WATER RESOURCES FOR URBAN CENTRES

By

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❑ INTRODUCTION :

- Life and living objects survive and bloom depending on sustainable supply of good quality water in adequate quantity. All activities from Puja to eternity is linked with water. Puja, hospitality, industry, environment, life, construction and destruction activities are linked with water.

Urban Growth is directly linked with:

a) Water Resources (Quantity),

b) Quality of Water available,

c) Drainage of Storm Water,

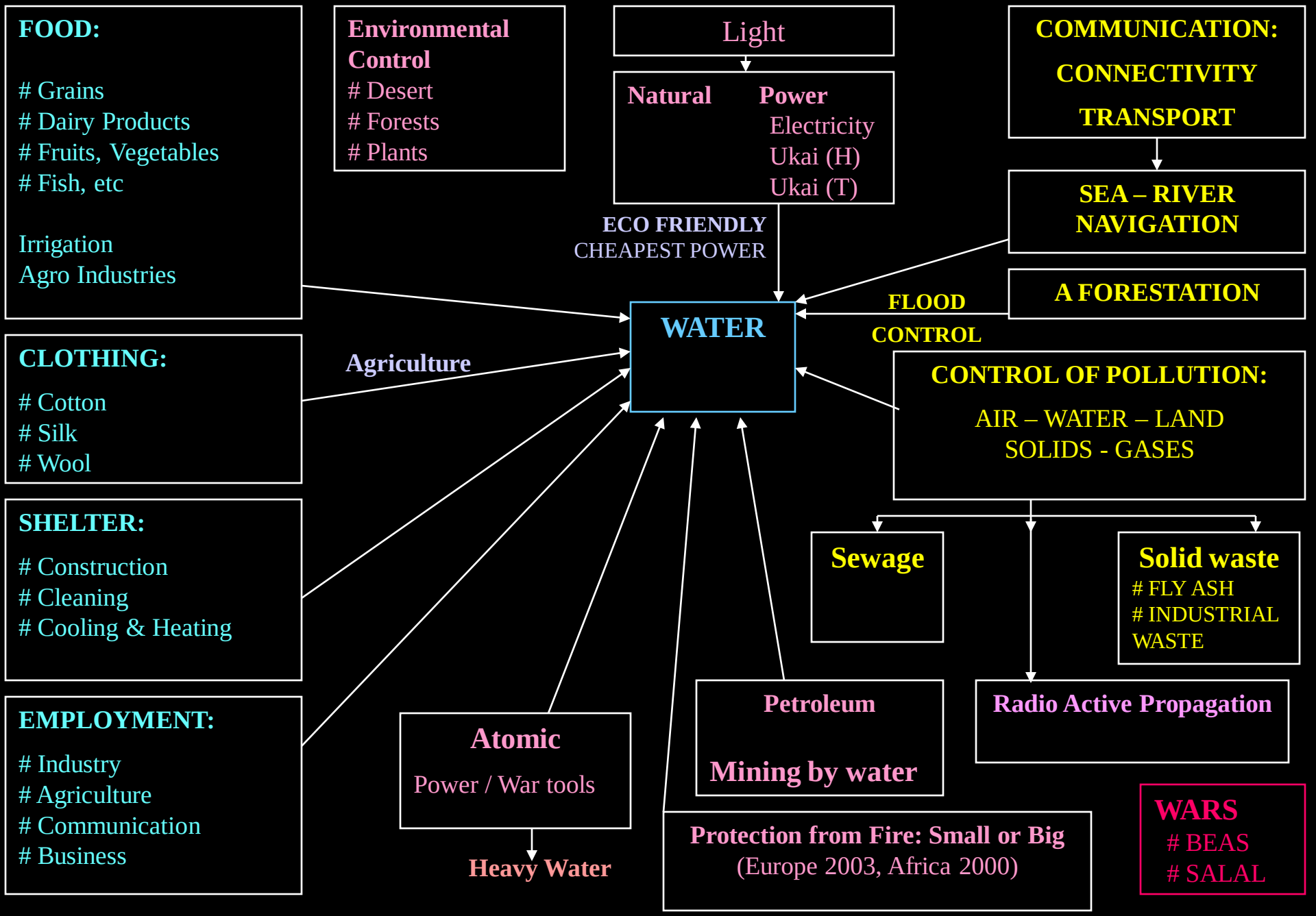
d) Management of Water Resources – Conservation, Recycling, Control of Salinity ingress in Coastal Areas – Surat – Bombay – Madras

e) Development Plan by Act provides reservations of land for Storage – Drainage - Recycle.

Note: All major Urban Centers, Cities have no adequate source.

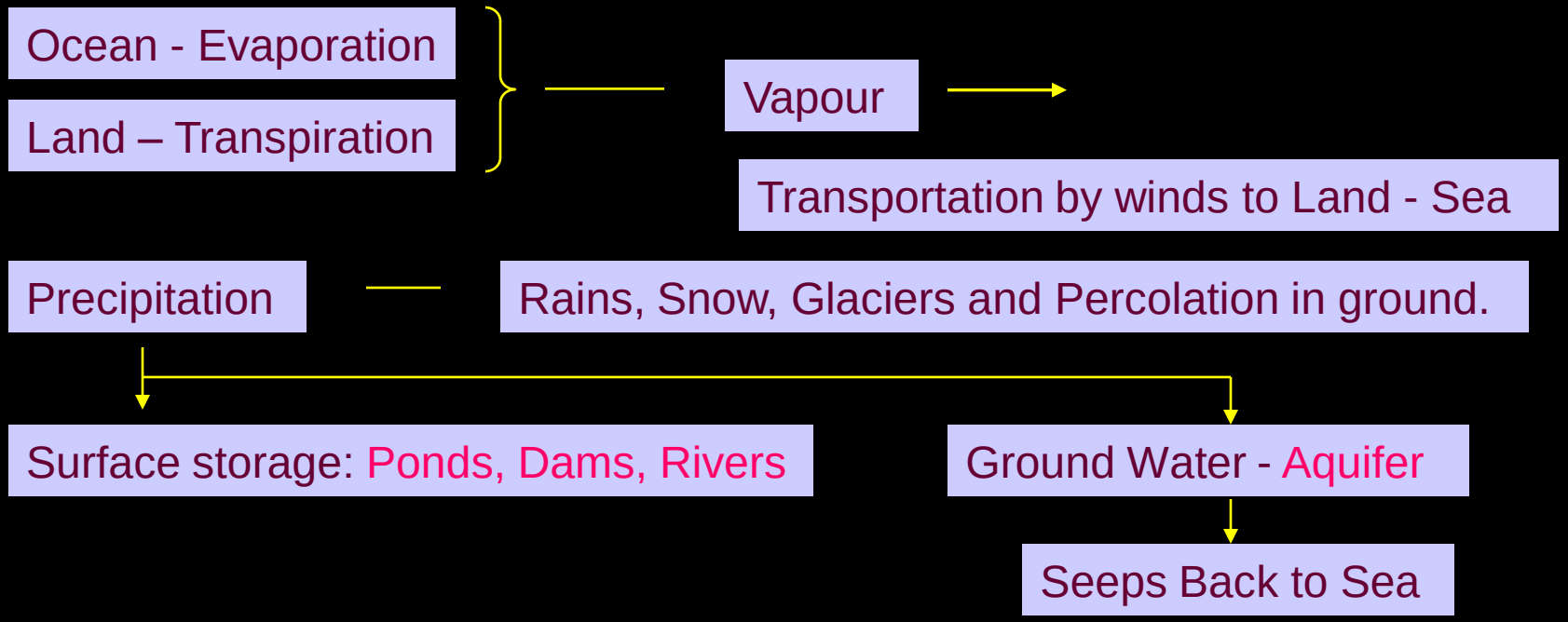
In present scenario good planning requires 15 years time for such projects. Rapid Urbanization, Land Pricing, Litigations indicate **need to reserve say 10 to 15 % land** for over coming repetition of Past Problems in Development Phase.

NEEDS OF LIVING BEINGS ON EARTH (PLANTS – ANIMALS INCLUDED) FOR GOOD LIVING:



GLOBAL SOURCE :

- Good water essential but scares commodity with zero growth (or decreasing with increasing pollution and intrusion of salinity in ground water over coastal belt) is hardly 2 cubic meter in every 1000 cubic meter of available resources.
- The cycle o f generation of fresh water – Hydrological Cycle on earth is shown in Plate – 1.



THE AVAILABLE STUDIES ESTIMATE:

WATER CYCLED / PRODUCED / YEAR = 108×10^{12} CM

CM-Cubic Meter

Continued..

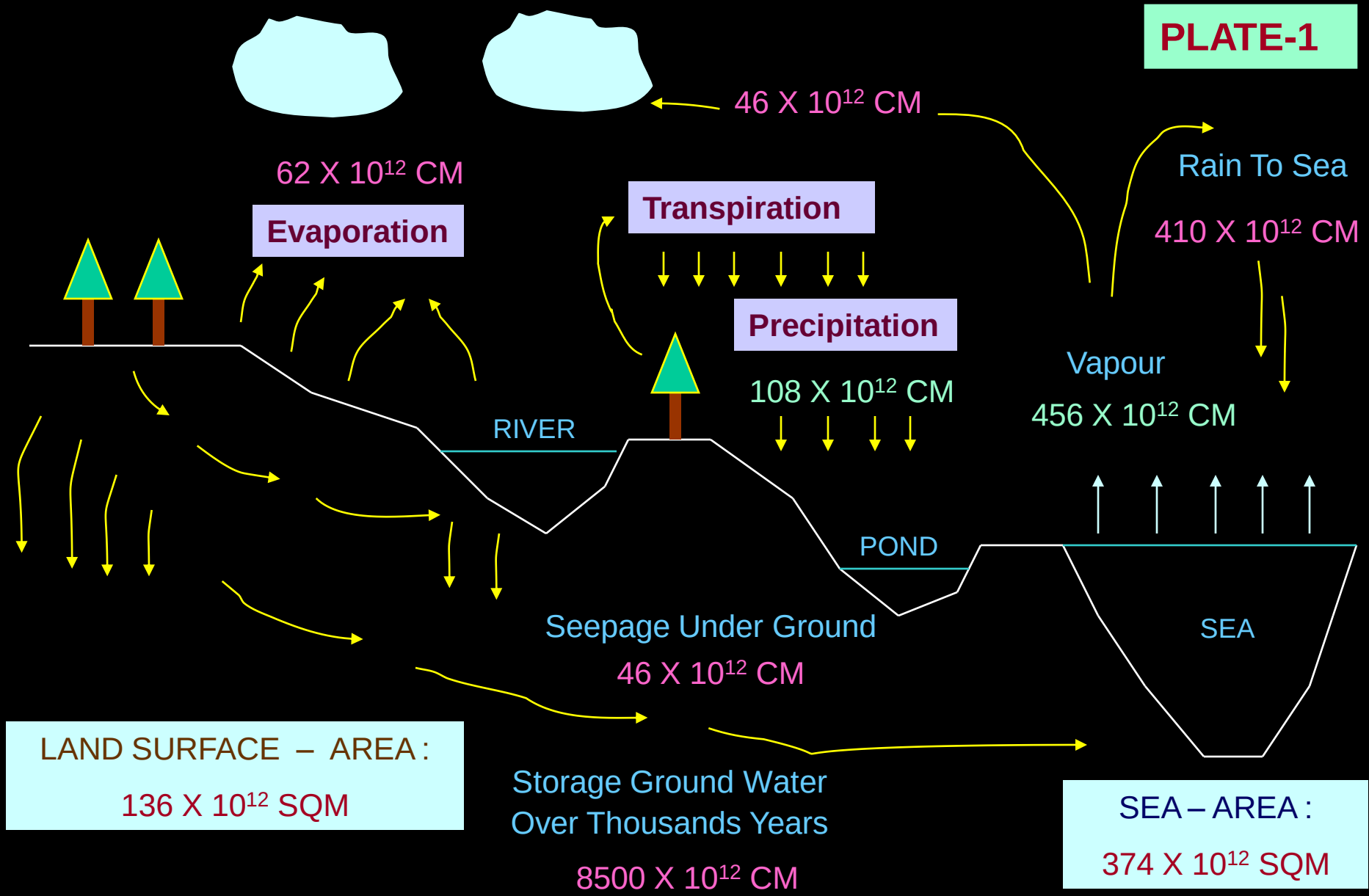
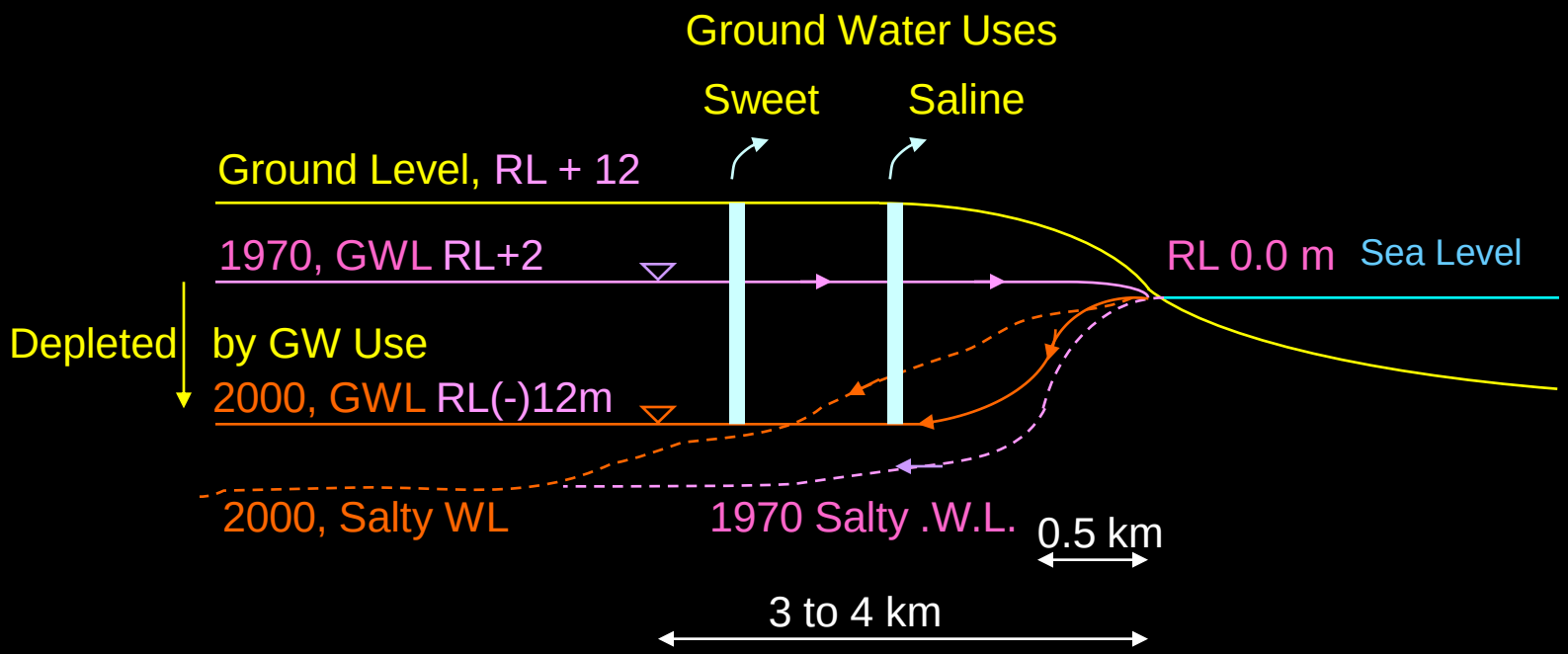


PLATE-1
46 X 10^12 CM
62 X 10^12 CM
Evaporation
Transpiration
Rain To Sea
410 X 10^12 CM
Precipitation
108 X 10^12 CM
Vapour
456 X 10^12 CM
RIVER
POND
SEA
Seepage Under Ground
46 X 10^12 CM
LAND SURFACE – AREA :
136 X 10^12 SQM
Storage Ground Water
Over Thousands Years
8500 X 10^12 CM
SEA – AREA :
374 X 10^12 SQM
WATER CYCLE – ANNUAL FOR GLOBE
CM-Cubic Meter
SQM-Square Meter

- The fresh water on surface is getting polluted by living processes. The millions of years seepage water stored under ground is depleted by use in areas of scarcity. The lowering of ground water by tube wells in coastal belt increases the intrusion of seawater. Thus both surface and ground water are expected to decrease in future. Plate – 2 illustrates this.

PLATE- 2



Over Use Of Ground Water By Bore: G.W.L. Depletes, Salinity intrudes

SEA WATER INTRUSION

❑ SWEET WATER RESOURCES OF EARTH :

- No planet with water source has been traced.
- Huisman (1890) estimated source, which is expected to decrease with years is:

Sr.No.	Source	Quantity in 10^5 (Lakh)CM	% of Total Water availability
1	Oceans	1330	97.00
2	Glaciers Polar Ice	29	2.12
3	Ground Water	8.4	0.61
4	Surface Water - Ponds, Rivers	0.13	0.01
5	Atmosphere Biosphere	-	Negligible

Available water for drinking is only 6 cubic meter of 1000 cubic meter. Some of this is not assessable by human settlements. Hence the available assessable drinking source could be placed at 2 cubic meters for every 1000 cubic meter.

❑ Norms of WHO :

For overall Global Consideration WHO considers:

	Quantity in CM / Year / Head
Minimum Supply	2000
Tolerable Supply	1700
Scarce Supply	1200

These norms will vary from country to country based on climate, growth rate of population, industry, pollution etc. Hence it is used to predict future trends only. The needs for irrigation, pollution control per head is included in above quantity.

❑ WORLD WATER RESOURCE :

- Ground Water Fresh Stored over Years …… 8500 x 10^{12} CM
- Considering Detention time of 200 - 300 years,

  Renewable Income of rains…… 46 x 10^{12} CM

❑ HUMAN NEEDS OF WATER :

FOR URBAN AREA (IS: 1172 – 1993)

Activity	Quantity in (L / Head / Day)
Drinking & Cooking	10
Bathing	75
Washing - Cloths & Urinals	40
Other Cleaning	15
Flushing Toilets	45

❑ INDUSTRIAL NEEDS :

The demand depends on processes:

- Textile industry requires 100 Kilo Ltr / tone of textile material handled.
- Paper industry requires 400 - 500 Kilo Ltr of water / tone of product.
- Fertilizer industry – 200 Kilo Ltr / tone

For Industrial Cities, Ultimate per capita water requirement may be as high as 450 L / Head / Day as compared to normal requirement of 50 L / Head / Day.

❑ AVAILABLE WATER RESOURCES IN FUTURE : PROJECTIONS FOR GLOBE :

Though fresh water under ground is estimated as 8500 x 10^{12} cubic meter, the renewable source of water is only 46 x 10^{12} cubic meter.

PROJECTIONS OF NEEDS & SUPPLY (GLOBAL) :

1	Year	1950	2000	2050
2	Population x 10^7 (Crores)	300	600	900
3	Available resources of water (CM / Year / Head)	3000	1650	1000
4	Minimum Desirable WHO (CM / Year / Head)	2000	2000	2000

Plenty → **Scarce** → **Scanty**

The scarcity supply will grow over years from 2000 and overall reach critical state by 2050. This period will, in each country may vary but trend is definite.

(A) NORMS OF QUANTITY OF WATER (WHO):

	Liters / Head / Day
(A) Minimum	5480
(B) Tolerable	4650
(C) Scare	* 3280

* 1200 m^3 / Head / Year

(B) AVAILABLE WATER IN INDIA:

ESTIMATE:

SOURCE	QUANTITY IN (Billion Cubic Meter (10^9 CM))
Rain – Snow / Year	1870
Ground Water	432
Total	2302 BCM

Usable water = (690 + 432) x 10^9 CM
= 1120 BCM

INDIA: Projection of Availability of usable / Total Resources over years:

Year	2001	2026	2051	
Population	103×10^7	140×10^7	160×10^7	
Distribution of water in Cubic Meter / Year / person	1090	800	700	Usable
	2000	1600	1400	Total Resources
Liters / Day Available	2986	2191	1917	Usable
	5480	4383	3835	Total Resources
Min Water Desirable	……..4650……..			

Note: To Convert Total Resources into Usable in Storage, Conservation, Recharge will be a massive effort for next 2 decades.

❑ CONFIRMATION OF FORECASTS :

Some recent surveys have shown:

1) About 100 crore (1 billion) people have no drinking water.

2) 280 crore people (2.8 billion) are waiting for water supply for sanitation.

3) 25 crores suffer water born diseases.

❑ CONFIRMATION OF TREND IN INDIA :

1) Increasing repeated scarcity of water in many parts of country.

2) The free drinking water supply is pre 1970 history. The price of litre of water for drinking is average Rs 15 / litre. The industrial needs of water has created new industry of water supply by tankers with cost ranging from Rs 250/- to 400/- for 1000 litre.

Continued..

3) Water becoming scares and costly, thefts from canals / reservoir and SMC industrial supply have become daily news headlines. Inter state, inter country legal battles have already started in country and will not take long when water may become a political tool for future politicians. Future wars could be for water.

4) Shortage of surface water have led to mass use of ground water lowering G. W. L. by 10 to 50 meters generally. In coastal belts Surat for example, Seawater therefore found entry in 2 – 4 km belt around estuary making G.W. source as polluted.

2051 FORECAST INDIA

	Needs (Population 160 crores)	Quantity in Billion Cubic Meter (10^9)	
(1)	Domestic	100	
(2)	(Irrigation for food 450 million tones) New storage to be created 600 BCM	1000	Available Total Ground + Surface 2300 BCM(Total) 1120 BCM (Usable)
(3)	Power Sector Atomic – Thermal – Hydro	150	
(4)	Industry for Employment	200	If efforts are made to Convert 1180 BCM As Usable
(5)	Keep Rivers Clean Flowing	70	
(6)	Needs for Fighting Hazards – Fire – Atomic- Salinity	60	* Planning For 20 Years * Cost . * Priority
(7)	To control Pollution of Air – Water – Ground	200	CAN LEAVE WITHOUT ROAD BUT NOT WITHOUT WATER!
(8)	Loss – Waste	600	
	Total Needs	2380 Say 2400	

Inter Country Disputes

Nepal, Bangladesh, Pakistan

Inter State Disputes

Gujarat – MP

Karnataka – Andhra - Tamil Nadu

Punjab – UP – Delhi

Fruits of Green Revolution

White Revolution?

Cost of Water Higher

Higher Living Cost

Purity of Water !

Diseases, Health Hazards

Guess 1 Liter Water At Railway:

1968……(Max) 1.0 Rs

1998……..…10.0 Rs

2021……100.0 Rs

2056……..…?

Industry:

2004 ---→ 25 Rs / 1000 L

2056---→500 Rs / 1000 L

PREDICT CRISIS FOR SURAT IN 2015 – 2020 (SALINITY INGRESS)

Available water sources	Need / day	Population	Year
Ukai –Tapti (Non Industrial Water)	750 MLD	25 lakh	2005
	1000 MLD	40 lakh	2015

Available Source:

(1990-2015) - 700 MLD

Summer - 400MLD

Capacity of Water Works - 550 MLD(2008)

Requirement 2015 - 1000 MLD

Now time to evolve projects for alternate sources for 10 -20 years

❑ CAN CRISES BE MINIMIZED?

The crisis in India are delayed due to slow and steady planning of 3000 or more minor, medium and major irrigation projects in priority over last 50 years. The white & green revolution has, through the network of canals, revolutionized water supply for domestic purposes to non-urban sector.

The additional water estimated as 600 x 10^{12} Cubic Meter has to be conserved from sustainable sources untapped so far. To locate sources, plan project, obtained required funds and generate public awareness to avoid politico – environmental – legal clearance to project, advanced planning is need of hour. The immediate need to identify source and ascertain land use reservations from government in 2-3 years. Whereas urban activity e.g. SUDA, TP Plans at Surat is in process, overall reservations of land required for storage and supply will be easy. Once TP is planned, step-by-step “Part to Whole System” will not be economical nor efficient. Once source is planned efficient economical system by parts can be evolved as growth occurs .

Continued..

To conclude, it is first step to locate / Plan source of water for urban center and ascertain that land is reserved. This establishes primary need for sustainable planning of water resources for future.

This plan requires legal back up of act (Development Plan / Town Planning scheme) to reserve land for water resources and storm drain.

❑ METHODS FOR MINIMIZING CRISIS :

Conserve sweet water:

E.g. Auto level gates of Singanpore weir releases water round the year, which merges in to tide. Balloon dam at Umra can conserves 100 million m^3. (Plate-3)

Harvest rain water/ Floodwater by storage check dams, Lagoons: 400 million m^3 (Lagoons on coast lines).

Harvest rainwater by recharging ground water – Each house, drain and plot: 170 million m^3. (Plate-4)

Recycle water for more than one use. E.g. collect wash & bath domestic water 120 L / Head / day and use for flushing & other cleaning (60 L / Head / day) saving more than half water consumed per capita for domestic use.

The sewage water, after tertiary treatment, can be used for gardens, green belts, irrigation and recharging in to ground.

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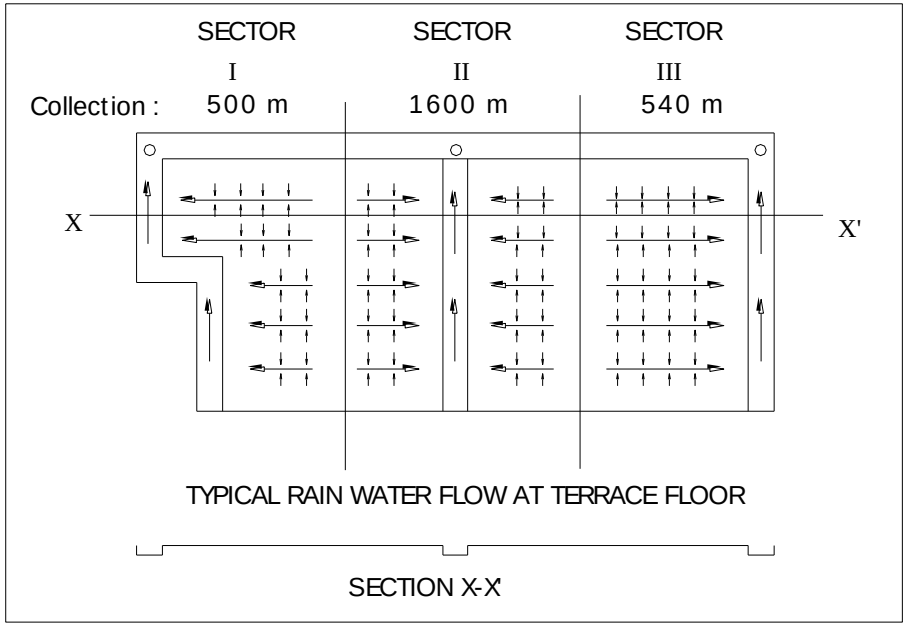
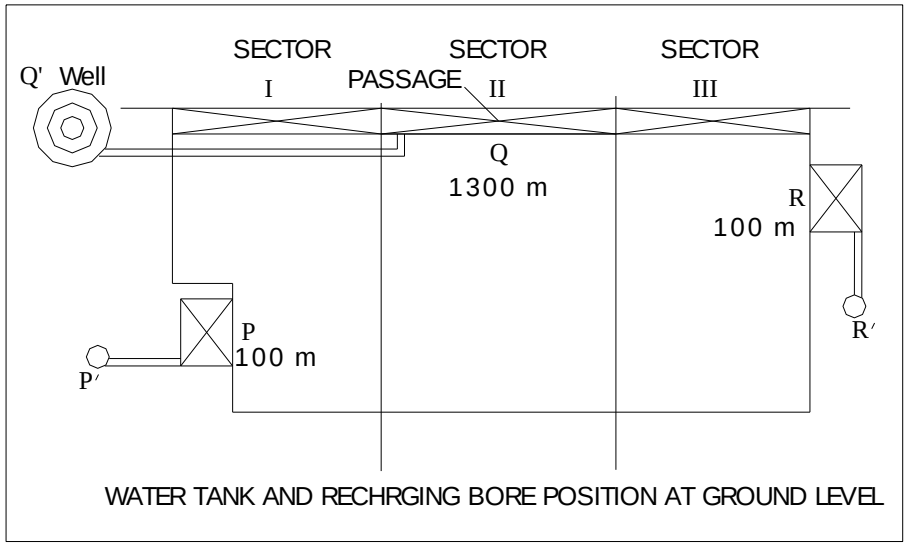
PLATE- 3

PLATE- 4

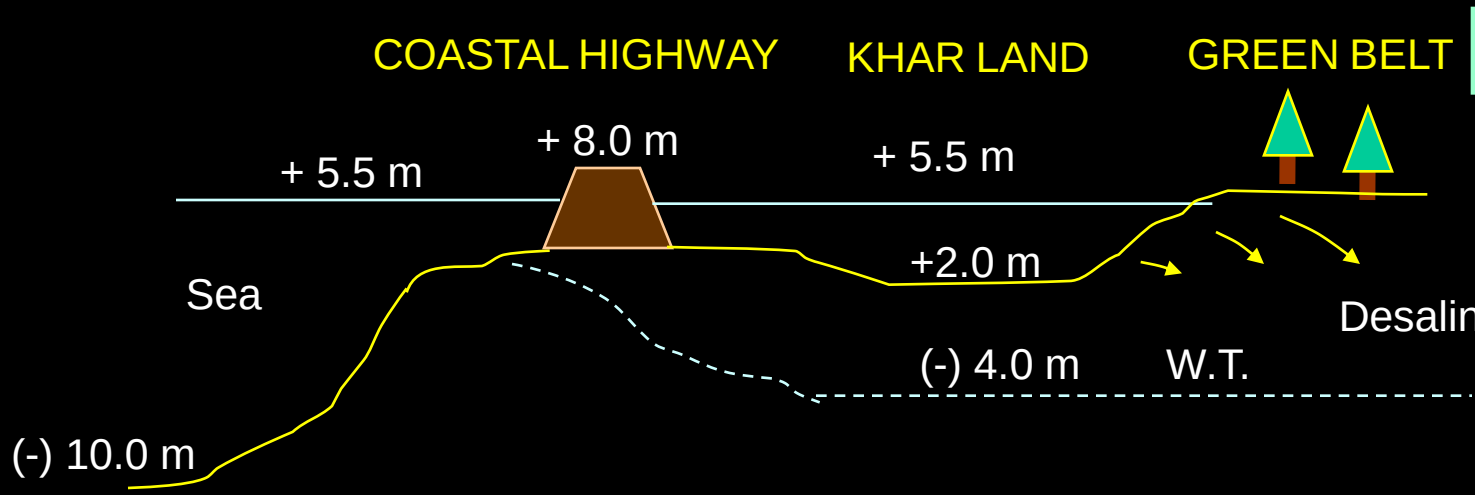

SECTOR I
SECTOR II
SECTOR III
Collection :
500 m
1600 m
540 m
X
X'
TYPICAL RAIN WATER FLOW AT TERRACE FLOOR
SECTION X-X'

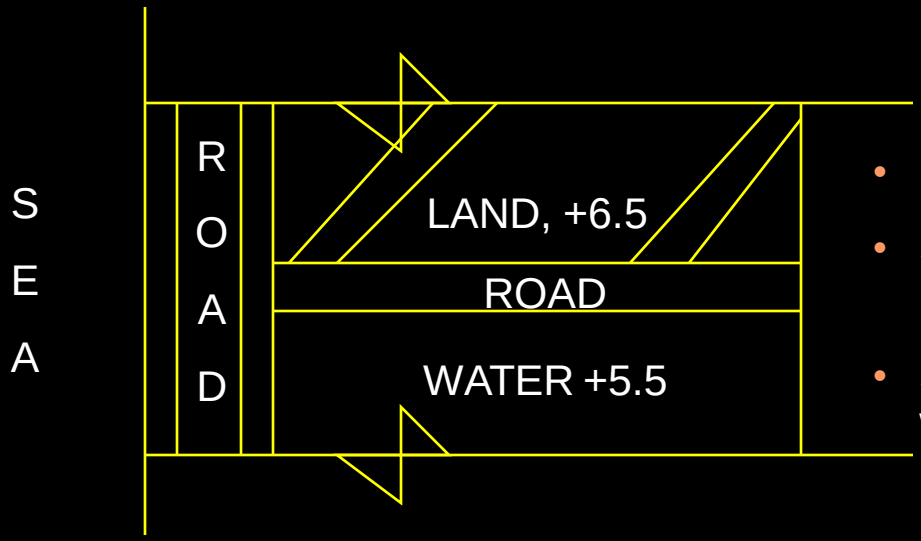

Q' Well
SECTOR I
PASSAGE
SECTOR II
SECTOR III
Q
1300 m
R
100 m
R'
P
100 m
P'
WATER TANK AND RECHRGING BORE POSITION AT GROUND LEVEL

Multipurpose Projects to Make Optimization of Water.

- Surat – Flood sustainable > 1000 million m^3 / year (Plate-5, 6)
- Use kharland along seacoast
- Hansol Umbharat- 4 lane coastal highway at R/L 8.0
- Length 50 to 60 km: Plan 50 % water lagoon & 50 % land reclamation.
- Disaster management : Sea Protection
  : Land salinity
  : Water source
  : Drainage to river
  : Drainage to Sea
- Land Creation

PLATE- 5

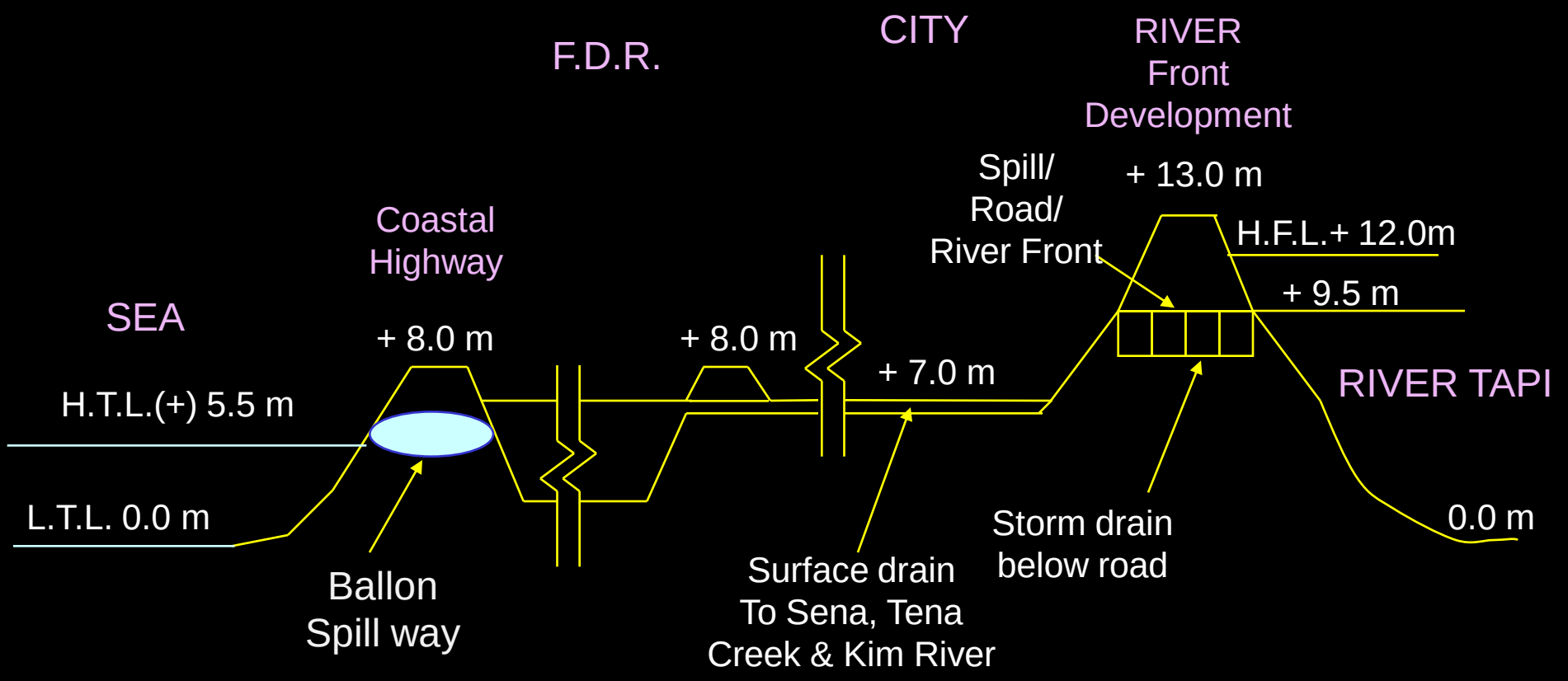




- Excavation Lagoon
- Soil F.A. reclaiming Land…25 Million SQM
- Store & Recharge Water up to 100+20 million CM

MULTIPURPOSE PROJECT TO MAKE OPTIMIZATION OF WATER.

PLATE- 6



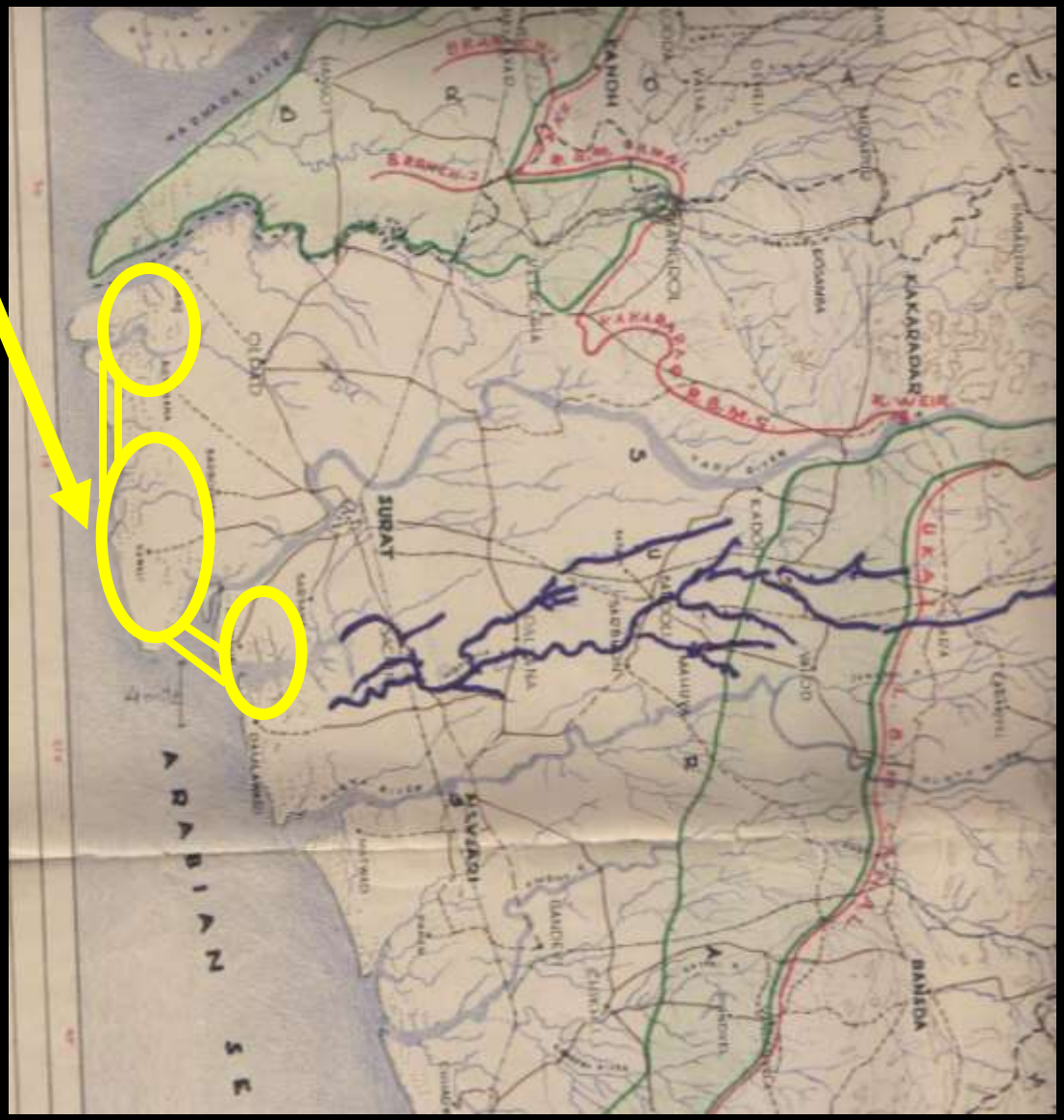
Sketch showing the sectional details for proposed Integrated planning with Coastal Highway & Flood Detention Reservoir

Plate shows flood, spills, barrel direct drain to act as storm drains interceptor, surface drain network to divert flood water to major khadies redeveloped, Tena, Sena, Kim, Mindhola.

Flood Detention Reservoir with Ballon dam spillway:

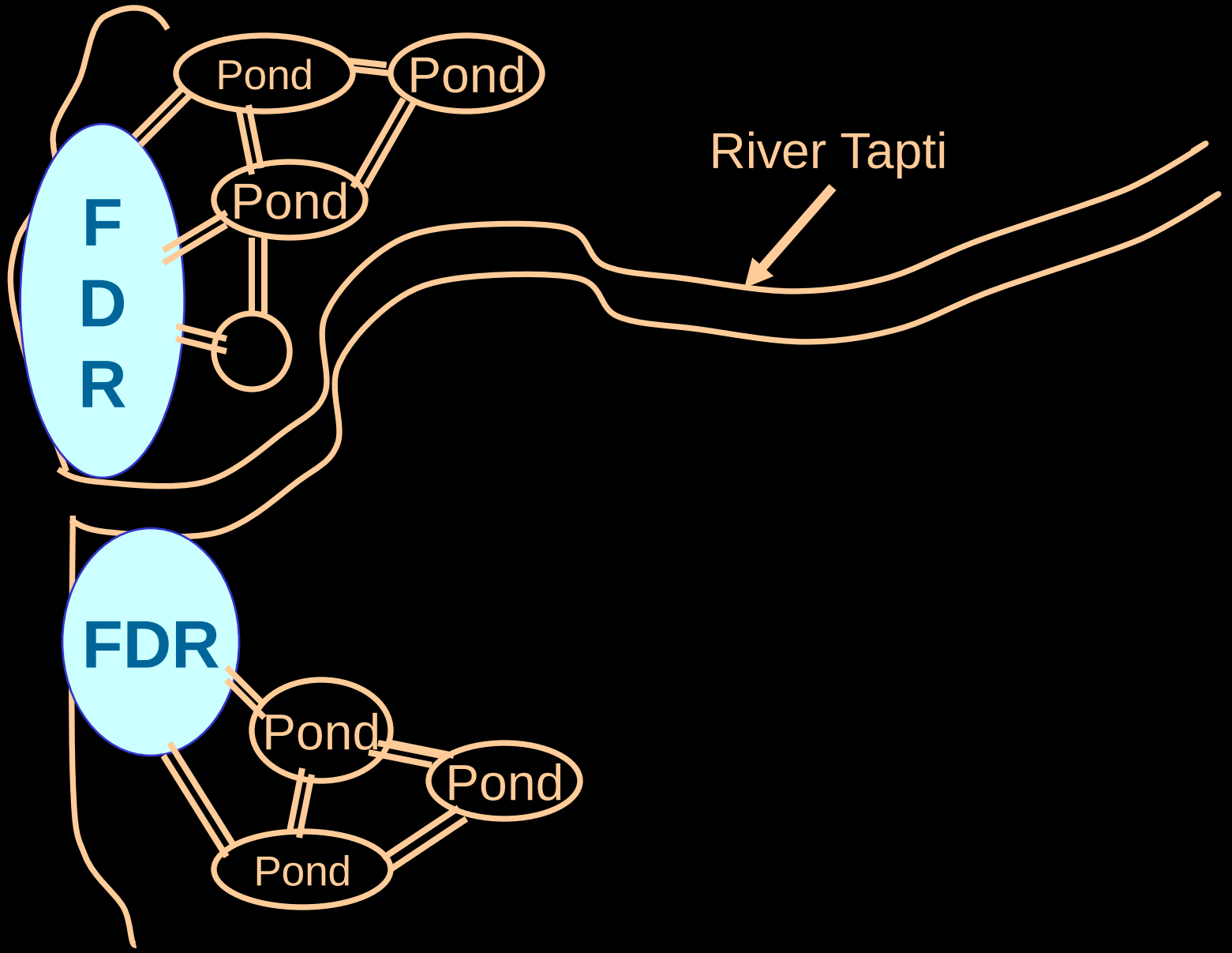
Coastal Area of Hajira, Olpad.
- Tena Sena Creek &
  Kim River

Coastal Area at Mouth of
- Mindhola River



Flood Detention Reservoir - Mindhola River

Linking of Village Ponds (reserved) for no source villages



Proposed Coastal Highway with Flood Detention Reservoir

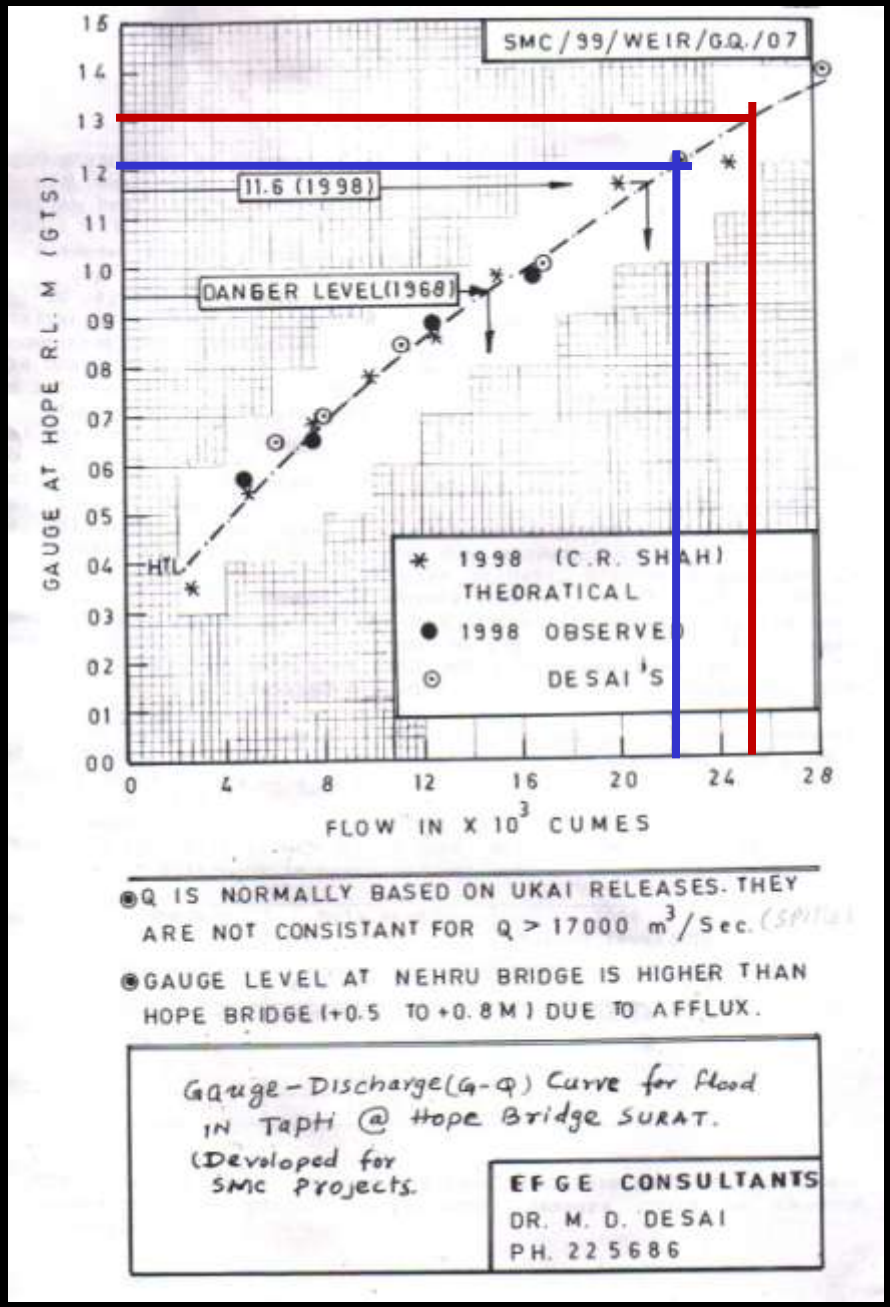
NH-8.

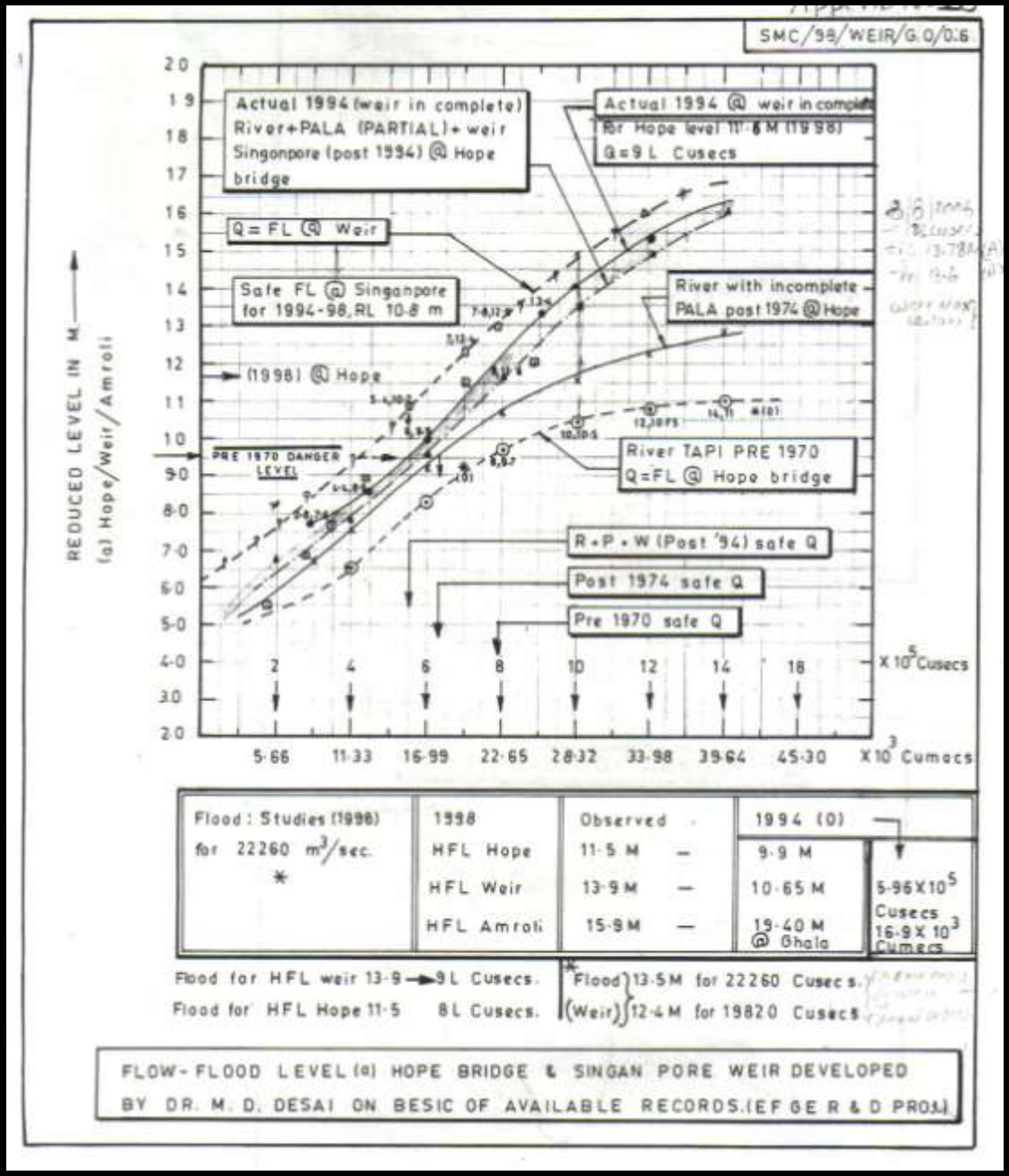
Proposed Coastal Highway Evacuation for Hajira in Disaster

HIGHWAY CONSTRUCTION ON COASTAL LINE

Coastal Erosion - Swaminarayan Temple, Tithal, Valsad


14:02
17. 9.2001


SMC/99/WEIR/G.Q./07
11.6 (1998)
DANGER LEVEL(1968)
HTL
1998 (C.R. SHAH) THEORATICAL
1998 OBSERVED
DESAI'S
GAUGE AT HOPE R.L. M (GTS)
FLOW IN X 10³ CUMES
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15
0 4 8 12 16 20 24 28
Q IS NORMALLY BASED ON UKAI RELEASES. THEY ARE NOT CONSISTANT FOR Q > 17000 m³/Sec.
GAUGE LEVEL AT NEHRU BRIDGE IS HIGHER THAN HOPE BRIDGE (+0.5 TO +0.8 M) DUE TO AFFLUX.
Gauge-Discharge(G-Q) Curve for flood IN Tapti @ Hope Bridge SURAT.
(Developed for SMC Projects.
EFGE CONSULTANTS
DR. M. D. DESAI
PH. 225686


SMC/98/WEIR/G.O/0.6
REDUCED LEVEL IN M
(a) Hope/Weir/Amroli
Actual 1994 (weir in complete) River+PALA (PARTIAL)+ weir Singonpore (post 1994) @ Hope bridge
Actual 1994 @ weir in complete for Hope level 11·6 M (1998) Q=9 L Cusecs
Q = FL @ Weir
Safe FL @ Singanpore for 1994-98, RL 10·8 m
River with incomplete PALA post 1974 @ Hope
(1998) @ Hope
PRE 1970 DANGER LEVEL
River TAPI PRE 1970 Q=FL @ Hope bridge
R+P+W (Post '94) safe Q
Post 1974 safe Q
Pre 1970 safe Q
X 10^5 Cusecs
X 10^3 Cumecs
5·66 11·33 16·99 22·65 28·32 33·98 39·64 45·30
Flood : Studies (1998) for 22260 m³/sec. *
1998 Observed
HFL Hope 11·5 M
HFL Weir 13·9 M
HFL Amroli 15·9 M
1994 (0)
9·9 M
10·65 M
19·40 M @ Ghala
5·96 X 10^5 Cusecs 16·9 X 10^3 Cumecs
Flood for HFL weir 13·9 → 9 L Cusecs.
Flood for HFL Hope 11·5 8 L Cusecs.
* Flood (Weir) 13·5 M for 22260 Cusecs. 12·4 M for 19820 Cusecs
FLOW-FLOOD LEVEL (a) HOPE BRIDGE & SINGAN PORE WEIR DEVELOPED BY DR. M. D. DESAI ON BESIC OF AVAILABLE RECORDS. (EF GE R & D PROJ.)

THANK YOU