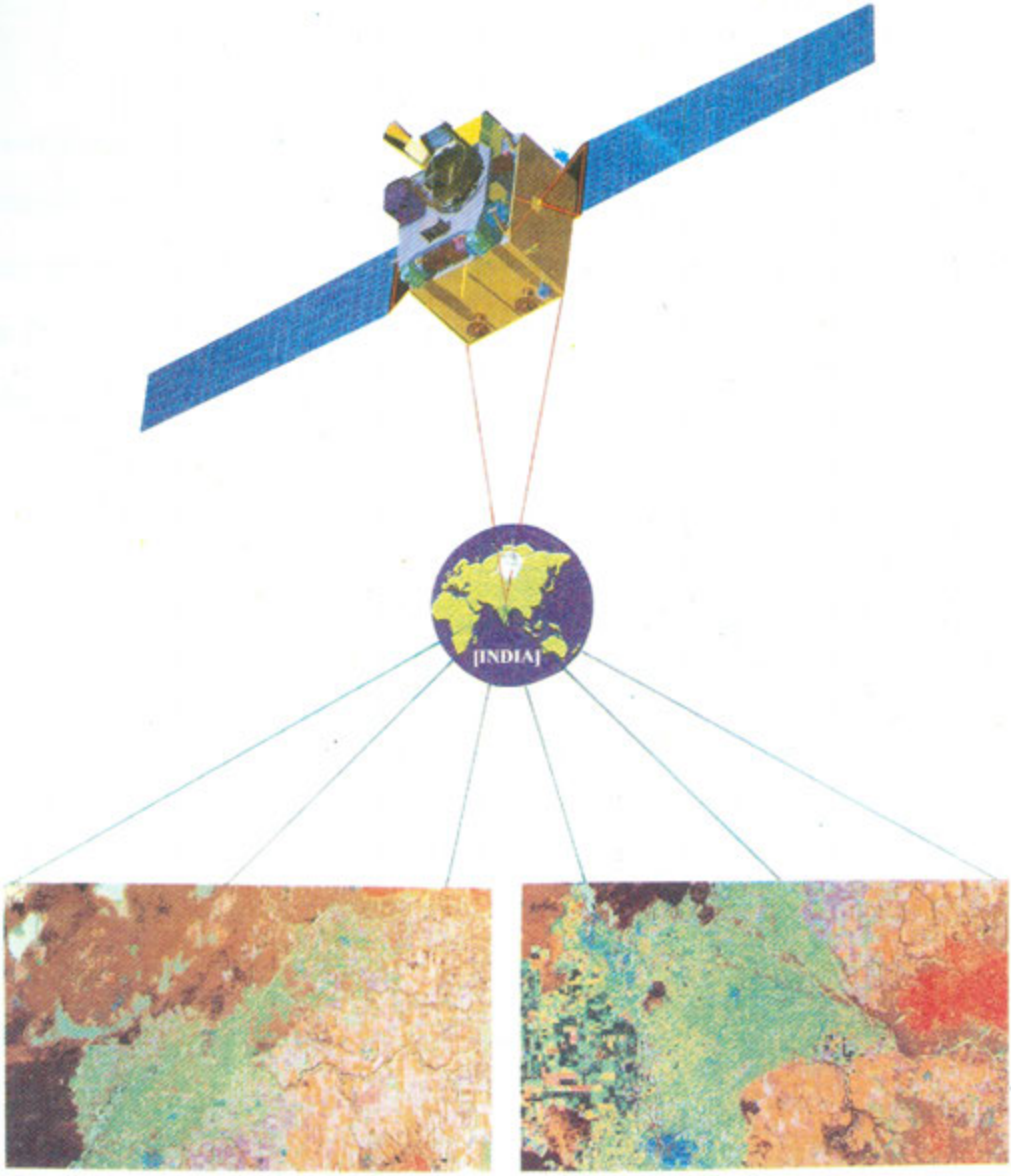


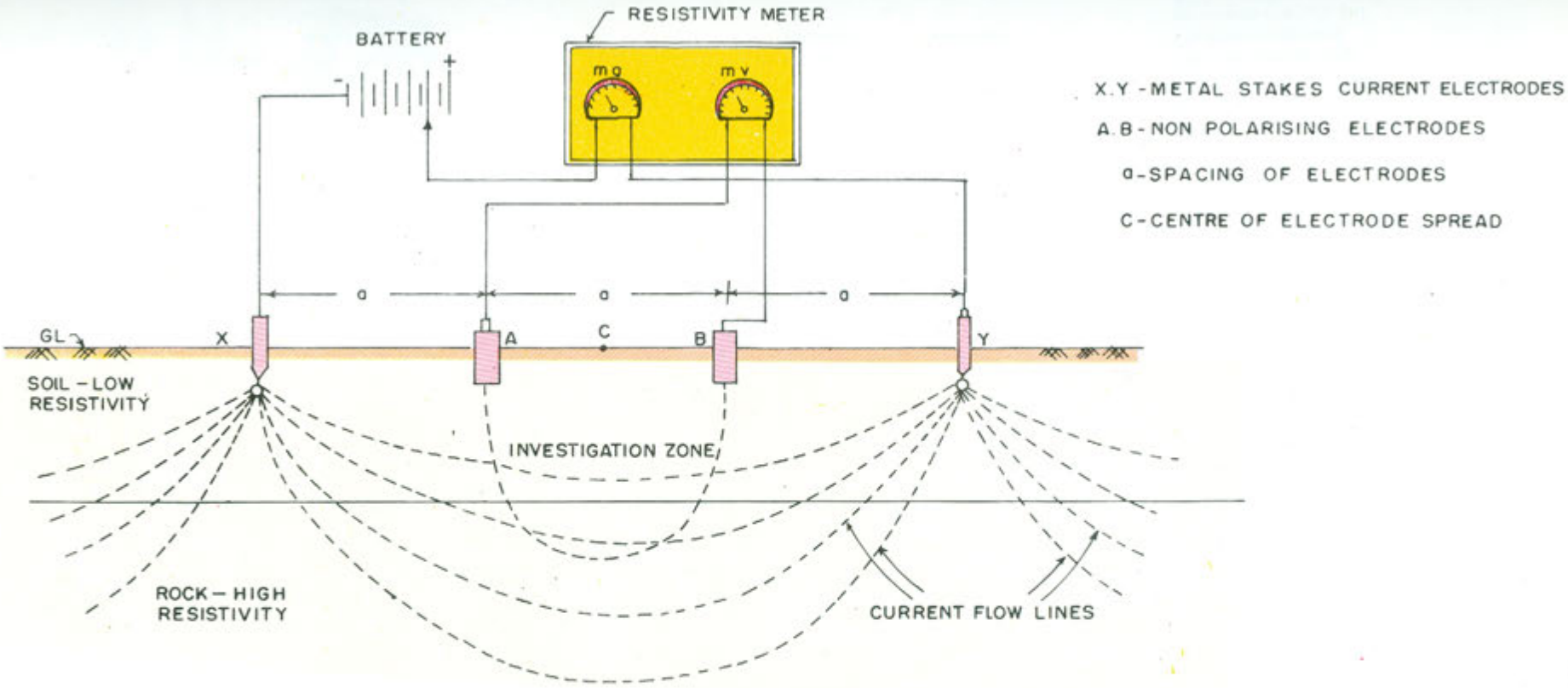
GROUND WATER IN HYDROLOGIC CYCLE



TYPE OF AQUIFERS

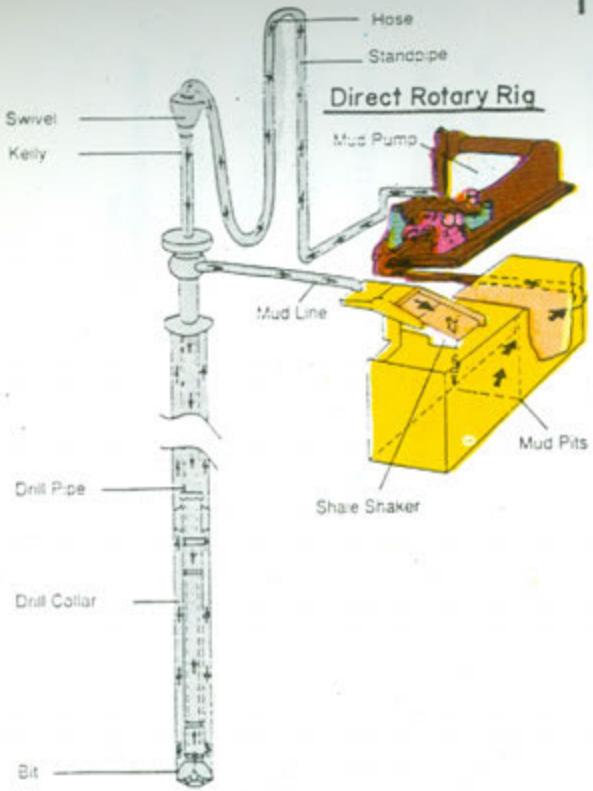


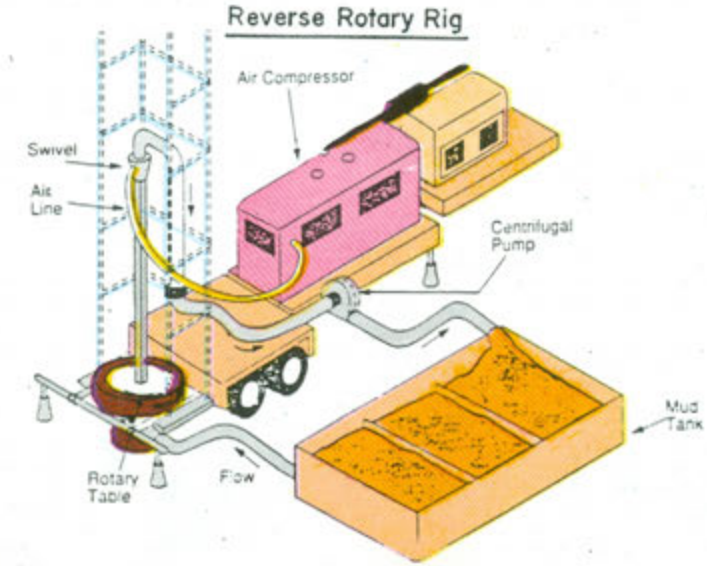
REMOTE SENSING APPLICATIONS

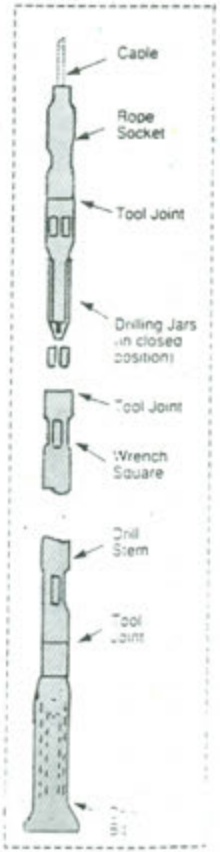


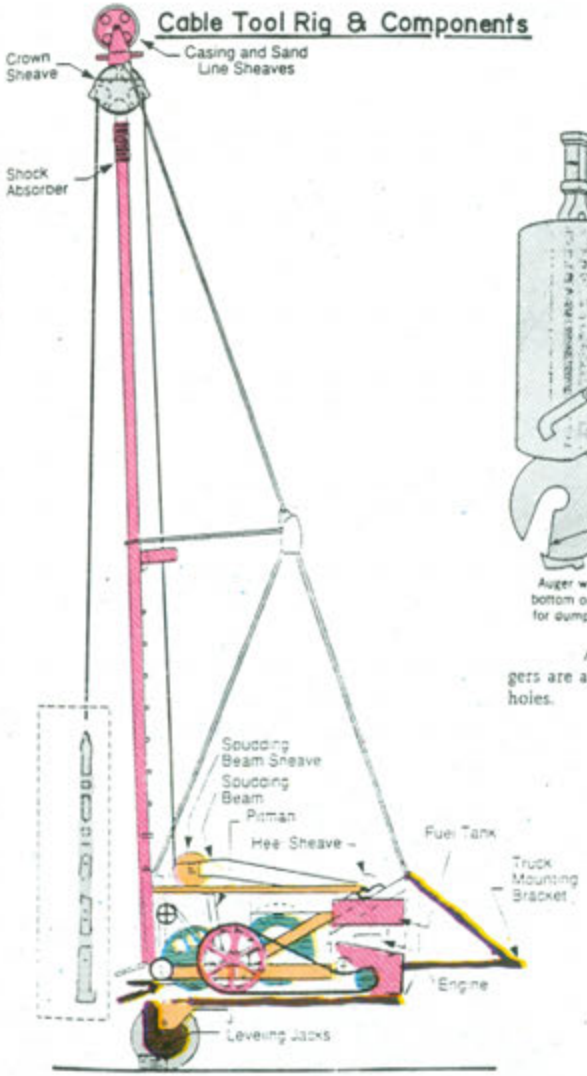
SURFACE GEOPHYSICAL SURVEY

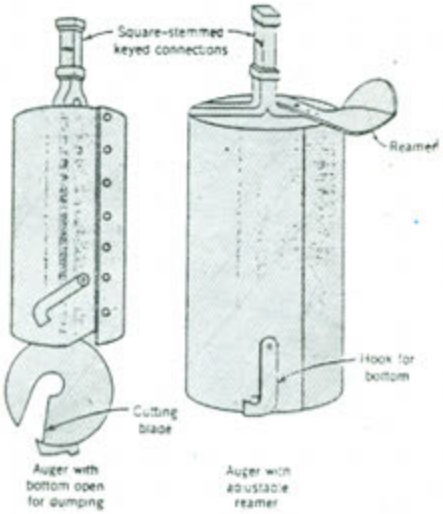
TYPE OF DRILLING RIGS



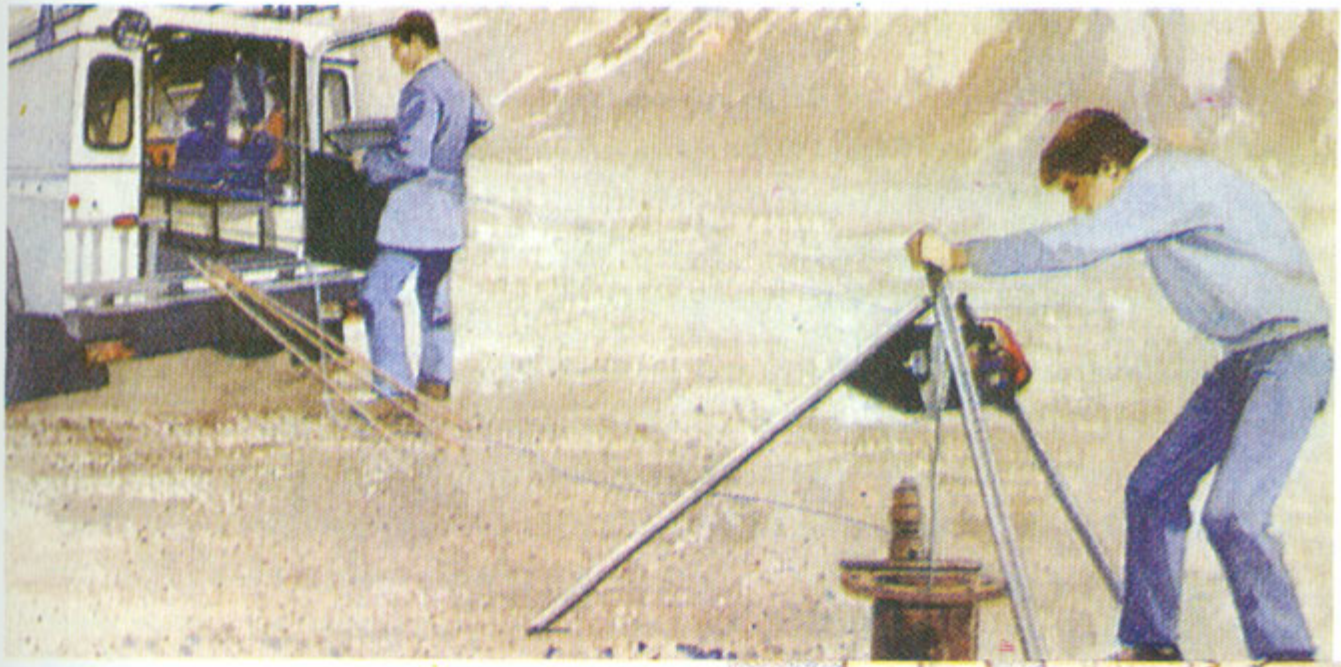


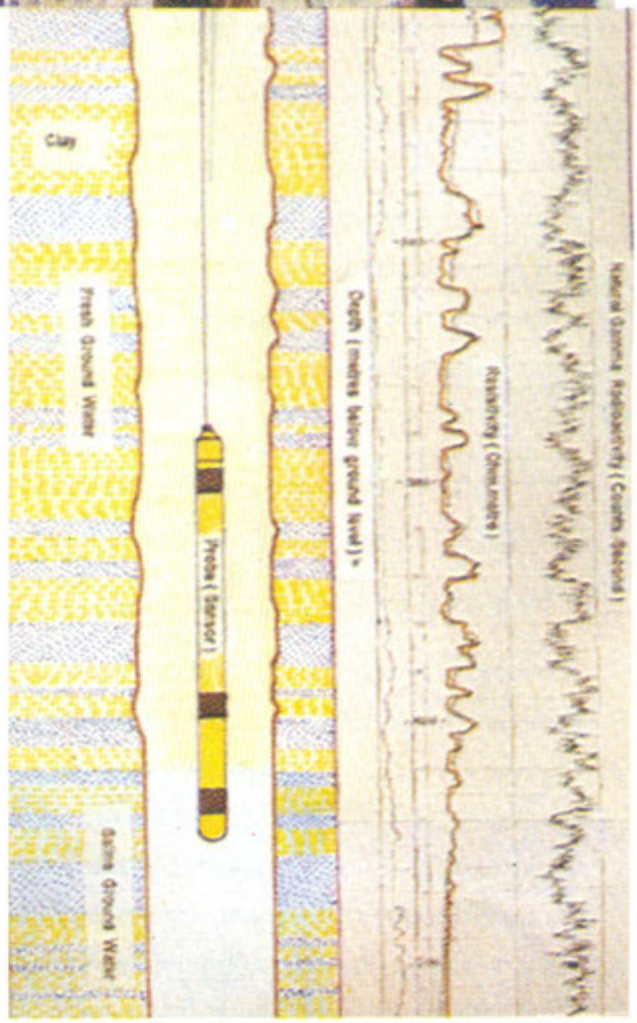






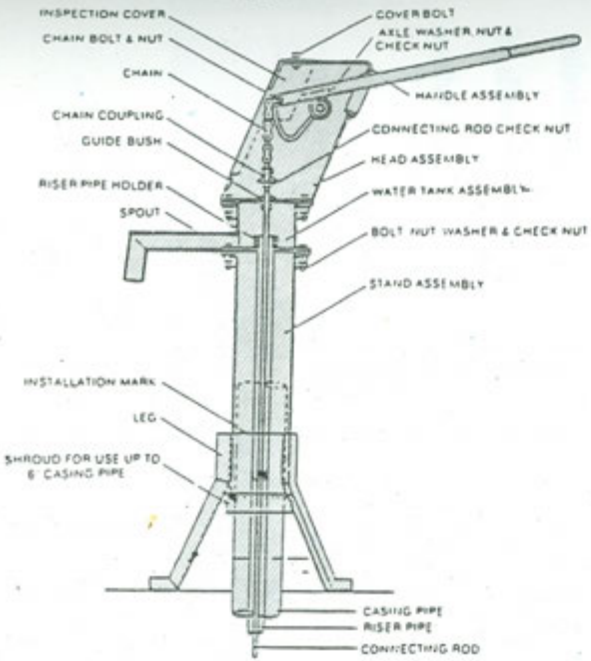
Augers for boring wells. Spiral flight augers are also widely employed for small-diameter holes.

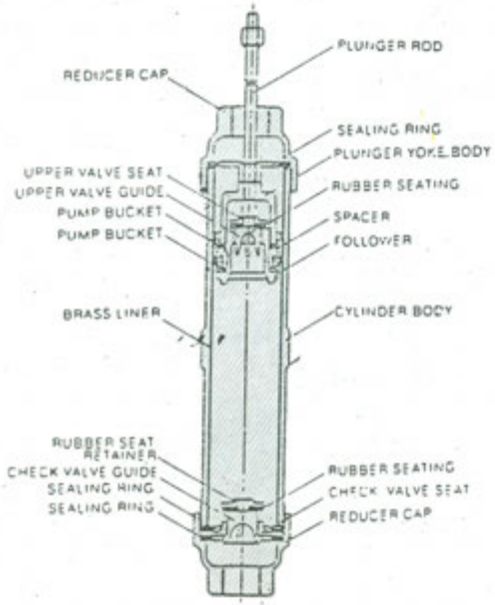




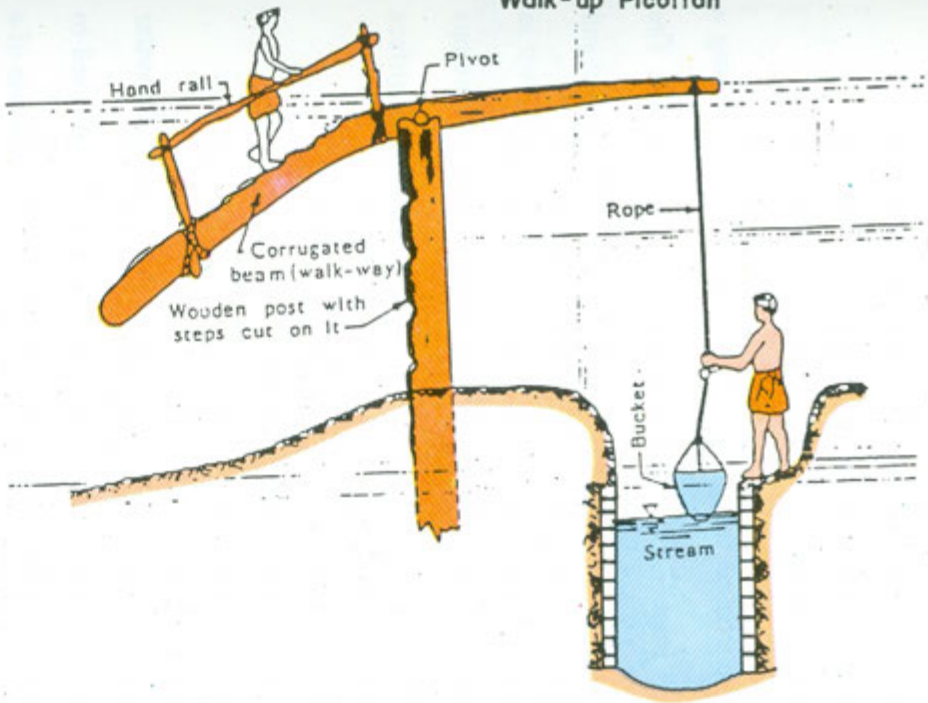
BORE HOLE GEOPHYSICAL LOGGING

Hand Pump (India Mark II)

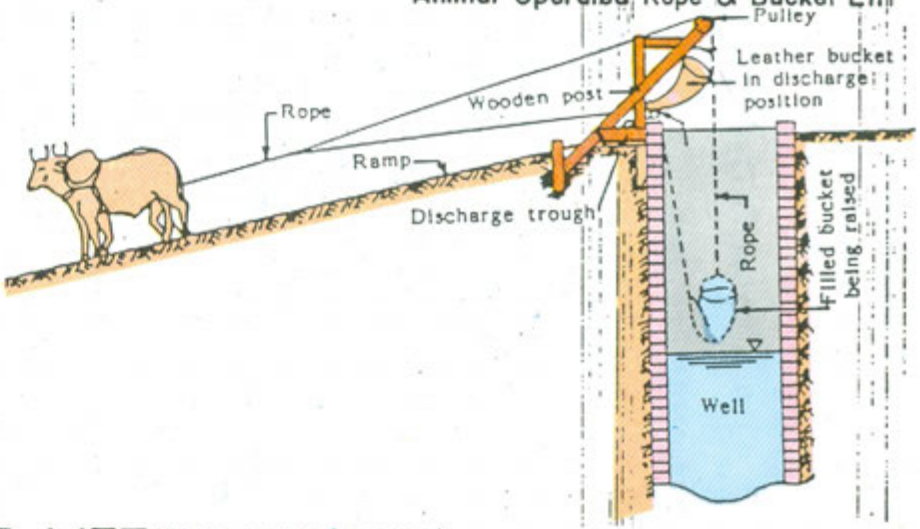




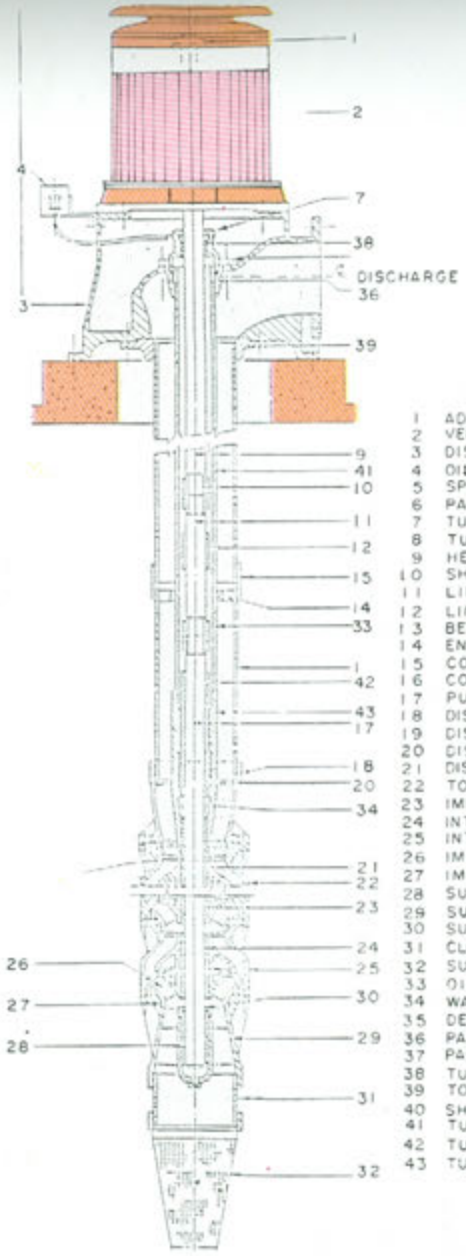
Walk-up Picottah



Animal Operated Rope & Bucket Lift

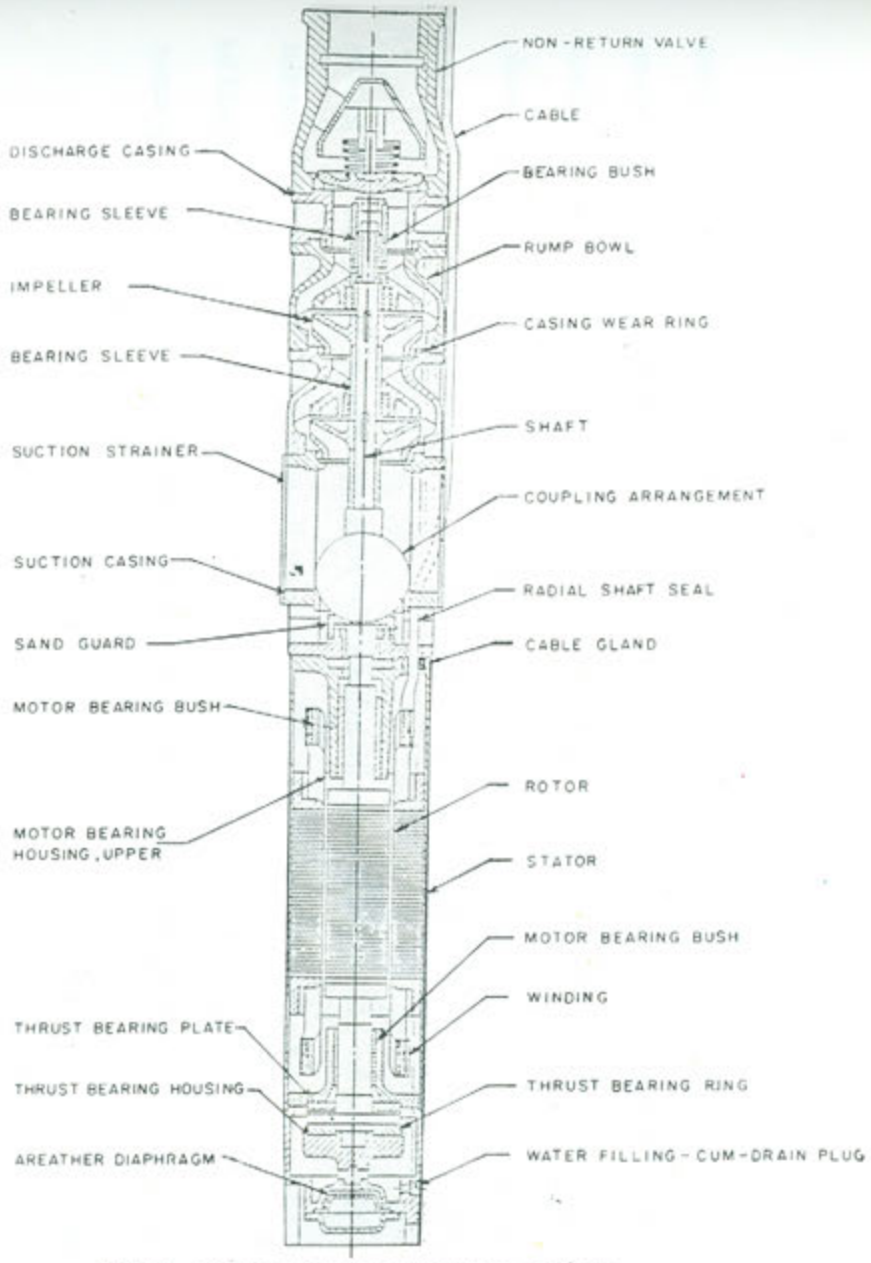


WATER LIFTING DEVICES



1 ADJUSTING NUT
2 VERTICAL HOLLOW SHAFT MOTOR
3 DISCHARGE HEAD
4 OILER ASSEMBLY
5 SPLIT PACKING GLAND
6 PACKING BOX
7 TUBE TENSION NUT
8 TUBE TENSION PLATE
9 HEAD SHAFT
10 SHAFT COUPLING
11 LINE SHAFT
12 LINE SHAFT BEARING
13 BEARING RETAINER
14 ENCLOSING TUBE STABILIZER
15 COLUMN COUPLING
16 COLUMN PIPE
17 PUMP SHAFT
18 DISCHARGE CASE
19 DISCHARGE CASE BEARING
20 DISCHARGE CASE SCREW BEARING
21 DISCHARGE COMBINATION BEARING
22 TOP BOWL
23 IMPELLER LOCK COLLER
24 INTERMEDIATE BOWL BEARING
25 INTERMEDIATE BOWL
26 IMPELLER
27 IMPELLER SEAL RING
28 SUCTION CASE BEARING
29 SUCTION CASE
30 SUCTION CASE SAND COLLAR
31 CLOSE NIPPLE OR SUCTION PIPE
32 SUCTION STRAINER (CONE TYPE)
33 OIL TUBE
34 WATER SLINDER
35 DEFLECTOR
36 PACKING
37 PACKING BOX BEARING
38 TUBE TENSION NUT BEARING
39 TOP COLUMN FLANGE
40 SHAFT SLEEVE
41 TUBE TESION NIPPLE
42 TUBING ADAPTER SCREW BEARING
43 TUBING ADAPTER

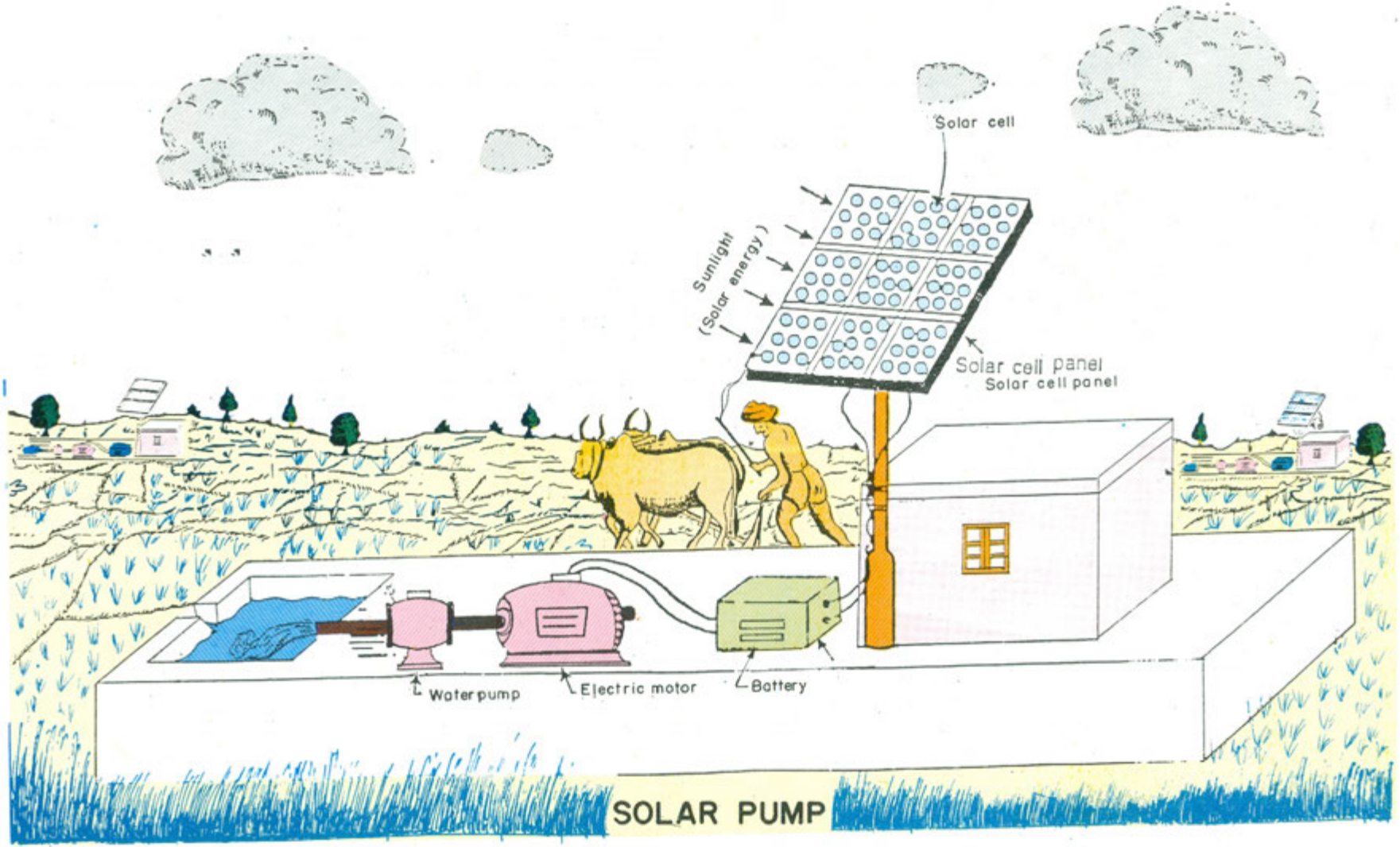
DEEP WELL VERTICAL TURBINE PUMP

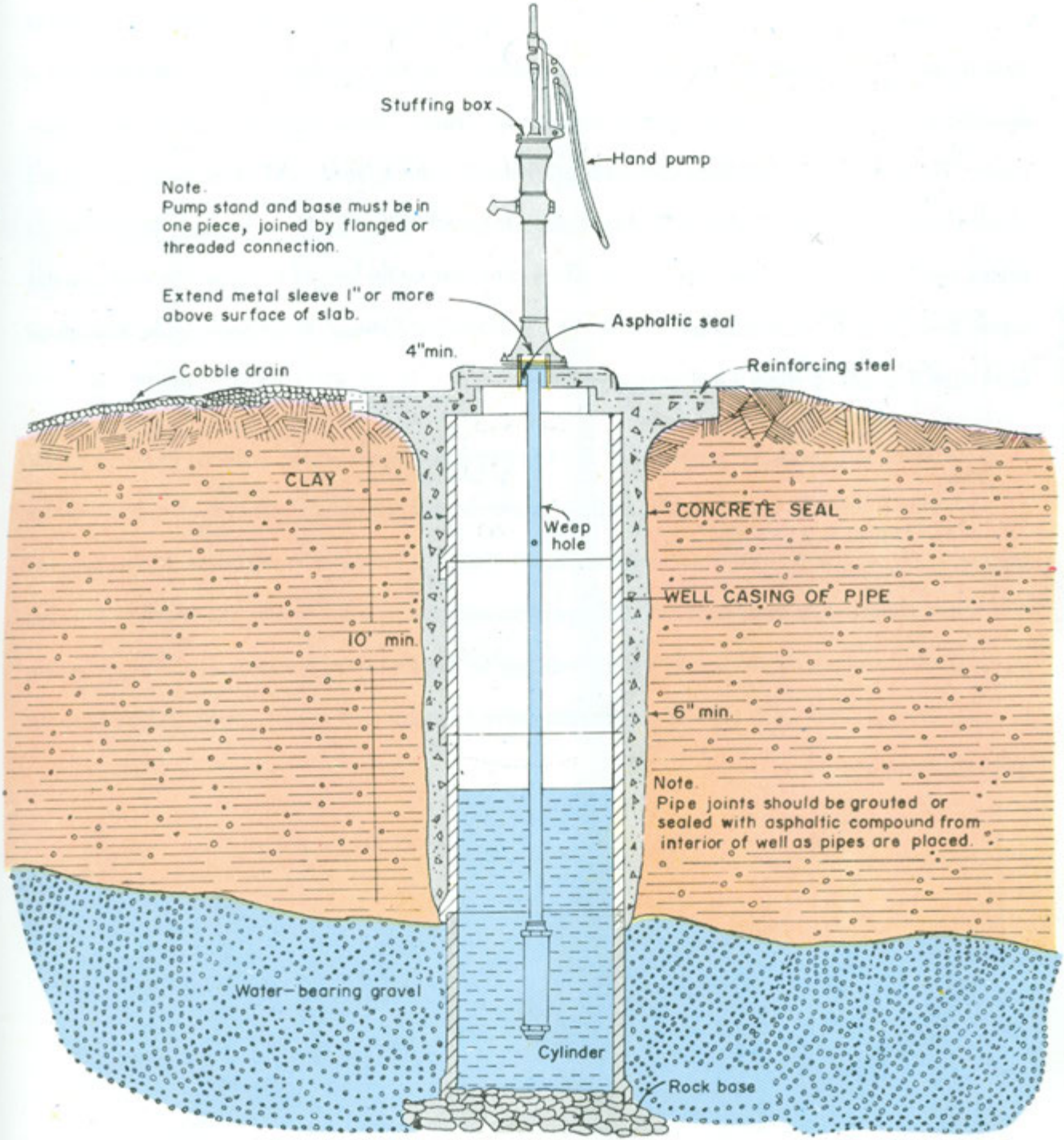


DEEP WELL SUBMERSIBLE PUMP

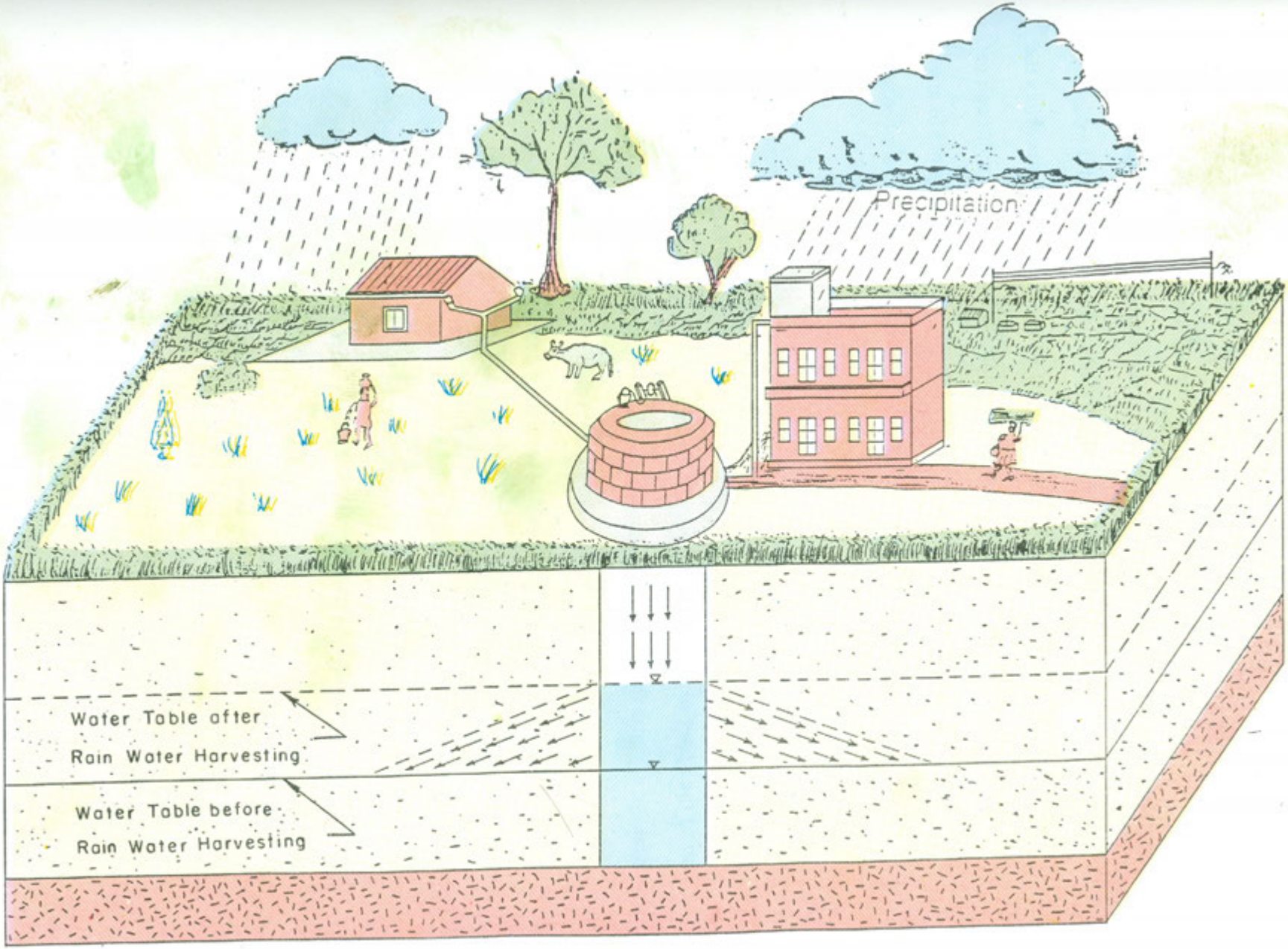
PUMPING DEVICES

WIND MILL

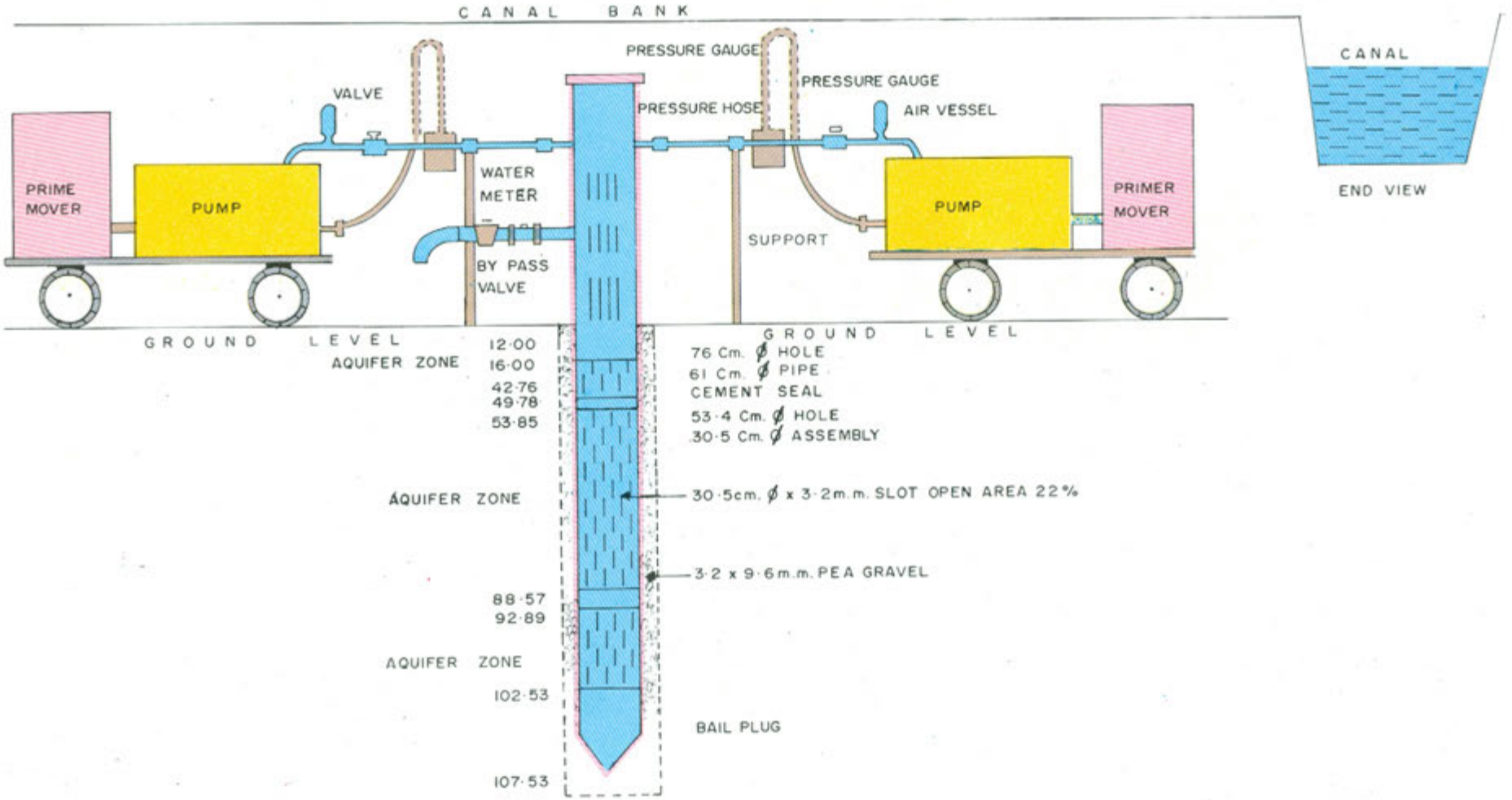

Solar cell
Sunlight
(Solar energy)
Solar cell panel
Solar cell panel
Water pump
Electric motor
Battery
SOLAR PUMP



SANITARY PROTECTION



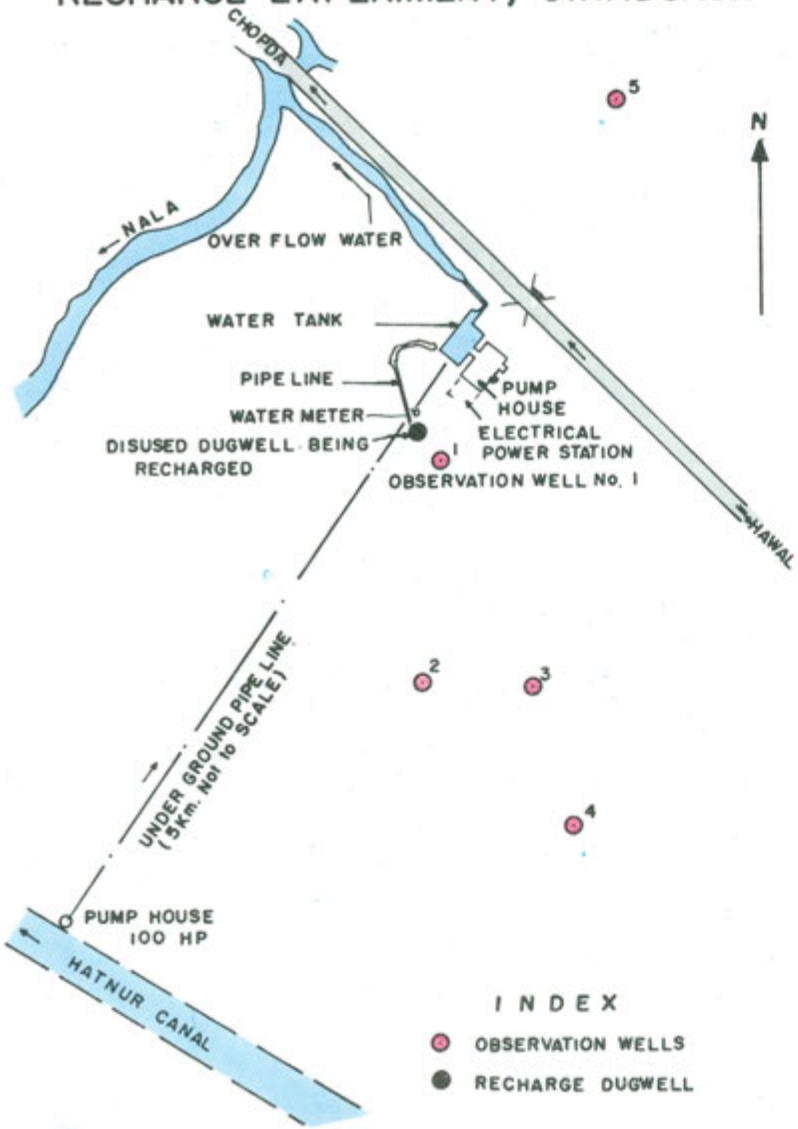
ROOF TOP RAIN WATER HARVESTING



ARTIFICIAL RECHARGE THROUGH INJECTION WELL

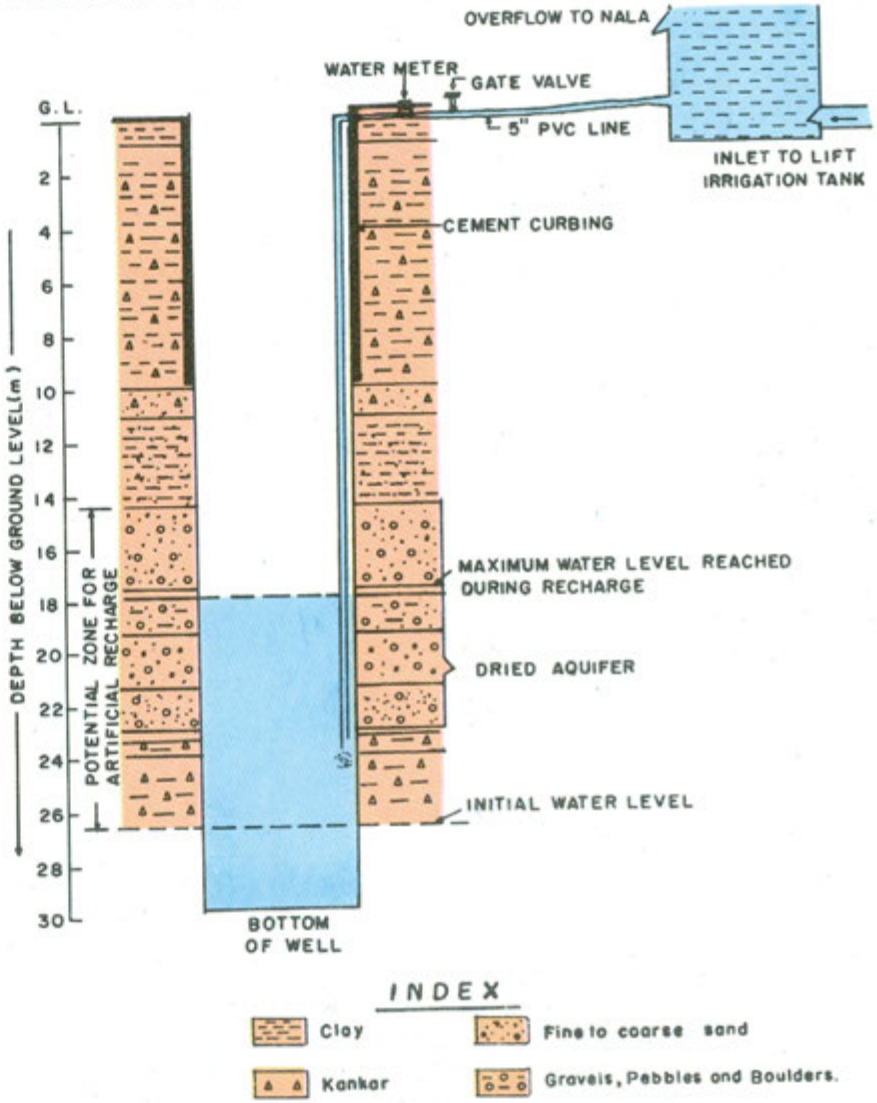
JALGAON DISTRICT, MAHARASHTRA

SKETCH PLAN OF DUGWELL RECHARGE EXPERIMENT, GIRADGAON

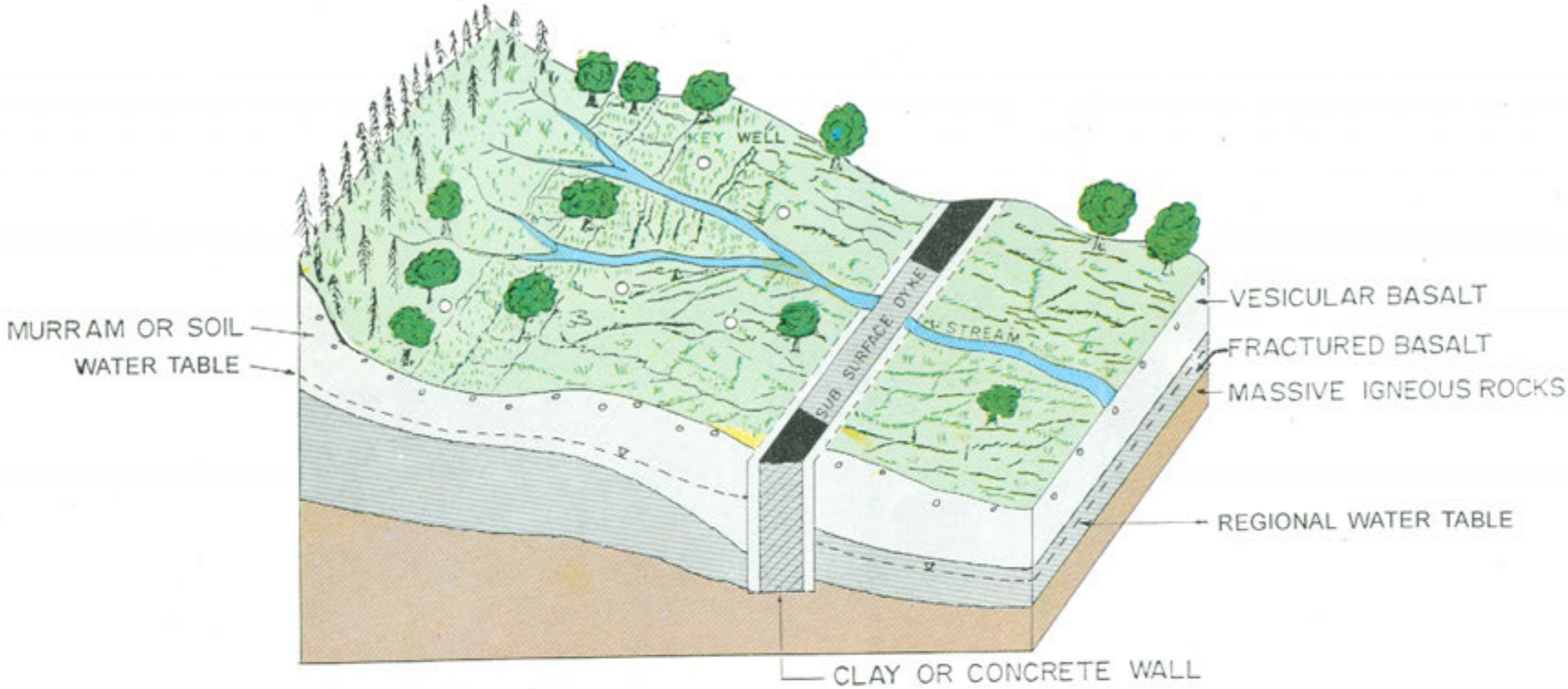


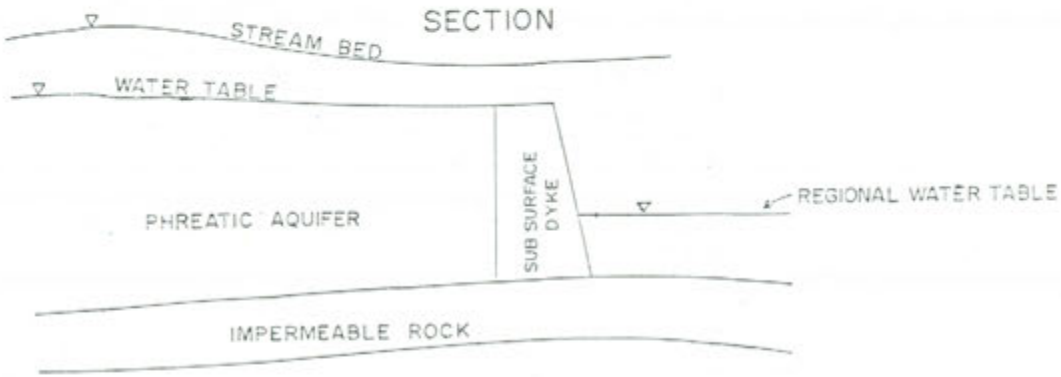
JALGAON DISTRICT, MAHARASHTRA

SCHEMATIC PRESENTATION OF RECHARGE THROUGH DUGWELL AT GIRADGAON

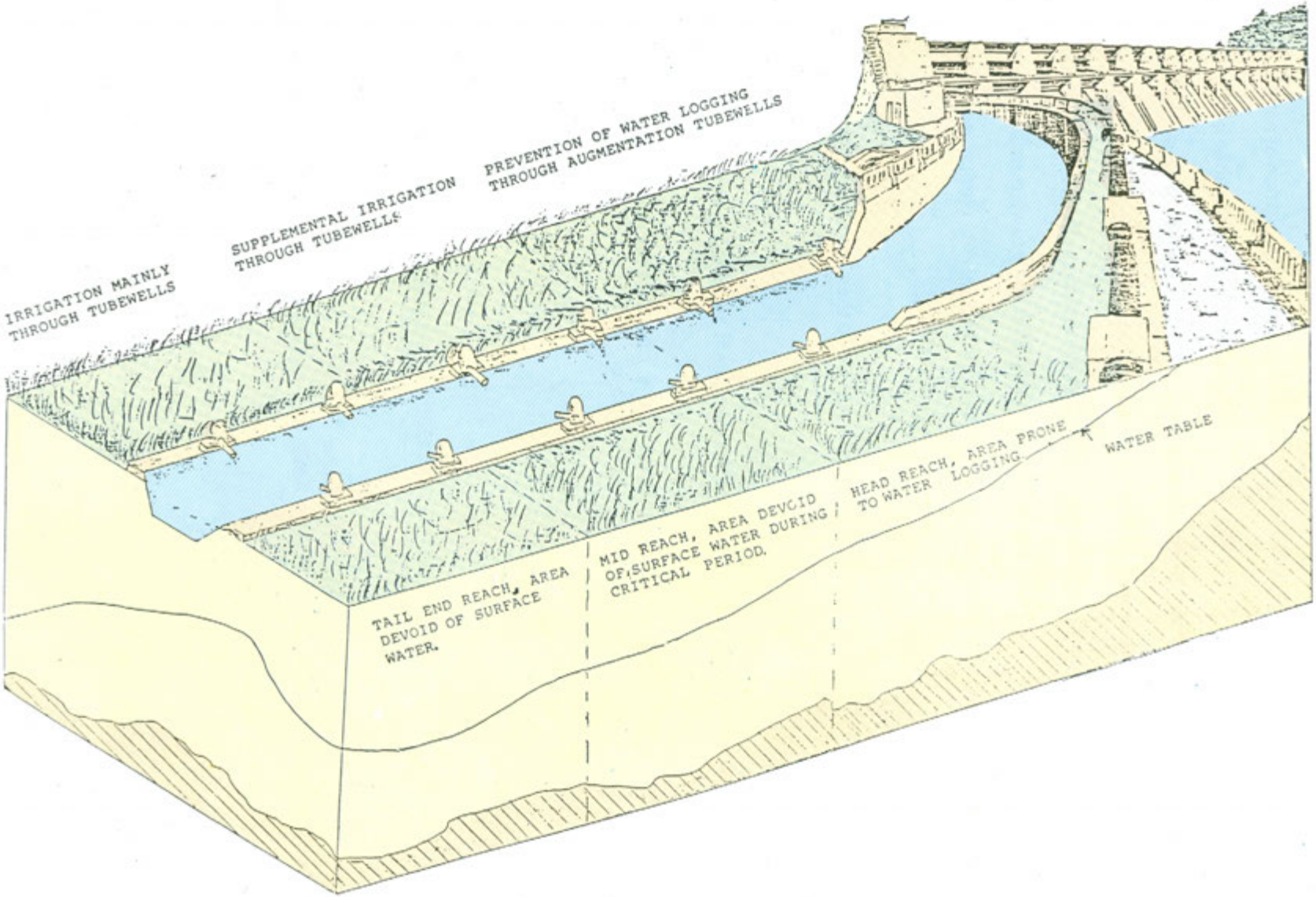


RECHARGE THROUGH DUGWELL



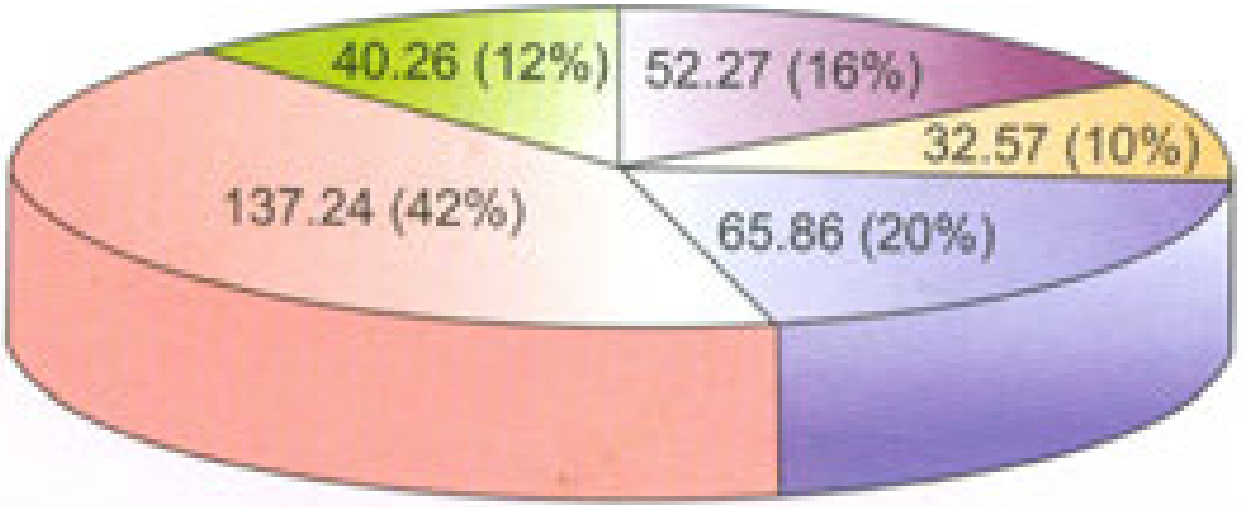


ARTIFICIAL RECHARGE THROUGH UNDERGROUND BANDHARA



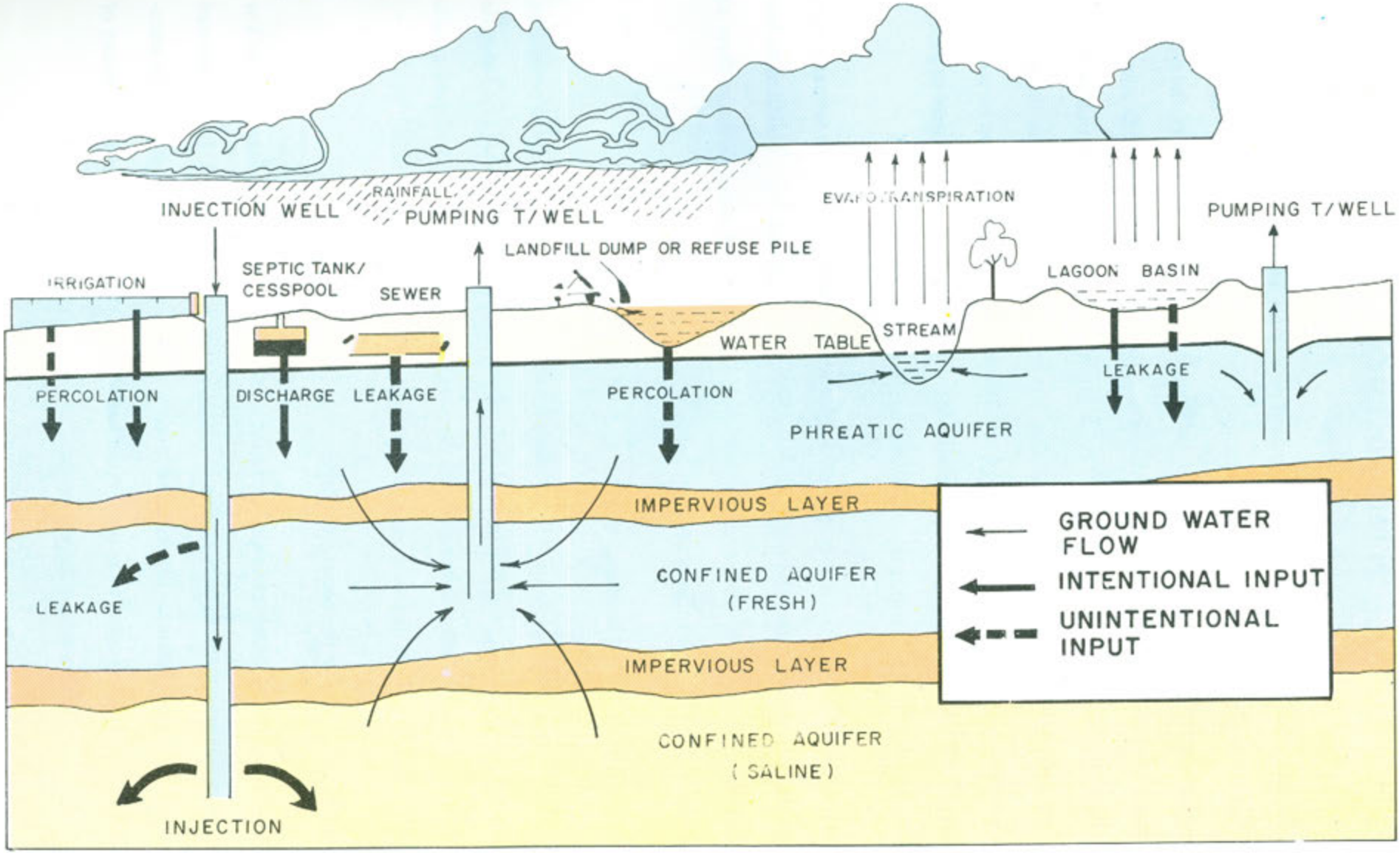
CONJUNCTIVE USE OF SURFACE AND GROUND WATER

RAINFALL RANGE BASED GEOGRAPHICAL AREA (328 M Ha)

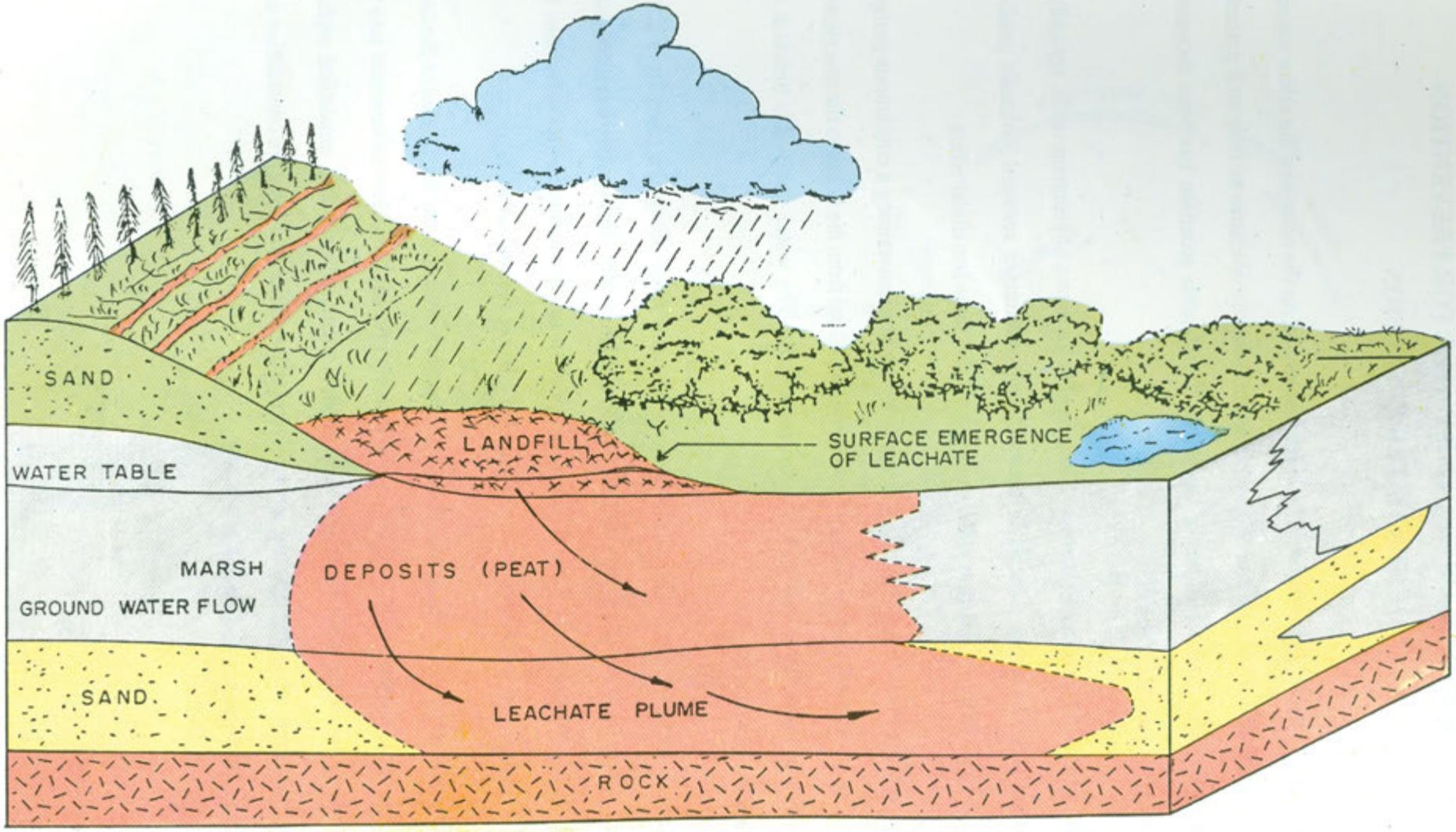


RANGE OF RAINFALL (mm)

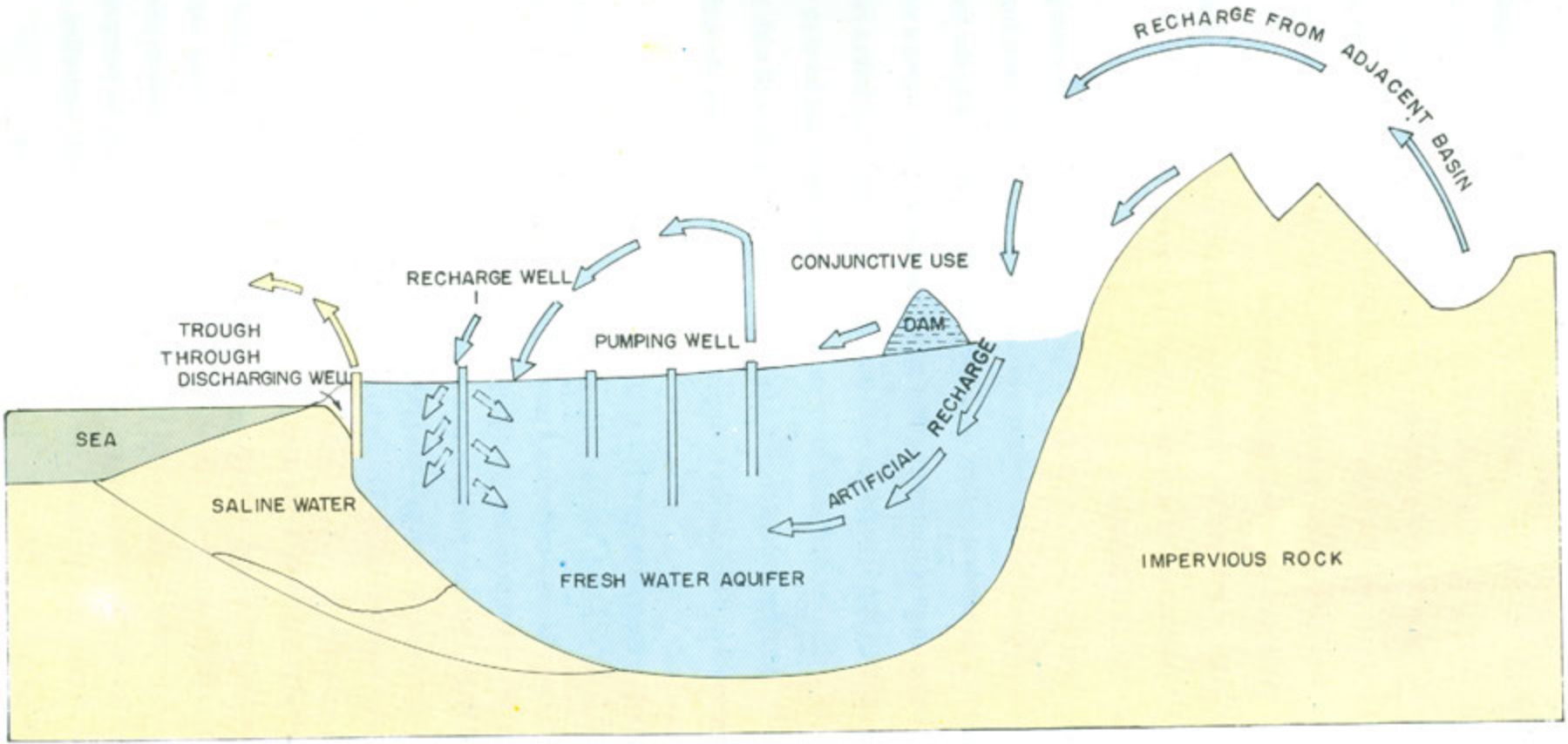
- 100-500
- 500-750
- 750-1000
- 1000-2500
- >2500



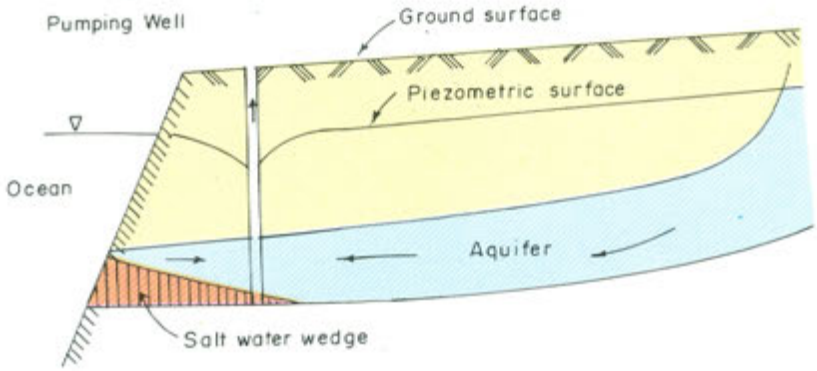
GROUND WATER POLLUTION

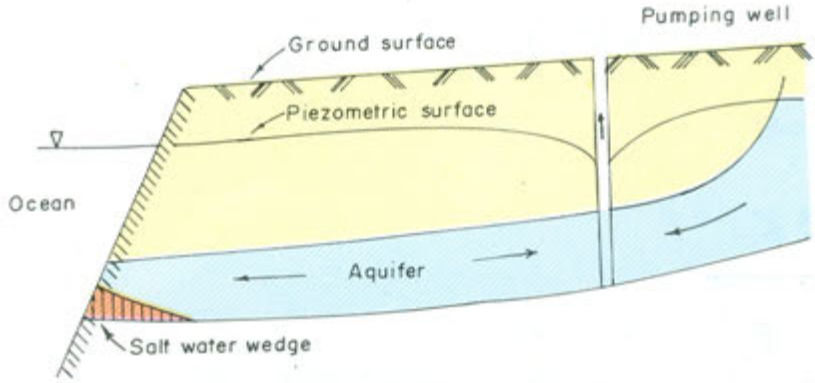


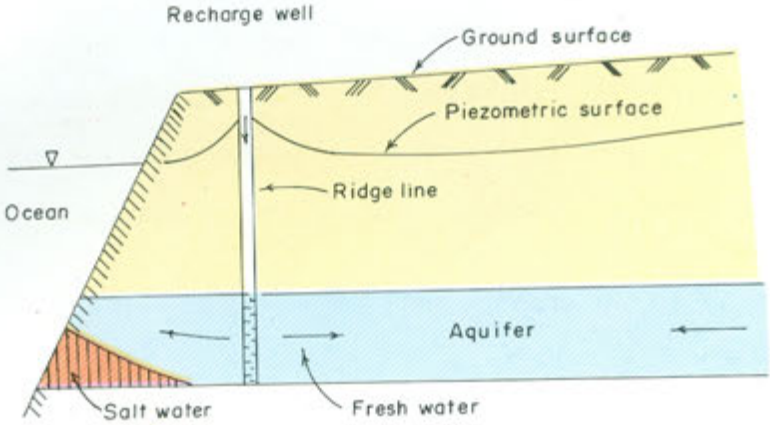
PLUME MOVEMENT IN GROUND WATER AQUIFER

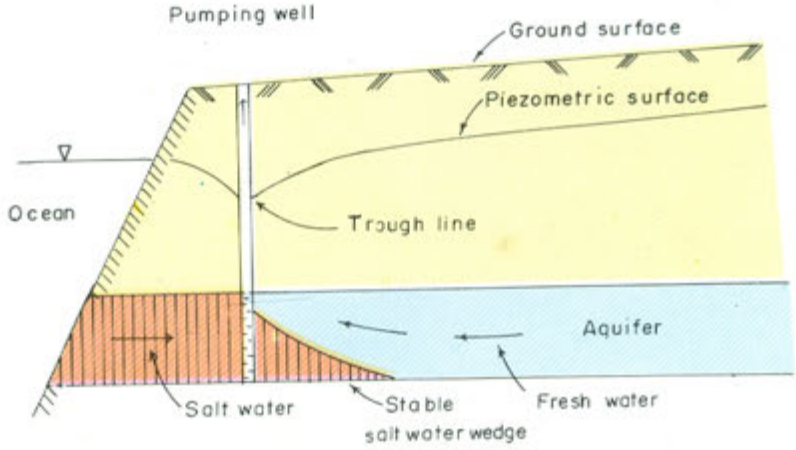


GROUND WATER MANAGEMENT TO PREVENT SEA WATER INTRUSION



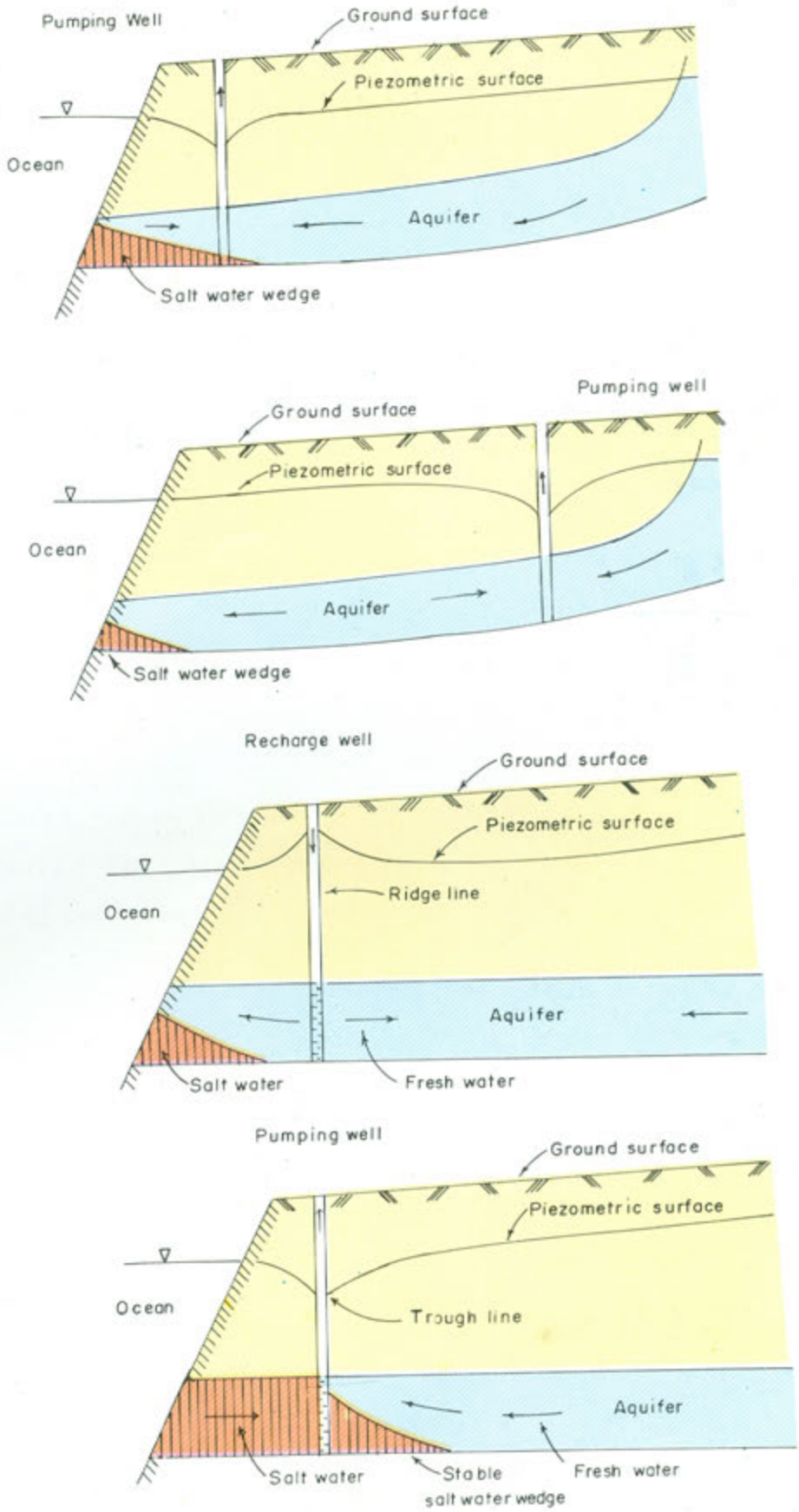






PREVENTION OF SEA WATER INTRUSION

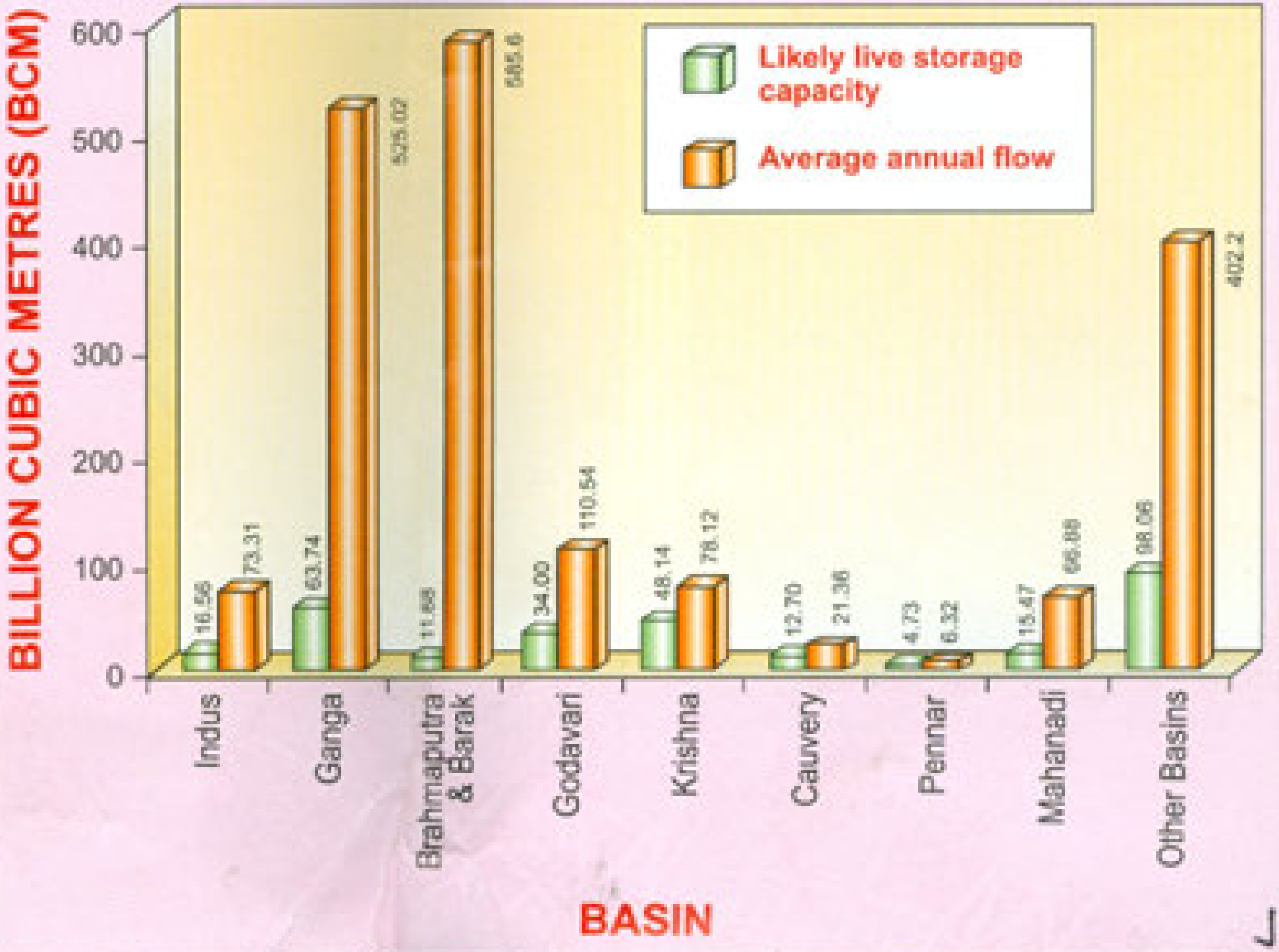
After Ground Water Hydrology By:- D.K.TODD



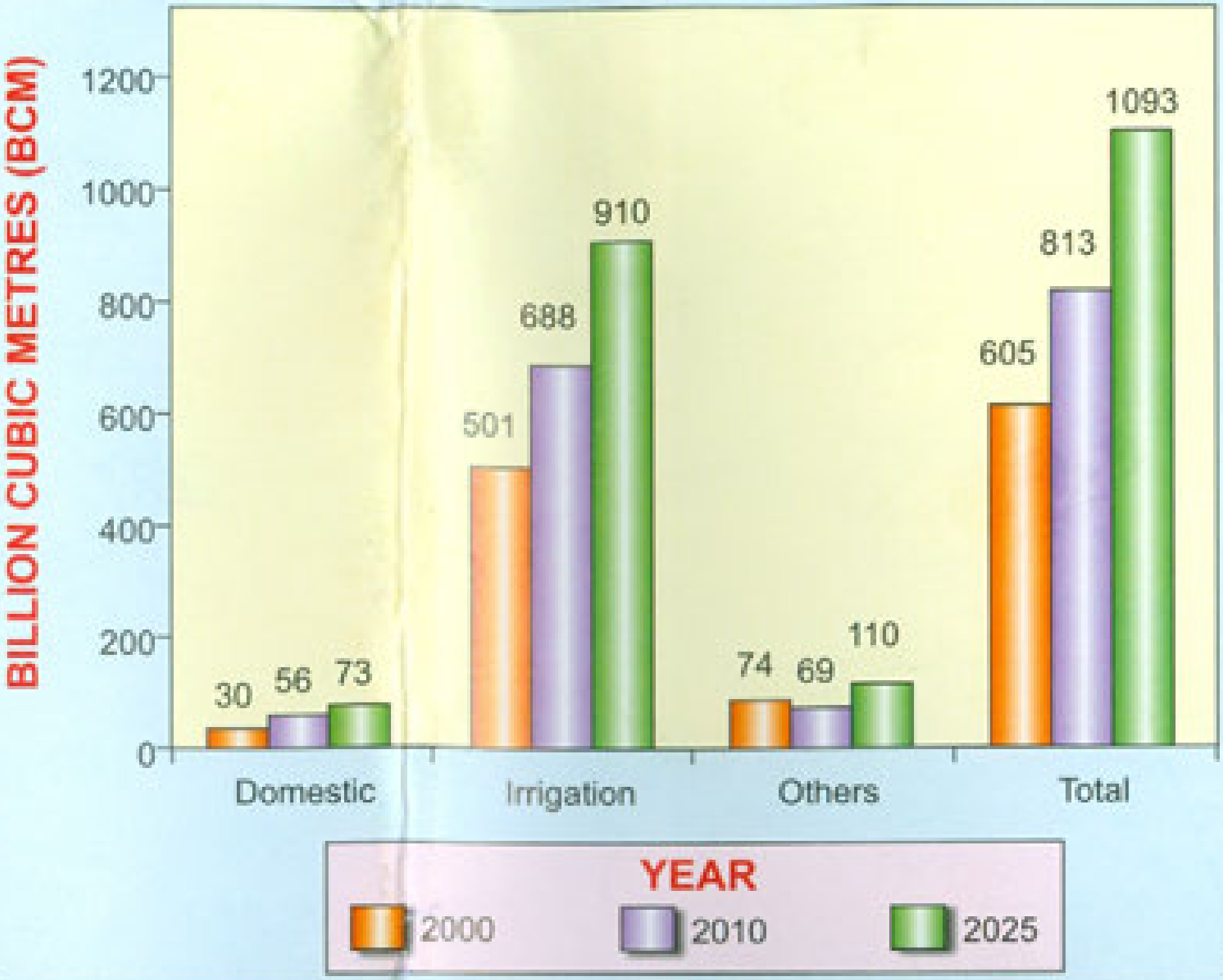
PREVENTION OF SEA WATER INTRUSION

After Ground Water Hydrology By:- D.K.TODD

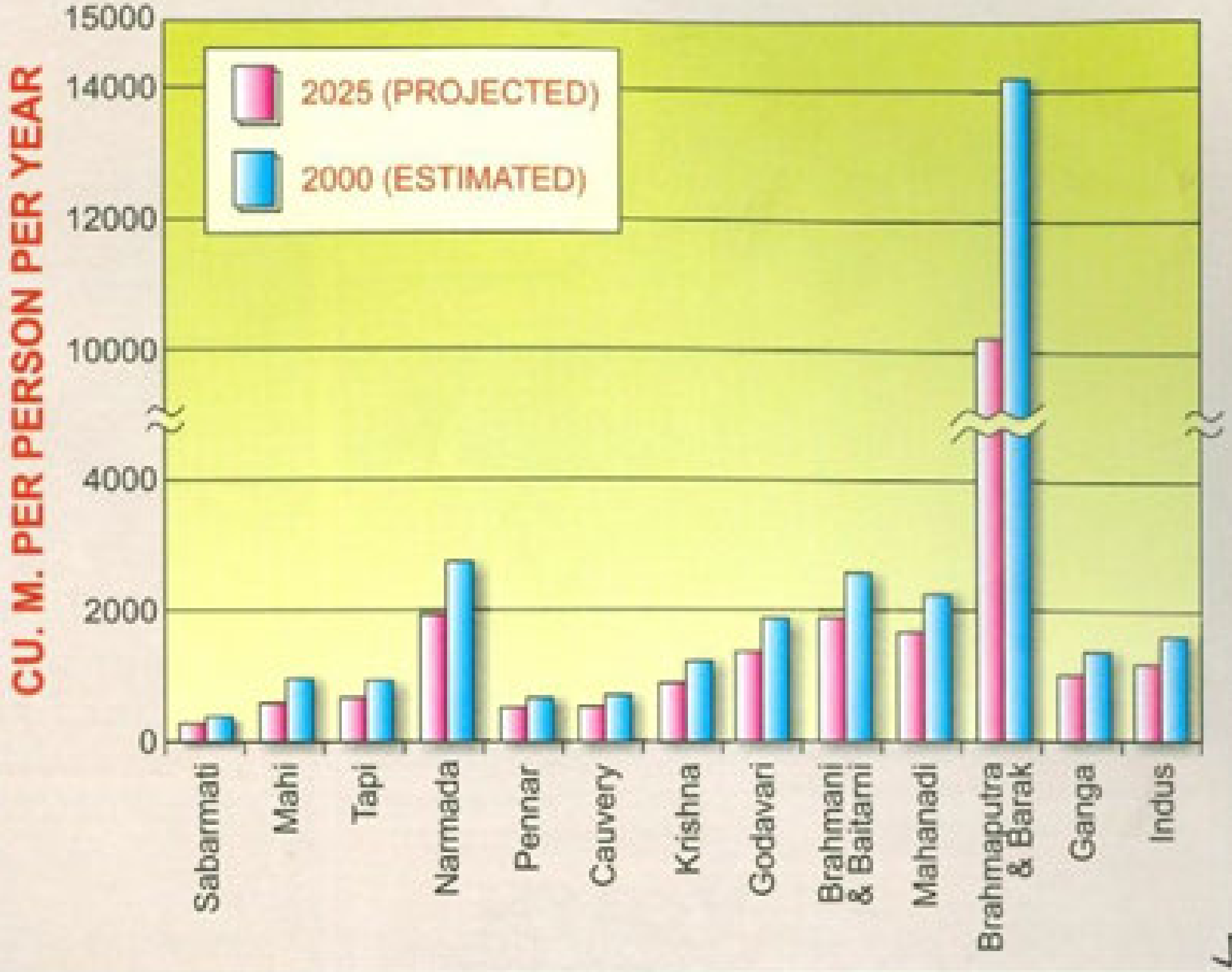
BASIN WISE FLOW & STORAGE POTENTIAL IN INDIA (BCM)



PROJECTED WATER DEMAND (BCM)



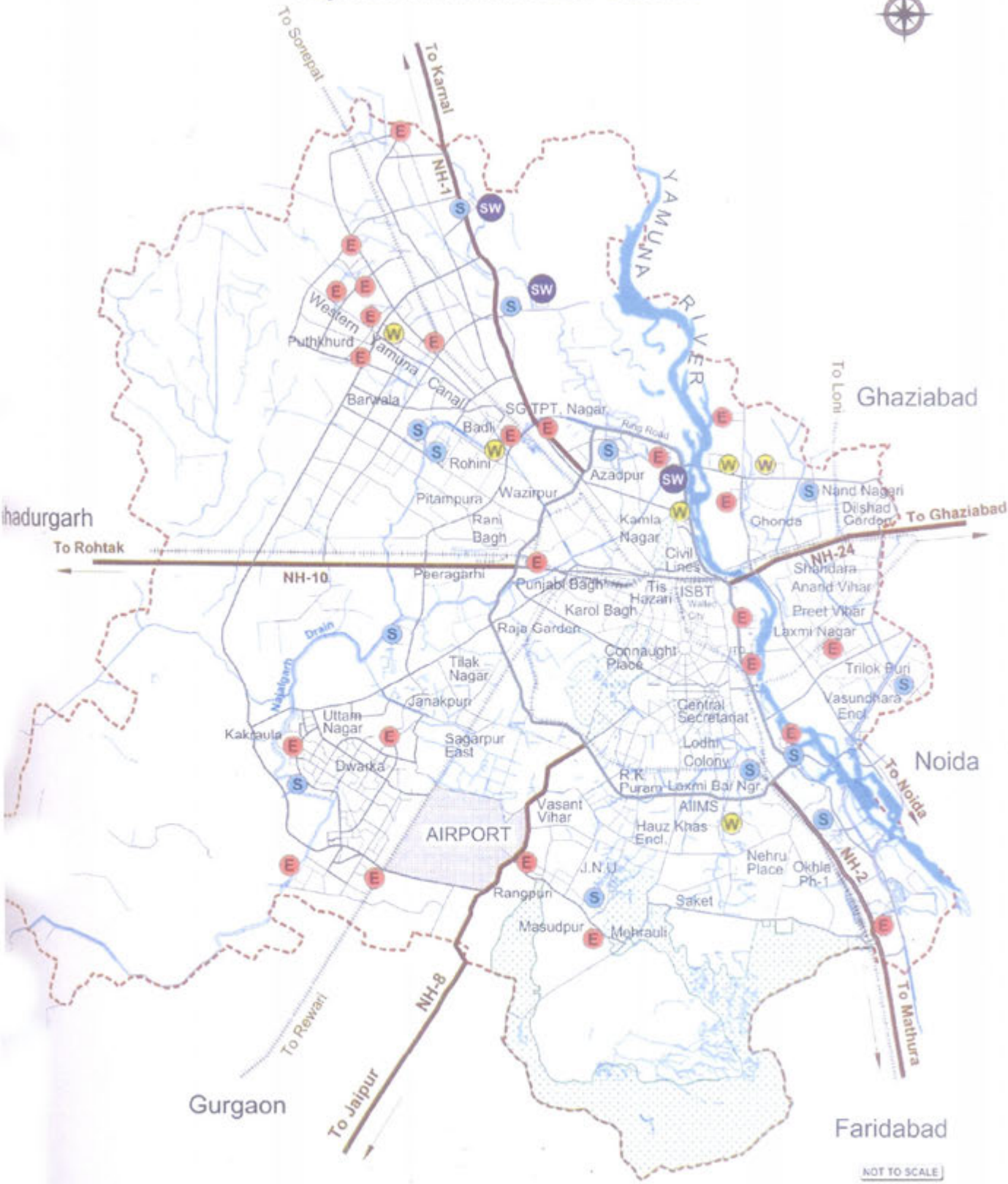
BASIN-WISE PER CAPITA WATER AVAILABILITY



KASHMIR
INDUS
HIMACHAL PRADESH
PUNJAB
HARYANA
UTTARAKHAND
UTTAR PRADESH
RAJASTHAN
BIHAR
ISLAMABAD
DELHI
Srinagar
Shimla
Chandigarh
Dehradun
Jaipur
Lucknow
Patna
JAMMU & KASHMIR
1. SAWALKOT-I
2. SEWA-II
PUNJAB
1. RANJIT SAGAR D. (THEIN)
2. SHAHPUR KANDI
3. MADHOPUR H/W
4. Madhopur-Beas Link Canal
5. ANANDPUR SAHIB-I&II
6. MUKERIAN PH-I TO IV
SIDHMUKH & NOHAR
SPRINKLER IRRIGATION

TAJI.
TAN
JAMMU
AND
KASHMIR
URI-II
WAGOORA
(PG)
URI-I
NEW WANPOH
BAGLIHAR
SAWALKOT
DULHASTI
KISHENPUR
CHAMERA
II
I
OP.AT 220kV
SAMBA
PS
LAHAL
PP
PARBATI
(II)
(III)
HIMACHAL
HAMIRPUR
KOLDAM
N.JHAKRI
MRITSAR
DEHAR
RAMPUR
KARCHAM
WANGTOO
JALANDHAR
(PG)
PRADESH
MUKU
(PATTI)
NAKODAR
NALAGARH
BASPA-II
LUDHIANA
(PG)
PANCHKULA
TALWANDI
SABO
PUNJAB
M.KOTLA
(PG)
RAJPURA
UTTARAKHAND
L.NAGRALA
P.MANERI
KOTESHWAR
MOGA
TEHRI
BARNALA
DHURI
PATIALA
(PG)
ABDULLAPUR
D.DUN
TEHRI(PP)
T.V.CAD
MUKTSAR
RISHIKESH
VP KOTI
FATEHABAD
(PG)
TO
ANGUL PP
SAHARANPUR
K.BHEL
SIRSA
KAITHAL
ROORKEE
SRINAGAR
K.PRAY
JIND
MUZ.NGR
HISAR
HARYANA
BAGHPAT
K.BARA
SURATGARH
STPS
PANIPAT
NEHTAUR
SONIPAT
MANDAULA
KASHIPUR
HAVEN
ROHTAK
D.PUR
MEERUT
HAPUR
±800kV
BHIWANI
BAWANA
M.NGR
MORADABAD
B.GARH
JHAJJAR-II
BADRI
BAREILLY
NORTHERN
MUNDKA
M.GARH
(HVDC)
G.NOIDA
BAMNAULI
PG

Physical Infrastructure : Utilities



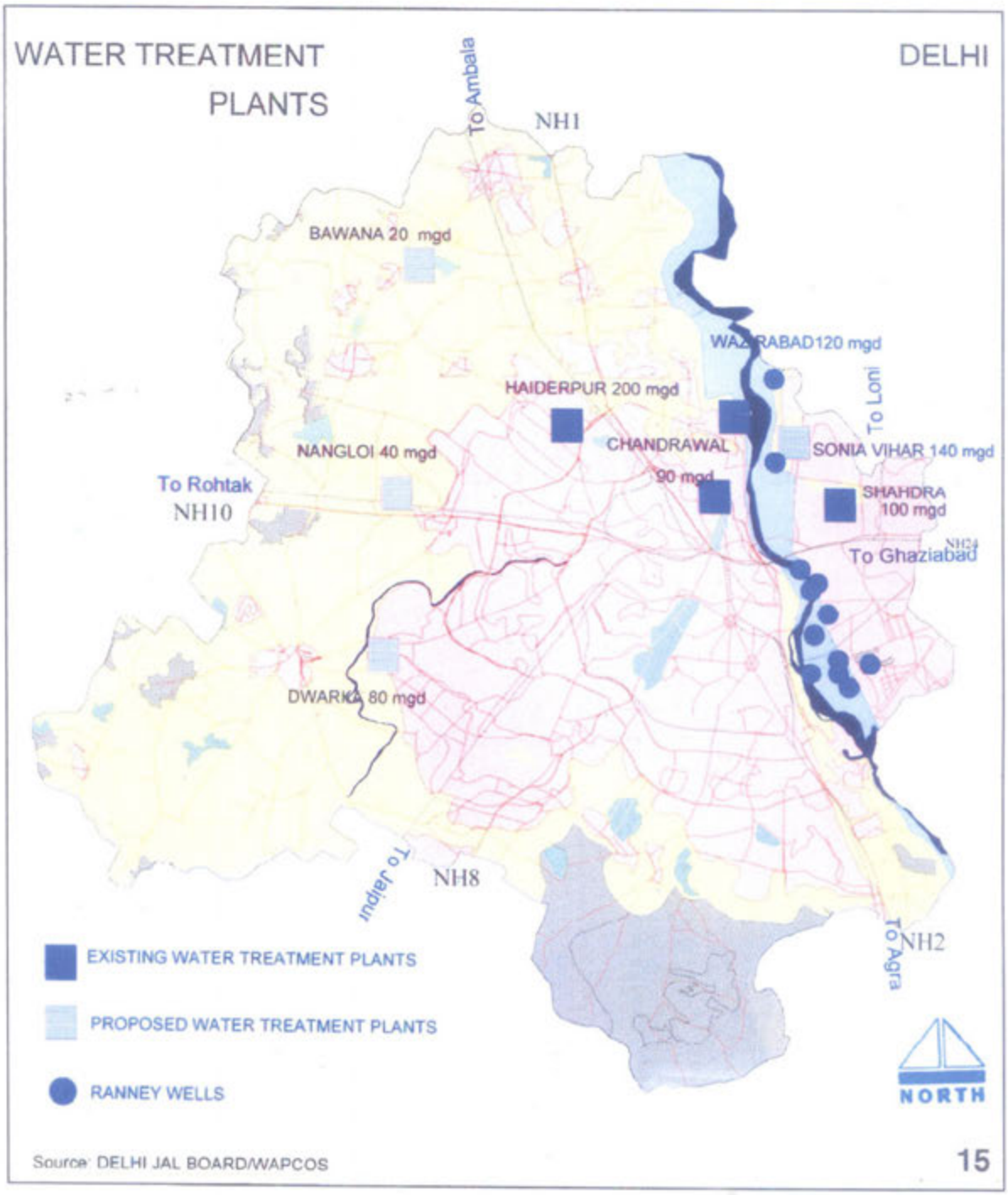
Legend

W	U1 Water (Treatment Plant etc.)
S	U2 Sewerage (Treatment Plant etc.)
E	U3 Electricity (Power Houses, Substations etc.)
SW	U4 Solid Waste (Sanitary Landfill etc.)
	Drains
	River Yamuna

5 . IMPLICATIONS

5.1 Water Supply

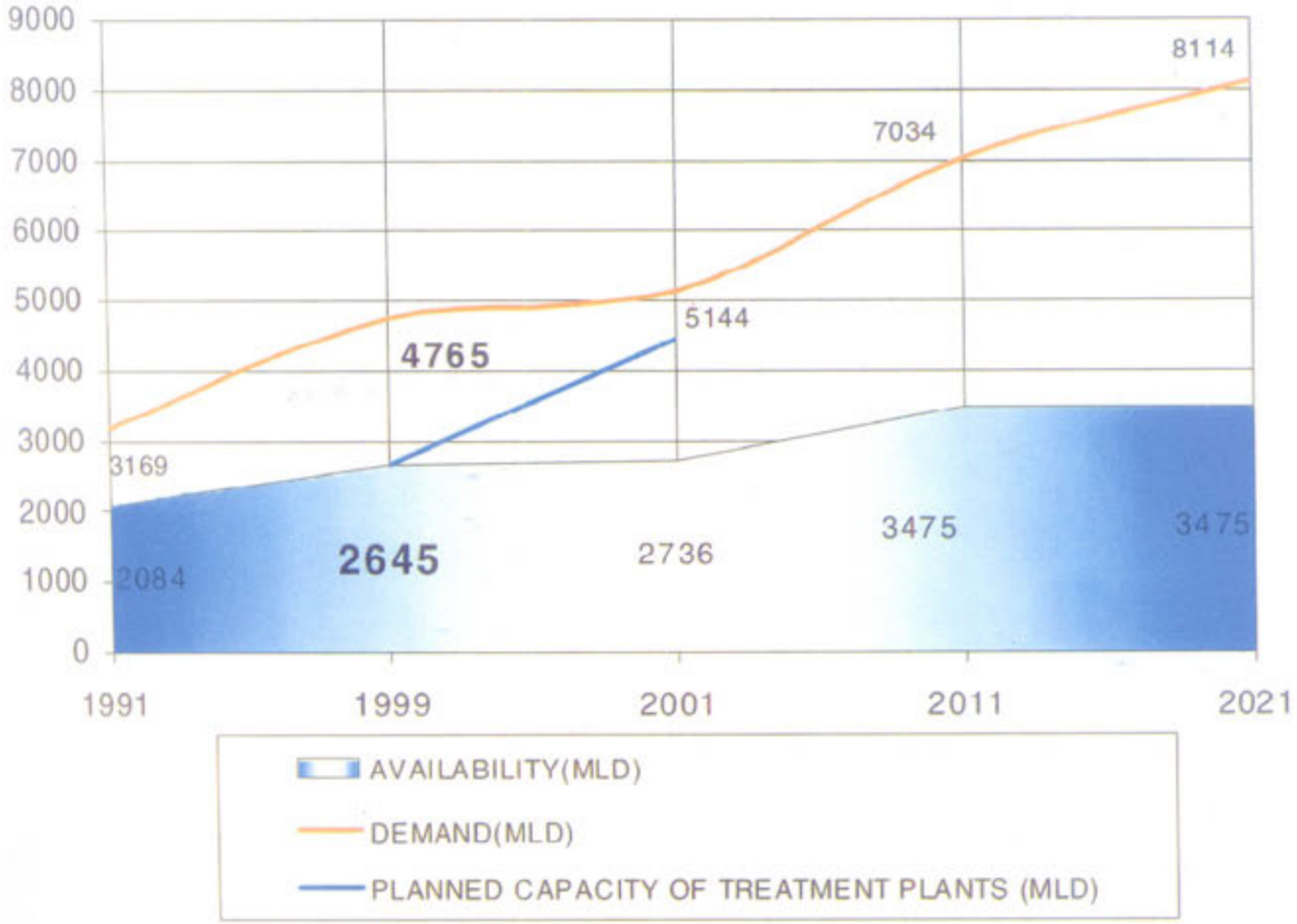
Every year various parts of Delhi face water scarcity. Delhi is dependent for raw water from distant sources and augmentation of raw water for Delhi has been a permanently unsolved issue i.e. escalating population cannot be matched by proportionate increase in the raw water availability. The water supply to citizens of Delhi is through water treatment plants i.e Chandrawal (90mgd), Wazirabad (120mgd), Haiderpur (200mgd), Shahdara (100mgd) and rest through Ranney Wells/Tubewells .



Source: DELHI JAL BOARD/WAPCOS

5.1.1 Excessive Pressure on Delhi's Water Supply

According to Delhi Jal Board, the current treatment capacity in the year 1999, is 2645 mld. and it is supplying water @ 232 mld. Against this, the demand for water is 4765 mld, based on MPD-2001 norm of 363 litres per capita per day for urban population and 100 lpcd. for rural population. Thus against the present water demand, the shortage is approx. 45%. This shortage/gap is likely to increase to 47% by 2001 AD which will increase to 57% in 2021 AD inspite of including the additional water supply from Tehri dam which is under construction and likely to be commissioned by 2002.

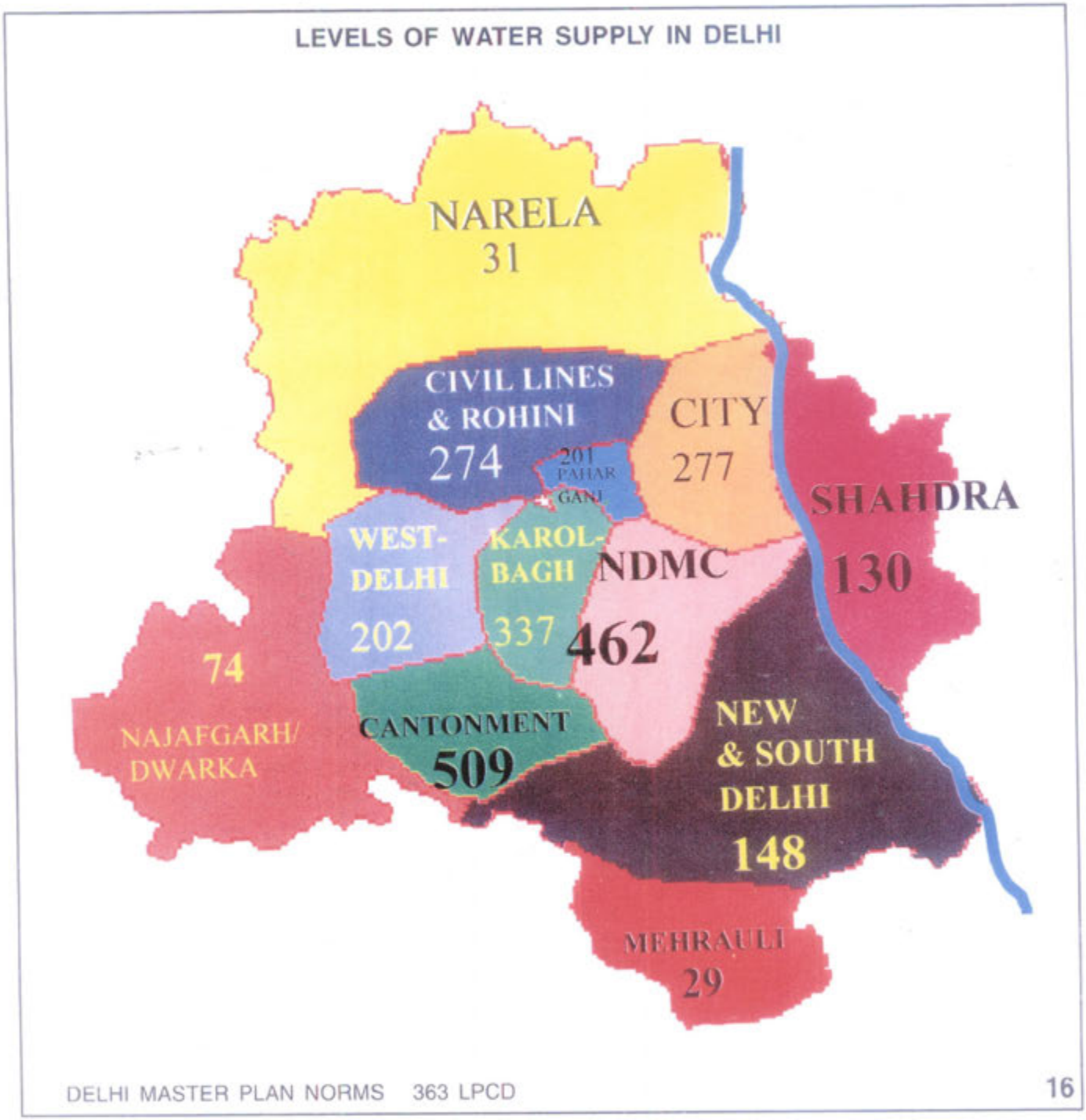


Source : Delhi Jal Board / NCRPB

However, the demand supply gap will become much wider in case water from Tehri dam is not made available as per original schedule. On the other hand, plans are underway in Delhi to install more and more water treatment plants without tying up the raw water sources. In fact, for the Kishau and Renuka dams in Himachal Pradesh, which are some of the proposed future water supply sources, even the project reports and investment decisions have not been taken up.

5.1.2. Levels of Water Supply

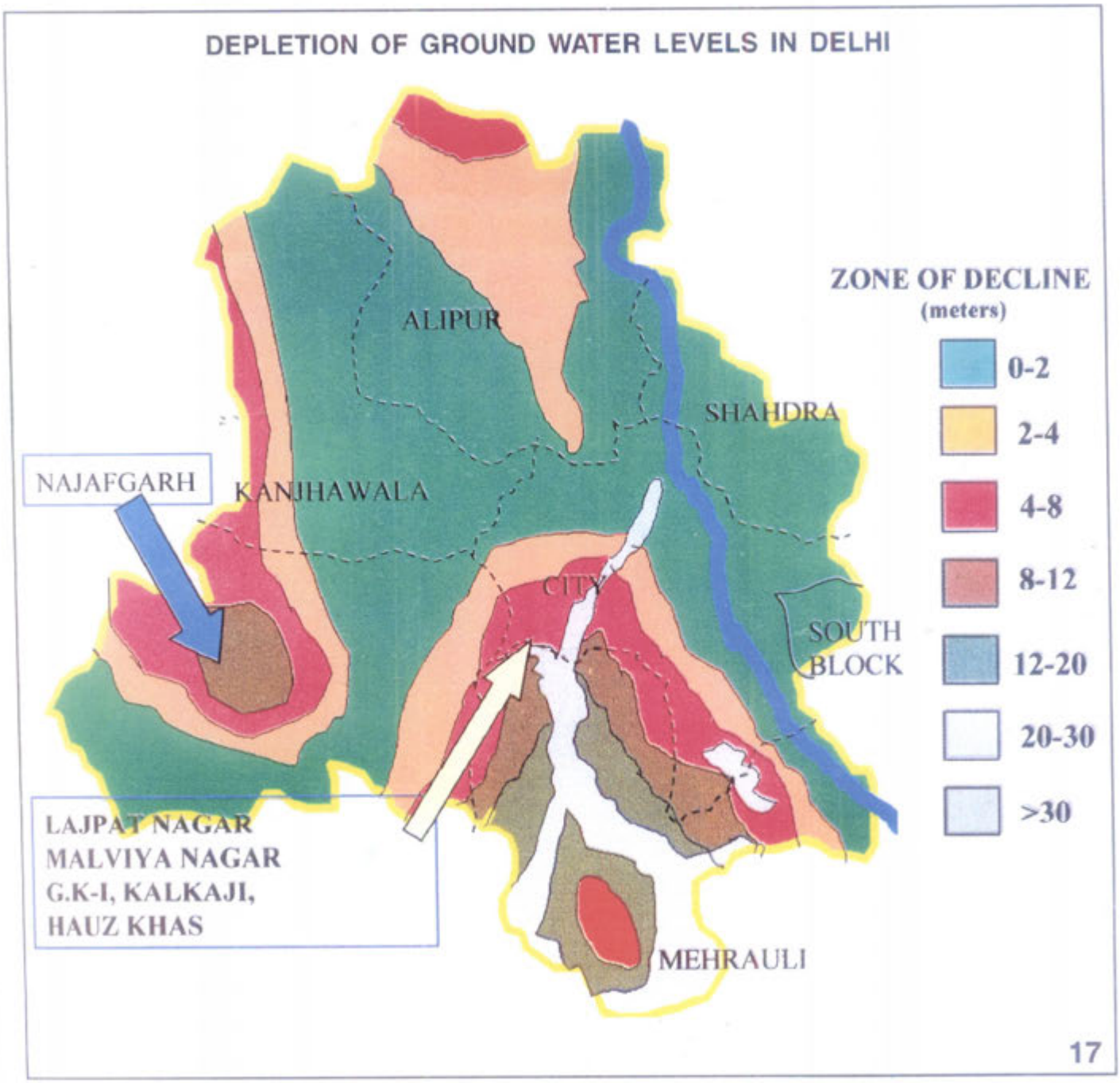
The Water Supply in Delhi is far from uniformly distributed. The NDMC area/Delhi Cantonment area gets average supply above 450 liters per capita per day while Narela/Najafgarh zone gets less than 80 liters per capita on an average with some parts getting less than 35 liters per capita per day water supply. Except the NDMC area the rest of the city has water problems i.e. low water pressure, erratic municipal water supply.



Source : Delhi Jal Board / NCRPB

5.1.3 Depletion of Ground Water

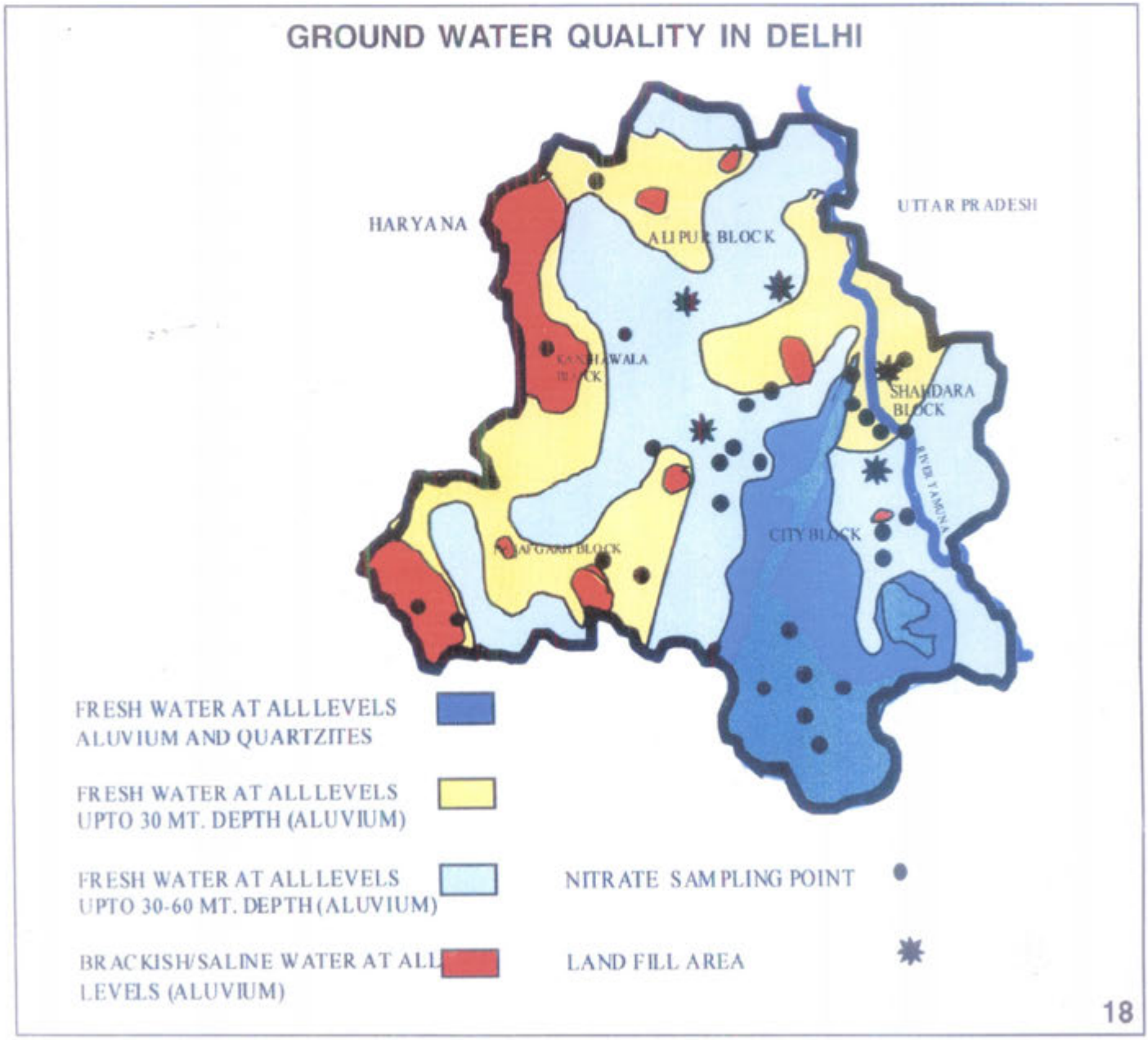
In order to meet the water demand - supply gap ground water withdrawal in the NCT Delhi has emerged as a common place phenomenon resulting in the ground water levels falling in the range of 20-30 meter below land surface in south and south western parts of Delhi. Over exploitation of ground water has disturbed the hydrological balance leading to decline in productivity of wells, increasing pumping cost, more energy requirement and brackish water upcoming etc.



Source : Central Ground Water Board

5.1.4 Ground Water Quality

Besides the quantity, quality of potable water is another serious concern as it directly affects the health of citizens. Instances have been noticed in the past where, in many places, the sewage water got mixed up with water supply thus contaminating it. The quality of ground water is also variable in space and depth. In the areas west of the ridge comprising blocks Najafgarh, Kanjhawala, Alipur, City (part) and Mehrauli (part) the salinity of ground water generally increases towards South-West and North-West direction being fairly high in areas around Dhansa , Raota in South-West and Auchandi, Kanjhawala and Tikri Kalan in North-West. Occurrence of high nitrate concentration are at several locations i.e. Saboli (Shahdara) and Kutabgarh (Kanjhawala) have nitrate contents above 1000 mg/l in ground water. Such high levels of nitrate concentration in shallow ground water could be due to leaching from solid wastes, discharge from sewage water etc. The ground water in vicinity of the landfill in Yamuna floodplains also have high nitrate concentration. Similarly Fluoride and other harmful chemical concentrations beyond permissible limits are observed in the ground water at several locations in Delhi.



Source : Central Ground Water Board

5.1.5 Future Water Supply to Delhi

The future raw water supplies for Delhi are proposed to be augmented through the following sources:

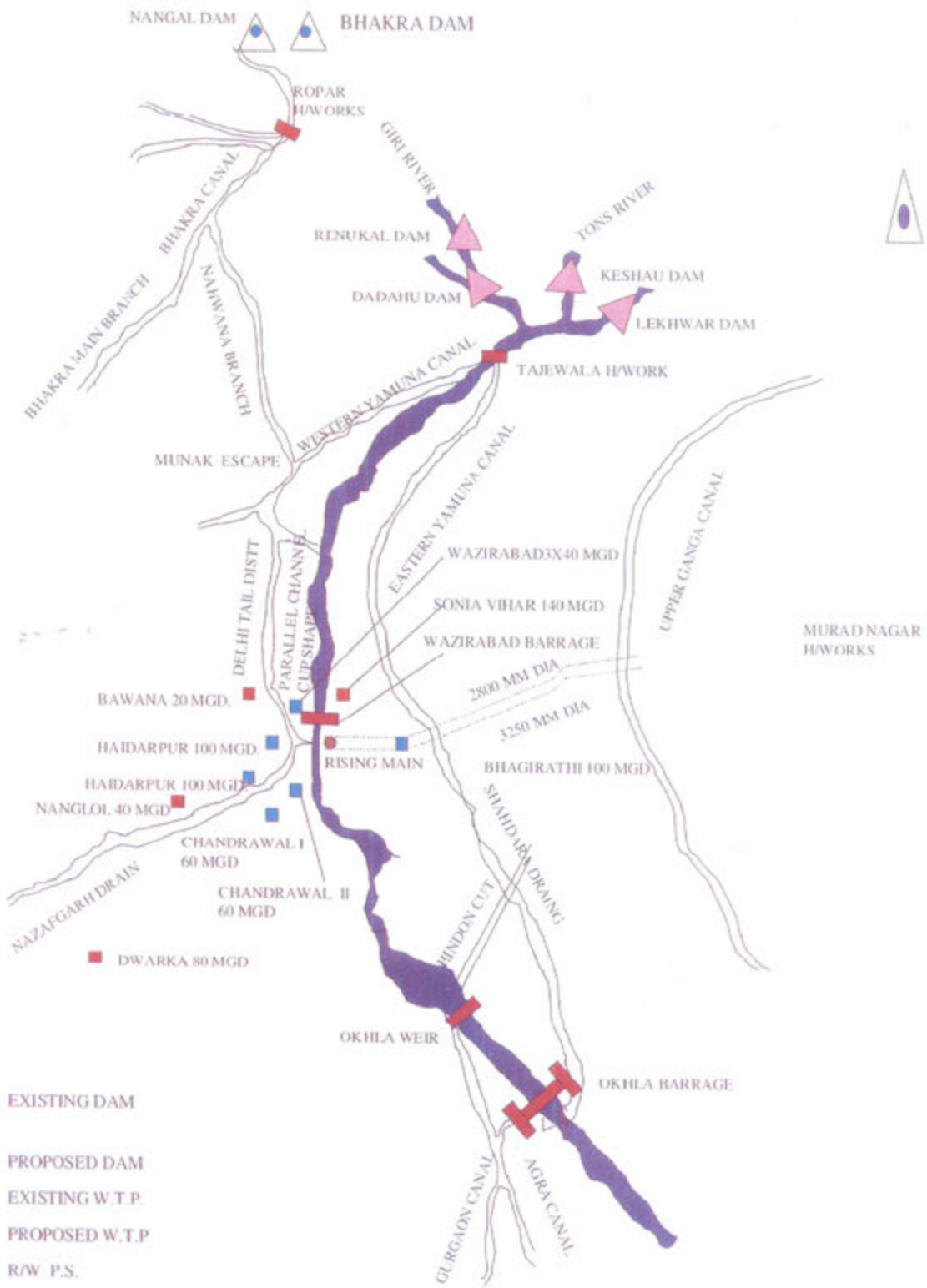
1. **Bhakra storage**
2. **Sub-surface water**
3. **Tehri Dam**
4. **Renuka Dam**
5. **Kishau Dam**
6. **Lakhwar Dam**

Of the above, so far only the first two sources are confirmed for water supply in the near future. The Tehri Dam is expected to be completed by 2002 AD and will be able to supply raw water at that stage. As far as the other three dams are concerned hardly any work has been started,in fact even the project reports and investment clearance are yet to be given for these projects. As such no raw water supplies can be foreseen in the near future from these dams. A flow diagram of the ultimate sources of water supply to different proposed treatment plans in Delhi has been drawn up by WAPCOS.

The total cost of the dams according to Central Water Commission (1996) was estimated to be Rs. 7714 crs. The cost component of the projects as have been given are of initial project estimates. The cost may escalate due to delay in execution, increase in cost of materials, manpower and priority of purposes.

Among the above proposed dams, Renuka and Kishau are under investigations and still to get clearances i.e. investment clearances, clearances from Ministry of Environment & Forests and Ministry of Welfare, etc. Tehri dam has been started but certain difficulties are being faced in the execution of the project due to paucity of funds, agitation by the local people and environmental groups. As per the schedule, stage I of the Tehri dam is to be commissioned by year 2002 AD provided that the carrier system is simultaneously put in position.

√ FUTURE SOURCES OF RAW WATER FOR DELHI



Source : WAPCOS