

GOVERNMENT OF PAKISTAN



Report of seven members of Technical
Committee on Water Resources alongwith
Elaborations and note of 8th member of TCWR

May 2005

Reproduced by
Sani H. Panhwar (2024)

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SALIENT FEATURES OF THE RECOMMENDATIONS OF THE TECHNICAL COMMITTEE ON WATER RESOURCES

Pakistan is an agricultural country with largest contiguous irrigation network in the world. About 64% its population resides in the rural area, 57% of rural workforce is engaged in agriculture and 23% of GDP is attributed to agriculture. However, the per capita availability of water, which was 5650 cubic meters in 1951, has been reduced to 1200 cubic meters and is projected to drop to the critical limit of 1000 cubic meters by 2010. This is a very alarming situation and it is, therefore, of utmost importance that water is used judiciously, efficiently and wastage of water should be avoided.

2. Pakistan largely depends on the flow of Western Rivers (Indus, Jhelum and Chenab) after the Indus Waters Treaty of 1960 with India. Flows of Western rivers are highly erratic with a maximum flow of about 186 MAF to a minimum of 97 MAF. There is also seasonal variation in the flows with 84% in Kharif. This necessitates that surplus water in Kharif be stored for supplementing water when its availability is inadequate. Pakistan's current storage capacity is only 9% of the available water resources against World's average of 40%.

3. The Salient Features of recommendations and views of the Technical committee on Water Resources (TCWR) appointed by the Government are as given below:-

- (1) Water Accord of 1991 is sacrosanct and should be followed in letter and spirit.
- (2) There is consensus that on the average 35.2 MAF water is available annually which had been going to sea during 1976-2003. It should be harnessed for development of future reservoirs and uses.
- (3) There is unequivocal consensus on immediate construction of new reservoirs.
- (4) There is complete satisfaction over the studies regarding escapages below Kotri.
- (5) All members agree that Kalabagh and Basha Dam can be constructed. One member has, however, observed that no diversion of water should be allowed from the dams. The Chairman of the Committee has observed that the construction of only one of the two dams, of which feasibility is available, can be started with edge for Basha Dam over Kalabagh Dam.
- (6) All members have no objection to the current distribution methodology being followed by IRSA. Chairman of the Committee is, however, of the view that exempting NWFP and Balochistan from sharing of shortages in water is a violation of the Accord.

IRSA's view is that NWFP and Balochistan are unable to fully utilize even their due share during surpluses and can be allowed flexibility under Para 3 of the Accord. Decisions taken by majority vote by IRSA for water distribution are in accordance with the IRSA Act.

(7) Seven members, giving the majority views, have expressed full satisfaction over IRSA's filling of Mangla reservoir and operation of link canals, as IRSA is the competent authority under the Act. The Chairman TCWR and one member have shown reservations and emphasized the need for legal guarantees and assurance that the criteria will be faithfully followed. Chairman of TCWR also differs with the current regulation by IRSA. IRSA has stated that the operation of these canals is being done on the basis of actual water availability in the rivers and the principle of equitable water distribution according to Water Accord Allocations.

REPORT OF THE TECHNICAL COMMITTEE ON WATER RESOURCES

In pursuance of the directive of the President of Pakistan, the Technical Committee on Water Resources was constituted by Ministry of Water and Power, Government of Pakistan, vide notification No.W.III-1(1)2002-Vol-IV dated November 15, 2003 (Annex-1). This notification was modified vide Ministry of Water and Power, Government of Pakistan notification of even number dated February 11, 2004 (Annex-2)

The President of Pakistan invited the members of the Technical Committee, along with the Parliamentary Committee and other top functionaries, on December 9, 2003 in the President's Camp Office, Rawalpindi and observed that the nation had high hopes in the two committees specifically to develop consensus on building of new river storages as the water situation for irrigated agriculture was worsening sharply. The committee is highly conscious of the confidence and trust reposed in them and of the message conveyed by the President personally in the meeting.

The Technical Committee has eight members, two from each province, in addition to the Chairman. Presumably they had been selected and appointed from considerations of their competence and their varied and lifelong professional experiences, at grass root level as well as in top public appointments in the fields of Water Resources Development and Operation including Planning, Construction, Canal Irrigation Systems, Storages, Irrigated Agriculture, Hydropower, and Human Resources Management.

The Committee has held a number of meetings in Islamabad regarding the task assigned to them. They greatly valued and benefited from excellent in-depth presentations on various issues and aspects made before them from the top management and experts of the Planning Division Government of Pakistan, WAPDA, Indus River System Authority (IRSA) and Pakistan Commissioner for Indus Waters (PCIW).

We submit for consideration and appropriate action our findings, observations and recommendations in this Note.

1. Hydrological Datas of Rivers, Stream, Irrigation Canals, Link Canals and Dams Operation

WAPDA receives from different field sources and organizations the hydrological data of various gauging and observation sites for the three Western Rivers (the Indus, the Jhelum and the Chenab), the tributary rivers and streams in Pakistan, the irrigation canals, the inter-river link canals, the three Eastern Rivers (the Sutlej, the Beas, the Ravi). WAPDA manages and controls the operation of the river reservoirs at Mangala on the Jhelum, and at Tarbala and Chashma on the Indus. WAPDA data has been accepted as reliable and the best available information for planning and operation purposes by all agencies of Government of Pakistan. (GOP) including the Planning Commission and Ministry of Water and Power, by the provinces, by national and international consultants and experts, by the World Bank, by all international financial and development agencies, and by all the judicial commissions set up (1970 to 1988) for apportioning river waters between the provinces. WAPDA hydrological data, accepted and acknowledged as accurate and reliable is further used for estimating losses and gains in the rivers, the Kharif/Rabi seasonal water forecasts for operation of canals and reservoirs, and sharing river waters between the provinces. It is the basis of numerous national and international reports, programs and plans for development and management of Pakistan's Water and Hydropower Resources. This data has formed the basis of the most recent comprehensive studies on Pakistan Water Resources: The Water Strategy Study under Asian Development Bank and the Water Policy Study under the World Bank. These Study Reports have been accepted by GOP and the provinces.

We submit that the hydrological data compiled/published by WAPDA on Western rivers, Eastern rivers, Streams, Canals and Reservoirs is comprehensive and reliable, and may be accepted and adopted.

2. Indian Uses on Western River.

The projections made by WAPDA and PCIW in the light of Indus Waters Treaty 1960 are realistic and may be adopted. An estimate of 2 MAF for Indian uses under the Treaty provisions is rational and reasonable.

3. Kabul River future uses in Afghanistan.

The projections made by PCIW for future Afghanistan uses of Kabul River are realistic and may be adopted. An estimated use level of 0.5 MAF may be adopted.

4. Operation of inter-river link canals, including the two Indus Link Canals of Chashma-Jhelum (CJ) and Taunsa-Punjab (TP).

As a consequence of the Indus Waters Treaty 1960, inter-river link canals have been constructed as Replacement Works under the Indus Basin Replacement Plan. These link canals were planned and designed, their alignment and full supply capacities determined, and their construction supervised by international consultants under the

World Bank and approved by Government of Pakistan. They sustain and support canal irrigated lands from those old canals whose pre-Independence headwaters/river water sources came under Indian control. Their operational criteria and flow regime by ten daily/monthly periods of the year has been laid down in their design reports and has been followed ever since their construction and operation. This position is supported and may continue to be followed.

5. Mangala Dam Filling and Operation.

Mangala Dam was constructed and commissioned in 1967 entirely as a replacement dam. Due to limitation of Jhelum river supplies, it only partly compensated for the heavy burden of Replacement supplies. Its design basis and operational criteria was laid down in the design and planning documents under the Replacement Plan. The balance replacement burden was placed on the Tarbela Dam on the Indus.

IRSA, in consultation with the provinces, WAPDA and GOP, periodically reviews/updates the Mangala filling and operational criteria to meet the Replacement requirements as the first priority. Even after planned raising of the Mangala Dam, there would be no change in its planned objectives and priorities in view of the constraint of limited Jhelum River flows.

The Upper Regulation Zone entirely dependent on the flow supplies of the Chenab and Jhelum rivers and the Mangala Storage is known as Jhelum Chenab (J-C) Zone. It has been strained under the Indus Treaty 1960 due to commitment of all reliable river supplies to replacement. It can get no support from any Indus river supplies even in such periods when Indus-cum-Kabul flows may be surplus. IRSA keeps in view this limitation, risk and restraint of the J-C Zone, and plans the timely filling of the Mangala Dam storage accordingly.

6. Kotri Outflow to Sea.

a) The hydrological data by WAPDA of escapages to sea below Kotri is available over the past years on daily, ten-daily, monthly, seasonal (K&R) and annual basis. Its reporting source is primarily the Sindh Irrigation Department. It has been accepted as reliable and satisfactory by all agencies. It may be accepted as such.

b) IRSA has ruled that all river supplies, including flood flows and future storages, stand allocated under the Water ACCORD 1991 which prescribes the provincial shares. Every province should use its allocated share in its discretion to meet its felt needs of irrigation and municipal uses, as well as for environmental and ecological control, checking sea water/brackish groundwater intrusion, anti-salinity operations etc.

7. FUTURE RIVER STORAGES: NEED, SCOPE, PLANS, SEQUENCING.

A. WAPDA VISION 2025:

WAPDA in its document "Water Resources and Hydropower Development Vision 2025" published in year 2000 has given an account of existing surface storages in Pakistan, the potential on-line and off-channel storage sites available for future development, and the need and urgency of their development. This document has relied considerably on the comprehensive World Bank Project Planning Study known as Liefertink Report regarding Water and Power Resources of Pakistan, and the Agriculture and Power needs for economic and social development. Irrigated agriculture, the backbone of Pakistan's economy, is the major user of water and its consumption would continue to grow and dominate water use. Indus Basin Irrigation System is the world's largest single integrated canal irrigation network. Out of 77 million acres (MA) cultivable land, only 36 MA or less than half is canal commanded. With increasing population, Pakistan is fast heading towards a situation of water shortage. Three storages at Tarbala, Mangala and Chashma were constructed primarily for Replacement under Indus Basin Replacement Plan. These storages with aggregate design capacity of about 15 MAF form about 90% of the existing storage capacity and are rapidly losing their capacity due to excessive sediment burden in the river water. By the year 2010, these storages would have lost about 6 MAF of their capacity, or equivalent to loss of one mega storage project. Due to lack of adequate storage capacity, on an average annually over 39 MAF escapes below Kotri varying from 8 MAF to 92 MAF. This surplus water in river system is available, however, only in a short summer period of 70-100 days. To save and utilize this available surplus, it has to be stored and released judiciously for agricultural production, hydropower generation, and flood control and mitigation. The additional required storage capacity has to be substantially large and adequate for inter-season (Kharif-Rabi) transfer and further enhanced for inter-year transfer from wet years to dry years.

Vision 2025 has identified new storages which can be integrated with existing irrigation system as:

i) On-line storages on Rivers and Tributaries	34.21 MAF
ii) Off-Channel Storages	21.65 MAF

All the identified new on-line storages, eight in number, are on the Indus and are hydropower multi-purpose projects.

B. Recent Studies to Identify Storage needs.

Two comprehensive studies on Water Resources Development to meet steadily rising water needs for Agriculture, Municipal and Rural Water Supply, and Industry have been completed in year 2000-2002:

- i) The Water Strategy Study under the Asian Development Bank.
- ii) The Water Policy Study under the World Bank.

It has been concluded that assuming successful implementation of conservation programmes of irrigation channel lining and improved agricultural practices, the additional water needs at field level by year 2020 would be 15 to 20 MAF. Allowing for conveying losses in the rivers/canals, the corresponding additional storage capacity required would be 20 to 25 MAF or 3 to 5 Mega dams for avoiding impending acute shortages and famine condition.

River storage dams are water conservation structures and do not consume water. They in no way reduce established canal irrigation uses of co-riparians. Due to improved regulatory capability, they afford better controlled inter-seasonal river flows to substantially increase agricultural production by increasing sown area and by improved timely irrigation supplies, and also generate hydropower in large quantities and at low cost. . They reduce flood losses and misery caused by uncontrolled river spills in high floods. Our existing live storage capacity is hardly 12 MAF or less than 10% of average annual river flows, while the world's average is 40%. We have evidently grossly inadequate storage capacity and this shortfall has enormous adverse effects on our use of rivers resource. In Egypt, Aswan Dam Storage on the Nile has a capacity of more than double the annual flow of the Nile river and has helped Egypt to tide over the cycle of extreme drought in dry years cycle and protect their agriculture. We are far away from such an ability to make productive use of every drop of precious fresh water in our rivers. A series of storage dams at all feasible sites are going to be our compelling requirement from considerations of water needs as well as hydropower and flood control.

C. Options Available.

The President is well aware of the situation and has repeatedly emphasized that we need not only one mega storage dam, but two or three dams for food security and economic survival, and to make the best use of available flood waters presently being wasted. The minimum option would be to start construction activity on at least two dams for sustaining bare minimum economic and social requirements, and to save us from dangers of a water-scarce situation.

The two available options in view are the Bhasha and the Kalabagh Storages on the Indus. These two multipurpose dams are not mutually exclusive or in competition as has erroneously been projected/stressed. The two storages, with an aggregate capacity of about 12 MAF, are complimentary and would provide bare minimum and pressing needs for food security and economic growth. We would briefly discuss the status of the two projects:

i) The Bhasha Dam.

a) Bhasha dam on the Indus is located about 200 miles upstream of Tarbala Dam and just downstream of Chilas town. Its catchment area is beyond the range of monsoons. Annual average Indus flow available is 50 MAF, almost entirely from Snow-melt.

b) In Vision 2025 published in year 2000, WAPDA had indicated a dam height of 660 ft, its live storage of 5.7MAF, installed generation capacity of 3360 MW, status of the project at pre-feasibility level, implementation period of 10 years.

c) In September 2003, WAPDA consultants have significantly upgraded and revised the project scope. The dam height has been raised to 908 ft, storage to 7.34 MAF, but implementation period reduced by 3 years to 7 years. The dam has been changed from rock-fill dam to rollcrete dam. A rather optimistic and unrealistic time schedule has been presented of commissioning the dam by year 2013.

d) The rollcrete dam option at Bhasha with a height of 908 ft, in an active seismic region, would be a state-of-art design. A dam of 600 to 650 ft, on the other hand would create substantial multi-benefits (Water-Power) without creating discomfort about its sustained safety. Pakistan needs a facility and NOT a monster. We need assured safety of structures, and NOT international records of physical dimensions. No rollcrete dam of this, or even lesser comparable height has so far been built in the world under such unfavorable conditions. Major dams of such a nature are not built in a hurry. They essentially require far extensive site investigations, options assessment, risk analysis, and design studies by a team that is not only internationally reputed for competence in dams engineering, but has experience of dams of comparable height and complexity, and construction/operation of long distance EHV transmission over rugged seismically active mountainous area. There is no evidence that this over-riding requirement has been met in case of Bhasha so far.

e) KKH approach road upgradation/relocation does not appear to have received due attention in the studies conducted. The Project Consultants appear to have followed an artificially laid schedule for studies and commissioning of the

project schedule prepared from considerations other than sound engineering and commitment to creating an infrastructure of sustainable service.

f) It would be prudent to restrict the dam height within 550-650 ft in the first instance and design and install an effective instrumentation system for monitoring of structure so that a decision on further raising could be taken on the basis of such data collected for 30 to 40 years. This would give us an assured safety. The dam has to be reasonably safe within limits of available knowledge and experience.

g) Bhasha Dam Project is undoubtedly a constructible project, but it requires far more intensive and extensive investigations and studies over a substantial period to make it a safe and bankable project to acceptable and recognized international standards. Its location in the Northern region, in a comparative rugged and barren region, that is also seismically not inactive, with major and grave technical, environmental, resettlement and social problems, would require deeper considerations and suitable contingency margins for time as well as costs. The unit cost of its generated benefits would be relatively high because of the difficult site access. The need for a great degree of caution need not be re-emphasized. Before launching the project for active construction of Dam, reasonable time has to be given for completion of the investigations and studies, and to upgrade and improve the KKH approach road.

ii) Kalabagh Dam.

a) WAPDA and World Bank were responsible for planning, investigation and detailed engineering studies of the multipurpose Kalabagh Storage dam on the Indus located about 110 miles below Tarbala. Services of competent local and foreign consultants and experts were used over a long period. This project of 6.1 MAF capacity and 3600 MW hydropower generation has been studied over thirty years and has been subjected to most rigorous scrutiny for technical and economic viability, and found viable on both counts.

b) Detailed field investigations were conducted, and detail design, hydraulic and computer model studies were carried out at a cost exceeding one billion rupees.

c) Kalabagh Dam site is the lower most possible multipurpose dam site on the Indus. This major river project is the only project ready for implementation and can be completed in 6 to 7 years by the year 2012. Any other identified mega storage project has yet to pass through time consuming field and desk studies and scrutiny by financing agencies. In that time period, water and hydropower situation would continue to get aggravated, and provincial confrontation on

sharing of mounting water shortages would sharpen. That is a very heavy price, and one that can be avoided.

d) Kalabagh as the lower most dam site on the Indus is the only site that will store monsoon flows/floods of the Indus and upstream tributary Kabul and Soan rivers. Indus annual average flows at Kalabagh are 90 MAF, at Tarbala 60 MAF and at Basha 50 MAF.

e) Kalabagh is nearest to power load centres and the 500 KV Transmission Network. It will also help to improve Tarbala generation by 30% by affording higher levels at Tarbala in many periods and by installation of three additional large capacity units. It has no access road problems. The colony at dam site is available for facilitating early start of construction.

f) Kalabagh Dam has the potential to be the major irrigation storage dam, leaving Tarbala to meet base load/peaking power needs. It has the potential to provide flow irrigation to large areas of D. I. Khan and enable integration of Indus-Jhelum-Chenab river systems as one basin for most optimum and productive water use.

iii) Skardu Dam.

Skardu site is the uppermost dam location site on the Indus. It has far lower available snow-melt flows for storage. The site is remote and only at conceptual level of study. The approach road along the Indus from Gilgat-Challas to Skardu is narrow and winding, and not fit to take heavy traffic. Its improvement/upgrading would be far more problematic than KKH upgrading. EHV Power Transmission would have grave problems and high costs. Skardu Town would be submerged, as also the Cantonment, Air Strip at Skardu and the best part of Baltistan Valley and civilization. At this early conceptual stage, nothing more can be said.

iii) Prioritization of dams Construction.

Pakistan has only a few good and viable river storage sites. Every site would need optimum exploitation after investigation and studies. It is the economic and social compulsions to productively use every drop of our fresh water river flows. The policy should be to have a plan to undertake a series of feasibility studies for indicated possible storage sites for future dam construction. It would be appropriate to envisage and plan integrated management of our three Western Rivers as one Zone for optimum operation and development. The urgent need is of prioritization of on-line as well as off-channel storages and break the shackles of no-action status quo.

CONCLUSION.

After consideration of all relevant factors, we conclude that Pakistan's requirements dictate that both Kalabagh and Basha dams be approved together and appropriate site activities initiated simultaneously. By the time Kalabagh Dam construction is completed by the year 2012, hopefully Bhasha Dam investigations would be satisfactorily completed to acceptable international technical/financial standards. The KKH approach road to Bhasha would also have been improved during the period to enable uninterrupted transport of heavy construction/project machinery and construction materials. Construction equipment and manpower may at that time be moved to the main Bhasha dam construction site to enable completion of Bhasha Dam by 2020. Simultaneous start of activities at the two dam sites of Bhasha and Kalabagh would be a big break through to afford rapid development of water and hydropower resources of Pakistan, to usher in an era of prosperity, to eradicate poverty, and to put at rest many anti-dam controversies. It would also give an impetus to plan and intensify studies and investigations on other identified storage sites. The dam construction activity over the future years has to be continuous, carefully planned and implemented. A reasonable minimum target for new dam capacities may be 30 MAF by the year 2030. The Committee also strongly believe that Pakistan's interests also dictate to plan and adopt an integrated system for the three Western Rivers based on single basin concept. Such a system would provide a flexibility to ensure equity in water distribution and optimum use of our river water resources.

(Shams-ul-Mulk)
Member (NWFP)

(Mazhar Ali)
Member (Punjab)

(Sardar Muhammad Tariq)
Member (NWFP)

(Abdul Razik Khan)
Member (Balochistan)

(Muhammad Azam Baloch)
Member (Balochistan)

(Mehmood-ul-Hassan Siddiqui)
Member (Punjab)

(Dr. Iqbal Ali)
Member (Sindh)

ANNEXURE-I.

Terms of Reference

1. Review issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the Provinces.
2. Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages.
3. Review the progress achieved so far regarding study on escapages below Kotri and recommend measures to expedite the completion of the study.
4. Ascertain actual quantity of water passed downstream Kotri from 1976-2003.
5. Examine the filling criteria of Mangla reservoir and make recommendations in this regard.
6. Complement the Parliamentary Committee on Water Resources in the discharge of its functions.
7. The Committee shall submit its report/recommendations within six months.

GAZETTE OF PAKISTAN PART-I
Government of Pakistan
Ministry of Water and Power

Islamabad November 15, 2003

NOTIFICATION

No.W.III-1(1)2002-Vol-IV. The following Technical Committee on water resources has been constituted in pursuance of the directive of the President of Pakistan:

Mr. A.N.G. Abbasi
Ex-Minister Irrigation, Province of Sindh

Chairman

SINDH

1. Dr. Iqbal Ali
Chief Design Engineer,
Sehwan Barrage Complex, Karachi.

Member

2. Mr. Sardar Ahmad Mughal
Ex-Chief Engineer,
Irrigation and Power Department

Member

PUNJAB

1. Mr. Mazhar Ali,
Adviser Irrigation Department

Member

2. Mr. Mehmood-ul-Hassan Siddiqui
Consultant Irrigation Department

Member

NWFP

1. Mr. Shams-ul-Mulk,
Ex-Minister Irrigation, NWFP

Member

2. Sardar Muhammad Tariq
Pakistan Water Partnership (PWP)

Member

BALUCHISTAN

1. Mr. Abdul Razzak Khan
Ex-Secretary
Irrigation and Power Department

Member

2. Mr. Muhammad Azam Baloach
Ex-Secretary,
Irrigation and Power Department

Member

Secretary

(To be notified later)

2. The Terms of Reference of the Committee are attached as Annexure-I.

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9. Mr. Muhammad Azam Baloach
C/o Secretary, Irrigation & Power Department,
Government of Balochistan, Quetta.

(Rashid Ali)
Deputy Secretary(W)

CC:

1. Chairman, Parliamentary Committee on Water Resources,
(Senator Nisar Ahmed Memon), Parliament House, Islamabad.
2. Chief Secretary, Government of Punjab, Lahore.
3. Chief Secretary, Government of Sindh, Karachi.
4. Chief Secretary, Government of NWFP, Peshawar.
5. Chief Secretary, Government of Balochistan, Quetta.
6. Chairman WAPDA, WAPDA House, Lahore.
7. Prime Minister's Secretariat (Mr. Ajaz Mohiuddin, Joint Secretary (E-II), Islamabad.
8. President Secretariat (Public), (Brig Syed Muhammad Owais), Islamabad.
9. Deputy Secretary (C-I), (Mr. Sikandar Ismail Khan),
National Assembly Secretariat, Islamabad.
10. PS to Minister for Water and Power.
11. PS to Secretary, Water and Power.

ANNEXURE-2

TO BE PUBLISHED IN THE GAZETTE OF PAKISTAN PART-I

Government of Pakistan Ministry of Water and Power
Islamabad: 11th February 2004.

NOTIFICATION

No. WIIL-1(1)/2002-Vol. IV: In partial supersession of this Ministry's notification of even number dated November 15, 2003, the following modifications are approved in the public interest with immediate effect.

1. The Committee may co-opt Secretary, Planning & Development, Government of Pakistan, Chief Engineering Adviser, Ministry of Water and Power, Chairman IRSA and Member(Water), WAPDA as members of the Committee.
2. Mr. Ghulam Sarwar Khichi is appointed as Secretary of the Technical Committee on Water Resources.
3. The terms of Reference of the Technical Committee are modified to include the following additional items:
 - a) Determination of water availability for future reservoirs and irrigation schemes.
 - b) Examination of operational criteria of link canals and future reservoirs.
4. The Committee shall submit its report/recommendations within one year.

The Manager,
Printing Corporation of Pakistan,
Islamabad.

(Rashid Ali)
Deputy Secretary(W)

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Co Secretary, Irrigation & Power Department,
Government of Balochistan, Quetta.
10. Mr. Javed Sadiq, Secretary,
P&D Division, Islamabad.
11. Mr. I.B. Sheikh, Chief Engineering Adviser/CFFC",
M/o Water & Power, Islamabad.
12. Mr. Rahim Khan Zarkun,
Chairman IRSA, Islamabad.

13. Ch. Muhammad Amin,
Member (Water), WAPDA, Lahore.

14. Mr. Ghulam Sarwar Khichi, J.S. (Retd)
Government of Pakistan,
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Near National Stadium, Karachi.

(Rashid Ali)
Deputy Secretary (W)

CC:

1. Chairman, Parliamentary Committee on Water Resources, (Senator Nisar Ahmed Memon), J Block, Room No.105, Parliament Lodges, Islamabad.
2. Chief Secretary, Government of Punjab, Lahore.
3. Chief Secretary, Government of Sindh, Karachi.
4. Chief Secretary, Government of NWFP, Peshawar.
5. Chief Secretary, Government of Balochistan, Quetta.
6. Chairman WAPDA, WAPDA House, Lahore.
7. Prime Minister's Secretariat,
(Mr. Ajaz Mohiuddin, Joint Secretary (E-11), Islamabad.
8. President Secretariat (Public),
(Brig Syed Muhammad Qwais), Islamabad.
9. Deputy Secretary (C-1),
(Mr. Sikandar Ismail Khan), National Assembly Secretariat, Islamabad.
10. P.S. to Minister for Water and Power.
11. P.S. to Minister of State for Water and Power.
12. P.S. to Secretary, Water and Power.

Government of Pakistan
Ministry of Water and Power Technical Committee on Water Resources

Terms of Reference

1. Review issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the Provinces.
2. Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages.
3. Reviews the progress achieved so far regarding study on escapages below Kotri and recommend measures to expedite the completion of the study.
4. a) Determination of water availability for future reservoirs and irrigation schemes.
b) Ascertain actual quantity of water passed downstream Kotri from 1976-2003.
5. a) Examine the filling criteria of Mangla reservoir and make recommendations in this regard.
b) Examination of operational criteria of link canals and future reservoirs.
6. Complement the Parliamentary Committee on Water Resources in the discharge of its functions.
7. The Committee shall submit its report/recommendations within one year.

REPORT OF THE TECHNICAL COMMITTEE ON WATER RESOURCES ELABORATIONS

MAY 2005

1. Preamble

1.1 Establishment of the Technical Committee

In pursuance of the directive of the President of Pakistan, Technical Committee on Water Resources was constituted by the Ministry of Water & Power, Government of Pakistan vide Notification of November 15, 2003. This notification was partially modified by Ministry of Water And Power on February 11, 2004 in respect of its composition, scope of work or TOR, and its time period. Accordingly, the Terms of Reference (TOR) prescribed for the Committee were as below:-

Terms of Reference:

1. Review issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the Provinces.
2. Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages.
3. Review the progress achieved so far regarding study on escapages below Kotri and recommend measures to expedite the completion of the study.
4. a) Determination of water availability for future reservoirs and irrigation schemes.
b) Ascertain actual quantity of water passed downstream Kotri from 1976-2003.
5. a) Examine the filling criteria of Mangla reservoir and make recommendations in this regard.
b) Examination of operational criteria of link canals and future reservoirs.
6. Complement the Parliamentary Committee on Water Resources in the discharge of its functions.

7. The Committee shall submit its report/recommendations within one year.

The composition of the Committee was as below:

Chairman

Mr.A.N.G. Abbasi

Members from Balochistan

1. Mr.Abdul Razik Khan
2. Mr.Muhammad Azam Baloch

Members from N.W.F.P.

3. Mr.Shams-ul-Mulk
4. Sardar Muhammad Tariq

Members from Punjab

5. Mr.Mazhar Ali
6. Mr.Mehmood-ul-Hassan Siddiqui

Members from Sindh

7. Dr. Iqbal Ali
8. Sardar Ahmad Mughal

To facilitate deliberations on certain policy issues and for presentation of the relevant data/information, the Committee was authorized to co-opt the following as members of the Committee:

1. Secretary, Planning & Development, Government of Pakistan.
2. Chief Engineering Adviser, Ministry of Water & Power, Government of Pakistan.
3. Chairman, IRSA
4. Member (Water) WAPDA

1.2. Deliberations of the Technical Committee

1.2.1 The Committee conducted its deliberations in eight meetings as below:

First	Mar. 11, 2004
Second	Sep. 04, 2004
Third	Sep 27-28, 2004
Fourth	Oct. 13-14, 2004

Fifth	Nov. 22-27, 2004
Sixth	Dec. 20-22, 2004
Seventh	Jan. 11-13, 2005
Eighth	Feb. 01-03, 2005

1.2.2 According to the notification dated February 11, 2004, the Committee was required to submit its report/recommendations within one year. However, through a subsequent notification of April 7, 2005, the duration of the Committee was further extended to June 30, 2005 with the proviso that the Committee should submit its report by April 30, 2004. Copies of the notification of November 15, 2003 and February 11, 2004 were apprehended as Annex-1 and 2 of TCWR Main Report. Copy of notification of April 7, 2005 is placed as Annex. 1 of these "Elaborations."

1.2.3 During its deliberations, the Committee, from time to time, also invited the following for participation in the meetings to contribute to some specific items:-

1. Secretary, Ministry of Water & Power, Government of Pakistan.
2. Special Secretary, Ministry of Water & Power, Government of Pakistan.
3. Pakistan Commissioner for Indus Waters, Ministry of Water And Power, Government of Pakistan.
4. Chairman WAPDA

1.2.4 To complement the Parliamentary Committee on Water Resources, its Chairman Senator Mr. Nisar A. Memon was specially invited to participate in all meetings of the Technical Committee.

1.2.5 Member (Water) WAPDA provided the basic technical assistance through:-

- a) Computation and submission of the basic data and information.
- b) Presentations on specific TOR items during various meetings.
- c) Responses and further elaborations of various presentations in light of the views and comments by various members during the meetings and/or communication through Secretariat of the Technical Committee.

Chairman IRSA and Pakistan Commissioner for Indus Waters also provided valuable information and support.

1.2.6 The eighth meeting of the Technical Committee held from February 1-3, 2005 was intended to finalize its report and recommendations but remained inconclusive. It also happened to be the last meeting called by the Chairman. Notwithstanding the suggestion by majority of Committee Members that drafting and finalization of the report be entrusted to a sub-committee, the Chairman observed that he would write the report himself independently and submit it directly to the competent authority without knowledge of the members.

1.3 Report of the Technical Committee

Due to insistence of the Chairman to submit his own report, without full participation of all members, which alone would have made it a Committee's Report as required under the Terms of Reference, the overwhelming majority of members i.e. seven out of eight, considered it appropriate to submit the consensus report of the TCWR. They apprehended that the report prepared by Chairman single handedly, against the acceptable procedures and norms, would neither be appropriate nor fair. Consequently in April 2005, the Report of the Technical Committee on Water Resources was submitted to the appropriate quarters. This Report focused upon the core issue of TOR-2 to assess the need and urgency of future dams/reservoirs and recommend their sequence of construction. The supplemental report now being submitted provides necessary Elaborations as well as a record of the consensus views of the majority Members. It has also been recast for convenience of reference in accordance with TOR of the Committed of February 11, 2004.

2- Terms Of Reference (TOR) as of Feb. 11, 2004 Views of The Committee

TOR-1

2.1.1 Review Issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the Provinces.

The Accord apportions the Indus Basin Waters amongst the Provinces under Paras 2 & 4. The mechanism for distributing the available supply equitably between the Provinces is laid down in Para 14(b) of the Accord which is reproduced below:

"The record of actual average system uses for the period 1977-82 would form the guideline for developing a future regulation pattern. These 10-daily uses would be adjusted pro-rata to correspond to the indicated seasonal allocations of the different canal systems and would form the basis for sharing shortages and surpluses on all Pakistan basis."

2.1.2 The mechanism of water distributional arrangements envisaged in Para 14(b) of the Accord is further guided by Para 14(a) reproduced below:-

2.1.3 "The systemwise allocations will be worked out separately on 10-daily basis and will be attached with this agreement as part and parcel of it".

During detailed deliberations of the Committee, provincial views on distribution of water as per Accord, emerged as below:-

i) NWFP and Balochistan were of the view that these two provinces should get their shares as allocated under Para 2 and the priority and flexibility under Para 3 of the Accord.

ii) Sindh held the view that the available Indus River System supplies, flow-cum-storages, should be shared between Punjab and Sindh on the basis of Para 2 shares elaborated through 10-daily allocations worked out under Para 14(a). Sindh held the strong view that this arrangement should be implemented in letter and spirit, without any other considerations, In particular, it should be regardless of the policy being followed to meet the need to substantially fill Mangla reservoir during early Kharif for ensuring late Kharif and Rabi supplies to 13 million acres under exclusive command of Mangla reservoir and Jhelum-Chenab river flow supplies.

iii) Punjab emphasized that the Accord gives express assurance that the existing uses of all the Provinces would be protected. Furthermore the mechanism of sharing the available river supply is detailed out in Para 14(b) of the Accord. Accordingly the shortages and surpluses on all Pakistan basis are to be shared on the basis of average system uses 1977-82 which provide the basis of working out 10-daily project-wise provincial allocations.

In practice, from 1991 to 1999, when the river supplies were ample to meet the existing uses of all the provinces the sharing was done by IRSA according to the indent reflective of present day average canal uses. However, when a serious controversy arose on interpretation of Accord during the drought years from 2000 to 2003, Sindh insisted that the available flow-cum-storage supplies be distributed strictly according to Para 14(a).

2.1.4 In view of the seriousness of the situation and its significant implications the matter was deliberated by IRSA in its various meetings, and also in consultation with the higher authorities. It was decided to continue the practice followed ever since the Accord 1991 to distribute available flow-cum-storage supplies to the co-sharers according to Para 14(b) of the Accord, specifically in the shortages situation. However, no shortages were to be passed on to the smaller user provinces of Balochistan and NWFP. Chairman IRSA in its presentation to TCWR submitted that IRSA is following Para 14(b) for its distribution planning to date, and further of exempting Balochistan and NWFP from any shortages.

2.1.5 It is considered that IRSA decision and the policy being followed since the Accord, is the best approach to distribute the available river-cum-storage supplies between the co-sharing provinces and should be continued to be followed till injection of major storage(s) in the system.

TOR 2

"Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangia dams and recommend sequencing of future storages."

2.2.1 This core issue was the primarily focus of the Main Report of the Technical Committee since submitted. It gave the following conclusion:-

"Conclusion

After consideration of all relevant factors, we conclude that Pakistan's requirements dictate that both Kalabagh and Basha dams be approved together and appropriate site activities initiated simultaneously. By the time Kalabagh Dam construction is completed by the year 2012, hopefully Basha Dam investigations would be satisfactorily completed to acceptable international technical/financial standards. The KKH approach road to Basha would also have been improved during the period to enable uninterrupted transport of heavy construction/project machinery and construction materials. Construction equipment and manpower may at that time be moved to the main Basha dam construction site to enable completion of Basha Dam by 2020. Simultaneous start of activities at the two dam sites of Basha and Kalabagh would be a big break through to afford rapid development of water and hydropower resources of Pakistan, to usher in an era of prosperity, to eradicate poverty, and to put at rest many anti-dam controversies. It would also give an impetus to plan and intensify studies and investigations on other identified storage sites. The dam construction activity over the future years has to be continuous, carefully planned and implemented. A reasonable minimum target for new dam capacities may be 30 MAF by the year 2030. The Committee also strongly believes that Pakistan's interests also dictate to plan and adopt an integrated system for the three Western Rivers based on SINGLE BASIN CONCEPT. Such a system would provide a flexibility to ensure equity in water distribution and optimum use of our river water resources."

2.2.2 The members would like to emphasize that their recommendations/observations regarding construction and prioritization of major storage dam projects have been made not from ad hoc considerations. They have been made after thorough deliberations, and from their deep sense of patriotism and their duty to the country. These are based on their expertise and lifelong professional experience of economic and social development in Pakistan and their first hand knowledge of issues and difficulties in planning and execution of water resources and hydropower projects.

2.2.3 In brief, the main considerations have been:

(i) Average annual escapages to sea of unutilized river waters is 35 MAF and equal to the total Rabi (Winter) uses of the canals of all four provinces serving 35 million acres. It is a multi-billion dollar treasure being dumped into the sea. This potential must be productively developed for the benefit of 150 million people of Pakistan. History does not forgive lack of will to meet the challenges and delayed decisions at national levels.

(ii) The emerging scenario in the 21st Century is of worsening water scarcity for agricultural, industrial and urban uses of the population growing at above 2% per annum.

(iii) River storage dams are water conservation structures and do not consume water. They improve and enhance regulatory capability to productively use widely fluctuating flow supplies in our rivers from snow melt and monsoon rains for equitable additional benefits of all the co-riparians. The construction of dams on our rivers has to be a continuous activity to meet future needs.

(iv) The two available storages options in view are the Basha and the Kalabagh Dam multipurpose projects on the Indus. These two projects are mutually complementary, and not mutually exclusive. It is important from larger considerations that decision be taken to start construction activities on the two dams concurrently.

(v) Basha Dam is the site 200 miles upstream of Tarbela:

a) At this site, Indus river annual flow is 50 MAF, entirely from snow melt.

b) It is a high concrete dam, in a highly seismic region, and with KKH as the access road needing substantial upgrading and relocations.

c) It would require 4 to 6 years for adequate site investigations/design options, for upgrading access roads and other logistics, risk and financial studies, field/desk investigation on high voltage transmission line(s) over rugged and barren hills in extreme climatic conditions, resettlement/environmental issues and a greater degree of caution and conservatism. An optimistic time estimate of its reaching the tendering and implementation status would be 5 to 6 years. Work on upgrading KKH and further site/design studies be taken in hand and accelerated to allow time for unpredictable difficulties for this state-of-art project.

(vi) Kalabagh Dam is the lower most available dam site on the Indus about 110 miles below Tarbela:

- a) This site has annual Indus river inflow of 90 MAF, compared to 60 MAF at Tarbela, and 50 MAF at Basha.
- b) Additional water availability is from monsoon rains in the catchment below Tarbela, and from the flows of major tributaries of Kabul, Soan and Haro. Only Kalabagh site can regulate this additional 30 MAF river potential.
- c) Kalabagh storage, as a re-regulating storage below Tarbela, would enhance power generation at Tarbela by about 30% in terms of GwH. No other storage site can provide this facility.
- d) This site is the only site enabling gravitational flow to irrigate about 5 lac acres, through a right bank outlet, for D.I. Khan and Bannu areas in NWFP which presently are at very low levels of development. There is no other dam site providing this facility to NWFP to use its share of river supplies. For any other storage, NWFP would have to provide lift irrigation which would cost 1500 to 5000 rupees per acre per year to the farmers.
- e) This site is the only site which would enable the integration of the Indus-Jhelum-Chenab rivers into one single river basin through a left bank outlet. The additional areas irrigated may not be significant, but the time adjustment for beneficial/optimum use of Jhelum river early snow-melt supplies with Indus river late snow-melt/monsoon supplies by inter-transfer capability would be most beneficial. This would make it feasible to meet the early Kharif (April-May) needs of Sindh canals in sowing season from Jhelum river snow-melt.
- f) Right/Left Outlets could be constructed as a part of the project as stubs, as was done for Pehur canal stub-tunnel on the right of Tarbela for Pehur canal. Pehur canal itself was started much later and completed only recently as an independent project.
- g) Kalabagh Dam is a low earth-rock fill dam 260 feet high, and needing no significant additional logistic activities. After detailed field/design studies and documentation the project is lying ready for implementation since two decades. This is the only major multipurpose dam whose construction be started now and completed by year 2012. On its completion, the project staff and equipment could move to Basha which may have reached the implementation status by that time. The financial phasing of the construction activities of the two dams makes this a viable option.

2.2.4 It may, further, be brought out that substantial additional allocations of river supplies have been made to the smaller co-sharing provinces of Balochistan and NWFP under Paras 2 and 4 of Water Accord. These two provinces are presently unable to

utilize their respective shares due to lack of adequate infrastructure. There is urgent need of these provinces to achieve agricultural development for poverty alleviation, and to bring prosperity to the significantly backward regions. Whereas in certain cases, the existing canal network is inadequate to enable them to efficiently and productively use their share of additional canal irrigation supplies, a major impediment is non-availability of storage supplies during the low river flow periods. With the injection of the two recommended storages in the system, this constraint would be largely removed. It is recommended that these two provinces should be helped and supported to develop the required infrastructure facilities progressively with the implementation schedule of the new dams on the Indus.

2.2.5 Additional Comments by Mr. Shams ul Mulk, Member TCWR

2.2.5.1 It appears necessary to record the conceptual foundations of our Report on TOR-2. This in essence, is the recapitulation of my submissions to the President of Pakistan on 14th January 2005 in the meeting called in the Presidency. Sardar Tariq the other member from NWFP, the two members from Punjab, the two members from Balochistan, and Dr. Iqbal Ali one member Sindh had fully endorsed my submissions.

2.2.5.2 Large dams on major rivers are strategic national assets and decisions parameters relating to them are strategic in nature. Pakistan, in the recent decades, has been a victim of the inherent seasonal shortages of the Indus rivers system, and we must move towards becoming the beneficiaries of its seasonal surpluses. Large storages are the sole technological instrument to achieve this goal. In the first phase of this strategic pursuit, we have to create adequate seasonal storage capacity for transfer and use to mitigate perennial seasonal shortages. Two dams - Kalabagh and Basha - together would substantially achieve this aim. But the endeavor has to continue by construction of more storages technically feasible and economically viable - so that adequate annual transfer capacity is created in the system; enabling the affluence of wet years to be shared with the drier years. This constitutes the second phase of Pakistan's strategy to provide water security for its people.

2.2.5.3 The action plan for the above enunciated strategy makes Kalabagh and Basha dams as mutually inclusive, rather than exclusive. Our recommendation of starting dam construction of Kalabagh earlier than Basha is based on very sound techno-economic considerations:

Firstly

The dam at Kalabagh would regulate annual average river flow of about 90 MAF. Compared to 50 MAF at Basha; the resource availability is better at Kalabagh. Without committing in Pakistan the water of Kabul river, our co-riparian would always be tempted to over-use/over-claim their share in this

river. Kalabagh is the only feasible site to achieve such a commitment, and also with better resource availability.

Secondly

There is no unfinished work of technical examination, review or analysis on Kalabagh. Basha dam is, on the other hand, many years behind Kalabagh in this respect. The provision of communication facilities, needed for a large dam construction, would in any case take five to six years for Basha and none for Kalabagh. It is obvious that Kalabagh dam construction can start at least five years ahead of Basha; and there is no reason to deny this advantage to the system.

Thirdly

The economic recovery achieved by Pakistan, would be sustainable only, if we follow sound and time-tested principles of economic management, which includes the core-policy of choice of Least-Cost Options. Kalabagh dam would be cheaper in Capital and Benefit-output/Unit Cost, than Basha. At this stage, therefore, Kalabagh first is the better option.

Fourthly

The commissioning of Kalabagh dam would enable sharing with Tarbela dam the burden of irrigation water supplies. By providing such a relief, Tarbela dam could be operated in a more appropriate multi-benefit mode. This would make 600 MW of additional capacity available at Tarbela. Such a benefit, again, is specific to Kalabagh.

2.2.5.4 But equally important, if not more, is another Kalabagh specific advantage, and that is its potential to provide gravity feed diversion for about 0.5 million acres in D.I.Khan and Bannu plains (through Right Bank High Level Canal) and of truly integrating the storages and diversion infrastructure (through Left Bank High Level Canal). No other dam creates these two facilities. Without the Kalabagh Right Bank Canal, NWFP would become the sole province to require lifting its share of water from all future storages at prohibitive cost. And without the Kalabagh Left Bank Canal, the Jhelum river water from early snowmelt would continue to be stored in early Kharif for reservoir filling rather than meeting the needs of Sindh during that period. These canals, therefore, create strategic advantages for NNWFP and Sindh provinces, and therefore, for Pakistan. We, therefore, firmly recommend the Kalabagh dam project to include the high level canals on the right and the left. My fellow member from NWFP, two members from Balochistan and two members from Punjab are in agreement with these recommendations.

2.2.5.5 NWFP and Balochistan are relatively the smaller users of Indus river waters; but they have vast irrigable lands. The large storages now envisaged in the future, would

create for them the water needed for irrigating such lands. However, limited financial resources would impede such development. We, therefore, recommend that the irrigation related infrastructure for NWFP and Balochistan should be financed by the Federal Government so that all provinces are equitably benefited from the storages.

2.2.5.6 We are not unaware of the apprehensions of Sindh province regarding off-taking canals from Kalabagh reservoir. We also understand that a few unfortunate incidents, committed by irresponsible officials in the past have contributed to such apprehensions. But there are positive examples NWFP has not received any flows in excess of its authorized shares from the Right Bank High Level Canal from Tarbela nor from Chashma Barrage. In any case, the telemetry system now installed would provide such information that any use, beyond authorized share, would become easily known. This new system is going through its teething problems, but it would undoubtedly become a dependable source of data.

2.2.5.7 All this notwithstanding, the core principle of sustainable relations between the joint users of a common resource is:

- each user is entitled to receive the agreed share and a credible mode of ensuring it; but
- no user is entitled to inflict a crippling sufferance, almost the denial of use of the agreed share, on another co-user as the instrument of that credibility.

The capacity buildup and strengthening of relevant institutions, refinement and improvement of the Telemetry System, and heavy penalties for upward deviations from IRSA allocations are adequate instruments to assure lower riparian (Sindh in particular). NWFP, a small user, cannot deny itself the use of its share, as a price to allay unfounded fears of another and a bigger user.

2.2.5.8 We are also not unaware of the other stated apprehensions of NWFP and Sindh. This is not the place to address them in detail. Suffice to say, that all such claimed apprehensions are misplaced. And this conclusion is based on the views and reports of the best professionals in the world; professionals whose words are internationally respected.

TOR-3

Review the progress achieved so far regarding study on escapages below Kotri and recommend measures to expedite the completion of the study.

2.3.1 Para 7 of the Water Apportionment Accord reproduced below. recognized the need for certain minimum escapege below Kotri:-

"The need for certain minimum escapages to sea, below Kotri, to check sea intrusion was recognized. Sindh held the view, that the optimum level was 10 MAF, which was discussed at length, while other studies indicated lower/higher figures. It was, therefore, decided that further studies would be undertaken to establish the minimal escapege needs downstream Kotri."

2.3.2 As a follow up action of Water Accord, the above issue came up for consideration in the meeting of the Council of Common Interests (CCI) held on September 16, 1991. CCI took the following decision:-

"The CCI directed that the study proposed to be carried out by International Panel of Experts to establish minimal escapege needs downstream Kotri should be completed within one year of the signing of the agreement with Consultants."

2.3.3 This matter was discussed by IRSA in its meeting held on August 20, 1994. Sindh held the view that the proposed study should include sea intrusion as well as ecology of the Indus river delta. IRSA finally decided, by a majority vote of 4:1, that in line with Para 7 of the Accord, the proposed studies should be restricted to sea intrusion only. IRSA also approved the TORs for the proposed study. The issue, however, remained dormant for over eight years. Subsequently, Federal Ministry of Water & Power considered the issue in a meeting held on October 21, 2002. It was decided that the following two independent studies may be undertaken in this regard:-

- i) To check sea intrusion as per TORs approved by IRSA.
- ii) For ecology of Indus Delta as per TORs proposed by Sindh

2.3.4 Punjab emphasized that only the Study (i) relating to sea intrusion was obligatory under the Accord and should be undertaken forthwith. Regarding Study (ii) on ecology, Punjab stressed that it should also cover the areas in Pakistan - Punjab as well as other provinces - adversely affected by Indus Waters Treaty 1960 and related developments in the post-Treaty period. Punjab further stressed that if the environmental studies were to be province specific, as emphasized by Sindh, then each province may commission

respective studies and come up with the projects to offset the adverse environmental impacts.

2.3.5 This issue came under the consideration of the Parliamentary Committee during its meeting held at Islamabad on December 16, 2003. The Parliamentary Committee decided that the following three studies should be undertaken simultaneously:-

S.No.	Name of Study
I	STUDY-I Study on Water Escapages below Kotri Barrage to check seawater intrusion.
II	STUDY-II Study on Water Escapages downstream Kotri Barrage to address Environmental Concerns
III	STUDY-III Study on Environmental Concerns of all the four Provinces (excluding areas covered under Study I & II)

2.3.6 Chief Engineering Adviser, Ministry of Water & Power, Government of Pakistan was given the assignment to formulate the consultancy contracts and award these studies to Panel(s) of Foreign Consultants. The three studies have since been awarded to three separate consortia of foreign/local consultants, and their funding and time frame have been finalized, A Panel of International Experts has also been appointed to overview the three studies. The Inception Reports of the three separate studies have since been received and the Panel of Experts has overviewed and commented on these Inception Reports in a high level meeting under the Chief Engineering Adviser at Islamabad on April 07, 2005. It has been decided that Interim Draft Reports would be issued by each consultant and circulated for comments/views of all provinces as well as POE. All the three studies are planned to be overviewed/monitored by P.O.E and completed by September 2005. The situation seems satisfactory.

TOR - 4(a)

Determination of Water Availability for Future Reservoirs and irrigation schemes

2.4.1 This TOR relating to hydrological data has been discussed briefly in the Main Report in Paras 1, 2, 3 & 6. Various aspects of the issue have been the subject of criticism and exhaustive documentation and observations by Sardar Ahmad Mughal from Sindh, the only dissenting Committee member, and supported by the Chairman TCWR. These dissenting views were in conflict with detailed presentations/documentations by WAPDA, Pakistan Commissioner for Indus Waters, Chairman IRSA, Planning Division, Water Sector Master Plans, WAPDA Vision 2025, and numerous national/international studies and plans on Development of Pakistan Water Resources by World Bank, Asian Development Bank, JICA etc. The main thrust of the dissenting views was to present an assumed bleak scenario for Pakistan of Nil or Negative surplus river flows for any future development, in contrast to exhaustive documentation to the contrary. It may be appropriate to deal with the various aspects in some detail for elaboration.

2.4.2 River flow data on Water Availability:

a) WAPDA hydrological data, published and documented, on main rivers, tributary rivers, streams, irrigation and link canals, storages etc. has been accepted as reliable and the best available information for planning and operation of Pakistan water resources by all government agencies and provinces, and national and international consultants and experts. The basic data and information for TCWR for this TOR was initially presented by WAPDA. It was reviewed and commented upon by Committee members, and was subject of adverse criticism by the Chairman and one learned member from Sindh. The criticism was duly responded to by WAPDA through communication(s) and presentations(s) in various meetings of the Committee.

b) The compilation of water availability figures and its adoption for planning future water projects was specifically considered by IRSA in its meeting held on November 14, 1995 and following unanimous decisions were taken at under the IRSA Act:-

"Accordingly, it is proposed that the Indus River System Authority may decide, under section (2), section 8 of the IRSA Act, that in implementation of the Water Accord the river discharges and canal withdrawals, as compiled and exhibited by WAPDA in the IBP and WRM publications, shall form the authentic and reliable data for purposes of water studies, feasibility reports and projects etc. carried out and formulated by the provinces, Ministry of Water And Power, Ministry of Food and Agriculture, and the

consulting engineers and approved by the Planning Commission, ECNEC and Government of Pakistan."

c) By consensus, TCWR accepted and adopted the hydrological data compiled/published by WAPDA on Western rivers, Eastern rivers, Streams, Canals, and Reservoirs being the best available, comprehensive and reliable:

2.4.3 Period of data for Water Availability Computations:

a) For presentation to the Committee, WAPDA had made the computation of water availability for the post-Tarbela period since 1976 i.e. for 1976-2004.

b) A view was expressed that the water availability computation should be based on the data pertaining to a longer period 1922-2004, for which river flow information was available WAPDA responded that the earlier data from 1922-1940 was not so consistent and reliable as it had been recorded by using earlier procedures now out-dated. It was added that in the international negotiations on river water dispute between India, Pakistan and the World Bank which culminated in signing of the Indus Waters Treaty 1960, the water availability computations were based on the available data for the pre-partition period 1937-46. Fazale Akbar Committee in 1970 adopted 30 years available data for the period 1941-70. After the completion of Indus Basin Projects, the rivers and canals systems had been subjected to substantial hydrological changes due to construction of new hydraulic works, the storages and the link canals. Consequently in all subsequent and current water studies, post-Tarbela data which was being recorded and monitored according to the available modern techniques was being adopted as accurate and reliable, as it took due notice of the impact of the Replacement Plan Works.

c) In view of the deliberations made in the Committee meetings and information furnished by WAPDA, the Technical Committee by consensus considered appropriate that the computation of water availability should be based on the post-Tarbela period starting from 1976.

2.4.4 Water Availability Criteria - Probability Analysis

a) The Committee deliberated at length on adopting the water availability probability criteria. A 100% probability would mean the lowest availability level and every other year availability figures would be higher. A 1% probability would be the highest recorded flow availability level. A 50% probability or average availability would imply that for half the time, the adopted flows would be available. WAPDA presented that the water availability criteria should be based on 50% probability or the average river flows. This was universally being

followed for planning of River Water Resources for Agriculture and for hydropower.

b) A view was expressed that this criteria should be conservative and based on 80% availability as adopted in some studies and plans. It was responded that the conservative criteria of 80% availability was adopted and was suitable only for the water supply schemes. It was not considered applicable to the storage/irrigation projects as it would lead to large wastages. The objective and target should be to store the entire river flows in dry as well as wet years. Each drop of fresh river water should be conserved and productively used as in future no wastages would be acceptable in emerging grave scarcity situation.

c) In view of above, it was the consensus that the planning of new reservoirs and irrigation projects should be based on the average flows or 50% probability in the rivers with an aim to conserve even the last drop of water. Starting with inter-seasonal storages capacity from summer to winter, the ultimate target should be inter-year storages capacity from wet years to dry years.

2.4.5 Eastern River Flows - Contributions in Pakistan

a) A view was expressed that since the flows of the three eastern rivers viz Ravi, Beas and Sutlej were assigned to India under the provisions of the Indus Waters Treaty. India could withdraw all the waters of these rivers in future. As such Eastern Rivers component should be taken as Nil for river water availability in Pakistan.

b) Ravi river crosses India-Pakistan international border at Kot Naina about 50 Km below Madupur Headworks and flows along the Indo-Pak boundary upto Ravi siphon about 30 Km upstream of Lahore. According to Article 11(2) of the Indus Waters Treaty the point of final crossing of river Ravi into Pakistan is one and half mile upstream of the Ravi siphon. From Kot Naina to Ravi siphon following three major tributaries join river Ravi on the right side:-

- i. Ujh
- ii. Bhein nullah
- iii. Basantar nullah

c) Another big right bank tributary of Deg nullah emanating from Jammu hills joins river Ravi above Balioki Headworks well within Pakistan territory. Similarly, Hadiara nullah joins river Ravi on the left bank. These tributaries bring substantial discharges, specially during the monsoon period.

d) The location of the international border along river Ravi in the reach Kot Naina to Ravi siphon is such that no barrage or any hydraulic structure can be constructed either by India or Pakistan, as has been the position since 1947. Consequently, the entire river flows of aforesaid tributaries are presently received in Pakistan and would continue to be received in future also.

e) Similarly Beas cum Sutlej river crosses the international border between India and Pakistan just downstream of the Ferozepur Headworks. The river flows almost along the international border for about 125 Km above Sulemanki Headworks. According to Article 11(2) of the Indus Waters Treaty the point of final crossing of river Sutlej into Pakistan is near the new Hasta Bund about 12 Km upstream of Sulemanki. Any Sutlej river escapage by India below Ferozepur Headworks appear at Sulemanki. Further any surplus flows of the tributaries of Sutlej and Beas rivers between Bhakra and Ferozepur which India cannot withhold also appear as escapages below Ferozepur Headworks. The entire drainage of the area along both banks of Sutlej river from Ferozepur to Sulemanki in a length of about 125 Km is also discharged into Sutlej river and picked up at Sulemanki.

f) There is no suitable site between Ferozepur and Sulemanki to construct any hydraulic structure to withdraw Sutlej water either by India or Pakistan. As such all these flows ultimately reach Sulemanki and become Pakistan waters.

g) It was also argued that most of these flows are received during the monsoon flood season when the western Rivers are also in flood and these cannot be made use of by Pakistan. The factual position is that when additional storage capability is developed in Pakistan, the flows of the Eastern Rivers would indirectly be utilized by higher conservation possible in the new storages. This practice is presently being followed, even with limited storage capability of Tarbela and Mangla, for making use of flood flows in the Kabul and the Chenab rivers.

h) It is also mentioned that no catchment areas of the tributaries joining Ravi and Sutlej rivers in Pakistan are demarcated nor any metering stations are established on these tributaries to check accuracy of the reported flows in these streams. Actually the flows of eastern rivers are properly computed and evaluated at Balloki (for the Ravi) and at Sulemanki for the Sutlej and form a significant component of water availability at these Headworks. These available flows are metered at the two barrages, and used and accounted for in the canal withdrawal accounts prepared by IRSA and the provinces.

i) In view of above position, the computations made and published by WAPDA and accepted by provinces and IRSA in respect of eastern river flows into

Pakistan, particularly during the post-Tarbela period since 1976 are considered dependable and authentic.

2.4.6 Additional Indian Uses from the Western Rivers under the Indus Waters Treaty Provisions

a) A view was expressed that under the Treaty India is entitled to irrigate 1,343,477 acres by making withdrawals from the western rivers. As India had so far reportedly developed 785,799 acres utilizing 6.75 MAF, therefore, for development of the remaining area India could further withdraw 4.8 MAF. These additional Indian uses should be accounted for while computing the overall river water availability for Pakistan.

b) It was brought out in the presentation before the Committee by Pakistan Commissioner for Indus Waters, that India is entitled to develop a total of 1,343,477 acres area on the western rivers out of which India had already developed 642,477 acres on the effective date of signing the Treaty and total of 811,568 acres (including 642,477 acres) up to the year 2002-03. India's entitlement to develop the balance area was therefore limited to additional 531,909 acres. This area was hilly and scattered in the catchment of the three western rivers in small lots where cultivation was possible only during summer. Most parts of these areas could not be cultivated because of extreme weather conditions.

c) According to the studies undertaken in early 1960s by M/s Harza and Tipton and Kalmbach, the total additional water requirements for developing the total area (1,343,477 acres) was estimated to be a little less than 2 MAF. This issue was also examined in detailed by the Fazle Akbar Committee in 1971 who also adopted the figure of 2 MAF for India's possible entitlement and capability of the withdrawal from the western rivers. Pakistan Commissioner for Indus Waters during his presentation to the Technical Committee on September 27, 2004 fully deliberated on this issue and estimated possible additional India uses between 1.6 to 2.6 MAF maximum, giving an average close to 2.0 MAF.

d) In view of above, WAPDA's estimation of 2.0 MAF (as the maximum figure) as India's entitlement from the Western rivers was considered reasonable. It may not be out of place to mention that out of 700,000 acres likely to be developed by India after the effective date India has so far reportedly developed about 169,000 acres. Its effect has not significantly influenced the rim-station inflows in Pakistan.

2.4.7 Additional Kabul River Uses in Afghanistan

a) A view was expressed that Afghanistan was likely to make use of 8.0 MAF of Kabul River supplies for development of its irrigated agriculture. This figure of 8.0 MAF was said to have been mentioned in some telecast broadcast. The Federal Government is already aware of possible additional irrigation uses in Afghanistan from the Kabul river. The valleys in Afghanistan are narrow, steep and barren. Reliable information so far collected in this regard through various agencies indicate that by a liberal estimate, Afghanistan could only use about 0.5MAF of Kabul river supplies to meet its consumptive uses for further irrigation developments. This was also the view expressed before the Committee by the Pakistan Commissioner for Indus Waters, and may be adopted.

2.4.8 Escapages below Kotri to Sea

a) This TOR has been addressed briefly in Para 6 of the Main Report. The actual quantity of water passed every year in the post-Tarbela period since 1976 has been documented under TOR-4(b). Data of these escapages on daily, ten-daily, monthly, and Kharif/Rabi basis is also available. The information reported by Irrigation And Power Department Sindh has been compiled and published by WAPDA.

b) In Para 7 of the Water Accord 1991, the need for further studies on the need of minimum escapages to Sea below Kotri to check sea intrusion was recognized in view of widely different ad-hoc figures quoted, with Sindh holding the view that the optimum level was 10 MAF. Presently three Studies have been awarded to three different international/national panel of consultants by the Chief Engineering Adviser, Government of Pakistan. These Studies are planned for completion by September 2005.

c) In computations of water availability for future development and new storages, the one dissenting member from Sindh had adopted 10 MAF as mandatory release and had sealed down the balance available figure accordingly.

d) IRSA has ruled that all river supplies, including flood flows and future storages stand allocated under the Water Accord which prescribes the provincial shares. The Accord has been accepted as a sacrosanct document. The shares so determined may be utilized by the provinces in their discretion and according to their priorities of uses. The felt needs may be of irrigation and municipal uses, ecological and environmental control, checking brackish water intrusion of

sea/groundwater, anti-salinity operations etc. No weightage is given to any use to alter provincial shares.

e) Indus river delta below Kotri has mostly been productively developed through Right and Left canal systems of Kotri Barrage. It is extensively cultivated and populated, has many urban and industrial centers, and is fully protected from the Indus River floods by construction of the flood embankments on Right/Left river banks. The Developed Indus Delta area covering about 3.2 million acres gets regulated canal flows of about 11 MAF from Kotri Barrage over the year and is immune to river flood flows below Kotri. The narrow strip of riverain area, about 5 miles wide between the flood bunds, has about 0.1 to 0.15 million acres cultivated patches between the river creeks and is sparsely populated. Only this narrow strip is subject to Indus floods and Sea tides travel upto 25 to 30 miles from Sea. The Coastal tidal delta extending from Karachi to Rann-of-Kachh has a separate identity and is un-influenced by any flows in the River Indus.

f) Studies I & II assigned to panels of international/national consultants on flow needs downstream Kotri are planned for completion by September 2005, and are being over viewed/monitored by a Panel of International Experts. In the high level meeting at Islamabad on April 07, 2005, the study I and II area below Kotri has been restricted to the narrow riverain belt between the flood bunds, as only this area is influenced by Indus flows/funds. The Coastal tidal delta and the developed delta irrigated by the Kotri Barrage canals have not been considered relevant and have been excluded.

g) Water needs of small cultivated patches in riverain belt aggregating to 0.1 to 0.15 million acres are likely to be nominal and may also need perennial supplies for irrigation and drinking needs from new storages. Pending finalizing of Studies and government decision on them, Water Availability estimates of balance available supplies for development are recommended to be made without this need. In the wide variations in river flows in the hydrological cycles, this would have no material effect.

2.4.9 Threshold for Future Development Uses/New Projects

a) Water Accord 1991 had adopted the average post-Tarbela canal uses data 1977-82 accepted by the Haleem Commission as the existing uses. These uses, after allowing for uses of NWFP canals above the rim stations of about 3 MAF, were estimated as 104 to 105 MAF annually. Annual canal uses show some fluctuations over the years, depending upon rainfall and river flow pattern - higher in wet years and lower in dry years. The current dry weather cycle 2000-2004 showed a marked fall. However, the long term averages over 1977 to 2003

give only marginal change over 1977-82 average. Without the commissioning of new major river storages, and with progressive silling of existing reservoirs, no sustainable upward movement in average levels is foreseen.

b) Para 7 of the Accord allocated about 12 MAF for development above the average use figure of 1977-82 mentioned in Para 14(b). It was envisaged that in the light of Para 6, new storages would come into the system for planned agricultural development. This unfortunately has not happened. No new desert lands have become green without canal irrigation and even existing integrated canal networks have faced increasing scarcity. Irrigation, agriculture and land development are provincial subjects. Without new storages, it is not appropriate to prioritize, determine and enumerate new development projects and irrigation/agriculture needs. The base line of canal uses for future development may be adopted as the accepted average figure of 1977-82. The additional Accord allocations under Para 2 are for development and be adopted as such.

2.4.10 Balance River Supplies for Future New Development Projects.

a) In their computation of balance supplies available, WAPDA had included additional requirements for such new projects as Greater Thal, Kachhi, Raineer, Pat Feeder Canals, Mangla Raising etc. out of the flood supplies under Para 4 of the Accord. One member from Sindh had demanded 2.2 MAF for LBOD scheme, and reduction of 1.0 MAF in projected water availability on account of Gomal Zam Dam.

b) It was considered that all additional uses indicated above 1977-82 level were developmental and were to be met out of the respective provincial shares. It would be possible to do so only after the commissioning of new reservoirs to cater for the additional needs on a sustained basis during the low river flow periods in Rabi, early and late Kharif. Further the computation should be based on the total average river water availability in the Indus Basin, allowing adjustments for present day average canal withdrawals, river transit losses, estimated additional/permissible Indian uses on western rivers, future estimated uses on Kabul river in Afghanistan, and the contribution of eastern rivers inflow to Pakistan. The water availability thus estimated will allow for further development, including irrigation projects and other uses by the provinces according to their priorities and shares under Para 2 & 4 of the Water Accord.

c) River storages are not water consuming structures but provide the essential regulatory capability to even out seasonal and yearly fluctuations in flows of our rivers and to achieve the estimated average use level for water availability. This aspect of storage capacity for adequate regulatory capability has been dilated under TOR-2, and would be further examined subsequently under this TOR-

4(a). The aspect of balance water availability, however, has relevance only to balance water availability for uses, and is not relevant to the need/construction of new storages capacity.

2.4.11 Balance Availability Computation - Approach Options 1- Upstream Approach

Starting from the upstream end, i.e. the rim-stations (upper most gauging points on the Indus Basin River) and proceeding downstream till the last control/diversion point of Kotri and with due consideration of the following facts :

- a) Total Water Availability: Average rim-station inflow in the western rivers.
- b) Average withdrawals of NWFP canals above the rim-stations
- c) Eastern rivers inflow contributions to Pakistan
- d) Adjustment for additional Indian Uses on Western rivers River system losses
- e) Kabul river estimated additional withdrawals in Afghanistan
- f) Kotri downstream to check sea intrusion (subject to the three studies in hand)
- g) Balance availability for further development above existing average canal withdrawals.

The final picture after deliberations/comments gives the following comparative picture, considering the different projections of one member from Sindh and of TCWR majority members:

UPSTREAM APPROACH (POST-TARBELA)			
BALANCE WATER AVAILABILITY COMPUTATIONS FOR ADDITIONAL USES			
Sr.No.	DESCRIPTION	1/	2/
1	Average Western Rivers Inflows below Rim-Station	138.09 (1922-03)	140.76 (post-Tarbela 1976-03)
2	NWFP's Canals above Rim Stations	5.65	5.65
3	Easter River run-off generated within Pakistan	0.5	3.53
4	Eastern River flows from India		4.94
5	(A) sub-total (1-4)	144.24	154.88
6	Water Accord Allocations	(Para 2) 117.40	Para 14(b) present use level 105.40
7	Indian uses on Western Rivers	4.8	2
8	Kabul River projected Uses in Afghanistan	4	0.5
9	System Losses	15	15
10	Kotri Downstream to check Sea Intrusions	10	
11	Requirement for projects under construction	11	Included in balance supplies for development
12	(B) sub-total (6-11)	162.15	123.28
13	Net for further development (5-12)	(-)17.75	31.6
14	Total Annual Development potential above present uses		31.6
1/ Projections by Sardar Ahmad Moghal, the only dissenting member of TCWR TCWR projections:			
2/ Note the Minus availability (for future development) computed by one learned member by making his ad-hoc assumptions. It would mean cutting down of existing uses and a worsening scarcity water situation and steep decline of agriculture production.			

2 - Downstream Approach

This alternative approach for determination of water availability is based on the escapages downstream Kotri over the post-Tarbela period of 1976-77, to 2002-2003. It accounts for all upstream canal abstractions/uses and the river channel conveyance losses. The other adjustments are similar to the Upstream Approach. In the present condition of Indus River System, this represents a more acceptable/dependable approach for the following reasons:

a) System operation of over 28 years after commissioning of Tarbela dam in 1976 has attained a certain level of stability due to various hydrologic changes as a consequence of Indus Waters Treaty specifically the storages and link canals, and other post-Independence developments.

a) By considering the escapages below Kotri, one controversial/significant item of prevailing river system losses is automatically taking care of, and results in exclusion from computation, thereby simplifying the matter to some extent.

The resultant comparative picture of water availability on the basis of downstream approach and as perceived by the only dissenting member and TCWR majority are listed below:

DOWNSTREAM APPROACH (POST-TARBELA)			
BALANCE WATER AVAILABILITY COMPUTATION FOR ADDITIONAL USES			
Sr.No.	DESCRIPTION	1/	2/
1	Escapage below Kotri (average post-Tarbela 1976-2003)	35.2	35.2
2	Estimated reductions/ adjustments		
2.1	Indian uses on Western rivers	4.8	2
2.2	Uses on Kabul river in Afghanistan	4	0.5
2.3	Kotri Outflow	10	
2.4	Requirement of Projects under construction	11	Included in balance supply for development
2.5	Future urban and industrial uses	5	
2.6	Un-utilized allocations under Water Accord (117.4 - 105.4)	12	14(b) uses. Additions including in balance supply for development
3	Total reductions	46.8	2.5
4	Net available for further development	(-) 11.6	32.7
1/ Projections by Sardar Ahmad Moghal, the only dissenting member TCWR			
2/ TCWR Projections			
NOTE: 1. All uses above the existing canal use levels are considered Development uses for Agriculture, industry, municipal supplies, Ecology, environmental control etc.			
2. Note the MINUS Availability (for future developments) computed by the one learned member by making ad hoc assumptions forecasting a bleak, anti-development scenario for Pakistan agriculture and grave shortages.			

2.4.12 The Committee members looked into the above comparative figures in the light of submissions/observations by the one dissenting member from Sindh. It was inferred that:

- a) The computation of balance water availability by one learned member was essentially based on rather inflated figures for various reduction adjustments and perceptive projections.
- b) Projections/estimates made by WAPDA/Pakistan Commissioner for Indus Waters of likely additional uses by India and Afghanistan were realistic. The same was the case for contributions by the Eastern River flows to river water availability additions.
- c) In view of the above, overwhelming majority of the members of the Committee (seven out of eight) support the computations of water availability by Upstream as well as Downstream Approach options in the above tables. It represents a rational balanced approach for proceeding with further development of Pakistan Water Resources.
- d) It may be noticed from the above comparative computations both for the Upstream and Downstream approach, that the prescribed water availability for further development above the existing levels by TCWR is about 32 MAF. In complete contrast, one learned member projects a bleak scenario of balance availability as Negative, (-)17.75 in one case and (-)11.6 MAF in other case, indicating adverse developments, heavy reductions in existing uses and steep fall in water uses for Agriculture, Industry and Urban uses etc. Judging it from

another angle, it implies that water is insufficient for meeting even the present day uses. This is untenable and quite unrealistic while considering that the presently about 35 MAF water is escaping unutilized below Kotri.

e) CONCLUSIONS

Water Accord recognizes that water is available for increasing the present day annual uses of about 105 MAF to above 117 MAF (Para 2). Further a significant amount of surplus water is available for further for development (Para 4) by the provinces, and the need of more storages for planned future development (Para 6). f)

In conclusion, the consensus of majority of the Committee members further recommended that water availability may be based on the Downstream Approach and adopting the average escapages below Kotri over the period 1976-2003.

2.4.13 Water for New Storages

a) It has been emphasized earlier under TOR-2 and also in Para-7(B) of the Main Report that River storage dams are not water users or water consuming structures. They help in improving the regulatory capacity to conserve river supplies in certain surplus periods of availability and use them in the deficient periods for production and development. This is due to very wide periodic fluctuations in our river waters availability over the year and between the years.

b) In the drought year 2003-04 when grave scarcity was experienced in early Kharif, heavy wastages to the extent of 20.2 MAF escapages to sea occurred when rivers rose unexpectedly in June-April, 2003 and Tarbela and Mangla Dams were full. It demonstrated significant lack of required storage regulatory capacity. Present capacity is hardly 12 MAF or less than 10% of average annual river flows, not even sufficient for inter-seasonal summer winter transfers in the year.

c) Reference TOR-4(b) giving annual escapages below Kotri in the post-Tarbela period since 1976, the peak of wettest year escapage (1994-95) is 91.63 MAF. There are contiguous wet years, and also dry years. The world's average is 40% of average annual flow as reasonable conservation and regulatory capacity. It would imply about 55 MAF storage capacities or 40 MAF above the present available level. Looking at the Escapage Table under TOR 4(b), additional 2 dams each of about 6 MAF would make +12 MAF available, and an added regulatory capacity of about 15 to 20 MAF. This should be the first priority target. Addition of more storage capacity over the system should be planned to make productive use of every drop of our fresh water even in the wet years. Fresh water is going to be a highly priced commodity in the 21st Century. We are not

lucky in having many good dam sites and should make use of every available on-channel/off-channel storages potential.

d) Creation of more storage capacity helps to improve, and in no case limit or reduce the existing uses and equity among the co-sharers. Good governance in a Federation is a core issue and perceived fears/apprehensions may not limit and cripple our growth. Ever since Water Accord 1991, inter-provincial sharing even in extreme shortage and drought periods, and operation of Tarbela and Mangla reservoirs have been carefully managed and monitored by IRSA and the federal government with the association of the provinces, and there have been no cases of deviations from the prescribed shares and discipline. River water is the most critical input for agriculture and other uses. It should be fully developed and conserved to alleviate poverty, to remove regional disparities and to accelerate economic and social development.

TOR-4(b)

Ascertain actual quantity of water passed downstream Kotri from 1976-2003

2.4.14 The relevant data in this regard compiled and published by WAPDA, on the basis of information provided by Irrigation & Power Department, Sindh is reproduced below:-

Year	Escapages Below Kotri (MAF)
76-77	69.08
77-78	30.39
78-79	80.58
79-80	29.81
80-81	20.1
81-82	33.79
82-83	9.68
83-84	45.9
84-85	29.55
85-86	10.97
86-87	26.9
87-88	17.53
88-89	52.86
89-90	17.22
90-91	42.33
91-92	53.29
92-93	81.49
93-94	29.1
94-95	91.83
95-96	62.76
96-97	45.4
97-98	20.79
98-99	35.15
99-00	8.83
00-01	0.79
2-Jan	1.93
3-Feb	2.37
Average	35.2

2.4.15 The minimum value is 0.79 MAF (2000-2001), the maximum value 91.83 MAF (1994-95), and the average 1976-2003 is 35.2 MAF. This is the data for the post-

Mangla/Tarbela period with about 15 MAF storages capacity (designed) in the system. In the last drought year 2003-04 when grave shortages were being experienced, 20.18 MAF escaped to Sea during June-August, 2004 due to inadequate regulatory storage facility. As storages provide the regulatory capability, substantially larger additional capabilities are required to be created to enable conservation and productive use of every drop of fresh river waters.

TOR-5(a)

Examine the filling criteria of Mangla Reservoir and make recommendations in this regard

2.5.1 Main observations and recommendations regarding Mangla Dam Filling and Operation were made in Para 5 of the Main Report. Filling of Mangla reservoir has to be ensured in order to provide relief after the assignment of three Eastern Rivers entirely to India, and to protect the Kharif and Rabi uses in the older canal systems serving about 13 million acres. Presently these irrigated lands could be only commanded from this reservoir which would supplement flow water availability from the Jhelum-Chenab rivers.

2.5.2 In support and elaboration of this recommendations the following facts are relevant:-

1. The Indus Waters Treaty 1960 assigned the waters of the three Eastern Rivers namely Ravi, Beas and Sutlej to India while the waters of the three Western Rivers namely Indus, Jhelum and Chenab were allocated to Pakistan except some specified uses in the occupied State of Jammu and Kashmir. Pakistan was required to meet the requirements of its Eastern River Canals from the Western rivers by constructing storage dams and inter-river links.

2. In consequence of the Indus Waters Treaty, two large storage dams: Tarbela on the Indus and Mangla on the Jhelum River along with a network of new barrages and link canals were constructed in Pakistan in an effort to meet the replacement requirements of the Eastern River canals. Details of these Replacement Works are given in Annex-D of the Indus Basin Development Fund Agreement.

3. After completion of the Indus Basin Replacement Works, known as Indus Basin Project, the Pakistan canals got divided into two zones i.e. Jhelum Chenab Zone (Mangla command) and Indus Zone (Tarbela command) according to their new sources of supply:

4. Mangla command canals provide irrigation to about 13 million acres in Northern Punjab while Tarbela command canals provide irrigation to about 8 million acres in southern Punjab, and the canal systems of NWFP, Sindh and Balochistan. Mangla command canals receive the storage supply of Mangla reservoir and flow supply in Jhelum and Chenab Rivers whereas Tarbela command canals receive storage supply of Tarbela reservoir and flow supplies of Indus/ Kabul Rivers. The Indus supplies are supplemented by flood supplies of the Jhelum and Chenab Rivers escaped involuntarily.

5. Mangla command canals are entirely dependent on the Mangla storage and river flows in Jhelum-Chenab rivers. Being the upper system, in case of shortage of supply in Jhelum-Chenab Zone, no relief can be provided even when Indus river has surplus flows. Filling of Mangla Reservoir is, therefore, essential to ensure and meet the requirements of Mangla command canals.

2.5.3 It would be beneficial if the Indus-Jhelum-Chenab rivers can be integrated into single river basin by providing an upper Indus Link above Rasul. This would benefit Sindh canals in early Kharif sowing season by utilizing early snow-melt flows of the Jhelum in March-April. Subsequently the Indus flows would provide support to the presently isolated upper system of Mangla, Jhelum-Chenab. It would enable optimum productive use of flows in all the three Western Rivers. Presently while it is the compulsion to start filling Mangla from March-April to capture early snow-melts, Sindh needs early supplies in its canals during April for Kharif sowing. Single basin regulation may enable provision of additional early supplies to Sindh canals as well as support to Punjab canals of upper system from the Indus rising in June-July.

2.5.4 Filling criteria of a reservoir entirely depends on the river hydrology. Jhelum River catchment for Mangla storage comprises of comparatively low hills having snow-melt in early summer, and outside the influence of heavy monsoons. Jhelum River starts rising in late March/early April due to early snow melt on low hills, and which is essentially over by middle of June. Hydrology of the river as well as the past experience of operating Mangla has indicted that if the reservoir does not get filled up to 80% of its storage capacity (level 1180 feet against maximum conservation level of 1202 feet) by June 30, there are strong chances that it will not fill up. The supporting information is provided by the following table for the post- Mangla period since 1967:

Filling Season	Reservoir Level on 30 June	Maximum Reservoir Level attained
1970	1105.6	1193.57 (23 Sep)
1971	1134.66	1183.76 (19 Sep)
1974	1125.01	1133.60 (03 Sep)
1979	1167.28	1196.88 (07 Sep)
1985	1130.95	1200.00 (08 Sep)
1999	1145.6	1189.30 (10 Sep)
2000	1134.25	1191.25 (Sep)
2001	1144.5	1181.35 (Sep)
2004	1139.2	1169.65 (31 Aug)

Partially Filled Mangla resulted in significant shortages of canal supply during ensuing Rabi season in the Northern Punjab canals which have no other supportive river source. The situation was exceptionally grave during the recent drought cycle 2000-2004.

2.5.5 IRSA, in consultation with the provinces and WAPDA, is responsible for developing the filling criteria of Mangla keeping in view the forecast for likely available river supply as well as irrigation requirements in the Jhelum-Chenab and Indus Zone canals. The equitable distribution of available river-cum-storage supplies and of any projected shortages is planned and kept under constant review, scrutiny and monitoring.

2.5.6 The policy and procedures followed by IRSA, with constant review and monitoring and understanding of all co-sharers, has been working satisfactorily for filling of Mangla and Tarbela storages; their draw-down and balanced distribution between Indus Zone and Mangla Zone Canals. The criteria for Mangla filling does not need any modification or change.

TOR-5(b)

Examine the Operational Criteria of Link Canals and Future Reservoirs

2.5.7 The basic recommendations under this item of TOR were made in Para 4 of the Main Report.

2.5.8 Operational criteria of link canals forming part of the Indus Basin Replacement Plan has been based on the irrigation requirements, by 10-daily/monthly periods, and has been laid down in their Design Reports. The two Indus river link canals, the Chashma-Jhelum and Taunsa-Panjnad were constructed as part of Indus Basin Project, their criteria has provided their operational guidelines and has been followed since their commissioning. This approach is supported and may continue to be followed.

2.5.9 For further elaboration, it is submitted that.

1. Controversy regarding operation of the link canals only pertains to the two Indus link canals viz: Chashma-Jhelum and Taunsa-Panjnad Links, and mainly to the Chashma-Jhelum Link.
2. The Link canals constructed in Punjab as a consequence of the Indus Waters Treaty 1960 are listed in Annex-D to Indus Basin Development Agreement. The Upper Indus Link Canal, the Kalabagh-Jhelum Link mentioned in the aforesaid Annex was later changed to Chashma-Jhelum Link from technical/economical considerations.

2.5.10 Since the enforcement of Water Accord, these Indus links are operated strictly out of the Punjab's share determined by IRSA in each crop season viz Kharif and Rabi. The two canals are perennial canals according to their design reports as well as in actual operation as they convey Replacement Supplies to the old irrigation canals from Trimmu, Panjnad and SVP systems.

2.5.11

1) Chashma-Jhelum Link with a maximum design capacity of 22000 cusecs was constructed as a perennial canal to divert storage-cum-flow supplies of Tarbela/Chashma/Indus River to feed Trimmu and Islam Canals (Lower Sutlej Valley Canals) irrigating an area of 2.8 million acres in the southern districts of Punjab.

2) Taunsa-Panjand Link was constructed with 12000 cusecs max. design capacity as a perennial canal to deliver storage-cum-flow supplies of Tarbela/Chashma/Indus River to feed the Panjnad Canals irrigating 1.5 million acres in Rahimyar Khan of southern Punjab.

2.5.12

1) Before the Indus Waters Treaty and prior to construction of these Indus link canals, Trimmu/Sidhnai Canals were receiving flow supplies of the Jhelum-Chenab and Ravi Rivers. Islam Canals (Lower Sutlej Valley Canals) were receiving supplies from the Sutlej River. The Panjnad Canals were receiving supplies from the Chenab-cum-Sutlej components.

2) As a consequence of the Indus Waters Treaty, all utilizable waters of the Jhelum and Chenab Rivers, including Mangla storage, were consumed as replacement supplies and transferred to Eastern River canals through upper links. The waters of the Ravi and the Sutlej River were assigned to India. The sources of supply of the old canals from Trimmu and Panjnad were changed and the burden of feeding these canals was shifted to the flow-cum-storage supply of Indus River. Trimmu and Panjnad were envisaged to have no dependable supplies from the Chenab-Jhelum rivers, and were to rely on the Indus Water transfers through the two Indus link canals.

2.5.13 The pattern of operating these two link canals as envisaged in the respective Design Reports, listed 10-daily requirements both for Kharif and Rabi, over the whole operating year. The design reports of Chashma-Jhelum link and Taunsa-Panjnad link canals estimated that Chashma-Jhelum link would convey 6.28 MAF in Kharif and 4.82 MAF in Rabi, while Taunsa-Panjnad link would convey 3.84 MAF in Kharif and 1.09 MAF in Rabi from the flow-cum-stored supplies of the Indus, with Tarbela storage envisaged as a Replacement Storage to supplement deficit of Mangla replacement storage. The Indus system of canals is planned to operate independently without any dependable support from the Jhelum-Chenab system.

2.5.14 A view has been expressed by Sindh that Chashma-Jhelum and Taunsa-Panjnad Link Canals were only flood water canals and should operate when there is surplus supply in the Indus River. Furthermore, views were also expressed that these two link canals should not be operated during the period when water is being stored in Mangla reservoir and also when there are shortages in the Sindh Canals. The views are not consistent with the concept of the Indus Waters Treaty, and the design and construction of the Replacement Plan Works including the storages at Mangla and Tarbela, and the link canal systems, including the two Indus river links.

2.5.15 As already mentioned, these two Indus link canals provide the new source of replacement supply for Trimmu, Islam and Panjnad old canals. These canals are, however, operated strictly out of the Punjab share under the Water Accord for equitable distribution of available supplies and fair sharing of any shortages. This is irrespective of the fact whether the supply is being stored in Mangla or Tarbela or there are shortages in Sindh or Punjab canals. The shortages are shared equitably and monitored by IRSA in consultation with provinces. Mangla and Tarbela reservoirs have essentially

to be filled as Replacement Storages as a first priority to make available supplies to the Eastern River canals from their new sources during Rabi as well as low flow periods of Kharif. Any shortages in Mangla and Tarbela Zone canals are equitably shared in the Punjab and Sindh Canals, with protection to Balochistan and NWFP canals and are closely monitored by IRSA.

The present pattern of operating the two Indus link canals is in accordance with the Replacement Plan, and sharing of shortages is constantly monitored by IRSA. It is the only appropriate course as a Consequence of the Indus Waters Treaty 1960 and the Water Accord 1991 and needs no modifications.

TOR - 6

Compliment the Parliamentary Committee on Water Resources in the discharge of its functions

2.6.1 According to the first notification of November 2003, both the Parliamentary and Technical Committees were established concurrently, and were to submit their reports within six months. However, the Parliamentary Committee under Senator Nisar A. Memon took off immediately, while the Technical Committee under Mr. A.N.G. Abbasi went through the process of finalization of its TORs and related administrative formalities till February, 2004. Thus by the time Technical Committee started its serious deliberations, Parliamentary Committee was by and large, through its deliberations and nearly completed its task. However, in order to remain in touch with the deliberations of Parliamentary Committee, the Chairman (designate) of the Technical Committee was invited to participate in its meetings. Further, upon the start of the Technical Committee deliberations through its first meeting on March 11, 2004, the Chairman of the Parliamentary Committee was specially invited to attend its TCWR meetings from time to time. He in particular actively participated in the concluding eighth meeting from February 1-3, 2005.

2.6.2 From the above it may be appreciated that both, the Parliamentary and the Technical Committees maintained a close liaison through participation by their respective Chairmen in the deliberations during various meeting. It is understood that the Parliamentary Committee had since submitted its report to the Speaker of the National Assembly/Senate. The extended date of the Technical Committee Report was April 30, 2005.

ANNEXURE-1

TO BE PUBLISHED IN THE
GAZETTE OF PAKISTAN PART-I

Government of Pakistan Ministry of Water and Power

NOTIFICATION

Islamabad April 7, 2005

No. W.III-1(1)2002-Vol-IV. Further to the Ministry of Water and Power notifications of even number dated November 15..2003 and February 14, 2004.

The duration of the Technical Committee on Water Resources headed by Mr. A.N.G. Abbasi, is hereby extended upto June 30, 2005. The Committee should however, submit its report by 30th April, 2005.

(Talat Mahmood)
Section Officer (W-III)

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Printing Corporation of Pakistan Press,
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4. Chief Secretary, Government of NWFP, Peshawar.

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6. Chairman WAPDA, WAPDA House, Lahore.

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8. President Secretariat (Public), (Brig Syed Muhammad Owais), Islamabad.

9. Deputy Secretary (C-I), National Assembly Secretariat, Islamabad.

10. PS to Minister for Water and Power.

11. PS to Secretary, Water and Power.

TECHNICAL COMMITTEE ON WATER RESOURCES

TOR-2 "Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages"

1. The solution should be found to the silting problem of Tarbella, the TAMS report should not be discarded.

2. Mangla raising will cater for most of the silting of existing reservoirs.

3. However, as per consensus reached, every drop of surplus water should be stored after meeting of the requirements of existing canals of all the Provinces under the Water Accord and for minimum outflow to sea.

4. The priority of the dams should be on the following basis:

(i) Capability to trap maximum percentage of highly variable river water surpluses.

(ii) Maximum benefits of storage and Power generation at minimum cost.

(iii) Non-Controversial projects should be given more priority. The Tunnels for high level Left and Right side outlets (Canals) of Kalabagh dam are strongly opposed. No stubs should be provided during its constructions.

5. Construction of future Dams including Kalabagh and Bhasha should be subject to the following conditions:

(i) No diversion of water should be allowed from the dam.

(ii) The criteria for operation of existing reservoirs and link canals as well as of future reservoirs should be clearly laid down and legal guarantees should be provided and there should be agency responsible to ensure that these criteria's are faithfully followed. One most important criteria should be that no storage should be allowed unless the Accord Allocations of all the provinces are met.

(iii) Readiness for implementation.

(Sardar Ahmed Mughal)

GOVERNMENT OF PAKISTAN
REPORT OF TECHNICAL COMMITTEE
ON WATER RESOURCES
Summary of Conclusions and Recommendations by the Chairman,
TCWR
AUGUST 2005

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1. TOR-4(a) "Determination of water availability for future reservoirs and irrigation schemes"
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4. TOR-2 "Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages"
5. TOR-1 "Review issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the provinces"

TOR-4(a)

"Determination of water availability for future reservoirs and irrigation schemes"

Conclusions and recommendations

1. WAPDA have not made water availability computations as a regular feature of their activities since inception, nor have they developed a standard format for computation of water availability. Had they done so, the differences of opinion which have developed could have been avoided. Moreover, WAPDA has been adopting different figures for components of water availability at different times, which has created confusion.
2. Normally the water availability computations are done on upstream basis to depict the proper accounting of the water available in a river system, and its utilization. The computation on downstream basis only indicates the outflow to sea. However, whether the computations are done on upstream basis, or downstream basis the net result should be the same if proper water accounting is done. For the purpose of this report, downstream approach is being considered in deference to the opinion of WAPDA as well as the seven members of TCWR.
3. WAPDA and Mr. Sardar Ahmad Mughal have given different computations of water availability, indicating net average water availability on downstream basis as 7.15 MAF and minus 11.6 MAF respectively. During the deliberations in the meetings of Technical Committee, the seven members fully supported WAPDA's computations, but in their report of May 2005, they have worked out their own computation of average water availability on downstream basis as 32.70 MAF. The Chairman, TCWR has given his comments on each item in this report.
4. Notwithstanding the views of the Chairman and his comments on the individual items of computation of water availability recorded in this report, the Chairman has prepared a table of computation of average water availability on downstream basis which is based almost entirely on WAPDA's figures, except the item of outflow to sea which has been taken as 10 MAF as indicated in the Water Accord, pending the completion of studies by consultants/International Panel of Experts which are in progress. According to this computation by Chairman, TCWR the net water availability comes to (-) 0.25 MAF on average year basis.

5. The non availability of surplus water on average year basis does not mean that there is no surplus water for storage at all. Considering the pattern of water availability of Western Rivers, there are large quantities of surplus water available during occasional flood years. It is this surplus water which has to be stored in future reservoirs.

6. A study of the pattern of water availability for post-Tarbela period from 1976-77 to 2002-03 reveals that during the 28 years period, more than 50% of the outflow to sea has occurred in seven years of highest flows, whereas in the lowest seven year period outflow to sea has been only about 5%. This study also shows that during most of the flood years when large quantities of surplus water are available for storage, the adoption of different values for computation of surplus water availability do not matter so much. 7. A study has also been carried out to examine the capability of the proposed future reservoirs to trap surplus water whenever available. This study indicates that storable surplus water is available for only 10 years out of 28 years of post-Tarbela period. The study also reveals that dam of 6.0 MAF will be able to trap only about 22 % of the surplus flood flows and another dam of 6.0 MAF will be able to trap additional 18.9 % of the flood flows. The two dams of 6.0 MAF together will trap about 41 %. 59% of surplus flows will still remain un-utilized after two dams are built. The study further reveals that carryover dam of 35 MAF will utilize 84% of the surplus water. According to the study, one dam of 6.0 MAF is likely to be filled for 10 years out 28 years and the second dam of 6.0 MAF will be filled for 7 years out of 28 years and partly filled for 3 years, and the carryover dam will be filled for 3 years out of 28 years and partly filled for 7 years out of 28 years.

8. The average Rabi flows of Western Rivers are 23 MAF. The present two storages i.e. Mangla and Tarbela have a capacity of about 15 MAF. The Rabi water availability has therefore increased by about 65% after construction of Mangla and Tarbela Reservoirs. A study of post-Tarbela data of canal withdrawals provided by WAPDA reveals that during Rabi the canals have drawn even higher than their Accord allocations, and there have been Rabi shortages only in a few very dry years. However, during Kharif there have been more shortages in canal supplies. Thus no more surplus water is available for transfer from Kharif season to Rabi season of the same year. Moreover, Rabi requirements of existing canals are fully satisfied by the normal river flows and the two existing reservoirs.

9. The future storages have to be planned for storage of surplus water in occasional flood years for use in subsequent low flow years. These surplus flows are of higher magnitude but with lesser frequency of occurrence. Thus the filling of future dams will be an occasional event, as compared to existing dams in which even partial filling in any year is considered as an unusual phenomenon. The prime factor for future reservoirs should be capability to store maximum quantity of surplus flood water when available. The distribution of water from future reservoirs should not be considered

according to their full capacity, but keeping in view the fact that the stored water will need to be used over a number of subsequent low flow years.

10. Three flood irrigation schemes i.e. Greater Thal canal, Kachhi canal and Raineer canal are under construction. The TCWR has unanimously agreed that the flood irrigation schemes should be given lower priority than future storages.

11. It is important to sustain and consolidate, if not to further develop and improve the agriculture in 36 million acres area commanded by existing canal systems. The allocated water of 117.35 MAF under the Accord for the existing canals therefore needs to be fully protected. The requirements of downstream Kotri to the extent of 10 MAF as indicated in the Water Accord, or any quantity decided by the government on the basis of outcome of the studies in progress, has also to be provided. The balance water whenever available should be stored.

TOR-5(a)

"Examine the filling criteria of Mangla reservoir and make recommendations in this regard"

Conclusions and recommendations

1. Mangla reservoir was constructed 38 years ago but no comprehensive operational criteria have been laid down so far. WAPDA and IRSA are reluctant to even propose the operational criteria of the reservoir. It is important to frame the operational criteria of the reservoir to remove the apprehensions of the stake holders for Mangla operations as well as future reservoirs.
2. WAPDA's view that during shortage periods, the canals should not be stressed beyond 80% (20% shortage) of their requirements, as yields are significantly affected beyond this point, is reasonable. However this is not being followed in actual practice and canals are reduced even by more than 60% when Mangla is being filled.
3. Mangla is a replacement work constructed under the Indus Waters Treaty. However the Treaty envisages the construction of replacement works for transfer of water from Western Rivers to meet the existing irrigation uses in PAKISTAN which have depended on waters of Eastern Rivers. Mangla and other replacement works are therefore not meant for any particular area or region. After construction of the replacement works, the available water in Western Rivers has to be equitably shared by all the canals under the Water Accord 1991.
4. There is adequate water in Jhelum and Chenab rivers in Kharif to meet the requirements of upper and lower tributary areas, including the areas previously receiving water from Eastern Rivers, as well for storage in Mangla reservoir, even after raising.
5. No additional link canal from Indus is justified, because the existing link canals have their capacities according to Indus Waters Treaty/ Indus Basin Development Fund Agreement. Indus River main does not have unlimited quantities of water to be transferred to Tributary areas. On the contrary, Indus main is more stressed than Jhelum and Chenab rivers.
6. Water is stored in Mangla dam during shortage periods and spilled over/wasted in the periods when it is surplus. Moreover the stored water in Mangla is not fully utilized in subsequent Rabi season in many years. This is highly regrettable.

7. The following guiding principles for operational criteria of Mangla reservoir are suggested:

(i) The basic principle of reservoir operations that a reservoir is a water bank in which water is stored when it is surplus to be used during the subsequent shortage periods must be adhered to. No water should be stored in Mangla reservoir, till the indents of the four provinces based on their Water Accord allocations are fully met.

(ii) During shortage periods if it is considered expedient and unavoidable to store water in Mangla reservoir, the allocations of canals may be reduced to not below 80% of the Water Accord allocations as per ten daily statements approved by CCI, with the unanimous consent of all the Provinces.

(iii) If adequate stored water is available in Mangla, it should be provided to lower riparian provinces, in early Kharif (April-May), when the river flows of Indus main are not enough for their minimum requirements.

(iv) The above guidelines will also be applicable after raising of Mangla dam.

TOR-5(b)

"Examination of operational criteria of link canals and future reservoirs"

Conclusions and recommendations

1. IRSA has stated that the designed discharge of CJ and TP links are only notional and that the actual operation of these canals depends on actual water availability in the rivers and on the principle of equitable water distribution according to Water Accord allocation in each 10-daily period. However in practice this principle is not being followed.
2. It has been stated that CJ and TP link canals have been constructed as replacement works under the Indus Waters Treaty and that they have certain designed discharges. However each and every canal of Indus river system has its designed discharge. Under the Treaty new sources have been provided to the canals located on Ravi and Sutlej rivers whose supplies got disconnected, but these canals have to share the water available in Western Rivers equitably under the provisions of Water Accord. No canal, whether constructed before or after the Treaty has any privileged position.
3. It is not correct that the water of Jhelum and Chenab rivers has been consumed in the canals of upper tributary areas. During Kharif, Jhelum and Chenab rivers have enough water not only for upper tributary areas, but also for lower Tributary areas and for Mangla storage even after raising. There is therefore no justification for operation of CJ and TP link canals during Kharif under normal conditions.
4. The lower Punjab Tributary areas linked to Indus through CJ and TP links cannot be treated as permanent burden on Indus main. If this unrealistic proposition is adhered to, the proposals for constructing new reservoirs on Indus will be in serious jeopardy, because there will remain no surplus water for storage in Indus main.
5. CJ and TP Link Canals are inter-Provincial canals and should be regulated as such. IRSA should not regulate these canals on the basis of the indent of one province, but these canals should be operated on the basis of principle of equitable distribution of water under Water Accord, on all Pakistan basis.
6. WAPDA and IRSA have not proposed any draft for operation of link canals, nor they have proposed the same for future reservoirs. TCWR has been assigned the responsibility to examine these criteria under this TOR. The guiding principles for operation of link canals and reservoirs have therefore to be prepared. The following guiding principles are proposed:

A. Guiding principles for operation of link canals (CJ and TP Links)

1. Water may not be transferred from Indus main to lower tributary areas through CJ and/or TP link canals in any 10-daily period, unless the Water Accord shares of the canals on Indus main according to 10-daily statements approved by CCI are satisfied.
2. Under normal conditions, no transfer of water from Indus to lower Tributary canals through CJ and TP link canals would be required in Kharif season, as sufficient water is usually available in Jhelum and Chenab rivers during this season. However, water may be transferred from Indus main to lower tributary canals through CJ and/or TP link canals only if in a 10-daily period, sufficient water is not available in Jhelum and Chenab rivers (including Mangla reservoir), after meeting the Water Accord shares of the Upper tributary canals, to satisfy the share of Water Accord allocations of the canals according to 10-daily statements approved by CCI.
3. No water should be transferred from Indus main to the lower tributary canals through CJ and/or TP link canals during the periods when water is being stored in Mangla reservoir.
4. CJ and TP Link Canals are inter-Provincial canals and should be operated as such, and not on the basis of indent of just one province.

B. Guiding principles for operation of future reservoirs

1. The storage of water in future reservoirs will be made only during the periods when surplus water is available after satisfying the indents of the provinces based on their 10-daily allocations under the Water Accord, approved by CCI, and the requirements of outflow to sea (10 MAF) or revised quantity decided by Federal Government on the basis of the result of studies being conducted by consultants/International Panel of Experts.
2. The filling of future reservoirs on Indus main will normally start only after Tarbela reservoir has attained its maximum conservation level of 1550 feet. However, in exceptional circumstances when more water is available at a particular stage of time than can be safely stored in Tarbela reservoir, the excess quantity may be stored in a new reservoir.
3. The operation of reservoirs will be done with due regard to the requirements of sediment flushing during the period June-July.
4. The following priorities will be observed for release of water stored in future reservoirs:

- i. The stored water will first be utilized to meet the shortfall in Water Accord allocations in each 10-daily period based on the canal-wise provincial allocations approved by CCI.
 - ii. The balance water will be distributed amongst provinces under para 4 of the Accord i.e. ratio 37: 37: 14: 12 for Punjab, Sindh, NWFP and Balochistan respectively.
5. The water from future storages will not be distributed on the basis of their full storage capacity, but on the basis of expected annual availability, considering that the reservoirs may not be filled up every year, and may even remain unfilled for a number of consecutive years.
6. The above guiding principles will apply to all reservoirs on Indus river system and its tributaries, except small reservoirs constructed for non-agricultural purposes like urban water supply.

TOR-2

"Assess the need for constructing dams/ reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages"

Conclusions and recommendations

(a) Silting of reservoirs

1. Reservoirs are needed to store surplus water when it is available, generation of cheap hydropower, and to compensate for the silting of existing reservoirs.
2. The siltation in the live storage capacity of existing reservoirs is about 3.2 MAF which will be off-set by raising of Mangla dam. In Tarbela, the rate of siltation is higher than that envisaged at design stage, whereas in case of Mangla, it is lower than design.
3. To increase the useful life of storage reservoirs, measures have to be taken for reducing silting, and providing efficient sediment sluicing devices. It appears that the sediment sluicing of Tarbela reservoir has not been carried out in a satisfactory manner which has resulted in huge accumulation of silt in the reservoir area.
4. The TAMS report of 1998 prepared by WAPDA's Consultants contains detailed study of siltation problem of Tarbela, and useful suggestions for remedial measures, but it has not been implemented by WAPDA, nor any satisfactory reasons have been stated for keeping it dormant. WAPDA has no other specific proposal for tackling silting problem of Tarbela. It is felt that silting problem of Tarbela needs more serious attention.

(b) Planning and prioritization of future reservoirs

5. The report of World Commission on Dams of the year 2000 has not been given adequate consideration by WAPDA. This report is based on the world experience regarding dams and it contains very useful suggestions, which need to be implemented and considered as a guideline for planning future reservoirs.
6. Considering the pattern of water availability in the Western Rivers, no surplus water is available for season to season transfer (Kharif to Rabi) of the same year, after construction of Mangla and Tarbela dams. However large quantities of surplus water for storage are available only in occasional flood years. These surplus flows are of higher magnitude but lesser frequency. This water can only be stored in carryover dam of high capacity. If any conventional dam of lower capacity i.e. about 6.0 MAF is constructed, it can trap only about 20% of surplus flood water.

7. The lower tributary areas linked to Indus through CJ and TP links should not be treated as permanent burden on Indus main. If this unrealistic proposition is adhered to, the proposals for constructing new reservoirs on Indus will be in serious jeopardy, because there will remain no surplus water for storage in Indus main. Jhelum and Chenab rivers have adequate water in Kharif season both for upper and lower tributary areas as well as for storage in Mangla dam, (even after raising), and therefore transfer of water through these links in Kharif season is not needed under normal conditions.

8. The feasibility study of the only available site of carryover dam i.e. Skardu/Katzarah has not yet been started. Pre-feasibility study of this dam was started in 2003 and is expected to be completed by September 2005. It is important that the feasibility of this dam is given high priority and it is completed within 2-3 years, because only this carryover dam can trap maximum out of the available flood waters (about 84 %).

9. The basic criteria for prioritizing and sequencing of dams should be as under:-

- i. Capability to trap maximum quantity of surplus water as and when available
- ii. Yielding maximum benefits of water storage capacity and power generation potential at minimum cost
- iii. Low capacity-inflow ratio to reduce silting problem
- iv. Readiness for implementation
- v. Nearness to the consumption areas for irrigation water and power
- vi. Considering apprehensions about a dam

10. The feasibility studies of Kalabagh dam and Basha dam are available. The feasibility study of Kalabagh dam was prepared in the year 1984-88. It therefore, requires updating, particularly with regard to the cost estimates and the reservoir filling study which was done in 1988 on pre-Water Accord scenario. The comparison of the main features of these two dams has been made in this report. Pending the completion of feasibility report of Skardu/Katzarah dam, the construction of only one of the two dams of which feasibility is available i.e. Kalabagh or Basha can be considered. It will however be appropriate if this decision is taken after updating the feasibility of Kalabagh dam. Basha dam has a definite edge over Kalabagh dam in terms of yielding more benefits of water storage capacity and power generation potential. The apprehensions about Kalabagh dam, particularly in respect of right bank and left bank canals, and flooding of Nowshera town should also be considered and settled, in consideration of the position discussed in this report.

11. If Kalabagh or Basha dam is constructed, they will not be filled every year and may remain unfilled for a number of consecutive years. These dams cannot therefore provide the full storage capacity (6-7 MAF) every year, but can provide only about 2 MAF per year. This fact has to be kept into consideration while allocating the water out of the dam. It is suggested that if one of these two dams is constructed, the available water should be earmarked for compensation of silting of existing reservoirs and to meet shortfall of Water Accord allocations.

(c) Power Generation

12. At present Pakistan has a power generation capacity of 17,309 MW, out of which 6,460 MW is from hydel power. WAPDA has projected a power requirement of 75,149 MW, by the year 2025. WAPDA has identified hydel schemes with total generation capacity of 47,306 MW.

13. According to WAPDA, 14 small hydel schemes with generation capacity of 1095 MW (ranging from 13 MW to 132 MW) are under implementation. WAPDA has completed feasibility of 25 hydel projects with total capacity of 2038 MW, most of which are very small projects. WAPDA has also completed feasibility study of 3 multi-purpose projects (Kalabagh dam, Basha dam and Munda dam) with total capacity of 8840 MW. However, WAPDA has not yet started feasibility of identified hydel projects with capacity of about 20,000 MW, which needs to be expedited. Also there are major run of the river hydel projects like Dasu, Bunji, Pattan and Thakot, some of which have the potential even higher than the multi-purpose dam projects. No major run of the river project has been implemented after completion of Ghazi-Barotha. It is important that the feasibility of major run of the river projects should be expedited and these projects implemented on fast track basis, one after the other as soon as possible.

14. WAPDA has a programme of 10 projects based on Thar Coal each of 600 MW capacity. The commencing date of these projects are from 2008 upto 2019. This programme is appreciated. However, the programme should be accelerated from the year 2011 and Thar Coal power generation increased initially to 1500 MW and then upto 3000 MW per year. It is important that the indigenous resource of Thar Coal is fully exploited to replace the costly imported oil.

TOR-1

"Review issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the provinces"

TOR-1 "Review the issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the provinces"

Conclusions and recommendations

1. In the first meeting of the TCWR held on 11th March 2004, it was unanimously decided that Water Accord 1991 is sacrosanct and should be followed in letter and spirit. The Water Accord 1991 prescribes only one method of sharing of surpluses and shortages of water on all Pakistan basis, according to provisions of paras 14(a) and 14(b) of the Accord, on the basis of ten daily statements approved by the Council of Common Interests.
2. In May 1994, the then Minister for Water and Power held a meeting of Inter Provincial Ministerial Committee in which the matters relating to the distribution of water were discussed. It was recorded in the minutes of the meeting that distribution of shortages should be made on "Historic Use Formula". Later, the Ministry advised IRSA that the Inter-Provincial Ministerial Committee is of an advisory nature and without legal mandate, and that IRSA should resolve the issue themselves.
3. In his presentation to the Technical Committee, the Chairman, IRSA stated that a decision was taken by IRSA by file circulation that the Historic Use formula should be followed for sharing shortages. However, the fro copies of the record supplied by him indicate that file was moved to and for over two years from 1994 to 1996 and after that the decision recorded by the then Chairman, IRSA by majority decision of 3-2, was not for adopting historic use formula, but for water distribution under the provisions of Water Accord. Moreover, the historic use formula was not used for water distribution till 1999.
4. IRSA referred the matter to Law Division, who advised on 16.10.2000 that the interpretation of sharing shortages on the basis of historic uses shall be a violation of the Water Accord and the Constitution. The Law Division also gave a similar advice on the subject in a more emphatic manner in their subsequent note dated 16.2.2001.

5. The Chief Executive issued instructions to IRSA on 23.10.2000 that the Ministerial Water Accord of 1994 to be annulled. IRSA issued the annulment notification according to the directives of Chief Executive after one year. However, IRSA neither acted on the advice of Law Division, nor on the instructions of the Chief Executive even after the issue of annulment notification.

6. IRSA has exempted NWFP and Balochistan from sharing the shortages which is a clear violation of para 14(b) of the Accord which lays down that the shortages and surpluses should be shared on all Pakistan basis. If NWFP and Balochistan are exempted from sharing shortages, they no more remain stakeholders in the waters of Indus River System, and as such they cannot and should not be allowed to retain their membership of IRSA.

7. According to historic use formula, during shortage periods, Punjab gets even more than its full Accord allocation, NWFP and Balochistan are exempted by IRSA for sharing shortages and therefore whole burden of shortages including additional water drawn by Punjab falls on Sindh province. This is highly unfair and unjust.

8. According to IRSA they are now following still a new distribution formula for sharing of water according to decision of IRSA's Advisory Committee. This formula consists of three different scenarios for water distribution, whereas the Water Accord provides for one and only one method of distribution of shortages and surpluses on all Pakistan basis in accordance with the 10-daily statements approved by CCI. IRSA has been established under para 13 of the Water Accord to implement the Accord. Moreover, under the IRSA Act 1992, it is required to lay down the basis for regulation and distribution of surplus water amongst the provinces according to allocation and policy set out in the Water Accord. However, not only IRSA but also its subsidiary agencies are flagrantly violating the clear and the specific provisions of Water Accord relating to water distribution.

9. The sanctity of Water Accord must be protected. The Federal Government should take effective steps to ensure that IRSA operates strictly within the scope of the provisions of Water Accord. The existing method of water distribution based on three scenarios being a flagrant violation of the Water Accord, should be annulled immediately and the distribution of shortages and surpluses made on the basis of the Water Accord and ten-daily statements approved by the Council of Common Interests.

**GOVERNMENT OF PAKISTAN
REPORT OF TECHNICAL COMMITTEE ON WATER RESOURCES**

**Including report of seven members of the Committee with comments of
the Chairman**

PART-II

Examination of TORs, Conclusions and Recommendations

AUGUST 2005

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**REPORT
OF
TECHNICAL COMMITTEE ON WATER RESOURCES**

PART-II

1. Examination of TORs, Conclusions and Recommendations

1.1 Terms of Reference of Technical Committee on Water Resources

1.1.1 The Terms of Reference of the Technical Committee notified by Government of Pakistan, Ministry of Water and Power in the two notifications No.W.III-1(1)2002-Vol-IV dated 15th November 2003, and No. W.III-1(1)/2002-Vol-IV dated 11th February 2004, as consolidated and renumbered are as under:-

1. "Review issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the Provinces".

2. "Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages".

3. "Review the progress achieved so far regarding study on escapages below Kotri and recommend measures to expedite the completion of the study".

4-a. "Determination of water availability for future reservoirs and irrigation schemes".

4-b. "Ascertain actual quantity of water passed downstream Kotri from 1976-2003".

5-a. "Examine the filling criteria of Mangla reservoir and make recommendations in this regard".

5-b. "Examination of operational criteria of link canals and future reservoirs".

6. "Complement the Parliamentary Committee on Water Resources in the discharge of its functions".

1.1.2 TORs 1 to 3, 4(b), 5(a) and 6 were notified in the first notification dated 15th November 2003, and TORs-4(a) and 5(b) were notified in second notification dated 11th February 2004.

1.2 Objections to the inclusion of two additional TORs

1.2.1 In the first meeting of the Technical Committee held on 11th March 2004, Mr. Mazhar Ali member, Technical Committee on Water Resources raised an objection that the availability of water for dams was never the issue. Chairman of the Technical Committee without any consultation with other members has got two contentious issues included under Additional Terms of Reference regarding water availability for future reservoirs and operational criteria of link canals since constructed with prescribed design and operation criteria under the Indus Waters Treaty 1960. Mr. Mazhar Ali also raised this point in the second meeting of Technical Committee held on 4th September 2004. Mr. Mazhar Ali raised the same point once again in the third meeting held on 28th September 2004, and stated that two TORs for Technical Committee were got added by the Chairman, on his own.

1.2.2 In the first meeting of the Technical Committee on Water Resources, Senator Nisar A. Memon, Chairman, Parliamentary Committee on Water Resources, advised that TORs as notified by the Government should be followed for further proceedings of the Committee. In the third meeting of the Technical Committee Mr. Shams-ul-Mulk, member Technical Committee on Water Resources said that we should follow the decision on the TORs faithfully.

1.2.3 The Chairman, Technical Committee on Water Resources explained that the TORs of the Technical Committee were decided in August 2003, immediately after the President's announcement nominating him as Chairman of the Technical Committee on Water Resources. The TORs included the matters about which people have apprehensions regarding present handling of affairs by concerned organizations in Water Sector and the future programmes. In the notification of November 2003, some of these TORs and other decided matters were missing. A summary was therefore submitted to the President/Prime Minister for their approval to correct the omissions. This was done in the notification of February 2004. The Technical Committee has therefore to follow the TORs as notified by Government, in its proceedings.

1.3 Order of consideration of TORs

1.3.1 During the proceedings of Parliamentary Committee on Water Resources the Chairman and the members of the Parliamentary Committee and the representatives of the provinces attending meetings of the Parliamentary Committee requested the Chairman, Technical Committee to start consideration of TOR relating to water availability, being more important, on priority basis. It was therefore considered proper

that the TOR-4(a) "Determination of water availability for future reservoirs and irrigation schemes" may be taken up first. It was also felt that TOR-5(a) "Examine the filling criteria of Mangla reservoir and make recommendations in this regard" and TOR-5(b) "Examination of operational criteria of link canals and future reservoirs", may be taken up next so as to prepare the ground for consideration of TOR-2 relating to construction and sequencing of future reservoirs.

1.3.2. In view of the above it was decided to arrange the presentations and take up the consideration of the TORs of Technical Committee in the following order.

4-a. "Determination of water availability for future reservoirs and irrigation schemes".

5-a. "Examine the filling criteria of Mangla reservoir and make recommendations in this regard",

5-b. "Examination of operational criteria of link canals and future reservoirs".

2. "Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages".

1. "Review issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the Provinces".

The TORs will be discussed in this report in the same order.

1.3.3 The following TORs were excluded from the presentations and detailed discussions due to reasons indicated against each:-

TOR-3 "Review the progress achieved so far regarding study on escapages below Kotri and recommend measures to expedite the completion of the study"

The position paper already supplied by the Chief Engineering Adviser in March 2004 was considered adequate. It was felt that progress of the three studies could be monitored through monthly progress reports.

TOR-4(b) "Ascertain actual quantity of water passed downstream Kotri from 1976-2003."

The information supplied by WAPDA regarding outflow to sea in post-Tarbela period was based on recorded data and therefore considered acceptable.

TOR-6 "Complement the Parliamentary Committee on Water Resources in the discharge of its functions".

No information, data or presentation is required for this TOR.

These TORs will also be dealt with in the report keeping in view the available information and material.

1.4 It was decided in the meeting held at President's House on 25th May 2005, that the Ministry of Water and Power will get the report containing views of the members of Technical Committee on Water Resources duly signed by them and send it to the Chairman, Technical Committee on Water Resources for incorporating the same in the report of Technical Committee on Water Resources along with his comments. The Chairman, TCWR received the report of the seven members of TCWR including a separate note of the eighth member of TCWR from the Minister for Water and Power on 9th June 2005. This report of seven members of Technical Committee and the note of the eighth member has been enclosed as an attachment with this report.

1.5 The issues relating to each of the TORs 4(a), 5(a), 5(b), 2 and 1 have been examined in subsequent paras of this report in the light of the data and material supplied and deliberations held in the meetings of the Technical Committee. The views of the members contained in their report of May 2005 have also been incorporated in this report under each TOR, along with the comments of the Chairman. No detailed examination was considered necessary for TORs 3, 4(b) and 6 and therefore no presentations were arranged as mentioned in para 1.3.3 above. However a brief report on these TORs is also included in this report.

1.6 The Conclusions and Recommendations by the Chairman, Technical Committee on Water Resources, in respect of TORs 4(a), 5(a), 5(b), 2 and 1 have been given at the end of each TOR. A summary of the Conclusions and Recommendations has also been prepared and it is presented as a separate compilation.

TOR-4(a)

"Determination of water availability for future reservoirs and irrigation schemes"

2. TOR - 4(a) "Determination of water availability for future reservoirs and irrigation schemes"

2.1 Sources of water availability

2.1.1 Water is an important resource of any country. Pakistan being predominantly an agricultural country, water plays a very significant role in its economy.

2.1.2 Pakistan depends almost entirely on the flows of the river Indus and its tributaries for its irrigation requirements. Under the Indus Waters Treaty 1960, the three Eastern Rivers (Ravi, Sutlej and Beas) of the Indus System have been allocated to India for their exclusive use whereas the three Western Rivers (Indus, Jhelum and Chenab) have been allocated to Pakistan, with certain provisions for uses of water of Western Rivers by India in the Northern Regions of occupied Kashmir.

2.1.3 The other sources of water are rainfall and groundwater. There are about six hundred thousand tube-wells (most of them located in sweet groundwater areas, in central Pakistan) yielding over 40 MAF of water for irrigation purposes.

2.2 Overall water availability scenario

2.2.1 The flows of the Western Rivers allocated to Pakistan are highly erratic. Maximum flow of 186.79 MAF occurred in the year 1959-60 and minimum flow of 97.17 MAF occurred in the year 2001-02. There is also seasonal variation in the flows. Major part of the flows (84%) occur in Kharif season (summer months) where as the flows in the Rabi season (winter months) are much lower (about 16 %).

2.3 Development of irrigated agriculture in Pakistan

2.3.1 The history of irrigated agriculture in Pakistan dates back to early nineteenth century. In earlier periods, irrigation water was provided from inundation canals which depended on the levels in the rivers and functioned only during floods. Later on barrages were constructed, first on smaller tributaries and then on Indus main, to provide weir controlled irrigation to the commanded areas. At the time of independence in 1947, the canal withdrawals were only about 64 MAF. Since then there has been further development and expansion in the irrigation system. The present irrigation system of Pakistan covers a culturable commanded area of about 36 million acres. The present system consists of 19 headworks, 43 canal systems and 2 large storage reservoirs. In the year 1991, the Water Accord was signed amongst the

provinces. Under the Accord 117.35 MAF of water has been allocated to the four provinces for their existing canals systems.

2.4 Presentations on TOR-4(a)

2.4.1 The presentations were made on TOR-4(a) by Secretary, Planning and Development Division and Member (Water), WAPDA to the Technical Committee in its second meeting held on 4th September 2004. The presentation made by Member (Water), WAPDA did not cover some points and therefore an additional presentation was made by him in the third meeting of the Technical Committee held on 27th September 2004.

2.4.2 The Pakistan Commissioner for Indus Waters was requested to make presentation on the following aspects of water availability.

- a) India's entitlement of Western Rivers and flows of water from Eastern Rivers in the light of Indus Waters Treaty 1960.
- b) Satisfactory observance of Indus Waters Treaty or any breaches of agreement etc., and the likely effects on Pakistan.
- c) Information regarding Kabul River flows and the proposed Treaty with Afghanistan for sharing of Kabul River waters.

The Pakistan Commissioner for Indus Waters made the presentation to the Technical Committee in the third meeting of the Committee held on 27th September 2004.

2.4.3 Mr. Sardar Ahmad Mughal, member Technical Committee gave his written comments on WAPDA's presentations dated 4.9.2004 and 27.9.2004. The Member (Water), WAPDA gave his responses to the comments of Mr. Sardar Ahmad Mughal. Mr. Sardar Ahmad Mughal then sent rejoinders to the responses made by WAPDA.

2.5 Observations on Presentation by Planning and Development Division

2.5.1 It was observed that the TOR-4(a) relates to "Determination of water availability for future reservoirs and irrigation schemes" but the Planning and Development Division made the presentation about water availability at farm gate. Moreover, the presentation contained the data of seepage losses in the irrigation system (presumably to identify the need for lining of water courses and irrigation channels), which was not required for the TOR under consideration. Moreover, the Planning and Development Division did not mention any thing about the approval status of WAPDA's Vision 2025 Programme. A list of the projects under implementation and those under process for feasibility and approval under the Vision 2025 programme has however been provided,

but the Planning and Development Division could not clearly indicate the priority between future reservoirs and flood irrigation schemes.

2.6 Observations on Presentation by WAPDA

2.6.1 WAPDA has not made water availability computations as a regular feature of their activities since its inception, nor have they developed any standard format for computations of water availability. Had they done so, and made water availability computations as an annual feature of their activities, the difference of opinion which has developed could have been avoided. This was pointed out to WAPDA by the Chairman, Technical Committee during the discussions on the TOR on water availability.

2.6.2 In WAPDA's Vision 2025 Programme estimated to cost over US \$ 50 billion, there are no computations of water availability. In fact, even there is no mention about water availability. In this document, storage reservoirs with capacity of 59.43 MAF have been included. It was however, explained by WAPDA that the Vision 2025 Programme only identifies the list of potential storage sites, but the actual implementation will be according to the feasibility of each project and the availability of water.

2.6.3 River Flow Data on Water Availability

2.6.3.1 In the first meeting of the Technical Committee held on 11th March 2004, it was unanimously agreed that the basic hydrological data relating to the river flow etc. as recorded and documented by WAPDA will be acceptable to the Technical Committee. This has been rightly pointed out by the seven members of the Technical Committee in their report of May 2005. 2.6.4 Water Availability Criteria

2.6.4.1 This issue was deliberated in the meetings of Technical Committee. One view point was that the criteria of average Water Availability (50% probability) may be adopted. The other view point was that the criteria 4 out of 5 (80% probability) may be adopted, because for future reservoirs, reliable availability of water has to be ensured. The Federal Government policy documents, the latest being Ten Year Perspective Plan 2001-2011, indicate that the 4 out of 5 years criteria has to be adopted. However, in the 5th meeting of the Technical Committee held on 22.11.2004, the Technical Committee felt that under the present circumstances of diminishing of Water Availability, every drop of water when ever available has to be conserved.

2.6.5 Upstream and Downstream Approaches

2.6.5.1 The normal procedure for water availability computations is on upstream approach basis i.e. how much water is received at the rim stations, what are the abstractions, usages, system losses etc and the outflow to the sea. Thus the upstream

approach enables the proper and complete accounting of the water in a river system. The concept of downstream approach was initiated by WAPDA for the first time in the year 1994. This approach only determines the net outflow to sea without indicating the total availability and how it was utilized. However, whether the water availability computations are made on upstream basis or downstream basis, the net result should be the same, if the water accounting is done correctly and meticulously.

2.6.6 Water Availability Computations by WAPDA.

2.6.6.1 WAPDA has included the following three tables in respect of their latest Water Availability computations in their presentations of 4th September 2004;

- i. Average water availability on downstream approach basis 14.95 MAF (Annexure II-1)
- ii. Average water availability on on upstream approach basis 14.23 MAF (Annexure II-2)
- iii. Latest Water availability on downstream basis 19.1 MAF (Annexure II-3)

It is not understood, why WAPDA has included two separate computations of water availability on downstream basis (Annexure II-1 and Annexure II-3) in their presentation.

2.6.6.2 There are following inconsistencies in the computations:-

(i) WAPDA's computations at (Annexure I-1) (downstream approach basis) and (Annexure II-2) (upstream approach basis) do not include the item of water requirements of projects under construction as indicated by WAPDA in the computations of water availability on downstream basis at (Annexure II-3). As decided in the fifth meeting of the Technical Committee held on 27th November 2004, provision has to be made in respect of the projects under construction in the water availability computations, and that some completed projects and those under construction omitted by WAPDA may also be included.

(ii) WAPDA's water availability computations on downstream basis at (Annexure II-3) do not include the item of balance Accord allocation which has been included in the water availability computation on downstream basis (Annexure II-1) and the computation on upstream basis (Annexure II-2). 2.6.6.3 The above inconsistencies have been corrected in the respective Annexures and resultantly the net water availability according to WAPDA's computations works out as under:-

i. Net water availability on upstream basis	6.43 MAF
ii. Net water availability on downstream basis	7.15 MAF

2.6.7 Variations in WAPDA's computations and non-observance of Government policies

2.6.7.1 WAPDA's method of water availability computations reveals the following variations:-

(i) Data base period

The data base period adopted by WAPDA for water availability computations has been different at different times, as depicted in the table included in the presentation to Technical Committee on 4th September 2004 (Annexure II-4). WAPDA has however omitted from this list the study of 1992 by their two General Managers of WAPDA, and the filling studies of Kalabagh reservoir of 1988 by Kalabagh Consultants. In both these studies WAPDA has taken the data base period of 1922 to date. Moreover, the latest policy documents of Federal Government i.e. Ten Year Perspective Plan 2001 - 2011 approved by the National Economic Council (NEC), and the National Water Policy Report by Federal Government (both listed by WAPDA in table at Annexure II-4), also indicate data base period to be 1922 to date. Thus adoption of any base period other than that stated in Federal Government policy documents and most of the earlier computations by WAPDA itself, is not justified in any case. Moreover, in the fifth meeting of Technical Committee held on 25.11.2004, it was unanimously agreed that the data base period of 1922 to-date may be adopted for water availability computations. (though one member, Mr. Mehmood-ul- Hassan Siddiqi later sent his dissent note).

(ii) Variation in computation of water availability from Eastern River Inflows

(a) Initially in the computation of water availability for National Commission on Agriculture (1987), WAPDA has indicated the figure of 2.0 MAF to be Eastern Rivers contribution, because at that time WAPDA was of the view that though Eastern Rivers have been allocated to India for their exclusive use, India will not be able to stop all the water of these rivers. At that time WAPDA had not mentioned anything about the regeneration of water within Pakistan. Later on, in the water availability computations of 1994, WAPDA stated that "No doubt India is entitled under the Treaty to unrestricted use of Eastern Rivers but it is limited only to run-off generated within its own territory, the lowest control points for which are Madhopur on Ravi and Ferozepur on Sutlej". Accordingly, in the water availability computations of 1994, WAPDA did not include any inflow from the Eastern Rivers from India, but only included the provision for regenerated water within Pakistan.

(b) In their presentation at the conference held by Senator Nisar A. Memon, the then Federal Minister for Information at Bhurban on 20th June 2002, WAPDA indicated the reduction due to loss of Eastern Rivers contribution from India as 4.9 MAF, in their computation of water availability on downstream basis, thus confirming that no contribution of inflows from Eastern Rivers from India can be expected. However in the latest computations presented to the Technical Committee on Water Resources, WAPDA has indicated Eastern River contribution both in the form of outflow from India as well as in the form of regeneration within Pakistan.

(iii) Difference in figures adopted for downstream Kotri

(a) In their first water availability computations in 1992 (by two General Managers of WAPDA), after the signing of Water Accord, WAPDA adopted a figure of 10.0 MAF for outflow to sea as indicated in the Water Accord. But in their subsequent water availability computation of 1994, WAPDA has shown the figure of 5.8 MAF.

(b) In the presentation in the Conference held at Bhurban by Senator Nisar A. Memon, the then Federal Information Minister, on 20th June 2002, WAPDA mentioned the figure of 6.5 MAF for outflow to sea.

(c) Further in the latest computation of water availability in their presentation to the Technical Committee on Water Resources, WAPDA has again indicated the figure of 5.8 MAF. It has been stated that this figure is based on graduated scale but it has not been explained what that "graduated scale" actually means. There is no rationale at all for this figure.

(d) The Water Accord provides a figure of 10 MAF pending the studies for outflow to sea, which are in progress. Moreover Ten Year Perspective Plan 2001-2011 approved by the National Economic Council (NEC) also indicates the figure of 10 MAF. Also in the presentation by the then Minister for Water and Power at Pakistan Development Forum on 18th March 2004, the figure of 10 MAF was indicated before donor agencies and the latest Federal Government document "National Water Policy 2005" also indicates the figure of 10 MAF for outflow to sea. Under the circumstances, the figure of 10 MAF has to be adopted for outflow to sea, pending completion of studies by consultants and international experts which are in progress and in final stages, and the decision of the Government thereon.

2.7 Computations of Water Availability by seven members of Technical Committee

2.7.1 The computations of Water Availability made by WAPDA in the presentations to the Technical Committee were discussed in detail in the subsequent meetings of the Technical Committee. The seven members of the Technical Committee fully supported WAPDA's computations during the deliberations in these meetings. Six members also supported WAPDA's computations in their letters to the Secretary, Technical Committee. Mr. Shams-ul-Mulk who could not attend earlier meetings of the Technical Committee in which the TOR-4(a) regarding Water Availability was being discussed, stated in the seventh meeting of Technical Committee held on 11th January 2005, that he entirely agrees with the presentations made by WAPDA in this regard. No separate computations were presented by any of the seven members for consideration by the Technical Committee.

2.7.2 Mr. Sardar Ahmad Mughal, member Technical Committee offered his written comments on the presentations of WAPDA. In his comments, Mr. Mughal also gave his own computations regarding water availability on upstream and downstream basis with reasons for disagreeing with WAPDA's figures on certain components of the computations.

2.7.3 The report of the seven members of the Technical Committee of May 2005, includes computations of Water Availability on upstream and downstream basis at pages 35 and 37 of the "Elaborations ". As mentioned at para 2.7.1 above, the distinguished seven members did not present any separate computations in the meetings of the Technical Committee in which the TOR-4(a) on Water Availability was deliberated, but they supported WAPDA's computations. In their computations now given in their report of May 2005, the seven members have compared their computations with those of Mr. Sardar Ahmad Mughal. However, they have not made any comparison of their computations with WAPDA's figures, with whom they had fully agreed during the proceedings of the Technical Committee. The following table gives a comparison of the figures of net Water Availability on upstream and downstream basis by WAPDA, by seven members of Technical Committee and by Mr. Sardar Ahmad Mughal, member Technical Committee.

Table			
Net water availability (MAF) computed by			
Item	WAPDA	Seven Members	Mr. Sardar Ahmad Mughal
1	2	3	4
Upstream approach	6.43 (Annexure II-2)	31.6	(-) 17.75
Downstream approach	7.15 (Annexures II-1 & 3)	32.7	(-) 11.60

The above table shows that the net water availability now computed by the seven members is much higher than that presented by WAPDA. 2.7.4 The seven members of TCWR in their report of May 2005, have stated regarding TOR-4(a) as under:-

"Various aspects of the issue have been the subject of criticism and exhaustive documentation and observations by Sardar Ahmad Mughal from Sindh, the only dissenting Committee member, and supported by the Chairman, TCWR. These dissenting views were in conflict with detailed presentations/ documentations by WAPDA, Pakistan Commissioner for Indus Waters, Chairman IRSA, Planning Division, Water Sector Master Plans, WAPDA Vision 2025, and numerous national/ international studies and plans on Development of Pakistan Water Resources by World Bank, Asian Development Bank, JICA etc. The main thrust of the dissenting views was to present an assumed bleak scenario for Pakistan of Nil or Negative surplus river flows for any future development, in contrast to exhaustive documentation to the contrary".

2.7.5 It is unfortunate that the seven members have singled out Mr. Sardar Ahmad Mughal for criticism. They have mentioned that Mr. Mughal's views were in conflict with WAPDA, PCIW, IRSA, Planning Divisions etc, but they have not made any comparison of the views and figures adopted by Mr. Mughal and other agencies. The seven members have also not realised that their own computations show a vast variation from WAPDA's figures. 2.7.6 The seven members have even accused the Chairman, TCWR of supporting Mr. Sardar Ahmad Mughal. This is both incorrect and unfair. During the deliberations of Technical Committee, the Chairman, encouraged every member, and every other participant to freely express their views. He never supported or opposed the views expressed by any member or participant.

2.7.7 The seven members have also stated that the main thrust of dissenting views was to present an assumed bleak scenario for Pakistan of Nil or Negative Surplus River flows for any future development. In this respect the comparison given in the table under para 2.7.3 is self explanatory. This table reveals that as against the net average water availability of 6.43 MAF and 7.15 MAF computed by WAPDA on upstream and downstream approach basis respectively, the seven members have calculated the water availability of 31.6 MAF and 32.7 MAF respectively. This is notwithstanding the fact that all the seven learned members had supported and endorsed WAPDA's computations of water availability during the proceeding of the Technical Committee. So if the computations of Mr. Sardar Ahmad Mughal are termed as "bleak", can the computations of seven members be considered "realistic"?

2.8 Item-wise comparison of Water Availability computations by WAPDA, seven members, TCWR and Mr. Sardar Ahmad Mughal, and comments of Chairman, TCWR

2.8.1 There has been consensus amongst WAPDA, seven members of Technical Committee and Mr. Sardar Ahmad Mughal on the figures adopted for the following components:-

i. NWFP's diversions above Rim -stations including un-gauged civil canals	5.65 MAF
ii. System Losses	15.00 MAF

2.8.2 The Water Availability computations on upstream and downstream basis by WAPDA in the presentation before the Technical Committee have been described in para 2.6.6 and 2.6.7 above. The seven members of the Technical Committee had generally agreed with the computations of WAPDA during the deliberations of the Technical Committee and they had not given any separate computations. However in their report of May 2005 the seven members have given their own computations of Water Availability on upstream and downstream basis. The net Water Availability now computed by the seven members shows wide variations from WAPDA's computations. Mr. Sardar Ahmad Mughal had given his own computations earlier in his comments on WAPDA's presentation. It is therefore necessary to examine the details item-wise by comparing the figures adopted by WAPDA, seven members and Mr. Sardar Ahmad Mughal. The component-wise figures are discussed in the following paragraphs:

2.8.3 Period of Water Availability Computations

2.8.3.1 The following periods of Water Availability computations have been adopted:

WAPDA	1976 to-date (post-Tarbela)
Seven Members	----do-----
Mr. Sardar Ahmad Mughal	1922 to-date

2.8.3.2 Views of WAPDA

WAPDA has adopted the post-Tarbela period from 1976 to-date in their computations of water availability.

2.8.3.3 Views of seven members, TCWR

The seven members of Technical Committee have expressed the view that the data from 1922-1940 was not so consistent and reliable as it had been recorded by using earlier procedures outdated now. They have also stated that the rivers and canals have been subjected to substantial changes due to construction of new hydraulic works, storages and link canals

2.8.3.4 Comments of the Chairman, TCWR

(i) This item has been fully discussed in para 2.6.7.1 (i) above. In most of the earlier computations by WAPDA and in the policy documents of the Federal Government, the data from 1922 to-date has been adopted and this should have been continued till now.

(ii) It has not been mentioned by seven members what was actually wrong with the earlier river flow measurements and why and on what basis these are being discarded. As regards construction of new works on the Indus River System, the construction of any dam or any other structure on a river does not change the total water availability in the river system, and the useful long term data cannot be disregarded on that account.

(iii) In the fifth meeting of the Technical Committee held on 25.11.2004, it was unanimously decided to adopt data base period for Water Availability computations from 1922 to-date. However, later on only Mr. Mehmood-ul-Hassan Siddiqi, member Punjab sent a letter of dissent. It is not understood how the seven members are now resiling from the unanimous decision of the Technical Committee. Under the circumstances it is prudent that the data-base for Water Availability computations from 1922 to-date should be adopted.

2.8.4 Eastern Rivers Run-off generated from within Pakistan and Eastern River Inflows

2.8.4.1 The figures indicated by WAPDA, seven members and Mr. Sardar Ahmad Mughal in their computations are given in the table below:

Table			
	Net water availability (MAF) computed by		
Item	WAPDA	Seven Members	Mr. Sardar Ahmad Mughal
1	2	3	4
i. Eastern Rivers Run-off generated from within Pakistan	3.53 (Annexure II-2)	3.53	0.5
ii. Eastern Rivers Inflows	4.94 (Annexure II-2)	4.94	

2.8.4.2 Views of WAPDA

WAPDA has expressed the view that India has already constructed number of dams on Eastern Rivers and therefore the water that is coming to Pakistan from India will not be

reduced hereafter. WAPDA has also stated that the water regenerated in Pakistan Territory will be available for use in Pakistan.

2.8.4.3 Views of seven members, TCWR

In their report of May 2005, the seven Members of the Technical Committee have not made any comments on the Eastern Rivers Inflows from India (4.94 MAF as given in WAPDA's presentation), though they have included this item in the table of their water availability computations. The seven members have however supported WAPDA's version about regeneration of water within Pakistan.

2.8.4.4 Comments of Chairman, TCWR

(i) In this respect the comments in para 2.6.7.1 (ii) are referred. As observed therein, in the earlier computations, WAPDA has not included the Eastern Rivers contributions from India but they have only incorporated re-generation in Eastern Rivers within Pakistan and that also later on, after 1994.

(ii) The Thein dam (2.65 MAF) has recently been commissioned on River Ravi in the year 2000. The flows of water from Ravi after construction of this dam have greatly reduced.

(iii) Since the three Eastern Rivers have been allocated to India for their exclusive use, there is no bar on India to utilize remaining available waters of Eastern Rivers, by remodelling of their exiting canals or construction of new works. Moreover the flows of Eastern Rivers are highly erratic. During post- Tarbela period the maximum Eastern Rivers contribution was 17.3 MAF in the year 1978-79 and the minimum was 0.41 MAF in the year 2000-2001. The maximum flows from Eastern Rivers generally comes at a time when the Western Rivers are already in high flood and therefore the water of Eastern Rivers cannot be utilized in these periods.

(iv) According to the presentation made by Pakistan Commissioner for Indus Waters before Technical Committee on 27th September 2004, regarding Eastern Rivers, he has stated :-

"Pakistan is allowed limited Agriculture Use of 45,500 acres from tributaries of Ravi, namely Basantar, Bien, Tarnah and Ujh".

Thus the total entitlement of Pakistan for use of water on these Nullas will therefore be only about 0.2 MAF.

(v) The quantity of re-generation of water within Pakistan according to the figures of WAPDA, is also highly erratic i.e. maximum re-generation of 9.65 MAF in 1991 and minimum of 0.67 MAF in 2000-01

(vi) A realistic view has therefore to be taken in respect of Eastern Rivers contribution from India and regeneration of water within Pakistan in consideration of above. We cannot expect any water to come from Eastern Rivers from India, as these rivers have been allocated for India's exclusive use.

2.8.5 Indian uses on Western Rivers and Kabul River Shortfall

2.8.5.1 The above two components pertain to the water uses by Upper Riparian countries i.e. India and Afghanistan. WAPDA, seven members of Technical Committee and Mr. Sardar Ahmad Mughal have indicated the following figures as shown in the table given below.

Table			
Net water availability (MAF) computed by			
Item	WAPDA	Seven Members	Mr. Sardar Ahmad Mughal
1	2	3	4
i. Indian Uses on Western Rivers	2 (Annexure II-1)	2	4.8
ii. Kabul River Short fall	0.5 (Annexure II-1)	0.5	4

2.8.5.2 Views of WAPDA and seven members of Technical Committee

In their report of May 2005, the seven members of Technical Committee have supported WAPDA's version that India can use only 2.0 MAF additional water for irrigating the remaining area according to their entitlement under the Indus Waters Treaty 1960. The learned members have also expressed the view that Afghanistan can only use 0.5 MAF of Kabul River water to meet its consumptive uses for irrigation development, because the valleys in Afghanistan are narrow, steep and barren.

2.8.5.3 Comments of Chairman, TCWR

(i) According to Indus Waters Treaty 1960, India is entitled to irrigate 1,343,477 acres of land from Western Rivers. This was also stated by the Pakistan Commissioner for Indus Waters in his presentation before the Technical Committee on 27th September 2004. No quantity of water has been prescribed in the Indus Water Treaty for irrigation of this area. The figure of 2.0 MAF shown by WAPDA in their computation and supported by seven members is based on water allowance of Chashma Right Bank Canal. It is for

consideration whether India's uses can be restricted to the figure indicated by WAPDA and seven members.

(ii) As stated by the Pakistan Commissioner for Indus Waters, India cannot be restricted to use lesser quantity of water to share the shortages with Pakistan during the periods of low flows. We are more concerned about water availability in shortage periods, because in high flow periods, adequate water will be available in any case.

(iii) According to presentation of Pakistan Commissioner for Indus Waters, there have been many violations on Indus Waters Treaty by India, as they have already constructed some structures and they are also planning to construct some more works on Jhelum and Chenab Rivers in violation of the provisions of Treaty. This will mean further reduction in the water available to Pakistan. The case of Baglihar dam has already been referred by Pakistan to World Bank and is now being examined by neutral expert appointed by the Bank. Similar is the case of Kirshan Ganga Project.

(iv) In consideration of above, WAPDA's assumption that India can be restricted to use only 2.0 MAF of Western Rivers for developing their remaining area as entitled in the Indus Waters Treaty, appears to be unrealistic. (v) As regards the water uses by Afghanistan on Kabul River, the figure adopted by WAPDA and supported by seven members of Technical Committee (0.5 MAF) pertains to only one project in Afghanistan (KAMA Project). Pakistan Commissioner for Indus Waters has given a list of some other projects which Afghanistan proposes to develop, though their details are not known to him. It is also known that International Agencies are assisting Afghanistan in a big way for development of their water resources. In this connection, some excerpts from Internet, which were also circulated to the members of Technical Committee in its third meeting held on 28.9.2004 are given in (Annexure II-5).

(vi) Kabul River makes substantial contributions to the flows of river Indus, particularly during low flow periods. There is no Treaty so far with Afghanistan, though the Government of Pakistan has initiated the process. It is important that this Treaty should be expedited. In initiating the Treaty the existing uses of Kabul River waters both on Kabul River itself in NWFP as well as in lower riparian areas of the country must be protected. It is pertinent to say that most of the waters of Kabul River are already being utilized in Pakistan, in the existing canal systems.

(vii) Under the circumstances Afghanistan cannot be restricted to use only 0.5 MAF for their development uses on Kabul River. More realistic figure has to be adopted.

(viii) In the presentation before Pakistan Development Forum on 18th March 2004, the then Minister for Water and Power has indicated the figure of anticipated water uses by Upper Riparian States (India and Afghanistan) to be 5.0 MAF. As against this WAPDA

has indicated the figure of only 2.0 MAF for use on Western Rivers by India and 0.5 MAF for Kabul River in Afghanistan i.e. total 2.5 MAF. This needs clarification.

2.8.6 Kotri Outflow to Check Sea Water Intrusion

2.8.6.1 The figures adopted by WAPDA, seven members of Technical Committee and Mr. Sardar Ahmad Mughal are as under:

Table			
Net water availability (MAF) computed by			
Item	WAPDA	Seven Members	Mr. Sardar Ahmad Mughal
1	2	3	4
To check sea water intrusion	5.8 (Annexure II-1)	0	10

2.8.6.2 Views of WAPDA

WAPDA has adopted the figure of 5.8 MAF on "graduated scale"

2.8.6.3 Views of seven members, TCWR

(i) The seven members of Technical Committee in their report of May 2005, have shown zero provision for downstream Kotri mentioning IRSA's ruling (neither specified nor copy enclosed) that provinces should use its allocated share to meet the needs of environment and ecological control of checking sea intrusion etc.

2.8.6.4 Comments by Chairman, TCWR

(i) At page 5 of their report, the seven members have mentioned that "due to lack of adequate storage capacity, on an average annually over 39 MAF escapes below Kotri varying from 8 MAF to 92 MAF. However the data provided by WAPDA shows that the average outflow to sea for the post- Tarbela period 1976-77 to 2003-04 is 35.2 MAF. Also WAPDA's statistics indicate the minimum outflow to sea has been 0.79 MAF during 2000-01. It seems that the figures mentioned by the learned members, have been indicated without proper verification.

(ii) During the deliberations in the meetings of Technical Committee on Water Resources, five out of seven Members of Technical Committee supported WAPDA's figure of 5.8 MAF. Two Members from Punjab, Mr. Mazhar Ali and Mr. Mehmood-ul-Hassan Siddiqi stated that no outflow to sea is necessary and that if any flow is to be allowed for downstream Kotri it may come from Sindh's share. Now in the report of

May 2005, all the seven members of TCWR, have stated that zero provision should be made for outflow to sea.

(iii) The views of seven members as an afterthought to make zero provision for downstream Kotri and to suggest that the requirement may be met from the allocations of the province is not understandable. The Accord allocations under para 2 are for existing canal systems and distributed canal wise for each canal in the 10 daily statements approved by the Council of common Interests (CCI). Also a figure of 10 MAF has been separately indicated in the Accord for outflow to sea, pending studies to be conducted by consultants. The Federal Government has since initiated the studies by consultants/international experts, after getting TORs agreed by all provinces, which are in final stages, and the reports are expected in October 2005. This very fact that studies are being conducted by Federal Government indicates that the requirements of outflow to sea as decided on the basis of recommendations of consultants and international experts have to be met from the total available river flows after meeting Accord allocations of existing canals, and not from the share of a province.

(v) This item has also been discussed in detail in Para 2.6.7.1(iii) above. As explained therein, the figure of 10.0 MAF outflow to sea has to be adopted pending the recommendations of the consultants/International experts and decision of Federal Government there on.

2.8.7 Requirements of Projects under construction

2.8.7.1 The following figures have been indicated by WAPDA, seven members of Technical Committee and Mr. Sardar Ahmad Mughal in the computations.

Table			
	Net water availability (MAF) computed by		
Item	WAPDA	Seven Members	Mr. Sardar Ahmad Mughal
1	2	3	4
Requirements of projects under construction	7.8 (Annexure II-3)	0	11

2.8.7.2 Views of WAPDA

WAPDA has included the water requirements of Projects under construction in their water availability computations. However, they have made some omission which need to be added.

2.8.7.3 Views of seven members of Technical Committee on Water Resources

(i) During the deliberations on the TOR-4(a) in the fifth meeting of Technical Committee, held on 27th November 2004, it was unanimously agreed that the provision of requirements of projects under construction in the Water Availability computations be made, and that provision should also be made for the projects omitted by WAPDA in their presentation. However, in the report of the seven members of Technical Committee of May 2005, they have not indicated any provision for the projects under construction and stated that the requirement of the projects can be adjusted against the additional Water Accord Allocation of 12 MAF under para 2 of the Accord.

2.8.7.4 Comments of Chairman, TCWR

(i) In the Water Availability computations presented to the Technical Committee on 4th September 2004, on upstream and downstream basis (Annexure II-2 and II-1), WAPDA has not shown the requirement of projects under construction. However in the last computation of Water Availability by WAPDA on downstream basis (Annexure II-3), WAPDA has rightly shown the requirement of projects under construction (7.8 MAF), but WAPDA has not included completed LBOD Project and ongoing Gomal Zam Dam Project in the list of projects under construction. The requirements of these two projects (2.2 MAF and 1.0 MAF respectively) therefore need to be included in the computations. It is also necessary to include the requirements of projects under construction in all the computations of Water Availability both on upstream and downstream basis.

(ii) It has been unanimously decided in the fifth meeting of the Technical Committee on Water Resources held on 27th November 2004, as under:

"At this stage, it was pointed out that WAPDA has shown the water requirement of the projects under construction i.e. flood canals (Kachhi Canal, Rainee Canal and Greater Thal), Mangla Raising and Pat Feeder Extensions in their computations for water available on downstream basis as per their table at page 21 of the presentation dated 4th September 2004. This water requirement may also, therefore, be included in the computation for water availability on upstream basis. Moreover the provision for LBOD completed scheme (2.2 MAF) Gomal Zam Dam (1.0 MAF) and Urban and Industrial Uses (5 MAF) has also to be made in computations both for upstream and downstream basis. The consensus was reached that these provisions should be made in the water Availability computation".

Therefore provision for new projects under implementation has to be made in water availability computations and that the omissions in WAPDA's lists have to be corrected. It is not understandable how the seven members have given different views in their report of May 2005.

(iii) The view of the seven members that the 117.35 MAF Water Allocation to the provinces under the Accord includes future development projects is not correct. This quantity (117.35 MAF) has been allocated to the provinces under para 2 of Water Accord for the existing canals, and the 10-daily statements for allocating these supplies to each of the existing canal systems have also been approved by the Council of Common Interest (CCI) in its meeting held on 16.09.1991.

(iv) The existing canal systems of Pakistan command an area of 36 million acres which has to be sustained. The Accord allocations meant for these canals cannot be denied to them and the water allocated to the existing canals cannot be diverted to be used for new projects.

2.8.8 Balance Water Accord Allocation

2.8.8.1 In their computation of Water Availability, WAPDA, seven members of Technical Committee and Mr. Sardar Ahmad Mughal have adopted following figures for "Balance Water Accord allocations".

Table			
Net water availability (MAF) computed by			
Item	WAPDA	Seven Members	Mr. Sardar Ahmad Mughal
1	2	3	4
Balance Water Accord allocation	117.35 (Annexures II-1 & II-2)	105.4	117.4

2.8.8.2 WAPDA's position

WAPDA has indicated the figure of 117.35 MAF as per para 2 of Water Accord.

2.8.8.3 Position of seven members, TCWR

During deliberations of Technical Committee, the seven members supported WAPDA's computations. However in their report of May 2005, the seven members have indicated the figure of 105.4 MAF, being average system uses for the period 1977-82.

2.8.8.4 Comments of Chairman, TCWR

It is not indicated anywhere in Water Accord that the para 2 of Accord allocations of 117.35 MAF include any development component. These allocations are for existing canals, as also discussed under para 2.8.7.4 above. It is emphasized that Water Accord is sacrosanct as also unanimously agreed in the first meeting of Technical Committee. The Water Accord Allocations must therefore be implemented in letter and spirit.

2.8.9 Urban and Industrial Uses

2.8.9.1 The provision for Urban and Industrial uses in the computation by WAPDA, seven members of Technical Committee and Mr. Sardar Ahmad Mughal are given below:

Table			
Net water availability (MAF) computed by			
Item	WAPDA	Seven Members	Mr. Sardar Ahmad Mughal
1	2	3	4
Urban and Industrial Uses	-	-	5

2.8.9.2 No specific views have been expressed by WAPDA or seven members of Technical Committee in this regard.

2.8.9.3 Comments of Chairman, TCWR

(i) During the deliberations of Technical Committee, it was emphasized that the requirement of Urban and Industrial uses have to be provided for. Sardar Muhammad Tariq Member, NWFP was very emphatic in advocating this provision and he stated "it is now growing trend in the world to give priority to further urban and industrial quota for urban and industrial uses from 35% to 40% of available fresh water. He suggested that in view of growing population of Pakistan and improvement in standard of living, we should have sufficient provision for urban and industrial use. He further said that we cannot depend on tubewell water because subsoil water levels are depleting and quality of water is also deteriorating. Moreover many areas do not have sweet ground water."

(ii) It was also unanimously decided in the fifth meeting of the Technical Committee on Water Resources held on 27th November 2004, that "Urban and Industrial uses (5 MAF) has also to be made in computations both for upstream and downstream basis."

(iii) In the report of seven members of May 2005, they have not given any specific views regarding Urban and Industrial uses in the water availability computations, although in the table for computation of Water Availability on Page - 37 of their report, no provision has been made for it and it has been mentioned that this item may be included in balance supply for development without clarifying this view.

(iv) The provision of water supply for Urban and Industrial uses is highly important and cannot be ignored. Adequate provision has therefore to be made for this purpose. Sardar Muhammad Tariq member NWFP, one of the learned seven members, during deliberations in the meetings of TCWR has suggested 35-40% of River Inflows to be earmarked for Urban and Industrial Uses. The provision for Urban and Industrial Uses

is therefore fully justified as unanimously decided in the fifth meeting of Technical Committee held on 27th November 2004. It is not understandable how this item can be covered under "balance supply for development", as suggested by the seven members.

2.9 Views of Chairman of Technical Committee based on the overall scenario emerging from the divergent views on each component of water availability computations

2.9.1 It is not possible to accurately forecast the future water availability. All we can do is to study the past trends from the available records of river flows data and estimate the future scenario from the analysis of this database. 2.9.2 Separate water availability computations have been made for average water availability on upstream and downstream basis. However, the seven members of the Technical Committee and WAPDA have shown their preference that water availability computations may be based on downstream approach. This aspect has been discussed in para 2.6.5 above. However, in consideration of the views of distinguished seven members, the computations of water availability based on downstream approach are being considered for the purpose of this report.

2.9.3 As discussed in the foregoing paragraphs, the water availability figures of each component by WAPDA, seven members of Technical Committee and by Mr. Sardar Ahmad Mughal show vast differences. The Chairman, Technical Committee on Water Resources feels greatly embarrassed in such a situation. He has therefore given deep consideration to the matter and is of the view that the maximum weightage may be given to the figures of WAPDA and the seven distinguished members, even though his views mentioned in the foregoing paragraphs have depicted a different position. The Chairman, Technical Committee has accordingly prepared a revised table of water availability on downstream basis on the following considerations:

(a) The components for which there is agreement between WAPDA and seven members may be adopted as such inspite of different views of Chairman mentioned in paras indicated against each.

These components on which there is agreement between WAPDA and seven members of the Technical Committee are given below:-

1. Eastern River run off generated from within Pakistan (Ref. para 2.8.4.4)	3.53 MAF
2. Eastern River inflows (Ref. para 2.8.4.4)	4.94 MAF
3. Indian Right on Western Rivers (Ref. para 2.8.5.3)	2.00 MAF
4. Short-term possible flows on Kabul River by Afghanistan (Ref. para 2.8.5.3)	0.50 MAF
5. Future Urban and Industrial uses (Ref. para 2.8.9.3)	0.00 MAF

(b) As regards the components in which there is difference between the figures of WAPDA and report of seven members, the Chairman, TCWR has adopted WAPDA's figures (given below) as given in WAPDA's presentation, except that downstream Kotri figure of 10.0 MAF has been adopted because this cannot be changed pending completion of study by consultants /international experts and decision of Government.

(i) Requirement of Projects under construction (Annexure II-3)	11.00 MAF
(ii) Shortfall in Accord allocations (Annexure II-1)	11.95 MAF

2.9.4 The table of water availability on downstream basis prepared by Chairman, TCWR on the above considerations, (as compared with figures of WAPDA, seven members and Mr. Sardar Ahmad Mughal) is given on the next page. This table is based entirely on WAPDA's figures, except S. No. 2.3 relating to Kotri outflow to sea.

Table					
Figures in MAF					
Sr. No.	Description	Water availability worked out by			
		WAPDA	Seven Members	Sardar Ahmad Mughal	Chairman TCWR (WAPDA'S figures except S.No. 2.3)
1	2	3	4	5	6
1	Post-Tarbela (1976-77 to 2002-2003) Escapage below Kotri	35.2	35.2	35.2	35.2
2	Possible reductions				
2.1	Indian uses on Western Rivers	2.0	2.0	4.8	2.0
2.2	Possible uses on Kabul River by Afghanistan	0.5	0.5	4.0	0.5
2.3	Kotri outflow to sea	5.8	-	10.0	10.0
2.4	Requirements of Projects under construction				
	a. Flood Canals				
	(Kachhi, Raine, Greater Thal)	4.8		4.8	4.8
	b. Mangla Raising	2.9		2.9	2.9
	c. Pat Feeder Extension	0.1		0.1	0.1
	d. LBOD	2.2*		2.2	2.2
	e. Gomal Zam Dam	1.0*	1.0		1.0
	Sub-Total	11.0		11.0	11.0
2.5	Shortfall in Accord allocations	12.0	-	12.0	12.0
2.6	Future Urban and Industrial uses	-	-	5.0	-
3	Total reductions (Items 2.1 to 2.6)	31.3	2.5	46.8	35.5
4	Net available for further development (1-3)	4.0	32.7	(-)11.60	(-) 0.25
*Projects omitted by WAPDA included as decided by TCWR.					
Note: No deductions made due to Eastern Rivers contribution.					

2.9.5 The above table reveals that even according to the projections of WAPDA, there is no surplus water availability on average year basis. However, this does not mean that no water is available for storage at all. It is re-iterated that surplus water is available for storage in flood years and it is this surplus water which has to be conserved and stored. Unfortunately enough consideration has not been given to the year to year water availability which depicts the correct picture of the water availability scenario.

2.10 Pattern of Water Availability on downstream basis 2.10.1 A table has been prepared (Annexure II-6) showing the figures of outflow to sea for 28 years post-Tarbela period from 1976-77 to 2002-03 These figures have been arranged in descending order. The mean (average) outflow to sea during this period has been 34.65 MAF. This table shows that there have been only 11 above average years and 17 below average years in the 28 years period. However, the median (midpoint) value is 29.68 MAF, which is 5 MAF less than the average value.

2.10.2 In this table the outflow to sea during 28 year post-Tarbela period has also been analysed by four, 7- year periods. This analysis indicates that in the highest seven years period, the outflow to sea was 50.70 % of the total, where as in the lowest seven years period out flow to sea was only 5.31 %. 2.10.3 The other table (Annexure II-7) has been prepared in which the capability of the proposed future reservoirs to trap the available surplus flows has been examined. Study of this table indicates that storable surplus water is available for only 10 years out of 28 years. The study further reveals that a dam of 6.0 MAF will be able to trap only about 22 % of the surplus flood flows and another dam of 6.0 MAF will be able to trap additional 18.9% of the flood flows. The two dams of 6.0 MAF each together will trap about 41 %. 59% of surplus flows will still remain unutilized after two dams are built. The study further indicates that carryover dam of 35 MAF will utilize 84 % of the surplus water. According to the study, one dam of 6.0 MAF is likely to be filled for 10 years during flood years out 28 years and the second dam of 6.0 MAF will be filled for 7 years out of 28 years and partly filled for 3 years, and the carryover dam will be filled for 3 years out of 28 years and partly filled for 7 years out of 28 years.

(a) The position emerging from the above analysis of river flow data indicates that in periods of floods, when the surplus water is actually available for storage, the adoption of different figures for individual components, of water availability computations, as has been done by WAPDA, seven members and Mr. Sardar Ahmed Mughal, do not matter so much. In most of these flood years, whatever values are adopted for these component items, sufficient surplus water is still available for storage. It is this undisputed large quantity of surplus water which requires to be trapped and stored.

2.11 Inter-seasonal and Inter-year transfer of surplus flows for storage

2.11.1 The seven members of Technical Committee in their report of May 2005, have mentioned the following categories for storage of surplus water:-

(i) Storage of surplus water in high flow season (Kharif) for use in subsequent low flow season (Rabi) of the same year.

(ii) Storage of surplus water in high flood years for use in subsequent low flow years.

2.11.2 Our present storages i.e. Mangla and Tarbela are of the first category. These store the surplus water by inter-seasonal transfer from Kharif season for use in subsequent Rabi season of the same year. The storage capacity of the existing dams is about 15.0 MAF. The average annual Rabi flows of the Western Rivers are about 23 MAF. Thus the Rabi water availability has increased by about 65 % after the construction of Mangla and Tarbela reservoirs.

2.11.3 In this respect it is appropriate to consider the season-wise canal withdrawals for post-Tarbela period to know what has been season-wise water use after construction of the two reservoirs. A statement showing the post- Tarbela season-wise canal withdrawals 1976-77 to 2002-03 as compared to the Water Accord Allocations is enclosed as (Annexure II-8). This statement is based on the figures given in the table at (Annexure-7) of the presentation by WAPDA in the third meeting of Technical Committee held on 27th September 2004. The study of the table shows that out of 27 years post-Tarbela period, Rabi canal withdrawals have been more than 100 % of the Water Accord allocations for 14 years. Further in 9 more years, the canal withdrawals have been above 90% of the Water Accord allocations. Thus during Rabi, the canals have been receiving full Water Accord allocation or even more during most of the years in post-Tarbela period, and only in a very few low flow years, there have been Rabi shortages. 2.11.4 As compared to the Rabi canal withdrawals, more shortages have occurred during Kharif. There is not even a single year in the 27 year post-Tarbela period in which Kharif withdrawals have exceeded the Water Accord allocations. In 5 years, the Kharif withdrawals have been less than 80%. In 16 years the Kharif withdrawals have been between 80% and 90%. Only in 6 out of 27 years the Kharif withdrawals have been above 90%. 2.11.5 The above figures reveal that the Rabi requirements of the existing canals are adequately met by the existing river flows and present storages. In fact there is no more surplus water for season to season transfer, and the surplus availability is only for year to year transfer, from flood years to dry years. The surplus flows are of higher magnitude but with lesser frequency of occurrence. Thus the filling of future dams will be an occasional event, as compared to existing dams in which even partial filling in any year is considered as an unusual phenomenon. This aspect needs to be considered in planning of future storages and deciding their operational criteria.

2.12 Future Irrigation schemes

2.12.1 According to the presentations of Planning and Development Division and WAPDA the following three irrigation schemes have been approved for construction and the work is in progress:

Sr. No	Name of Irrigation Schemes	Estimated Cost (Rs)	Water requirement (MAF)
i.	Greater Thal Canal (Punjab)	30.46 billion	2.5
ii.	Kachhi Canal (Balochistan)	31.20 billion	1.2
iii.	Rainee Canal (Sindh)	18.86 billion	1.1

2.12.2 The seven members of Technical Committee have not given any views about future irrigation schemes in their report of May 2005.

2.12.3 Para 4 of the Water Accord reproduced below prescribes the shares of the provinces in the balance water supplies:

"Balance river supply (including flood supplies and future storages) shall be distributed as below:

Punjab	Sindh	Balochistan	NWFP	Total
37	37	12	14	100%

2.12.3 The comparative priority between future storages and irrigation schemes has not been indicated in the Accord. This aspect was however discussed in the fifth meeting of Technical Committee held on 27th November 2004, and it was unanimously agreed that "first priority from balance surplus water available should go to the future reservoirs and the flood canals should have lower priority than the future reservoirs".

2.13 Sustainance of existing developed agriculture and coastal ecosystem 2.13.1 It is important to sustain and consolidate, if not further develop and improve the agriculture in the 36 million acres commanded by existing canal systems. The allocated water of 117.35 MAF under the Accord for existing canals therefore needs to be fully protected. The shortfall in the low flow years may be provided from the new reservoirs.

2.13.2 It is also important to provide the requirements of downstream Kotri, after meeting Accord allocations of existing canals (117.35 MAF), to the extent of 10 MAF as indicated in the Water Accord, or any other quantity decided by Government on the basis of the outcome of studies in progress. 2.13.3 The new schemes, i.e. future reservoirs and irrigation schemes should be considered out of balance water availability, after meeting Accord allocations of existing canals and requirements of outflow to sea.

2.14 Conclusions and recommendations

1. WAPDA have not made water availability computations as a regular feature of their activities since inception, nor have they developed a standard format for computation of water availability. Had they done so, the differences of opinion which have developed could have been avoided. Moreover, WAPDA has been adopting different figures for components of water availability at different times, which has created confusion.

2. Normally the water availability computations are done on upstream basis to depict the proper accounting of the water available in a river system, and its utilization. The computation on downstream basis only indicates the outflow to sea. However, whether the computations are done on upstream basis, or downstream basis the net result should be the same if proper water accounting is done. For the purpose of this report, downstream approach is being considered in deference to the opinion of WAPDA as well as the seven members of TCWR.

3. WAPDA and Mr. Sardar Ahmad Mughal have given different computations of water availability, indicating net average water availability on downstream basis as 7.15 MAF and minus 11.6 MAF respectively. During the deliberations in the meetings of Technical Committee, the seven members fully supported WAPDA's computations, but in their report of May 2005, they have worked out their own computation of average water availability on downstream basis as 32.70 MAF. The Chairman, TCWR has given his comments on each item in this report.

4. Notwithstanding the views of the Chairman and his comments on the individual items of computation of water availability recorded in this report, the Chairman has prepared a table of computation of average water availability on downstream basis which is based almost entirely on WAPDA's figures, except the item of outflow to sea which has been taken as 10 MAF as indicated in the Water Accord, pending the completion of studies by consultants/International Panel of Experts which are in progress. According to this computation by Chairman, TCWR the net water availability comes to (-) 0.25 MAF on average year basis.

5. The non availability of surplus water on average year basis does not mean that there is no surplus water for storage at all. Considering the pattern of water availability of Western Rivers, there are large quantities of surplus water available during occasional flood years. It is this surplus water which has to be stored in future reservoirs.

6. A study of the pattern of water availability for post-Tarbela period from 1976-77 to 2002-03 reveals that during the 28 years period, more than 50% of the outflow to sea has occurred in seven years of highest flows, whereas in the lowest seven year period outflow to sea has been only about 5%. This study also shows that during most of the

flood years when large quantities of surplus water are available for storage, the adoption of different values for computation of surplus water availability do not matter so much.

7. A study has also been carried out to examine the capability of the proposed future reservoirs to trap surplus water whenever available. This study indicates that storable surplus water is available for only 10 years out of 28 years of post-Tarbela period. The study also reveals that dam of 6.0 MAF will be able to trap only about 22 % of the surplus flood flows and another dam of 6.0 MAF will be able to trap additional 18.9 % of the flood flows. The two dams of 6.0 MAF together will trap about 41 %. 59% of surplus flows will still remain un-utilized after two dams are built. The study further reveals that carryover dam of 35 MAF will utilize 84% of the surplus water. According to the study, one dam of 6.0 MAF is likely to be filled for 10 years out 28 years and the second dam of 6.0 MAF will be filled for 7 years out of 28 years and partly filled for 3 years, and the carryover dam will be filled for 3 years out of 28 years and partly filled for 7 years out of 28 years.

8. The average Rabi flows of Western Rivers are 23 MAF. The present two storages i.e. Mangla and Tarbela have a capacity of about 15 MAF. The Rabi water availability has therefore increased by about 65% after construction of Mangla and Tarbela Reservoirs. A study of post-Tarbela data of canal withdrawals provided by WAPDA reveals that during Rabi the canals have drawn even higher than their Accord allocations, and there have been Rabi shortages only in a few very dry years. However, during Kharif there have been more shortages in canal supplies. Thus no more surplus water is available for transfer from Kharif season to Rabi season of the same year. Moreover, Rabi requirements of existing canals are fully satisfied by the normal river flows and the two existing reservoirs.

9. The future storages have to be planned for storage of surplus water in occasional flood years for use in subsequent low flow years. These surplus flows are of higher magnitude but with lesser frequency of occurrence. Thus the filling of future dams will be an occasional event, as compared to existing dams in which even partial filling in any year is considered as an unusual phenomenon. The prime factor for future reservoirs should be capability to store maximum quantity of surplus flood water when available. The distribution of water from future reservoirs should not be considered according to their full capacity, but keeping in view the fact that the stored water will need to be used over a number of subsequent low flow years.

10. Three flood irrigation schemes i.e. Greater Thal canal, Kachhi canal and Rainee canal are under construction. The TCWR has unanimously agreed that the flood irrigation schemes should be given lower priority than future storages.

11. It is important to sustain and consolidate, if not to further develop and improve the agriculture in 36 million acres area commanded by existing canal systems. The allocated water of 117.35 MAF under the Accord for the existing canals therefore needs to be fully protected. The requirements of downstream Kotri to the extent of 10 MAF as indicated in the Water Accord, or any quantity decided by the government on the basis of outcome of the studies in progress, has also to be provided. The balance water whenever available should be stored.

TOR-5(a)

"Examine the filling criteria of Mangla reservoir and make recommendations in this regard"

3. TOR-5(a) "Examine the filling criteria of Mangla reservoir and make recommendations in this regard"

3.1 Importance of reservoir operational criteria

3.1.1 Whenever a reservoir is constructed on a river, it is important that its operational criteria should be laid down. These criteria should be clearly and comprehensively spelt out while planning the construction of a reservoir or at least before start of the operation of the reservoir. Mangla reservoir was completed in the year 1967 i.e. 38 years ago but its operational criteria have not been prescribed so far.

3.1.2 Reservoirs are water banks where water is stored in the periods when it is surplus to be used during the periods of shortages. This basic consideration should not be ignored while prescribing the operational criteria of a reservoir.

3.1.3 In the absence of specifically laid down operational criteria of Mangla reservoir, its operations are being carried out in an adhoc manner with the result that the lower riparian provinces have expressed their apprehensions and concerns particularly in the periods when water is stored in Mangla reservoir during shortage periods. Moreover reservations are also being voiced against construction of future reservoirs due to unsatisfactory management of Mangla reservoir. It is therefore that this TOR has been included in the TORs of Technical Committee on Water Resources for examination.

3.2 Presentations and deliberations on TOR-5(a)

3.2.1 The presentations on TOR-5(a) were made by Indus River System Authority (IRSA) and WAPDA in the fifth meeting of the Technical Committee on Water Resources held on 23rd November 2004. Detailed deliberations on the TOR were held in the subsequent sessions of the fifth meeting and continued in the sixth meeting of TCWR held from 20th to 22nd December 2004. Mr. Sardar Ahmad Mughal member, Sindh submitted his written comments on the presentations. IRSA and WAPDA provided their responses. Mr. Sardar Ahmad Mughal submitted rejoinders to the responses of IRSA and WAPDA. These rejoinders were also responded to by IRSA and WAPDA.

3.3 Views of WAPDA IRSA and seven members of Technical Committee on the points relating to TOR-5(a), and comments of Chairman, TCWR

3.3.1 80% filling of Mangla reservoir by 30th June

3.3.1.1 IRSA/WAPDA's views

WAPDA and IRSA have expressed the view that Mangla reservoir has to be filled upto 80% by 30th June, each year, i.e. upto the level of 1180 otherwise it may not be filled. They have stated that Jhelum is an early riser river and there are more flows during early Kharif (April to June) which is 57 % of seasonal flow, and lesser flows in late Kharif (July to September) which is 43 %. In their presentations, WAPDA and IRSA have also given a table in which they have listed nine years from history of Mangla Dam i.e. 1970, 1971, 1974, 1979, 1985, 1999, 2000, 2001 and 2004 in which maximum reservoir level of 1202 SPD. could not be attained because the reservoir level on 30th June was less than 1180 SPD.

3.3.1.2 Views of seven members, TCWR

The seven members of Technical Committee, in their report of May 2005, have supported the version of WAPDA/IRSA. They have also given the same list of nine years in which maximum reservoir level of 1202 SPD could not be attained as in those years the reservoir level on 30th June, was less than 1180 SPD. The seven members have further stated that partially filled Mangla resulted in significant shortages of water in Northern Punjab canals during ensuing Rabi seasons.

3.3.1.3 Comments of Chairman, TCWR

(i) It is unrealistic and un-workable proposition that if any reservoir is constructed, it must be filled even during shortage periods without regard to the current requirements of the existing canal systems. Reservoirs are water banks where water is stored when it is surplus to be used in subsequent periods of shortages. If the flows of Jhelum River are such that more water is available in April - June than in July - September, surely the water can be stored in April June but only after the current requirements/allocations of canals on Indus rivers System are met.

(ii) During the deliberations, WAPDA has stated that water is stored in Mangla after meeting 80% of the requirements of canal systems, but even this criteria has not been followed in the regulation of Mangla reservoir.

(iii) The seven members of Technical Committee have mentioned of Rabi shortages in the Upper Punjab Canals in the nine years when Mangla could not be filled, but they have not given any attention to the shortages occurring in other provinces during the corresponding periods. However, the study of the relevant data (Annexure II-9) from WAPDA's presentation reveals that in 5 out of 9 years i.e. 1971, 1974, 1979, 1985 and

2001, when Mangla could not be filled upto the maximum conservation level of 1202, even then the stored water was not fully utilized upto 31st March of the following Rabi season. Moreover the canal withdrawal data of these nine years also reveals that in some of these years, the utilization by Punjab has been even more than full Rabi Accord allocation. Of course there have been shortages in very dry periods, particularly after the year 2000, but this was the situation all over the country due to drought cycle and had to be shared and endured by all co-sharers.

3.3.2 Filling Criteria of Mangla reservoir

3.3.2.1 WAPDA/IRSA's Views

(i) No detailed and comprehensive filling criteria of Mangla reservoir have been laid down by WAPDA or IRSA, but the criteria are decided on year to year basis by Advisory Committee of IRSA. It has been further stated that even after the raising of Mangla reservoir this existing procedure will be followed.

(ii) During the deliberations of the Technical Committee, WAPDA and IRSA did not propose any specific criteria for filling of Mangla reservoir. 3.3.2.2 Views of seven members, TCWR

In their report of May 2005, the seven members of Technical Committee have stated that:

"The policy and procedures followed by IRSA, with constant review and monitoring and understanding of all co- sharers, has been working satisfactorily for filling of Mangla and Tarbela storages, their draw-down and balanced distribution between Indus Zone and Mangla Zone Canals. The criteria for Mangla filling does not need any modification or change".

3.3.2.3 Views of Mr. Sardar Ahmad Mughal

In his note annexed to the report of seven members of Technical Committee of May 2005, Mr. Sardar Ahmad Mughal has stated that:

"The criteria for operation of existing reservoirs and link canals as well as of future reservoirs should be clearly laid down and legal guarantees should be provided and there should be agency responsible to ensure that these criteria's are faithfully followed. One most important criteria should be that no storage should be allowed unless the Accord Allocations of all the provinces are met".

3.3.2.4 Comments by Chairman, TCWR

It is highly regrettable that the importance of filling criteria of Mangla reservoir is not being realized. The dam was constructed 38 years back, but still its operational criteria are not framed, and the regulation is being done in an adhoc and arbitrary manner. The fact that this TOR has been included in the assignment of the TCWR indicates that the Government considers the problem as serious requiring attention. However it is surprising that not only the omission of not framing the operational criteria so far is not being realized, but even now WAPDA/IRSA are reluctant to propose a draft of the operational criteria. It is important that if comprehensive operational criteria cannot be framed immediately, for whatever reasons (or excuses), at least the guiding principles for filling of Mangla reservoir should be prescribed and implemented without delay.

3.3.3 Restricting the canal shortages to 80% of their authorized allocations during shortages for filling Mangla reservoir.

3.3.3.1 Views of WAPDA

It has been mentioned by WAPDA that during low flows, it is ensured that the canals are not stressed beyond 80% of requirements as yields are significantly affected beyond this point.

3.3.3.2 Views of seven members, TCWR

The seven members of Technical Committee have not mentioned anything about this aspect in their report of May 2005.

3.3.3.3 Comments by the Chairman, TCWR

WAPDA has stated that canals are not stressed beyond 80% of the requirements (limiting the shortage to 20%) during the low flow periods. This seems to be a reasonable proposition. However, the canal withdrawals data provided by WAPDA and IRSA during their presentations indicates that there have been much higher shortages (even 60%), and still Mangla was being filled in those periods. This indicates that filling of Mangla reservoir has been done in an arbitrary manner even during the periods of acute shortages in the canals.

3.3.4 Operation of Mangla reservoir as a replacement work under Indus Waters Treaty 1960

3.3.4.1 Views of IRSA/WAPDA

During the presentations on the TOR-5(a) by IRSA and WAPDA, no mention whatsoever was made about any relationship of operation of Mangla reservoir with Indus Waters Treaty, 1960. However, during the deliberations, Mr. Mehmood-ul-

Hassan Siddiqi, member Punjab raised the point that Mangla being a replacement work under Indus Waters Treaty, its regulation and operation has to be carried out accordingly. WAPDA raised the same point at a later stage.

3.3.4.2 Views of seven members, TCWR

In their report of May 2005, the seven members of the Technical Committee have raised the following points regarding filling and operation of Mangla dam vis-a-vis Indus Waters Treaty.

(a) Mangla dam was constructed as a replacement dam under the Indus Waters Treaty 1960. Its design basis and operational criteria was laid down in the design and planning documents under the Replacement Plan.

(b) The Upper Regulation Zone is entirely dependent on flow supplies of Chenab and Jhelum rivers and Mangla storage. It can get no support from Indus river supplies.

(c) After completion of Replacement Works, the Pakistan canals got divided into two zones i.e Jhelum - Chenab zone (Mangla command) and Indus zone (Tarbela command) according to their new source of supply.

(d) It would be beneficial if the Indus - Jhelum - Chenab rivers are integrated into single river basin by providing an Upper Indus Link above Rasul. This would benefit Sindh canals in early Kharif sowing season. Single basin regulation may enable provision of additional early supplies to Sindh canals as well as support to Punjab canals of upper system.

3.3.4.3 Comments of Chairman, TCWR

(a) It is correct that Mangla dam has been constructed as a replacement work under the Indus Waters Treaty, 1960/Indus Basin Development Fund Agreement. These documents envisage construction of replacement works for transfer of water from the three Western Rivers of the Indus system (Indus - Jhelum and Chenab) to meet existing irrigation uses in PAKISTAN which have hitherto depended upon the waters of three Eastern Rivers (Ravi, Beas and Sutlej), thereby releasing the whole flow of the three Eastern Rivers for irrigation development in India.

(b) The above description clearly indicates that Mangla dam and other replacement works were constructed to cater for the loss of Eastern River waters to Pakistan. At the time of the Treaty, the annual water flow of three Eastern Rivers was about 33 MAF, out of which India was utilizing about 8.0 MAF. The rest of the water (25 MAF) used to flow into Pakistan which is no more available. The Jhelum and Chenab rivers have an

annual flow of about 23 MAF & 26 MAF respectively. Thus the total flow of the tributary rivers including Eastern Rivers coming into Pakistan before Indus Waters Treaty was 74 MAF (25+23+26). The Water Accord amongst the provinces was signed in 1991 i.e. about 30 years after the Indus Waters Treaty 1960. The Water Accord allocation of Tributary areas of Punjab (including areas previously getting water from Eastern Rivers) under the Water Accord is 43.33 MAF (55.94 total Punjab allocation minus 12.61 Punjab canals on Indus main). Thus the balance water (74-43 = 31 MAF), after meeting the full Accord allocations of the tributary areas of Punjab used to flow downstream Panjnad and was available to lower riparian provinces before the Indus Waters Treaty. This water has been lost to the lower riparian provinces after the Treaty. It cannot therefore be said that loss of Eastern Rivers to India means that loss was confined to only one particular area/region. Of course it is correct that the original sources of supply to barrages situated on the Ravi and Sutlej rivers were disconnected and therefore new source had to be provided by construction of link canals from Western Rivers. The new sources having been provided to these canals on Sutlej and Ravi rivers, all the canals in Pakistan, whether located on Indus main, Jhelum or Chenab, or those on Sutlej or Ravi connected through link canals, have to share the waters of Western Rivers including surpluses and shortages according to the provisions of the Water Accord, 1991. No canal anywhere has any privilege whether constructed before or after the Treaty.

(c) The seven members have stated that the design basis and operational criteria of Mangla dam were laid down in the design and planning documents under the replacement plan. However, neither WAPDA/IRSA, nor the learned members have supplied a copy of these operational criteria. Surely these criteria, if they exist, would not provide that the dam should be filled even during shortage periods.

(d) It has been simply stated by the seven members that the Upper Irrigation Zone is entirely dependent on the flow supplies of Jhelum and Chenab rivers and Mangla storage giving an incorrect impression that water of Jhelum and Chenab is not adequate to meet the requirement of these areas. However, the figures about the quantity of river flows available in Jhelum and Chenab rivers have not been indicated. A simple glance at the river flow data of Jhelum and Chenab rivers and Eastern Rivers contribution show that these rivers have adequate water to meet the water requirement of not only the upper tributary areas of Punjab but also the lower tributary areas including the canals of Eastern Rivers.

(e) It is not a correct statement by seven members that after completion of replacement works, the Pakistan canals got divided into two zones i.e. Jhelum - Chenab zone (Mangla command) and Indus zone (Tarbela command), according to their source of supply. No such zoning was envisaged in the Indus Waters Treaty. The Water Accord 1991 provides the province-wise and season-wise allocations and the 10 daily canals-wise allocations approved by CCI, on all Pakistan basis. Nowhere in the Water Accord

it is indicated that the Pakistan canals have been divided into two separate zones. Thus all the water available in three Western Rivers including any water for the time being coming from Eastern Rivers has to be shared by all the provinces, including shortages and surpluses, in accordance with their allocated shares in the Water Accord.

(1) The Indus - Jhelum

Chenab Rivers are already fully integrated, rather over integrated, by the construction of existing link canals system. This link canals system provides the facility of equitable distribution of the available water in all the rivers, particularly during shortage periods. The transfer capacity of existing link canals from Indus to Tributary areas (i.e. CJ and T-P Link canals) is according to the provisions of Indus Basin Development Fund Agreement, and based on the worst scenario with the assumption that Indus has all the water whereas Tributary rivers have no water at all. Under the circumstances there is absolutely no justification for another upper Indus link above Rasul, because Jhelum and Chenab Rivers have more than adequate water to cater for the requirements not only of the Upper Punjab areas, but also of the lower tributary areas as well. Moreover Indus main does not have unlimited quantities of water to be transferred to Tributary areas.

(f) It is surprising that by propounding an idea of upper Indus link, it has been said that this will benefit Sindh canals! This thinking is absolutely fantastic and strange. It is mind boggling to suggest that instead of letting the water available in Indus River flow undisturbed to meet the requirements of canals on Indus main, the water should be diverted through proposed Rasul link and then supplied to lower riparian areas of Indus along a much longer route. No technical details of this bright idea have however been supplied. 3.4 Some other important aspects about Mangla reservoir 3.4.1 During the presentation, WAPDA has given details of maximum conservation level and lowest drawn down level of Mangla dam for the years 1967-68 to 2004-05 (38 years period). This table (Annexure II-9) shows that out of 38 years, Mangla dam stored water was not fully utilized in Rabi season for 27 years. The balance un-utilized water on 31st March was over 2 MAF on two occasions and over 1 MAF on 15 other occasions. This shows the arbitrary manner in which the Mangla dam operations are being done.

3.4.2 In the presentations, WAPDA/IRSA have also given the figures of the operation of spillways of Mangla reservoir. The purpose of getting these figures from WAPDA/IRSA was to know how much water was being spilled over after filling of the reservoir upto maximum conservation level. The figures provided by WAPDA/IRSA do not give any clear indication about the water spilled over in August/September after the filling of the reservoir. However, Mr. Sardar Ahmad Mughal, member Sindh circulated a table about operation of Mangla reservoir from the year 1968 to 1992 (25 years) in the meeting of the Technical Committee held on 20th December 2004. Copy of this table is enclosed as (Annexure II-10). This table reveals that while water was being

stored in Mangla dam during the shortage periods of April to June (even in March), the water was wasted during July and August of the same years, when actually it should have been stored. During the period of 1968 to 1992 (25 years), over 1 MAF water was wasted in July and August in 20 years. Over 5 MAF of water was wasted in July-August during 8 years. It is surprising that the water was stored during shortage periods and spilled during the period of surpluses. This negates the basic fundamental principles of reservoir operations. This table circulated by Mr. Sardar Ahmad Mughal has not been commented upon by WAPDA, IRSA or any of members of Technical Committee.

3.5 Guiding principles for operational criteria of Mangla reservoir

3.5.1 As discussed in para 3.3.2, no comprehensive filling criteria of Mangla reservoir have yet been laid down by WAPDA or IRSA though it was constructed 38 years ago, and the operation of the reservoir is being done in an adhoc manner. It is regrettable that even at this stage, both WAPDA and IRSA are reluctant to prepare the filling criteria of the reservoir, though this specific TOR has been assigned to the TCWR for examination. The seven members of Technical Committee have also not given any suggestions for filling criteria of Mangla reservoir. The Chairman, TCWR considers it very important that clear and specific filling criteria for Mangla reservoir should be laid down, because proper operation of this reservoir will help remove the apprehensions of lower riparian provinces for construction of new reservoirs. The Chairman, TCWR therefore suggests the following guiding principles for the filling of Mangla reservoir:

1. The basic principle of reservoir operations that a reservoir is a water bank in which water is stored when it is surplus, to be used during the subsequent shortage periods must be adhered to. No water should be stored in Mangla reservoir, till the indents of the four provinces based on their Water Accord allocations and ten-daily statements approved by CCI are fully met.
2. During shortage periods if it is considered expedient and unavoidable to store water in Mangla reservoir, the allocations of canals may be reduced to not below 80% of the ten-daily Water Accord allocations, with the unanimous consent of all the Provinces.
3. If adequate stored water is available in Mangla, it should be provided to lower riparian provinces, in early Kharif (April-May), when the river flows of Indus main are not enough for their minimum requirements.
4. The above guidelines will also be applicable after raising of Mangla dam.

3.6 Conclusions and recommendations

1. Mangla reservoir was constructed 38 years ago but no comprehensive operational criteria have been laid down so far. WAPDA and IRSA are reluctant to even propose the operational criteria of the reservoir. It is important to frame the operational criteria of the reservoir to remove the apprehensions of the stake holders for Mangla operations as well as future reservoirs.

2. WAPDA's view that during shortage periods, the canals should not be stressed beyond 80% (20% shortage) of their requirements, as yields are significantly affected beyond this point, is reasonable. However this is not being followed in actual practice and canals are reduced even by more than 60% when Mangla is being filled.

3. Mangla is a replacement work constructed under the Indus Waters Treaty. However the Treaty envisages the construction of replacement works for transfer of water from Western Rivers to meet the existing irrigation uses in PAKISTAN which have depended on waters of Eastern Rivers. Mangla and other replacement works are therefore not meant for any particular area or region. After construction of the replacement works, the available water in Western Rivers has to be equitably shared by all the canals under the Water Accord 1991.

4. There is adequate water in Jhelum and Chenab rivers in Kharif to meet the requirements of upper and lower tributary areas, including the areas previously receiving water from Eastern Rivers, as well for storage in Mangla reservoir, even after raising.

5. No additional link canal from Indus is justified, because the existing link canals have their capacities according to Indus Waters Treaty/ Indus Basin Development Fund Agreement. Indus River main does not have unlimited quantities of water to be transferred to Tributary areas. On the contrary, Indus main is more stressed than Jhelum and Chenab rivers.

6. Water is stored in Mangla dam during shortage periods and spilled over/wasted in the periods when it is surplus. Moreover the stored water in Mangla is not fully utilized in subsequent Rabi season in many years. This is highly regrettable.

7. The following guiding principles for operational criteria of Mangla reservoir are suggested:

- (i) The basic principle of reservoir operations that a reservoir is a water bank in which water is stored when it is surplus to be used during the subsequent shortage periods must be adhered to. No water should be stored in Mangla reservoir, till the indents of the four provinces based on their Water Accord allocations are fully met.

(ii) During shortage periods if it is considered expedient and unavoidable to store water in Mangla reservoir, the allocations of canals may be reduced to not below 80% of the Water Accord allocations as per ten daily statements approved by CCI, with the unanimous consent of all the Provinces.

(iii) If adequate stored water is available in Mangla, it should be provided to lower riparian provinces, in early Kharif (April-May), when the river flows of Indus main are not enough for their minimum requirements.

(iv) The above guidelines will also be applicable after raising of Mangla dam.

TOR-5(b)

"Examination of operational criteria of link canals and future reservoirs"

4. TOR-5(b) "Examination of operational criteria of link canals and future reservoirs"

4.1 Regulation of link canals and future reservoirs

4.1.1 There are two link canals off-taking from the River Indus to connect the irrigation system of lower tributary areas. These link canals are:-

(i) Chashma - Jhelum (CJ) link canal (capacity of 22000 cusecs)

(ii) Taunsa - Panjnad (T-P) link canal (capacity of 12000 cusecs) Apprehensions have been expressed about the operation of these link canals, particularly during the periods of shortages. It is therefore necessary to examine the operational criteria of these link canals.

4.1.2 At present Pakistan has two major reservoirs, i.e. Mangla and Tarbela which are in operation since 1967 and 1977 respectively. Apprehensions have been expressed about the operations of these reservoirs, particularly Mangla reservoir. This aspect has been examined by the Technical Committee under TOR-5(a).

4.1.3 It is envisaged that more reservoirs have to be built to utilize the surplus water when available in the Western Rivers. It is therefore considered necessary to lay down the operational criteria of the future reservoirs so that their regulation can be conducted in consideration of the basic principles and in a transparent manner. This TOR has therefore been included to examine the operational criteria of the link canals and future reservoirs.

4.2 Presentations by IRSA and WAPDA and deliberations on TOR-5(b)

4.2.1 The presentations on TOR-5(b) were made by IRSA and WAPDA in the fifth meeting of the Technical Committee on Water Resources held on 23rd November 2004. The deliberations on the TOR were held in the subsequent sessions of the fifth meeting of the Technical Committee on 24th November 2004 and continued in the sixth meeting of the Technical Committee held from 20th to 22nd December 2004. Mr. Sardar Ahmad Mughal, member Sindh gave his written comments which were responded by WAPDA/IRSA. He submitted the rejoinders to the responses of WAPDA and IRSA which were also replied by WAPDA/IRSA.

4.3 Views of WAPDA/IRSA and seven members of Technical Committee on the points relating to TOR-5(b) and comments of Chairman, TCWR

4.3.1 Views of WAPDA/IRSA

(i) Operation of C-J and T-P link canals from the share of Punjab

IRSA has stated that C-J and T-P Link canals are operated on the basis of indent placed by Punjab province out of their allocated share. WAPDA states that link canals are operated by provinces except C-J link canal which is operated by WAPDA according to the indent placed by IRSA.

(ii) Operation of C-J and T-P link canals during shortage periods and the operation of these canals when water is being stored in Mangla reservoir

IRSA has said that water is being distributed amongst the provinces as per their shares. Operation of C-J-T-P link canals is justified because provinces draw the allocated agreed share only. WAPDA has stated that during low flow periods Mangla is being filled by curtailing canal uses to a reasonable level.

(iii) C-J and T-P link canals have been constructed under Indus Waters Treaty 1960

WAPDA and IRSA have stated that C-J and T-P link canals have been constructed under Indus Waters Treaty. WAPDA has also stated that under the Water Accord equal water rights have been given in the 10-daily allocations. IRSA has also stated that these link canals are operated while remaining within the provincial allocations under the Water Accord.

(iv) Design discharges of C-J and T-P link canals

The design discharge of C-J link is 22000 cusecs and T-P link canal is 12000 cusecs. IRSA has stated that these design discharges are only notional and that the actual operation of these canals depends on actual water availability in the rivers and on the principle of equitable distribution according to Water Accord allocation in each 10-daily period.

(v) Operational criteria of future reservoirs

No proposal for operational criteria for future reservoirs has been given by IRSA and WAPDA. IRSA has stated that operation of future reservoirs will be done in accordance with the hydrology of river and availability of water keeping in view the recommendations of IRSA Advisory Committee. WAPDA has stated that the future

reservoirs will be operated in consideration of irrigation needs, power generation requirements and sediment flushing.

4.3.2 Views of the seven members, TCWR

(i) As a consequence of Water Treaty 1960 inter river link canals have been constructed as replacement works under the Indus Basin Replacement Plan. These link canals were planned, designed and their alignment and full supply capacity determined. These sustain and support canal irrigated land from those old canals whose pre-independent head waters/river water sources came under Indian control. Their operational criteria and flow regime by 10-daily/monthly period of the year has been laid down in their design reports.

(ii) Since the enforcement of Water Accord these Indus link canals are operated strictly out of Punjab's share determined by IRSA. The two canals are perennial canals according to their design report as well as under actual operation as they convey replacement supply.

(iii) As a consequence of Indus Waters Treaty the utilizable water of Jhelum and Chenab Rivers including Mangla storage were consumed as replacement supplies and transfer to Eastern River canals through Upper Links. The waters of Ravi and Sutlej Rivers were assigned to India. The source of supply of old canals from Trimmu and Panjnad were changed and the burden of feeding these canals was shifted to flow cum storage supply of Indus River. Trimmu and Panjnad were envisaged to have no dependable supplies from the Chenab-Jhelum rivers and were to rely on Indus waters transfer through two Indus link canals.

(iv) The Design Report of Chashma-Jhelum (C-J) and Taunsa- Panjnad (T-P) link canals estimated that C-J link would convey 6.28 MAF in Kharif and 4.82 MAF in Rabi, while TP link would convey 3.84 MAF in Kharif and 1.09 MAF in Rabi from the flow-cum-stored supply in Indus.

(v) The seven members have further stated that views have been expressed by Sindh that C-J and T-P link canals were only flood water canals and should operate when there is surplus waters in Indus. Furthermore views were also expressed that these two link canals should not be operated during the period when water is being stored in Mangla reservoir and also when there is shortages in Sindh canals. These views are not consistent with the concept of Indus Waters Treaty.

(vi) The seven members of Technical Committee have not given any views on the operational criteria of future reservoirs.

4.3.3 Comments of the Chairman, TCWR

(i) IRSA and WAPDA have not mentioned anything about the Indus Waters Treaty in their presentations to the Technical Committee on TOR-5(b), However this point was raised later. The seven members of TCWR have also stressed this point. It is correct that the link canals including CJ and TP links were constructed as a consequence of Indus Waters Treaty 1960. The Indus Waters Treaty provides for construction of replacement works to transfer waters from three Western Rivers (Indus, Jhelum and Chenab), to meet existing irrigation uses in PAKISTAN which have depended upon the waters of three Eastern Rivers (Ravi, Sutlej and Beas), thereby releasing the whole flow of three Eastern Rivers for irrigation development in India. Thus the Indus Waters Treaty transfers the burden of the areas which depended on Eastern River waters to the three Western Rivers. The designs of CJ and TP link canals are however not the part of Indus Waters Treaty or Indus Basin Development Fund Agreement. These designs were prepared subsequently. It must be noted that all the canals of the Indus System in all the provinces including link Canals, whether constructed under the Indus Waters Treaty or before or after that event, have also their designed discharge and design criteria. None of the canals has a privileged position, and all the existing canals including link canals have therefore to share the available water in the Western Rivers equitably, according to their shares under the Water Accord. It is therefore important that there should be realistic and transparent operational criteria for CJ and TP links canals. This task has been enjoined upon the Technical Committee under TOR-5(b).

(ii) IRSA and WAPDA have stated that CJ and TP link canals are operated out of Punjab share of water under the Water Accord. The seven members of the Technical Committee have also stated the same. However it is apparent that in actual practice this principle is not being followed in letter and spirit.

(iii) The TP and CJ link canals are neither perennial canals nor flood canals but these are enabling devices to transfer the water from Indus to the lower tributaries areas of Punjab, if and when required by the water availability scenario in the three Western Rivers i.e. Indus, Jhelum and Chenab at any stage of time. If there is more water in Indus than the share of Indus main canals and at the same time there is less water in Jhelum-Chenab than the share of Tributary canals, surely that shortage can be met by transfer through the link canals.

(iv) It has been stated by seven members of Technical Committee that as a consequence of Indus Waters Treaty the utilizable waters of Jhelum and Chenab Rivers including Mangla storage were consumed as replacement supplies and transferred to Eastern River canals through upper links. However, this statement has not been supported with facts and figures from the recorded river flow data. To assess the correct position the table giving average inflows of Jhelum and Chenab Rivers and Eastern Rivers contribution as compared to Water Accord allocations of the tributary canals of Jhelum - Chenab System, based on WAPDA's figures is given below:

Table

Average inflows of Jhelum and Chenab Rivers and Eastern Rivers contribution, compared with Water Accord allocations of Jhelum-Chenab System

(Based on WAPDA's figures)

Sr. No	Source	Kharif		Rabi	
		1922-03 (MAF)	Post-Tarbela (MAF)	1922-03 (MAF)	Post-Tarbela (MAF)
1	2	3	4	5	6
1	Jhelum River	17.99	17.99	4.81	5.07
2	Chenab River	21.39	22.22	4.38	4.77
3	Eastern Rivers Contribution	4.31	4.31 (post-Tarbela)	0.63	0.63 (post-Tarbela)
4	Generated in Pakistan	2.35	2.35 (post-Tarbela)	1.18	1.18 (post-Tarbela)
Total Inflows		46.04	46.87	11	11.65
Water Accord Allocation of:-					
i) Jhelum-Chenab System (Upper Zone) including Eastern River canals		19.466		10.796	
ii) Jhelum-Chenab System (Lower Zone) including Eastern River canals		8.62		4.27	
Total (J-C) System		28.086		15.066	
System Losses		1.5		-	
Mangla filling					
(i) Present		4.5		-	
(ii) Additional after raising		2.9		-	
Total water requirements of Jhelum-Chenab System		36.986		15.066	

(v) From the above table it is apparent that the river flows of Jhelum-Chenab rivers are more than adequate for meeting the Kharif water requirements of the tributary areas, (including the Eastern River canals) both in upper and lower zones as well as filling of Mangla reservoir even after raising. There is therefore no justification for transfer of water to the lower tributary areas through TP and CJ link canals during Kharif. However, river supplies of Jhelum and Chenab rivers during Rabi are adequate only for the upper tributary areas of the Punjab even without availability of stored water, but if the lower tributary areas were also to get Rabi water from Jhelum - Chenab rivers, there will be some shortfall which will be required to be met from storages.

(vi) The lower Punjab Tributary areas linked to Indus through CJ and TP links should not be treated as permanent burden on Indus main. If this unrealistic proposition is adhered to, the proposals for constructing new reservoirs on Indus will be in serious jeopardy, because there will remain no surplus water for storage in Indus main.

(vii) The estimated water requirements for CJ and TP link canals indicated by the seven members of the Technical Committee are different from the Accord allocations as per comparison given in the table below:

Table				
Figures in MAF				
Link Canal	Seven members		Accord Allocation	
	Kharif	Rabi	Kharif	Rabi
1	2	3	4	5
Chashma - Jhelum Link	6.28	4.82	5.22	2.75
Taunsa - Panjnad Link	3.84	1.09	3.4	1.52

(viii) As explained in para 4.3.3 (iii) above, the CJ and TP Link canals are neither flood canals nor perennial canals, but they are enabling devices to transfer the share of water to lower Punjab canals from Indus River depending on the water availability in the three Western Rivers at any stage of time. However, under normal conditions no transfer of water through these link canals is required in Kharif season.

(ix) According to the figures given in WAPDA's presentation, TP and CJ Link canals were operated in shortage periods of April to June while at the same time water was being stored in Mangla reservoir (Annexure II-11), indicating that there was no shortage in Tributary areas. No reasons for this type of regulation are explained by IRSA, WAPDA or seven members. This arbitrary practice is highly regrettable.

4.4 Guidelines for operational criteria for link canals and future reservoirs

4.4.1 Neither WAPDA nor IRSA has given any proposal for operational criteria of link canals and future reservoirs. Seven members of the Technical Committee have not even mentioned about the operational criteria of future reservoirs in their report of May 2005. It is however important that clear and specific operational criteria be laid down for link canals and future reservoirs, as envisaged in the TOR. The following guiding principles for operation of link canals and future reservoirs are proposed:-

A. Guiding principles for operation of link canals (CJ and TP Links)

1. Water may not be transferred from Indus main to lower tributary areas through CJ and/or TP link canals in any 10-daily period, unless the Water Accord shares of the canals on Indus main according to 10-daily statements approved by CCI are satisfied.
2. Under normal conditions no transfer of water from Indus to lower Tributary canals through CJ and TP link canals would be required in Kharif season, as sufficient water is usually available in Jhelum and Chenab rivers during this season. However, water may be transferred from Indus main to lower tributary canals through CJ and/or TP link

canals only if in a 10-daily period, sufficient water is not available in Jhelum and Chenab rivers (including Mangla reservoir) after meeting the Water Accord shares of the Upper tributary canals to satisfy the share of Water Accord allocations of the lower tributary canals according to 10-daily statements approved by CCI.

3. No water should be transferred from Indus main to the lower tributary canals through CJ and/or TP link canals during the periods when water is being stored in Mangla reservoir.

4. CJ and TP Link Canals are inter-Provincial canals and should be operated as such, and not on the basis of indent of just one province.

B. Guiding principles for operation of future reservoirs

1. The storage of water in future reservoirs will be made only during the periods when surplus water is available after satisfying the indents of the provinces based on their 10-daily allocations under the Water Accord, approved by CCI, and the requirements of outflow to sea (10 MAF) or revised quantity decided by Federal Government on the basis of the result of studies being conducted by consultants/International Panel of Experts.

2. The filling of future reservoirs on Indus main will normally start only after Tarbela reservoir has attained its maximum conservation level of 1550 feet. However, in exceptional circumstances when more water is available at a particular stage of time than can be safely stored in Tarbela reservoir, the excess quantity may be stored in a new reservoir.

3. The operation of reservoirs will be done with due regard to the requirements of sediment flushing during the period June-July.

4. The following priorities will be observed for release of water stored in future reservoirs:

i. The stored water will first be utilized to meet the shortfall in Water Accord allocations in each 10-daily period based on the canal-wise provincial allocations approved by CCI.

ii. The balance water will be distributed amongst provinces under para 4 of the Accord i.e. ratio 37: 37: 14: 12 for Punjab, Sindh, NWFP and Balochistan respectively.

5. The water from future storages will not be distributed on the basis of their full storage capacity, but on the basis of expected annual availability, considering that the

reservoirs may not be filled up every year, and may even remain unfilled for a number of consecutive years.

6. The above guiding principles will apply to all reservoirs on Indus river system and its tributaries, except small reservoirs constructed for non-agricultural purposes like urban water supply.

4.5 Conclusions and recommendations

1. IRSA has stated that the designed discharge of CJ and TP links are only notional and that the actual operation of these canals depends on actual water availability in the rivers and on the principle of equitable water distribution according to Water Accord allocation in each 10-daily period. However in practice this principle is not being followed.

2. It has been stated that CJ and TP link canals have been constructed as replacement works under the Indus Waters Treaty and that they have certain designed discharges. However each and every canal of Indus river system has its designed discharge. Under the Treaty new sources have been provided to the canals located on Ravi and Sutlej rivers whose supplies got disconnected, but these canals have to share the water available in Western Rivers equitably under the provisions of Water Accord. No canal, whether constructed before or after the Treaty has any privileged position.

3. It is not correct that the water of Jhelum and Chenab rivers has been consumed in the canals of upper tributary areas. During Kharif, Jhelum and Chenab rivers have enough water not only for upper tributary areas, but also for lower Tributary areas and for Mangla storage even after raising. There is therefore no justification for operation of CJ and TP link canals during Kharif under normal conditions.

4. The lower Punjab Tributary areas linked to Indus through CJ and TP links cannot be treated as permanent burden on Indus main. If this unrealistic proposition is adhered to, the proposals for constructing new reservoirs on Indus will be in serious jeopardy, because there will remain no surplus water for storage in Indus main.

5. CJ and TP Link Canals are inter-Provincial canals and should be regulated as such. IRSA should not regulate these canals on the basis of the indent of one province, but these canals should be operated on the basis of principle of equitable distribution of water under Water Accord, on all Pakistan basis. 6. WAPDA and IRSA have not proposed any draft for operation of link canals, nor they have proposed the same for future reservoirs. TCWR has been assigned the responsibility to examine these criteria under this TOR. The guiding principles for operation of link canals and reservoirs have therefore to be prepared. The following guiding principles are proposed:

A. Guiding principles for operation of link canals (CJ and TP Links)

1. Water may not be transferred from Indus main to lower tributary areas through CJ and/or TP link canals in any 10-daily period, unless the Water Accord shares of the canals on Indus main according to 10-daily statements approved by CCI are satisfied.
2. Under normal conditions, no transfer of water from Indus to lower Tributary canals through CJ and TP link canals would be required in Kharif season, as sufficient water is usually available in Jhelum and Chenab rivers during this season. However, water may be transferred from Indus main to lower tributary canals through CJ and/or TP link canals only if in a 10-daily period, sufficient water is not available in Jhelum and Chenab rivers (including Mangla reservoir), after meeting the Water Accord shares of the Upper tributary canals, to satisfy the share of Water Accord allocations of the canals according to 10-daily statements approved by CCI.
3. No water should be transferred from Indus main to the lower tributary canals through CJ and/or TP link canals during the periods when water is being stored in Mangla reservoir.
4. CJ and TP Link Canals are inter-Provincial canals and should be operated as such, and not on the basis of indent of just one province.

B. Guiding principles for operation of future reservoirs

1. The storage of water in future reservoirs will be made only during the periods when surplus water is available after satisfying the indents of the provinces based on their 10-daily allocations under the Water Accord, approved by CCI, and the requirements of outflow to sea (10 MAF) or revised quantity decided by Federal Government on the basis of the result of studies being conducted by consultants/International Panel of Experts.
2. The filling of future reservoirs on Indus main will normally start only after Tarbela reservoir has attained its maximum conservation level of 1550 feet. However, in exceptional circumstances when more water is available at a particular stage of time than can be safely stored in Tarbela reservoir, the excess quantity may be stored in a new reservoir.
3. The operation of reservoirs will be done with due regard to the requirements of sediment flushing during the period June-July.
4. The following priorities will be observed for release of water stored in future reservoirs:

- i. The stored water will first be utilized to meet the shortfall in Water Accord allocations in each 10-daily period based on the canal-wise provincial allocations approved by CCI.
 - ii. The balance water will be distributed amongst provinces under para 4 of the Accord i.e. ratio 37: 37: 14: 12 for Punjab, Sindh, NWFP and Balochistan respectively.
5. The water from future storages will not be distributed on the basis of their full storage capacity, but on the basis of expected annual availability, considering that the reservoirs may not be filled up every year, and may even remain unfilled for a number of consecutive years.
6. The above guiding principles will apply to all reservoirs on Indus river system and its tributaries, except small reservoirs constructed for non-agricultural purposes like urban water supply.

TOR-2

"Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages"

5. TOR-2 "Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages"

5.1 Need for constructing dams/reservoirs

5.1.1 Reservoirs are needed to store and regulate surplus water in rivers so that it can be conserved for meeting the needs for food and energy of the country's growing population. Reservoirs are also needed for harnessing the potential for generation of hydropower which provides cheap source of energy.

5.1.2 The construction of storage reservoirs depends upon the water availability potential. It also depends on the pattern of water availability. These aspects have been examined and discussed under TOR-4(a) of this report. It will be prudent if these facTORS are kept in view while planning the future reservoirs.

5.1.3 At present we have two major reservoirs in Pakistan i.e. Mangla and Tarbela. There have been reductions in their storage capacities due to silting. It is important to ensure that the silt deposition in the present and future reservoirs should be reduced to the extent possible, and that efficient arrangements should be made for silt extrusion by providing adequate flushing capabilities in the design of the reservoirs and the efficient management of these sediment sluicing devices.

5.1.4 Apprehensions have been expressed about the operation of Mangla reservoir. It is therefore necessary to examine the operations of Mangla dam and also prescribe the operational criteria of future reservoirs. This has been done under TOR-5(a) and 5(b) of this report.

5.1.5 The sequencing of future dams/reservoirs has to be guided by the important facTORS like trapping maximum possible surplus water whenever it is available. It would also depend upon yielding maximum benefits at the lesser cost.

5.2 Presentation on TOR-2 by WAPDA and response by Planning and Development Division

5.2.1 WAPDA made the presentation on TOR-2 in the seventh meeting of Technical Committee held on 11th January 2005. The deliberations on the TOR were held in the subsequent session of the seventh meeting and continued in the eighth meeting of the Technical Committee.

5.2.2 Mr. Sardar Ahmad Mughal, member Sindh gave his comments on WAPDA's presentation which were responded by WAPDA.

5.2.3 Ch. Mazhar Ali member Punjab had earlier circulated a note about Basha and Kalabagh Dams, and their prioritization. The note was also considered by the Committee. Moreover Mr. M. H. Siddiqi, member Punjab also sent a note which was also considered by the Committee.

5.2.4 Planning and Development Division forwarded their note dated 6th January 2005, alongwith their response to the points relating to TOR-2. Planning and Development Division have also provided on 10th January 2005, the details about financial allocations for water sector including future storages.

5.3 Views of WAPDA, seven members of Technical Committee and comments of Chairman, TCWR on the points arising from the presentations and deliberations on TOR-2

5.3.1 Need for reservoirs

5.3.1.1 WAPDA's views

(i) Reservoirs are required to meet the needs of food and energy for rapidly increasing population. They are also needed to cater for fast depleting on-line storages and to harness the large spates of un-controlled flood flows to sea. Further the future reservoirs are needed for effective and complete river regulation and to optimize water/power benefits.

(ii) Without adequate water supply from storage no crop can achieve full production.

5.3.1.2 Views of seven members, TCWR

In their report of May 2005, the seven members of Technical Committee have supported WAPDA's views regarding need for future storages. The seven members have also stated that river storage dams are water conservation structures and do not consume water. They have further stated that in Pakistan existing live storage capacity is less than 10% of average annual river flows while the world average is 40%. They have further mentioned that Aswan dam on Nile river in Egypt has the capacity of more than

double the annual flows of Nile river and it helps Egypt to tide over the cycle of extreme drought in dry years.

5.3.1.3 Comments of Chairman, TCWR

(i) No doubt there is need for construction of reservoirs to meet the increasing need of food and fiber as well as for generation of hydropower. However, in Pakistan the future reservoirs have to be planned keeping in view the water availability potential in the Western Rivers. The guiding principle should be that every drop of surplus water when ever available should be stored. This has been unanimously agreed in the fifth meeting of the Technical Committee held on 22nd November 2004.

(ii) Reservoirs are needed to off-set effects of silting of reservoirs. However, there is need for efficient operation of sediment sluicing and silt reducing measures. This aspect will be discussed further in subsequent paragraphs.

(iii) It is correct that the reservoirs are water conservation structures and do not consume water. However, they store the surplus water when available. It is, therefore, necessary to assess availability of surplus water for storage. This aspect has been discussed under TOR-4(a). The world average storage capacity of 40% of river inflow has been mentioned by the seven members of Technical Committee without any details of even one river basin study. The storage capacity requirements vary from river basin to basin. This depends on the hydrology, annual and long term river flow patterns, existing water use commitments, topography of the river basin etc. The example of Aswan dam quoted by seven members points out the importance of a storage reservoir's capability for storing large quantity of surplus water during occasional floods for use in subsequent drought years. It must however be noted that the storages cannot be planned or built simply to conform to certain percentage of river flows at a flat rate, but these have to be planned according to the requirements of a particular river basin.

5.3.2 Silting of reservoirs

5.3.2.1 WAPDA's Views

According to the figures provided by WAPDA in their presentation the gross storage capacity of three existing reservoirs (Tarbela, Mangla and Chashma) has reduced from 18.37 MAF to 13.82 MAF and the live storage capacity has reduced from 15.74 MAF to 12.54 MAF due to siltation. Thus the reduction in the gross storage capacity is 4.55 MAF and live storage capacity has reduced by 3.20 MAF. The annual average loss of live storage in Mangla dam has been about 0.021 MAF per year and that of Tarbela reservoir has been 0.065 MAF per year. The silting rate of Tarbela dam as mentioned by WAPDA is more than that predicted at design stage and the rate of sedimentation of Mangla

dam is less than predicted at design stage. According to WAPDA's projection, at the present rate of silting, Tarbela dam will lose 25% of its live storage capacity upto the year 2010 and 31% upto the year 2020. Mangla will lose 17% of live storage capacity upto year 2010 and 22% of its live storage capacity upto the year 2020.

5.3.2.2 Views of seven members, TCWR

In their report of May 2005, the seven members of Technical Committee have not given any specific views on the silting of reservoirs.

5.3.2.3 Views of Chairman, TCWR

The figures of silting of reservoirs presented by WAPDA are based on the recorded data. The quantum of silting in live storage capacity is more relevant for knowing the net utilizable water availability. In the three existing reservoirs it is 3.2 MAF. This loss of 3.2 MAF in live storage capacity will nearly be balanced by raising of Mangla dam which is in progress.

5.3.3 TAMS' report on silting of Tarbela dam

5.3.3.1 Views of WAPDA

(a) WAPDA has stated that the detailed management study was carried out by TAMS in association with a British Firm HR Wellingford in 1998. Main recommendations of this report are:-

- (i) By the year 2008 an underwater dyke should be constructed to protect the intakes of the Right Bank Tunnels, the crest of the dyke should be at 1381 ft. (AMSL).
- (ii) By the year 2015, a by-pass should be constructed for flushing out the sediments. The by-pass should comprise four new tunnels to be built between the service and Auxiliary Spillways.
- (iii) Dredgers having very high dredging capacity should be procured for dredging the intake channel required for carrying the silt laden water to the new tunnels.

(b) WAPDA has further stated that:

- (i) The estimated cost of the measures proposed by TAMS was indicated as U.S \$ 663 million.

(ii) WAPDA did not agree with the recommendations of TAMS' report and as such it was not implemented.

(iii) However, WAPDA has stated that they are fully alive to the sedimentation problem of Tarbela dam and is exploring all possible avenues to prolong the life of reservoir. WAPDA is also planning to organize an international seminar on sedimentation.

5.3.3.2 Views of members, TCWR

In their report of May 2005, the seven members of Technical Committee have not given any views on TAMS' report and the measures for controlling/reducing the siltation of Tarbela reservoir. However, Mr. Sardar Ahmad Mughal has stated in his note enclosed with the report of seven members that the solution should be found to the silting of Tarbela dam and TAMS' report should not be discarded.

5.3.3.3 Views of Chairman, TCWR

During the deliberation on the subject in the meetings of the Technical Committee, the Chairman had made the following observations.

(i) The study was considered necessary and it was entrusted to TAMS' by WAPDA itself, and WAPDA must have discussed the approach of consultants and their recommendations with them during and after the study.

(ii) WAPDA should have taken some specific decisions at its level or in higher forum regarding accepting or otherwise, of all or some of TAMS' recommendations, with or without modifications.

(iii) WAPDA should have clearly stated whether they feel that no more studies were needed for silting problem of Tarbela and that we have to live with present situation.

(iv) His other concern is about silting of Tarbela as to whether it is curable or not. WAPDA should have come up with definite strategy by now. In case TAMS' report was found not feasible, why it was not stopped at an early stage.

(v) It is felt that the acute silting problem of Tarbela reservoir cannot be solved by holding a seminar as proposed by WAPDA. TAMS are a firm of International repute and therefore it was engaged by WAPDA to study the silting problem of Tarbela reservoir and suggest remedial measures. If WAPDA was not entirely satisfied with TAMS thinking they should have given their feed back to TAMS during the currency of consultancy assignment. Even after the expiry of consultancy period if no satisfactory outcome was achieved, the period could have been extended and further deliberations

or investigations carried out to come to some definite and positive conclusions. It is highly regrettable that this important report of consultants submitted in 1998 has still not been formally accepted or rejected.

(vi) Apprehensions have been expressed that the silting of Tarbela reservoir is due to improper operation of the sediment sluicing devices. Though WAPDA has not accepted this version, still it seems that there is something wrong somewhere.

(vii) Tarbela is a national asset and its silting problem should be a matter of serious concern. Surely the problem is not such for which solution cannot be found.

5.3.4 WAPDA Vision 2025 Programme

5.3.4.1 WAPDA's Views

WAPDA has stated that the Vision 2025 Programme provides the storage potential of 59.43 MAF on Indus River System. They have further stated that 59.43 MAF is the total storage potential that can be developed on the system. On completion of feasibility studies in a phased manner only most attractive projects would be selected for implementation.

5.3.4.2 Views of seven members, TCWR

In their report of May 2005, the seven members of the TCWR have supported WAPDA's views.

5.3.4.3 Comments of Chairman, TCWR

WAPDA have identified the potential of 59.43 MAF for storage on Indus River System, but they have not included the computations of water availability or even made any mention of it in the Vision 2025 Programme document. Moreover they have not stated in the document that the storage potential of 59.43 MAF only identifies the available storage sites and that the actual implementation will be subject to water availability. It is regrettable that importance of water availability computations has not been appreciated.

5.3.5 Report of World Commission on Dams

5.3.5.1 Views of Planning and Development Division.

The Planning and Development Division have stated that the parameters/conditions recommended in the World Commission on Dams (WCD) Report will be followed in line with national policies and law of the land.

5.3.5.2 WAPDA's Views

(a) Dams and Development Report of 2000 has suggested the following approach:

- Gaining public acceptance
- Comprehensive options assessment
- Addressing existing dams
- Sustaining river and livelihood
- Recognizing entitlements and sharing benefits
- Ensuring compliance
- Sharing river for peace, development and security

(b) Dams and Development Report of 2000, has not been accepted by most of the developing countries. Pakistan is in a worse situation than many developing countries and if two dams are not built urgently we will lose both the development and environment of the country.

(d) WCD report was of recommendatory nature and as part of global circulation also furnished to GOP.

5.3.5.3 Views of seven members, TCWR

In their report of May 2005, the seven members of TCWR have not given any views on the report of World Commission on Dams.

5.3.5.4 Comments of Chairman, TCWR

(i) In their report of November 2000, the World Commission on Dams has identified and examined the different aspects of construction of dams in consideration of the experiences gained so far all over the World. The report has focused on both positive and negative aspects, and it has not been stated specifically whether dams should or should not be constructed.

(ii) The World Commission on Dams has highlighted five fundamental principles for reservoirs i.e.

- Equity
- Efficiency
- Participatory decision-making
- Sustainability
- Accountability

These fundamental principles along with those listed in WAPDA's own comments are such that no one should ignore them.

(iii) The World Commission on Dams Report has been received by WAPDA and Ministry of Water and Power in 2000, but no specific decision on the recommendations has yet been taken at appropriate level. This is highly regrettable.

5.3.6 Constructing storage reservoirs even if they may not be filled for a number of consecutive years in drought periods

5.3.6.1 Views of Planning and Development Division

Water reservoirs are needed for better and efficient utilization of scarce water resources.

5.3.6.2 Views of WAPDA

At this point in time, water for additional storage is available without any doubt. Firstly on the average 34.7 MAF is flowing to the sea. Secondly due to sedimentation we have lost about 5 MAF of existing storages which is going to sea. Environmental changes due to global warming are causing severe droughts as well as floods. But as we don't have any feasible site for a carryover reservoir, we should have as many as possible dams on main Indus and tributaries.

5.3.6.3 Views of seven members, TCWR

The seven members of Technical Committee, in their report of May 2005, have not given any specific views on this point. However, the Technical Committee on Water Resources decided in the fifth meeting held on 22nd November 2004, that every drop of surplus water when ever available should be stored.

5.3.6.4 Views of Chairman, TCWR

It should be borne in mind that considering the water availability scenario as elaborated under TOR-4(a), there is no more surplus water available for inter-seasonal transfer (Kharif to Rabi of the same year), after construction of Mangla and Tarbela dams. The surplus water at present is available only from occasional flood flows. These surplus flows are of higher magnitude but of lesser frequency. Under the circumstances, the future dams may not be filled every year and in fact they may remain un-filled for a number of consecutive years in drought periods. Thus the filling of future dams will be an occasional event, as compared to existing dams in which even partial filling in a year is considered an unusual phenomenon. The operational criteria of future reservoirs should therefore take note of this eventuality.

5.3.7 Time required for feasibility studies of carry-over dam

5.3.7.1 WAPDA's Views

(i) Comprehensive feasibility study for any big dam requires a very long period. The study has to be prepared in stages, reconnaissance, pre-feasibility, detailed feasibility, design/tender documents, which takes about 4-5 years. As studies involve lot of expenditure viability of the project is ensured before embarking on the next stage. Only Katzarah/Skardu dam on Indus is being pointed out by some quarters as a possible carryover reservoir. Pre-feasibility study of this dam has been taken in hand in September 2003 at a cost of 70.0 million with 2 years completion period. So far topographic surveys and initial environmental impact assessment studies have been carried out which have revealed that:

(ii) Skardu/Katzarah Dam site has great resettlement issues, which in practical terms, render its viability doubtful.

(iii) Purpose of a carryover dam could also be achieved by constructing all the 3 dams i.e. Kalabagh, Basha and Akhori.

5.3.7.2 Views of seven members, TCWR

In their report of May 2005, the seven members of TCWR have not given any views on this aspect.

5.3.7.3 Comments of Chairman, TCWR

(i) Taking into consideration hydrology of Indus River System and the scenario of water availability for future storages as discussed under TOR-4(a), which indicates that large quantities of surplus water are available only in a few high flood years, the feasibility study for a carryover dam should have been initiated by WAPDA much much earlier. However as stated by WAPDA, the pre-feasibility study of Katzarah/Skardu dam has been started only recently in September 2003, and it is expected to be completed in September 2005. It is important that the detailed feasibility study is also undertaken without further delay. All the positive and negative aspects of the project should be thoroughly studied and clear and specific decision taken at highest level of government for this project, which is probably the only available site for carryover dam. It should also be noted that the foremost criterion for future dams will be its capability to trap maximum quantities of surplus water when available. Skardu/Katzarah dam has a large storage capacity of about 35 MAF which will enable a major portion of the surplus water to be stored and regulated.

(ii) WAPDA should not have focused on the negative aspects of the carryover dam even before its feasibility has been prepared. This attitude indicates their biased approach towards this important dam site.

(iii) WAPDA has stated that the purpose of carryover dam can be achieved by constructing three dams. They have however not considered costs involved and time factor. Moreover, even the suggested three dams at Kalabagh, Basha and Akhori will have total capacity of about 18 MAF, which is only half the capacity of carryover dam at Skardu/Katzarah. Apparently a number of smaller dams cannot be a substitute for a carryover dam of large capacity which is needed under our conditions.

5.3.8 Sequencing of reservoirs

5.3.8.1 Basis of Planning, Prioritizing and Sequencing of future reservoirs

(a) Views of Planning and Development Division

(i) Water reservoirs are needed for better and efficient utilization of scarce water resources.

(ii) Prioritizing and sequencing depends on need for water and energy and readiness for implementation on the basis of feasibility, planning and design.

(b) Views of WAPDA

(i) Rivers Sutlej, Beas, Ravi and Chenab have no suitable dam site in Pakistan. The only suitable site on River Jhelum at Mangla has already been exploited to its maximum.

(ii) Large mid Kharif surplus on the Indus and its relative reliability suggests that future sites for storage development following Mangla and Tarbela should be on the Indus. Consequently, on Indus the following major storage sites have been identified during the last 50 years.

- (a) Kalabagh
- (b) Basha - Diamer
- (c) Skardu
- (d) Yugo (Shyok)
- (e) Akhori (Tarbela off-channel)

(iii) The above promising sites were considered over a number of years and some of them are in the different stages of planning and design.

(iv) The important aspect of trapping the maximum quantity of surplus water as and when available should be guiding factor with due consideration of site, type (carryover, non-carryover) and hydrology of each specific project.

(c) Views of seven members, TCWR

In their report of May 2005, the seven members of Technical Committee have said that Pakistan has only a few good and viable river storage sites. Every site would need optimum exploitation after investigation and studies. It is the economic and social compulsions to productively use every drop of our fresh water river flows. The policy should be to have a plan to undertake a series of feasibility studies for indicated/possible storage sites for future dam construction. The urgent need is of prioritization of on-line as well as off-channel storages and break the shackles of no-action status quo.

(d) Views of Mr. Sardar Ahmad Mughal, member, TCWR

In his note attached with the report of seven members of May 2005, Mr. Sardar Ahmad Mughal has stated that:-

The priority of dams should be on the following basis:

- (i) Capability to trap maximum percentage of highly variable river water surpluses.
- (ii) Max. benefits of storage and power generation at minimum cost.
- (iii) Non-controversial projects should be given more priority. The tunnels for high level Left and Right side outlets (canals) of Kalabagh dam are strongly opposed. No stubs should be provided during its constructions. No diversion should be allowed from the dam.
- (iv) Readiness for implementation.

(e) Comments of Chairman, TCWR

The basic criteria for planning, prioritizing and sequencing of dam should be as under:-

- (i) Capability to trap maximum quantity of surplus water as and when available. This has also been suggested by WAPDA.
- (ii). Yielding maximum benefits of water storage capacity and power generation, at minimum cost

- (iii) Low capacity - Inflow ratio to reduce silting problem.
- (iv) Readiness for implementation.
- (v) Nearness to the consumption areas for irrigation water and power.
- (vi) Considering apprehensions about a dam.

5.3.8.2 Available options for future reservoirs and their sequencing

(a) Views of Planning and Development Division

Planning and Development Division has not given any separate views on this aspect. However, their general views on planning of reservoirs are indicated in para 5.3.8.1(a) above.

(b) WAPDA's Views

WAPDA's views are as per para 5.3.8.1 (b) above. However WAPDA has given views on each reservoir as reflected in subsequent paragraphs.

(c) Views of seven members, TCWR

In their report of May 2005, the seven members have stated that the two available options in view are the Basha and the Kalabagh storages on the Indus. These two multipurpose dams are not mutually exclusive or in competition as has erroneously been projected/stressed. The two storages, with an aggregate capacity of about 12 MAF, are complementary and would provide bare minimum and pressing needs for food security and economic growth.

(d) Comments of Chairman, TCWR

WAPDA has indicated three storage sites on Indus main i.e.

- Kalabagh
- Basha and
- Skardu/Katzarah

Another site i.e. off channel storage at Akhori has also been listed. The feasibility study of Kalabagh Dam was done in the year 1988. The feasibility study of Basha dam has been completed in the year 2004. The pre-feasibility study of Skardu/Katzarah dam has been started in September 2003 and is expected to be completed by September 2005. The

priorities for sequencing of dams have to be considered out of these three available options, keeping in view the basis for planning, prioritizing and sequencing of dams suggested in para 5.3.8.1 (e) above.

5.4 KALABAGH DAM

5.4.1 WAPDA's position

(a) WAPDA has stated that the last feasibility study of Kalabagh dam was conducted in 1984-88. They have further stated the updating of the feasibility study is not required.

(b) The estimated cost of Kalabagh dam project as indicated in the feasibility report of 1984 was US \$ 6.0 billion and WAPDA has given the latest updated cost estimate of Kalabagh dam project to be also same i.e. US \$ 6.0 billion. WAPDA has indicated that international prices of power generation equipment have decreased and therefore the estimated cost of Kalabagh dam project has reduced.

(c) WAPDA has indicated the live storage capacity of Kalabagh project to be 6.1 MAF. They have indicated the hydropower generation capacity of Kalabagh dam to be 3600 MW.

(d) WAPDA has stated that the feasibility, design and tender documents of the project are ready. The project can be taken up for construction almost immediately. It would take about 6 years to build and can be completed in 2010.

(e) Kalabagh is the lower most storage site on river Indus before it debouches into plains.

5.4.2 Views of seven members, TCWR

In their report of May 2005, the seven members of Technical Committee have stated that:-

(a) Detailed field investigations were conducted, and detail design, hydraulic and computer model studies were carried out at a cost exceeding one billion rupees.

(b) Mr. Shams-ul-Mulk, member Technical Committee has given his additional views that there is no unfinished work of technical examination, review or analysis on Kalabagh.

(c) In their report of May 2005, the seven members of Technical Committee have also indicated live storage capacity of the dam to be 6.1 MAF and hydropower generation capacity of Kalabagh dam to be 3600 MW.

(d) The seven members have further stated that:-

(i) Kalabagh dam is the only project ready for implementation and can be completed in 6 to 7 years.

(ii) Kalabagh dam will store monsoon flows/floods of Indus and upstream tributary Kabul and Soan rivers. Indus annual average flows at Kalabagh are 90 MAF, at Tarbela 60 MAF and at Basha 50 MAF. It has further been stated that without committing in Pakistan the water of Kabul River, our co-riparian would always attempt to overview/over claim their share in the river.

(iii) Kalabagh dam will help to improving Tarbela generation capacity by 30%.

5.4.3 Comments of Chairman, TCWR

(a) WAPDA's view that feasibility study of Kalabagh dam of 1988 (18 years old) does not need any updating is neither understandable nor acceptable. It is necessary to update the feasibility of the project, particularly the following aspects:-

(i) Cost estimates.

(ii) Reservoir filling study.

(b) WAPDA's statement that the present cost estimate of 2004 of the project are the same as the cost estimate of 1984 (21 years back) is not tenable. The prices of steel, cement, oil, labour etc has risen manifold. Moreover the re-location and re-settlement costs have also shown tremendous increase. It is therefore necessary that realistic cost estimates based on the present price levels are worked out.

(c) Kalabagh Consultants' feasibility report of 1988 includes filling study of Kalabagh dam based on the river flow data from 1921-22 to 1985-86. This study was made on pre-Water Accord scenario. Moreover, the projected irrigation requirements indicated in the study do not seem to include the system losses and the requirements of outflow to sea downstream Kotri. The table of estimated irrigation demand (on which basis the study has been conducted), given in the Consultants' Kalabagh Reservoir Filling Study Report of 1988 is enclosed (Annexure II-12). A table depicting the post- Accord Water requirement below Kalabagh dam, based on the Water Accord allocations of the canals downstream Kalabagh including the system losses and the requirement of outflow to sea (10 MAF) is also enclosed as (Annexure II-13). In this table the requirements of the three ongoing flood canal schemes (5 MAF) have also to be added. The comparison of the two tables indicates that the estimated irrigation demand considered by the

Kalabagh Consultants particularly during the reservoir filling period of July- September is much lower than the actual post-Accord requirements. The filling study must therefore be reviewed and updated, and the release capacities of the outlets of Kalabagh reservoir be re-checked and re-designed as necessary.

(d) The live storage capacity of Kalabagh dam i.e. 6.1 MAF has been correctly indicated by WAPDA. However, hydropower generation capacity of Kalabagh dam according to the Kalabagh Consultants feasibility report is 2400 MW, initially, to be increased to 3600 MW at a later stage (date not indicated). The cost estimates of Kalabagh Consultants are however based on the initial power generation capacity of 2400 MW.

(e) The average annual inflow of 90 MAF at Kalabagh (including the flow of Kabul River) is not indicative of availability of large amount surplus water for storage. Infact the average annual inflow at Kalabagh is not even sufficient to meet the requirements of downstream canal systems of the four provinces on the basis of their Accord allocations as detailed below:

(i) Accord allocation of NWFP, Punjab, Sindh & Balochistan canals on Indus main downstream Kalabagh = 81 MAF

(ii) System Losses = 13 MAF

(iii) Outflow to sea = 10 MAF

Present water requirements downstream Kalabagh = 104 MAF

Additional water required for Kalabagh storage (6 MAF)

+ ongoing Greater Thal, Raineer and Kachhi flood canals (5 MAF) = 11 MAF

Total water requirements including storage and floods canals = 115 MAF

The above figures include the water requirements (about 13 MAF) of lower Tributary areas, connected to Indus River through CJ and TP link canals. If these link canals are treated as a permanent burden on the Indus River main, (which is not correct), the future of all reservoirs planned on Indus will be in jeopardy. It is stated that water of Jhelum-Chenab rivers and Eastern Rivers contribution are more than adequate to meet the Kharif requirements of both Upper and Lower Tributary areas, including storage at Mangla and no transfer of water from Indus through CJ and TP Links is needed under normal conditions. This has been elaborated under TOR-5(b) of this report.

(f) Kalabagh dam capacity is 6.1 MAF, whereas average annual average river flow at Kalabagh is 90 MAF. Such large quantity is not needed to fill the dam, and on the

contrary this high river inflow is disadvantageous because Kalabagh dam will have to cater for much higher silt load as well as it will have to be provided with higher spillways capacity.

(g) The capacity inflow ratio of Kalabagh dam is 15 (90 divided by 6) i.e. the dam has to regulate and cater for 15 times the quantity of water to be stored, with consequent problems of higher silt and also requirement of higher spillways capacity etc.

(h) Regarding silting problem at Kalabagh, the feasibility study of Kalabagh dam by Kalabagh Consultants (1988) regarding Sediment Studies states as under:-

"The high sediment load carried by the Indus at Kalabagh has an important bearing on the design of Kalabagh dam and on the operating rules for the reservoir. If a high proportion of the sediment is trapped, the storage volume will rapidly reduce with the loss of irrigation benefits derived from the storage. Such sedimentation could eventually also cause unacceptable backwater effects".

According to consultants' report, the sediment inflow at Kalabagh could eventually reach 0.25 MAF per annum. Such high silt load will fill up the Kalabagh reservoir in just 25 years. The Kalabagh Consultants have however, suggested sluicing Kalabagh reservoir for 50 days from 1st June to 20th July for the flushing of silt.

(i) The availability of additional water from Kabul River at Kalabagh dam site does not in any way help to supplement the water required for Kalabagh dam for storage. On the contrary additional silt brought by Kabul River will aggravate the sedimentation problems. The construction of Kalabagh dam will in no way strengthen the cause of Pakistan for claiming additional water from Afghanistan, because the Kabul River water is already committed for existing uses on Kabul main as well as in the Indus canal systems downstream, which should be the basis for our legitimate claim on Kabul River waters.

(j) WAPDA's document "Kalabagh Dam project-Executive Summary (October, 1988)" indicates that projected energy generation at Kalabagh dam is 11413 GWh and the extra generation at Tarbela due to Kalabagh will be 336 GWh. Thus the extra generation at Tarbela will be about 3%, and not 30%, as stated by the seven members of TCWR.

5.5 Kalabagh Right and Left Banks Canals

5.5.1 Views of WAPDA

WAPDA has stated that according to design already completed there is no proposal to include the right bank canal or left bank canal in Kalabagh Dam Project, though these outlets have some technical advantages.

5.5.2 Views of seven members, TCWR

(i) In their report of May 2005, the seven members of TCWR have stated that Kalabagh has the potential to provide flow irrigation to large areas of D.I.Khan and enable integration of Indus - Jhelum - Chenab River systems as one basin for most optimum and productive water use. They have further stated that Kalabagh is the only site enabling gravitational flow to irrigate about 5.0 lac acres, through a right bank outlet, for D.I.Khan and Bannu area in NWFP. They have also stated that there is no other dam site providing this facility to NWFP to use its share of river supplies. It has also been stated that without Kalabagh left bank canal, the Jhelum River early snow-melt supplies will continue to store in early Kharif for reservoir filling rather than meeting the need of Sindh during that period.

(ii) Further, in the report of May 2005, Mr. Shams-ul-Mulk, member NWFP has stated that "We are not unaware of the apprehensions of Sindh province regarding off-taking canals from Kalabagh reservoir. We also understand that a few unfortunate incidents, committed by irresponsible officials in the past have contributed to such apprehensions. But there are positive examples NWFP has not received any flows in excess of its authorized shares from the Right Bank High Level Canal from Tarbela nor from Chashma Barrage. In any case, the telemetry system now installed would provide such information that any use, beyond authorized share, would become easily known".

5.5.3 Views of Mr. Sardar Ahmad Mughal, member TCWR

In his note enclosed with the report of seven members of Technical Committee of May, 2005, Mr. Sardar Ahmad Mughal has stated as under:- "The tunnels for high level Left and Right side outlets (canals) of Kalabagh dam are strongly opposed. No stubs should be provided during construction"

5.5.4 Comments of Chairman, TCWR

(i) WAPDA has stated that there is no proposal to include right bank and left bank canals in the Kalabagh dam Project.

(ii) The seven members of TCWR have however, strongly advocated the construction of right bank and left bank canals, but they have not mentioned anything about the basis of justification and planning and design of the canals, nor have they even indicated the main features of these canals. The main features of the proposed Kalabagh right bank and left bank canals as mentioned in the Project Planning Report of Kalabagh dam project by Kalabagh Consultants (July 1984) are as under:

(a) Right Bank Canal

- It caters for irrigation supplies for Culturable Commanded Area of 850,710 acres. About 65% of the area would be served by gravity and 35% area by pumped supply.
- Maximum monthly withdrawal capacity would be 8300 cusecs.
- The right bank canal works would include 15.5 miles of 37.5 ft. diameter tunnel and 34 miles of canal.

(b) Left Bank Canal

- It caters for irrigation supplies for Culturable Command Area of 287,310 acres. It will involve pumping of over 8000 cusecs through 63.6 ft. head.
- Maximum monthly withdrawal capacity is 13100 cusecs.
- The left bank canal would include twin 33 ft. diameter tunnels each 8.5 miles long and a link canal to the river Jhelum.

(c) The total annual volume of withdrawal of both the canals would amount to about 8 MAF, almost equal share in Kharif and Rabi seasons.

(d) The tunnels would be extremely costly to build and would have to pass through zones where the geological conditions are very unfavourable. Use of the outlets would incur a substantial energy penalty loss of over 1000 GWh per year, which is about 10% of the generation capacity of Kalabagh Dam. The Consultants have concluded that it would be difficult to construct the tunnels, which would be vulnerable to future tectonic disturbance and that the development is not feasible by normally accepted standards.

(iii) In their report of May 2005, the seven members of Technical Committee have indicated an area of 5 lac acres to be irrigated by right bank outlet in D.I. Khan and Bannu districts of NWFP. They have not mentioned anything about the area to be irrigated by left bank canal. However, as per details given above, according to the feasibility report of Kalabagh Consultants, 850,710 acres of land in D.I. Khan, D.G. Khan, Mianwali and Bannu districts would be served by right bank canal and an area of 287,310 in Khushab/Jalalpur area of Punjab would be served by left bank canal. The total commanded area of both the canals comes to 11,38,020 acres. A fairly large proportion of this area will require lift irrigation. The total water requirements of these canals are about 8 MAF, (about 4 MAF in Kharif and 4 MAF in Rabi) as against the design live storage capacity of Kalabagh dam which is 6.1 MAF. The withdrawal capacity of the two canals will be over 21000 cusecs.

(iv) The Kalabagh Left Bank Canal includes provision for Kalabagh-Rasul Link, of which no details have been given and it has not been explained on what basis it is needed. No such link is justified, because the two Indus Links (CJ and TP Links) having designed capacity of 34000 cusecs as envisaged under Indus Waters Treaty already exist and Indus main cannot bear any further additional burden of transfer of water to Tributary areas. This aspect has also been elaborated under TOR-5(b). The idea of seven members that the proposed link will benefit Sindh is mind-boggling and prima facie unrealistic.

(v) The above facts clearly indicate that Kalabagh Right Bank and Left Bank Canals are neither feasible nor justifiable. The design of 1984 provides for a huge capacity of over 21000 cusecs and water requirement of 8 MAF, much more than the capacity of the dam. Out of this, 4 MAF are required during Rabi season from the stored water which is about 66% of the capacity of the dam. Though WAPDA has stated that there is no proposal to include these canals in the project, still there are justifiable apprehensions caused by this idea. The proposal for these canals should therefore be finally dropped. No stubs for these canals need to be provided.

(vi) Mr. Shams-ul-Mulk has mentioned about the apprehensions regarding Kalabagh canals in a rather casual manner. He has referred to a few unfortunate incidents committed by irresponsible officials but has neither identified those incidents nor suggested any corrective measures. He should have realised that construction of the canals which are neither realistic nor feasible, and then suggesting that they will not be operated to the detriment of lower riparian provinces, is hardly a convincing proposition.

(vii) In their report of May 2005, the seven members have also stated that Kalabagh dam site is the only site to irrigate the areas of NWFP by gravitational flow. In this connection the following points have to be considered:-

(a) Under para 4 of the Water Accord 1991, the shares of provinces in the balance river supplies (including flood supplies and future storages) have been determined. The share of each province can be utilized by them in any manner they deem appropriate, i.e. by increasing the capacities of existing canals, converting non-perennial canals into perennial, by extension of the command area of these canals, or by constructing new canals. It is for the provinces to see that they select more suitable areas for new canals which can be cultivated by flow irrigation. However, neither it has been indicated in the Accord, nor it is practicable to assure these allocated supplies by flow irrigation. The idea of getting flow supplies directly from a dam is again unreasonable and unrealistic. If this idea is accepted or encouraged, it will give rise to similar demands for all future dams, which will be impossible to meet.

(b) In WAPDA's Vision 2025 document, a number of small and medium storage sites in NWFP have been listed. These include Gomal Zam, Tank Zam, Kurram Tangi, Munda dam etc. The capacity of some of these dams is over 1.0 MAF. NWFP can get more than their Water Accord share of the stored water from these dams. Gomal Zam project with a capacity of 1.13 MAF is an ongoing scheme and under construction, which will provide NWFP much more water than their share in Kalabagh dam. It may also be noted that the provinces particularly NWFP, need not get its share of storage water from each dam on Indus main, but it will be more realistic that NWFP may get its allocated share of storage water from the dams, to be built in the province on the tributaries of Indus River.

(c) As brought out in the discussions under TOR-4(a) "Determination of water availability for future reservoirs and irrigation schemes", it is not likely that the future storages will be filled every year and therefore it will not be possible to supply the water according to their full storage capacity every year. As per computations given in the table at (Annexure II-7) of this report under TOR-4(a), a dam of 6.0 MAF capacity is likely to be filled for 10 years out of 28 years and it will provide 2.14 MAF per year against full capacity of 6.0 MAF. The shares of the provinces from future storages must therefore be determined on the basis of expected water availability of 2 MAF per year and not on the basis of full capacity of 6 MAF. The regulation and operational criteria of the future reservoirs shall also be framed accordingly.

(d) It has been vehemently argued and also stressed by the seven members that full Water Accord allocation cannot be met, during shortage periods without construction of new reservoirs. The average short fall in meeting Water Accord allocations is about 12 MAF. This short fall is mostly in the Kharif season. The future reservoirs will therefore first cater for this shortfall, before any water can be provided to the provinces for development of new projects. Thus the first dam to be constructed will have to be earmarked entirely for providing water for meeting shortfall in Accord allocations.

5.6 Flooding of Nowshera Town

5.6.1 WAPDA's Views

WAPDA has stated that backwater effect of Kalabagh Lake would end about 10 miles downstream of Nowshera. A state-of-art computer based study, backed by physical modeling in Pakistan, has established that recurrence of record flood of 1929 would not affect the water level at Nowshera even after 100 years of sedimentation in reservoir. The computer study, did not include the effect of Tarbela reservoir which is now factually providing relief by attenuating flood peaks. These studies were reviewed by Chinese Expert (Dr. Lianzhen) and later by an International Panel of Experts (POE) headed by Dr. Kennedy of USA who was nominated by Government of NWFP. Both

reviews are highly supportive of the studies. The POE has stated in their report that the results of this study are conservative.

5.6.2 Views of seven members, TCWR

In their report of May 2005, the seven members have not given any specific views regarding flooding of Nowshera town. However they have stated that " We are also not unaware of the other stated apprehensions of NWFP and Sindh. This is not the place to address them in detail. Suffice to say, that all such claimed apprehensions are misplaced. And this conclusion is based on the views and reports of the best professionals in the world; professionals whose words are internationally respected".

5.6.3 Comments of Chairman, TCWR

WAPDA has mentioned that according to the studies carried out there will be no flood at Nowshera at the conservation level of 915 ft. at Kalabagh site. However the following points need to be considered:

(i) In their report of July 1984, about flood levels at Nowshera town, the Kalabagh Consultants have stated that "The effect of flood level of long term deposits has not been evaluated. There is little doubt, however, that Nowshera will become progressively more difficult to protect from flooding and that low level sluicing will pro-long effectiveness of flood protection". The reducing silting of the Kalabagh dam will therefore depend upon regular and effective sluicing of sedimentation. It may be stated that design of Kalabagh dam provides mid level sluicing and not low-level sluicing.

(ii) The proposed conservation level of Kalabagh dam is 915 ft. However, according to the design indicated by the Consultants, the spillway will operate at the level of 934 ft. What will be the consequential effect of this level at Nowshera during floods when spillway is operating? This point was also raised during the discussion 'on the subject in the seventh meeting of the Technical Committee held on 12th January 2005, but WAPDA did not respond to it. In the Kalabagh dam Consultant's report of 1984, it has been mentioned that for every 2.5 ft increase in reservoir level at Kalabagh, there will be 1.0 ft. corresponding rise in flood level at Nowshera. Thus there will be 8.0 ft. rise in level at Nowshera during the period when spillway at Kalabagh dam operates at the level of 934 ft. It is to be expected that the flood effect at Nowshera will mostly occur in the flood season, when spillways are operating rather than in the normal flow periods of the river, when storage level is 915 or less.

(iii) In the report of Kalabagh Consultants of 1984, it was proposed to construct dykes upto 25 ft. height for protection of Nowshera town. With the proposed reduction of the conservation level from 925 to 915 ft. it is stated that dykes will not be constructed. It

may, however, be noted that with the reduction of conservation level by 10 ft. the corresponding reduction of level at Nowshera will also be about 10 ft. Thus even by WAPDA's estimates the dykes of atleast 15 feet height will be required. It is being stated by WAPDA that such flooding at Nowshera, if it occurs at Kalabagh at conservation level of 915 ft, will not be due to construction of Kalabagh dam. However, it would be difficult to stop the reaction of the affectees if such a situation arises at Nowshera during floods, after construction of Kalabagh dam.

(iv) The Federal Government/Chief Engineering Adviser are conducting three studies, two studies for outflow to sea downstream Kotri, and one study regarding environmental concerns in remaining part of the country. The TORs of the third study also include the possible effects in NWFP if Kalabagh dam is constructed. It is expected that the recommendations of the Consultants on the studies will be available by October 2005. It will be prudent to wait for the recommendations of the Consultants which may be examined in consultation with the province concerned and suitable decision taken accordingly.

5.7 Basha Dam Project

5.7.1 WAPDA's Views

(i) WAPDA has stated that feasibility study of Basha Dam project would be completed in June 2004, (Feasibility Study has since been completed). The financial cost of Basha dam indicated by WAPDA is US\$ 6.7 billion.

(ii) Basha dam has a live storage of 7.34 MAF and hydro-power generation capacity of 4500 MW.

(iii) The detailed engineering design and tender documents would be completed in 2006. The construction work can be started in the year 2007. It would take seven years to complete.

(iv) Average annual river inflow at Basha is about 50 MAF.

(v) The project involves upgrading and widening of KKH from Mansehra upto Chilas.

5.7.2 Views of seven members, TCWR

In their report of May 2005, the seven members of TCWR have stated as under:

i. (a) In Vision 2025 document, WAPDA has indicated the dam height of 660 ft, live storage of 5.7 MAF, installed generation capacity of 3360 MW. Status of the project is at pre-feasibility level and implementation period 10 years. However, in September 2003,

WAPDA Consultants have significantly upgraded and revised the scope. The dam height has been raised to 908 ft, storage to 7.34 MAF, but implementation period reduced by 3 years to 7 years. The dam has been changed from rock-fill dam to rollcrete dam. Rather optimistic and un-realistic time schedule has been presented of commissioning the dam by the year 2013.

(b) The rollcrete dam option at Basha with a height of 908 ft, in an active seismic region, would be a state-of-art design. A dam of 600 to 650 ft, on the other hand would create substantial multi-benefits (Water-Power) without creating discomfort about its sustained safety. Pakistan needs a facility and NOT a monster. We need assured safety of structures, and NOT international records of physical dimension. No rollcrete dam of this, or even lesser comparable height has so far been built in the world under such unfavourable conditions. Major dams of such a nature are not built in a hurry. They essentially require far extensive site investigations, options assessment, risk analysis, and design studies by a team that is not only internationally reputed for competence in dams engineering, but has experience of dams of comparable height and complexity, and construction/operation of long distance EHV transmission over rugged seismically active mountainous area. There is no evidence that this over-riding requirement has been met in case of Basha so far.

(c) It would be prudent to restrict the dam height within 550-650 ft in the first instance and design and install an effective instrumentation system for monitoring of structure so that a decision on further raising could be taken on the basis of such data collected for 30 to 40 years. This would give us an assured safety. The dam has to be reasonably safe within limits of available knowledge and experience.

(ii) The storage capacity is 7.34 MAF.

(iii) WAPDA consultants have reduced implementation period by 3 years to 7 years. It would require 4 to 6 years for adequate site investigations/design options, for upgrading access roads and other logistics, risk and financial studies, field/desk investigation on high voltage transmission line(s) over rugged and barren hills in extreme climatic conditions, resettlement/environmental issues and a greater degree of caution and conservatism. An optimistic time estimate of its reaching the tendering and implementation status would be 5 to 6 years. Work on upgrading KKH and further site/design studies be taken in hand and accelerated to allow time for unpredictable difficulties for this state-of-art project.

(iv) That at Basha dam site Indus River annual inflow is 50 MAF, entirely from snow melt.

(v) KKH approach road up-gradation/relocation does not appear to have received due attention in the studies conducted. The Project consultants appear to have followed an

artificially laid schedule for studies and commissioning of the project schedule prepared from considerations other than sound engineering and commitment to creating an infrastructure of sustainable service.

(vi) Basha Dam Project is undoubtedly a constructible project, but it requires far more intensive and extensive investigations and studies over a substantial period to make it a safe and bankable project to acceptable and recognized international standards. Its location in the Northern region, in a comparative rugged and barren region, that is also seismically not inactive, with major and grave technical, environmental, resettlement and social problems, would require deeper considerations and suitable contingency margins for time as well as costs. The unit cost of its generated benefits would be relatively high because of the difficult site access. The need for a great degree of caution need not be re-emphasized. Before launching the project for active construction of Dam, reasonable time has to be given for completion of the investigations and studies, and to upgrade and improve the KKH approach road.

5.7.3 Comments of Chairman, TCWR

(i) (a) The feasibility study of Basha dam has since been completed. Copy of the Executive Summary of the Feasibility Report was also provided by WAPDA to all the members of the Technical Committee on 9.10.2004. According to the feasibility report, the estimated cost of the project is US \$6.46 billion.

(b) The seven members of TCWR have objected to the raising of the height and increasing the capacity of Basha dam as compared to the figures given in the WAPDA's Vision 2025 Programme. This view of the learned members is not appreciated because the figures in the Vision 2025 programme are not based on any detailed feasibility. The latest estimates of the dam height and capacity are based on detailed feasibility report of the project prepared by the consultants appointed by WAPDA. Moreover the increase in capacity should be considered as an advantage rather than the subject of criticism.

(c) The salient features of Basha dam project given in the Vision 2025 programme document of WAPDA indicate the estimated cost of the project to be Rs. 31.3 billion (April 2002), which is equivalent to less than 0.5 billion US \$. Is this cost estimate acceptable and realistic?

(d) The height of the dam and its construction material (rollcrete) has also been objected to by seven members and they have termed Basha dam as a monster. This comment of learned members is not tenable, because the consultants have established the feasibility of the dam. It is not difficult to design a dam of any height and capacity in modern technology. Nurek dam built in 1980 in Tajikistan is of a height of 300 meters (about 1000 ft) and there are a number of such dams elsewhere in the World having a height of

800 to 1000 feet. We must therefore accept the design aspects of the dam as depicted in the feasibility report of consultants, unless there are any strong reasons against the same. The observations of the learned members that the over-riding requirements of the site investigation, design studies etc. have not been met in case of Basha dam is not correct, because detailed and comprehensive feasibility of the project has been carried out by qualified consultants, and reviewed by International Panel of Experts.

(ii) According to the feasibility report of Basha dam the installed power generation capacity of dam is 4500 MW. The total annual energy generation at Basha is estimated to be 16768 GWh. Moreover, there will be additional energy generation of 1452 GWh, at Tarbela after construction of Basha dam.

(iii) As regards the readiness of the project for implementation, the feasibility study of the project has already been completed. According to WAPDA, the detailed Engineering Design and Tender documents would be completed by the year 2006. The construction can be started in 2007 and it would take 7 years to complete. In the feasibility study, the consultants have confirmed the same time schedule as indicated by WAPDA. The seven members of the Technical Committee have stated that in Vision 2025 Programme the status of the project has been shown at pre-feasibility level. This version of the seven members is not correct because in Vision 2025 Programme the project has been shown at feasibility level which has already been completed in 2004. The seven members of TCWR have also stated that WAPDA's Vision 2025 Programme indicates implementation period of 10 years, whereas this figure of 10 years cannot be found anywhere in the Vision 2025 Programme. Both WAPDA and Consultants have indicated the time schedule for implementation to be 7 years. Further, the learned seven members have indicated that it would require 4 to 6 years for adequate site investigation design, etc. and optimum time for reaching the tendering and implementation status would be 5 to 6 years, but the fact is that the feasibility study stands already completed, and according to WAPDA and also as indicated in the feasibility report of the Consultants, the design and tender documents will be completed in two years and the tendering formalities could be completed by the year 2007 and that mobilization by the contractors can start in the mean time. There is no reason for not accepting the projections of WAPDA and Basha dam Consultants.

(iv) It is stated by seven members that the average annual Indus inflow at Basha is about 50 MAF entirely from snow melt. This is a positive feature of Basha dam because the river flows coming from snow melt are more steady and dependable than occasional flashy rainfall/monsoon generated flows.

(v) It has been stated by seven members that the construction of Basha dam will involve the upgrading and widening of KKH from Mansehra upto Chilas. According to the feasibility report of Basha dam Consultants, need for upgrading KKH has not only been indicated but also high-lighted and it has been stated that to cope up with the

construction work, early upgrading of KKH is imperative. As stated in the feasibility report, separate independent Consultants appointed by WAPDA have in consultation with the National Highway Authority (NHA) already devised a plan to complete upgrading of KKH within 30 months. According to the implementation schedule of the project given by the Consultants, in the feasibility report, the up-gradation of KKH is expected to be completed by the time the detailed design and tendering formalities are processed for start of construction on the main dam.

(vi) The Feasibility Report of Consultants also indicates that Basha dam will have positive impact in enhancement of useful life of Tarbela dam by about 30 years.

5.8 Skardu/Katzarah Dam

5.8.1 WAPDA's Views

According to WAPDA, the pre-feasibility study of Skardu dam was initiated in September 2003 and would be completed by September 2005. After that feasibility and design would start if found technically and economically feasible and environmentally viable. Its construction can be started after 2015. It would take at least 8 years for completion. WAPDA has also pointed out some negative aspects of the proposed Skardu/Katzarah dam such as, submerging of Skardu town and airport, displacement of population, etc.

5.8.2 Views of seven member, TCWR

In their report of May 2005, the seven members of TCWR have stated as under:

"Skardu site is the uppermost dam location site on the Indus. It has far lower available snow-melt flows for storage. The site is remote and only at conceptual level of study. The approach road along the Indus from Gilgat-Chilas to Skardu is narrow and winding, and not fit to take heavy traffic. Its improvement/upgrading would be far more problematic than KKH upgrading. EHV Power Transmission would have grave problems and high costs. Skardu Town would be submerged, as also the Cantonment, Air Strip at Skardu and the best part of Baltistan Valley and civilization. At this early conceptual stage, nothing more can be said".

5.8.3 Comments of Chairman, TCWR

(i) Skardu/Katzarah dam is the only possible site for carry-over dam with storage capacity of about 35 MAF. According to the studies of water availability carried out under TOR-4(a) of this report, there is no surplus water available for season to season transfer (Kharif to Rabi) after construction of Mangla and Tarbela dams. However

surplus water is available for storage in occasional flood years. The pattern of the surplus water availability for storage is such that it cannot be trapped in one or two reservoirs of 6.0 MAF capacity each. A carryover dam of 35 MAF can however trap over 84% of the available surplus flows. In this connection reference is made to para 2.10.3 of this report and table at Annexure II-7 of this report. It may be emphasized that the most important criteria of prioritization of the future reservoirs is the capability to trap maximum of the surplus flows when ever available.

(ii) It is improper and rather unfair to point out the negative aspects of Skardu/Katzarah dam even before feasibility study is conducted. It is also very unfortunate that it is being stated that construction of the dam cannot be started earlier than the year 2015. It is necessary that the feasibility of this very important project must be completed on priority basis which can be done in a period of 2-3 years i.e. upto 2008 and then early decision taken on its construction. Apparently, before feasibility of the project, negative aspects pointed out by WAPDA and seven learned members of the TCWR appear un-called for.

5.9 Akhori Dam

5.9.1 WAPDA's Views

It is an off-channel storage project taking surplus water from Tarbela reservoir. Feasibility study of the scheme has been initiated by WAPDA and will be completed in August 2005. After detailed investigation and completion of design and contract documents, the project may start from 2009 and likely to be completed in 2015. However, there is only small potential of hydro-power generation (600 MW) on this dam.

5.9.2 Views of seven members of Technical Committee

The seven members of the TCWR in their report of May 2005, have not given their views about Akhori dam.

5.9.3 Comments of Chairman, TCWR

The proposed Akhori dam is an off-channel storage dam in which the filling can start only after Tarbela dam is filled by middle of September. Thus the filling of Akhori dam will be extremely difficult. Moreover its power generation potential being only 600 MW is not a positive factor. However we must wait for completion of feasibility report of the Project.

5.10 Sequencing of reservoirs out of available options-Comments of Chairman, TCWR

5.10.1 The basis for planning, prioritizing and sequencing of future reservoirs has been discussed in para 5.3.8.1 above. The views of the Chairman are given in para 5.3.8.1 (e). The most important criterion for prioritization of future reservoir is the capability to trap maximum quantity of surplus water as and when available. This criterion has to be the principle guiding factor in consideration of the pattern of water availability in Western Rivers, discussed under TOR-4(a) of this report, which indicates that there is no surplus water for season to season transfer in the same year after construction of Mangla and Tarbela reservoirs. However large quantities of surplus water for storage are available in occasional flood years. This surplus water can only be trapped in a carryover dam of large capacity, because the smaller dams can trap only a small fraction out of it.

5.10.2 As discussed in the preceding paragraphs, there is only one possible site of carryover dam i.e. Skardu/Katzarah which has a potential storage capacity of about 35 MAF. The feasibility of this dam should have been undertaken long back, but for reasons best known to WAPDA, it has been abnormally delayed. WAPDA has now started the pre-feasibility study of the dam, which is expected to be completed by September 2005. It is surprising to note that even before completion of the pre-feasibility study, WAPDA has given adverse comments on this dam. It is however, absolutely important to have detailed feasibility of the dam in a period of 2-3 years and take an objective decision about its construction, keeping in view that this is the only possible site for a carryover dam in Pakistan which can trap about 84% of the available flood flows for storage. Two or three smaller dams cannot be an alternative for this carryover dam.

5.10.3 Pending the feasibility of Skardu/Katzarah dam, the only options before us are the two proposed dams i.e. Kalabagh dam and Basha dam of which the feasibility studies have been completed.

A table showing the comparison of the main features of these two dams is given below.

KALABAGH DAM AND BASHA DAM			
MAIN FEATURES			
<i>(based on feasibility reports)</i>			
Sr. No.	Feature	Kalabagh	Basha
1	2	3	4
1	Feasibility status	i. Feasibility report (1984-88) available. Requires updating (Ref. Para 5.4.3(a) It will require revision of cost and release capacity on post-Accord conditions (Ref. para 5.4.3(b)&(c)	i. Feasibility report completed in June 2004. Reviewed by International Panel of Experts.
		ii. Detailed design completed	ii. Detailed design to be completed by 2006
2	Estimated cost in US \$ Million	US \$ 6,000 million at 1984 prices (To be updated/ revised) (Ref. Para 5.4.3(b)	US \$ 6,458 million at 2004 prices
3	Live Storage Capacity	6.1 MAF	7.34 MAF
Power Generation			
4	i. Installed capacity	2400 MW (11,413 GWh) (1st Phase) 3600 MW (2nd Phase) (Ref. Para 5.4.3(d)	4500 MW (16,768 GWh)
	ii. Additional power at Tarbela	336 GWh	1452 GWh
5	Maximum height of dam	260 ft	766 ft. (Above river bed), 927 ft. (Above bed rock)
6	Type of dam	Earth Rock Fill	Roller Compact Concrete Gravity
7	Spillway capacity	10,70,000 Cusecs (Overflow spillway) 9,80,000 (Orifice spillway)	6,52,000 Cusecs
8	Access Road	Nominal up-gradation requirement (Included in cost estimates)	Up-gradation and widening required for KKH from Mansehra upto Chilas. (Included in cost estimates) (To be completed by 2007) (Ref. Para 5.7.3(d)(v)
9	Nearness to consumption areas for irrigation water and power	Near to consumption areas	Farther
10	Annual Average River Inflow	90 MAF	50 MAF
11	Reservoir filling study	1988 study by Kalabagh Consultants on pre-Accord conditions available. (To be reviewed). (Ref. Para 5.4.3 (c)	Similar filling study also required for Basha
12	Capacity - Inflow ratio	1:15 (Ref. Para 5.4. 3 (f) and (g)	01:06.8
13	Sedimentation	Higher Sedimentation Probability. (Ref. Para 5.4.3 (f) and (h)	i. Lower Sedimentation, ii. Positive impact in enhancing useful life of Tarbela reservoir by about 30 years

KALABAGH DAM AND BASHA DAM			
MAIN FEATURES			
<i>(based on feasibility reports)</i>			
14	Sluicing	Mid level sluicing (for 50 days, 1st June to 20th July)	Intermediate level outlets (ILOS) and low level outlets (LLOS)
15	Implementation schedule	Can be started in 2007 & completed in 2014. Reservoir filling study to be done on Post- Accord conditions, as for Kalabagh dam.	Can be started after updating of feasibility study, mainly cost estimates & reservoir filling study on post- Accord conditions. It will take 7 years for completion.
16	Apprehensions (a) General for all dams (i) Water availability (ii) Operation of Mangla reservoir and future reservoirs and link canals	This aspect has been examined under TORS 4(a), of this report. These aspects have been examined under TORS 5(a) and 5(b) of this report.	
	(b) About Kalabagh Dam (I) Right and left banks canals/outlets	i. Consultants have considered these canals to be unfeasible ii. WAPDA has no proposal to include these canals in the project iii Seven members of TCWR insist on their inclusion but Mr. Sardar Ahmad Mughal has strongly opposed the proposal of these canals and even provision of stubs. (Ref. Para 5.5)	
	(II) Flooding of Nowshera Town	i. NWFP have apprehensions about flooding of Nowshera. ii WAPDA should study effect of flooding at Nowshera when spillway is operating at level of 934 ft. (Ref. para 5.6.3) iii This item is included in TORS of Study No. III being conducted by Consultants. Recommendations expected by October, 2005	

5.10.4 The Planning and Development Division has stated that there will be no difficulty in financing future reservoirs, once the decision is taken. However, it is not practicable that the construction of both dams, i.e. Kalabagh and Basha can be started simultaneously. In fact considering the overall pattern of surplus water availability, the construction of either Kalabagh or Basha Dam can only be an interim arrangement, pending the completion of feasibility study of carryover dam at Skardu/Katzarah. The decision as to which dam out of the two may be taken up first, has to be in consideration of the following factors:

- i. Capability to trap maximum quantity of surplus water as and when available
- ii. Yielding maximum benefit of water storage capacity and power generation at minimum cost
- iii. Readiness for implementation
- iv. Lower capacity-inflow ratio to reduce silting problem
- v. Nearness to consumption areas for irrigation water and power

vi. Considering apprehensions about a dam

5.10.5 The table in para 5.10.3 above gives a fairly clear picture about the main features of both the dams. The feasibility studies of both Kalabagh and Basha dams are available. However, the feasibility study of Kalabagh dam of 1984-88 requires updating, particularly the cost estimates, and reservoir filling study, to give the correct picture about the dam. The apprehensions of the provinces about Kalabagh dam, i.e. right and left bank canals (discussed in para 5.5) and flooding of Nowshera town (discussed in para 5.6) have also to be considered while taking any decision.

5.10.6 It may be understood that if Kalabagh or Basha dam is constructed, it may not be filled for a number of consecutive years as discussed under TOR-4(a) of this report. As examined in the table at Annexure II-7, either of the two dams is likely to be filled in 10 years out of 28 years, which will provide about 2 MAF of water per year. Thus, if Kalabagh or Basha dam is constructed, the distribution of water from the dam can be made only for the expected annual availability of 2 MAF, and not full capacity of 6 or 7 MAF per year.

5.10.7 Considering the position stated in para 5.5.4 (vii) (d) above, the future reservoirs will first cater for shortfall in Water Accord allocations which is about 12 MAF. It is therefore appropriate that the first dam (either Kalabagh or Basha) may be earmarked to compensate the silting of existing reservoirs, as well as to meet shortfall in Water Accord allocations, as a first charge, because it has been repeatedly highlighted that the Accord allocations cannot be fully met in shortage periods without future storages. No allocation may be made out of the first dam to the provinces for development under para 4 of Water Accord.

5.11 Power Generation

5.11.1 WAPDA's Position

(i) According to WAPDA the present generation capacity in Pakistan is 17309 MW as under:

Hydel power generation capacity	6460 MW
Thermal power generation capacity	4779 MW
IPPs generation capacity	6070 MW

(ii) WAPDA has projected the power requirements of Pakistan by the year 2025 to be 75149 MW at the growth rate of 8%.

(iii) Government has given highest priority to the generation of hydel power. WAPDA has identified hydel schemes with total generation capacity of 47306 MW (including the

existing projects under operation). According to WAPDA 14 small schemes with total generation capacity of 1095 MW (ranging from 13 MW to 132 MW) are under implementation.

(iv) WAPDA has completed the feasibility study of three multipurpose projects namely Kalabagh Dam (3600 MW), Basha Dam (4500 MW) and Munda dam (740 MW), total 8840 MW. WAPDA has also completed the feasibility study of 25 hydel projects with total capacity of 2038 MW, out of which only 4 projects, Neelum Jhelum (969 MW), Doyian (425 MW), Gulpur (116 MW) and Taunsa (120 MW) are above 100 MW. The other 21 projects have the capacity ranging from 3 MW to 87 MW. The feasibility study of 5 run of the river hydel projects with total capacity of 9072 MW is said to be in progress. It has further been stated by WAPDA that there are hydel projects with capacity of 19666 MW for which feasibility studies are still to be carried out.

(v) According to the details provided by WAPDA, the maximum hydel generation is available during the high flow months of July and August where as during the low flow winter months particularly month of January the hydel generation is at the minimum. During the last 10 years period (1994-95 to 2003-04) the maximum generation of the existing operational hydel projects was 3,373,359,154 KWh in August 1994 and the minimum was 344,485,847 KWh in January 2001, which is only 10.2% of maximum. This indicates the necessity of supplemental thermal generation to avoid load shedding.

(vi) WAPDA has stated that it intends to utilize Thar Coal for generation of electricity as it has to play an important role in Pakistan. WAPDA has given tentative commissioning dates of 10 projects based on Thar Coal. Each of these is of 600 MW capacity and the tentative commissioning dates are from 2008 upto 2019.

5.11.2 Views of seven members, TCWR

In their report of May 2005, the seven members of TCWR have not given any views about power generation.

5.11.3 Comments of Chairman, TCWR

(i) The present hydel-power generation is mainly from two high dams (Tarbela and Mangla). Recently completed Ghazi Barotha is the only major run of the river project.

(ii) The feasibility studies have been completed for Kalabagh dam, Basha dam and Munda dam multipurpose projects with the total capacity of 8840 MW. The multipurpose projects can be taken up one at a time and will take a long time for completion.

(iii) According to WAPDA's figures, there are 14 small ongoing hydropower with the capacity of ranging from 13 to 132 MW with a total potential of 1095 MW. There are no major ongoing projects in this list. After completion of Ghazi Barotha project, WAPDA should have taken up at least one major run of the river project like Dasu, Bunji, Pattan or Thakot. It should be a policy that these major run of river projects, some of which have potential even higher than the multipurpose dam projects, should be taken up and completed one after the other.

(iv) In the list of 25 projects of which feasibility is completed, there are only 4 projects with the capacity of more than 100 MW. Other projects are very small, many of them having capacity of 10 MW and less. The feasibility study of none of the major run of the river project has yet been completed. This is highly regrettable.

(v) It has been stated by WAPDA that feasibility studies of hydel projects of nearly 20000 MW are still to be carried out, though the list of these projects has not been provided. The feasibilities of all potential hydel projects should be completed expeditiously, particularly those of major run of the river projects.

(vi) It has been indicated by WAPDA that 10 projects of power generation based on Thar Coal will be implemented between 2008 and 2019 i.e. approximately one such a project will be commissioned every year. This concept of WAPDA's planning for utilizing Thar Coal is highly appreciated. The start of the Thar Coal Power generation programme cannot be very ambitious, and initially the generation of power from Thar Coal at 600 MW per year appears reasonable. However, the tempo should be increased further so that by the year 2011, the generation is increased to about 1500 MW annually. The generation may then further be increased gradually upto about 3000 MW annually, from the year 2016, and maintained at this level. It is important that the indigenous resource of Thar Coal is fully exploited to replace the costly imported oil.

5.12 Conclusions and recommendations

(a) Silting of reservoirs

1. Reservoirs are needed to store surplus water when it is available, generation of cheap hydropower, and to compensate for the silting of existing reservoirs.
2. The siltation in the live storage capacity of existing reservoirs is about 3.2 MAF which will be off-set by raising of Mangla dam. In Tarbela, the rate of siltation is higher than that envisaged at design stage, whereas in case of Mangla, it is lower than design.
3. To increase the useful life of storage reservoirs, measures have to be taken for reducing silting, and providing efficient sediment sluicing devices. It appears that the

sediment sluicing of Tarbela reservoir has not been carried out in a satisfactory manner which has resulted in huge accumulation of silt in the reservoir area.

4. The TAMS report of 1998 prepared by WAPDA's Consultants contains detailed study of siltation problem of Tarbela, and useful suggestions for remedial measures, but it has not been implemented by WAPDA, nor any satisfactory reasons have been stated for keeping it dormant. WAPDA has no other specific proposal for tackling silting problem of Tarbela. It is felt that silting problem of Tarbela needs more serious attention.

(b) Planning and prioritization of future reservoirs

5. The report of World Commission on Dams of the year 2000 has not been given adequate consideration by WAPDA. This report is based on the world experience regarding dams and it contains very useful suggestions, which need to be implemented and considered as a guideline for planning future reservoirs.

6. Considering the pattern of water availability in the Western Rivers, no surplus water is available for season to season transfer (Kharif to Rabi) of the same year, after construction of Mangla and Tarbela dams. However large quantities of surplus water for storage are available only in occasional flood years. These surplus flows are of higher magnitude but lesser frequency. This water can only be stored in carryover dam of high capacity. If any conventional dam of lower capacity i.e. about 6.0 MAF is constructed, it can trap only about 20% of surplus flood water.

7. The lower tributary areas linked to Indus through CJ and TP links should not be treated as permanent burden on Indus main. If this unrealistic proposition is adhered to, the proposals for constructing new reservoirs on Indus will be in serious jeopardy, because there will remain no surplus water for storage in Indus main. Jhelum and Chenab rivers have adequate water in Kharif season both for upper and lower tributary areas as well as for storage in Mangla dam, (even after raising), and therefore transfer of water through these links in Kharif season is not needed under normal conditions.

8. The feasibility study of the only available site of carryover dam i.e. Skardu/Katzarah has not yet been started. Pre-feasibility study of this dam was started in 2003 and is expected to be completed by September 2005. It is important that the feasibility of this dam is given high priority and it is completed within 2-3 years, because only this carryover dam can trap maximum out of the available flood waters (about 84%).

9. The basic criteria for prioritizing and sequencing of dams should be as under:-

- i. Capability to trap maximum quantity of surplus water as and when available

- ii. Yielding maximum benefits of water storage capacity and power generation potential at minimum cost
- iii. Low capacity-inflow ratio to reduce silting problem
- iv. Readiness for implementation
- v. Nearness to the consumption areas for irrigation water and power
- vi. Considering apprehensions about a dam

10. The feasibility studies of Kalabagh dam and Basha dam are available. The feasibility study of Kalabagh dam was prepared in the year 1984-88. It therefore, requires updating, particularly with regard to the cost estimates and the reservoir filling study which was done in 1988 on pre-Water Accord scenario. The comparison of the main features of these two dams has been made in this report. Pending the completion of feasibility report of Skardu/Katzarah dam, the construction of only one of the two dams of which feasibility is available i.e. Kalabagh or Basha can be considered. It will however be appropriate if this decision is taken after updating the feasibility of Kalabagh dam. Basha dam has a definite edge over Kalabagh dam in terms of yielding more benefits of water storage capacity and power generation potential. The apprehensions about Kalabagh dam, particularly in respect of right bank and left bank canals, and flooding of Nowshera town should also be considered and settled, in consideration of the position discussed in this report. 11. If Kalabagh or Basha dam is constructed, they will not be filled every year and may remain unfilled for a number of consecutive years. These dams cannot therefore provide the full storage capacity (6-7 MAF) every year, but can provide only about 2 MAF per year. This fact has to be kept into consideration while allocating the water out of the dam. It is suggested that if one of these two dams is constructed, the available water should be earmarked for compensation of silting of existing reservoirs and to meet shortfall of Water Accord allocations.

(c) Power Generation

12. At present Pakistan has a power generation capacity of 17,309 MW, out of which 6,460 MW is from hydel power. WAPDA has projected a power requirement of 75,149 MW, by the year 2025. WAPDA has identified hydel schemes with total generation capacity of 47,306 MW.

13. According to WAPDA, 14 small hydel schemes with generation capacity of 1095 MW (ranging from 13 MW to 132 MW) are under implementation. WAPDA has completed feasibility of 25 hydel projects with total capacity of 2038 MW, most of which are very small projects. WAPDA has also completed feasibility study of 3 multi-purpose

projects (Kalabagh dam, Basha dam and Munda dam) with total capacity of 8840 MW. However, WAPDA has not yet started feasibility of identified hydel projects with capacity of about 20,000 MW, which needs to be expedited. Also there are major run of the river hydel projects like Dasu, Bunji, Pattan and Thakot, some of which have the potential even higher than the multi-purpose dam projects. No major run of the river project has been implemented after completion of Ghazi-Barotha. It is important that the feasibility of major run of the river projects should be expedited and these projects implemented on fast track basis, one after the other as soon as possible.

14. WAPDA has a programme of 10 projects based on Thar Coal each of 600 MW capacity. The commencing date of these projects are from 2008 upto 2019. This programme is appreciated. However, the programme should be accelerated from the year 2011 and Thar Coal power generation increased initially to 1500 MW and then upto 3000 MW per year. It is important that the indigenous resource of Thar Coal is fully exploited to replace the costly imported oil.

TOR-1

"Review issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the provinces"

6. TOR-1 "Review issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the provinces"

6.1 Water Apportionment Accord

6.1.1 Water Apportionment Accord was signed by the Chief Ministers and the representatives of the four provinces on 16th March 1991. It was ratified by the Council of Common Interests (CCI) on 21st March 1991.

6.1.2 Apprehensions have been raised that the water distribution, particularly during shortage periods, is not being made according to the provisions of the Water Accord. The Technical Committee has therefore been assigned the task to review the issues relating to distribution of water according to 1991 Accord. 6.2 Presentation by IRSA

6.2.1 The presentation on TOR-1 was made by IRSA and discussions were held in the seventh meeting of the TCWR held on 13th January 2005. The deliberations were continued in the eighth meeting of the Technical Committee on 2nd and 3rd February 2005. Mr. Sardar Ahmad Mughal, member Sindh submitted his comments on the presentation which were responded to by IRSA.

6.3 Views of IRSA

6.3.1 IRSA has stated that "Currently, IRSA is distributing the Indus River Waters according to para-14(b) of Water Apportionment Accord 1991 as the only para which stipulates the mechanism of sharing shortages/surpluses on all Pakistan bases. NWFP and Balochistan are exempted from shortages because due to lack of irrigation infrastructure these provinces cannot utilize their apportioned water and the shortages are being distributed between Punjab and Sindh Provinces as per their Actual Average System Uses of 1977-82. 6.3.2 IRSA has also mentioned the following points about water distribution in their presentation:-

(i) Decision of Inter-Provincial Ministerial Committee meeting held on May 2, 1994, that the shortages between Sindh and Punjab will be shared according to historic uses.

(ii) Ministry of Water and Power letter to IRSA stating that the Inter-Provincial Ministerial Committee is of an advisory nature and without any legal mandate. The Ministry advised IRSA to resolve the issue themselves.

(iii) IRSA's decision through file circulation that shortages whenever they occur would always be distributed on Actual Average System Uses. (iv) Reference to Law Division for interpretation of clause 14(b) of Water Accord and the Law Division's advice thereon.

(v) The Chief Executive directive that the Inter-provincial Ministerial Water Accord of 1994 should be annulled immediately.

(vi) Further, IRSA has stated that at present the decision of IRSA Advisory Committee taken in the meeting held on 09.04.2003 in Islamabad is being followed which is as under:

OPTIONS	WATER AVAILABILITY	DISTRIBUTION
Scenario - I	Water Availability < Actual Average System Uses 1977-82	Distributed as per 14(b) of the Water Apportionment Accord 1991
Scenario - II	Water Availability > Actual Average System Uses 1977 82 but < Para 2 of the Water Apportionment Accord 1991	Firstly, Actual Average System Uses of 1977-82 are protected. Secondly, balance available are distributed as per Para 2 i.e. the 10-dailies approved by the CCI
Scenario-III	Water Availability > Para 2 of the Water Apportionment Accord 1991	Firstly, Para 2 uses of the Provinces i.e. the 10-dailies approved by the CCI are protected. Secondly, the balance available water are distributed as per Para 4 of the Water Apportionment Accord 1991

6.4 Views of seven members, TCWR

6.4.1 In their report of May 2005, the seven members of the Technical Committee have referred to paras 2, 4 and 14(a) and 14(b) of the Water Accord relating to water distribution.

6.4.2 The seven members of the Technical Committee have further stated as under:

(i) In practice, from 1991 to 1999, when the river supplies were ample to meet the existing uses of all the provinces the sharing was done by IRSA according to the indent reflective of present day average canal uses. However, when a serious controversy arose on interpretation of Accord during the drought years from 2000 to 2003, Sindh

insisted that the available flow-cum-storage supplies be distributed strictly according to Para 14(a).

(ii) In view of the seriousness of the situation and its significant implications, the matter was deliberated by IRSA in its various meetings, and also in consultation with the higher authorities. It was decided to continue the practice followed ever since the Accord 1991 to distribute available flow-cum- storage supplies to the co-sharers according to Para 14(b) of the Accord, specifically in the shortages situation. However, no shortages were to be passed on to the smaller user provinces of Balochistan and NWFP. The seven members have further stated that Chairman, IRSA in its presentation to TCWR submitted that IRSA is following Para 14(b) for its distribution planning to date, and further of exempting Balochistan and NWFP from any shortages.

(iii) It is considered that IRSA's decision and the policy being followed since the Accord, is the best approach to distribute the available river-cum-storage supplies between the co-sharing provinces and should be continued to be followed till injection of major storage(s) in the system.

6.5 Comments of Chairman, TCWR

6.5.1 As correctly stated by IRSA and seven members of the Technical Committee, paras 2, 3, 4, 14(a) and 14(b) of the Water Accord relate to the allocations of water to the provinces and the sharing of shortages and surpluses. Out of these paras, para 4 relates to shares of Provinces in the balance river supplies, which is not connected with sharing of shortages and surpluses in the existing canals. Paras 2 and 3 relate to seasonal allocation of water to the existing canals, and paras 14(a) and 14(b) relate to sharing of shortages and surpluses.

6.5.2 Above paras of the Water Accord, 1991 are reproduced below:

Para - 2

In the light of the accepted water distributional principles the following apportionment was agreed to:

(Fig. in MAF)			
Province	Kharif	Rabi	Total
Punjab	37.07	18.87	55.94
Sindh*	33.94	14.82	48.76
N.W.F.P. (a)	3.48	2.3	5.78
(b) Civil Canals**	1.8	1.2	3
Balochistan	2.85	1.02	3.87
	77.34	37.01	114.35
	+	+	+
	1.8	1.2	3
* Including already sanctioned Urban and Industrial uses for Metropolitan Karachi.			
** Un-gauged Civil Canals above the rim stations.			

Para 3) NWFP/Balochistan projects which are under execution have been provided their quota of water as existing uses.

Para 4) Balance river supplies (including flood supplies and future storages) shall be distributed as below:

Punjab	Sindh	Balochistan	NWFP	Total
37	37	12	14	100

Para 14 (a) The system-wise allocation will be worked out separately, on ten daily basis and will be attached with this agreement as part and parcel of it.

(b) The record of actual average system uses for the period 1977-82, would form the guide line for developing a future regulation pattern. These ten daily uses would be adjusted pro-rata to correspond to the indicated seasonal allocations of the different canal systems and would form the basis for sharing shortages and surplus on all Pakistan basis.

6.5.3 Paras 2 and 3 of the Water Accord pertain to the seasonal allocations to the provinces. However, the actual day to day regulation of water cannot be done on seasonal (six-monthly) basis, and it is an established norm that the regulation is done on ten daily basis. Para 14(b) of the Water Accord therefore provides the guide line and basis for working out ten daily allocations of the different canal systems consistent with overall seasonal allocations made under Para 2 of the Accord. This exercise was carried out in September 1991 and the ten daily system wise allocations were worked out by the provinces and approved by the Council of Common Interest (CCI) in its meeting held

on 16th September 1991. These ten daily allocations approved by CCI form a part and parcel of the Accord as envisaged in Para 14(a) of the Accord.

6.5.4 The above mentioned ten daily statements approved by CCI were prepared in the light of the provisions of Para 14(b) of the Water Accord. This para states "The record of actual average system uses for the period 1977-82, would form the GUIDE LINE for DEVELOPING A FUTURE REGULATION PATTERN. These ten daily uses would be adjusted pro-rata to correspond to the indicated seasonal allocations of different canal systems and would form the BASIS for sharing shortages and surpluses on all Pakistan basis. The purpose of mentioning "the actual average system uses for the period 1977-82" in para 14(b) of Water Accord is that it serves only as GUIDE LINE for determining the future regulation pattern. On the basis of this GUIDE LINE, by adjusting these figures pro-rata to correspond to the indicated seasonal allocations of the different canal systems under Para 2 of the Accord, the ten daily statements were prepared and got approved by the Council of Common Interest (CCI) in its meeting held on 16th September 1991 and these ten daily statements form the BASIS for sharing shortages and surpluses under the Accord. It may be noted that paras 14(a) and 14(b) are complementary and do not have a different meaning as envisaged by the seven members of the Technical Committee.

6.5.5 The para 14(b) of the Water Accord indicates that at the time of signing the Water Accord, it was known that there would be shortages and surpluses and that it will not be possible to provide full Water Accord allocations to the provinces during the periods of shortages. This is why specific provision for sharing of shortages and surpluses on all-Pakistan basis was made in para 14(b) of the Accord. The shortages in low flow periods have therefore to be shared on the basis of 10-daily statements approved by CCI, under the provisions of paras 14(a) and 14(b) of the Accord. The Accord does not prescribe different criteria for sharing shortages under different conditions of water availability with reference to Accord allocation of 117.35 MAF or 1977-82 average system uses of 105 MAF. Further, the Accord does not provide different criteria for sharing shortages than those for sharing surpluses.

6.5.6 The sharing of surpluses and shortages have also been linked by the seven members of Technical Committee with the construction of future storages. There is no relationship what so ever between sharing the surpluses and shortages in existing canals under the present conditions, with the construction of future storages, as no such condition exists in the Water Accord 1991. A similar point was raised by a province in the meeting of CCI held on 16th September 1991, when the ten daily statements were approved, but the CCI did not consider this point of view to link the Accord allocations of existing canals with future reservoirs, and approved the ten daily statements to become a part and parcel of the Accord. The minutes of the meeting of CCI dated 16.09.1991 are enclosed (Annexure II-14).

6.5.7 It has been stated by IRSA and seven members that NWFP and Balochistan have been exempted by IRSA from sharing the shortages because these are smaller provinces and lack in infrastructure. This is clear violation of Para 14(b) of Water Accord which provides that the shortages and surpluses would be shared **on all Pakistan basis**.

6.5.8 The Indus River System Authority (IRSA) was set up under para 13 of the Water Accord, 1991 for the implementation of the Water Accord. Moreover, under section 8(1)(a) of the Indus River System Authority Act 1992, IRSA is required to lay down the basis for regulation and distribution of surface waters amongst the Provinces, according to the allocations and policies spelt out in the Water Accord. IRSA has to implement the Water Accord and it has no authority to amend or modify any of the provisions of the Water Accord. Thus IRSA's decision to exempt the two provinces from sharing shortages is clear violation of the Water Accord.

6.5.9 If the provinces of NWFP and Balochistan are exempted from sharing of shortages in the Indus River System, they no more remain the stakeholders in the waters of Indus River System. Therefore, they cannot and should not be allowed to remain the members of the Indus River System Authority, because the Authority represents the interests of stakeholders.

6.5.10 As regards infrastructure development for use of Water Accord allocations by NWFP and Balochistan, para 3 of the Water Accord provides that NWFP/Balochistan projects which are under execution have been provided their quota of water as existing uses. Thus the of NWFP/Balochistan projects under implementation at the time of signing of Water Accord in 1991, i.e. CRBC and Pat Feeder were provided water allocations under Para 2 of the Water Accord, though these canals were not completed and operational at that time. These projects did not exist on ground in the year 1977-82, but still in consideration of the provision of para 3 of the Water Accord, they were included in the ten daily statements approved by CCI. Thus the water was provided to NWFP and Balochistan even for these incomplete schemes as a special provision. Not only that, but NWFP and Balochistan were allowed to use the water allocated for these ongoing incomplete schemes in their existing operational canals till the completion of the schemes. The CRBC and Pat Feeder schemes have been recently completed but the command areas are not yet fully developed. NWFP and Balochistan will therefore be able to use their allocations in due course of time. No further new infrastructure for the utilization of the Accord allocations is therefore needed, and if any such new infrastructure or new canal is to be constructed, it will require additional allocations outside para 2 of the Water Accord, from balance river supplies under para 4 of the Accord.

6.5.11 (a) IRSA has mentioned about the decision of the Inter-Provincial Ministerial Committee meeting held on 2nd May 1994 to the effect that the shortages between Sindh and Punjab will be shared on the basis of historic uses. IRSA has further

mentioned that subsequently Ministry of Water and Power informed IRSA that the Inter-provincial Ministerial Committee is of advisory nature and without legal mandate and that IRSA should resolve the issue themselves. IRSA has further stated that such a decision was taken by IRSA with 3:2 majority by file circulation that the shortages whenever they occur would be distributed on actual average system uses 1977-82. The relevant record provided by IRSA however, shows that some views were recorded by members of IRSA by to and fro movement of the file over a period of more than two years (1994-96). None of these recorded views of members on the file is clear and specific and the members have recorded different views at different times. Some of them have even requested for discussion on the subject in the meeting of IRSA. However, the then Chairman IRSA has summed-up the views expressed by the members in his note dated 4.8.1996 which is reproduced below:

"Historic vis-à-vis para 2 allocations are quite different and at the time of sharing shortages, we should follow the Water Accord para 14(b) and also ensure that there is no adverse publicity. In fact we may not in those years make any mention of the percentage "of shortage". Since Member (Federal), Member (Balochistan) and Member (Sindh) and Chairman agree to distribution of water supplies available, as per para 2 of the allocations, the case stands settled by 3:2 majority under sub section 2, of section 8 of IRSA Act. C.E (O) may see the file and keep it on record".

(b) The above decision recorded by the then Chairman IRSA indicates that the water distribution has to be done under para 2 of the Water Accord allocations and not on historic use formula 1994. Thus it is apparent that no such decision for sharing water on historic basis was ever taken by IRSA either by holding regular meeting or by file circulation. Also such decision, if any, was not communicated to all concerned in the form of a specific letter to the effect that such and such decision has been taken by IRSA by file circulation. Moreover as mentioned by IRSA as well as seven members of Technical Committee, the 1994 historic use formula was not implemented till year 1999.

6.5.12 IRSA has stated that the matter regarding sharing of shortages on the basis of Actual Average System uses (1977-82) was referred to the Law Division. The Law Division gave its interpretation dated 16.10.2000 as under:

1. "As per plain interpretation of Clause 14 of the Accord, the ten daily uses, having become part and parcel of the Accord, shall be adjusted pro-rata for sharing shortages. Any interpretation of sharing shortages on the basis of historic use shall be a violation of the concurrent Accord. Moreover under clause 13 of the Accord, IRSA is responsible for implementation of Accord, similarly any dispute on the subject should have been referred to the CCI under the Constitution. Hence the formation of any other body or committee or taking any

decision or interpretation on such report shall be a distortion of the Accord as well as violative of the Constitution.

2. However, since the matter has not been referred to the appropriate body i.e. CCI by the aggrieved party, therefore, the existing arrangements as decided by the IRSA, may be allowed to continue till the constitution of, and decision by, the CCI".

6.5.13 The Law Division issued their second advice on the subject on 16.2.2001 as under:

"The opinion of this Division dated 16.10.2000 and the said Directive of the Chief Executive Secretariat dated 23.10.2000 were placed before the then Law Minister who approved the proposal that para 2 of the advice dated 16.10.2000 be recalled and consequently this Division issued a revised note on 16.02.2001 in these words:

"In view of the said Directive, regarding apportionment of Water of Indus River System the ministerial award of 1994 is annulled and the Accord of 1991 has to be implemented, the opinion already conveyed by this Division on 16.10.2000 is revised and para 2 thereof is accordingly recalled"

6.5.14 According to second advice of Law Division, para 2 of their first advice regarding reference to CCI has been recalled and therefore para 1 of the advice of Law Division prevails by which the sharing of shortages on the basis of historic use shall be a violation of the Accord and the Constitution. A copy of this second advice of Law Division was forwarded by the then member Federal, IRSA to the Secretary, Ministry of Water and Power and copy to the Chairman, IRSA on 30.5.2002. Copy of this advice and forwarding letter of member Federal, IRSA is enclosed as (Annexure II-15). However, during the presentation and deliberations on the TOR in the meetings of TCWR, the Chairman, IRSA denied to have received copy of second advice of Law Division. This denial is neither reasonable nor acceptable. Even if the Chairman, IRSA does not have copy of this advice, the matter having been pointed out to him, it was his duty to get a copy and take action on it.

6.5.15 The advice of the Law Division is very clear and comprehensive. According to this advice, the ten daily uses having become part and parcel of the Accord, shall be adjusted pro-rata for sharing shortages. Any interpretation of sharing shortages on the basis of historic uses shall be a violation of the concurrent Accord and violative of the Constitution.

6.5.16 The Chief Executive issued instructions to IRSA on 23.10.2000 that "all instructions given on the issue by Chief Executive regarding IRSA to be implemented immediately alongwith apportionment of the waters of Indus River System between the

provinces on 16.3.1991. Moreover Ministerial Water Accord of 1994 to be annulled immediately". In pursuance of this directive of Chief Executive, IRSA issued the annulment notification of 1994 Inter-provincial Ministerial meeting on 12.11.2001 i.e. more than one year after the directives were issued by the Chief Executive. However, even after the issue of annulment decision, it has not been implemented to date, and the matter has again been referred by IRSA to Chief Executive's Secretariat, just to avoid implementation of the clear cut decisions.

6.5.17 The table given by IRSA in their presentation at (Annexure II-16) reveals that during shortages, Punjab get even more than their Accord allocations, NWFP and Balochistan are exempted from sharing shortages and only Sindh not only bears the total burden of shortages, but even the higher withdrawals by Punjab. This is highly unjust and unfair.

6.5.18 According to IRSA, at present still a new water distribution arrangement is being followed as decided in the meeting of the IRSA Advisory Committee meeting held on 9.4.2003. The formula is different from the Water Accord 1991 and even the historic uses formula of 1994. This present distribution arrangement consist of 3 scenarios as described in para 6.3.2 (vi).

6.5.19 It is regrettable that IRSA is riding rough shod and taking decisions on distribution of water in violation of Water Accord and inconsistent with the advice of Law Division and directives of the Chief Executive. Now the Advisory Committee of IRSA, which is only a subsidiary of IRSA having been given limited functions under section 9 and 10 of the IRSA Act 1992, has taken upon itself to prescribe a new water distribution formula, violative of Water Accord which is also being implemented and enforced.

6.5.20 There is one and only one formula for sharing shortages and surpluses that is on the basis of ten daily statements approved by CCI, as provided in Para 14(a) and 14(b) of the Water Accord. However, IRSA insisted on following historic use formula under which shortages were being shared on the basis of 1977-82 uses and surpluses were shared on the basis of Water Accord. Now Advisory Committee of IRSA has decided to follow still another formula with three different scenarios. All this means that the Water Accord and 10-daily statements approved by CCI have no meaning at all, and that not only IRSA but even its subsidiaries can devise any formulae of their own for water distribution.

6.5.21 In the very first meeting of the Technical Committee on Water Resources held on 11th March 2004, it was unanimously decided that the Water Accord is sacrosanct and it has to be followed in letter and spirit. It is however, regrettable that the seven members of the Technical Committee in their report of May 2005, have considered IRSA's decision and policies (which are flagrant violation of Water Accord), as the best

approach to distribute available water. It is emphasized that if the sanctity of the Water Accord is not protected and such obvious and flagrant violations of the Accord are allowed to continue, the Accord which is a binding force amongst the provinces will become obsolete, resulting in complete confusion and chaos.

6.6 Conclusions and recommendations

1. In the first meeting of the TCWR held on 11th March 2004, it was unanimously decided that Water Accord 1991 is sacrosanct and should be followed in letter and spirit. The Water Accord 1991 prescribes only one method of sharing of surpluses and shortages of water on all Pakistan basis, according to provisions of paras 14(a) and 14(b) of the Accord, on the basis of ten daily statements approved by the Council of Common Interests.

2. In May 1994, the then Minister for Water and Power held a meeting of Inter Provincial Ministerial Committee in which the matters relating to the distribution of water were discussed. It was recorded in the minutes of the meeting that distribution of shortages should be made on "Historic Use Formula". Later, the Ministry advised IRSA that the Inter- Provincial Ministerial Committee is of an advisory nature and without legal mandate, and that IRSA should resolve the issue themselves.

3. In his presentation to the Technical Committee, the Chairman, IRSA stated that a decision was taken by IRSA by file circulation that the Historic Use formula should be followed for sharing shortages. However, the copies of the record supplied by him indicate that file was moved to and for over two years from 1994 to 1996 and after that the decision recorded by the then Chairman, IRSA by majority decision of 32, was not for adopting historic use formula, but for water distribution under the provisions of Water Accord. Moreover, the historic use formula was not used for water distribution till 1999.

4. IRSA referred the matter to Law Division, who advised on 16.10.2000 that the interpretation of sharing shortages on the basis of historic uses shall be a violation of the Water Accord and the Constitution. The Law Division also gave a similar advice on the subject in a more emphatic manner in their subsequent note dated 16.2.2001.

5. The Chief Executive issued instructions to IRSA on 23.10.2000 that the Ministerial Water Accord of 1994 to be annulled. IRSA issued the annulment notification according to the directives of Chief Executive after one year. However, IRSA neither acted on the advice of Law Division, nor on the instructions of the Chief Executive even after the issue of annulment notification.

6. IRSA has exempted NWFP and Balochistan from sharing the shortages which is a clear violation of para 14(b) of the Accord which lays down that the shortages and

surpluses should be shared on all Pakistan basis. If NWFP and Balochistan are exempted from sharing shortages, they no more remain stakeholders in the waters of Indus River System, and as such they cannot and should not be allowed to retain their membership of IRSA.

7. According to historic use formula, during shortage periods Punjab gets even more than its full Accord allocation, NWFP and Balochistan are exempted by IRSA for sharing shortages and therefore whole burden of shortages including additional water drawn by Punjab falls on Sindh province. This is highly unfair and unjust.

8. According to IRSA they are now following still a new distribution formula for sharing of water according to decision of IRSA's Advisory Committee. This formula consists of three different scenarios for water distribution, whereas the Water Accord provides for one and only one method of distribution of shortages and surpluses on all Pakistan basis in accordance with the 10-daily statements approved by CCI. IRSA has been established under para 13 of the Water Accord to implement the Accord. Moreover, under the IRSA Act 1992, it is required to lay down the basis for regulation and distribution of surplus water amongst the provinces according to allocation and policy set out in the Water Accord. However, not only IRSA but also its subsidiary agencies are flagrantly violating the clear and the specific provisions of Water Accord relating to water distribution.

9. The sanctity of Water Accord must be protected. The Federal Government should take effective steps to ensure that IRSA operates strictly within the scope of the provisions of Water Accord. The existing method of water distribution based on three scenarios being a flagrant violation of the Water Accord, should be annulled immediately and the distribution of shortages and surpluses made on the basis of the Water Accord and ten-daily statements approved by the Council of Common Interests.

TOR-3

"Review the progress achieved so far regarding study on escapages below Kotri and recommend measures to expedite the completion of the study"

7. TOR-3 "Review the progress achieved so far regarding study on escapages below Kotri and recommend measures to expedite the completion of the study"

7.1 It was not considered necessary to get any presentation on this TOR. The studies are being conducted by the Ministry of Water and Power through the Chief Engineering Adviser, Government of Pakistan. In March 2004, the Chief Engineering Adviser submitted a position paper regarding the matters related to the studies. Further progress is being monitored by the Technical Committee on Water Resources through monthly progress reports being submitted by the Chief Engineering Adviser.

7.2 The study to establish the minimal escapages needs downstream Kotri was to be undertaken as envisaged in para 7 of the Water Accord 1991. However, this study could not be started due to difference of opinion amongst the provinces.

7.3 In September 2003, Senator Nisar A. Memon, Chairman, Parliamentary Committee on Water Resources succeeded in developing consensus amongst four provinces on the subject. Accordingly the three studies have been undertaken by the consultants through the Chief Engineering Adviser i.e. :-

- i. Study on Water Escapages below Kotri Barrage to check sea water intrusion.
- ii. Study on Water Escapages downstream Kotri Barrage to address environmental concern and
- iii. Study on environmental concern of the four provinces (excluding areas covered in Study I and II).

7.4 The studies have been entrusted to three Joint Ventures of Consultancy firms as under:-

Study-I: Joint Venture of Montgomery - Watson - Harza in association with Associated Consulting Engineers - ACE (PVT) Ltd and National Engineering Services Pakistan (PVT) Ltd.

Study-II: Joint Venture of Lahmeyer International GmbH Germany in association with Indus Associated Consultants, Lahore BAK Consulting Engineers, Peshawar - Pakistan

Architects & Consulting Engineers, Hyderabad Infra-D Consultants, Islamabad - Engineering and Agricultural Services Entity, Lahore.

Study-III: Joint Venture of AAB Private Limited in association with DHV Water BV The Netherlands and Infra-D Consultants (IDC), Islamabad.

7.5 In order to enhance the credibility of the above studies, it was further decided by the Ministry of Water & Power, Government of Pakistan, with the consensus of all the Provinces, to appoint an International Panel of Experts (IPOE) comprising: (i) Expert on Water Resources Management, (ii) Expert on Irrigation & Drainage and (iii) Environmental Specialist, to review the work done by the consultants of the three studies.

7.6 For the above IPOE, the basic TORS as agreed to through consensus by the stakeholders include:

- (i) Review the work of consultants for all the three studies at three stages namely Inception, Interim and Final Draft Report.
- (ii) Review the recommendations given by the consultants in the light of the scope of work envisaged in the TORs for all the three studies.
- (iii) Analyze the recommendations of the consultants in full perspective and suggest judicious trade-offs and interventions amongst various requirements.

7.7 It was also decided with the consensus of all the Provinces that for the above TORS, the IPOE shall be required to work intermittently with following three visits to Pakistan:

- (i) Inception Report stage Review
- (ii) Interim Report stage Review
- (iii) Draft Final Report stage Review

7.8 A long list of CVs of suitable international experts for the above assignments was prepared after head hunting and based on World Bank's Guidelines in view of the fact that financing of entire assignment of IPOE was proposed to be met out of Public Sector Capacity Building Project of Ministry of Water & Power through World Bank's credit (Cr. No. 3904-PAK). The CVs of the long listed international experts were evaluated by the Provinces under the auspices of Ministry of Water and Power and finally three experts were selected and contracts made for a joint assignment under the umbrella of IPOE with the approval of all relevant forums of GOP and the World Bank.

The selected experts under IPOE are:

S. No	Position of IPOE	Name and Nationality of Expert
1	Expert on Water Resources Management	Dr. M.S. Basson (Nationality: South African)
2	Expert on Irrigation & Drainage	Mr. Fernando J. Gonzalez (Nationality: Mexican)
3	Environmental Specialist	Prof. Dr. Bart Schultz (Nationality. The Netherlands)

7.9 As reported by the Chief Engineering Adviser, the present position of the three studies is as under:-

- Draft Inception Reports of the three studies were prepared and submitted by the three Consultants in March 2005;
- Draft Inception Report of the three studies were commented upon by all the concerned stakeholders in March 2005;
- IPOE undertook their Draft Inception Reports Review Visit to Pakistan between March 19, 2005 to April 14, 2005;
- IPOE held detailed discussions with all the stakeholders during their above visit;
- Study-I, II & III Inception Reports were discussed in detail during Steering Committee's meetings held on March 28, 2005 and April 07, 2005;
- IPOE presented their recommendations during Steering Committee's meeting held on April 07, 2005. IPOE presented their written recommendations on three draft Inception Reports on April 14, 2005;
- Based on above recommendations, Inception Reports of three studies were prepared and submitted by the three joint venture of Consulting firms in May 2005 after their prior consultation with IPOE.
- Draft Interim Reports of the three studies have been received in July 2005.

7.10 As further reported by Chief Engineering Adviser, future Actions/Present Schedule/Present Target Dates of Completion of Studies based on IPOE's Review, are as under:-

- Review of Draft Interim Reports of three studies by the four Provinces/Steering Committee by August 13, 2005;
- Review of Draft Interim Reports of three studies by the IPOE between August 15 to August 19, 2005.
- Submission of final Interim Reports by August 25, 2005 by the Consultants;
- Draft Final Reports are expected to be submitted by the Consultants by September 10, 2005;
- Review of Draft Final Reports of three studies by the Provinces upto September 18, 2005;
- Review of Draft Final Reports of three studies by IPOE between September 19 to September 25, 2005; and
- Submission of Final Report of three Studies by the Consultants in October 2005 after incorporating recommendations of IPOE.

7.11 The progress of the studies is considered to be satisfactory and the final report is expected by October 2005. The seven members of the Technical Committee have also expressed their satisfaction over the progress of the studies.

TOR-4(b)

"Ascertain actual quantity of water passed downstream Kotri from 1976-2003"

8. TOR-4(b) "Ascertain actual quantity of water passed downstream Kotri from 1976-2003"

8.1 It was not considered necessary to get any presentation on this TOR. WAPDA submitted a position paper in which the relevant data in this regard was supplied to the Technical Committee on Water Resources. This data was based on information provided by the Irrigation and Power Department, Government of Sindh.

8.2 According to the data provided by WAPDA, the average outflow to sea during the period 1976-77 to 2002-03 was 35.2 MAF, the maximum being 91.83 MAF in 1994-95 and the minimum being 0.79 MAF in 2000-01.

8.3 The data provided by WAPDA is considered correct and acceptable. The seven members of the Technical Committee have also expressed their satisfaction with this data.

TOR-6

"Complement the Parliamentary Committee on Water Resources in the discharge of its functions"

9. TOR-6 "Complement the Parliamentary Committee on Water Resources in the discharge of its functions"

9.1 The Parliamentary Committee on Water Resources was constituted in November 2003. It held a number of meetings at Islamabad and also at Provincial headquarters. The Chairman, Parliamentary Committee invited the Chairman, Technical Committee on Water Resources to attend these meetings, to which the Chairman Technical Committee responded. The Chairman, Technical Committee also invited the Chairman, Parliamentary Committee on Water Resources to attend the meetings of the Technical Committee to which the Chairman, Parliamentary Committee also responded. The exchange of views and participation of the two Chairmen in the meetings of the respective Committees was quite useful. Thus close liaison was established between the two Committees for mutual benefit.

9.2 The Parliamentary Committee on Water Resources has submitted its report to Government in August 2004. However, a copy of this report has not been supplied inspite of informal requests of the Chairman, Technical Committee to the concerned quarters. It would have been useful if the report could have been made available to the Chairman, Technical Committee on Water Resources.

REPORT OF TECHNICAL COMMITTEE ON WATER RESOURCES
including report of seven members of the Committee with comments of the
Chairman

PART-II
Examination of TORS, Conclusions and Recommendations

LIST OF ANNEXURES

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- II-16. Table presented by IRSA indicating province-wise distribution of water during shortage periods.

Annexure II-1

WAPDA's Presentation on 4th September 2004

Average future water availability for canal diversions furnished to technical committee in March 2004* downstream approach		
SR. NO.	DESCRIPTION	AVERAGE (MAF)
1	Actual Post-Tarbela (1976-77 To 2002-2003) Escapage Below Kotri	35.2
2	Balance Accord Allocations (117.35-105.40 MAF)	11.95
3	Indian Right On Western Rivers	2.00
4	Eastern River Inflows	4.94
5	Eastern Rivers Contribution From Within Pakistan (Ujh, Deg, Basanter, Bein; Hudiara, Rohl etc.)	3.53**
6	Kotri Outflow To Check Sea Intrusion	5.80
7	Short Term Possible Flows On Kabul River By Afghanistan	0.50
8	Total (2+3+6+7)	20.25
9	Net For Further Development Under Para 4 Of WAA (1-8)	14.95
8	Total Development Potential Above Present Uses (14.95 + 11.95)	26.90
* Furnished to Technical Committee on Water Resources on March 25, 2004		
** Included In 35.2 MAF		
Note: (refer paras 2.6.6.2-3 of Part-II of this report)		
(i) Balance Accord allocations (11.95 MAF) is not additional availability as confirmed by WAPDA. The net availability under item 9 of WAPDA's table is therefore relevant.		
	(ii) Requirements of Projects under construction (7.8 MAF) given by WAPDA (Item 2.4 of Annexure II-3) have to be accounted for in this table also.	7.80
	(iii) Net availability (14.95-7.8)	7.15

Annexure II-2

WAPDA's Presentation on 4th September 2004

Average future water availability for canal diversions furnished to technical committee in March 2004* upstream approach		
SR. NO.	DESCRIPTION	AVERAGE (MAF)
1	Actual post-Tarbela (1976-77 to 2002-2003) Western River Rim-Station Inflows	140.76
2	NWFP'S Diversions Above Rim-Station Including Un-Gauged Civil Canals	5.65
3	Eastern River Run-Off Generated From Within Pakistan	3.53
4	Eastern River Inflows	4.94
5	Sub-Total (1 to 4)	154.88
6	Indian Uses On Western Rivers	2.00
7	Para-2 Allocations OF WAA (1991):-	
	a. Post-Tarbela Average (1977-82)	105.40
	b. Water Accord (1991)	117.35
	c. Additional (a - b)	11.95
8	Present System Losses	15.00
9	Kotri Outflow to check Sea Intrusion	5.80
10	Kabul River Short Fall	0.50
11	Net For Further Development Under Para 4 (5-6-7b-8-9-10)	14.23
12	Total (11.95 + 14.23)	26.18
* Furnished to Technical Committee on Water Resources on March 25, 2002 Note: (refer paras 2.6.6.2-3 of Part II of this report)		
(i) Balance Accord allocations (11.95 MAF) is not additional availability as confirmed by WAPDA. The net availability under item 11 of WAPDA's table is therefore relevant.		
	(ii) Requirements of Projects under construction (7.8 MAF) given by WAPDA (Item 2.4 of Annexure II-3) have to be accounted for in this table also.	7.80
	(iii) Net availability (14.23-7.8)	6.43

Annexure II-3

WAPDA's Presentation on 4th September 2004

Water Availability For Further Development* (Based On The Post-Tarbela Escapages Below Kotri)		
NO.	DESCRIPTION	AVERAGE (MAF)
1	Post-Tarbela (1976-77 to 2002-2003) Escapage Below Kotri	35.2
2	Possible Reductions	
2.1	Indian Uses on Western Rivers	2.00
2.2	Kotri Outflow to Check Sea Intrusion (Graduated scale)	5.8**
2.3	Possible Uses on Kabul River by Afghanistan	0.50
2.4	Requirements of Projects Under Construction	
	a. Flood Canals (Kachhi, Raine, Greater Thal) 4.8***	
	b. Mangla Raising 2.9	
	c. Pat Feeder Extension 0.1	
	Sub-Total	7.80
3	Total Reductions (Item 2)	16.10
4	Net Available for Further Development (1-3)	19.1****
* Furnished by WAPDA to Parliamentary Committee on May 13, 2004		
** To be determined by Study No. 4 now in progress. Till final solution of issue, we can safely adopt this average, based on a gradual river scale of release in keeping with the flow conditions. We could release: 10 MAF for average and wet flow condition; 5 MAF for below average flow condition; 2 MAF for poor flow condition; and all for worst flow condition.		
*** Including allocations of 2.50 MAF for Greater Thal, 1.2 MAF for Kachhi and 1.1 MAF for Reines.		
**** Including additional accord allocations and future storages.		
Note: (refer paras 2.6.6.2-3 of Part-II of this report)		
	(i) Balance Accord allocations (11.95 MAF) included in WAPDA's computations at Annexure II-1 and II-2 are not shown in this table, which need to be accounted for	11.95
	(ii) Net availability (19.1-11.95)	7.15

Annexure II-4

WAPDA's Presentation on 4th September 2004

Adoption Of Average Dependability Criterion For Various Studies/Documents			
Sr. No.	Study/Document	Year	Average Data Base
1	Indus Waters Treaty	1960	1936-46
2	Master Plan by Harza	1964	1922-61
3	World Bank (Lieftinck) Study	1967	1922-63
4	Fazle Akbar Committee	1971	1940-70
5	WAPDA's Revised Action Programme	1979	1936-75
6	WAPDA's Report on Surface Water Potential	1989	1966-87
7	Water Apportionment Accord	1991	Post-Tarbela
8	Water Resources Strategy Study (ADB)	2001	1975-2000
9	Ten Years Perspective Plan 2001-11 (Planning Commission)	2002	1922-2001
10	National Water Policy Report (Min: of W&P)	2003	1922-99

Annexure II-5

Circulated in third meeting of Technical Committee on 28th September, 2004

AFGHANISTAN-RIVERS

(South Asia Media Net & Portal. UNESCO.org/es/ev.php.URL)

15-07-2003 2:00 pm Water rhymes with survival in Afghanistan. In a country prone to prolonged periods of drought, 85% of people remain reliant on agriculture for their livelihood. Competition for the resources of the region's rivers is rife; the negotiation of international agreements between Afghanistan and its downstream neighbors will thus be essential to ensuring the consoling of peace.

Although water-sector development is one of the highest priorities of Afghanistan's transitional government, two decades of war have deprived the country of the hydrological skills, managerial capacities and infrastructure to attain this objective. Trapped until recently in a time warp, Afghanistan has been side-stepped by foreign investments and by developments in education and technology. If the country can count on a relatively high proportion of national experts for the reconstruction of the water sector, these experts need urgent training in modern techniques.

On the premise that leadership of Afghanistan's recovery and rehabilitation process must rest with the Afghans themselves, UNESCO has been helping Afghanistan since 2002 to develop its human and institutional capacity, design a national water policy and establish regional co-operation for the management of its shared river basins.

(ii) Since agriculture accounts for 85% of water use, increasing the productivity of irrigated water is particularly critical for reducing poverty in the rural areas. As for the cities, they need a reliable water supply and hydropower at a reasonable cost. To ensure long-lasting availability of basic resources such as fuel, fodder and timber, Afghanistan must engage in sustainable water resources development. Detailed field studies and an inventory of natural resources and the population's socio-economic conditions would facilitate the process.

(iii) Signs of 'neighbourly' goodwill are not lacking. Since April 2003 for example, the Iranian government has been collaborating with UNESCO on a study of Kabul River and related projects which will cost US\$1.1 million over the next three years.

(iv) Afghanistan is situated upstream of several internationally shared river basins (the Kabul, Helmand and Amu Darya Rivers among others). In order to develop its own

water resources, Afghanistan will need to establish regional co-operation with the downstream countries of Tajikistan, Turkmenistan, Uzbekistan, Iran and Pakistan. Kabul river of Afghanistan, 300 m.in length. The Kabul (ancient Kophes), which is the most important (although not the largest) river in Afghanistan, rises at the foot of the Tjnai pass leading over the Sanglakh range, an offshoot of the Hindu Kush towards Bamian and Afghan Turkestan. Its basin forms the province of Kabul, which includes all northern Afghanistan between the Hindu Kush and the Safed Koh ranges. From its source to the city of Kabul the course of the river is only 45 m., and this part of it is often exhausted in summer for purposes of irrigation. Half a mile east of Kabul it is joined by the Logar, a much larger river, which rises beyond Ghazni among the slopes of the Gul Koh (14,200 ft.), and drains the rich and picturesque valleys of Logar and Wardak. Below the confluence the Kabul becomes a rapid stream with a great volume of water and gradually absorbs the whole drainage of the Hindu Kush. About 40 m. below Kabul the Panjshir river joins it; 15 m. farther the Tagao; 20 m. from the Tagao junction the united streams of Alingar and Alishang (rivers of Kafiristan); and 20 m. below that, at Balabagh, the Surkhab from the Safed Koh. Two or three miles below Jalalabad it is joined by the Kunar, the river of Chitral.

Thenceforward it passes by deep gorges through the Mohmand hills, curving northward until it emerges into the Peshawar plain at Michni. Soon afterwards it receives the Swat river from the north and the Bara river from the south, and after a further course of 40 m. falls into the Indus at Attock. From Jalalabad downwards the river is navigable by boats or rafts of inflated skins, and is considerably used for purposes of commerce.

(v) There are four dams on Kabul River and its tributaries. The government is planning to add to these to reinforce irrigation, fishing and hydropower generation but, unless an agreement is found, Kabul River's further development could trigger tensions between Afghanistan and Pakistan. The story is much the same for Helmand River. Draining 31% of Afghanistan's land area, it is (at 1007 km) the longest river and a key player in the development of the southwest desert region. Wetlands in this massive depression, stretching about 200 km from north to south, have supported irrigated agriculture throughout Afghanistan's history. Afghanistan is planning new dams on the river for hydropower, irrigation and flood control. Further studies will be needed to determine whether the Kabul and Helmand River projects can be realized without harming the interests of neighboring countries.

Annexure II-6

Annual outflows to sea in descending order with mean and median values

S.No.	Year	Annual Outflows (In descending order) (MAF)	Cumulative Total (MAF)	Cumulative Percentage	Remarks
1	2	3	4	5	6
1	1976-1977	69.08	323.03	33.28	
2	1977-1978	30.39	725.09	74.72	
3	1978-1979	80.60	253.95	26.16	
4	1979-1980	29.81	754.90	77.79	Median
5	1980-1981	20.10	881.30	90.81	
6	1981-1982	33.79	694.70	71.58	
7	1982-1983	9.68	956.74	98.59	
8	1983-1984	45.90	537.89	55.43	
9	1984-1985	29.55	784.45	80.83	29.38
10	1985-1986	10.97	947.06	97.59	
11	1986-1987	26.90	840.46	86.61	
12	1987-1988	17.53	918.87	94.69	
13	1988-1989	52.86	491.99	50.70	
14	1989-1990	17.22	936.09	96.46	
15	1990-1991	42.34	625.68	64.47	
16	1991-1992	53.29	439.13	45.22	
17	1992-1993	81.49	173.35	17.86	
18	1993-1994	29.11	813.56	83.83	
19	1994-1995	91.86	91.86	9.46	
20	1995-1996	62.81	385.84	39.76	
21	1996-1997	45.45	583.34	60.11	
22	1997-1998	20.74	861.20	88.74	
23	1998-1999	35.23	660.91	68.10	Mean/ Average 34.6
24	1999-2000	8.84	965.58	99.50	
25	2000-2001	0.74	970.39	100.00	
26	2001-2002	1.92	969.65	99.92	
27	2002-2003	2.15	967.73	99.72	
28	2003-2004	20.04	901.34	92.88	

Total	970.39
Mean	34.65
Median	29.68

Maximum	19.9
Minimum	0.74

ABSTRACT

	MAF	Percentage
7 highest flow years	491.99	50.70
Next 7 flow years	262.91	27.09
Next 7 flow years	163.97	16.90
7 lowest flow years	51.52	5.31
Total	970.39	100.00

Annexure II-7

Similar table circulated in third meeting of Technical Committee on 28th September, 2004

CAPABILITY OF DAMS TO STORE SURPLUS FLOOD FLOWS (Based on WAPDA's figures)

Year	Annual outflow to sea	Reduction due to existing commitments	Net surplus	Possible utilization in one dam of 6 MAF	Possible utilization in second dam of 6 MAF	Possible utilization in curry-over dam of 3.5 MAF in place of two dams	Balance Unutilized: from two dams of 6 MAF	Balance utilization from carry-over dam
1	2	3	4	5	6	7	8	9
1976-77	69.08	35.45	33.63	6.00	6.00	33.63	21.63	-
1977-78	30.39	30.39	-	-	-	-	-	-
1978-79	80.60	35.45	45.15	6.00	6.00	35.00	33.15	10.15
1979-80	29.81	29.81	-	-	-	-	-	-
1980-81	20.10	20.10	-	-	-	-	-	-
1981-82	33.79	33.79	-	-	-	-	-	-
1982-83	9.68	9.68	-	-	-	-	-	-
1983-84	45.90	35.45	10.45	6.00	4.45	10.45	-	-
1984-85	29.55	29.55	-	-	-	-	-	-
1985-86	10.97	10.97	-	-	-	-	-	-
1986-87	26.90	26.90	-	-	-	-	-	-
1987-88	17.53	17.53	-	-	-	-	-	-
1988-89	52.86	35.45	17.41	6.00	6.00	17.41	5.41	-
1989-90	17.22	17.22	-	-	-	-	-	-
1990-91	42.34	35.45	6.89	6.00	0.89	6.89	-	-
1991-92	53.29	35.45	17.84	6.00	6.00	17.84	5.84	-
1992-93	81.49	35.45	46.04	6.00	6.00	35.00	34.34	11.04
1993-94	29.11	29.11	-	-	-	-	-	-
1994-95	91.86	35.45	56.41	6.00	6.00	35.00	44.41	21.41
1995-96	62.81	35.45	27.36	6.00	6.00	27.36	15.06	-
1996-97	45.45	35.45	10.00	6.00	4.00	10.00	-	-
1997-98	20.74	20.74	-	-	-	-	-	-
1998-99	35.23	35.23	-	-	-	-	-	-
1999-00	8.84	8.84	-	-	-	-	-	-
2000-01	0.74	0.74	-	-	-	-	-	-
2001-02	1.92	1.92	-	-	-	-	-	-
2002-03	2.15	2.15	-	-	-	-	-	-
2003-04	20.04	20.04	-	-	-	-	-	-
Total	970.39	699.21	271.18	60.00	51.34	228.58	159.84	42.60

Note: Breakup of the figure of 35:45 is given in the table at para 2.9.4 Part II of this report.

A. Two dams of 6 MAF each

- (i) First dam of 6 MAF will be filled for 10 years out of 28 years.

(ii) Second dam of 6 MAF will be filled for 7 years and partly filled for 3 years out of 28 years.

(iii) First dam will utilize 60.00 MAF out of 271.18 MAF of surplus flows i.e. 22.1%.

(iv) Second dam will utilize 51.34 MAF i.e. 18.9% of surplus flows. A quantity of 159.84 MAF, i.e. 58.9 % of surplus flows, will still remain un-utilized after both dams are built.

(v) First dam of 6 MAF will provide an average of 2.14 MAF per year and second dam will provide an average of 1.83 MAF per year. Both dams of 12 MAF capacity will provide 3.97 MAF per year.

(vi) Both dams of 6 MAF each will not be filled for 7 consecutive years on one occasion and in 4 consecutive years on two other occasions.

B. Carryover dam of 35 MAF

(i) Carryover dam (35 MAF) will be filled for 3 years out of 28 years and partly filled for 7 years out of 28 years.

(ii) Carryover dam (35 MAF) will utilize 228.58 MAF out of 271.18 MAF of surplus flows i.e. 84.3%.

(iii) Carryover dam (35 MAF) will provide an average of 8.16 MAF per year for 28 years.

(iv) Carryover dam (35 MAF) will not be filled for 7 consecutive years on one occasion and in 4 consecutive years on two other occasions.

(v) A quantity of 42.60 MAF i.e. 15.7 % of surplus flows, will remain un-utilized after carry-over dam is built.

Annexure II-8

*Season-wise canal withdrawals 1976-77 to 2002-03 as compared to Accord allocations
(Annexure-7 of the presentation to Technical Committee by WAPDA on 27th Sept, 2004
reproduced with computation of percentages)*

Year	Accord allocations			Canal withdrawals (MAF)		
	2	3	4	5	6	7
1	Kharif	Rabi	Total	Kharif	Rabi	Total
1976-77	79.17	38.21	117.35	59.74 (75.49%)	39.55 (103.50%)	99.29 (84.61%)
1977-78	79.17	38.21	117.35	66.29 (83.76%)	38.89 (101.77%)	105.18 (89.62%)
1978-79	79.17	38.21	117.35	61.85 (78.15%)	37.29 (97.59%)	99.14 (84.48%)
1979-80	79.17	38.21	117.35	69.99 (88.43%)	37.59 (98.37%)	107.58 (101.33%)
1980-81	79.17	38.21	117.35	71.19 (89.555)	38.72 (101.33%)	109.91 (93.65%%)
1981-82	79.17	38.21	117.35	68.79 (86.92%)	35.58 (93.11%)	104.37 (88.93%)
1982-83	79.17	38.21	117.35	69.08 (87.28%)	36.73 (96.12%)	105.81 (90.16%)
1983-84	79.17	38.21	117.35	64.13 (81.03%)	38.9 (101.50%)	103.03 (87.79%)
1984-85	79.17	38.21	117.35	67.41 (85.17%)	36.20 (94.73%)	103.61 (88.29%)
1985-86	79.17	38.21	117.35	62.08 (78.44%)	36.76 (96.20%)	98.84 (84.22%)
1986-87	79.17	38.21	117.35	68.91 (87.05%)	39.44 (103.21%)	108.35 (92.33%)
1987-88	79.17	38.21	117.35	72.50 (92.11%)	38.73 (101.36%)	111.63 (95.12%)
1988-89	79.17	38.21	117.35	68.34 (86.35%)	39.28 (102.80%)	107.62 (91.70%)
1989-90	79.17	38.21	117.35	67.03 (84.69%)	37.56 (98.20%)	104.59 (89.12%)
1990-91	79.17	38.21	117.35	70.77 (89.42%)	41.49 (108.58%)	112.26 (95.66%)
1991-92	79.17	38.21	117.35	72.90 (92.11%)	39.58 (103.58%)	112.48 (95.85%)
1992-93	79.17	38.21	117.35	63.38 (80.08%)	40.54 (106.09%)	103.92 (88.55%)
1993-94	79.17	38.21	117.35	73.23 (92.53%)	37.36 (97.77%)	110.59 (89.55%)
1994-95	79.17	38.21	117.35	59.12 (74.70%)	38.35 (100.36%)	97.47 (94.23%)
1995-96	79.17	38.21	117.35	64.59 (81.61%)	40.77 (106.69%)	105.36 (89.78%)
1996-97	79.17	38.21	117.35	74.51 (94.14%)	39.59 (103.61%)	114.10 (97.23%)
1997-98	79.17	38.21	117.35	69.31 (87.57%)	36.85 (96.44%)	106.16 (90.46%)
1998-99	79.17	38.21	117.35	74.59 (94.25%)	39.11 (102.35%)	113.70 (96.88%)
1999-00	79.17	38.21	117.35	76.51 (96.71%)	33.20 (86.88%)	109.71 (93.48%)
2000-01	79.17	38.21	117.35	64.67 (81.71%)	24.54 (64.22%)	89.21 (76.02%)
2001-02	79.17	38.21	117.35	59.92 (75.71%)	22.71 (59.43%)	82.63 (70.41%)
2002-03	79.17	38.21	117.35	68.20 (86.17%)	28.23 (73.88%)	96.43 (82.17%)
Average	79.17	38.21	117.35	67.76 (85.61%)	36.79 (96.3%)	104.55 (89.27%)

ABSTRACT			
S.No.	Canal withdrawals by all provinces, 1976-77 to 2002-03	Kharif (No. of years out of 27 years)	Rabi (No. of years out of 27 years)
1	Withdrawals less than 75%	1	3
2	Withdrawals less 75% to 80%	4	0
3	Withdrawals 80% to 85%	6	0
4	Withdrawals 85% to 90%	10	1
5	Withdrawals 90% to 95%	5	2
6	Withdrawals 95% to 100%	1	7
7	Withdrawals above 100%	0	14
Total		27	27

Annexure II-9

WAPDA'S PRESENTATION ON 23rd NOVEMBER 2004

TABLE-7

MAXIMUM CONSERVATION LEVELS AND LOWEST DRAWDOWN LEVELS MANGLA DAM RESERVOIR LEVELS

MANGLA DAM RESERVOIR LEVELS						
YEARS	MAXIMUM			MINIMUM		
	DATE	LEVEL (MSL)	GROSS CONTENT (MAF)	DATE	LEVEL (MSL)	GROSS CONTENT (MAF)
1967-68	14-9-1967	1202.32	5.903	07-6-1968	1122.10	2.175
1968-69	30-8-1968	1202.10	5.889	05-3-1969	1074.20	1.178
1969-70	15-9-1969	1202.24	5.888	4-4-1970	1050.05	0.052
1970-71	23-9-1970	1193.57	5.382	11-4-1971	1040.05	0.504
1971-72	19-9-1971	1183.76	4.795	5-3-1972	1084.57	1.273
1972-73	29-9-1972	1202.19	5.894	24-2-1973	1106.54	1.748
1973-74	13-9-1973	1202.02	5.817	25-5-1974	1052.11	0.088
1974-75	3-9-1974	1173.60	4.249	4-3-1975	1059.48	1.033
1975-76	23-8-1975	1203.44	5.978	4-4-1975	1108.28	1.074
1976-77	4-9-1976	1202.14	5.981	31-3-1977	1074.89	1.013
1977-78	13-9-1977	1202.05	5.836	5-3-1978	1105.44	1.663
1978-79	3-9-1978	1202.00	5.682	19-2-1979	1116.84	1.962
1979-80	7-9-1979	1198.88	5.562	22-2-1980	1076.73	1.110
1980-81	11-8-1980	1202.09	5.888	30-1-1981	1117.25	1.973
1981-82	27-8-1981	1202.00	5.882	28-2-1982	1050.15	0.727
1982-83	22-5-1982	1202.02	5.883	11-3-1983	1086.70	1.207
1983-84	2-9-1983	1202.47	5.913	17-3-1984	1043.50	0.594
1984-85	25-8-1984	1202.23	5.897	26-3-1985	1040.04	0.550
1985-86	08-9-1985	1200.00	5.225	12-3-1986	1081.21	0.841
1986-87	26-9-1986	1202.13	5.373	20-3-1987	1101.70	1.190
1987-88	18-8-1987	1202.17	5.376	11-3-1988	1073.07	0.760
1988-89	27-8-1988	1202.57	5.358	22-3-1989	1056.24	0.747
1989-90	29-8-1989	1202.48	5.397	17-3-1990	1058.32	0.608
1990-91	15-8-1990	1204.02	5.500	27-12-1990	1138.07	2.188
1991-92	19-9-1991	1202.57	5.410	23-3-1992	1106.45	1.323
1992-93	10-9-1992	1207.83	5.750	11-3-1993	1078.72	0.802
1993-94	3-9-1993	1202.15	5.374	31-3-1994	1051.21	0.520
1994-95	23-3-1994	1202.38	5.390	23-3-1995	1078.70	0.825
1995-96	20-9-1995	1202.00	4.958	13-3-1996	1113.00	1.151
1996-97	4-10-1996	1202.20	4.971	27-3-1997	1040.00	0.259
1997-98	20-6-1997	1205.10	5.161	01-4-1998	1112.95	1.151
1998-99	1-9-1998	1202.00	4.958	31-3-1999	1051.45	0.370
1999-00	27-9-1999	1149.10	4.053	14-3-2000	1040.00	0.192
2000-01	11-9-2000	1181.25	4.175	5-3-2001	1040.00	0.229
2001-02	8-9-2001	1191.25	3.628	10-3-2002	1058.20	0.309
2002-03	5-9-2002	1205.00	4.952	16-2-2003	1040.00	0.195
2003-04	4-6-2003	1205.95	4.959	3-3-2001	1040.00	0.191
2004-05	31-8-2004	1159.65	2.020			

Annexure II-10

Circulated by Mr. Sardar Ahmed Mughal
Member Sindh, TCWR.

MANGLA RESERVOIR									
INBOUNDING IN MAF						MAXIMUM DRAWDOWN			
YEARS	Mar 1 to Mar 31		April 1 to June 30	During floods onward July to Max level is achieved	Total 2+3+4	Water wasted July and August	Date	Reservoir Level	Live Storage
1968	0.120	1131.90	3.079	3.079	3.499	1.34	7-6-1968	1122.10	1.634
	(4%)	1141.75	(88%)	(88%)	(100%)				
1969	0.571	1107.00	2.879	2.879	4.722	2.57	5-3-1969	1024.20	0.635
	(12%)	7147.18	(63%)	(63%)	(100%)				
1970	0.000	1054.36	3.109	3.109	4.630	0.18	4-4-1970	1054.46	0.121
	(0%)	1105.06	(112%)	(112%)	(100%)				
1971	0.000	1047.70	2.422	2.422	4.099	0.79	7-4-1971	1040.05	0.665
	(0%)	1134.66	(59%)	(59%)	(100%)				
1972	0.284	1101.57	0.975	0.975	4.621	3.80	5-3-1972	1084.57	0.232
	(6%)	1185.96	(27%)	(21%)	(100%)				
1973	0.543	1128.34	1.331	1.331	4.135	6.33	24-2-1973	1106.54	1.207
	(13%)	1179.39	(32%)	(32%)	(100%)				
1974	0.024	1061.52	3.172	8.172	3.426	0.74	25-5-1974	1052.11	0.132
	(1%)	1125.01	(63%)	(63%)	(100%)				
1975	0.273	1069.91	1.663	1.663	4.943	5.40	4-3-1975	1069.46	0.492
	(5%)	1124.83	(34%)	(34%)	(100%)				
1976	0.000	1110.71	1.352	1.352	4.155	7.93	4-4-1976	1106.26	1.133
	(0%)	1180.00	(33%)	(33%)	(100%)				
1977	0.000	1174.87	3.466	3.466	4.873	1.57	31-3-1977	1074.89	0.472
	(0%)	1131.44	(91%)	(71%)	(100%)				
1978	1.080	1140.44	1.373	1.313	4.217	6.25	5-3-1978	1105.44	1.114
	(2%)	1129.74	(31%)	(31%)	(100%)				
1979	0.926	1143.91	1.532	1.532	3.605	2.75	19-2-1979	1145.84	1.423
	(26%)	1167.28	(45%)	(45%)	(100%)				
1980	0.645	1142.09	0.351	0.361	4.776	3.95	22-2-1980	107623.00	0.569
	(13%)	1192.99	(12%)	(12%)	(100%)				
1981	1.044	1149.07	0.984	0.984	5.565	3.99	30-1-1981	1112.25	4.492
	(2%)	1185.89	(23%)	(25%)	(100%)				
1982	1.027	1112.90	0.431	0.431	5.566	2.99	28-2-1982	1050.15	0.196
	(2%)	1195.70	(8%)	(8%)	(100%)				
1983	0.446	1108.90	0.506	0.506	1.175	6.82	11-3-1983	1086.70	0.666
	(9%)	1194.32	(11%)	(11%)	(100%)				
1984	0.215	1063.16	1.541	1.541	4.706	2.27	17-3-1984	1043.50	0.055
	(4%)	1175.64	(29%)	(29%)	(100%)				

MANGLA RESERVOIR									
INBOUNDING IN MAF						MAXIMUM DRAWDOWN			
YEARS	Mar 1 to Mar 31		April 1 to June 30	During floods onward July to Max level is achieved	Total 2+3+4	Water wasted July and August	Date	Reservoir Level	Live Storage
1985	0.050	1045.19	3.265	3.265	5.301	0.55	26-3-1985	1040.04	0.009
	(1%)	1130.95	(65%)	(65%)	(100%)				
1986	0.637	1114.41	1.135	1.135	4.532	5.77	12-3-1986	1080.21	0.424
	(1%)	1182.95	(25%)	(25%)	(100%)				
1987	0.379	1119.60	1.083	1.085	4.154	4.26	20-3-1987	1041.70	0.773
	(9%)	1163.90	(28%)	(28%)	(100%)				
1988	0.721	1117.90	1.005	1.005	4.648	7.15	11-3-1988	1073.07	0.349
	(18%)	1125.80	(22%)	(22%)	(100%)				
1989	0.227	1067.02	1.197	1.197	4.680	3.93	22-3-1989	1066.24	0.300
	(5%)	1112.29	(25%)	(25%)	(100%)				
1990	1.360	1131.30	1.039	1.039	4.893	2.48	17-3-1990	1058.32	0.191
	(28%)	1166.80	(31%)	(31%)	(100%)				
1991	1.255	1172.37	0.447	0.447	2.941	5.35	28-2-1991	1144.27	2.035
	(4%)	1174.67	(15%)	(15%)	(100%)				
1992	1.669	1134.85	0.834	0.834	5.343	6.21	23-2-1992	1106.45	0.901
	(54%)	1194.78	(17%)	(17%)	(100%)				

Annexure II-11

WAPDA's Presentation on 23rd November 2004

TABLE-11

STORAGE OF WATER IN MANGLA RESERVOIR DURING THE CORRESPONDING PERIOD WHERE LINK CANALS WERE IN OPERATION

Period	2000			2001			2002			2003			2004		
	Flows Through		Water Storage At Mangla	Flows Through		Water Storage At Mangla	Flows Through		Water Storage At Mangla	Flows Through		Water Storage At Mangla	Flows Through		Water Storage At Mangla
	C-J	T-P		C-J	T-P		C-J	T-P		C-J	T-P		C-J	T-P	
Apr 1	0.0	0.0	0.0	1.3	0.8	6.0	0.0	0.0	14.8	4.2	0.3	12.8	3.4	0.0	2.5
Apr 2	0.0	0.0	4.8	0.1	0.8	8.7	3.4	1.0	16.1	5.0	1.8	21.6	3.3	0.1	2.5
Apr 3	1.9	1.2	5.0	0.7	2.0	9.6	2.2	6.4	14.7	5.7	8.5	33.0	3.3	1.8	7.6
May 1	6.7	3.7	5.9	4.1	6.3	0.0	0.5	8.1	5.3	9.2	10.7	42.6	0.0	6.2	25.4
May 2	19.5	9.6	19.8	4.2	10.4	9.5	0.6	9.1	27.8	8.4	8.7	2.0	0.0	4.9	15.7
May 3	19.5	11.8	4.7	12.7	11.9	2.7	7.6	12.0	20.3	5.0	11.8	9.0	7.1	10.0	14.9
June 1	9.3	7.8	1.9	12.2	8.4	12.6	13.1	12.0	17.6	7.2	11.9	28.7	5.8	7.6	0.0
June 2	9.5	8.8	13.5	11.8	10.6	17.7	20.0	12.0	28.7	10.0	7.4	16.9	12.9	6.5	14.5
June 3	12.6	9.0	13.3	13.3	7.8	14.7	20.0	12.0	22.5	10.0	5.6	12.0	18.2	11.3	19.9
July 1	16.5	11.6	13.2	11.5	8.1	13.1	20.0	12.0	16.2	10.0	4.0	2.5	19.0	11.8	15.3
July 2	13.8	11.7	13.0	8.0	6.8	15.7	18.6	11.0	9.9	13.8	4.4	14.3	19.0	9.8	17.7
July 3	9.2	5.5	24.5	8.0	4.7	20.0	17.0	10.7	6.0	15.0	2.9	3.0	18.2	9.0	1.8
Aug 1	1.8	3.2	42.7	8.0	6.0	14.4	11.5	8.8	0.3	15.0	2.0	5.3	12.5	9.3	11.7
Aug 2	12.4	9.1	18.2	8.0	6.0	11.3	12.9	11.4	19.6	16.3	2.0	3.8	14.2	5.5	10.9
Aug 3	9.0	10.2	8.4	10.9	6.3	6.7	17.0	12.0	2.0	18.0	2.4	5.7	7.3	5.7	5.8
Sep 1	10.0	11.2	8.3	17.8	8.9	0.2	18.0	12.0	0.5	18.0	5.6	0.0	17.7	9.0	0.0
Sep 2	16.9	11.6	0.0	18.6	8.7	0.0	17.5	8.5	0.0	17.2	3.4	0.0	4.1	6.6	0.0
Sep 3	18.3	10.4	0.0	15.7	8.0	0.0	10.7	6.5	0.0	7.6	7.2	0.0	8.8	8.0	0.0
K-MAF	3.6	2.71	3.95	3.4	2.43	3.29	4.3	2.26	4.42	4	2.03	4.26	3.5	2.49	3.34

ANNEXURE II-12

KALABAGH CONSULTANTS RESERVOIR FILLING STUDY, 1988 (PRE-ACCORD)

TABLE-3
ESTIMATED IRRIGATION DEMAND PPR

<i>(1000 cfs)</i>			
ESTIMATED IRRIGATION DEMAND PPR			
Period	Demand	Period	Demand
Oct 1	38	Apr 1	75
Oct 2	43	Apr 2	75
Oct 3	56	Apr 3	95
Nov 1	74	May 1	116
Nov 1	82	May 2	139
Nov 1	83	May 3	155
Dec 1	80	June 1	174
Dec 1	73	June 2	191
Dec 1	63	June 3	206
Jan 1	51	July 1	211
Jan 1	47	July 2	223
Jan 1	54	July 3	249
Feb 1	67	Aug 1	201
Feb 1	75	Aug 2	178
Feb 1	78	Aug 3	156
Mar 1	80	Sep 1	131
Mar 1	80	Sep 2	102
Mar 1	79	Sep 3	76

ANNEXURE II-13

WATER REQUIREMENTS BELOW KALABAGH DAM (POST-ACCORD)

(1000 Cusecs)									
Period	Punjab Indus Canals	Sindhi Canals	NWFP Canals	Balochistan Canals	Kotri Downstream	Total	System Losses	Grand Total	Kalabagh Consultants (Pre-Accord)
Apr 1	25.90	40.20	4.53	2.24	-	72.87	14.57	87.44	75
Apr 2	26.48	41.30	4.20	1.27	-	73.25	14.65	87.90	75
Apr 3	38.00	39.90	3.74	0.40	-	82.01	16.40	98.41	95
May 1	44.20	51.10	3.99	0.68	-	99.97	19.99	119.96	116
May 2	48.70	61.70	4.39	1.84	-	116.63	23.33	139.96	139
May 3	50.50	77.40	4.62	3.24	-	135.76	27.15	162.91	155
June 1	53.40	98.70	5.37	7.64	-	165.11	33.02	198.13	174
June 2	54.50	119.50	5.45	8.64	-	188.09	37.62	225.71	191
June 3	55.20	129.60	5.55	10.03	-	200.38	40.08	240.46	206
July 1	55.30	136.50	4.27	11.69	40.00	247.76	49.55	297.31	211
July 2	49.90	123.10	4.09	11.00	75.00	263.09	52.62	315.71	223
July 3	47.50	115.40	4.03	12.00	100.00	278.93	55.79	334.72	219
Aug 1	47.20	110.10	4.62	11.41	100.00	273.33	54.67	328.00	201
Aug 2	51.00	117.80	4.24	11.43	80.00	264.47	52.89	317.36	178
Aug 3	56.20	107.10	4.62	11.65	50.00	229.57	45.91	275.48	156
Sep 1	56.80	109.20	5.42	11.42	40.00	222.84	44.57	267.41	131
Sep 2	55.80	107.40	5.25	11.98	-	180.43	36.09	216.52	102
Sep 3	54.90	104.90	6.01	12.44	-	178.25	35.65	213.90	76
Oct 1	45.20	79.20	4.94	4.74	-	134.08	-	134.08	38
Oct 2	39.90	62.50	4.97	4.05	-	111.42	-	118.42	43
Oct 3	31.50	50.60	4.01	4.05	-	90.16	-	90.16	56
Nov 1	24.30	45.10	3.87	3.18	-	76.45	-	76.45	74
Nov 2	22.40	42.40	3.24	3.44	-	71.48	-	71.48	82
Nov 3	19.60	40.00	3.64	2.77	-	66.01	-	66.01	83
Dec 1	19.90	39.00	2.19	2.91	-	64.00	-	64.00	80
Dec 2	19.70	38.49	1.96	2.33	-	62.48	-	62.48	73
Dec 3	15.80	32.79	2.00	1.82	-	52.41	-	52.41	53
Jan 1	15.40	20.80	1.84	2.43	-	40.47	-	40.47	51
Jan 2	11.70	24.40	1.82	2.77	-	40.69	-	40.69	47
Jan 3	9.90	37.50	2.07	2.88	-	52.05	-	52.05	54
Feb 1	14.70	42.00	2.52	2.51	-	61.75	-	61.72	67
Feb 2	18.00	37.70	2.93	2.71	-	61.34	-	61.34	55
Feb 3	17.80	37.50	3.81	2.63	-	61.74	-	61.71	78
Mar 1	19.80	36.80	3.92	2.03	-	62.55	-	62.55	80
Mar 2	23.80	37.00	3.86	2.23	-	66.78	-	66.89	80
Mar 3	24.50	35.20	3.66	1.52	-	64.88	-	64.88	89

Note: Additional requirements of Greater Thal, Raineer and Kachhi Flood canals have also to be provided for.

Annexure II-14

SECRET

MINUTES AND DECISIONS OF THE MEETING OF THE COUNCIL OF COMMON INTERESTS HELD AT 12.30 P.M. ON MONDAY THE 16TH SEPTEMBER 1991. IN THE PRIME MINISTER'S SECRETARIAT ISLAMABAD.

Case No. 5/CCI-3/91 Follow-up Actions of the Water Accord

Dated: 16.09.1991

MINUTES

1. 10-Day Average System-wise Allocations

The follow-up actions of the Water Accord required that a system-wise allocation would be worked out on a 10-daily basis and would be attached with the Agreement as its integral part. In order to implement the decision the Provisions were required to furnish the relevant data so that the Accord would be complete in all respects for implementation.

2. Punjab expressed the view that Water Accord was a comprehensive package and it would not be appropriate to take up any one clause in isolation. The data provided in the form of 10-daily system-wise allocations by the provinces should not be taken into account in isolation without protecting the existing uses and deciding on future storages. During the critical periods of Rabi and early or late kharif any increase in the existing level of uses would be possible only after additional storage capacity becomes available. Till then the existing sharing arrangements had to continue during these deficit. periods.

3. In Rabi season, Punjab is presently using about 1 MAF of water more than allocated to it under the Water Accord since this water had been allocated to Frontier Province. In order to compensate for the ultimate loss of this water Punjab would need to improve their canal lining system through a federally financed programme to reduce seepage. An understanding to this effect had been given at the time of signing of the Accord. Punjab had submitted a PC-I to the Federal Government which needed to be examined urgently. Another view was that the scheme in its present shape was not viable as it envisaged the cost of irrigation to be as high as Rs. 15,000 per acre. It was desirable therefore, that it should be revised. It was suggested that the Deputy Chairman, Planning Commission should associate the Chief Engineering Adviser and two representatives of the Government of Punjab to look into the viability of the proposal.

4. Government of Sindh expressed the view that the providing data on 10-Daily average allocations on a system-wise basis was an integral part of the Accord. It would not be appropriate to link other issues such as development of future storages etc. with this provision of the Accord. The Accord should be religiously implemented and there should be openness in dealing with all issues.

5. NWFP pointed out that it would have no difficulty in accepting Annex II provided small discrepancies in the data were corrected. Page 5 of Annex II should be revised accordingly.

6. Balochistan supported the adoption of data in Annex II to complete the Accord.

7. The status of the independent study proposed to be carried out by the international panel of experts to establish minimal escape needs down-stream of Kotri was noted. It was stated that the provincial governments might also be associated with the study at an appropriate stage.

DECISION

I. The Council of Common Interests authorised the 10-Day Seasonal System-wise Adjusted Allocations (excluding flood flows and future storages) provided by the provinces (Annex-II-page 5 as revised) to become part and parcel of the Water Accord.

II. The Council of Common Interests directed that the study proposed to be carried out by International panel of experts to establish minimal escape needs down-stream of Kotri should be completed within one year of the signing of the agreement with the consultants.

III. Dy Chairman, Planning Commission would head a Committee to review the proposal of the Government of Punjab for canal lining. The Secretary, Ministry of Water and Power, Chief Engineering Adviser and representatives of Punjab may be associated.

Annexure II-15

Letter from Indus River authority reproduced below:

INDUS RIVER SYSTEM AUTHORITY
GOVT. OF PAKISTAN

Tel: 2202973
Fax: 9201282.
No: M(F)/IRSA. 521-22

Building R-3, G-7 Markaz,
Sitara Market Islamabad.
Dated: 30.06.2002

Mr. Mirza Hamid Hasan
Secretary.
Ministry of Water & Power Govt. of Pakistan.
Islamabad.

Subject: Apportionment of Water of Indus River System among the Provinces

Ref: (i) Ministry of Water & Power, Govt. of Pakistan letter No. W.I- 25(1)/2002 (IRSA), dated 17.04.2002

(ii) Member (Federal) IRSA letter No. M(F)/IRSA/132-36, dated 06.05.2002

Sir,

In continuation of my letter referred above I hereby submit a copy of the Law Division's views/comments in the matter, received under their No: 913/97-Law (Vol. II) dated 20.05.2002.

Enc/As above

(Nasar Ali Rajput).
Member (Federal)
Indus River System Authority

CC: Chairman IRSA, Islamabad.

No: 943/97-CAW(Vol. III)
Government of Pakistan
Law Justice and Human Rights Division

From Raja Qamar Sultan,
Section Officer.

To Nasar, Al Rajput
Member (Federal)
Indus River System Authority
Building R-3, G-7 Markaz,
Sitara Market Islamabad.

APPORTIONMENT OF INDUS WATER RIVER SYSTEM
BETWEEN THE PROVINCES.

I am directed to refer to your letter No:, M(F)/IRSA. 521-22 dated 6-5-2002 on the above subject.

A copy of this Division's decision/views/comments to the matter is enclosed herewith.

Raja Qamar Sultan
Section Officer

Under Rule 14 of the Rules of Business this Division can be consulted in the matters of interpretation of statutes or the judgments of the Superior Courts. In case of the conflict, of opinion the matter can be referred to the Attorney General of Pakistan. If the controversy is still not resolved the matter can be placed before the Law Minister. Thereafter the case can be referred to the Prime Minister/Chief Executive who may refer the same to the Cabinet if he so desires.

The issue of apportionment of water between the provinces was not a matter requiring the interpretation of my law or judgment. The issue rested to the interpretation of the Water Apportionment Accord of 1991 which has already been ratified on 31.3.1991 by the Council of Common Interest, set up under Article 153 of the Constitution. IRSA being the implementing body of the said Accord had to implement it "until altered,

amended or repealed by the Chief Executive of Pakistan". Hence this Division had no positive role under the Rules of Business to interfere in the inter-provincial controversy.

However, purely for academic purposes of interpretation of the provisions of the Contract/ Accord, this Division tendered the following advice on 16.10.2000:-

"As per plain interpretation of clause 14 of the Accord, the ten daily uses, having become part and parcel of the Accord, shall be adjusted pro-rata for sharing shortages. Any interpretation of sharing shortages on the basis of historic use shall be a violation of the concurrent Accord. Moreover under clause 13 of the Accord, IRSA is responsible for implementation of Accord. Similarly any dispute on the subject should have been referred to the CCI under the Constitution. Hence the formation of any other body or committee or taking any decision or interpretation on such report shall be a distortion of the Accord as well as violation of the Constitution.

However, since the matter has not been referred to the appropriate body i.e., CCI by the aggrieved party, therefore, the existing arrangements as decided by the IRSA, may be allowed to continue till the constitution of, and decision of the CCI."

The Chief Executive Secretarial issued a Directive on 26.10.2000

Stating that:-

"All instructions given on the issue by the Chief Executive regarding, IRSA to be implemented immediately along with the Apportionment of the Water of the Indus River System between the Provinces on 16.03.1991. Moreover Ministerial Water Accord of 1944 to be annulled immediately"

The opinion of this Division dated 16.10.2000 and the said Directive of e Chief Executive Secretariat dated 23.10.2000 were placed before the then Law Minister who approved the proposal that para 2 of the advice dated 16.10.2000 be called and consequently this Division issued a revised note on 16.02.2001 in these Words:-

"In view of the said Directive, regarding apportionment of Water of Indus River System the ministerial award of 1994 is annulled and the Accord of 1991 has to be implemented, the opinion already conveyed by this Division on 16.11.2000 is revised and para 2 thereof is accordingly recalled."

Now the Government of Punjab has made a fresh reference on 09.04.2002 asking this Division to review the earlier opinion by examining clauses 14(n) and 14(6) of the Accord in the light of para 2 of the Preamble thereof.

As stated in para 51/N above, the Rules of Business 1973 provide a hierarchy of authorities for the resolution of conflict in opinion. In this case since the issue has been examined upto the level of the Federal Law Minister as well as the Chief Executive of Pakistan, therefore, this Division can neither re-open nor review the said earlier communications. The matter on only be resolved by the CCI or the Chief Executive of Pakistan.

(Mohammad Raza Khan)
Joint Secretary
25.04.2002

Annexure II-16

Indus River System Authority (IRSA) Study For Technical Committee On Water Resources

**January 13, 2005
Kharif Season**

Period	Actual Average System Uses 1977-82	Accord Allocations Para 2	Shares as per Present Arrangement 14 (b)	(MAF)								
				Availability less 1.0 MAF			Availability less 1.5 MAF			Availability less 2.0 MAF		
				Exercise 1 (1977-82)	Exercise 2 (Para 2)	Exercise 3 14 (b)	Exercise 1 (1977-82)	Exercise 2 (Para 2)	Exercise 3 14 (b)	Exercise 1 (1977-82)	Exercise 2 (Para 2)	Exercise 3 14 (b)
Punjab	34.647	37.070	34.647	39.589	36.575	38.239	39.320	36.327	37.966	39.052	36.079	37.693
Sindh	28.786	33.940	28.786	32.899	33.488	31.771	32.675	33.261	31.544	32.452	33.034	31.317
NWFP (Below Rim)	0.181	0.823	0.823	0.205	0.810	0.823	0.205	0.805	0.823	2.040	0.799	0.823
Balochistan	853.000	2.848	2.848	0.987	2.807	2.848	0.981	2.788	2.848	0.974	2.769	2.848
Total	64.477	74.581	67.104	73.681	73.661	73.681	73.181	73.161	73.181	72.581	72.681	72.881
Exercise 1: Distribution as per 1977-82 Shares with shortages to all provinces.												
Exercise 2: Distribution as per Accord Allocations with shortages to all provinces.												
Exercise 3: Distribution as per present arrangements with shortages to Punjab & Sindh provinces only.												

GOVERNMENT OF PAKISTAN

REPORT OF TECHNICAL COMMITTEE
ON WATER RESOURCES

Including report of seven members of the
Committee with comments of the Chairman

PART-I

Background, Logistics and Procedures

AUGUST 2005

REPORT OF TECHNICAL COMMITTEE ON WATER RESOURCES

**Including report of seven members of the Committee with comments of the
Chairman**

PART-I

Background, Logistics and Procedures

CONTENTS

Letter of Transmittal

1. Announcement
2. Notification of the Technical Committee on Water Resources
3. Logistics for the Technical Committee on Water Resources
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5. Meetings of Parliamentary Committee on Water Resources
6. Studies of river basins and reservoirs in other countries
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8. Consensus on the TORS of the Technical Committee
9. Meetings with the President/Prime Minister and Minister for Water and Power
10. Report of the Technical Committee
11. Extension in time for submission of the Report of the Technical Committee
12. Acknowledgements
13. Annexures I-1 to I-8

No. TC(WR)1(2)Tech/2005/513
Government of Pakistan
Ministry of Water and Power
Technical Committee on Water Resources
State Life Building No.9, 5th Floor (West Wing) Blue Area,

Islamabad, dated 25 August 2005

1. General Pervez Musharraf
President
Islamic Republic of Pakistan
Islamabad

2. Mr. Shaukat Aziz
Prime Minister
Islamic Republic of Pakistan
Islamabad

Subject: Report of Technical Committee on Water Resources

I have the honour to submit herewith the report of the Technical Committee on Water Resources. The report consists of two parts. Part-I of the report relates to the background, logistics and procedures of the Technical Committee. Part-II of the report pertains to examination of the TORs, conclusions and recommendations. The summary of conclusions and recommendations on the TORs has also been prepared as a separate compilation.

As decided in the meeting held by the President of Islamic Republic of Pakistan on 25th May 2005, a report containing the views of the seven members of Technical Committee duly signed by them along with a copy of note of the eighth member of the Technical Committee was provided to me on 9th June 2005. A copy of this report of seven members has been included in the report of the Technical Committee on Water Resources as an attachment. As directed by the President, my comments on the points mentioned in the report of the seven members have also been incorporated in the report of the Technical Committee.

I apologize that consensus could not be reached in the preparation of this report. However, best possible efforts have been put forward to examine the issues involved, for facilitating objective decisions.

I am extremely grateful for your confidence and trust, and continued assistance in the affairs of the Technical Committee.

I dedicate this modest and humble effort to the great Pakistani nation and its future generations.

(A.N.G.Abbasi)
Chairman
Technical Committee on Water Resources

Copy with compliments to Mr. Liaquat Ali Jatoi, Minister for Water and Power, Government of Pakistan, Islamabad.

REPORT OF TECHNICAL COMMITTEE ON WATER RESOURCES

PART-I

Background, Logistics and Procedures

1. Announcement

1.1 On 25th August 2003, the President of Pakistan called a meeting of technocrats and agriculturists from Sindh at Governor's House, Karachi to discuss matters relating to water management and distribution, construction of future reservoirs and irrigation schemes, water availability, outflow to sea etc. While addressing the participants of this meeting, the President announced the appointment of Mr. A. N. G. Abbasi as Chairman of Technical Committee on Water Resources, to examine contentious water issues and submit recommendations to the Federal Government.

1.2 On the directives of the President, Lt. Gen. (Retd) Zulfiqar Ali Khan, the then Chairman, WAPDA, held a meeting with the Chairman designate of Technical Committee on Water Resources (Mr. A. N. G. Abbasi) on 26th August 2003, at WAPDA rest house, Karachi to discuss and decide the Terms of Reference (TORS) for the Committee and other matters related thereto. The TORS and other matters related to the Technical Committee on Water Resources were accordingly decided in this meeting. The then Chairman, WAPDA informed the Chairman designate of Technical Committee that the formal notification for constitution of the Committee, including the TORS and other matters as decided in the meeting will be issued by the Federal Government shortly.

2. Notification of the Technical Committee on Water Resources

2.1 The notification for constitution of the Technical Committee on Water Resources was issued by the Ministry of Water & Power on 15th November 2003 (Annexure I-1), in which the names of the Chairman and the members of Technical Committee on Water Resources and its Terms of Reference (TORS) were notified. This notification was issued after nearly three months from the date on which the President announced the appointment of Chairman of Technical Committee on Water Resources.

2.2 The notification of 15th November 2003, was not in accordance with the decisions taken in the meeting held at Karachi on 26th August 2003, between the then Chairman, WAPDA (Lt. Gen. (Retd) Zulfiqar Ali Khan) and the Chairman designate of Technical Committee on Water Resources (Mr. A.N.G. Abbasi), under instructions of the President of Pakistan. This situation arose because no one had contacted the Chairman-designate since August 2003, till the issue of notification. The Chairman, Technical

Committee on Water Resources therefore submitted a summary (Annexure 1-2), to the President and the Prime Minister of Pakistan, with a copy to the then Minister for Water and Power on 8th December 2003. In this summary the variations and omissions in the notification of 15th November 2003, were pointed out with a request to issue a revised notification accordingly. In pursuance of this request of the Chairman, Technical Committee on Water Resources, a second notification was issued by the Ministry of Water and Power on 11th February 2004 (Annexure I-3). In this notification, two additional Terms of reference were included, four co-opted members of the Technical Committee were appointed and the Secretary of the Technical Committee was also appointed.

3. Logistics for the Technical Committee on Water Resources

Since the Technical Committee on Water Resources was assigned a very important task to be completed in short time, and the announcement about the Committee and appointment of the Chairman designate was made by the President more than five months before issue of formal notifications, it was to be expected that the logistic arrangements etc. for the working of the Technical Committee on Water Resources would have been made before hand to enable it to start functioning right away. However, this was not done. The Chairman and Secretary, Technical Committee on Water Resources who assumed the charge in response to the notification dated 11th February 2004, had therefore to struggle hard for getting minimum requirement of logistics arrangements to enable them to start the work. The proverbial red tape did not spare the Technical Committee and it had to meet hurdles and handicaps at every step in its efforts to arrange accommodation, staff, budget grant etc. It took over three months before the Committee could settle down. In this respect, the Chairman, Technical Committee gratefully acknowledges the assistance of Mr. Saeedullah Jan, former Secretary, Water and Power and Mr. Tariq Hameed, Chairman, WAPDA, in arranging office accommodation, equipment, furniture, vehicles etc.

4. Meetings of Technical Committee on Water Resources

4.1 The first meeting of the Technical Committee on Water Resources was held in the office of the Chief Engineering Adviser/Chairman, Federal Flood Commission on 11th March 2004. Besides the members and co-opted members of Technical Committee the following participants were also invited to attend the meeting and also subsequent meetings of the Committee:

- (i) Senator Nisar A. Memon, Chairman, Parliamentary Committee on Water Resources, Islamabad

- (ii) Secretary, Water and Power, Islamabad

(iii) Additional/Special Secretary, Water and Power, Islamabad

(iv) Chairman, WAPDA, Lahore

In this meeting the basic procedures regarding collection of data from the concerned agencies i.e. Planning and Development Division, WAPDA, IRSA, and Ministry of Water and Power were discussed. In accordance with the decisions taken in this meeting, the co-opted members of Technical Committee on Water Resources namely Secretary, Planning and Development Division, Member (Water), WAPDA, Chairman, IRSA and Chief Engineering Adviser were requested to prepare position-cum-approach papers in respect of the TORS concerning each of them as listed in (Annexure I-4).

4.2 It was also decided in the first meeting that:-

- i. The Water Accord 1991 is sacrosanct and has to be implemented in letter and spirit.
- ii. The basic recorded data of WAPDA shall be acceptable to the Technical Committee on Water Resources.

4.3 The Terms of Reference of the Technical Committee as notified by Government in the two notifications dated 15th November 2003, (Annexure I-1) and 11th February 2004 (Annexure I-3) were consolidated and renumbered as under:-

1. "Review issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the Provinces".
2. "Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages".
3. "Review the progress achieved so far regarding study on escapages below Kotri and recommend measures to expedite the completion of the study".
- 4-a. "Determination of water availability for future reservoirs and irrigation schemes".
- 4-b. "Ascertain actual quantity of water passed downstream Kotri from 1976-2003".
- 5-a. "Examine the filling criteria of Mangla reservoir and make recommendations in this regard".

5-b. "Examination of operational criteria of link canals and future reservoirs".

6. "Complement the Parliamentary Committee on Water Resources in the discharge of its functions".

4.4 In pursuance of the decision taken in the first meeting of the Technical Committee on Water Resources, Member (Water), WAPDA, Chairman, IRSA and Chief Engineering Adviser prepared and sent the position papers to Chairman and the members of the Technical Committee. However, the Planning and Development Division informed that the position papers prepared by WAPDA had been reviewed by Planning and Development Division and they endorsed these papers. Therefore, these papers should be considered as combined papers from WAPDA and Planning and Development Division. Copies of the position papers received from WAPDA, IRSA and Chief Engineering Adviser are placed in the Document Box.

4.5 To continue the deliberations of the Committee, it was decided that the co-opted members concerned will be requested to make presentations to the Technical Committee on Water Resources in respect of each TOR on the basis of the points communicated to them, and that they may also add any more points in the presentations if so desired by them. However, the following TORS were excluded from the presentations, because of reasons indicated against each:-

TOR-3 "Review the progress achieved so far regarding study on escapages below Kotri and recommend measures to expedite the completion of the study"

The position paper already supplied by the Chief Engineering Adviser was considered adequate. It was felt that progress of the three studies could be monitored through monthly progress reports.

TOR-4(b) "Ascertain actual quantity of water passed downstream Kotri from 1976-2003"

The information supplied by WAPDA regarding outflow to sea in post-Tarbela period was based on recorded data and therefore considered acceptable.

TOR-6 "Complement the Parliamentary Committee on Water Resources in the discharge of its functions.

No information, data or presentation is required for this TOR.

4.6 The second meeting of the Technical Committee on Water Resources was fixed for 21st June 2004, for consideration of TOR-4(a) "Determination of water availability for

future reservoirs and irrigation schemes". The Member (Water), WAPDA and Secretary, Planning and Development Division were requested to make the presentations on the points supplied to them, and they also confirmed to make the presentations.

4.7 At the last minute, only two days before the date fixed for the meeting, the Planning and Development Division declined to make the presentation. Efforts were made to persuade them to make the presentation but of no avail. The second meeting of the Technical Committee had therefore to be postponed.

4.8 The Chairman, Technical Committee on Water Resources felt that under the circumstances when the co-opted members concerned are reluctant to make the presentations to the Technical Committee, the Committee could not accomplish its task in an objective manner. Moreover, some of the logistic problems of the Committee, which were hampering smooth working of the Committee still remained unresolved. Under the circumstances the Chairman, Technical Committee on Water Resources submitted his resignation to the President/Prime Minister of Pakistan on 5th July 2004. In the resignation, the Chairman mentioned that it was being submitted due to personal reasons.

4.9 On 7th July 2004, the Chairman, Technical Committee on Water Resources received telephonic call from the President's and Prime Minister's Secretariats, and he was also called for a meeting in the President's house. After discussions, the President's Secretariat issued a letter that the resignation tendered by the Chairman, Technical Committee on Water Resources may be treated as withdrawn. Directives were also issued from the President's Secretariat on 16th July 2004, and from the Prime Minister's Secretariat on 17th July 2004, to the effect that the Planning and Development Division should make presentation to the Technical Committee and that the genuine problems of the Chairman, Technical Committee on Water Resources should be resolved accordingly.

4.10 In pursuance of the directives issued by the President's Secretariat and Prime Minister's Secretariat, the concerned agencies initiated necessary action for resolving the problems being faced by the Technical Committee. During the period, while action was being taken on the directives of President's and Prime Minister's Secretariats, the Chairman, Technical Committee was forced by circumstances to proceed on leave from 9th July to 15th August 2004, due to serious illness, hospitalization and subsequent death of his wife.

4.11 The Planning and Development Division agreed to make the presentation to the Technical Committee, in response to the directives of the President's and Prime Minister's Secretariats. The second meeting of the Technical Committee on Water Resources was thereafter re-fixed on 4th September 2004, for presentations and

consideration of TOR-4(a) "Determination of water availability for future reservoirs and irrigation schemes".

4.12 The presentations on the TORS and their consideration were continued in the subsequent meetings of the Technical Committee on Water Resources held on the dates given below:-

- i. Third meeting on 27th and 28th September 2004
- ii. Fourth meeting on 13th and 14th October 2004
- iii. Fifth meeting held from 22nd to 27th November 2004
- iv. Sixth meeting from 20th to 22nd December 2004
- v. Seventh meeting from 11th to 13th January 2005
- vi. Eighth meeting from 1st to 3rd February 2005

The details of the matters discussed in all the eight meetings of the Technical Committee are given in (Annexure I-5).

4.13 The proceedings of all the eight meetings of Technical Committee are placed in the Document Box. The copies of the documents provided during the meetings on each TOR, i.e. copies of presentations, written comments, rejoinders etc. are also placed in the Document Box.

5. Meetings of Parliamentary Committee on Water Resources

5.1 The Chairman, Technical Committee on Water Resources (TCWR) attended the meetings of the Parliamentary Committee on Water Resources (PCWR), on the invitation of the Chairman, PCWR. However, some members of the Technical Committee objected to the participation of Chairman, Technical Committee in the meetings of the Parliamentary Committee.

5.2 During the proceedings of the Parliamentary Committee, the Chairman and members of the Parliamentary Committee and representatives of provinces attending the meetings of the Parliamentary Committee requested the Chairman, Technical Committee to start consideration of TOR relating to Water Availability, being important, on priority basis, which was agreed by the Chairman, Technical Committee.

5.3 The report of the Parliamentary Committee on Water Resources has since been submitted to Government. However, a copy of the report has not been supplied to the

Chairman, Technical Committee inspite of personal requests. It would have been helpful to the Technical Committee, if a copy of the report was made available.

6. Studies of river basins and reservoirs in other countries

6.1 During discussions in the meetings of the Technical Committee on Water Resources, some of the members frequently mentioned the examples of other countries particularly USA, Egypt, China and Australia, regarding the storage reservoirs built in those countries. In response to this, the Chairman, Technical Committee observed that it would be appropriate to have a detailed study of some of the river basins in other countries to properly evaluate those models so as to provide guidance for planning and management of water resources in Pakistan. He observed that without knowing the important aspects of water resource planning and management in contemporary world, we are like a frog in a well. The Chairman suggested that a visit to some of the countries mentioned by the members could be useful. However, some of the members of the Technical Committee, who themselves had given examples of other countries, during the deliberations of the Technical Committee, vehemently opposed this idea because they felt it will delay the report of Technical Committee. Under the circumstances, the Chairman did not deem it appropriate to follow up this proposal.

6.2 The Chairman visited WAPDA headquarters in September 2004, and tried to obtain some books, documents and material about river basin management, development and reservoir planning, construction and operation in some countries, but could not get any relevant information or assistance.

7. Visit to Provinces

In the initial stages of the deliberations of the Technical Committee, it was felt that it would be useful for the members of the Committee to visit the provinces at appropriate stage to get the feedback from the Provincial Governments agriculturists and technocrats regarding matters being examined by the Technical Committee. However, it was realized that most of the members of Technical Committee were not interested in such visits.

8. Consensus on the TORS of the Technical Committee

As the deliberation on the TORS of the Technical Committee progressed, it became apparent that consensus could not be reached. Most of the members wanted to hurry through the proceedings of the Technical Committee, without proper examinations of the issues and the related material, facts and figures. Some of the members even suggested to submit a one page report to the President. The Chairman, Technical Committee did not agree with this approach and suggested that we should move as fast

as possible, but ensure that a quality report is submitted to Government after proper examination of the important issues involved.

9. Meetings with the President/Prime Minister and Minister for Water and Power

9.1 The President of Pakistan called the Chairman, Technical Committee on Water Resources, for a meeting on 11th November 2004. The Chairman met the President and reported to him the progress of the work of the Technical Committee and the difficulties/problems etc. The Chairman also brought to the kind notice of the President that it appears from the proceedings of the Technical Committee held so far that consensus on the TORS could not be reached. The Chairman also informed the President that some members wanted to hurry through the proceedings of the Committee, and have even suggested submission of one page report, but the Chairman, did not agree to this approach of the members. The President was very kind and considerate and assured the Chairman of his continued assistance and support. The President directed the Chairman to continue the work of the Technical Committee in best possible manner.

9.2 The Chairman, Technical Committee on Water Resources also met the Prime Minister of Pakistan on 22nd December 2004, and briefed him about the working of the Technical Committee. The Chairman also informed the Prime Minister that it appeared that no consensus would be reached on the TORS of the Committee. He also informed the Prime Minister about the attitude of some members to hurry through the proceedings and submit one page report. The Prime Minister was kind enough to assure the Chairman of his full cooperation and support. He advised the Chairman to continue work as best as possible under these circumstances.

9.3 The President of Pakistan called another meeting with the Chairman and all the members of the Technical Committee, on 14th January 2005. The Minister for Water and Power and Deputy Chairman, Planning Commission also attended this meeting. The President heard the views of all the members and the Chairman, Technical Committee. He was also briefed about the proceedings of the Technical Committee and informed that the presentations and deliberations on almost all TORS had been completed and those on the remaining TORS will be completed in the next meeting of the Technical Committee to be held from 1st to 3rd February 2005.

10. Report of the Technical Committee

10.1 In the above meeting with the President on 14th January 2005, some views were expressed by a member of Technical Committee about the writing of the report of the Committee, on which the Chairman, Technical Committee also gave his comments. It however, became clear from the discussions in the meeting that consensus amongst the Chairman and some of the members of the Technical Committee could not be reached

and therefore, it would not be possible to prepare a report reflecting unanimity of views. This position was also brought to the notice of the President and the Prime Minister by the Chairman, Technical Committee on Water Resources in his earlier meetings with them. The President therefore directed the Minister for Water and Power to resolve the matter regarding writing of the report by the Technical Committee on Water Resources.

10.2 The Minister for Water and Power held a meeting with the Chairman, Technical Committee on Water Resources on 11th February 2005. He advised the Chairman, Technical Committee that as discussed in the meeting held at President's House on 14th January 2005, he may get the views of all the members of Technical Committee and include them in the report of the Technical Committee alongwith his comments and submit the same for consideration of Government. In this respect, copy of D.O. letter dated 11th February 2005, from the Minister for Water and Power to the Chairman, Technical Committee on Water Resources is enclosed as (Annexure I-6). As suggested by the Minister for Water and Power, the members of the Technical Committee on Water Resources were requested vide letter dated 14th February 2005, that if the members like to highlight any views already expressed in the meetings of the Technical Committee or through letters, or wish to record any further views on the TORS of the Technical Committee, the same may be communicated to the Secretariat of the Committee.

10.3 In response to the above request of the Secretariat of Technical Committee, the replies of six members were received. The replies of two members from Balochistan i.e. Mr. Abdur Razik Khan and Mr. Muhammad Azam Baloch were not received. None of the members has furnished any additional views than those already expressed during the meetings of the Technical Committee which are already available on record. However, two of the six members i.e. Mr. Shams-ul-Mulk and Mr. Mazhar Ali have, in their replies made some observations about writing of the report of the Technical Committee by the Chairman. These two members also endorsed the copies of their letters to the Chief of Staff to the President and Secretary, Ministry of Water and Power.

10.4 The Ministry of Water Power asked for some clarifications from the Chairman, Technical Committee on Water Resources about the points raised in the letters of the two members. The Chairman informed the Ministry that the letter dated 14th February 2005, was written to the members of the Technical Committee for getting their views on the TORS for incorporating the same in the report of Technical Committee alongwith the comments of the Chairman, as advised by the Minister for Water and Power in his D.O. letter dated 11th February 2005. The Ministry of Water and Power responded vide their U.O. letter No. PA/JS (W)/Misc/2005 dated 28.2.2005 signed by Joint Secretary, Water and Power that "It is advised that after inclusion of the views of all members, the report of the Committee should be jointly signed and submitted at the earliest". This U.O. letter of the Joint Secretary was contradictory to the D.O. letter of the Minister for

Water and Power dated 11th February 2005, and it was written in the absence of the Minister for Water and Power while he was on tour abroad. Moreover this U.O. letter could not be acted upon because the report of Chairman, Technical Committee including his comments on the views of members could not be sent to the members for their signature.

10.5 The above position was brought to the notice of Minister for Water and Power by the Chairman, Technical Committee in telephonic talk with him at London on 28th February 2005. The Minister assured that the matter will be resolved soon after his return to Islamabad. On his return to Islamabad, the Minister for Water and Power held a meeting with the Chairman, Technical Committee and Secretary and Special Secretary, Water and Power on 10th March 2005. In this meeting it was decided that the letter issued by the Joint Secretary on 28th February 2005, would be withdrawn. It was assured by the Special Secretary, Water and Power that the withdrawal letter would be issued by 11th March 2005.

10.6 The withdrawal letter was not issued on 11th March 2005, as decided in the meeting on 10th March 2005. On enquiry from the Special Secretary, Water and Power, it was informed that some difficulties had arisen and therefore there will be some delay in the issue of the withdrawal letter, although no such difficulty was pointed out in the meeting held by the Minister on 10th March 2005.

10.7 The letter was not withdrawn inspite of repeated telephonic requests and therefore the work of drafting the report remained held up. Under the circumstances, the Chairman, Technical Committee addressed a D.O. letter to Minister for Water and Power on 24th March 2004, and also requested him on telephone to expedite issue of withdrawal letter. As there was no response to this D.O. letter and it was being stated that there are certain difficulties, another D.O. letter was addressed by the Chairman, Technical Committee on Water Resources to the Minister for Water and Power on 21st April 2005. Also, the Secretary, Special Secretary, and the Minister for Water and Power were repeatedly reminded on telephone, but with no result.

10.8 As the dormant situation continued for over two months and the work of drafting the report of the Technical Committee could not make any progress, the Chairman, Technical Committee submitted his resignation to the President and Prime Minister of Pakistan on 10th May 2005. To this, minister for Water and Power responded by making a telephonic call to the Chairman, Technical Committee, informing him that the President of Pakistan will soon hold a meeting to resolve the issue.

10.9 The President of Pakistan kindly held the meeting at President's House on 25th May 2005, which was also attended by the Minister for Water and Power, the Chief of Staff to the President and the Secretary to the President. The President was kind enough to hold a detailed discussions in this meeting, followed by discussions by Chief of Staff

and Secretary to the President with the Minister for Water and Power and Chairman, Technical Committee. After these discussions, it was decided that:-

- i. Resignation tendered by the Chairman, Technical Committee on Water Resources may be treated as withdrawn.
- ii. The Ministry of Water and Power will withdraw the letter of the Joint Secretary dated 28th February 2005, immediately.
- iii. The date of submission of report of Technical Committee will be extended upto 31st August 2005.
- iv. A report containing the views of the members of Technical Committee duly signed by them will be sent to the Chairman, Technical Committee for incorporating the same in the report of Technical Committee on Water Resources alongwith his comments.

10.10 Pursuant to the above decisions, the letter of Joint Secretary, Ministry of Water and Power dated 28th February 2005, has been withdrawn on 26th May 2005. The date for submission of the report of the Technical Committee has also been extended upto 31st August 2005. The signed report by the seven members of Technical Committee on Water Resources alongwith a signed note of eighth member of Technical Committee on Water Resources was handed over by the Minister for Water and Power to the Chairman, Technical Committee on 9th June 2005. A copy of this report is being enclosed as an attachment to this report.

10.11 No letter of transmittal has been written for the report of the seven members. Moreover, it is mentioned at page 4 of the Elaborations of the report of seven members that " In April 2005, the report of the Technical Committee on Water Resources was submitted to the appropriate quarters". It is not known to which "appropriate quarters" this report of April 2005, was submitted. A copy of this report of April 2005, has not been supplied to the Chairman, Technical Committee on Water Resources. A separate note signed by the eighth member of the Technical Committee i.e. Mr. Sardar Ahmad Mughal, has been appended to the report of the seven members. This note contains the views of Mr. Sardar Ahmad Mughal in respect of only one TOR i.e. TOR-2 "Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages". It is not known whether the entire report of the seven members was shown and discussed with Mr. Sardar Ahmad Mughal and his views on all the points mentioned in the report were taken.

10.12 It is mentioned at page 4 of the Elaborations of the report of seven members of Technical Committee that "the eighth meeting of the Technical Committee held from

February 1-3, 2005 was intended to finalize the report and recommendations but remained in-conclusive. It also happened to be the last meeting called by the Chairman. Notwithstanding the suggestion by the majority of Committee members that drafting and finalization of the report be entrusted to sub-committee, the Chairman, observed that he would write the report himself independently and submit it directly to the competent authority without the knowledge of the members".

10.13 The above statement of the seven members is far from truth. According to the agenda of the eighth meeting of Technical Committee circulated to the members the following items were to be taken up in this meeting:-

Tuesday, 1st February 2005

(i) Confirmation of the minutes of the first and second Sessions of the seventh meeting of Technical Committee (sessions held on 11th and 12th January 2005).

(ii) Discussions with Secretary, Planning and Development Division and Member (Water) WAPDA on TOR-2 "Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages", in the light of presentations, earlier discussions, observations by members and responses by WAPDA.

Wednesday, 2nd February 2005

(i) Confirmation of the minutes of third session of the seventh meeting of Technical Committee (session held on 13th January 2005).

(ii) Discussions with Chairman, IRSA on TOR-1 "Review issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the Provinces", in the light of presentation, earlier discussions, observations by members and responses by IRSA.

Thursday, 3rd February 2005 (For members only)

Discussions on TOR-2 and TOR-1 in the light of presentations made, observations by members and discussions in earlier meetings.

10.13 The proceedings of the Technical Committee were held strictly in accordance with the agenda. None of the members of the Technical Committee requested before or during the three sessions of the meeting to take up any other item for discussion. The minutes of the eighth meeting were also issued and circulated to all the members on

12th February 2005. However, no correction to the minutes of the meeting mentioning discussions about the report of the Technical Committee was pointed out by any of the members.

10.14 It is however, correct that after the conclusion of the last session of the meeting of the Technical Committee on 3rd February 2005, Mr. Shams-ul-Mulk raised a point about writing of the report of the Committee. To this point of Mr. Shams-ul-Mulk the Chairman, Technical Committee responded by stating that Mr. Shams-ul-Mulk himself raised the point of writing of report in the meeting held by the President of Pakistan on 14th January 2005, on which the Chairman, Technical Committee had also given his views. After hearing the views, the President had decided that the matter regarding writing of report will be resolved by the Minister for Water and Power. The Chairman, Technical Committee therefore, informed Mr. Shams-ul-Mulk that further action for writing the report will be taken in accordance with the instructions given by the President on 14th January 2005, and further decision by the Minister for Water and Power, as directed by the President.

10.15 Since this point was raised by Mr. Shams-ul-Mulk on 3rd February 2005, after the conclusion of the meeting of the Technical Committee, it was not included in the minutes of the meeting. Neither Mr. Shams-ul-Mulk nor any other member requested for inclusion of this point in the minutes, when the minutes were issued and supplied to the members. It is therefore not proper to raise the point now in the report of seven members.

10.16 The Chairman, TCWR has gone through the report of seven members thoroughly. Before going through the report, the Chairman, Technical Committee expected that it would be possible for him to agree with the views of the members and endorse the report. But after detailed study of the report, the Chairman regrets his inability to do so. The Chairman, Technical Committee has therefore incorporated the views of the seven members alongwith his comments on each TOR in Part-II of this report. This is in accordance with the decisions taken in the meeting held by the President on 25th May 2005.

11. Extension in time for submission of the Report of the Technical Committee

11.1 According to Government of Pakistan, Ministry of Water and Power notification No.W. III-1 (1) 2002-Vol. IV dated 11th February 2004 (Annexure I-3), the Technical Committee on Water Resources was required to submit its report within one year. The date of submission of the report was extended upto June 30 2005, vide Government of Pakistan, Ministry of Water and Power notification No. W.III-1 (1) 2002 - Vol. IV dated 7th April 2005 (Annexure I-7). Finally, as decided in the meeting held at the President's House on 25th May 2005, the date for submission of the report of the Technical Committee has been extended upto 31st August 2005, vide Government of Pakistan,

Ministry of Water and Power letter No. A-II-TC/WR/04-02 dated 6th June 2005 (Annexure I-8).

12. Acknowledgements

12.1 The Chairman, Technical Committee on Water Resources would like to place on record the valuable contribution made by Mr. Sardar Ahmad Mughal, member Technical Committee on Water Resources who took keen interest in the deliberations of the Technical Committee. Mr. Mughal not only took active part in the discussions, but also submitted his written comments on each presentation, and on receipt of responses from the agencies concerned (WAPDA and IRSA), he also submitted rejoinders to these responses. The Chairman, Technical Committee also wishes to place on record his appreciation of the contribution of all other members of the Technical Committee, and the assistance provided by the four co-opted Members namely, Secretary, Planning and Development Division, Member (Water) WAPDA, Chairman, IRSA and Chief Engineering Adviser. Further, the Chairman also acknowledges with gratitude the participation of Senator Nisar A. Memon, Chairman, Parliamentary Committee on Water Resources, Secretary, Water and Power, Special Secretary, Water and Power and Chairman, WAPDA in the meetings of the Technical Committee. The Chairman also wishes to record his appreciation of the assistance and help provided by Mr. Mohsin Hafiz, Secretary to the President in the matters relating to the affairs of the Technical Committee. The Chairman also acknowledges the valuable services rendered by Mr. Ghulam Sarwar Khichi, Secretary, Technical Committee on Water Resources, who not only assisted in ably conducting the proceedings of the Technical Committee, but also helped in making the logistic arrangements, and also in the compilation of this report. The Chairman also acknowledges the contribution of his Private Secretary, Mr. Muhammad Tufail and other members of the staff of the Technical Committee who worked with dedication and zeal in the performance of their duties.

REPORT OF TECHNICAL COMMITTEE ON WATER RESOURCES

PART-I

Background, Logistics and Procedures

LIST OF ANNEXURES

- I-1. Notification by Ministry of Water and Power, dated November 15, 2003
- I-2. Summary submitted by Chairman, Technical Committee on Water Resources to the President and the Prime Minister of Pakistan
- I-3. Notification by Ministry of Water and Power, dated 11th February 2004
- I-4. Preparation of Position-Cum-Approach papers, on TORS by co-opted members
- I-5. Meetings of Technical Committee on Water Resources, indicating dates and matters discussed
- I-6. D.O letter dated February 11, 2005 of Minister for Water and Power
- I-7. Notification by Ministry of Water and Power, dated April 7, 2005
- I-8. Letter dated June 06, 2005 of Ministry of Water and Power

ANNEXURE I-1

GAZETTE OF PAKISTAN PART-I
Government of Pakistan
Ministry of Water and Power

Islamabad November 15, 2003

NOTIFICATION

No.W.III-1(1)2002-Vol-IV. The following Technical Committee on water resources has been constituted in pursuance of the directive of the President of Pakistan:

Mr. A.N.G. Abbasi Ex-Minister Irrigation, Province of Sindh	Chairman
--	----------

SINDH

1. Dr. Iqbal Ali Chief Design Engineer, Sehwan Barrage Complex, Karachi.	Member
2. Mr. Sardar Ahmad Mughal Ex-Chief Engineer, Irrigation and Power Department	Member

PUNJAB

1. Mr. Mazhar Ali, Adviser Irrigation Department	Member
2. Mr. Mehmood-ul-Hassan Siddiqui Consultant Irrigation Department	Member

NWFP

1. Mr. Shams-ul-Mulk, Ex-Minister Irrigation, NWFP	Member
2. Sardar Muhammad Tariq Pakistan Water Partnership (PWP)	Member

BALUCHISTAN

1. Mr. Abdul Razzak Khan Ex-Secretary	Member
--	--------

Irrigation and Power Department

2. Mr. Muhammad Azam Baloach
Ex-Secretary,
Irrigation and Power Department

Member

Secretary

(To be notified later)

2. The Terms of Reference of the Committee are attached as Annexure-I.

(Rashid Ali)
Deputy Secretary (W)

The Manager,
Printing Corporation of Pakistan Press,
Islamabad.

Distribution:

1. Mr. A.N.G. Abbasi
C/o Secretary, Irrigation & Power Department,
Government of Sindh, Karachi.

2. Dr. Iqbal Ali
C/o Secretary, Irrigation & Power Department,
Government of Sindh, Karachi.

3. Mr. Sardar Ahmad Mughal
C/o Secretary, Irrigation & Power Department,
Government of Sindh, Karachi

4. Mr. Mazhar Ali,
Irrigation & Power Department,
Government of Punjab, Lahore

5. Mr. Mchmood-ul-Hassan Siddiqui
Irrigation & Power Department,
Government of Punjab, Lahore

6. Mr. Shams-ul-Mulk,
Ex-Minister Irrigation, NWFP,
II.No. 12, St.42, F-7/1, Islamabad.
(Mobile No. 0333-5218688) Phone No. 2651354

7. Sardar Muhammad Tariq
Pakistan Water Partnership (PWP),
638 WAPDA House, the Mall, Lahore.
Phone No. 042-9202226 (Fax No. 042-9202485)

8. Mr. Abdul Razzak Khan
C/o Secretary, Irrigation & Power Department,
Government of Balochistan, Quetta.

9. Mr. Muhammad Azam Baloach
C/o Secretary, Irrigation & Power Department,
Government of Balochistan, Quetta.

(Rashid Ali)
Deputy Secretary(W)

CC:

1. Chairman, Parliamentary Committee on Water Resources,
(Senator Nisar Ahmed Memon), Parliament House, Islamabad.
2. Chief Secretary, Government of Punjab, Lahore.
3. Chief Secretary, Government of Sindh, Karachi.
4. Chief Secretary, Government of NWFP, Peshawar.
5. Chief Secretary, Government of Balochistan, Quetta.
6. Chairman WAPDA, WAPDA House, Lahore.
7. Prime Minister's Secretariat (Mr. Ajaz Mohiuddin, Joint Secretary (E-II), Islamabad.
8. President Secretariat (Public), (Brig Syed Muhammad Owais), Islamabad.
9. Deputy Secretary (C-I), (Mr. Sikandar Ismail Khan),
National Assembly Secretariat, Islamabad.
10. PS to Minister for Water and Power.
11. PS to Secretary, Water and Power.

Terms of Reference

1. Review issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the Provinces.
2. Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages.
3. Reviews the progress achieved so far regarding study on escapages below Kotri and recommend measures to expedite the completion of the study.
4. a) Determination of water availability for future reservoirs and irrigation schemes.
b) Ascertain actual quantity of water passed downstream Kotri from 1976-2003.
5. a) Examine the filling criteria of Mangla reservoir and make recommendations in this regard.
b) Examination of operational criteria of link canals and future reservoirs.
6. Complement the Parliamentary Committee on Water Resources in the discharge of its functions.
7. The Committee shall submit its report/recommendations within one year.

Annexure I-2

SUMMARY FOR THE PRESIDENT/PRIME MINISTER

Subject: Technical Committee on Water Resources

On 25th August 2003, the President called a meeting of technocrats and agriculturists from Sindh at Governor's House, Karachi to discuss matters relating to water management and distribution, construction of future reservoirs and irrigation schemes, water availability, outflow to sea etc. While addressing the participants, the President announced the appointment of A.N.G. Abbasi as Chairman of the Technical Committee to examine the contentious water issues and submit recommendations to the Federal Government.

2, On the directives of the President, Lt. Gen. (rtd.) Zulfiqar Ali Khan, the then Chairman WAPDA, held a meeting with the Chairman designate of the Technical Committee (A.N.G. Abbasi) on 26th August 2003 at WAPDA rest house, Karachi to discuss and decide the Terms of Reference (TOR) for the Committee and other matters related thereto. A copy of the TOR and other matters decided in the meeting is enclosed as Annexure I. Most of the points mentioned in the Annexure I were proposed by the Chairman, WAPDA himself and agreed to by me.

3, A notification has now been issued by the Ministry of Water and Power on 15th November, 2003 in which the names of the Chairman and Members of the Committee and its Terms of Reference (TOR) have been notified. A copy of this notification is enclosed as Annexure II. This notification has been issued after nearly three months from the date on which the President announced the appointment of the Chairman of Technical Committee.

4, Neither Chairman, WAPDA, nor any one from the Ministry of Water and Power contacted me (Chairman-designate) during this period. It was therefore presumed that the TOR and other matters decided in the meeting held by Chairman, WAPDA with me (Chairman-designate) on 26th August, 2003 at Karachi, would have been approved by the competent authority, because if any changes were to be made, the concerned Ministry should have consulted me before issue of the notification. However a perusal of notification issued on 15th November, 2003 by the Ministry of Water and Power (Annexure II) indicates the following variations :-

(i), It has not been mentioned in the notification that the Chairman would be full-time and the members part-time. More over 8 members of the Committee have

been notified instead of four decided in the meeting held on 26th August 2003. Also the four co-opted members have not been notified.

(ii), The terms of reference as notified are not complete and comprehensive in accordance with the decisions taken in the meeting of 26th August 2003. The following points seem to have been either inadvertently omitted, or not mentioned in proper context:-

(a), Determination of water availability for future reservoirs and irrigation schemes has been omitted from the notified TOR;

(b), Whereas filling criteria for Mangla reservoir have been included in the notified TOR, but the operational criteria of other reservoirs and Indus Link Canals, which are an integral part of the system have not been mentioned. Moreover the operational criteria of future reservoirs have also not been mentioned (These criteria have to be as far as possible similar to the recommended criteria for the existing reservoirs);

(c), Review of progress of study on escapages below Kotri Barrage has been mentioned in the notified TOR of the Technical Committee. However nothing has been indicated about approval of the TOR by the Technical Committee, for the proposed study downstream Kotri Barrage which has been pending for 10 years.

(iii), Other matters related to the Technical Committee viz. logistics, budget, status of the Chairman, appointment of the Secretary etc, as decided in the meeting held by the Chairman WAPDA with the Chairman-designate Technical Committee on 26th August 2003 (Annexure I) have not been notified at all.

(iv), A time period of only six months has been allowed for submission of the report of the Committee, which is too tight, considering that the issue of notification has taken nearly three months, and that the job to be done requires lot of efforts to collect and analyze the data, meet and discuss matters with concerned persons/agencies etc.. The time period may therefore may be extended to at least one year.

5, In consideration of the above, it is proposed that:-

(i), The membership of the Committee though different from the agreed pattern may be allowed to remain unchanged to avoid embarrassment. However it may be notified that Chairman will be full-time and members part-time. Also the four co-opted members as indicated in the Annexure I may be notified,

(ii), Terms of Reference (TOR) may be modified and other matters relating to the Technical Committee may be notified as decided in the meeting held on 26th August 2003 by Chairman WAPDA with the Chairman Technical Committee, under instructions of the President of Pakistan (Annexure I).

(iii), The time period for submission of the report/recommendations may be extended to one year.

(iv), The provision regarding complementing the work of Parliamentary Committee may be retained.

6(i), It will be extremely difficult for the Technical Committee to start its work without the logistics and without complete and comprehensive TOR. The President/Prime Minister may therefore kindly approve the proposals in para 5 above and direct the Ministry of Water and Power to issue revised notification (s) accordingly, so that the Committee may be able to start its work.

The Ministry of Water and Power may also advise all concerned agencies in the Federal and Provincial Governments to assist the Committee in its work and provide full facilities, data/records etc.

(ii), If considered appropriate, the President/Prime Minister may kindly call me for discussions on the subject at any time convenient to them.

Address :-
71/1, 3rd. Street,
Off Khayaban-e-Badar,
DHA Phase VI, Karachi.
Telephone: 021/5845804

(A.N.G. Abbasi)
Chairman
Technical Committee on Water Resources

President (Through COS to President);

Prime Minister (Through Principal Secretary to Prime Minister);

Copy with regards and compliments to Mr. Aftab Ahmad Khan Sherpao, Minister for Water and Power Govt. of Pakistan, Islamabad.

ANNEXURE I

Matters Relating To Technical Committee on Water Resources as decided in the Meeting Held under the Instructions of President of Pakistan at Wapda Rest House, Karachi on 26th August 2003, Between Lt. Gen.(RTD.) Zulfiqar Ali Khan, Chairman Wapda And Mr. A.N.G. Abbasi, Chairman Designate of Technical Committee.

A. MEMBERSHIP

1, The Technical Committee will consist of a full-time Chairman and the following part time members:-

(i), One technical member from each province to be nominated by the President/Prime Minister on the recommendations of the Chairman, Technical Committee from amongst a panel of three persons proposed by each Province. (ii), The following co-opted members to assist the Technical Committee when ever invited by the Chairman:

(a), The Secretary, Planning Division, Govt. of Pakistan, Islamabad;

(b), Chief Engineering Advisor, Ministry of Water & Power, Govt. of Pakistan, Islamabad;

(c), Chairman, IRSA, Islamabad;

(d), Member (Water), WAPDA, Lahore.

B. TERMS OF REFERENCE

The Technical Committee will have the following Terms of Reference (TOR):

(i), To review the issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the Provinces;

(ii), To determine the water availability for future development projects, i.e. future reservoirs and irrigation schemes;

(iii), To assess the viability of construction of future dams/reservoirs and irrigation schemes in consideration of water availability, also keeping in view the silting of reservoirs, and also recommend sequencing of the future storages;

(iv), To finalize the TOR for study for outflow to sea and recommend measures to expedite completion of the study;

(v), Examine operational criteria for existing reservoirs and Indus Link Canals and make recommendations so that these operations do not create shortages in lower riparian provinces. Further, to make recommendations for adoption of similar criteria for future reservoirs.

C, OTHER MATTERS

(i), The Chairman will have the status of Federal Minister. He will report to the Prime Minister/President;

(ii), An adhoc allocation of Rs.5.0 million will be released to the Technical Committee;

(iii), The logistic support to the Technical Committee will be provided by the Ministry of Water & Power;

(iv), Mr. Ghulam Sarwar Khichi, retired Joint Secretary to Govt. of Pakistan will be appointed as Secretary of the Technical Committee. His address and telephone numbers are given below:-

A-9, Block A,
KDA Officers' Co-operative Housing Society,
near National Stadium, Karachi.
Telephone: 021/4824509 & 4989834; Mobile: 0320-5052829;

(v), The concerned agencies of Federal/Provincial Govt. will be advised to provide all assistance and facilities to the Committee.

GAZETTE OF PAKISTAN PART-I
Government of Pakistan
Ministry of Water and Power

Islamabad November 15, 2003

NOTIFICATION

No.W.III-1(1)2002-Vol-IV. The following Technical Committee on water resources has been constituted in pursuance of the directive of the President of Pakistan:

Mr. A.N.G. Abbasi
Ex-Minister Irrigation, Province of Sindh

Chairman

SINDH

1. Dr. Iqbal Ali
Chief Design Engineer,
Sehwan Barrage Complex, Karachi.

Member

2. Mr. Sardar Ahmad Mughal
Ex-Chief Engineer,
Irrigation and Power Department

Member

PUNJAB

1. Mr. Mazhar Ali,
Adviser Irrigation Department

Member

2. Mr. Mehmood-ul-Hassan Siddiqui
Consultant Irrigation Department

Member

NWFP

1. Mr. Shams-ul-Mulk,
Ex-Minister Irrigation, NWFP

Member

2. Sardar Muhammad Tariq
Pakistan Water Partnership (PWP)

Member

BALUCHISTAN

1. Mr. Abdul Razzak Khan
Ex-Secretary
Irrigation and Power Department

Member

2. Mr. Muhammad Azam Baloach
Ex-Secretary,
Irrigation and Power Department

Member

Secretary

(To be notified later)

2. The Terms of Reference of the Committee are attached as Annexure-I.

(Rashid Ali)
Deputy Secretary (W)

The Manager,
Printing Corporation of Pakistan Press,
Islamabad.

Distribution:

1. Mr. A.N.G. Abbasi
C/o Secretary, Irrigation & Power Department,
Government of Sindh, Karachi.

2. Dr. Iqbal Ali
C/o Secretary, Irrigation & Power Department,
Government of Sindh, Karachi.

3. Mr. Sardar Ahmad Mughal
C/o Secretary, Irrigation & Power Department,
Government of Sindh, Karachi

4. Mr. Mazhar Ali,
Irrigation & Power Department,
Government of Punjab, Lahore

5. Mr. Mchmood-ul-Hassan Siddiqui
Irrigation & Power Department,
Government of Punjab, Lahore

6. Mr. Shams-ul-Mulk,
Ex-Minister Irrigation, NWFP,
II.No. 12, St.42, F-7/1, Islamabad.
(Mobile No. 0333-5218688) Phone No. 2651354

7. Sardar Muhammad Tariq

Pakistan Water Partnership (PWP),
638 WAPDA House, the Mall, Lahore.
Phone No. 042-9202226 (Fax No. 042-9202485)

8. Mr. Abdul Razzak Khan
C/o Secretary, Irrigation & Power Department,
Government of Balochistan, Quetta.

9. Mr. Muhammad Azam Baloach
C/o Secretary, Irrigation & Power Department,
Government of Balochistan, Quetta.

(Rashid Ali)
Deputy Secretary(W)

CC:

1. Chairman, Parliamentary Committee on Water Resources,
(Senator Nisar Ahmed Memon), Parliament House, Islamabad.
2. Chief Secretary, Government of Punjab, Lahore.
3. Chief Secretary, Government of Sindh, Karachi.
4. Chief Secretary, Government of NWFP, Peshawar.
5. Chief Secretary, Government of Balochistan, Quetta.
6. Chairman WAPDA, WAPDA House, Lahore.
7. Prime Minister's Secretariat (Mr. Ajaz Mohiuddin, Joint Secretary (E-II), Islamabad.
8. President Secretariat (Public), (Brig Syed Muhammad Owais), Islamabad.
9. Deputy Secretary (C-I), (Mr. Sikandar Ismail Khan),
National Assembly Secretariat, Islamabad.
10. PS to Minister for Water and Power.
11. PS to Secretary, Water and Power.

ANNEXURE I-3

TO BE PUBLISHED IN THE GAZETTE OF PAKISTAN PART-I

Government of Pakistan Ministry of Water and Power
Islamabad: 11th February 2004.

NOTIFICATION

No. WIII-1(1)/2002-Vol. IV: In partial supersession of this Ministry's notification of even number dated November 15, 2003, the following modifications are approved in the public interest with immediate effect.

1. The Committee may co-opt Secretary, Planning & Development, Government of Pakistan, Chief Engineering Adviser, Ministry of Water and Power, Chairman IRSA and Member(Water), WAPDA as members of the Committee.
2. Mr. Ghulam Sarwar Khichi is appointed as Secretary of the Technical Committee on Water Resources.
3. The terms of Reference of the Technical Committee are modified to include the following additional items:
 - a) Determination of water availability for future reservoirs and irrigation schemes.
 - b) Examination of operational criteria of link canals and future reservoirs.
4. The Committee shall submit its report/recommendations within one year.

The Manager,
Printing Corporation of Pakistan,
Islamabad.

(Rashid Ali)
Deputy Secretary(W)

Distribution:

1. Mr. A.N.G. Abbasi
71/II, Street, Off Khayaban-e-Badar,
DHA Phase-VI, Karachi. Ph: 021-5845804.

2. Dr. Iqbal Ali
C/o Secretary, Irrigation & Power Department,
Government of Sindh, Karachi.
3. Mr. Sardar Ahmad Mughal
Co Secretary, Irrigation & Power Department,
Government of Sindh, Karachi
4. Mr. Mazhar Ali,
Irrigation & Power Department
Government of Punjab, Lahore
5. Mr. Mehmood-ul-Hassan Siddiqui
Irrigation & Power Department,
Government of Punjab, Lahore
6. Mr. Shams-ul-Mulk,
Ex-Minister Irrigation, NWFP,
H.No. 12, St.42, F-7/1, Islamabad.
(Mobile No. 0333-5218688) Phone No. 2651354
7. Sardar Muhammad Tariq
Pakistan Water Partnership (PWP),
638 WAPDA House, the Mall, Lahore.
Phone No. 042-9202226 (Fax No. 042-9202485)
8. Mr. Abdul Razzak Khan
C/o Secretary, Irrigation & Power Department,
Government of Balochistan, Quetta.
9. Mr. Muhammad Azam Baloach
Co Secretary, Irrigation & Power Department,
Government of Balochistan, Quetta.
10. Mr. Javed Sadiq, Secretary,
P&D Division, Islamabad.
11. Mr. I.B. Sheikh, Chief Engineering Adviser/CFFC",
M/o Water & Power, Islamabad.
12. Mr. Rahim Khan Zarkun,
Chairman IRSA, Islamabad.

13. Ch. Muhammad Amin,
Member (Water), WAPDA, Lahore.

14. Mr. Ghulam Sarwar Khichi, J.S. (Retd)
Government of Pakistan,
A-9, Block-A, KDA Officers Cooperative Housing Society,
Near National Stadium, Karachi.

(Rashid Ali)
Deputy Secretary (W)

CC:

1. Chairman, Parliamentary Committee on Water Resources, (Senator Nisar Ahmed Memon), J Block, Room No.105, Parliament Lodges, Islamabad.
2. Chief Secretary, Government of Punjab, Lahore.
3. Chief Secretary, Government of Sindh, Karachi.
4. Chief Secretary, Government of NWFP, Peshawar.
5. Chief Secretary, Government of Balochistan, Quetta.
6. Chairman WAPDA, WAPDA House, Lahore.
7. Prime Minister's Secretariat,
(Mr. Ajaz Mohiuddin, Joint Secretary (E-11), Islamabad.
8. President Secretariat (Public),
(Brig Syed Muhammad Qwais), Islamabad.
9. Deputy Secretary (C-1),
(Mr. Sikandar Ismail Khan), National Assembly Secretariat, Islamabad.
10. P.S. to Minister for Water and Power.
11. P.S. to Minister of State for Water and Power.
12. P.S. to Secretary, Water and Power.

ANNEXURE I-4

PREPARATION OF POSITION-CUM-APPROACH PAPERS		
S.No	Terms of Reference	Position-cum-Approach Papers along with complete data and related documents to be supplied by:
1	Review issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the Provinces.	Chairman, IRSA
2	Assess the need for constructing dams/ reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages.	1. Member (Water), WAPDA 2. Secretary, Planning & Division Development
3	Review the progress achieved so far regarding study on escapages below Kotri and recommend measures to expedite the completion of the study.	Chief Engineering Adviser
4-a	Determination of water availability for future reservoirs and irrigation schemes.	1. Member (Water), WAPDA 2. Secretary, Planning & Division Development
4-b	Ascertain actual quantity of water passed downstream Kotri from 1976-2003.	Member (Water), WAPDA
5-a	Examine the filling criteria of Mangla reservoir and make recommendations in this regard.	1. Member (Water), WAPDA 2. Chairman, IRSA
5-b	Examination of operational criteria of link canals and future reservoirs.	1. Member (Water), WAPDA 2. Chairman, IRSA

ANNEXURE I-5

MEETINGS OF TECHNICAL COMMITTEE ON WATER RESOURCES		
No. of meeting	Dates on which held	Matters discussed
1st	11th March 2004	Preliminary meeting, co-opted members requested to prepare position-cum-approach papers relating to the TORs concerning each of them
2nd	4th September 2004	Presentations by Secretary, Planning & Development Division and Member (Water), WAPDA on TOR-4(a) "Determination of water availability for future reservoirs and irrigation schemes"
3rd	1st session, 27th September 2004	(i) Presentation by Member (Water), WAPDA on the additional data on TOR-4(a) (ii) Briefing by Pakistan Commissioner for Indus Waters (iii) Discussions of members with co-opted members and PCIW on TOR-4(a)
	2nd session, 28th September 2004	Deliberations amongst the members TCWR on TOR-4(a)
4th	1st session, 13th October 2004	Continued discussions with the co-opted members on presentations and observations made on TOR-4(a)
	2nd session, 14th October 2004	(i) Deliberations amongst the members TCWR on TOR-4(a) (ii) Consideration of Work Plan for Technical Committee
5th	1st session, 22nd November 2004	Further deliberations amongst the members TCWR on TOR-4(a)
	2nd session, 23rd November 2004	Presentation by Member (Water), WAPDA and Chairman, IRSA on TOR-5(a) "Examine the filling criteria of Mangla reservoir and make recommendations in this regard" and 5(b) "Examination of operational criteria of link canals and future reservoirs"
	3rd session, 24th November 2004	Discussions with co-opted members TCWR on Presentations
	4th to 6th session from 25th Nov. to 27th Nov. 2004	Deliberations amongst the members TCWR on TOR-4(a)
6th	1st session, 20th December 2004	Discussions with co-opted members on TOR-5(a) and 5(b)
	2nd session, 21st December 2004	Deliberations amongst the members TCWR on TOR-5(a) and 5(b)
	3rd session, 22nd December 2004	Deliberations amongst the members TCWR on TOR-5(a), TOR-5(b) and 4(a)
7th	1st session, 11th January 2005	Presentation by Member (Water), WAPDA on TOR-2 "Assess the need for constructing dams/reservoirs for future requirements and to make up for the shortages of water due to silting of Tarbela and Mangla dams and recommend sequencing of future storages"
	2nd session, 12th January 2005	Discussions with Secretary, Planning and Development Division and Member (Water), WAPDA on TOR-2
	3rd session, 13th January 2005	Presentation by Chairman, IRSA on TOR-1 "Review issues relating to distribution of water according to 1991 Water Apportionment Accord and submit recommendations for streamlining water distribution amongst the Provinces"
8th	1st session, 1st February 2005	Discussions with Secretary, Planning and Development Division and Member(Water), WAPDA on TOR-2
	2nd session, 2nd February 2005	Discussions with Chairman, IRSA on TOR-1
	3rd session, 3rd February 2005	Deliberations amongst the members TCWR on TOR-2 and TOR-1

Annexure I-6

D.O.No.PF-M(W &P)/Corr./2005
Ministry of Water & Power
Government of Pakistan
Tel : 921 1442
Fax : 922 1825



LIAQUAT ALI Jatoi
MINISTER

Islamabad, the February 11, 2005

Subject:- Report of the Technical Committee on Water Resources :

My dear

As discussed in the meeting held at President's House on January 14, 2005, it is requested that you may get the views of all the members of Technical Committee and include them in the report of the Technical Committee alongwith your comments and submit the same for consideration of the Government.

With best regards,

Yours sincerely,

(Liaquat Ali Jatoi)

Mr. A. N. G. Abbasi,
Chairman,
Technical Committee on
Water Resources,
Islamabad.

Page 34

ANNEXURE I-7

TO BE PUBLISHED IN THE
GAZETTE OF PAKISTAN PART-I

Government of Pakistan Ministry of Water and Power

NOTIFICATION

Islamabad April 7, 2005

No.W.III-1(1)2002-Vol-IV. Further to the Ministry of Water and Power notifications of even number dated November 15, 2003 and February 11, 2004.

The duration of the Technical Committee on Water Resources headed by Mr. A.N.G. Abbasi, is hereby extended upto June 30, 2005. The Committee should however, submit. its report by 30th April, 2005.

s/d
(Talat Mahmood)
Section Officer (W-III)

The Manager,
Printing Corporation of Pakistan Press, Karachi,
Distribution:

1. Mr. A.N.G. Abbasi, Technical Committee on Water Resources, State Life Building No.9,5th Floor, (West Wing), Blue Area. Islamabad.
2. Dr. Iqbal Ali, State Life Building No.9, 5th Floor, (West Wing), Blue Area, Islamabad.
3. Mr. Sardar Ahmad Mughal, State Life Building No.9, 5th Floor, (West Wing), Blue Area, Islamabad
4. Mr. Mazhar Ali, Technical Committee on Water Resources State Life Building No.9, 5th Floor, (West Wing), Blue Area, Islamabad
5. Mr. Mehmood-ul-Hassan Siddiqui, State Life Building No.9, 5th Floor, (West Wing), Blue Area, Islamabad

6. Mr. Shams-ul-Mulk, State Life Building No.9, 5th Floor, (West Wing), Blue Area, Islamabad

7. Sardar Muhammad Tariq, State Life Building No.9, 5th Floor, (West Wing), Blue Area, Islamabad

8. Mr. Abdul Razzak Khan, State Life Building No.9, 5th Floor, (West Wing), Blue Area, Islamabad.

9. Mr. Muhammad Azam Baloach, State Life Building No.9, 5th Floor, (West Wing), Blue Area, Islamabad

CC:

1. Chairman, Parliamentary Committee on Water Resources, (Senator Nisar Ahmed Memon), Parliament House, Islamabad. (Block, Room No. 105, Parliament Lodges)

2. Chief Secretary, Government of Punjab, Lahore.

3. Chief Secretary, Government of Sindh, Karachi.

4. Chief Secretary, Government of NWFP, Peshawar.

5. Chief Secretary, Government of Balochistan, Quetta.

6. Chairman WAPDA; WAPDA House, Lahore.

7. Prime Minister's Secretariat (Mr. Ajaz Mohiuddin, Joint Secretary (E-II), Islamabad.

8. President Secretariat (Public), (Brig Syed Muhammad Owais), Islamabad

9. Deputy Secretary (C-I), National Assembly Secretariat, Islamabad.

10. PS to Minister for Water and Power.

11. PS to Secretary, Water and Power

ANNEXURE I-7

Government of Pakistan
Ministry of Water and Power



A-II-TC/WR/04-02

Islamabad June 6, 2005

To

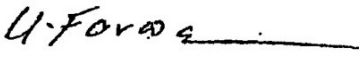
The Secretary,
Technical Committee on Water Resources,
Islamabad.

Subject: CONTINUATION OF TECHNICAL COMMITTEE ON WATER RESOURCES.

Dear Sir,

I am directed to refer to your U.O. No.TCWR-1(1)/Admn/2004/377, dated 27.5.2005 on the above noted subject and to convey the approval of the Prime Minister of Pakistan for extension of the tenure of the Technical Committee on Water Resources upto 31st December, 2005. The Competent Authority has been pleased to further direct that the Committee should submit its report by 31st August, 2005.

Yours-faithfully,


(Umar Farooq)
Section Officer (A.II)

ڪوٽڙي بيراج جي هيٺان پاڻي جي چوڙ جي اڀياس جا خاص خاص نڪتا

صوبن وچ ۾ پاڻي جي حصي رسي جو ٺاهه 16 مارچ 1991 تي صوبن جي نمائندن طرفان صحيح

ڪيو ويو. هن وقت صوبن وچ ۾ پاڻي جي ورهاست انهي ٺاهه مطابق ڪئي پئي وڃي.

2. ٺاهه جي اسم 7 جي مطابق:

« ڪوٽڙي کان هيٺ سمنڊ ڏانهن پاڻي جي هڪ خاص مقدار جي نيڪال جي ضرورت تسليم

ڪئي وئي. سنڌ صوبو ان خيال جو هئو ته وڌ ۾ وڌ 10 ايم اي ايف جي ليول تي پاڻي جي

نيڪال جي ضرورت هئي، اهو نڪتو تفصيلي بحث هيٺ رهيو. جڏهن ته ٻين اڀياسن ان ليول کان

گهٽ/وڌ نيڪال جي نشاندهي ڪئي. ان ڪري اهو فيصلو ڪيو ويو ته ان سلسلي ۾ وڌيڪ

اڀياس (studies) ڪيا وڃن ته جيئن ڪوٽڙي هيٺ درياه سنڌ جي گهٽ ۾ گهٽ پاڻي جي نيڪال

جو مقدار مقرر ڪري سگهجي. »

3. ان ٺاهه جي مٿين شق جي پوئيواري ۾ حڪومت پاڪستان، آڪٽوبر 2004 ۾ هيٺ ڄاڻايل

اڀياسن (studies) جي شروعات ڪئي: -

(i) سامونڊي پاڻي جو زمين ڏانهن وهڪرو روڪڻ لاءِ ڪوٽڙي هيٺ پاڻي جي نيڪال جو اڀياس.

(ii) سنڌ صوبي جي ماحوليات متعلق خدشن کي ختم ڪرڻ لاءِ ڪوٽڙي هيٺ پاڻي جي نيڪال جو اڀياس.

(iii) چئن صوبن جي ماحوليات متعلق خدشن (مٿين ٻن اڀياسن ۾ ڄاڻايل نڪتن کي ڇڏي) جو اڀياس.

مٿي ڄاڻايل اڀياس (Studies) سٺي شهرت رکندڙ ڪنسلٽنٽ فرم کي سپرد ڪيا ويا. هيٺين ٽن

بين الاقوامي شهرت رکندڙ فرمن جي پينل کي مقرر ڪيو ويو ته هو انهن اڀياسن جي نظرثاني ڪن

۽ سفارشن کي آخري شڪل ڏين:

1. ڊاڪٽر فرنيڊو جي گونزاليز، ميڪسيڪو جي قوميت رکندڙ، ريجنل ڊائريڪٽر، ورلڊ بئنڪ.

(Dr. Fernando J Gonzalez, Mexican national, Ex-regional Director, World Bank).

2. ڊاڪٽر ٿينوز باسن آمريڪي شهرت رکندڙ پروفيسر ۽ آمريڪن يونيورسٽن سان لاڳاپيل ڪنسلٽنٽ.

(Dr. Thinus Basson, American national, Professor and Consultant)

3. ڊاڪٽر بارت شلٽز، ڊچ شهرت رکندڙ، جڳ مشهور ڪنسلٽنٽ اريگيشن ۽ ڊرينج .

(Dr. Bart Schultz, Dutch national, world-renowned consultant)

4. مٿين طريقڪار ذريعي ڪيل اڀياس جي نتيجن جا خاص خاص نڪتا هيٺين ريت آهن .

(i) ساليانو ڪوٽڙي بئراج کان 5000 ڪيوسڪس پاڻي جو وهڪرو سمجهيو وڃي ٿو ته سمنڊ جي پاڻي جي چاڙهه کي روڪي ٿو، مڇي جي پالنا جي گهرجن جو پورا ٿو ڪري ٿو، ماحول کي پائيدار رکي ٿو ۽ ننڍين جي چئلن کي قائم رکي ٿو.

(ii) بين الاقوامي ماهرن جي نتيجي موجب سمنڊ جي اندروني چاڙهه سبب رڳو زمين جي سطح وارو پاڻي متاثر ٿئي ٿو. انهن ان تاثر کي رد ڪيو آهي ته سمنڊ جي پاڻي جي زمين ڏي چاڙهه سبب ڪو زميني پاڻي ۾ لوڻياڻ وڌن ٿا. اهو به پتو ڪيو ويو آهي ته اهو گهڻو ارضياتي باقيات جي رهي وڃڻ ڪري ٿيندو آهي.

(iii) پنجن سالن ۾ 25 ايم اي ايف (جيڪو ساليانه 5 ملين ڪيويڪ فوٽ برابر آهي). ڪوٽڙي کان هيٺ ٻوڏ جي وهڪري (خريف جي موسم) ۾ ڇڏيو وڃي. اهو سالياني طور تي وهڪرو 5 ايم اي ايف جي حساب سان جاري ڪري سگهجي ٿو ۽ ايترو سراسري قائم رکجي.

(iv) ڪوٽڙي کان پاڻي جي وهڪري جي نموني موجب خريف جي موسم (اپريل کان سيپٽمبر تائين) ڪوٽڙي کان هيٺ 0.3 ايم اي ايف کان وڌيڪ يا برابر هجڻ ڪپي. ربيع جي مند ۾ (آڪٽمبر کان مارچ). 0.3 ايم اي ايف ماهوار پاڻي جي وهڪري جي سفارش ڪئي وئي آهي. البت خشڪ سالي جي مند ۾ آبپاشي واسطي پاڻي جي ڪمي ڪي حصي رسيءَ مطابق گهٽائي سگهجي ٿو.

(v) تربلا ڊيم جي ٺهڻ کان پوءِ واري وهڪري جي انگن اکرن کي بنياد بنائي ڪري، دستياب وسيلن مان پاڻي ڪنو ڪرڻ کان پوءِ، مٿين سفارشن جي نتيجي ۾ جمع ڪيل ذخيرن مان ساليانو عام مند ۾ 1.26 ايم اي ايف ۽ خاص خشڪ سالي واري مند ۾ تقريبن 2.20 ايم اي ايف پاڻي وهائي سگهيو. ان لاءِ وڌيڪ پاڻي ڪنو ڪرڻ وارن ذخيرن جي ضرورت پوندي ته جيئن آبپاشي لاءِ پاڻي جي گهٽجندڙ دستيابي کي روڪي سگهجي. ماحولياتي وهڪرو، جڏهن ۽ جيئن، مٿين ندين منجهان مناسب نموني، ڪوٽڙي بيراج کان هيٺ پيچاڙ تائين وڃڻ لاءِ جاري ڪرڻ گهرجي.

**FINAL REPORT OF IPOE
FOR REVIEW OF STUDIES
ON
WATER ESCAPAGES
BELOW KOTRI BARRAGE**

**Fernando J Gonzalez
Thinus Basson
Bart Schultz**

**Delft, the Netherlands
20th of November 2005**

IPOE:

- * Dr. Fernando J Gonzalez
- * Dr. Thinus Basson
- * Dr. Bart Schultz

EXECUTIVE SUMMARY

- I. Three studies were commissioned to reach consensus on the minimum required escapages below Kotri Barrage, which is the main outstanding item of the Water Apportionment Accord (WAA). It concerns:
 - Study I: *Water escapages below Kotri Barrage to check seawater intrusion;*
 - Study II: *Water escapages downstream of the Kotri Barrage to address environmental concerns;*
 - Study III: *Environmental concerns of all the four provinces.*In order to have an independent external review of the studies an international panel of experts (IPOE) was appointed. The IPOE took good note of the historical developments and the WAA, especially of para 7 on *The need for certain minimum escapages to the sea, below Kotri, to check sea intrusion.* The IPOE reviewed the studies at relevant stages, had in depth discussions with government staff at Federal and Provincial level, as well as with the consultants, and analysed international experiences and practices.
- II. The following aspects primarily justify the need for water escapages below Kotri Barrage: (i) salinity encroachment in the river, aquifer and coastal zone; (ii) requirement of coastal stability; (iii) requirement of a sustainable environment; (iv) fisheries; (v) prevention of salinity accumulation in Indus Basin. In addition other factors may play a role: riverine forests, riverine agriculture, pollution control and drinking water supply.
- III. In the determination of the IPOE's recommendations on the minimum escapages the following considerations have played a role: (i) to check seawater intrusion downstream of Kotri Barrage as identified in Study I; (ii) the needed environmental flows upstream of Kotri Barrage as provisionally indicated in Study III; (iii) the impact of the recommended environmental flows on the availability of water for economic and social needs (irrigation, domestic and industrial water supply) as indicated in Study III; (iv) the minimum needs for fisheries and maintenance of mangroves in the Expanded Delta as indicated in Study II; (v) flows to keep the river morphology in good condition; (vi) the international developments and practices with respect to environmental flows; (vii) the recognition that a structural solution will not be feasible.
- IV. An escape at Kotri Barrage of 5000 cfs throughout the year is considered to be required to check seawater intrusion, accommodate the needs for fisheries and environmental sustainability, and to maintain the river channel. The IPOE likes to stress that seawater intrusion only concerns problems related to surface water, because salinity in the aquifer is predominantly due to fossil water salinity from geological origin.
- V. The IPOE understands the problem of sea intrusion/coastal erosion as occurring in the Indus Delta area and considers this as a National problem. The reasons for this problem are primarily: (i) reduction in sediment supply by Indus River as indicated in Studies I and II; (ii) reduction in the mangrove vegetation as indicated in Study II; (iii) prevention of flooding of the outlying delta areas due to the river bunds; (iv) sea level rise; (v) recent extreme weather conditions possibly due to climate change. With respect to the required sediment supply and mangrove vegetation the IPOE likes to give the following observations and recommendations.

- VI. As far as the sediment supply is concerned a substantial reduction has taken place over the years due to the diversion of most of the water for irrigation. The original supply of sediment is estimated at 400 million tons/year. Then the coastal accretion was about 30 m/year. A substantially smaller amount of sediment is needed to establish a stable coastline, especially when this supply is combined with coastal protection measures. By far most of the sediment is supplied during peak flows. It is recommended that a total volume of 25 MAF in any 5 years period (an annual equivalent amount of 5 MAF) be released in a concentrated way as flood flow (Kharif period), to be adjusted according to the ruling storage in the reservoirs and the volume discharged in the four previous years.
- VII. As far as the mangrove vegetation is concerned a certain flow and sediment supply will be required, together with control of camel grazing and fire wood cutting, and mangrove replanting. In order to spread the water over the flats a concentrated high flow would be needed during the Kharif season. The amounts of fresh water as mentioned under item VI will be sufficient for a sustainable mangrove growth. It is considered to be of utmost importance to manage the mangroves in such a way that a sufficiently wide mangrove belt is being maintained in front of the coastline. The IPOE recommends that this be considered to be a National responsibility.
- VIII. Based on the above considerations the IPOE recommends the escapages below Kotri Barrage as shown in Table I. The flows can be adjusted according to the proportions of the allocations delivered to irrigation. In addition the IPOE recommends that peak discharges during the Kharif period, as explained in item VI, will be made to supply sediment to the delta, sustain mangrove vegetation and preserve river morphology.

Table I. Recommended escapages below Kotri Barrage in cfs and MAF

	Kharif						Rabi *)						Totals		
	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Year	Rabi	Kharif
In cfs	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000			
In MAF	>=0.3	>=0.3	>=0.3	>=0.3	>=0.3	>=0.3	0.3	0.3	0.3	0.3	0.3	0.3	3.6 +**)	1.8	1.8 +**)

*) In a dry year the amount can be proportionally reduced in relation to the reductions in irrigation water supply

**) A total volume of 25 MAF in any 5 years period (an annual equivalent amount of 5 MAF) to be released in a concentrated way as flood flow (Kharif period), to be adjusted according to the ruling storage in the reservoirs and the volume discharged in the four previous years

- IX. Based on the post Tarbela flow data the above recommendations would result in a required additional release downstream of Kotri Barrage during low flow months of 1.26 MAF in an average year and 2.20 MAF in a typical dry year. This will require additional storage capacity to prevent a reduction of water availability for irrigated agriculture. Environmental flows would as and when appropriate be routed via upper rivers before release downstream of Kotri Barrage.
- X. The IPOE recommends that the proposals as made by Study III with respect to the environmental concerns of the provinces, not reducing the escapages downstream of Kotri Barrage as recommended in item VIII and acceptable to the concerned province, be prioritised for implementation.

1 Background

- 1.1 The Indus Basin Irrigation System provides irrigation to about 40.0 Mac (million acre) (16.2 Mha [million hectares]) (73% of the total cultivable area in Pakistan) and generates about 90% of the nation's total value of agricultural output. Provision of irrigation on a controlled year around basis started in 1859. A rapid expansion occurred during the last 50 years with large investments in dams that provided about 13 MAF (million acre feet) (16 Bm³ [billion cubic metres]) of live storage (Tarbela, Chasma and Mangla are the main storages), and greater use of groundwater to increase both the irrigated area and the cropping intensity. Today the system comprises 19 barrages and head works, 12 link canals, 43 commands and some 107,000 watercourses. Some background information is given in Annex I.
- 1.2 In March 1991 the Water Apportionment Accord (WAA) was signed by the provinces, which replaced previous agreements to distribute the Indus River waters among the provinces and command areas. It established the water rights among the provinces and protects future water rights, including the effect of future storages. A formula is available for sharing river flows. The Indus River System Authority (IRSA) was created as the regulatory authority for monitoring and distribution of the water sources of the Indus River in accordance to the WAA. The WAA recognized:

'The need for certain minimum escapages to the sea, below Kotri, to check sea intrusion. Sindh held the view that the optimum level was 10 MAF (12.3 Bm³), which was discussed at length, while other studies, indicated lower/higher figures. It was therefore, decided that further studies would be undertaken to establish the minimal escapages needed below Kotri.'

- 1.3 Since 1991 several studies have indicated a range of minimum flows to check seawater intrusion, none of which had been agreed upon. It is important that consensus be reached on the minimum escapages required below Kotri Barrage, which is the main outstanding item of the WAA. Therefore three studies jointly agreed to by the stakeholders were commissioned in this respect. The main objective of Study I - *Study on water escapages below Kotri Barrage to check seawater intrusion* - was to determine the minimum quantity of the Indus River water that needs to pass below Kotri Barrage to control seawater intrusion at desirable levels, and to suggest alternative measures to alleviate adverse impacts. Study II - *Study on water escapages downstream of the Kotri Barrage to address environmental concerns* - was to investigate and address environmental impacts from river water and sediment flows and their seasonal distribution below Kotri Barrage (forests, mangrove forests, fisheries, riverine agriculture, population, flora and fauna, seawater intrusion), identify mitigation measures and evaluate trade offs. Study III - *Study on environmental concerns of all the four provinces* - was to identify and address environmental concerns of all four provinces and needed to address a wide range of issues related to the management of water resources in the Indus Basin upstream of Kotri Barrage. The current studies had to verify the data on salinity of the water entering into Sindh Province. The Terms of Reference (TOR) for the present three studies were the product of intensive negotiations in which the provinces expressed their

concerns about the issue of minimum flows needed to check seawater intrusion. However, they also address more general environmental concerns.

- 1.4 In order to have an independent external review of the studies at various relevant stages an international panel of experts (IPOE) was appointed. The three members of the IPOE were Fernando J Gonzalez, Thinus Basson and Bart Schultz. The Terms of Reference (TOR) for the IPOE stated clearly 3 objectives:
- Review work of consultants for the three studies in 3 stages. Namely inception, interim and draft final reports;
 - Review recommendations given by the consultants in the light of the scope of work envisaged in the TORs for all the three studies;
 - Analyse the recommendations of the consultants in full perspective and suggest judicious trade-offs and interventions amongst various requirements.
- In Annex II a brief overview is given of IPOE's activities with respect to its TOR.
- 1.5 The first visit to Pakistan by the IPOE took place during the period 19th of March to 15th of April 2005. At that moment the draft Inception Reports for the three studies were available. The findings and recommendations of the IPOE, based on the three Inception Reports and the discussions held during the visit, were laid down in its 1st report, dated 14th of April 2005. The second visit of the IPOE took place from 12th to 23rd of August 2005. Draft Interim Reports of the three studies were received before the visit. The IPOE could submit its written comments on the draft Interim Reports of Studies I and II before the visit. The IPOE received the draft Interim Report of Study III too late to give comments beforehand. These comments were submitted during the visit. All the three consultants accommodated a substantial part of the comments and recommendations by the IPOE and submitted a large amount of additional information during the visit. It was agreed that the Interim Reports would not be revised, but that all comments and suggestions would be included in the draft Final Reports. The findings and recommendations of the IPOE, based on the draft Interim Reports and the discussions held during the visit, were laid down in its 2nd report, dated 23rd of August 2005.
- 1.6 The third visit of the IPOE took place from 7th to 16th of October 2005. Draft Final Reports of the three studies were received shortly before the visit. Therefore the IPOE could only submit their written comments during the visit. The IPOE had:
- Regular meetings with Mr. I.B. Shaikh, Chairman Federal Flood Commission (FFC) and Mr. A. Kamal, Project Director Kotri Studies;
 - A meeting with the Secretary of the Ministry of Water and Power, Mr. A. Mahmood;
 - A meeting in Karachi with the Secretary of the Sindh Irrigation and Power Department (SIPD) and his delegation and in Lahore with the Secretary of the Punjab Irrigation and Power Department (PIPD) and his delegation;
 - Meetings respectively in Islamabad (Study I, II and III) and in Lahore (Studies I and II) with the project leaders and team members of each consultant to ask for clarifications and to make suggestions for finalisation of the draft Final Reports;
 - A meeting with Mr. Muhammad Karim Khan, NWFP Provincial Coordinator and Mr. Naseem Bazoi, Provincial Coordinator Balochistan;

- Attended the Steering Committee meeting at the FFC on 12th and 13th of October 2005. During the meeting Thinus Basson presented the findings and recommendations of the IPOE.

The slides of this presentation are attached as Annex III. The comments of the IPOE on the draft Final Reports of the three Studies that were submitted during the visit are attached as Annexes IV to VI.

- 1.7 Subsequent to the visit the IPOE has received the revised Final Reports of the three consultants and have submitted their remaining comments, especially on the Executive Summaries, by e-mail to the FFC and the consultants. Based on these facts the IPOE recommends that the reports for Studies I and III be approved. As far as Study II is concerned the IPOE has made quite some observation and recommendation with respect to the submitted explanatory notes and various draft versions of the Final Report. Major issues were that considerations on environmental items below Kotri Barrage would have to be based on relevant data, clear identification of the relevant areas and the requirement of an integrated analyses of the relevant processes. In addition there were quite some inconsistencies in the report. The consultant has finally submitted a report that may be considered acceptable. We therefore recommend that the report of Study II will also be approved.
- 1.8 The IPOE recognizes the prominent role of Mr. I.B. Shaikh and Mr. A. Kamal in managing the studies and facilitating the work of the IPOE. The IPOE especially recognizes the support of Mr. Kamal and his staff.

2 Findings of the IPOE on the draft Final Reports

- 2.1 The needs of and concerns on the environment play an important role in the studies. The relatively new approach of environmental flows is being introduced in Pakistan. In the development of practices in various other countries and river basins basically three approaches to determine environmental flows may be distinguished. These are:
 - *A fixed percentage (around 10%) of the average annual flow.* This approach has to be considered as an initial estimate;
 - *Hydrological analysis.* In such an analysis normally a low flow for different duration is taken as a reference;
 - *Analytical assessment of the basic needs of the ecosystems in the riverine area.* This is the most comprehensive approach. In fact this approach has been followed in the present studies. However, it has to be realised that in practice not all the environmental needs can be accommodated, and a realistic optimum of the needs of society and of the environment will have to be formulated.
- 2.2 *Main findings with respect to the Final Report of Study I: Study on water escapages below Kotri Barrage to check seawater intrusion*

The Final Report of Study I is well written, it focuses on the issues of relevance, is based on a good database, reliable calibrations and to the point modelling. The study is of a high

professional standard and in compliance with the TOR. In the draft Final Report there were some important issues to be solved and points to be clarified, which concerned:

- The period 1955 - 1975 is not really a homogeneous one, while the diversion of flows to India started during this period. Therefore it is not optimal for comparison of the desirable conditions encountered in the past. However, it is the best possible option that is available and therefore considered to be acceptable;
- The recommendations about the feasibility to build a barrage to check seawater intrusion were not fully clear. It was considered to be important to make the recommendations clear and to explain in more detail the basis for the proposed option;
- The justification for eliminating zero discharges and application of 1000 cfs as minimum flow would have to be explained. The IPOE believes that the minimum volume to keep seawater intrusion checked is not dependent on a hydrologic year selected as the 10% driest or 10% wettest year. The source of the water to be released can be different and could be calculated by making a simple simulation of the post 1975 period;
- According to results of the groundwater model, there was a need to clarify the conclusion that groundwater quality has not been affected by seawater intrusion. The results of dating the groundwater samples still needed to be included;
- The draft report needed to be checked for consistency and the proper use and unit prescription of levels compared to MSL (Mean Sea Level). In addition a check was needed, in consultation with the consultant for Study II, on the text where overlaps occur and for the use of names for different areas. This referred especially to the hydraulic computations, the sediment figures, the groundwater data and the names and areas for different types of the riverine and delta area.

The detailed findings of the IPOE with respect to the draft Final Report of Study I are given in Annex IV.

In its Final Report the consultant has accommodated these comments and therefore the IPOE recommends that the Final Report be approved.

2.3 Main findings with respect to the Final Report of Study II: Study on water escapages downstream of the Kotri Barrage to address environmental concerns

The draft Final Report of Study II needed substantial improvement, before it could become acceptable. Although the consultant had accommodated a substantial part of the comments that were made by the IPOE on its Interim Report, another substantial part of the comments that was discussed with and approved by the consultant were not accommodated in the draft Final Report. These comments have been given again in the detailed findings of the IPOE as given in Annex V.

Reading and understanding the draft Final Report was very difficult because each section seemed to have been written by a different team without the needed integration. The consultant had collected and showed in the draft Final Report a substantial amount of data. In general it was also made clear where the gaps in the data are. It was, however, not always shown what was the source of the data and under what conditions, or for which area the given data are applicable. In addition in different parts of the report different data for the same topic

were given. Several times the same data were repeated at different places. At the Interim phase it was discussed that there is a need to develop a spatial zoning and distribution to understand the main phenomena and forces acting in each of them. It was often unclear for what area and under what conditions the comments, observations, suggestions and proposals of the consultant are applicable. This referred especially to the different parts of the Delta and whether an issue is applicable to the land, the sea, or the transition zone.

During the visit there have been several meetings with the consultant. Following the meeting of the Steering Committee the consultant has submitted a revised Executive Summary and attached explanatory notes on: mangroves, sediment and fisheries. However, these documents were still not acceptable, because of lack of analysis and inconsistencies. There was still no analysis of the relevant processes, nor an integration of related issues. In a study like this an overall/integrated analyses for understanding of the processes at stake, assessing the relative contributions and a justification of the conclusions and recommendations is an absolute requirement. This is more valid in the complicated environments and processes we have to deal with. For details of the comments made by the IPOE on these issues reference is made to Annex V where other detailed findings of the IPOE with respect to the draft Final Report of Study II are given.

In addition a check was needed in consultation with the consultant for Study I on the text where overlaps occur and for the use of names for different areas. This referred especially to the hydraulic computations, the sediment figures, the groundwater data and the names and areas for different types of the riverine and delta area. Also a check with the consultant of Study III was needed on the requirements for the riverine ecosystem, forests and agriculture.

After the visit a new revised Executive Summary was submitted. In this summary the consultant still did not show the requested analyses and integration and came with several new data that were not based on his own study. Therefore, also this Executive Summary was still not acceptable. The IPOE has separately given its comments on this revised Executive Summary as well and expects that these comments be taken into account in finalising the Executive Summary, the explanatory notes and the Final Report. As already stated under item 1.7, after several revised versions the consultant has finally submitted a report that may be considered acceptable. The IPOE therefore recommends that the Final Report be approved.

2.4 Main findings with respect to the Final Report of Study III: Study on environmental concerns of all the four provinces

Study-III addresses the water related environmental concerns of all the four provinces with respect to the Indus Basin upstream of the Kotri Barrage as well as for the Non-Indus irrigated area of Balochistan, together with a number of specific issues as of interest to the relevant provinces. Only the main findings of common interest to most provinces are summarized below. The findings and recommendations with respect to the individual TORs were considered too voluminous for the purpose of this summary, and reference is made to the Executive Summary of Study-III in this regard.

The diversion of river flows, following on the Indus Water Treaty (IWT) with India in 1960, had a major impact on the flow regime of the Indus River and Eastern Rivers. Long reaches of the Eastern Rivers have very low flows and are dry for extended periods during the year, while flows in the Indus River below Tarbela Dam and the Chashma Barrage are highly altered and reduced. The impacts of the above on wildlife, fisheries, riverine forests, riverine agriculture, groundwater, water quality, associated social impacts and others, have been assessed and quantified where possible. A clear need has been identified for certain minimum flows for environmental purposes.

Estimates were made with respect to the quantification of environmental flows in the Eastern Rivers and the middle reaches of the Indus River. These were used as basis for the mathematical modelling of different representative flow scenarios. Although there is not sufficient information at this stage for specific decisions to be taken on environmental flows in these rivers, the combined flows for the rivers upstream of Kotri Barrage is of the same magnitude as what is recommended for the reach below the Kotri Barrage.

The pumping of groundwater for irrigation has significantly increased during recent years, resulting in a general, although limited, overall decline of the groundwater table. Mining of groundwater is evident in several areas, particularly in parts of Balochistan, around Lahore and some others. Recommendations are made with respect to the possible recharge of groundwater from river flow. In contrast, waterlogging from irrigation canals is experienced in certain areas.

Water quality and pollution surveys have been carried out in various parts of the study area. The chemical quality of surface water is generally of a high standard, but biological/bacteriological contamination is of wide spread concern and can only be addressed by the implementation of more complete wastewater treatment over time. The salinity of groundwater is increasing in several areas, while some bacterial contamination was recorded.

Individual TORs of the provinces were addressed as covered in the Executive Summary and Main Report of Study III. During the visit some parts of the report had not satisfactorily responded to the TORs and required substantiation by the consultant. Separate meetings were held, especially with representatives of NWFP and Balochistan. Improvements have been made in the consultants Final Report.

A check with the consultant of Study II was needed on the requirements for the riverine ecosystem, forests and agriculture.

An extensive computerized database on water and environmental related information was established, which could form the basis for a national database. In its Interim Report the IPOE had advised that the data of the other studies will in the future be included in the database and that adequate provisions be made to have issues relating to:

- Environmental flow models;
- GIS of all the four provinces with similar perspective;
- Establishment of the above in Government Offices.

Shortly after its second visit the IPOE had submitted a general framework for a TOR to get

this implemented in practise. It is understood that project preparation is on going to get this implemented at short notice.

The detailed findings of the IPOE with respect to the draft Final Report of Study III are given in Annex VI.

After the visit the IPOE has received the revised Final Report, including a revised Executive Summary. In general the comments made have been accommodated in the final version. The IPOE therefore recommends that the Final Report be approved.

3 Overall findings of the IPOE

Based on its findings the IPOE considers that the following aspects primarily justify the need for water escapages below Kotri Barrage:

- Salinity encroachment in the river, aquifer and coastal zone;
- Requirement of coastal stability;
- Requirement of a sustainable environment;
- Fisheries;
- Prevention of salinity accumulation in Indus Basin.

In addition other factors may play a role: riverine forests, riverine agriculture, pollution control and drinking water supply.

With respect to these aspects the following has been made clear in the present studies:

- *Salinity encroachment in the river, aquifer (below Kotri Barrage) and coastal zone.* Seawater intrusion only concerns problems related to surface water, because salinity in the aquifer is predominantly due to fossil water salinity from geological origin. The results of the groundwater measurements and modelling as presented in Study I clearly show this fact;
- *Requirement of coastal stability.* The present coastal instability is to a certain extent a consequence of the economic and social developments in the country, resulting in lower water escapages to the delta and less sediment supply than in the past. It is also a consequence of uncontrolled local activity, especially with respect to camel grazing and fire wood cutting. For the coastal stability two aspects play a major role, being the supply of fresh water and sediment and a controlled growth of the mangroves, at least in a wide belt in front of the coastline. May be additional coastal protection measures would need to be required. However, at present it is very difficult to determine the need of such measures, while the effect of a better insight in the processes at stake by better monitoring, future water and sediment supply and a controlled growth of the mangroves cannot yet be quantified. While the supply of fresh water and sediment, as well as the management of the mangroves are considered to be of major importance with respect to coastal stability, these two items will be separately described in the next sections;
- *Requirement of a sustainable environment.* There is globally an increasing awareness that measures will have to be taken in light of the creation of sustainable environments. When no due attention is being paid to this aspect, sooner or later substantial problems will be encountered, generally resulting in huge cost for the compensation and

- mitigation measures to be taken;
- *Fisheries.* With respect to escapages below Kotri Barrage the needs of fisheries concern a certain minimum flow as indicated in Study II;
 - *Prevention of salinity accumulation in Indus Basin.* Due to the large-scale development of irrigation in the Indus Basin a gradual accumulation of salts will occur when not a certain discharge of salts, that are disposed through the drains, or are entering into the rivers through the groundwater, is taking place towards the Arabian Sea.

It is found that with respect to the escapages downstream of Kotri Barrage the needs for riverine forests, riverine agriculture, pollution control and drinking water supply play a marginal role and will therefore not be further discussed in underneath considerations. For these aspects reference is made to the Final Report of Study II.

While a principle question concerns the choice of a structural, or a non-structural solution, in section 3.3 attention will be paid to the relevant issues with respect to this choice.

3.1 Findings with respect to the sediment transport

The Indus Delta is in a complex and delicate transition from the original dynamic equilibrium before the diversion of irrigation water, when the average annual sediment supply from the Indus River was estimated at about 400 million tons, to a new state. The river used to periodically change its course near the coast leaving a series of dead rivers or dorohs and advancing the shoreline towards the sea at an estimated rate of 30 m/year. The flow regime and its associated sediment transport built up the delta and a long gentle foreshore slope below sea level.

The new state will also be dynamic according to the changes in the Indus River hydrologic and sediment regimes, the storms in the Arabian Sea and the coastal protection during storm surges. The fragile equilibrium among fluctuating river discharges, tidal and littoral currents, storm surges and sediment supply and transport has been changed. Increased water use in the Indus Basin, mainly for the expansion of irrigated agriculture, has changed the water flow and the sediment load that had built the delta over geologic time. Sediment measurements below Kotri Barrage estimate an annual sediment transport of 126 million tons in post-Tarbela period. Construction of the bunds for flood protection has also fixed the position of the river near its mouth and concentrated the pattern of the discharge.

The observed changes at macro scale have been interpreted, by some experts, including scientists from the National Institute of Oceanography (NIO), as a *shrinking* of the Active Delta - an area of 91,331 ha around the mouth of Indus River - and this fact seems to be confirmed by the finding of oceanic origin organisms in the tidal creeks by the same scientists. Satellite image interpretation by Study II shows that the Expanded Delta - an area of 151,887 ha, including the Active Delta - is apparently changing its shape having erosion at the river mouth in the Active Delta, because of the decreasing sediment inflow and (lateral) transport of sediment under the influence of the tides, littoral currents and storm surges, and is building up at parts of the Expanded Delta and the remaining part of the Tidal Delta - the much larger tidal zone (about 620,000 ha), which spans from the Korangi Creek area near

Karachi and the Sir Creek near the border of India. - away from the river mouth. This change in shape (with zones of erosion and deposition) will continue until bathimetry and shape of the coast reach a new dynamic equilibrium with the sediment transport.

Stable river cross-sections depend on the sediment bed load and the distribution of high and low discharges. In an alluvial river like the Indus River below Kotri Barrage, there are two different kinds of sediment transport processes, the bed load and the wash load. The bed load depends on the flow of the river and the sizes of the bed material. Therefore there is a relation between the flow of the river and the bed load sediment transport. The wash load is composed of the finer material (usually fine silt and clay) that is transported in suspension along the cross-section of the river. Wash load depends on the inflow of sediment from watershed soil erosion and does not have a fixed relation with the flow of the river in any particular time.

The wash load in Indus River has been modified due to the deposition of fine sediment in the Tarbela and Mangla reservoirs and the diverted volumes to the irrigation canals. A storage dam can stop the inflow of bed load sediment in a river reach producing a scour immediately downstream of the dam until the relation of flow and bed load is re-established. Therefore the slope and the section of the river downstream of the dam would gradually change to attain a new equilibrium according to the flow regime defined mainly by the large and medium floods. Figures 1 and 2 show how the recorded sediment flows below Kotri Barrage change with flow rate. In Figure 2 it is clearly shown that most of the sediment is discharged during the peak flows. As said, the concentration of the wash load will be more or less independent of the flow. The difference will therefore be primarily caused by the increase in the bed load in relation to the increase in discharge.

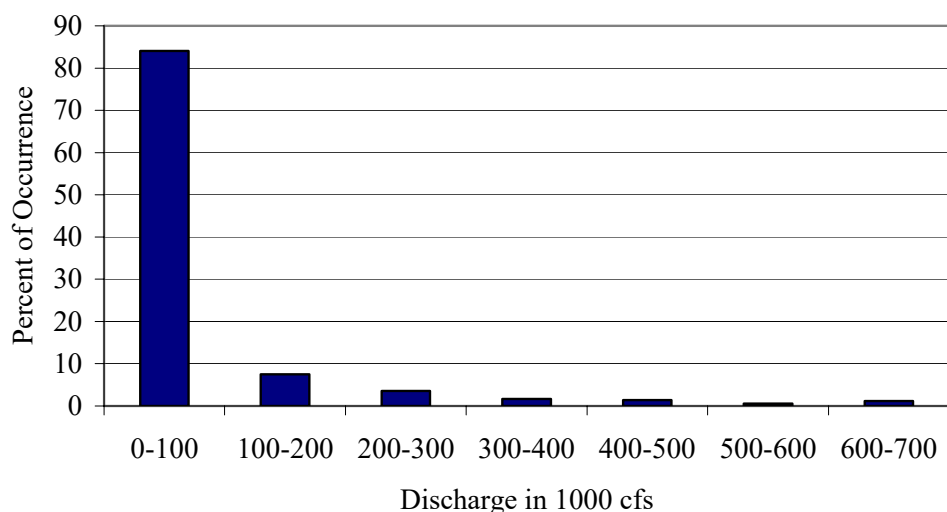


Figure 1 Distribution of the discharge below Kotri Barrage in percent of occurrence, based on data over the period 1972 - 2004

With respect to monitoring of the sediment in the Indus River generally a distinction is made in sand, silt and clay. When released beyond the river mouth the sand will be first deposited,

followed by the silt and the clay. The understanding exists that most of the deposition in the Active Delta consists of the sand and the silt particles and not so much of the clay particles. It is expected that at least a substantial part of these clay particles and a certain part of the silt particles are disposed further in the Arabian Sea. How the ratios of sand, silt and clay change in relation to the magnitude of the flow and over the river reach downstream of Kotri Barrage is not really known. It is therefore also not really known which part of the sediment contributes to the accretion of the Active Delta. In order to develop a better insight in these important processes a careful monitoring of the sediment load and its composition downstream of Kotri Barrage, as well as in the mouth of the river will be required.

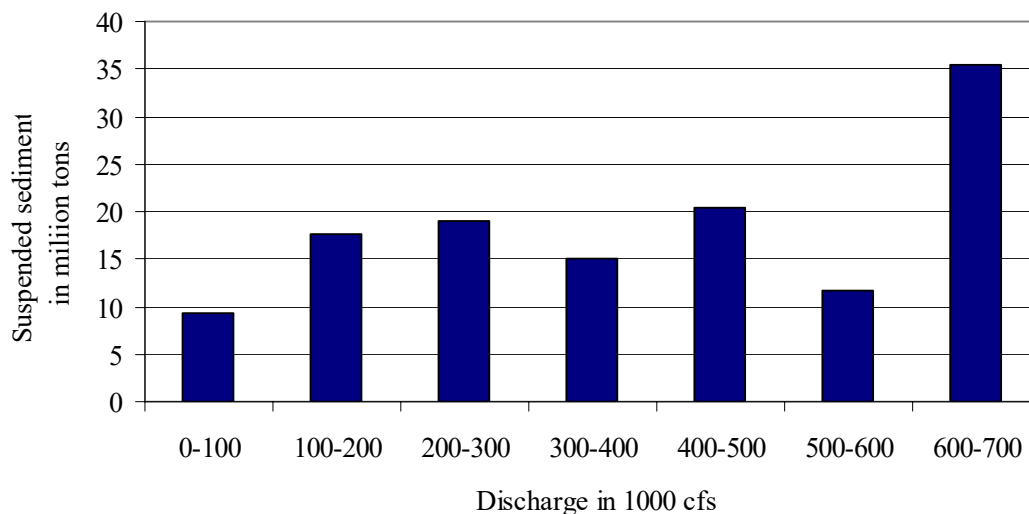


Figure 2 Distribution of the average suspended sediment flow in million tons per year below Kotri Barrage, based on data over the period 1972 - 2004

Maintaining frequent flood flows below Kotri Barrage is essential for preserving adequate river morphology. The stable river cross-section below Kotri Barrage is a function of the flow regime defined by large and medium flood flows. In a barrage like Kotri Barrage the river flow changes drastically and the bedload upstream of the diversion is larger than at the downstream side of the barrage. This change is especially important for relatively low flows and produces a deposition of bed load downstream of the barrage (accumulation of sand in the river bed) until the modified slope and section attain a new equilibrium according to the river regime.

The IPOE believes that maintaining an acceptable river morphology (cross-section, level of the channel bed and slope) requires periodic high discharges that can only be possible during the monsoon months, especially July, August and September. They are not needed every year but long periods of more than 5 years without considerable flood flows would induce vegetation growth and sedimentation that could irreversibly change the river morphology and the resulting habitat.

3.2 *Sustaining the mangrove vegetation*

Mangroves may play an important role in coastal protection, especially while they can act as a 'natural barrier during storm surges'. In addition they have a high value in the coastal ecosystem and can be used for camel grazing and fire wood cutting. According to data as presented in Study II, especially camel grazing and to a smaller extent the cutting of fire wood is taking place at a large scale and will undoubtedly have substantially contributed to the reduction in the mangrove area. By their impact on the mangroves these uses of the area have therefore also contributed to the process of coastal erosion. Sustaining the mangrove vegetation is of importance for:

- Their ecological role and economic value;
- Coastal protection and stabilisation (a broad mangrove belt along the coast would be needed).

Although the dominant species in the Tidal Delta have proven to be able to survive in purely marine conditions and seem to require a relatively small physiological freshwater amount, a certain freshwater flow and sediment supply during the Kharif season will be beneficial to ensure a healthy growth and reproduction of the mangroves. However, a high flow rate is needed to spread the fresh water over the Active Delta and may be over the remaining parts of the Expanded Delta. Flow rates and sediment supply that are needed for coastal stability, should also meet the needs of mangroves. In light of their role for coastal protection it is essential that the human use of mangroves be managed in such a way that a belt is being created and can be maintained.

3.3 *Findings with respect to a structural and a non-structural solution*

In Study I it has been investigated whether a structural solution - submerged weir, flap gates, or a barrage - could be implemented to prevent seawater intrusion and whether such a solution would be advisable compared to a non-structural solution. It was concluded that in principle a structural solution is possible. It would have the advantage of water saving and enabling the use of that water for other purposes. It was found that a barrage could be a solution, but it was not recommended.

There are important negative aspects related to the structural solution. The IPOE has analysed these aspects and likes to mention especially the following:

- The barrage would have to be closed, especially during the low flow periods. This may extend over several months with negative impacts to the environment. When it would be opened from time to time (during a low flow period to overcome this problem) its effect to water saving would be reduced;
- The river reach downstream of Kotri Barrage will be frequently dry during low flow periods, which also will have a negative impact on the environment;
- From a construction point of view the barrage will have to be built in a very unstable soil. In addition it will be required to connect the barrage to the bunds along the river while otherwise the river will flow around the barrage during peak flows and will find its new course;
- While the barrage will have to be operated in a tidal environment and from time to time

- be exposed to storm surges its operation will be complicated, maintenance cost will be high and there will be a serious risk of failure of the barrage or certain components of it;
- By connecting the barrage to the bunds, during peak flow periods high water levels may develop at the upstream side of the barrage, because the discharge will be constrained due to the barrage and the connecting bunds. In the type of soil that prevails in the area, piping may easily develop resulting in collapsing bunds and the river finding its course through the developed breach.

Because of the negative aspects as stated above the IPOE strongly recommends not to choose a structural solution and will therefore base their recommendations on the non-structural option.

4 Recommendations

Based on the findings as explained in the previous chapters the IPOE has formulated its recommendations as shown in the next sections.

4.1 Recommendations on escapages below Kotri Barrage

In the determination of the IPOE's recommendations on the minimum escapages below Kotri Barrage the following considerations have played a role:

- To check seawater intrusion downstream of Kotri Barrage (at the end of the bunds) as identified in Study I;
- The needed environmental flows upstream of Kotri Barrage as provisionally indicated in Study III;
- The impact of the recommended environmental flows on the availability of water for economic and social needs (irrigation, domestic and industrial water supply) as indicated in Study III;
- The minimum needs for fisheries of about 5000 cfs, more or less during the year, as indicated in Study II
- Maintenance of mangroves in the Expanded Delta as roughly indicated in Study II;
- Flows to keep the river morphology in good condition;
- Provision for general environmental sustainability (species diversity and habitat needs not yet fully known);
- The international developments and practices with respect to environmental flows;
- The recognition that a structural solution will not be feasible.

An escape at Kotri Barrage of 5000 cfs throughout the year is considered to be required to check seawater intrusion, accommodate the needs for fisheries, environmental sustainability, and to maintain the river channel.

The IPOE understands the problem of sea intrusion/coastal erosion as occurring in the Indus Delta and considers this as a National problem, because it is to a large extent the consequence of the developments in the country, especially of the diversion of water for irrigation. As far as the sediment supply is concerned it is of importance that by far most of the sediment is

supplied during peak flows as explained in section 3.1. The sediment supply is required to maintain a stable coastline, sustain mangrove vegetation and preserve river morphology. It is recommended that a total volume of 25 MAF in any 5 years period (an annual equivalent amount of 5 MAF) be released in a concentrated way as flood flow (Kharif period), to be adjusted according to the ruling storage in the reservoirs and the volume discharged in the four previous years.

As far as the mangrove vegetation is concerned a certain flow and sediment supply will be beneficial to sustain a healthy growth and reproduction of the mangroves, together with control of camel grazing and fire wood cutting, and mangrove replanting. It is considered to be of utmost importance to manage the mangroves in such a way that a sufficiently wide mangrove belt is being maintained in front of the coastline. The IPOE recommends that this be considered to be a National responsibility. It will therefore be of importance to prepare a coastal zone management plan.

The plan would have to describe:

- The coastal morphological processes under the influence of the river discharges, sediment supply, tidal and littoral currents, storm surges;
- The needed location and width of the mangrove belt with respect to their role for coastal protection;
- The locations where camel grazing and wood cutting can be permitted and the conditions for these activities;
- A replanting scheme for the mangroves;
- A description of the other relevant activities with respect to the coastal areas.

The plan would have to be the basis for the future management of the coastal area.

In order to spread the water over the flats a concentrated high flow would be needed during the Kharif season. The amounts of fresh water as mentioned above would be sufficient for a healthy mangrove growth. Based on the above considerations the IPOE recommends the escapages below Kotri Barrage as shown in Table 1. The flows can be adjusted according to the proportions of the allocations delivered to irrigation.

Table 1. Recommended escapages below Kotri Barrage in cfs and MAF

	Kharif						Rabi *)						Totals		
	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Year	Rabi	Kharif
In cfs	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000			
In MAF	>=0.3	>=0.3	>=0.3	>= 0.3	>=0.3	>=0.3	0.3	0.3	0.3	0.3	0.3	0.3	3.6 +**)	1.8	1.8 +**)

*) In a dry year the amount can be proportionally reduced in relation to the reductions in irrigation water supply

***) A total volume of 25 MAF in any 5 years period (an annual equivalent amount of 5 MAF) to be released in a concentrated way as flood flow (Kharif period), to be adjusted according to the ruling storage in the reservoirs and the volume discharged in the four previous years

4.2 Recommendations on storages

Based on the post Tarbela flow data the above recommendations would result in a required additional release downstream of Kotri Barrage during low flow months of 1.26 MAF in an average year (Figure 3) and 2.20 MAF in a typical dry year (Figure 4) (Table 2). The storage capacity in the Indus Basin is only 9% of the average annual river flow and is reducing because of siltation - thus difficult to maintain recommended flows in dry years. Therefore additional storage capacity will be required to prevent a reduction of water availability for irrigated agriculture.

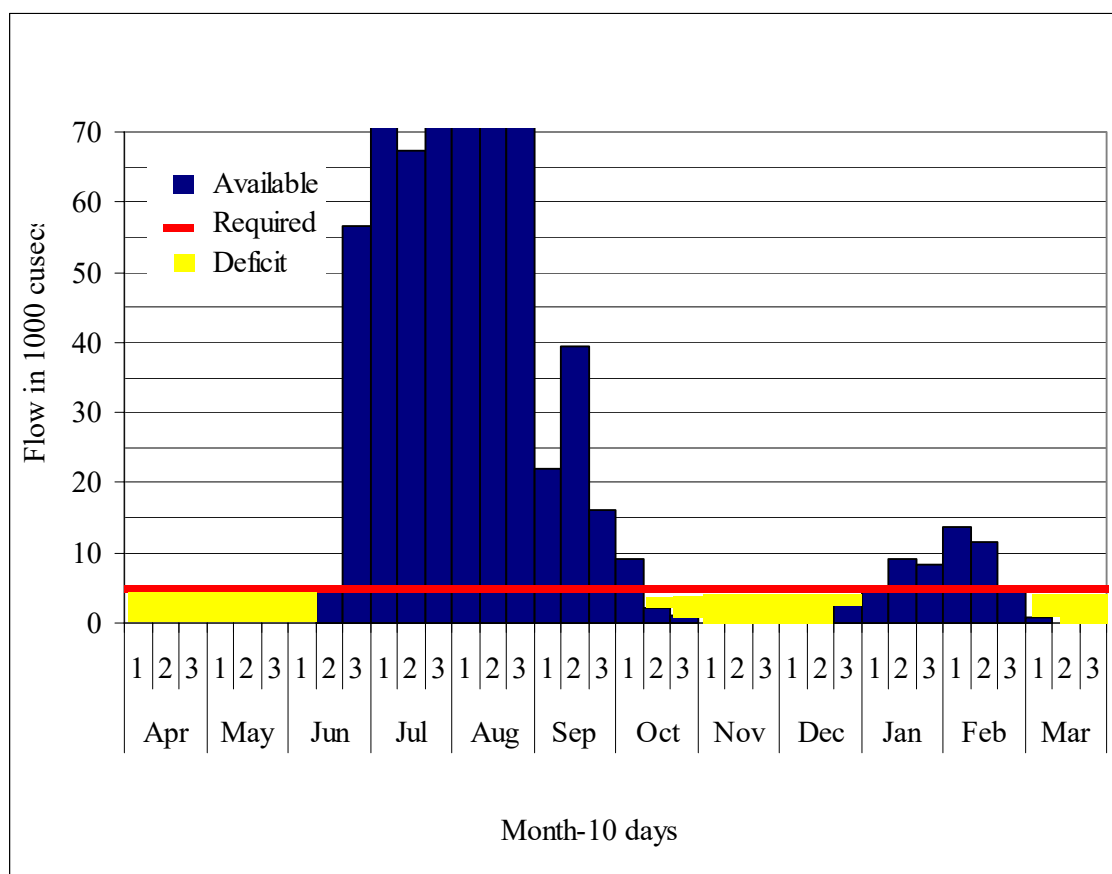


Figure 3 10-day average flows of Indus River below Kotri Barrage for a typical average year 1980 – 1981

Table 2 Summary of flows and deficits

Representative Average/dry year	Escapages in MAF			Deficit in MAF		
	Kharif	Rabi	Year	Kharif	Rabi	Year
Average year	1.80	1.80	3.60	0.59	0.67	1.26
Dry year	1.74	1.22	2.96	1.02	1.18	2.20

As said, the storage capacity is very low and does not sufficiently provide for the efficient management of the basin’s water resources. The storage capacity is also reducing due to high sediment inflows and retention. It therefore imposes constraints on the ability to maintain the recommended environmental flows during low flow months, in particular during dry years.

4.3 Recommendations for the development upstream of Kotri Barrage and in non-Indus areas

In Study III a comprehensive set of proposals has been formulated that refer to the development upstream of Kotri Barrage, or to areas outside the Indus Basin. The IPOE recommends that the proposals as made by Study-III with respect to the environmental concerns of the provinces, not reducing the escapages downstream of Kotri Barrage as recommended in section 4.1 and acceptable to the concerned province, be prioritised for implementation.

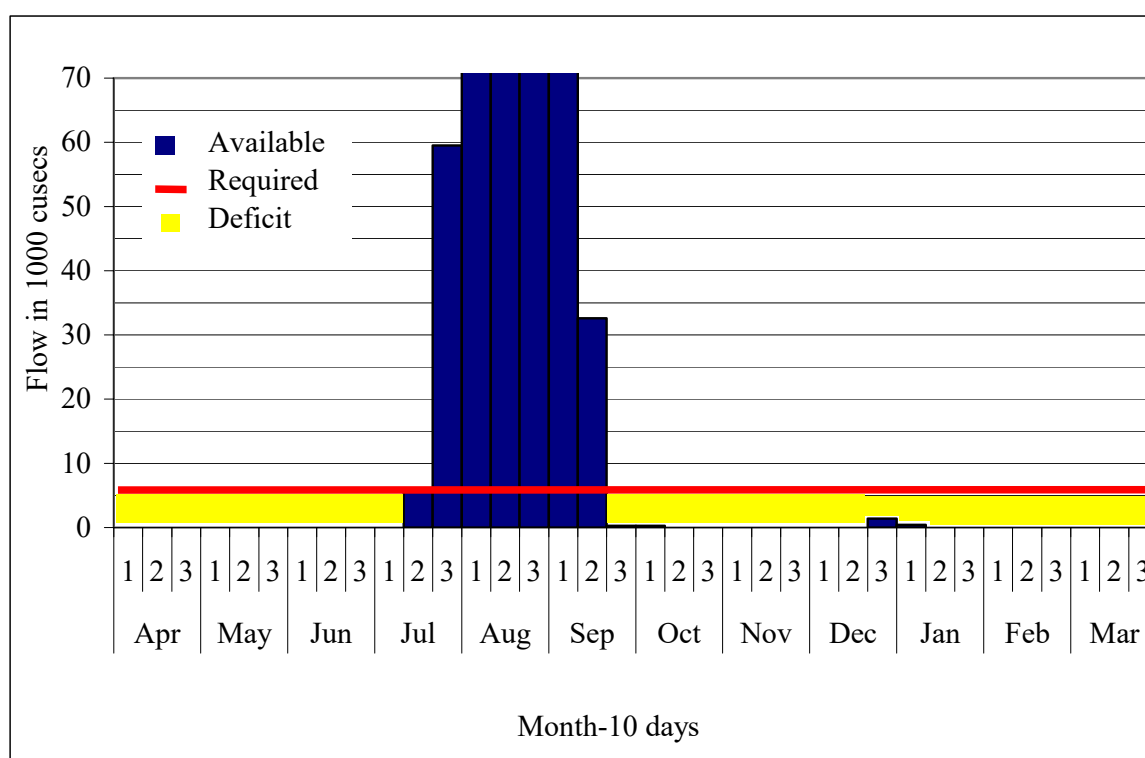


Figure 4 10-day average flows of Indus River below Kotri Barrage for a typical dry year 1985 - 1986

4.4 Recommendations on implementation of environmental flows

In accordance with international practice it is recommended that detailed planning with respect to the implementation of environmental flows be done, prior to commencing with actual implementation. This normally requires investments in management and institutional

arrangements, the introduction to technological refinement (such as to improve the efficiency of irrigation water distribution and application), as well as in infrastructure developments (storage and conveyance works), in order to mitigate the negative impacts on existing users. It may be required that the environmental flows are introduced over a period of time to allow for implementation of at least the primary mitigating measures.

Should new regulation infrastructure (dams, canals) be built in future, it is recommended that the following be taken into account:

- Provision of bottom outlet facilities to allow for the through flow of sediment during periods of high flow;
- Provision, already during the planning stage, for the management of releases in such a way that high flows can be achieved downstream of Kotri Barrage. The preference would be for higher flows of short duration, rather than lower flows of longer duration; within the limits of technical and economic feasibility;
- Environmental flows would preferably be routed via the upper rivers where required and where feasible, to also realise the benefits in these rivers before flowing into the reach downstream of Kotri Barrage.

It is essential that the environmental releases and key environmental indicators and parameters be monitored and regularly assessed as background to the possible future improved management of the system.

4.5 General recommendations

In its 2nd report the IPOE had advised that the database as developed by the consultant for Study III be transferred to a Government Office. The IPOE was informed that project preparation is on going to get this implemented at short notice. While the consultant of Study III developed the present database the IPOE recommends that implementation will take place under contract with this consultant.

Continued monitoring and assessment of key environmental parameters and indicators is needed for the whole Indus Basin, in order to improve the environmental and water resources database. The IPOE recommends that a plan for such a monitoring be developed. This could be included in the project for the transfer of the data base.

Well-planned and executed sediment sampling and monitoring of the escapages is required downstream of the Kotri Barrage. Study I has included a proposal for such a monitoring.

5 Concluding remarks

The flow regime in the Indus River downstream of the Kotri Barrage during the post-Tarbela period is not sufficient for environmental sustainability in the lower reaches of the river and the delta. The construction of a barrier on the river will only control seawater intrusion in the river and will not serve the other environmental needs, while creating additional negative impacts. It is also realised that it is not realistically possible to re-instate the past. A balance

therefore needs to be found between maintaining the benefits from upstream developments whilst also meeting the needs for environmental sustainability.

Man-made changes in the Indus Basin have substantially contributed to the food production and development of Pakistan. However, also negative impacts may be observed, like water shortage, dry river sections, coastal erosion, and reduction in environmental values. The present studies have substantially improved the insight and understanding of such processes. They have enabled the formulation of a proposal for escapages below Kotri Barrage as shown in this report, based on a judicious approach to release certain minimum flows downstream of Kotri Barrage throughout the year, supplemented by short duration peak flows.

Annex I Some background information

- I.1 The Indus Basin Irrigation System provides irrigation to about 40.0 Mac (million acre) (16.2 Mha [million hectares]) (73% of the total cultivable area in Pakistan) and generates about 90% of the nation's total value of agricultural output. Provision of irrigation on a controlled year around basis started in 1859. A rapid expansion occurred during the last 50 years with large investments in dams that provided about 13 MAF (million acre feet) (16 Bm³ [billion cubic metres]) of live storage (Tarbela, Chasma and Mangla are the main storages), and greater use of groundwater to increase both the irrigated area and the cropping intensity. Today the system comprises 19 barrages and head works, 12 link canals, 43 commands and some 107,000 watercourses.
- I.2 The increase in use of Indus River water for irrigation has significantly changed the hydrological balance of the basin. The annual water flow to the Arabian Sea diminished from 170 MAF (210 Bm³) to approximately 10 MAF (12 Bm³) at present and its distribution is basically in the Kharif season (July - September). This year the flow was 24.4 MAF (30.1 Bm³) during the Kharif season. Sediment transport was also altered. It was estimated that only a certain fraction of the original 400 million tons per year now reaches the delta.
- I.3 River flows are almost fully utilized except in some years during the Kharif period. The use of floodwater is limited for agricultural purposes unless additional storage is provided. There are a number of new dams that are now under consideration, among them Basha-Diamer, Kalabagh and Skardu. Future construction and raising of dams would increase water availability for irrigation, also improve usability of water and could as well enable better management of escapages over the year from Kotri Barrage to the Arabian Sea.
- I.4 Kotri Barrage was built in 1955. It is the most downstream barrage on the Indus River, before it discharges into the Arabian Sea. There is about 178 mi (miles) (286 km [kilometres]) of river reach from Kotri Barrage to the sea. If there is fresh water flow in this section it provides recharge to the aquifer and irrigation for agriculture in the riverine area. It also maintains low salinities in the Indus River last reach, prevents seawater intrusion, avoids environmental hazards and maintains growth of forests and certain mangrove species.
- I.5 The Indus Water Treaty (IWT) signed by Pakistan and India in 1960, resulted in an altered distribution of flows in the river system. Extensive infrastructure development took place that included link canals, barrages and reservoirs, to mitigate for the allocation of waters from the Beas, Sutlej and Ravi rivers to India. It is estimated that 1,057 mi (1,700 km) of the eastern rivers have now reduced flows during the Rabi season with impacts on riverine ecology, fisheries and groundwater flows to and from the rivers. There is no evidence that environmental aspects were considered during the discussions preceding the IWT.

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- I.6 The increase in irrigated area, on-farm percolation due to irrigation, percolation from distribution canals and lack of drainage infrastructure, have resulted in a gradual rising of the groundwater table causing critical problems of waterlogging and salinity over a substantial part of the commanded area. The groundwater table has risen about 100 ft (feet) (30 m [metres]) in some areas and it is estimated that salinity and waterlogging are causing a 25% reduction in agricultural productivity. This condition is worse in Sindh Province and especially in the Kotri district where the groundwater is naturally brackish or saline in more than 50% of the territory. On the other hand a gradual and sometimes rapid lowering of the groundwater table is taking place in other areas, due to the large-scale extraction of groundwater, primarily for irrigation purposes. The recent dry years have contributed to this lowering of the groundwater tables.
- I.7 Since the IWT was signed almost 30 years passed to get agreement among the provinces on the sharing of water. The Water Apportionment Accord (WAA) signed by the provinces in March 1991 replaced previous agreements to distribute the Indus River waters among the provinces and command areas. It established the water rights among the provinces and protects future water rights, including the effect of future storages. A formula is now available for sharing river flows. The Indus River System Authority (IRSA) was created as the regulatory authority for monitoring and distribution of the water sources of the Indus River in accordance to the WAA. The WAA recognized:

'The need for certain minimum escapages to the sea, below Kotri, to check sea intrusion. Sindh held the view that the optimum level was 10 MAF (12.3 Bm³), which was discussed at length, while other studies, indicated lower/higher figures. It was therefore, decided that further studies would be undertaken to establish the minimal escapages needed below Kotri.'

- I.8 Water quality of the rivers, canals and drains is deteriorated by direct wastewater discharges from cities, industries and agricultural lands. It is estimated that only a small percentage of domestic and industrial wastewater is treated. Even at large cities like Islamabad and Karachi that have wastewater treatment plants; these are not operated according to acceptable standards. Disposing wastewater without treatment is causing health problems and environmental impacts. According to the available information a special program to address this issue is being considered in the National Water Strategy.
- I.9 Since 1991 several studies have indicated a range of minimum flows to check seawater intrusion, none of which had been agreed upon. It is important that consensus be reached on the minimum escapages required below Kotri Barrage, which is the main outstanding item of the WAA. The current three studies jointly agreed to by the stakeholders were therefore commissioned in this respect. The Terms of Reference (TOR) for the present three studies were the product of intensive negotiations in which the provinces expressed their concerns about the issue of minimum flows needed to check seawater intrusion. However, they also address more general environmental

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concerns. The main objective of Study I - *Study on water escapages below Kotri Barrage to check seawater intrusion* - was to determine the minimum quantity of the Indus River water that needs to pass below Kotri Barrage to control seawater intrusion at desirable levels, and to suggest alternative measures to alleviate adverse impacts. Study II - *Study on water escapages downstream of the Kotri Barrage to address environmental concerns* - was to investigate and address environmental impacts from river water and sediment flows and their seasonal distribution below Kotri Barrage (forests, mangrove forests, fisheries, riverine agriculture, population, flora and fauna, seawater intrusion), identify mitigation measures and evaluate trade offs. Study III - *Study on environmental concerns of all the four provinces* - was to identify and address environmental concerns of all four provinces and needed to address a wide range of issues related to the management of water resources in the Indus Basin upstream of Kotri Barrage. The current studies had to verify the data on salinity of the water entering into Sindh Province.

- I.10 The studies had to verify the data on salinity of the water entering into Sindh Province. According to the International Panel of Experts (IPOE) for reviewing the Drainage Master Plan (DMP), the data do not indicate a worsening of the salinity content of the Indus River water at Kotri Barrage over a 30-year period. Additional measurements will have to provide more information about the salinity and water quality entering into Sindh Province.
- I.11 Information that may be derived from the three studies concerns:
- Study I transformed discharges at Kotri Barrage into salinity distribution along the river and the estuary and sediment discharge for a range of selected discharges;
 - Study II indicated benefits/costs of the range and distribution with respect to the ecological considerations and economic activities below Kotri Barrage;
 - Study III identified a way to operate the system above Kotri Barrage in order to deliver a certain distribution of discharges in the main river and its branches above Kotri Barrage.
- I.12 It is evident from the information, and already stated in several reports, that storage in the Indus River system is insufficient for an effective management of the waters of the system. Some of the existing storages are also silting up at an alarming rate which can have a detrimental impact on the efficiency with which water can be used for irrigation, for power generation as well as on the ability to beneficially manage the flow of water for environmental purposes (accepting that the system is already highly altered from the natural state).

Annex II Brief overview is given of IPOE's activities with respect to its TOR

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Annex II Brief overview is given of IPOE's activities with respect to its TOR

The international panel of experts (IPOE) for review of studies on water escapages below Kotri Barrage consisted of Fernando J Gonzalez (Mexico), Thinus Basson (South Africa) and Bart Schultz (the Netherlands). The Terms of reference (TORs) for the IPOE stated clearly 3 objectives:

- Review work of consultants for the three studies in 3 stages. Namely inception, interim and draft final reports;
- Review recommendations given by the consultants in the light of the scope of work envisaged in the TORs for all the three studies;
- Analyse the recommendations of the consultants in full perspective and suggest judicious trade-offs and interventions amongst various requirements.

Underneath a brief overview is given of IPOE's activities with respect to its TOR.

Review work of consultants for the three studies in 3 stages. Namely inception, interim and draft final reports

The first visit to Pakistan by the IPOE to review the work of consultants at the end of the inception phase took place during the period 19th of March to 15th of April 2005. At that moment the draft Inception Reports for the three studies were available. Main activities by Fernando Gonzalez included a visit to Sindh's coastal and the Kotri district area. He had meetings with main officials of the Ministry of Water and Power, Sindh Irrigation and Power Department (SIPD), Sindh Irrigation and Drainage Authority (SIDA), National Institute for Oceanography (NIO), World Conservation Union (IUCN) and WWF-Pakistan offices in Karachi and local authorities and social organizations in the lower Kotri basin. He also made a trip to Lahore to meet with the different consultants for Studies I and II in their Lahore offices. He also had a meeting with the Punjab Provincial coordinator for the studies. Meetings in Islamabad with the Federal Flood Commission (FFC), and the Chairman of the Indus River System Authority (IRSA) were an important part of the agenda of Fernando Gonzalez and Thinus Basson. They also attended and gave initial impressions during the Steering Committee meeting on 28th of March 2005. All IPOE members had regular meetings and feed back with Mr. I.B. Shaikh, Chairman FFC and Mr. A. Kamal, Project Director Kotri Studies and visited the consultants of study III in their Islamabad offices. Thinus Basson and Bart Schultz visited the Water and Power Development Authority (WAPDA), Punjab Irrigation and Power Department (PIPD) and consultants for Studies I, II and III in Lahore. They attended the Steering Committee meeting on 7th of April 2005 where Thinus Basson presented the draft conclusions and recommendations of the IPOE. After this Steering Committee meeting Bart Schultz paid a visit to Karachi to discuss in more detail the draft Inception Reports of Studies I and II with the SIPD officials and the consultants for these studies. However, at the latest stage the consultant for Study II could not attend this meeting. The comments of the IPOE on the draft Inception Report of Study II are in line with what was agreed during the Steering Committee meeting and the follow-up meeting in Karachi. The IPOE analysed the draft Inception Reports presented by the consultants and had meetings

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with them to ask for clarifications and to make suggestions for improvements to be presented at the Steering Committee meetings on 28th of March and 7th of April. During the meeting of 28th of March it was agreed that the Steering Committee would be the forum to examine and discuss the reports and recommendations for the three studies. The Steering Committee was therefore a very important body for mutual acceptance of the results and recommendations of the studies. The suggestions and recommendations (minutes of the meetings) formed part of the final Inception Reports. During the mission all the three consultants already accommodated a substantial part of the comments and recommendations by the IPOE in their revised draft Inception Reports. The findings and recommendations of the IPOE, based on the three Inception Reports and the discussions held during the visit, have been laid down in its 1st report, dated 14th of April 2005. In this report only the remaining IPOE comments of general nature and issues that needed careful attention during the further implementation of the studies are shown.

The second visit of the IPOE to Pakistan took place from 12th to 23rd of August 2005. Draft Interim Reports of the three studies were received before the visit. The IPOE could submit its written comments on the draft Interim Reports of Studies I and II before the visit. The IPOE received the draft Interim Report of Study III too late to give comments beforehand. All the three consultants already accommodated a substantial part of the comments and recommendations by the IPOE and submitted a large amount of additional information during the visit. It has been agreed that the draft Interim Reports would not be revised, but that all comments and suggestions would be included in the draft Final Reports. During the visit the IPOE had: (i) regular meetings with Mr. I.B. Shaikh, and Mr. A. Kamal; (ii) a meeting with the Secretary of the Ministry of Water and Power, Mr. A. Mahmood; (iii) a meeting with the Chairman of the Technical Committee on Water Resources, Mr. A.G.N. Abbasi; (iv) a meeting with the Secretary of the Sindh Irrigation and Power Department (SIPD) and his delegation; (v) two meetings with the project leaders and several members of each consultant to ask for clarifications and to make suggestions for the next steps to be taken; (vi) attended the Steering Committee meeting at the FFC on 17th and 18th of August 2005. During the meeting Thinus Basson presented the findings and recommendations of the IPOE. In addition Fernando Gonzalez and Bart Schultz paid a visit the consultant for Study III. Thinus Basson had meetings in Karachi with the Secretary of the SIPD, World Conservation Union (IUCN) and the consultant for Study III. He made a trip to Lahore to meet with the different consultants for studies I, II and III in their Lahore offices, and with the Punjab Provincial Coordinator for the studies. He also made a trip to Peshawar to meet with the NWFP Provincial Coordinator and the Deputy Team Leader for NWFP of the consultant for Study III. Bart Schultz made a trip to Lahore to meet with the Secretary of the Punjab Irrigation and Power Department (PIPD) and his delegation, Punjab Provincial Coordinator for the studies, Team Leaders and other staff members of the consultant for Study II and III. He also made a trip to Karachi to meet with main officials of the SIPD, the General Director and staff of the NIO, and the General Director of the Coastal Development Authority of Sindh.

The third visit of the IPOE to Pakistan took place from 7th to 16th of October 2005. Draft Final Reports of the three studies were received shortly before the visit. Therefore the IPOE

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could only submit its written comments during the visit and in this draft Final Report. The IPOE had: (i) regular meetings with Mr. I.B. Shaikh and Mr. A. Kamal; (ii) a meeting with the Secretary of the Ministry of Water and Power; (iii) a meeting in Karachi with the Secretary of the Sindh Irrigation and Power Department (SIPD) and his delegation and in Lahore with the Secretary of the Punjab Irrigation and Power Department (PIPD) and his delegation; (iv) meetings respectively in Islamabad (Study I, II and III) and in Lahore (Studies I and II) with the project leaders and team members of each consultant to ask for clarifications and to make suggestions for finalisation of the Final Reports; (v) a meeting with the NWFP Provincial Coordinator and the Provincial Coordinator Balochistan; (vi) attended the Steering Committee meeting at the FFC on 12th and 13th of October 2005. During the meeting Thinus Basson presented the findings and recommendations of the IPOE. The slides of this presentation are attached as Annex III.

In addition to the activities by the IPOE during the visits to Pakistan, substantial work was also done by the members of the IPOE from their home offices. This included reviews of advance copies of draft reports prior to the Pakistan visits as well as continued communications with and recommendations to the FFC and the Study consultants throughout the duration of the studies. Substantial time was spent after the last visit in assisting with the finalisation of the reports and also preparing the draft scope of the work for the implementation of the recommendations.

Review recommendations given by the consultants in the light of the scope of work envisaged in the TORs for all the three studies

At the three stages the IPOE has had meetings with the three consultant teams and with the government representatives at Federal and Provincial level as outlined above. In all these meetings the IPOE has presented its questions, ideas, (preliminary) analyses and (preliminary) recommendations. In the meetings with the consultant teams the IPOE has generally focussed on the consultants' considerations behind his analysis and recommendations. Especially in the meetings with the Federal and Provincial representatives, the IPOE has asked for their opinion with respect to certain items. The IPOE appreciates that the meetings had an open character and that generally the items could be discussed at a professional level. During the meetings the IPOE has requested clarification on a broad spectrum of items, both from the consultants as well as from the representatives at Federal and Provincial level. Besides the improvement of the IPOE's own insight in the matter, these questions have in various instances resulted in modifications in the consultant reports as well.

As is described in the three reports of the IPOE, with respect to several items the IPOE could not agree with the draft analysis, or the draft recommendations as formulated by the consultants. In all these cases the IPOE has made clear to the concerned consultant, what were considered the reasons for the difference in opinion, or analysis, and what would be the recommendations of the IPOE. The IPOE has also raised such issues in its meetings with the government representatives and asked for their opinion as well. Last but not least the IPOE

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has reported on such issues in the Steering Committee meetings. In many instances this has resulted in modifications of the consultant reports, especially with respect to Study II and Study III. The items are listed in the annexes of the three reports of the IPOE.

Analyse the recommendations of the consultants in full perspective and suggest judicious trade-offs and interventions amongst various requirements

During all stages the IPOE has carefully analysed the recommendations of the consultants in full perspective and has suggested judicious trade-offs and interventions amongst various requirements. It has reported on its (initial) findings and recommendations during the individual meetings, the three meetings of the Steering Committee and in its three reports.

The findings and recommendations as presented in this report are based on the review of the studies at relevant stages, the in depth discussions with government staff at Federal and Provincial level, as well as with the consultants, and an analysis of the international experiences and practices. In this report the IPOE's has formulated its own recommendations. The considerations to come to these recommendations are given in the text. The following factors have played a major role in the formulation of the recommendations:

- The understanding that the following aspects primarily justify the need for water escapages below Kotri Barrage:
 - salinity encroachment in the river, aquifer and coastal zone;
 - requirement of coastal stability;
 - requirement of a sustainable environment;
 - fisheries;
 - prevention of salinity accumulation in Indus Basin.In addition other factors may play a role: riverine forests, riverine agriculture, pollution control and drinking water supply;
- The consideration that in the determination the minimum escapages below Kotri Barrage the following factors play a role:
 - to check seawater intrusion downstream of Kotri Barrage as identified in Study I;
 - the needed environmental flows upstream of Kotri Barrage as provisionally indicated in Study III;
 - the impact of the recommended environmental flows on the availability of water for economic and social needs (irrigation, domestic and industrial water supply) as indicated in Study III;
 - the minimum needs for fisheries and maintenance of mangroves in the Expanded Delta as roughly indicated in Study II;
 - the need for certain flows to keep the river morphology in good condition;
 - the international developments and practices with respect to environmental flows;
 - the recognition that a structural solution will not be feasible.

Annex III General findings and recommendations of the IPOE as presented during the Steering Committee meeting on 13th of October 2005

Indus River, Pakistan

Studies on Water Escapages Below Kotri Barrage

Review of Draft Final Reports
and Integrated Overall Recommendations by IPOE
Fernando Gonzalez, Bart Schultz, Thinus Basson

13 October, 2005

Approach Followed

- Reviews at home offices and in Islamabad
- Detailed discussions with Study Teams in Pakistan
- In depth discussions with Federal and Provincial Officers

Recommendations based on above, plus other relevant work and international experiences and practices

Study – I: Sea Water Intrusion

- Work again of high technical standard, good data base, reliable calibrations and modeling
- Report clear, concise, focused on issues of relevance
- Section on groundwater submitted later, and was presented at Steering Committee
- Additional results presented at Steering Committee
- The work completed and in compliance with the TOR

Study – I: Results

- Position of saltwater interface and salinity profiles determined for flows of 5,000, 10,000 and 15,000 cfs
- No possibility of seawater intrusion into groundwater (high salinity groundwater of ancient origin)
- Post Tarbela sediment discharge below Kotri on average 126 million tons/year, largely in high flows
- Structural option for prevention of seawater intrusion not favoured
- Recommendation for dry, average and wet years not acceptable

Study-II: Environmental Impacts Downstream of Kotri

- Valuable information gathered and documented
- An overall integrated analysis of processes at stake, assessment of relative contributions and justification of conclusions and recommendations not given
- Report still requires integration of components plus refinement. Presentation disappointing
- Erroneous statements had unfortunate impacts
- Assessment of overall impacts associated with different salinity profiles not addressed
- New executive summary + revised report

Study –II: Results

- Freshwater requirements given for mangroves, fishery and riverine agriculture (some uncertainties)
- Water requirements also given for riverine forest, domestic water and pollution control (to be revised)
- Highlights various social and ecological impacts and aspects of specific importance - such as related to mangroves
- Documentation of processes and key factors re mangroves, coastal sustainability, fisheries in progress

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Study – III: Environmental Concerns of Provinces

- Substantial work done and most of earlier comments addressed
- Main report clearly presented in accordance with TOR
- Conclusions and recommendations not always following from or addressing the TORs - particularly in draft Executive Summary
- All TORs addressed; some still in general terms
- Expectations in some cases were ambitious

Study – III: Findings

- Long reaches of rivers are dry at times, requiring environmental flows
- Groundwater in some areas being mined
- Quality of both surface and groundwater problematic in certain areas
- Assessed and where possible, quantified environmental impacts
- Modeled selected scenarios of environmental flows in upstream rivers
- Independent TORs individually addressed

Summarising statements by IPOE - 1

Need for water escapages below Kotri Barrage primarily justified by:

- Salinity encroachment in river and coast zone
- Instability of deltaic coastline
- Requirement of a sustainable environment
- Fisheries
- Prevention of salt accumulation in Indus Basin
- Considerations on riverine forests, agriculture, domestic water, pollution control

Statements by IPOE - 2

Main considerations backing IPOE recommendations:

- To check seawater intrusion in river (not in groundw.)
- Minimum needs of fisheries
- Maintenance of mangroves in the expanded delta
- Maintaining of river bed morphology
- Environmental flows needed upstream of Kotri and need to flush salts from Indus Basin
- Recognition that structural solution is not feasible
- Relatively limited impact of position salinity interface
- International practices on environmental flows

Statements by IPOE - 3

Flow of 5,000 cfs considered to be required:

- To check seawater intrusion (at end of bunds)
- Accommodate needs for fisheries (5,000 cfs in June, 4000 cfs in November – February)
- To maintain the river channel for low flows
- Provide for general environmental sustainability (species diversity and habitat needs not yet fully known)

Statements by IPOE - 4

Coastal erosion primarily ascribable to:

- Reduction in sediment supply by Indus River
- Reduction in mangrove vegetation (stabilisation)
- Restricted area of flooding due to bunds
- Sea level rise
- Possible more extreme weather due to climate change

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Statements by IPOE - 5

Coastal erosion – continued:

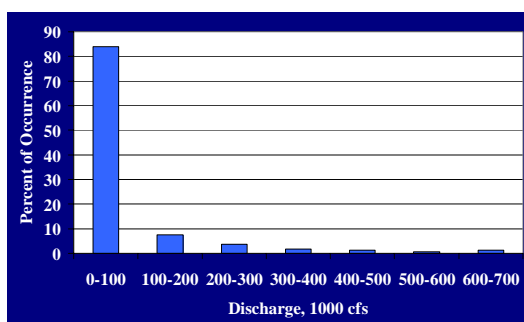
- Original 400 million tons/year sediment: accretion about 30 m/year. In post Tarbela period estimated 25 million tons/year average shortfall to prevent decreation. Composition of sediment important
- Important to ensure periodic high flows (short period), also in future, for deposition of sediment on coast and delta area

Statements by IPOE - 6

Sustaining the mangrove vegetation:

- Required for its ecological role and economic value;
- Of specific importance for coastal protection and stabilisation (need broad mangrove belt along coast)
- Certain freshwater flow and sediment supply beneficial to ensure healthy growth
- Relatively small physiological freshwater requirements. However, high flow rate needed to spread water over the area

Discharge distribution 1972 - 1999



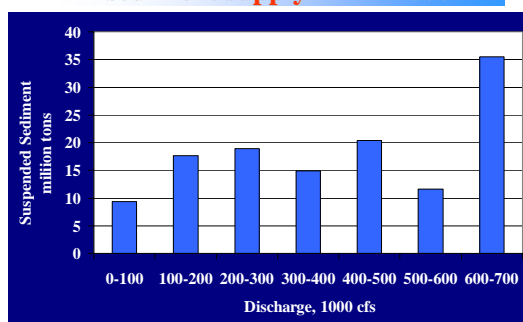
Statements by IPOE - 7

Mangrove vegetation – continued:

- Flow rates and sediment for coastal stability, should also amply meet needs of mangroves
- Essential that human use of mangroves be properly managed

Coastal stability recognised by IPOE of National importance, and management of mangrove as a National responsibility

Discharge and average annual sediment supply 1972 - 1999



Recommended escapages

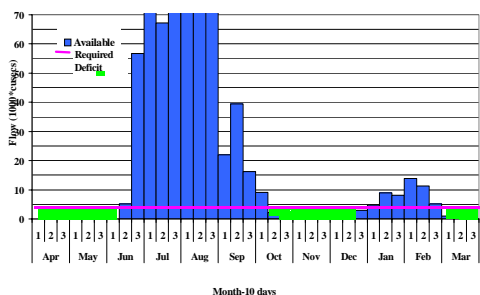
	A	M	J	J	A	S	O	N	D	J	F	M
Cfs *)	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
MAF	0.3	0.3	0.3	>= 0.3	>= 0.3	>= 0.3	0.3	0.3	0.3	0.3	0.3	0.3

>= high flow to be released in a concentrated way, to be adjusted according to the storage in the reservoirs and the volume discharged in the four previous years (equivalent of 5 MAF, currently 30 MAF)

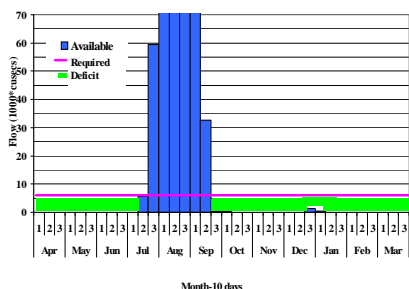
*) In a dry year the amount in any month has to be proportionally reduced in relation to the reductions in irrigation water supply

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Average year and minimum flows



Dry year and minimum flows



Summary of Flows and Deficits

Representative Average/dry year	Escapages (MAF)			Deficit (MAF)		
	Kharif	Rabi	Year	Kharif	Rabi	Year
Average year	1.80	1.80	3.60	0.59	0.67	1.26
Dry year	1.74	1.22	2.96	1.02	1.18	2.20

Statements by IPOE - 8

Storage in Indus Basin is limited (only 9% MAR) and reducing – thus difficult to maintain recommended flows in dry years

International practice to have detailed implementation planning for environmental flows:

- Normally requires investments in management, technology and infrastructure
- Implemented over time to mitigate negative impacts on existing users

Statements by IPOE - 9

Possible new storages in future:

- Provision to be made for bottom release of sediment during high flows
- Provide for high flows downstream of Kotri Barrage, probably of shorter duration
- Environmental flows to be routed via upper rivers where appropriate, then for release downstream of Kotri

Statements by IPOE - 10

Upstream of Kotri and non-Indus areas:

- to proceed with further investigations, monitoring, implementation planning

For the whole basin:

- need for continued monitoring and assessment to improve environmental and water resources data base

Downstream of Kotri Barrage:

- Well planned sediment sampling
- Coastal management and protection works

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Finalisation arrangements

- All executive summaries to be updated and finalised by 18 October
- Study I report to be finalised by 18 October
- Study II and III main reports and appendices to be finalised 27 October for final comments and 31 October final
- Draft report by IPOE to FFC by 16 October
- Final report by IPOE to FFC by 31 October

Concluding remarks

- Not realistically possible to re-instate the past
- Judicious approach is to release water for environmental purposes, supported by proper monitoring and assessment
- Not recommended to implement structural measures

Annex IV Review of the Draft Final Report of Study I

General comments

The IPOE likes to give the following general comments:

- I.1 The report is well written, of a high professional standard and covers the TOR. There are, however, some important issues to be solved and points to be clarified, which will be specified in our comments.
- I.2 The period 1955 - 1975 is not really a homogeneous one, while the diversion of flows to India started during this period. Therefore it is not optimal for comparison of the desirable conditions encountered in the past. However, the IPOE understands that it is the best possible option that is available and therefore considered to be acceptable;
- I.3 The recommendations in section S9 about the barrage to check seawater intrusion are not clear. Are you recommending its construction or not? Can the river flow be simulated?
- I.4 Item 10 needs more examination. Why do you want to eliminate the zero discharges and apply 1,000 cfs as minimum flow? The IPOE believes that the minimum volume to keep seawater intrusion checked is not dependant on the hydrologic year selected as the 10% driest or wetter. The source of the water to be released can be different and could be calculated by making a simple simulation of the post 1975 period.
- I.5 A minimum flow of around 5,000 cfs seems appropriate for the low flow months. This flow can be changed if there is a deficit in the water for irrigation in the same proportion. Water for escapages could then be similar to the water for one additional canal.
- I.6 The salinity distribution for zero (0) flow is not correct. Explain the results in terms of diffusion and dispersion.
- I.7 Exhibit S-4 needs to be reviewed if the 5,000, 10,000 or 15,000 cfs are to be maintained.
- I.8 Is it possible to calculate a minimum flow to maintain the river section during the Kharif season?
- I.9 What would be the influence of additional storage on low flows and flow to maintain the river flood channel?
- I.10 There is a need to clarify the conclusion that the groundwater has not been affected by

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the seawater intrusion and the results of the dating analysis.

- I.11 Please check proper use and unit prescription of levels compared to +MSL (Mean Sea Level).
- I.12 Please consult with the consultant of Study II for consistency of text where overlaps occur and for the use of names for different areas. This refers especially to the hydraulic computations, the sediment figures, the groundwater data and the names and areas for different types of the riverine and delta area.

Detailed comments

The IPOE likes to give the following detailed comments per chapter or section:

- I.13 Review exhibit S-7 including the source of the water.
- I.14 If possible add in the definitions the definitions for:
- BCM;
 - Bilateral slope;
 - Coastal erosion;
 - Fossil groundwater;
 - RL.
- I.15 *Section 2.3.1*
- With respect to the flow regulation there are also several barrages and link canals;
 - With respect to the decrease of flow the percolation to groundwater may have to be added.
- I.16 Figure 2.1 will have to be modified.
- I.17 *Section 2.8.* Review the confining of the river effect on the delta.
- I.18 *After section 2.13.3.* Add a brief description on storm surges.
- I.19 Add in Exhibit 2.1 the location of the outfall drains
- I.20 *Page 4-1.* Please comment on the validity of previous studies for the present results. A period of 4 months without flow for an impact (page 3-7) of several days (page 3-9) or 2 weeks.
- I.21 *Section 7.1.* We still wonder if the anisotropy should not be given as 100:1, instead of 1:100 as is done now in the text. Please check.

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- I.22 *Section 6.8.*
- Please explain scenario 1 in page 6-10;
 - The IPOE has not recommended certain discharges, but has requested to investigate certain discharges.
- I.23 *Section 7.6.2.* The sentence: *However, the shallow zone of fresh groundwater layer developed will be now impacted by seawater intrusion.* This sentence may be misleading. Please clarify to which area this applies.
- I.24 *Section 8.3.2 second paragraph.* Please clarify how many hectares this concerns and what it would mean in financial terms.
- I.25 *Page 9-2.* Why is Dandho the appropriate place for the interface? Why not to select the one for 5,000 cfs. The last paragraph needs to be reviewed.
- I.26 *Page 10.3.* The use of the DE Index is not clear.
- I.27 A monitoring and evaluation program seems to be a good idea. Please add sediment monitoring.

Annex V Review of the Draft Final Report of Study II

General Comments

The IPOE likes to give the following general comments:

- II.1 Although the consultant has accommodated a substantial part of the comments that were made by the IPOE in its Interim Report, another substantial part of the comments that was discussed with and approved by the consultant have not been accommodated in the draft Final Report. Therefore several of our comments as made during the Interim phase will be repeated in these comments, taking into account what has been shown in the draft Final Report.
- II.2 The draft Final Report does not integrate related issues. In our opinion in a study like this an overall/integrated analyses for understanding of the processes at stake, assessing the relative contributions and a justification of the conclusions and recommendations is an absolute requirement. This is the more valid in the complicated environments and processes we have to deal with.
- II.3 Reading and understanding the draft Final Report is very difficult because each section seems to be written by a different team without the needed integration. The consultant has collected and shows in the draft Final Report a substantial amount of data. In general it is also made clear where the gaps in the data are. It is, however, not always shown what is the source of the data and under what conditions, or for which area the given data are applicable. In addition in different parts of the report different data for the same topic are given. Several times the same data are repeated at different places. This refers especially to:
- Data on discharge and sediment transport/supply of Indus River;
 - Mangrove grows, types and location in time;
 - Economic value of the activities in the riverine area and of fisheries;
 - Etc.
- II.4 At the Interim phase it was discussed that there is a need to develop a spatial zoning and distribution to understand the main phenomena and forces acting in each of them. It was often unclear for what area and under what conditions the comments, observations, suggestions and proposals of the consultant are applicable. This referred especially to:
- II.4.1 *The different parts of the Delta.* Although the consultant now gives definitions or prescriptions for: Core Delta, Expanded Delta, Tidal Delta and Active Delta, we find the following other names in the report, which need to be made consistent to enable a reader to follow the text:
- *Core Delta, core delta, Active Indus delta, active delta, active delta area and active delta region.* It has been agreed that the consultant will call this area the Active Delta. It is an area of 91,331 ha. It is the yellow area

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in Figure 5. It has to be carefully checked throughout the report that the same terminology be used;

- *Expanded Delta and expanded Indus delta.* It has been agreed that the consultant will call this area the Expanded Delta. This is an area of 151,887 ha. It is the yellow and the green area in Figure 5.
- *Tidal Delta and tidal delta.* It has been agreed that the consultant will call this area the Tidal Delta. The area represents a much larger tidal zone (about 620,000 ha) beyond the study area and it spans from the Korangi Creek area near Karachi and the Sir Creek near the Indian border of India. Tidal Delta is the entire shore land base inundated by the sea characterized by mangroves, mudflats and salt shrub with most of the area beyond the influence of the Indus River freshwater and floods. This area is not shown in Figure 5;
- All other names as mentioned underneath would have to be changed in the above-mentioned three names, unless there is a reason not to do this.
 - o Indus River Delta, Indus Delta, Indus delta and Indus delta area;
 - o Delta, delta, Delta area and delta area;
 - o subaerial delta;
 - o delta land base;
 - o lower delta;
 - o deltaic islands;
 - o southern delta, Southern Indus Delta and southern Indus Delta;
 - o lower active delta;
 - o delta study area;
 - o mouth of the delta;
 - o deltaic region and delta region;
 - o central delta area;
 - o delta estuarine area;
 - o inter tidal delta (385,000 ha);
 - o river delta;
 - o delta communities;
 - o delta district;
 - o Indus delta population;
 - o extreme deltaic districts;
 - o Indus Deltaic Eco-region and Indus Delta Eco-region;
 - o South-eastern part of the delta;

We still have the impression that when just the words delta, or Indus delta are used, they may have a different meaning at different places. We consider it therefore required that the terminology is carefully checked and be made consistent, and that the remaining areas and their names are clearly shown in Figure 5 and its legend;

- II.4.2 Whether an issue is applicable to the land, the sea, or the transition zone. In our comments to the Interim Report we have expressed that it would be useful if a clear distinction is made in the following areas and that these areas are shown

Draft Final Report of IPOE for Review of Studies on Water Escapages Below Kotri Barrage

as good as possible on a map as well:

- Areas that can be flooded from the river
- Areas that are never flooded from the sea;
- Areas that can be flooded during a storm surge;
- Areas that can be flooded during spring high tide;
- Areas that are flooded during every tide;
- Areas that are permanently under water.

In our perception this is very relevant, while then it becomes clear to a reader which process occurs where. In the draft final report it is shown that in fact only downstream of the flood protection bunds flooding from the river outside the bunds may occur. The other areas are not shown on a map, nor is attention paid to this classification in the report. In section 16.8, Table 52 is given with land under seawater intrusion in Thatta and Badin Districts of Sindh (repeated in section 7.1 of the appendices, and most probably also reflected in the text of 3.2.4 H). However, these areas are not shown on a map, nor is it explained how often they are flooded and what is the reason of the flooding. In addition in section 18.6.1 some information is given with respect to Keti Bandar, or Keti Bunder (both names are used in the same section).

- II.5 In our comments to the Interim Report we have stated that the time or period in the analysis needs to be the same and be clearly specified whether it is before Kotri, before Tarbela, the present or the future conditions. In the draft Final version it is only for some items fully clear what time horizon is taken into account. We have the impression that for different items different time horizons have been taken into account, although we are not fully clear about this while it has not been clearly described.
- II.6 Although, compared to the Interim Report, substantial improvements can be observed, in several of the chapters still a substantial part of the text is going beyond the issues at stake and therefore can better be deleted to get more focus on the things that real matter in this study.
- II.7 Page and figure numbers are inconsistent. The same applies to the use of units, which is quite different at different places in the report. It would be most helpful if this can also be made consistent.

Detailed comments per chapter or section

The IPOE likes to give the following detailed comments per chapter or section:

- II.8 First of all we like to repeat several of our comments as given on the Interim Report that we consider of importance and that in our opinion are not yet accommodated in the draft Final Report. These concern:
- if possible to indicate the part of the delta area that received water before the dams

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were built, or before the Kotri Barrage was built;

- to pay much more attention to the past, present and potential future role and requirements of the mangrove forests for coastal protection;
- silt and nutrient demand of the mangroves eco-system and the proportion provided by the Indus River discharge. As said we fully underline the importance of this issue. However, it is described that there were five types of mangrove species in the Indus Delta. Each species has a different salt tolerance as shown in Table 4 and requires a different environment, also with respect to flushing with fresh water and sediment supply. Out of these species *Avicennia marina* covers by far the largest area and seems to be able to grow in purely marine conditions. We suppose that this is the species that growth at the mudflats near to the open sea as can be seen on the satellite images (Figures 9, 10 and 11). Two other species - *Ceriops tagal* and *Aegiceras corniculatum* - cover small areas and seem to be more in need of flushing with fresh water and sediment as mentioned above. The remaining two species in the Table seem to have totally disappeared. We understand from the report that it is not possible to show in a map where the three remaining species are growing. In the report only one figure on the need for flushing is given which is 1 cusec per 100 acres. Is this figure also applicable to *Avicennia marina*? In addition we like to remark that at different places in the report, different requirements are formulated for the growth of the mangroves. This needs to be made consistent;
- The report mentions the three important issues for the damage to mangroves, being: (i) lack of freshwater and silt; (ii) camel browsing; (iii) fire wood cutting. We had requested to clarify what can be the contribution of each of these items. We cannot find such a clarification in the draft Final Report. Figures are given for the camel grazing 67,000 tonnes of twigs and leaves per year, 18,000 tonnes per year. Can any indication be given how this compares to the annual regrowth? Although not mentioned in the report, we see from Figure 11 that important reasons for the disappearance of mangroves are: shrubs, sand and sediment (in total 34,184 ha). This gives us the impression that the flats have become (slightly) higher at such places and that the loss doesn't have to do so much with lack of sediment, or of fresh water. Is this understanding right, or do we misinterpret the processes at stake.

II.9 *Executive summary 1.1.*

- See our previous comments on the mangroves;
- We understand that the 15 MAF is based on a mistake and wait for the corrected data;
- How do you know that the increase in salinity is the main reason in the decrease of mangroves if you cannot put in perspective the contributions of Camel grazing and fire wood? See also our remark above, based on Figure 11;
- What is meant with the existing flow regime;
- Why should the Management plan for the protection of the mangroves only be developed for the Active Delta;

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II.10 *Executive summary 1.2.*

- To which delta apply the figures of loss and gain;
- ‘... seawater can intrude further inland’. What is meant here?
- It is unclear how we have to interpret the cumulative discharge volume of 36.3 MAF and 2.3 MAF of low flow discharge during the Rabi season.

II.11 *Executive summary 1.3.*

- ... no over bank flow... What is meant here, the riverbed?
- It is said that there are drought problems for the riverine forest. However, when we see the flow simulations in the Figures 34 – 38 there would already be more or less full coverage of the flood plain area at 10,000 m³/s (about 350,000 cfs) flow. According to Table 24 this flow can be expected at least once in two years. So the question is, is there really such a drought problem for the riverine forest that you have to irrigate it.
- To what areas are the 974, 1,105 and 1,591 cusecs applicable (45,283 ha, 51,376 and 73,979)? Will this be river water, or existing canal water?

II.12 *Executive summary 1.5.*

- On which condition is the 4,000 cusecs in the main channel from November to February based. What goes wrong when it would be 1,000 cusecs in a dry Rabi as proposed by Study I, or respectively 8,000, 6,000, 3,000 and 3,500 for an average year as proposed by Study I;
- We wonder if the second part of the recommendations as given here is applicable to this study, which is dealing with flow requirements to Indus River downstream of Kotri barrage.

II.13 *Executive summary 1.6.*

- In our opinion pollutants will have to be treated at the source. Dilution is basically no solution to pollution, it can only be applied as an intermediate, preferably short term, solution;
- ‘... Indus water can be treated by slow or rapid sand filtration ...’ what is meant here in light of this study?

II.14 *Executive summary 1.7.*

- We wonder if there is no overlap in the areas identified for riverine forestry and riverine agriculture;
- We also wonder whether it will not be better for the government to discourage riverine agriculture, because of the risk of flooding and resulting responsibility questions. Agriculture at own risk could be acceptable, but then the farmers would have to take care for their own provisions and own risk. We therefore don’t recommend that the government will supply water for riverine agriculture;
- If nevertheless it will be decided to supply 0.615 MAF, the question arises will this be water from the river, or irrigation canal water that has been diverted

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upstream of Kotri barrage.

II.15 *Executive summary 1.8.* It is unclear for us how the 0.36 MAF for domestic use from Indus River water downstream of Kotri Barrage has been determined.

II.16 *Executive summary 1.9.* It is unclear for us what are the consequences of this item for use of Indus River water downstream of Kotri Barrage.

II.17 *Glossary of Terms*

- It would be most welcome if this can be put in alphabetic order;
- Several terms are missing, like FPB, EEZ, MST. At several places the text starts directly with the abbreviation without the full term first. This makes reading not easy.

II.18 *4. Introduction*

- To what area is the 30 m/year applicable?
- At page 17 and 18 different figures are given for the tidal amplitude, the discharge and the basin area;
- What is the meaning of Figures 2 and 3 and Table 1 for this study?

II.19 *8. Riverine Forest*

- the statements in this chapter are in our opinion not in agreement with the data and simulations on flooding as given at page 88 section 12.4, nor with Table 24 on page 112;
- we also have the feeling that section 8.4.3. is not in agreement with the results shown in Figures 34 – 39 at pages 130 – 18
- Memon (2000) gives a total figure for fire wood demand of $31.6 + 40.9 = 72.5$ tonnes per year. For 45,283 ha this would imply 1.6 kg/ha, which in our opinion is neglectable. Is our interpretation right?
- What is the impact of the livestock figures as given on the Riverine forest?
- The Figures as given in Table 5, page 38 work on average out in our opinion for respectively Hyderabad, Thatta and Badin as: 3.5 cft/ha, 22.4 cft/ha and 15.3 cft/ha. These figures look very low. Is our interpretation right?
- It is stated on page 38 that *Riverine forests act as a barrier to inundating floods.* Is that really applicable in this case?
- ...1345 MAF.... How has this been computed? It cannot come from 974 cusecs.

II.20 *9. Wildlife habitats*

- *page 40 first paragraph.* It looks like other species of mangroves are mentioned here than in the mangrove chapter. Please check;
- *page 40 third paragraph* nine snakes. At page 43 eight snakes;
- *page 40* from 62,720 to 60,406 is not an increase, but a decrease;
- *page 40* on the bottom 14 Dolphins, page 46 600 dolphins, please check;

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- several items in this chapter are just duplications;
- *page 45 on top*. Is the increase of the farmland from 4,352 to 18,346 ha at the cost of the riverine forest? See also page 48;
- *9.7.1* Is this applicable to the study area?
- It would be useful to show the sites in Table 6 and 7 on a map;
- *9.8.1 second paragraph*. What does this mean under what conditions?
- 8,181 is different from the figure that is given at other places in the text;
- *9.8.2* extinction of the Indus Dolphin population. Is this right in light of page 46?
- *9.8.2* we don't have Appendix W. Droughts.

II.21 *10. Indus delta mangroves*

- see our previous remarks;
- *10.3.1* we cannot find the list with organizations consulted;
- what are the experiences with the replanted mangroves, while these have had very dry (saline conditions)?
- *Figure 15, page 61*. Does the Figure imply a loss of about 50 million tones per year? What is supposed to be the increase in height of the shallows?
- *Page 62*. On which reference is the story on wave energy in the second paragraph based?
- We had asked to give an indication of the required width of the mangrove belt for coastal protection. Can such information be added?
- What are the units for clay, silt and sand in Table 9?
- What would be the requirements for the management of the mangroves?

II.22 *11. Fishery impact studies*

- *page 71*. 675.3 million tons and 675,000 metric tons are mentioned. What is right?
- Also in this chapter there are several duplications with previous texts;
- *Page 76* 218,880 metric tons. Is this high, normal or low per unit area?
- *Page 77*. several amounts of fish catch are given. The question would be what are sustainable amounts;
- What requirements would there be for Indus River flow with respect to coastal fish production?
- *11.4.1*. It is unclear in this section what is the gain and what is the loss?
- *11.4.3* We thought it was agreed that 1000 ppm would be used, or are for sea fish the 2000 and 5000 ppm levels more relevant?

II.23 *12. Hydrologic studies*. Are the results consistent with Study I, and if not what to decide?

II.24 *14. Sediment transport*

- how do the results relate to the results of Study I?
- *Table 35*. How has the sediment load of 88322 tons/day been determined?

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II.25 *15. Ecologically alternative agricultural practices*

- a fundamental question is why to promote agriculture in the riverine area. See also our earlier remarks;
- *15.3 page 22.* What means 5,00000 cusecs and 5,00,000 cusecs;
- *page 23.* The figure of 95,038 acres is as far as we can see not in agreement with previous figures;
- *15.8 page 19.* We recommend that agriculture in the riverine area will not be supported for reasons as mentioned before;
- where does the figure of 1500 ppm comes from. We thought it would be 1000 ppm;
- *page 20.* To which area are the income figures applicable?

II.26 *16. Pollutant control*

- *16.2.* The Water Apportionment Accord is wrongly quoted here;
- *16.10.* The recommendation in the first paragraph is not considered to be realistic.

II.27 *17. Water demand to sustain ecosystem*

- *17.1.* What is the reason to suppose that the per capita water requirement for the domestic sector will not change over 20 years?
- *Page 30 last paragraph.* Where should the water come from and if from the river what would it mean in cusecs?
- *17.3.1 first sentence.* As far as we can see, this is not in agreement with the findings in Study I;
- *Figure 47.* Is this Figure in agreement with the results of Study I?

Note: Following the meeting of the Steering Committee the consultant for Study II has submitted a revised Executive summary and attached explanatory notes on: mangroves, sediment and fisheries. The IPOE has separately given its comments on the revised Executive Summary and expects that these comments be taken into account in finalising the Executive Summary, the explanatory notes and the report as a whole. In addition it was found that the formula showing the relation between discharge and sediment load can not be right, while the exponent would have to be larger than 1.

Annex VI Review of the Draft Final Report on Study III

III.1. Substantial work has been done since the Interim Report stage and the draft final report has been presented in a logical and comprehensive way. Most of the earliest comments of the IPOE have been addressed and with singular exceptions, all the items of the TORs have been addressed.

III.2. From the comments of the provinces, it is evident that several of the TORs have not yet been satisfactorily addressed by the consultants. These need to be reviewed in direct consultation with the provincial coordinators to ensure that all TORs are satisfactorily addressed.

III.3. Whilst the main report is rather complete, substantial improvement of the executive summary is still required. Some specifics on the executive summary are given below, as also discussed with the study team on 8th of October, 2005. It is important that these are to be carried through to the main report where applicable.

III.3.1. Units should be standardized throughout the reports. Currently use is made off various mixes of metric, imperial, and other units. (MAF, maf, acres, ha, lac Acres, Mds, cusec, cumec, etc.)

III.3.2. *page 1-35:*

- Resources given as 145.5 MAF compared to 175 MAF on p2-2 of main report;
- 'Physical shortage' and accompanying paragraph: to be reworded and expanded upon in proper context. Several statements are not clear;

III.3.3. *page 2-35:* Paragraph referring to WAA to be reworded;

III.3.4. *page 3-35:*

- Numbering of sub heading (also further on);
- To refer to 'water balance' rather than 'groundwater deficit';
- Item-iii: to be expanded upon and properly put in context;

III.3.5. *page 4-35:*

- Wording of section on groundwater sustainability to be refined;
- Reference made to 75 MAF groundwater recharge, compared to 50 MAF elsewhere;
- Minimum flow of thousand cusecs to be motivated or to be put in context;

III.3.6. *page 5-35:*

- Scenarios in upper table to be expanded upon. Also to bring in context of the environmental flow requirements;
- Middle table: correct heading 'volume in river downstream Kotri'. Second row of headings to be moved to correct columns;

III.3.7. *page 7-35:* Second best option' to be reworded;

III.3.8. *page 8-35:*

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- To clarify the reference to IBT replacement works intended as reference in time;
 - Statements in last paragraph refers to ‘most countries’, not only to Pakistan neither world wide;
 - Quite some of the text that is given for Punjab is of a general nature for Pakistan and would have to be moved to the previous sections;
- III.3.9. *page 9-35:*
- Increased groundwater recharge to be explained in broader context together with interdependence with surface flows;
 - Distinction to be drawn between natural and artificial or induced recharge. Also elsewhere and in the main report;
- III.3.10. *page 13-35:* 12000 cusecs to be verified and motivated or adjusted.
- III.3.11. *page 14-35:* Future growth in last paragraph to be addressed in context of constrained water resources potential
- III.3.12. *page 16-35’:*
- The recommendations given do not really address the concerns of the provinces, and do not respond to the TORs. To be completely re-assessed and re- written;
 - Conclusions under item 2.3.1 completely out of context with TORs. To be re-written;
- III.3.13. *page 18-35:* The recommendations not properly justified or substantiated. To be reconsidered and re worded.
- III.3.14. *pages 18-35 to 32.35:*
- All the conclusions to be reviewed against the TORs to ensure that the TORs are properly responded to;
 - In some cases the TORs have not or could not be fully addressed. This need to be clearly stated where applicable;
- III.3.15. *page 26-35:* Item-6 refers to water scarcity, while item-ii on previous refers to surplus resources still available. Reword to clarify and avoid confusion.
- III.4. Condensed comments on main report, in addition to relevant comments under item-3 above:
- III.4.1. Quite a lot of statements and responses are of a very general nature. If it will be not possible to address these in detail, they would have at least be made relevant and site specific;
- III.4.2. Different dates for the completion of Kotri barrage given by the different study teams. To verify and co-ordinate with study-I and study-II;
- III.4.3. GIS maps showing the geographic locations and extent of impacts addressed in the report will be of great value in describing these. (It is understood that GIS maps will be given in a separate volume.);
- III.4.4. *page 2-7:* Reference to ‘sub- tropical and moist temperate climate zones’ and ‘permanent snow-covered mountain ranges’ for apparently the same area, appears contradictory;
- III.4.5. *page 2-12, 2-13, and 2-15 and elsewhere:* Various units used, to standardize.

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- III.4.6. *page 3-12*: The quantifications of rainfall to be explained in proper context in relation to surface and groundwater resources.
- III.4.7. *Groundwater (page 3-13 onwards, 3-34, volume-II)*:
- To distinguish between natural recharge/resource potential and artificial and induced recharge;
 - Feasibility, practicality of artificial recharge to be assessed in context of overall resource (IWRM);
 - Be specific about what conditions appear in which areas (where salinity built-up, mining/ continued lowering of the groundwater table, waterlogging, etc.). Generalized statement may be misleading;
- III.4.8. *page 3-15*: Statements on future agricultural water requirements to be put in context of resource potential;
- III.4.9. *page 3-23*: Surface water storage at 90% of total surface flows not correct.
- III.4.10. *page 2-7*: Some items of the NWFP TORs not directly compiled with. To be addressed and clarified.