



PAKISTAN WATER & POWER DEVELOPMENT AUTHORITY



PRESENTATION TO PAKISTAN DEVELOPMENT FORUM

April 27, 2007

UNDERLYING PRINCIPLES FOR CREATION OF WAPDA

- **UNIFIED DEVELOPMENT OF WATER & POWER
RESOURCES**
- **RESERVOIR OF COMPETENT, PROFESSIONAL &
TECHNICALLY QUALIFIED WORK FORCE**
- **ADMINISTRATIVE AND FINANCIAL AUTONOMY**

CHARTER OF DUTIES

- **GENERATION, TRANSMISSION AND DISTRIBUTION OF POWER**
- **IRRIGATION, WATER SUPPLY AND DRAINAGE**
- **PREVENTION OF WATERLOGGING AND RECLAMATION OF WATERLOGGED AND SALINE LAND**
- **FLOOD MITIGATION**

RESTRUCTURING & REFORM PROGRAMME

PAKISTAN POWER SECTOR

Restructuring & Reform Objectives

To establish in phases a competitive and efficient Electric Power System covering generation, transmission and distribution according to a carefully designed strategy and plan of action.

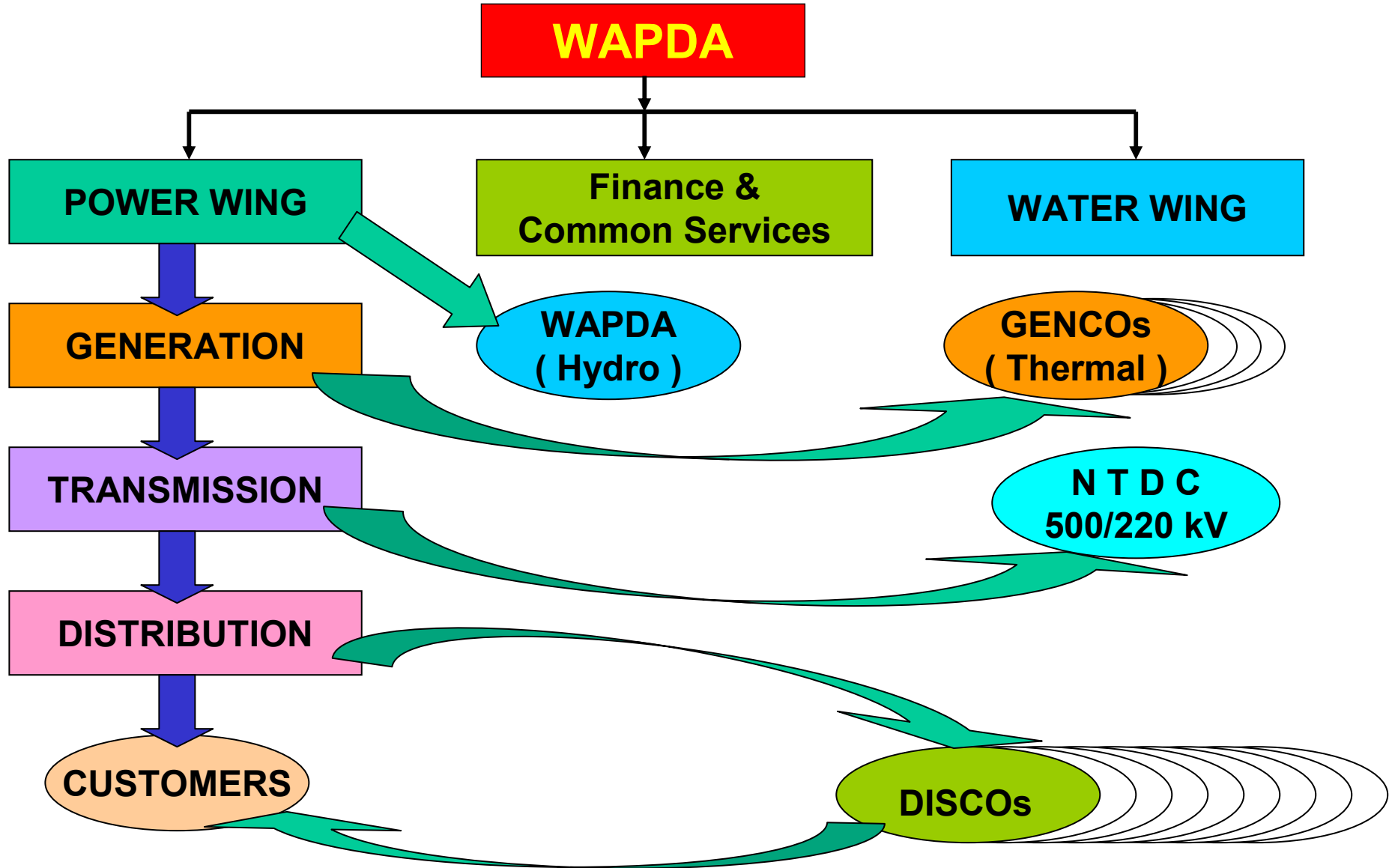
RESTRUCTURING & REFORM PROGRAMME

Reform Initiatives

Government of Pakistan has approved a Strategic Plan for Restructuring of the Vertical-Monolithic Power Sector to form distinct autonomous entities for Generation, Transmission and Distribution. The salient futures of the programme are:

- Restructuring of Unified Power Wing of WAPDA into public limited companies under the corporate law, separating Generation, Transmission and Distribution functions. Today 8 DISCOs + 4 GENCOs + 1 Transmission companies are operating**
- Promote competition to eventually offer affordable electricity to customers**
- Enhance privatization initiatives**

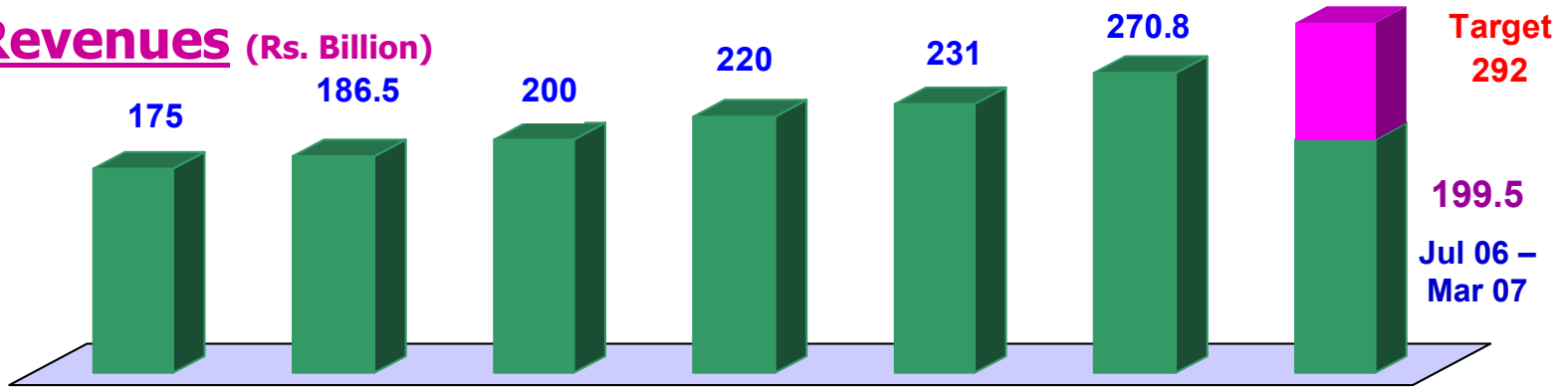
POWER SECTOR REFORMS UNBUNDLING & RESTRUCTURING OF WAPDA



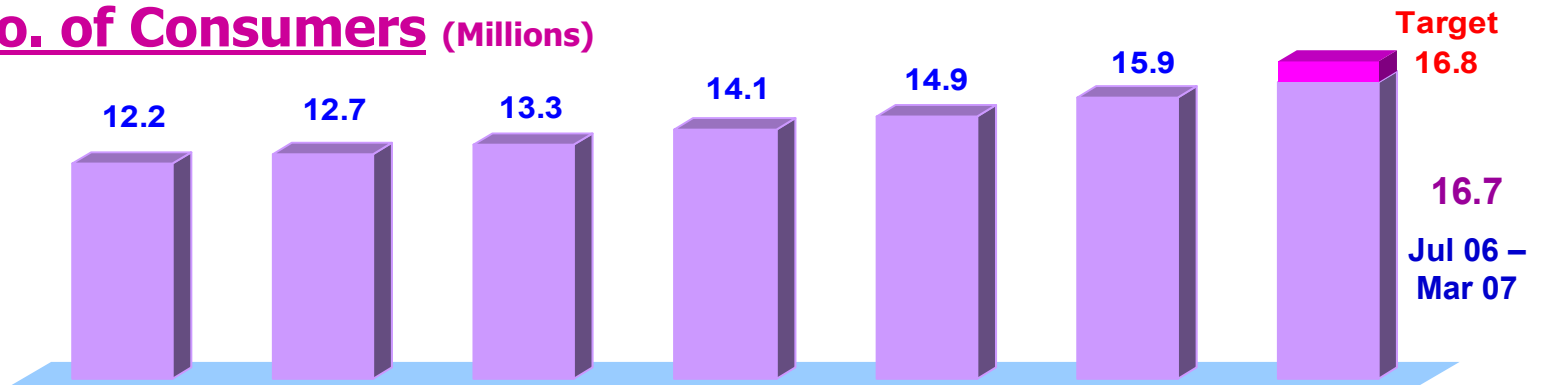
**... TRANSFORMING THESE ORGANIZATIONAL COMPONENTS
INTO INDEPENDENT CORPORATE ENTITIES**

OVERVIEW OF PERFORMANCE

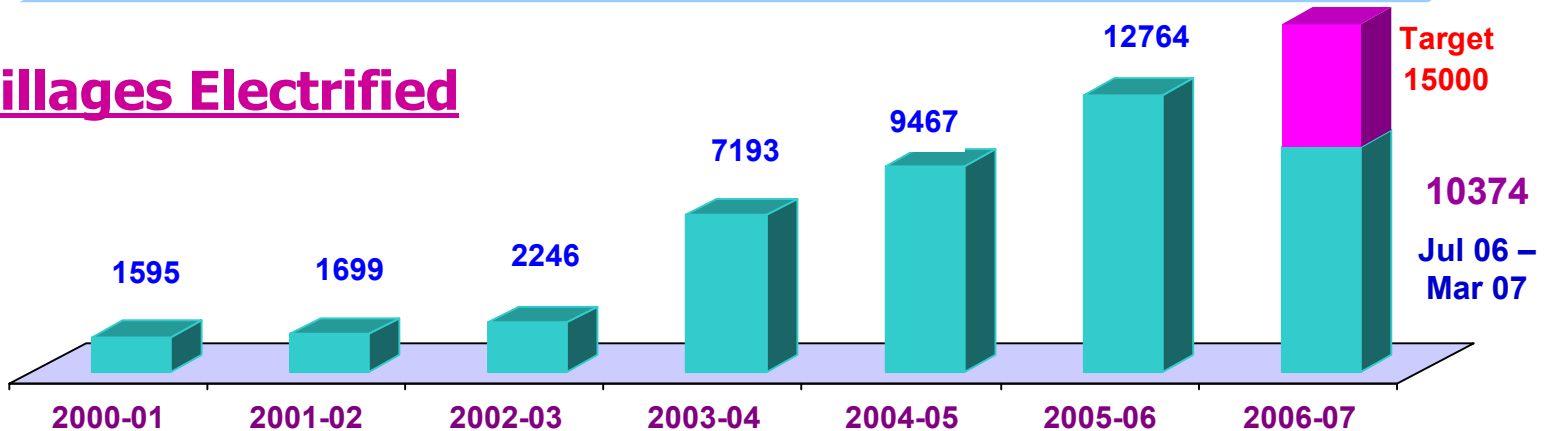
Revenues (Rs. Billion)



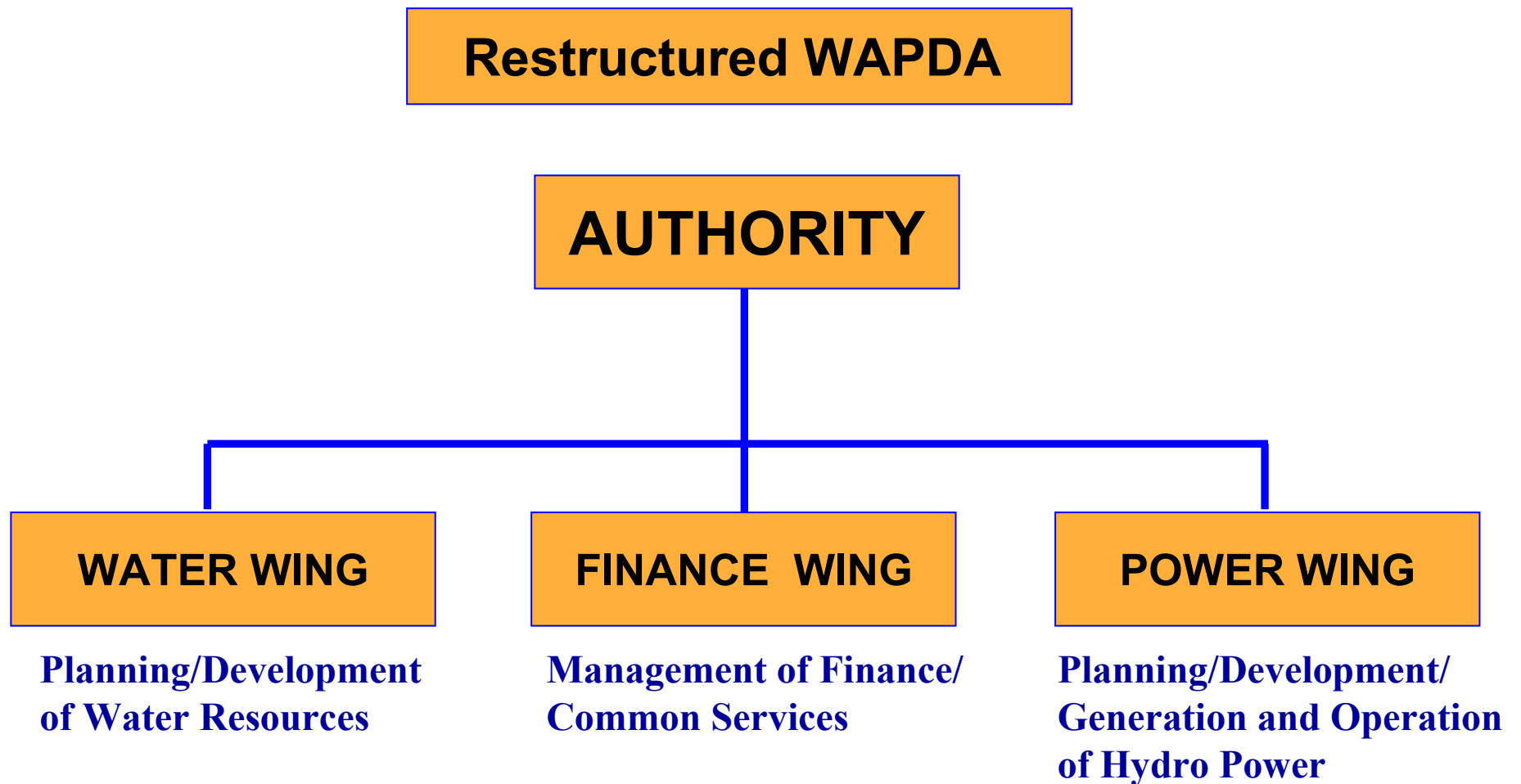
No. of Consumers (Millions)



Villages Electrified



WAPDA (POST-RESTRUCTURING SCENARIO)



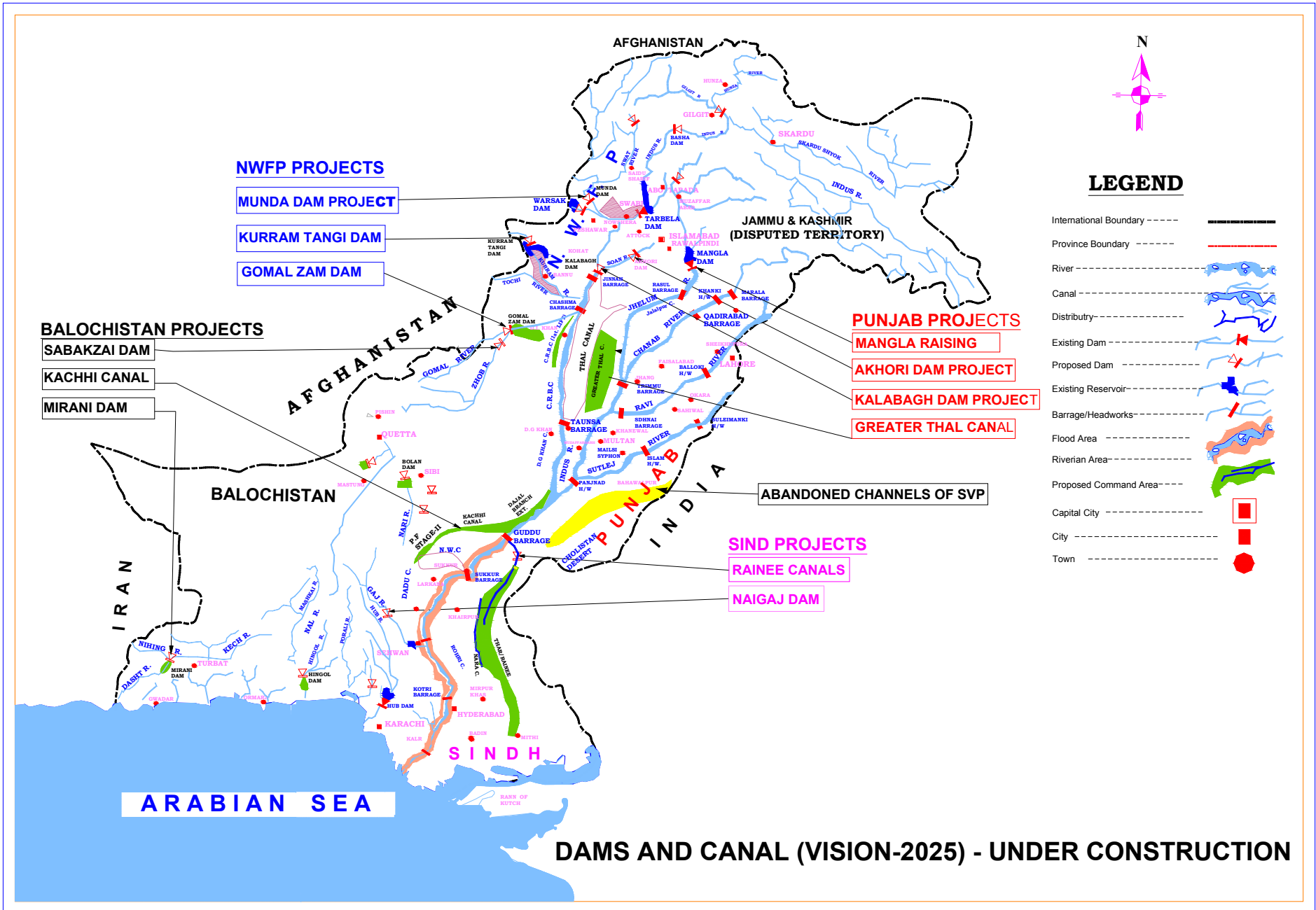


VISION 2025

BACKGROUND

- **Agriculture based economy, about 24% of GDP**
- **Over 70% exports rely upon agricultural based products**
- **90% of food and fiber requirement meets from Irrigated Agriculture**
- **1/3 of agricultural potential remains untapped**
- **Semi Arid to Arid Climate**

CHALLENGES



Challenge No.1

- **INDIA CLOSED SUPPLIES FROM EASTERN RIVERS RAVI, BEAS & SUTLEJ IN APRIL 1948**
- **INDUS BASIN TREATY ON 19 SEPT. 1960**
- **DIVERTED WATER FROM WESTERN RIVERS INDUS, JHELUM & CHENAB**

DAMS - 2

Mangla Dam

Tarbela Dam

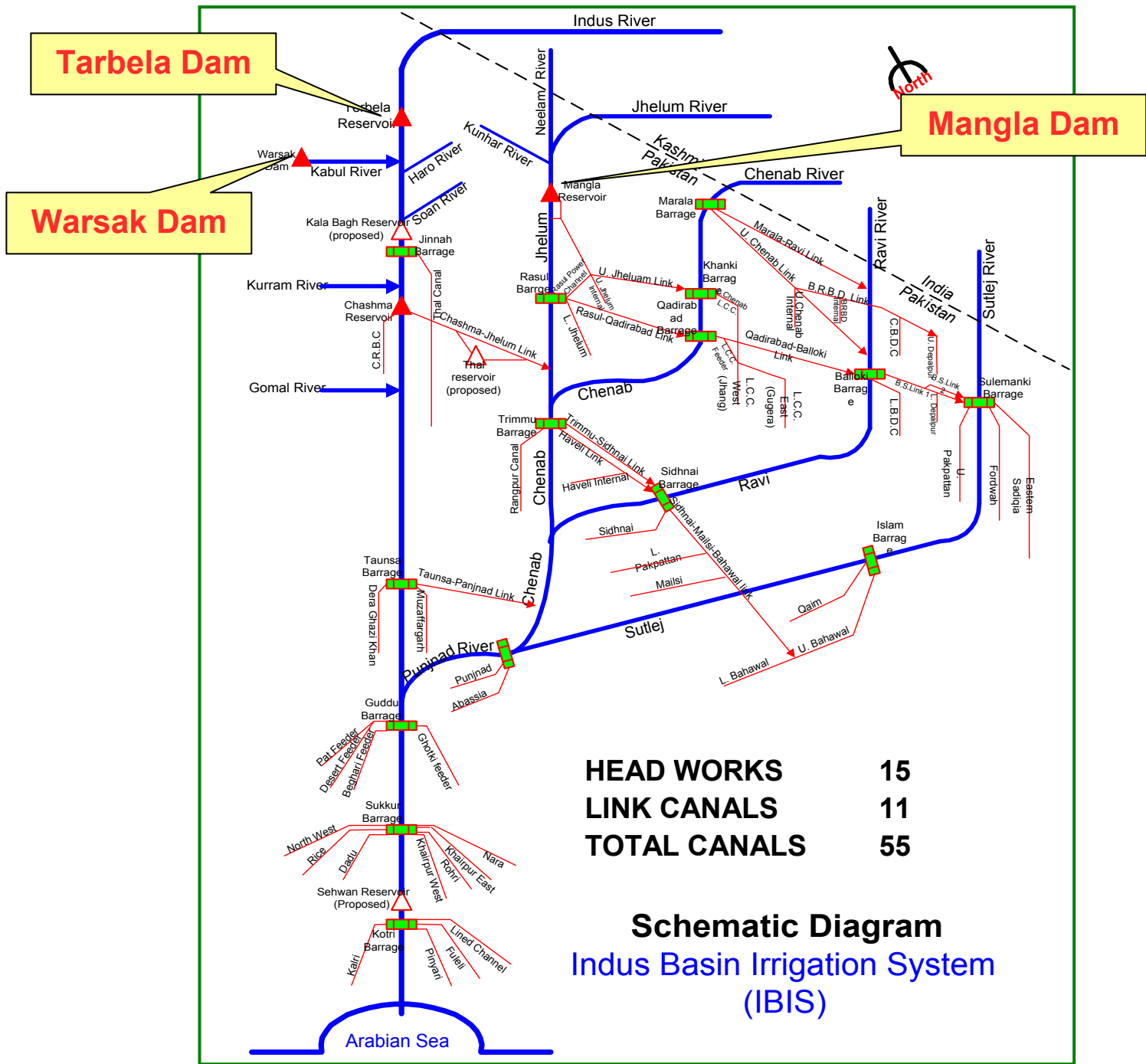
BARRAGES - 5

LINK CANALS - 8

Challenge No.2

WATER LOGGING & SALINITY

- **WAPDA Completed** **46 SCARP Projects**
- **Open Drains** **12,700 Km**
- **Tile Drains** **9600 Km**
- **Public Tube Wells** **14800**
- **Private Tube Wells** **700,000**



IRRIGATION SYSTEM

- **Large Dams** **2**
- **Barrages** **23**
- **Inter River Canals** **12**
- **Perennial and
non Perennial Canals** **48**
- **Irrigation Canals Length** **60,000 Km**
- **Water Courses Length** **100,000 Km**

Challenge No.3

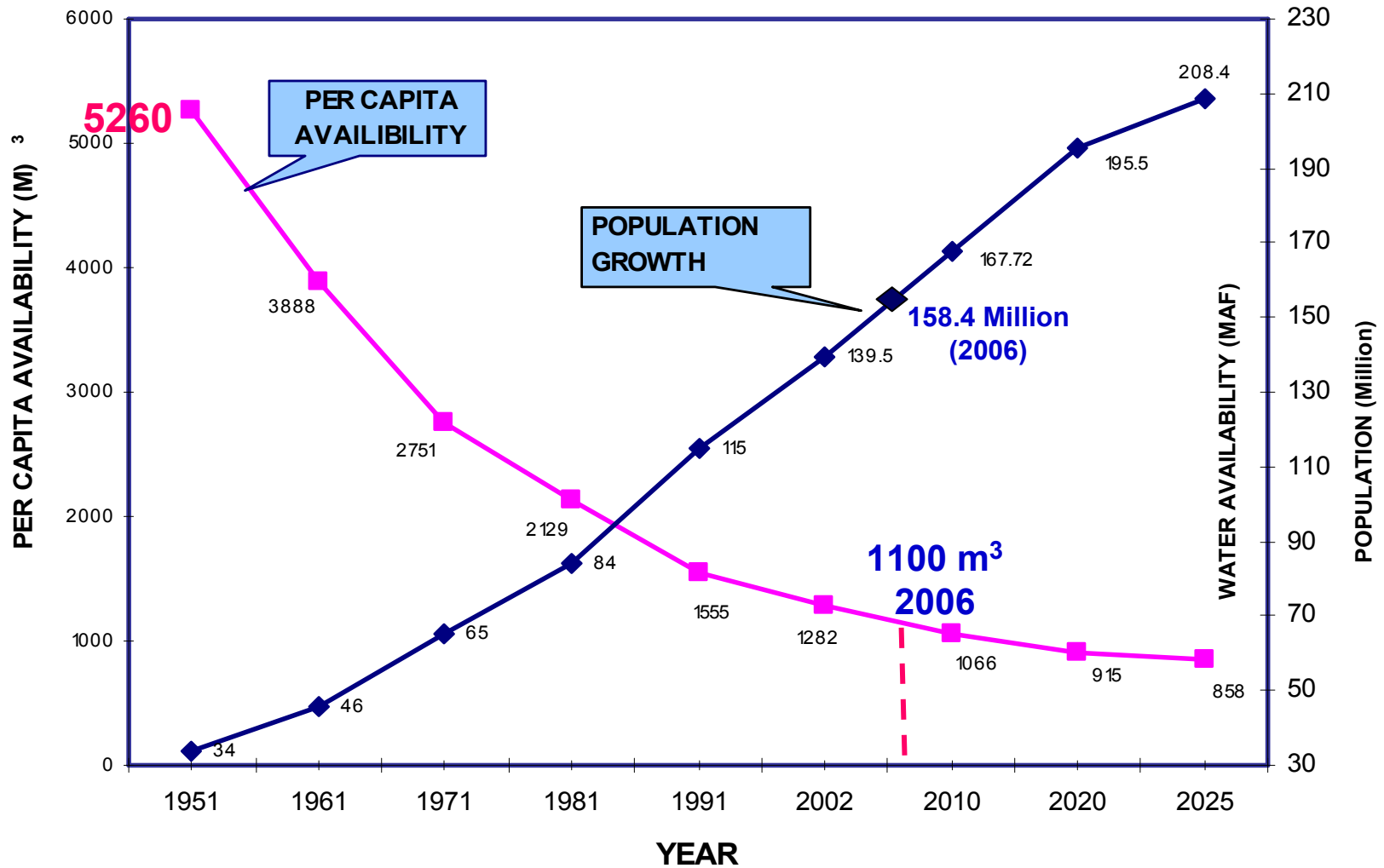
REHABILITATION OF IRRIGATION SYSTEM

- **Remodeling of Barrages**
- **De-silting of canals**
- **Canal lining**

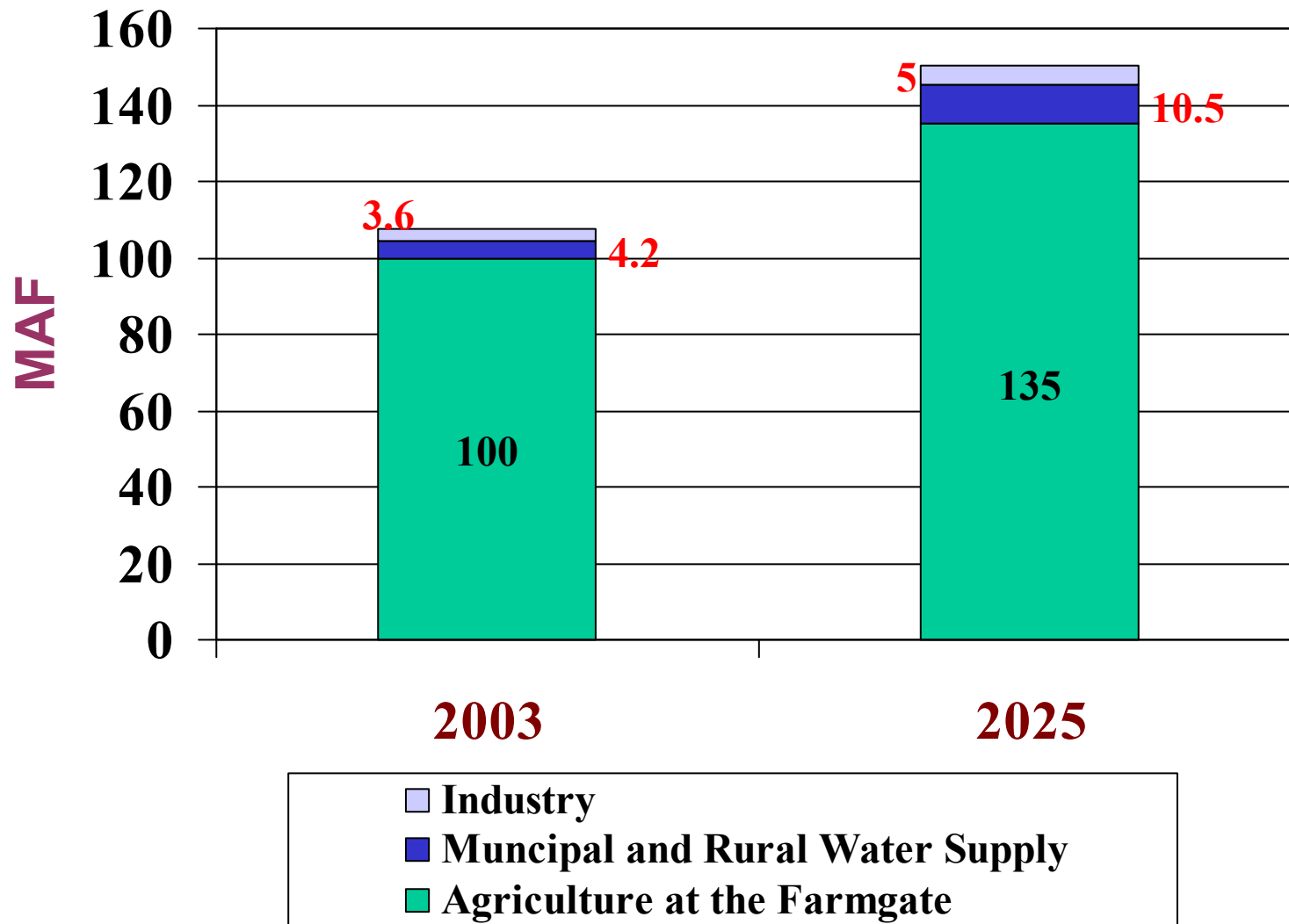
Challenge No.4

- **INCREASING POPULATION**
- **DECREASING STORAGE CAPACITY**
- **SUSTAINABILITY OF RESERVOIR
(SEDIMENT MANAGEMENT)**

WATER AVAILABILITY VS POPULATION GROWTH



PROJECTED DEMAND FOR WATER



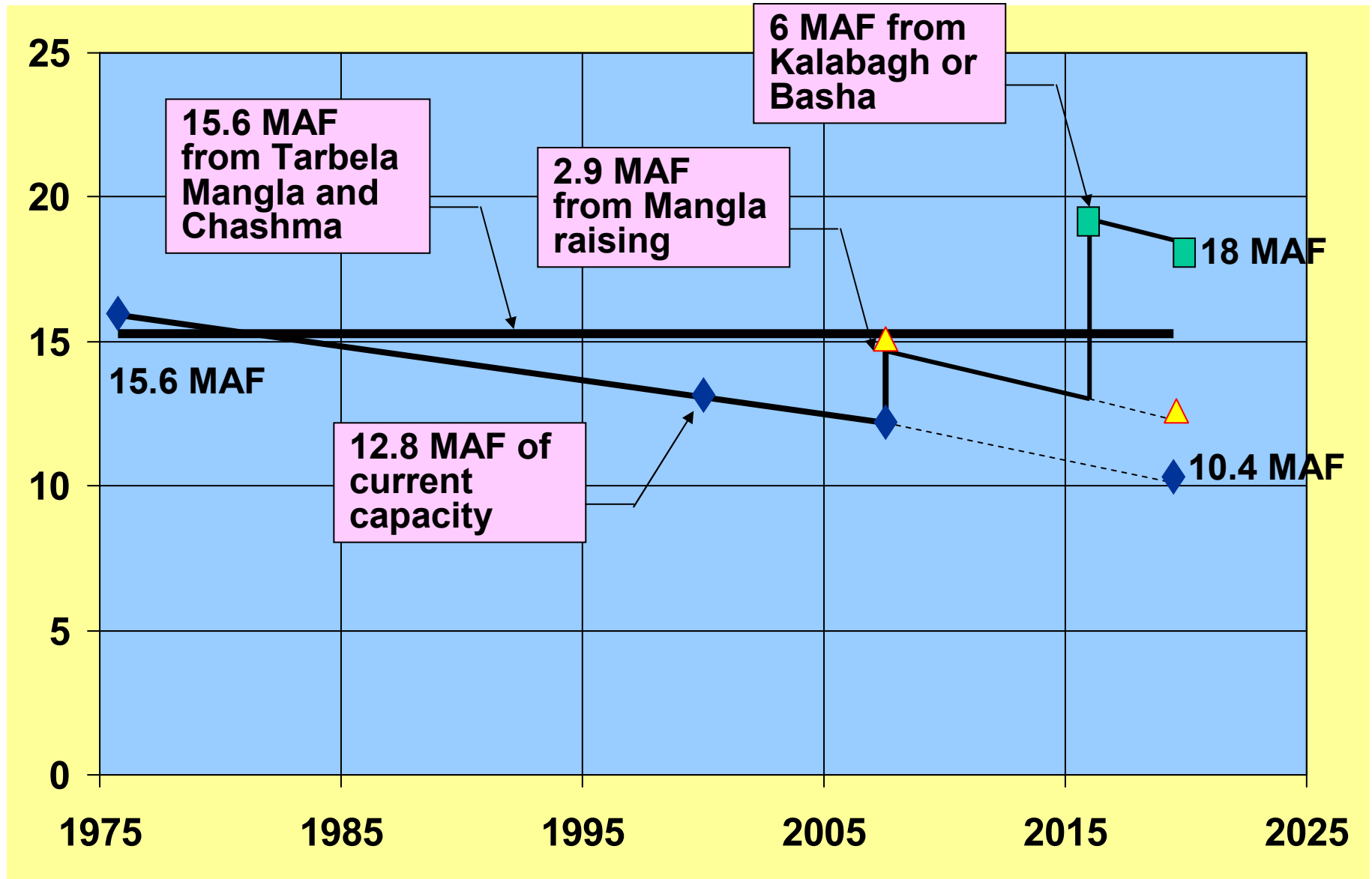
PROBLEM DUE TO WATER SHORTAGE

- **Water demand increasing due to population growth, rapid urbanization and Industrialization**
- **Rising Imbalance between supply and demand leading to inter provincial tension**
- **Misuse of Water leads to Environmental Degradation.**

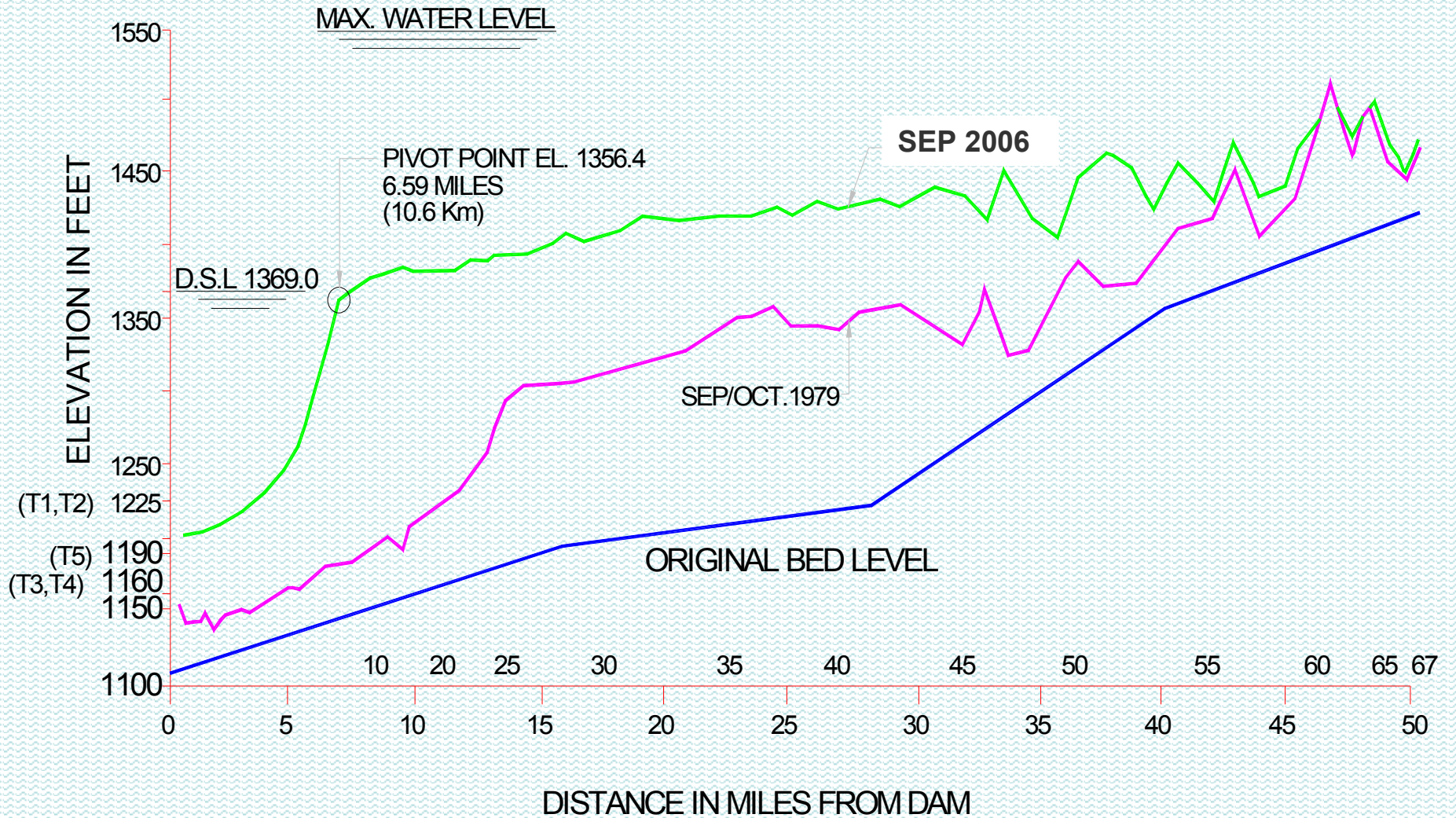
RESERVOIR SEDIMENTATION (MAF)

RESERVOIR	GROSS STORAGE CAPACITY		GROSS STORAGE LOSS		
	ORIGINAL	YEAR 2006	YEAR 2006	YEAR 2012	YEAR 2025
TARBELA	11.62 (1974)	8.24 (71%)	3.38 (29%)	4.02 (35%)	5.40 (46%)
MANGLA	5.88 (1967)	4.52 (77%)	1.36 (23%)	1.72 (29%)	1.97 (34%)
CHASHMA	0.87 (1971)	0.46 (53%)	0.41 (47%)	0.48 (55%)	0.50 (57%)
TOTAL	18.37	13.22 (72%)	5.15 (28%)	6.22 (34%)	7.87 (43%)

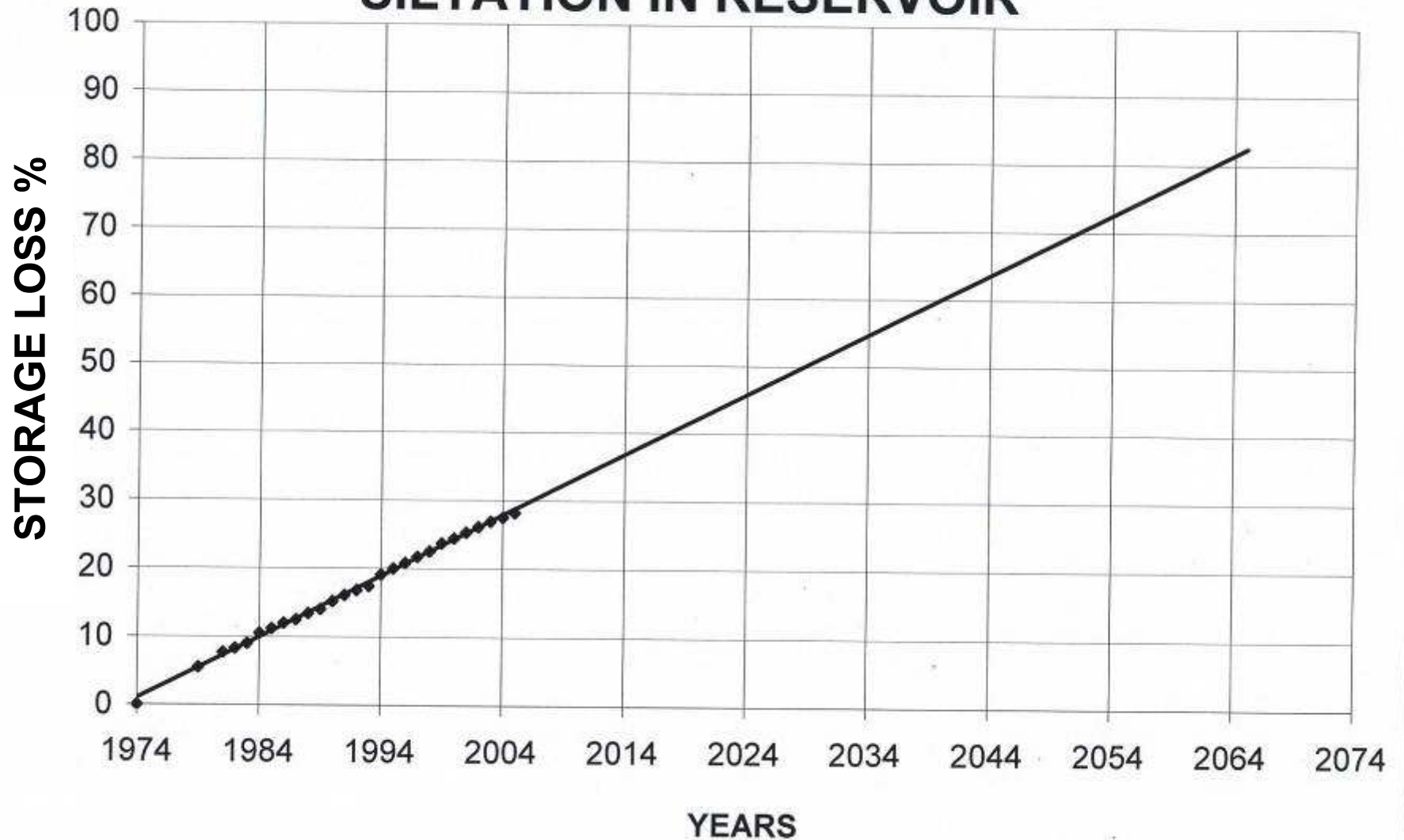
SEDIMENTATION AND STORAGE CAPACITY



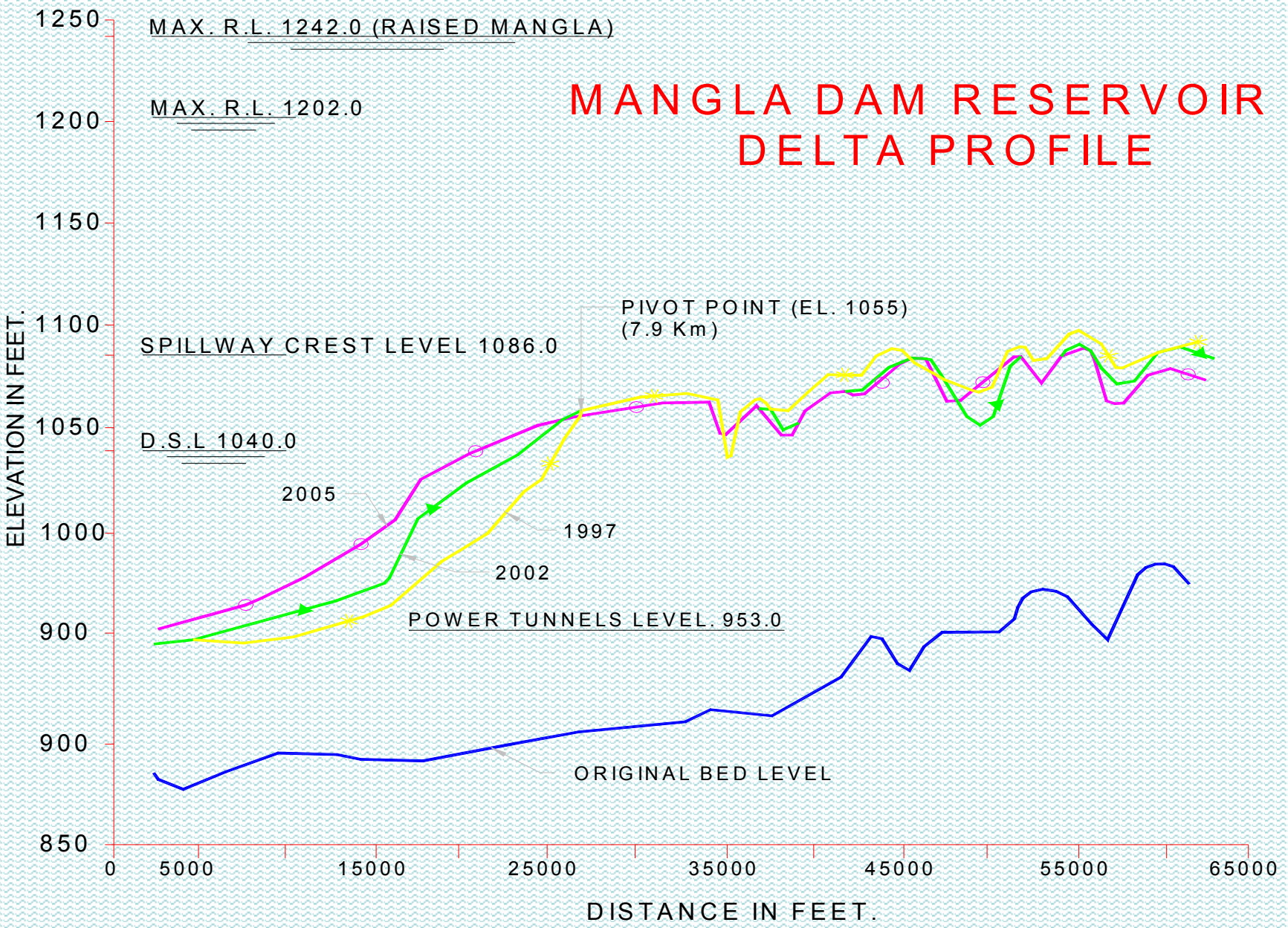
TARBELA DAM RESERVOIR DELTA PROFILE



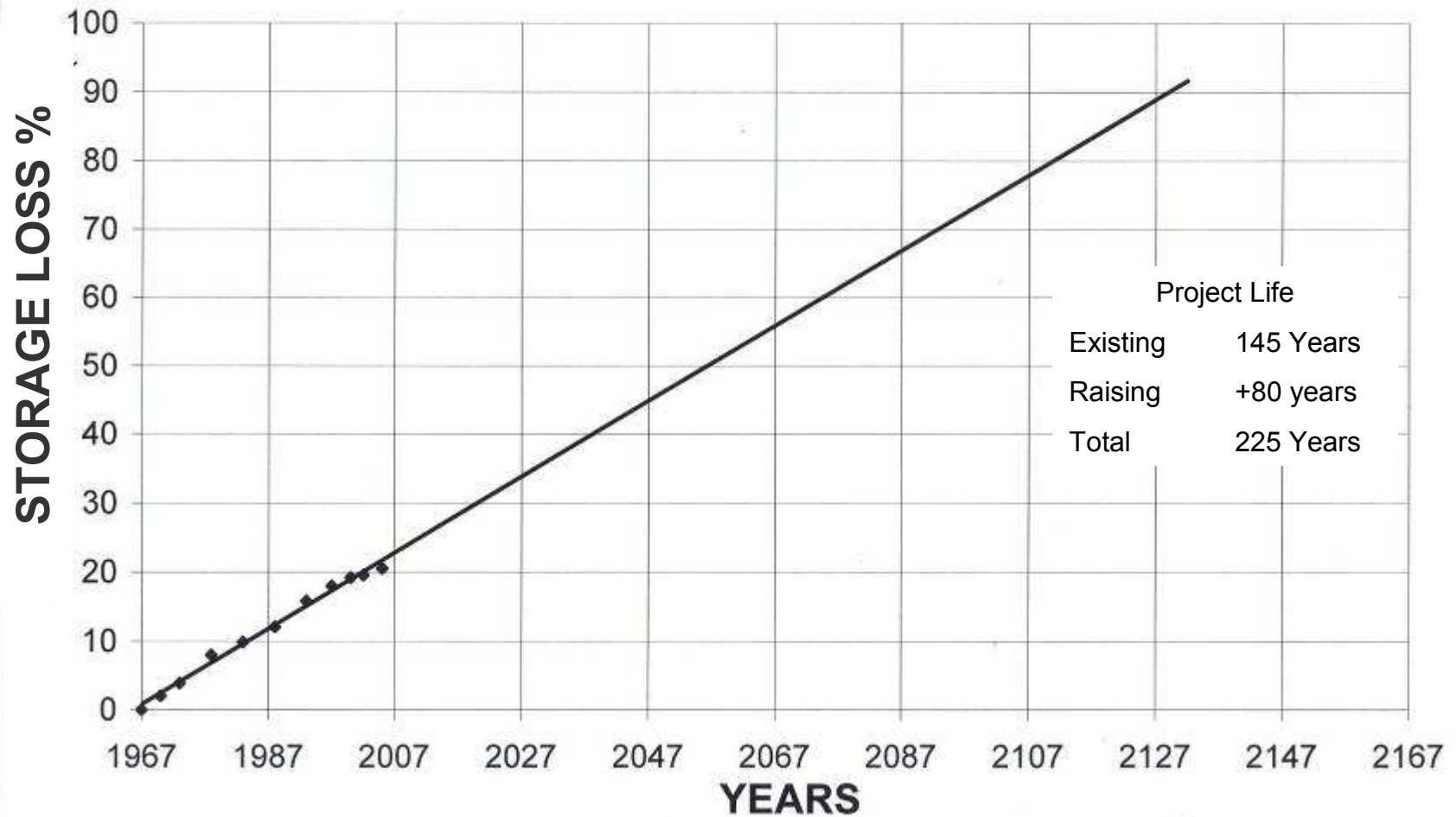
TARBELA DAM PROJECT SILTATION IN RESERVOIR



MANGLA DAM RESERVOIR DELTA PROFILE



MANGLA DAM PROJECT SILTATION IN RESERVOIR



PROBLEMS DUE TO RESERVOIR SEDIMENTATION

- **Loss of live storage, reduction in water availability**
- **Reduction in the energy produced**
- **Physical Effects of Sedimentation:**
 - **Erosion of Turbine Blades**
 - **Risk of Clogging of Low Level Outlets**
 - **Erosion of Concrete outlet structures**
 - **Exorbitant maintenance costs**

Challenge No.5

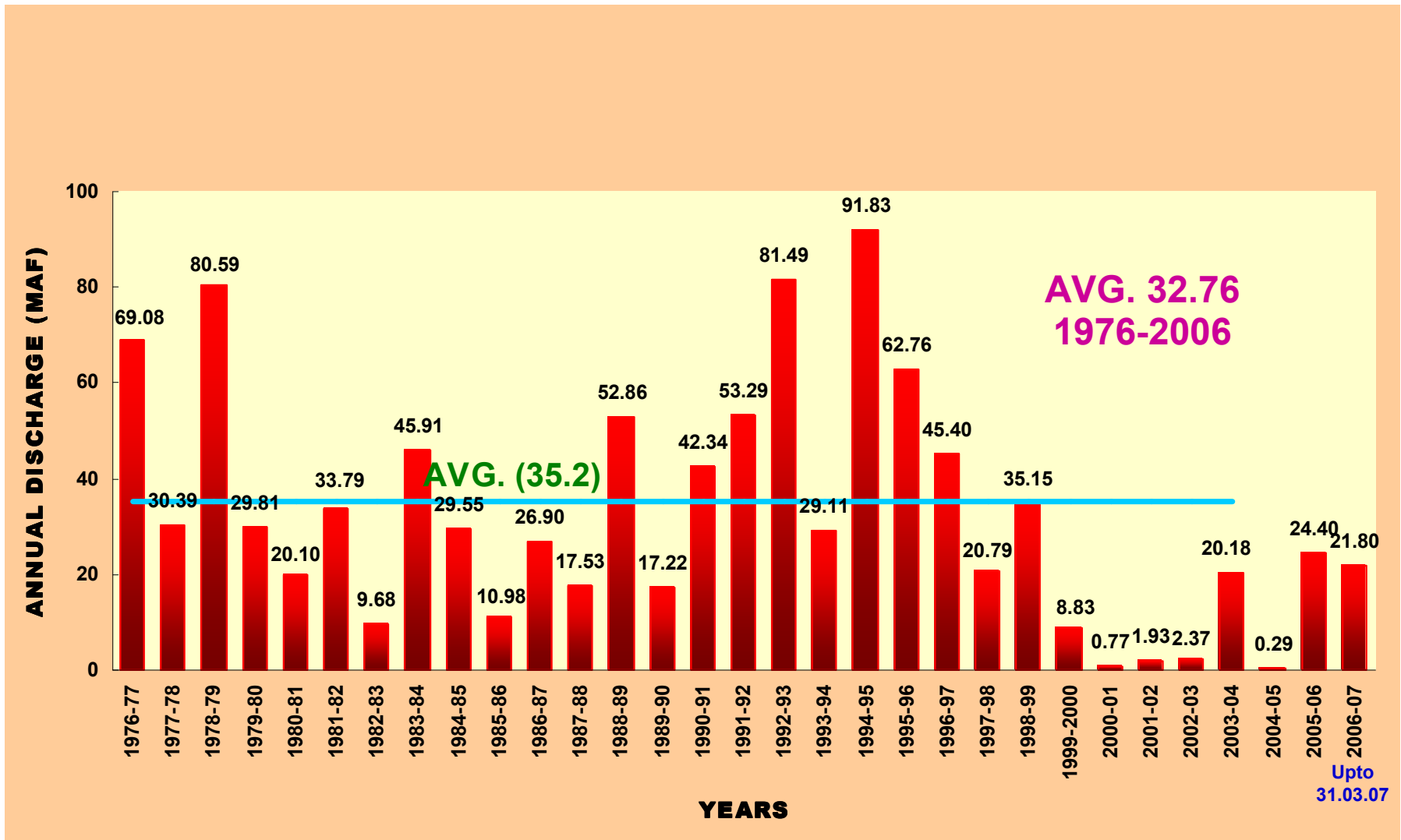
FLOODS

DROUGHT

BUILD RESERVOIRS

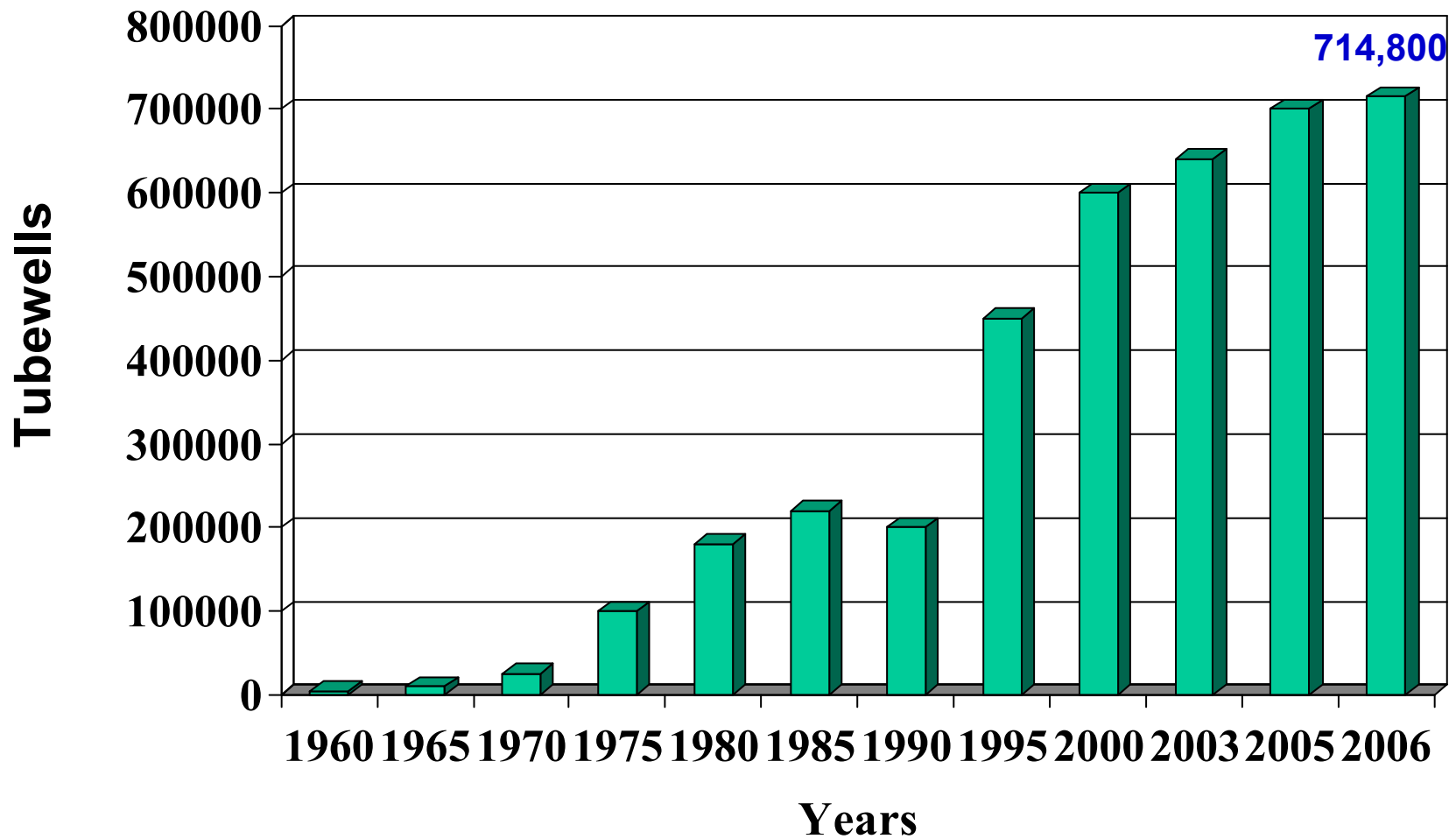
ESCAPAGE BELOW KOTRI

HYDROLOGICAL YEAR FROM APRIL TO MARCH



Source: WRMD WAPDA based on data supplied by Govt. of Sindh

GROWTH OF TUBERWELLS



Challenge No.6

DEGRADATION OF GROUND WATER

**Laws Regulating Ground Water
Extraction**

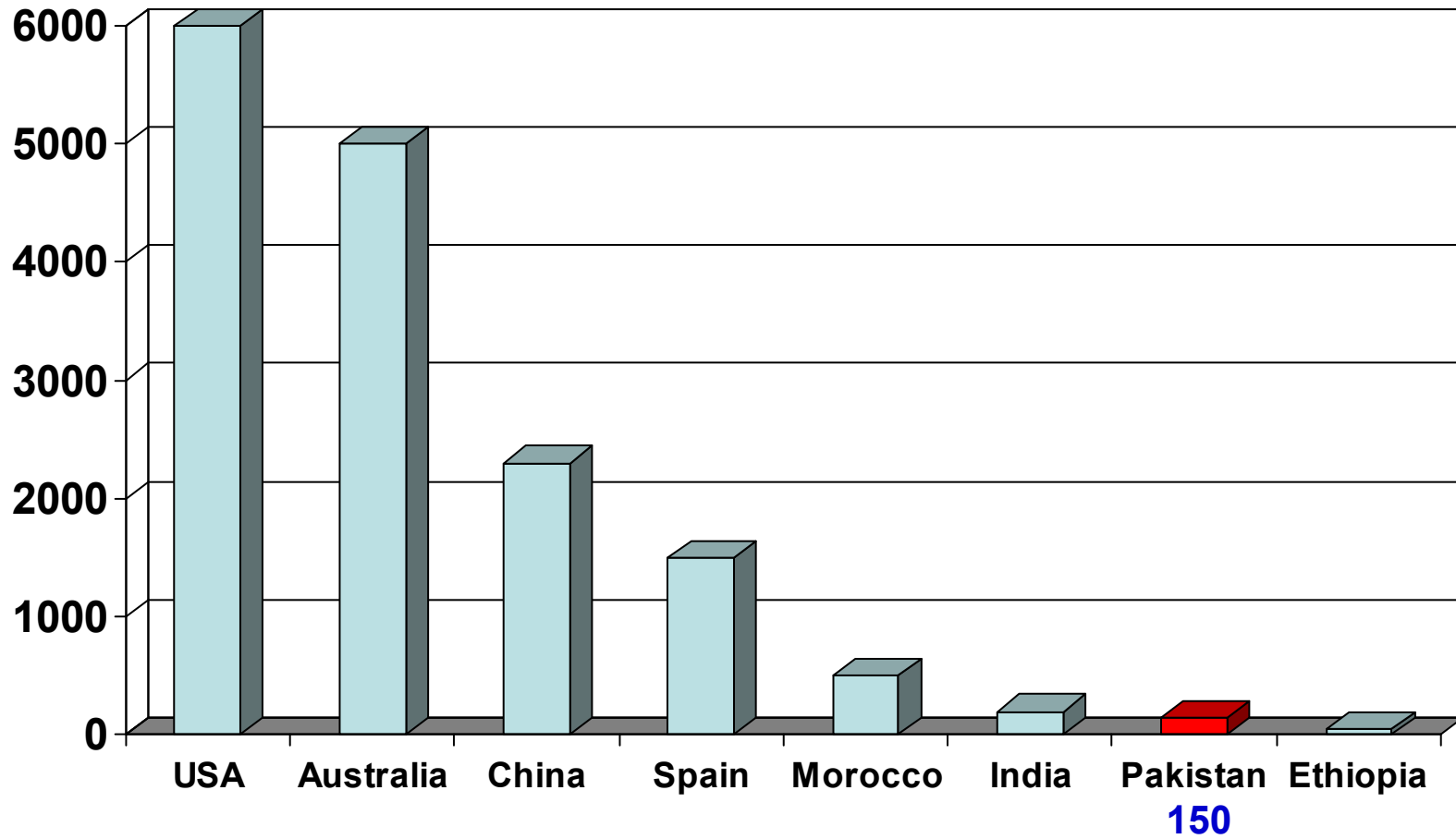
Small dams to capture seasonal runoff

MEASURES REQUIRED

- **Develop available water resources**
- **Develop Hydropower Potential**
- **Conserve Water**
- **Adopt modern Irrigation Techniques**

STORAGE PER CAPITA IN DIFFERENT SEMI-ARID COUNTRIES

Cubic meter per capita



NEED FOR ADDITIONAL RESERVOIRS

- **WATER-SHORT LAND-RICH COUNTRY**
- **RAPIDLY INCREASING POPULATION**
- **DEPLETING ON-LINE STORAGES**
- **LARGE ESCAPAGES OF UNCONTROLLED FLOOD FLOWS INTO SEA.**
- **EFFECTIVE RIVER REGULATION AND INTEGRATED WATER RESOURCE MANAGEMENT**

Challenge No.7

CONSENSUS BUILDING

PROVINCES & STAKEHOLDERS AGREEMENT

Challenge No.8

IMPLEMENTATION OF MEGA DAMS

INSTITUTION BUILDING

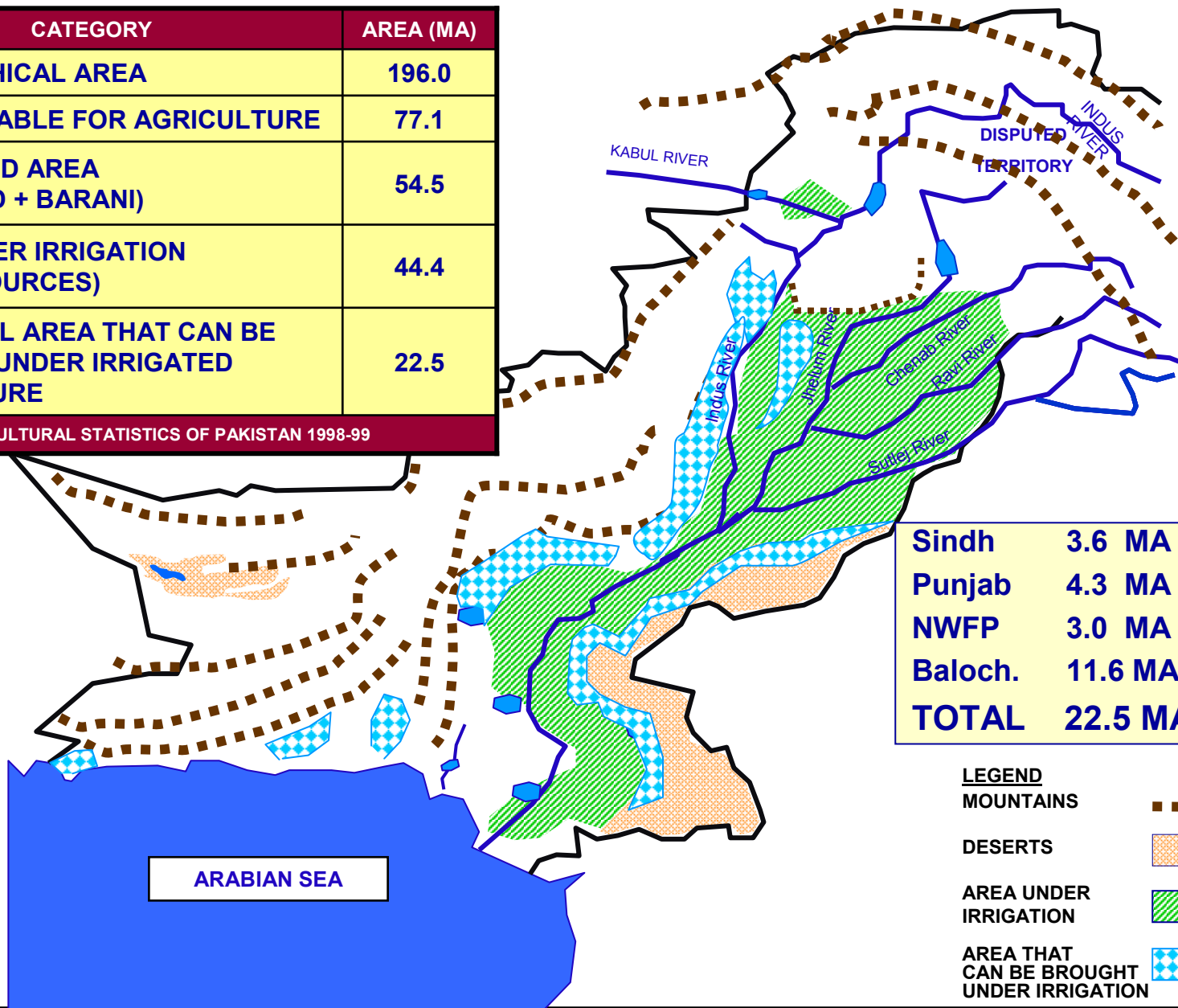
- i. Capacity building in Consultancy**
- ii. Capacity building in construction**
- iii. Strengthening of Execution & Monitoring of projects**
- iv. O&M of Projects**

OPPORTUNITIES

LAND USE IN PAKISTAN

CATEGORY	AREA (MA)
GEOGRAPHICAL AREA	196.0
AREA SUITABLE FOR AGRICULTURE	77.1
CULTIVATED AREA (IRRIGATED + BARANI)	54.5
AREA UNDER IRRIGATION (BY ALL SOURCES)	44.4
ADDITIONAL AREA THAT CAN BE BROUGHT UNDER IRRIGATED AGRICULTURE	22.5

SOURCE: AGRICULTURAL STATISTICS OF PAKISTAN 1998-99



Sindh	3.6 MA
Punjab	4.3 MA
NWFP	3.0 MA
Baloch.	11.6 MA
TOTAL	22.5 MA

LEGEND

MOUNTAINS	
DESERTS	
AREA UNDER IRRIGATION	
AREA THAT CAN BE BROUGHT UNDER IRRIGATION	

PAKISTAN SURFACE WATER RESOURCES

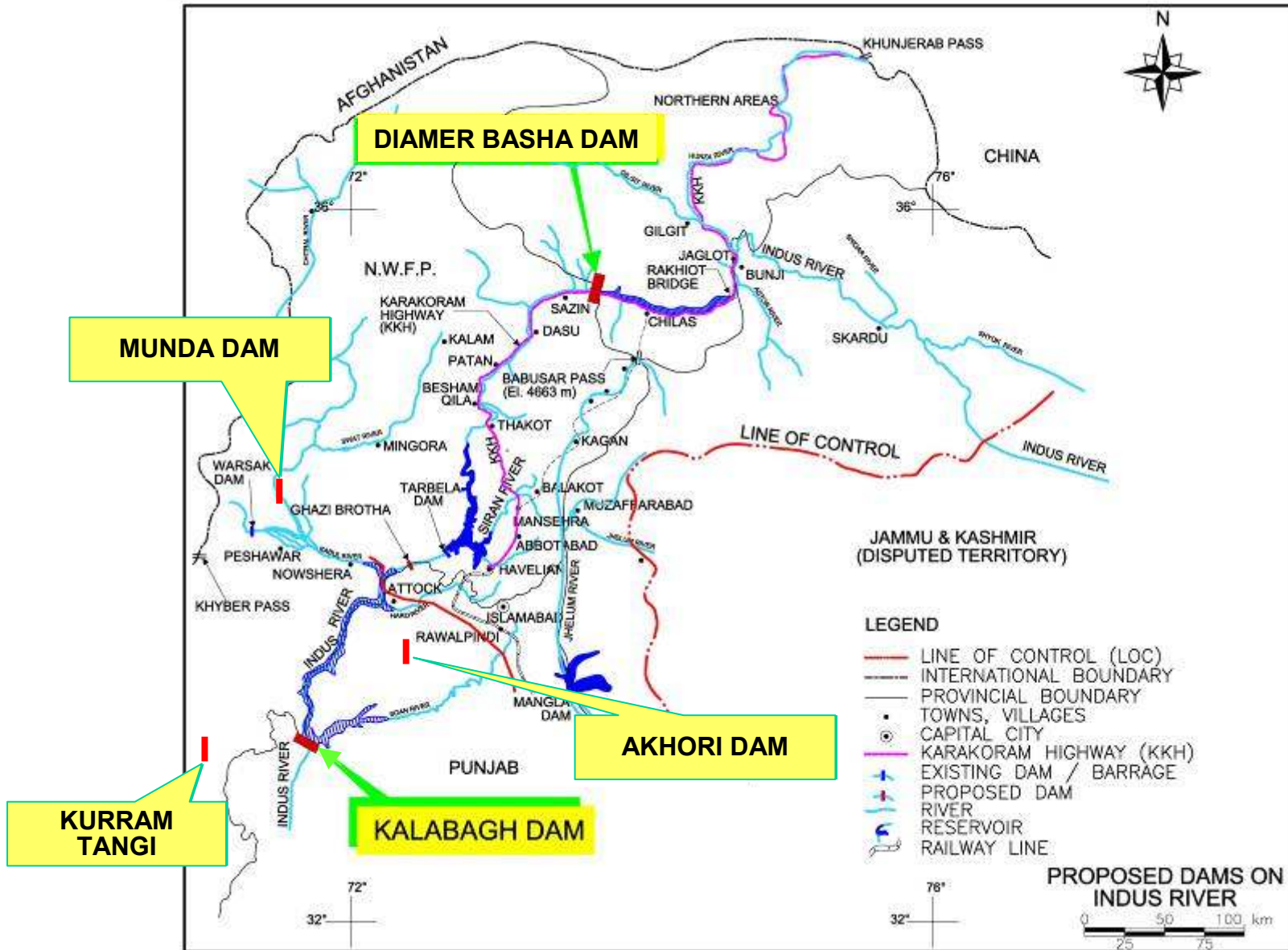
SR. NO.	ITEM	INFLOW^{1/} (MAF)
1.	SURFACE WATER AVAILABILITY	
	• Indus At Kalabagh	90.71
	• Jhelum At Mangla	23.06
	• Chenab At Marala	26.99
	• NWFP diversions above Rim Stations	5.65
	• Eastern River run-off Generated within Pakistan	3.53
	• Eastern River Inflows	4.94
	Total Surface Water Available	154.88
2.	PRESENT CANAL DIVERSIONS	105.00
3.	SYSTEM LOSSES	15.00
4.	AVAILABLE FOR FURTHER USES	34.88

1/: Post Tarbela Average

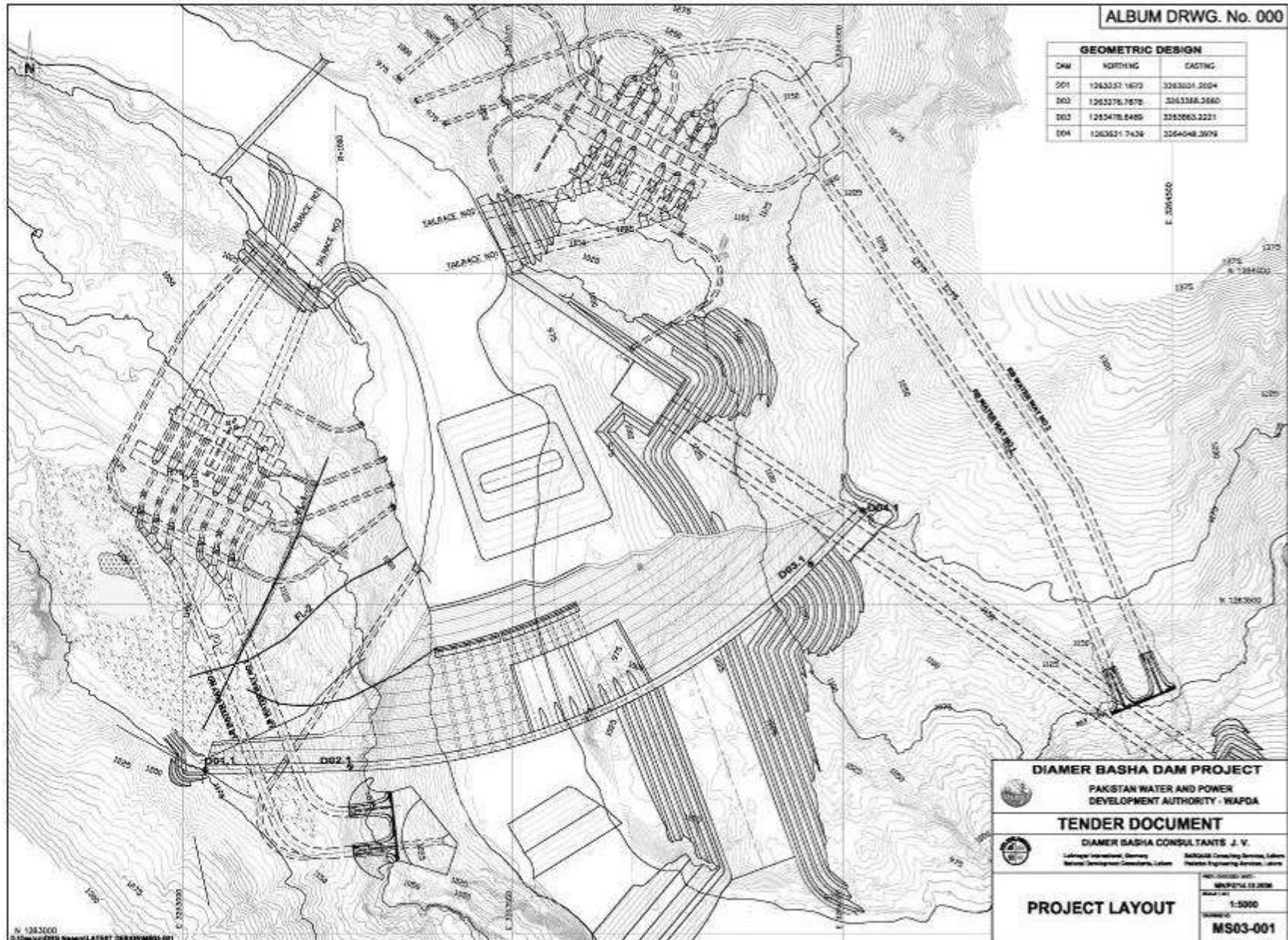
DAMS PROPOSED FOR CONSTRUCTION

- **THE PRESIDENT OF PAKISTAN ON JANUARY 17, 2006 ANNOUNCED TO COMPLETE THE CONSTRUCTION OF THE FOLLOWING DAMS IN PAKISTAN BY 2016**
 - **Diamer-Basha Dam**
 - **Munda Dam**
 - **Kalabagh Dam**
 - **Akhori Dam**
 - **Kurram Tangi Dam**

PROPOSED DAMS



DIAMER BASHA DAM PROJECT



DIAMER BASHA DAM PROJECT

SALIENT FEATURES

MAIN DAM:

Maximum Height	270 m
Type	Roller Compacted Concrete (RCC)

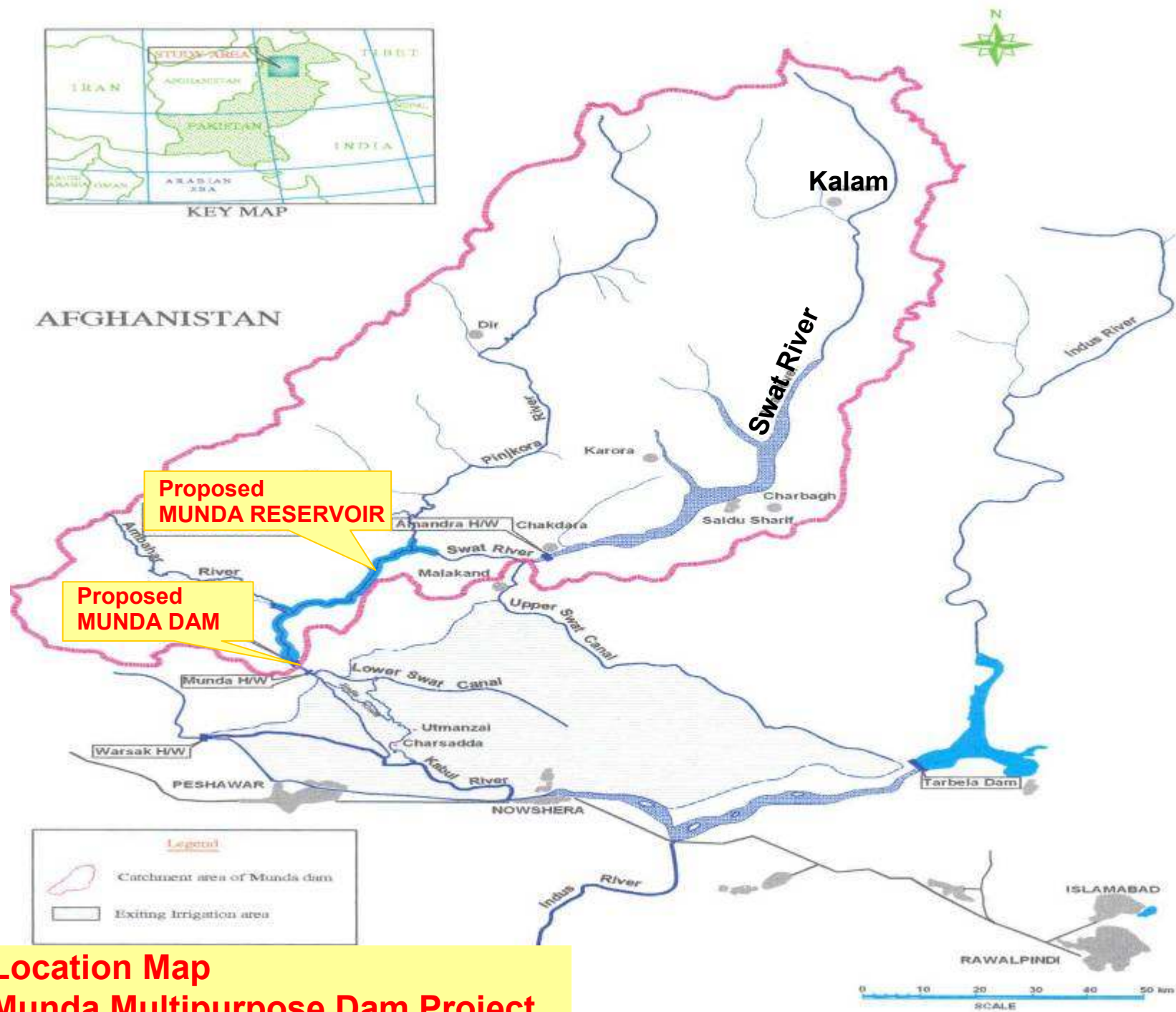
RESERVOIR EL 1160

Gross capacity	7.3 MAF
Live capacity	6.4 MAF
Min. operation level	El. 1060 m

POWER HOUSE(S):

Total installed capacity	4500 MW
No. of units	12, each of 375 MW
Average generation	16,500 Gwh/year

ESTIMATED COST (Year 2005) US\$ 6.5 Billion



**Location Map
Munda Multipurpose Dam Project**

***MUNDA DAM PROJECT**

SALIENT FEATURES

DAM

- Type **Concrete face rockfill dam**
- Height **650 Ft**
- Length **2500 Ft**

RESERVOIR

- Gross Storage **1.30 MAF**
- Live Storage **0.67 MAF**
- Reservoir Area (Acres) **5930 Acres**

Hydropower Generation

660 MW (2669 GWh)

LEFT BANK CANAL

- CCA **10057 Acres**
- Length (main & distributaries) **23 Miles**
- Discharge **155 Cs**
- Pressure Tunnel 7.2 ft dia **3 Miles long**

RIGHT BANK CANAL

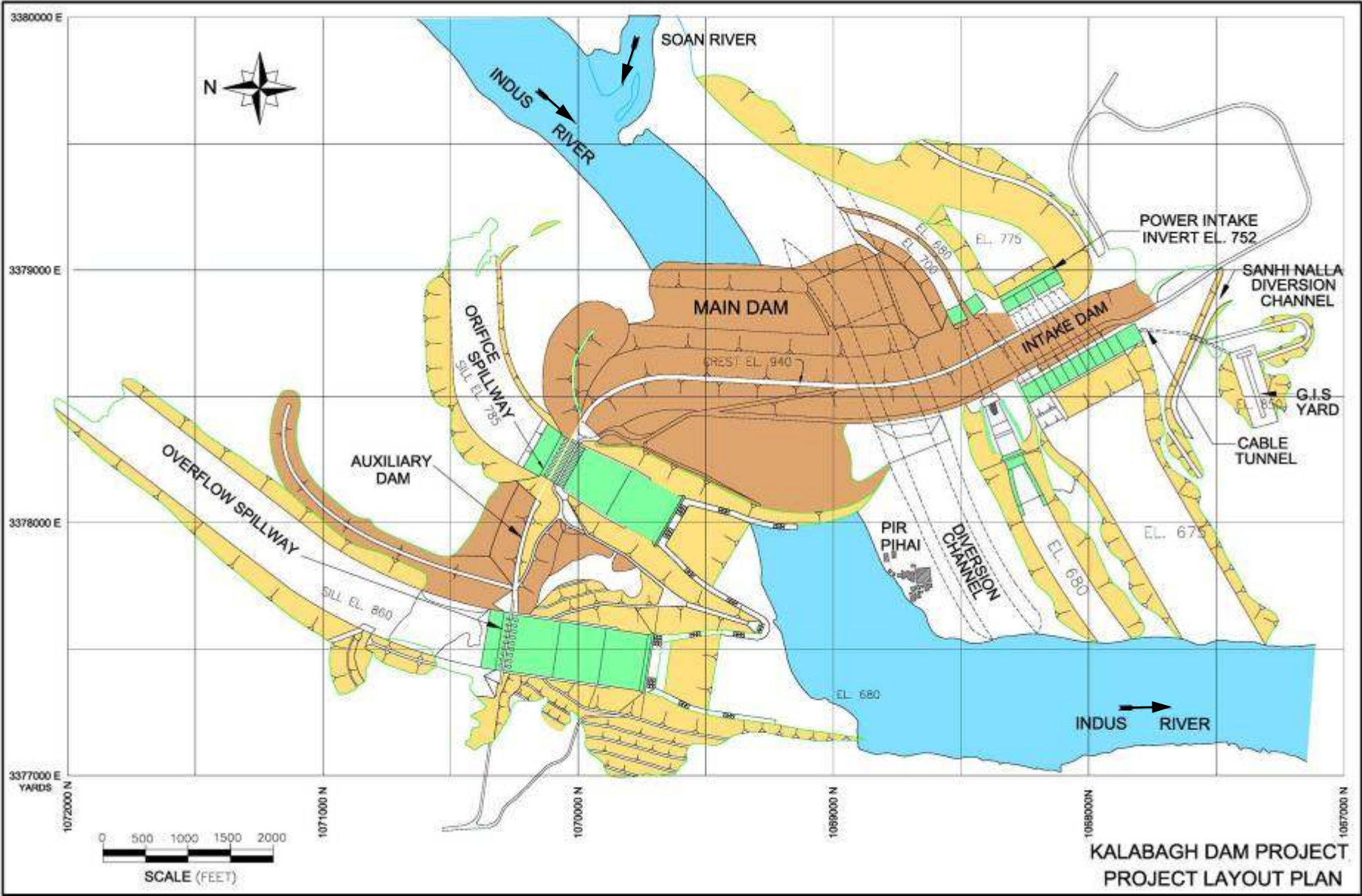
- CCA **5040 Acres**
- Length (main & distributaries) **13 Miles**
- Discharge **78 Cs**
- Lift Pump Head **62 Ft**

COST

US \$ 1.023 Billion
(Year 2006 Feasibility)

***Awarded to Private Sector Company (M/s AMZO) in March 2004**

KALABAGH DAM PROJECT LAYOUT



KALABAGH DAM PROJECT

SALIENT FEATURES

RESERVOIR

GROSS STORAGE	7.9 MAF
LIVE STORAGE	6.1 MAF
RETENTION LEVEL	915 FT

MAIN DAM

CREST ELEVATION	940 FT.
MAXIMUM HEIGHT	260 FT.
LENGTH	11,000 FT.

SPILLWAYS

OVERFLOW SPILLWAY	1,070,000 Cusecs
ORIFICE	980,000 Cusecs

POWERSTATION

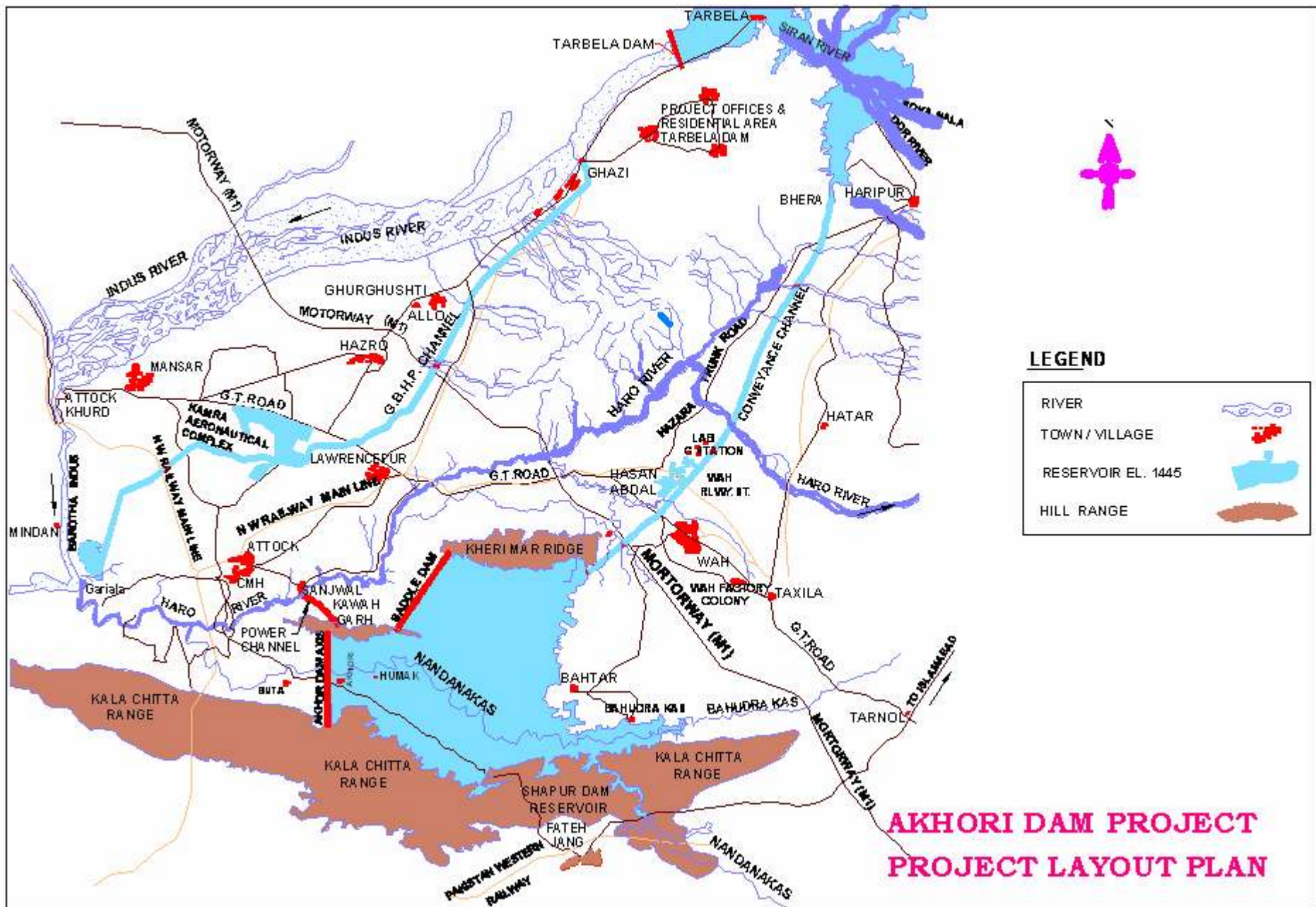
NUMBER OF UNITS	8/12 Nos.
Initial/Ultimate	

INSTALLED CAPACITY

2,400/3,600 MW
(11,400 GWh per year)

ESTIMATED COST (SEPTEMBER 2005)

US \$ 6.1 Billion



AKHORI DAM PROJECT

SALIENT FEATURES

DAM

- Type of Dam Earth Core & Rock fill Dam
- Length 5.16 Km (3.23 Miles)
- Maximum Height 122 meters (400 Ft)

SADDLE DAM

- Type of Dam Earth & Rock fill Dam
- Height 65 meters (213 Ft)
- Length 7.65 Km (4.78 Miles)

CONVEYANCE CHANNEL

- Discharge 1700 m³/s (60,000 Cusecs)
- Length 37 Kms

STORAGE

- Gross 7.0 MAF
- Live 6.0 MAF

POWER

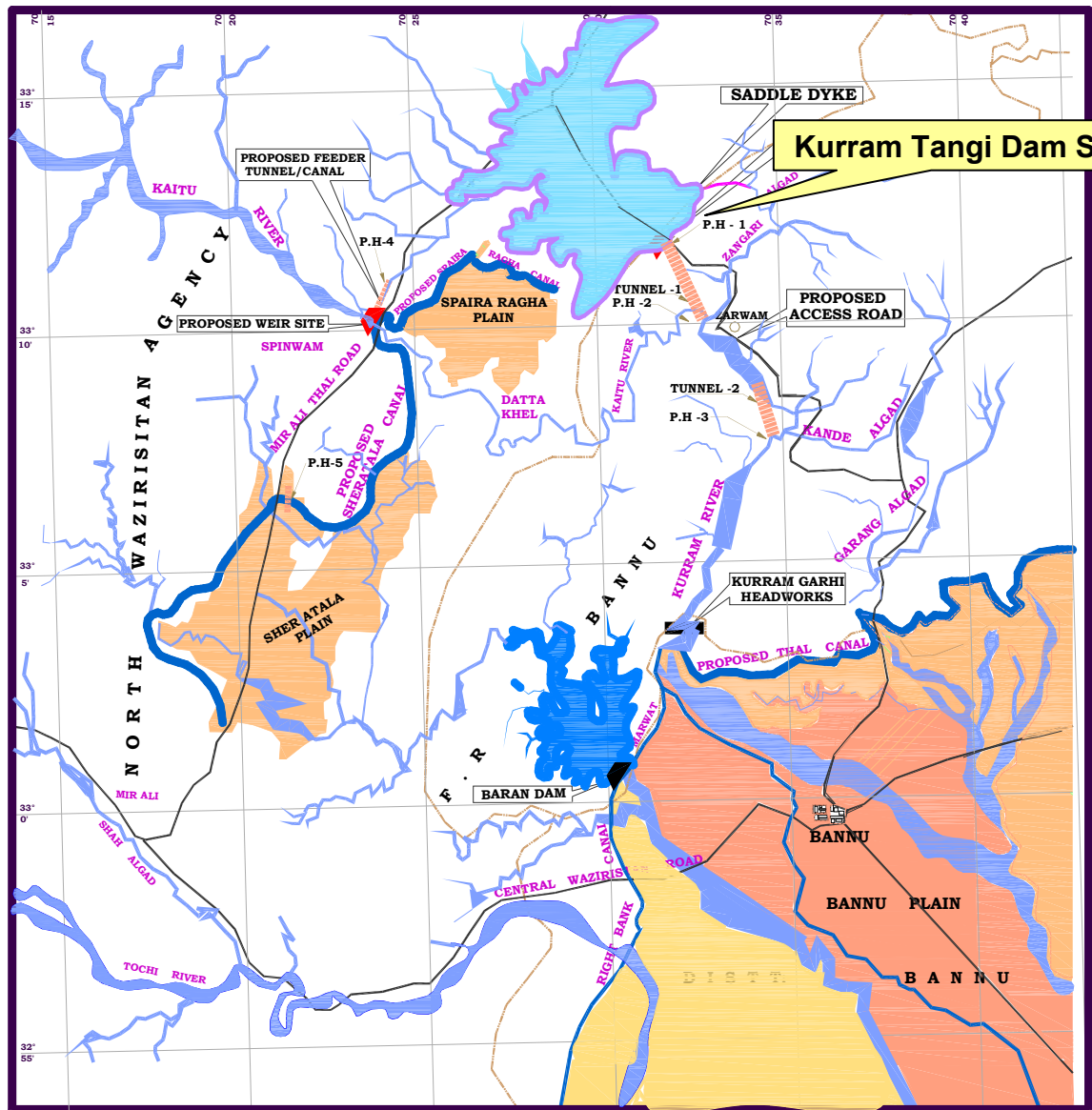
600 MW (2155 GWh)

ENVIRONMENTAL IMPACTS

- Area Submerged 65,976 Acres
- Population Displaced 49,600

ESTIMATED COST

US\$ 4.4 Billion



LEGEND

- PROPOSED RESERVOIR-----
- EXISTING RESERVOIR---
- PROPOSED POWER TUNNEL/POWER HOUSE---
- RIVERS-----
- EXISTING CANALS -----
- PROPOSED CANALS ----
- COMMAND AREA UNDER CIVIL CANALS-----
- UNDER MARWAT CANALS---
- NEW COMMAND AREA-----
- PROVINCES BOUNDARY-----
- ROADS -----
- EXISTING DAM -----
- PROPOSED DAM -----



**KURRAM TANGI DAM PROJECT
PROJECT LAYOUT PLAN**

KURRAM TANGI DAM PROJECT

SALIENT FEATURES

DAM	
- Height	295 Ft
- Live Storage	0.614 MAF
- Gross Storage	0.914 MAF
- Power	83 MW (331 GWh)

2. TOTAL COMMAND AREA = 362,380 Acres

NEW COMMAND AREAS	84,380 Acres
- SHERATALA CANAL (North Waziristan Agency)	12,300 Acres
- SPAIRA RAGHA CANAL (North Waziristan Agency)	4,080 Acres
- THAL CANAL (Bannu)	68,000 Acres

REMODELLING OF EXISTING COMMAND AREAS	278,000 Acres
- Civil Canal (Bannu)	107,500 Acres
- Marwat Canal (Bannu)	170,500 Acre

TOTAL FINANCIAL OUTLAY FOR KALABAGH, DIAMER-BASHA & AKHORI DAM (Including IDC)

US \$ Millions

YEARS	KALABAGH DAM			DIAMER-BASHA DAM			AKHORI DAM			TOTAL KALABAGH, DIAMER-BASHA & AKHORI
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	
2007	32	9	41	-	-	-	-	-	-	41
2008	250	11	261	147	-	147	-	-	-	408
2009	250	150	400	147	-	147	-	-	-	547
2010	480	357	837	215	54	269	30	14	44	1150
2011	670	486	1156	250	160	410	60	28	88	1654
2012	650	550	1200	380	240	620	359	168	527	2347
2013	704	566	1270	465	445	910	599	282	881	3061
2014	517	416	933	490	425	915	748	351	1099	2947
2015	-	-	-	520	530	1050	598	281	879	1929
2016	-	-	-	545	555	1100	599	282	881	1981
2017	-	-	-	455	435	890	-	-	-	890
	3553	2545	6098	3614	2844	6458	2993	1406	4399	16955
Say 17 Billion										

*Kalabagh Dam starts immediately & Akhori Dam completes by 2016

NEW HYDROPOWER PROJECTS - CONSTRUCTION PERIODS

Projects	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
• Golen Gol		█								
• Dasu			?	█						
• Keyal Khwar			█							
• Spat Gah			█							
• Palas Valley			█							
• Lawi			█							
• Bunji			█							
• Kohala			█							
• Basho			█							
• Phandar			█							

THANK YOU