CHAPTER - 1

INTRODUCTION

1.1 THE ORIGIN OF THE SYSTEM : THE RIVER

Jamuna rises in the Tehri Region ; 12.5 km west of the lofty Bander Punch mountain. It flows past the sacred shrine of Jamnotri and winds through Himalayas; piercing Shivalik 153 km from its source. It is at Tajewala Headworks located on the border of Uttar Pradesh and Haryana; at a distance of 3 Km. where the river enters lower foot hills; that Western Jamuna Canal (WJC) takes off. Catchment of the river upto Tajewala is 12950 sq. km. Normal high flow is of the order of 7079 cumecs whereas minimum flow is 70 cumecs. Index map of WJC system is enclosed (Drg. No.1.1 and 1.2.)

1.2 HISTORICAL BACKGROUND

Western Jamuna Canal is one of the oldest of renowned canals in the erst while undivided Punjab province; it was utilised as a canal in one of the river creeks since 1356 AD. Regular control structure and shaping of canal was done from 1626 AD and reconditioning in the shape of canal was done in 1819 AD for Delhi Branch and in 1825 AD for Hansi Branch. Piecemeal remodelling schemes were initiated between 1870 AD and 1882 AD. The large scale water logging; swamps and unhealthy conditions were overcome by implementation of systematic remodelling by 1908 AD.

1.3 WJC CANAL SYSTEM

Western Jamuna Canal in the initial 23 km of its run; flows almost entirely in the old Western Creek of the river. Problem of sediment ingress

assumed alarming proportions despite conventional sediment exclusion measures. This resulted in reduction in the capacity of canal. The Somb river a torrent with level crossing with canal upstream of Dadupur works provided a versatile sediment trapping and flushing device without wastage of canal supplies through conventional silt ejectors. Map showing various W.J.C. Sub-systems are enclosed (Drg. 1.2, 1.3 and 1.4.)

Discharge of WJC was fixed and increased from time to time

Year		**Discharges**
1842	-	142 cumecs
1900	-	182 cumecs
1940	-	228 cumecs
1953	-	397 cumecs
1976	-	453 cumecs
Post HKB* operation	-	715 cumecs through HKB

* HKB → Hathni Kund Barrage

With gradual increase in the discharge of canal; the magnitude of sediment comprising gravel, shingle and coarse sand etc. also increased.

Remedial measures however taken up included the following three aspects.

(i) Construction of tunnel shingle excluder

(ii) Creation of proper approach conditions at the intake regulator by construction of block bar spur island

(iii) Judicious regulation of the undersluice gates

WJC Canal system comprised of

(a) Main Line Upper

(b) Main Line Lower

(c) Main Branch upto Munak

Munak is 49 km downstream of Indri which is 61 km downstream of the head of canal.

WJC Main Branch is unlined with capacity of 345 cumecs approx.and it entailed very heavy losses. As such a lined augmentation canal was constructed with a capacity of 135 cumecs to carry all the available supplies upto 135 cumecs d/s Dadupur straight to control point at Munak to avoid losses.

Offtakes at Munak comprises of

(i) Hansi Branch
(ii) Parallel Delhi Branch
(iii) Munak escape

Schematic-diagram of W.J.C. network is enclosed (Drg. 1.5)

Augmentation of Bhakra Supplies

NBK link supplements WJC with Bhakra supplies u/s of Munak

Supplies Received at Munak

The first major distribution control point of WJC system is at Munak where supplies are received from river Yamuna via

(i) Augmentation Canal (lined)
(ii) Main WJC Canal (unlined); and
(iii) Supplies of river Satluj /Beas from Bhakra are supplemented through NBK link.

Offtakes of Main Branch WJC (unlined) comprised of the following 3 systems,

(a) Sirsa Branch: This branch generally runs during monsoons and near Bhadera at RD88 it is added supplies from Bhakra through Narwana Branch. Sirsa Branch feeds Habri Sub branch, Shudhkan S/branch and Dhamtan S/Branch

(b) Chautang feeder and those under replacement include Bazida Disty, Kheri, Jundla; BDK.

(c) Direct offtakes of NBK link are Nardak Disty and Gogri pur Minor etc. with total capacity of about 17 cumecs.

PARALLEL DELHI BRANCH (PDB)

Parallel Delhi Branch : -

i) Carries supplies to (a) Delhi sub branch (b) Gurgaon water supply, (c) Haidarpur Treatment Plant and (d) Gurgaon canal after release for it in Najafgarh Drain at RD 73. (Km 22.3)

ii) Bhalaut sub branch taking off from Parallel Delhi Branch at RD 145000 (Km 44.2)at Khubru feed at its tail; Jhajjar sub branch and Dulehra sub branch.

Jawahar Lal Nehru (JLN) feeder feeds (a) JLN canal (b) Loharu system and (c) Mohindergarh canal system.

Total length of Parallel Delhi Branch is 49 km
Total length of Delhi Branch is 45 km
Total length of Delhi sub branch is 28 km
The individual discharge of all offtakes; direct outlets in each group are shown in Annexures 3.1 to 3.5 comprised of all the various rotational groups of canals.

Hansi Branch : - Hansi Branch feeds Sunder Sub Branch System and Butana system, (Details shown in Rotational Groups at Annexures 3.1 to 3.5).

1.4 ALLOCATION OF WATER

The flows in the river Yamuna were regulated between Punjab (later on Haryana) and UP according to May 1954 agreement and subsequent MOU of 1994 (made effective in 1995). The available supplies on the WJC system despite augmenting of supplies from Bhakra system through NBK link fall short of requirement. As such Rotational Programme by regulating supplies to entire network through various groups of average supply of 105 cumecs approx. is framed each year for both the crops.

1954 Agreement and 1994-95 MOU on sharing of Yamuna Water is at Annexures 1.1 and 1.2.

1.5 REMODELLING OF WJC

Even though western Jamuna Canal is one of the oldest canal systems of Punjab, keeping in view the availability of water; requirement of the commanded area and network feeding far flung areas including lift system; the lower carrier and entire distribution network have been grouped into various rotational combinations to deliver full supply capacity in the first preference turn.

The water allowance has been differential keeping in view the soil characteristics and various other considerations as also some of the channels were non-perennial to start with. The first remodeling of the main branch was taken up from Indri to Munak in 1941-42 with design para-meters as :

TABLE - 1.1

S.No	Parameters	New	Old
1.	Authorised full supply discharge	172 Cumecs	150 Cumecs
2.	Bed Width	55 m	51m
3.	Slope	0.13	0.135
4.	Full Supply Level	255.43 m	240.74 m
5.	Full Supply Depth	2.8 m	2.65 m

By 1953; the hydraulic data was changed and discharge at head was raised to 182 cumecs; slope 0.261; full supply level 256.5 m and full supply depth 2.66 m. This capacity was further proposed to be increased to 230 cumecs for passing additional discharge of 60 cumecs (released for Sirsa Branch) which had been decided to be served from Bhakra System below RD 88 (Km 26.8) i.e. Badhera Regulation Complex at tail of Narwana Branch of Bhakra System. Parameters of Main Branch post shifting of Sirsa Branch areas on Bhakra was kept as under,

TABLE - 1.2

S.No	Parameter	Value
1.	Authorised full supply discharge at Head	230 cumces
2.	Bed Width	64.6 m
3.	Full Supply Depth	2.8 M
4.	Slope	0.20
5.	F.S.L	256.2 m

Western Jamuna Canal Remodelling Project mooted in 1954 envisaged remodelling of entire WJC system for utilising supplies made available by transfer of Sirsa Branch area; Hissar Major Distributary areas to Bhakra Canal System and thus utilise additional availability.

Jagadhri Tubewells Project

On completion of 1954 scheme for remodelling it was envisaged that 1.93 lakh hectares of new area will receive Irrigation facilities. In addition 1.84 lakh hectares of old areas with then existing water allowance of 0.163 cumecs per 1,000 hectares will be raised the water allowance to 0.17 cumecs /per 1000 hectares. An area of 0.65 lakh hectares with exiting water allowance of 0.163 cumecs/1000 hectares will be enhanced a water allowance of 0.17 cumecs. Substantial improvement was aimed to be achieved in picking up irrigation by also converting 1.125 lakh hectares non-perennial areas into perennial area. During execution itself it was realized that there was further scope of extending Irrigation facilities and improving water allowance on the various channels. The revised project (1959) provided following benefits compared to 1954 project.

TABLE - 1.3

S.No	Detail of area	Area as per 1954 project (Ha.)	Area as per 1959 revised project (Ha.)
1.	New Culturable Command Area	1,93,318	2,61,811
2.	Old area where water allowance increase from 0.163 to 0.17 cumecs	6,52,00	6,52,03
3.	Old area where water allowance raised from 0.135 cumecs to 0.17 cumecs	1,84,557	3,54,817
4.	Conversion from Non-perennial to perennial	1,12,415	1,49,432

1.6 PROJECT PARAMETERS

The 1959 project comprised of the following units.

1. Main Branch Indri to Munak
2. Hansi Branch
3. Butana Branch
4. Sunder sub-branch
5. Delhi Branch
6. Bhalaut Sub-branch
7. Jagadhri Tubewell Project
8. Dadri Irrigation Scheme
9. Remodelling Tajewala Headworks
10. Remodelling and Canalising Main Line Lower
11. Extension of Irrigation to Dadupur Area
12. Constructing Silting Tanks along Main Branch.
13. Enlarging Escapes along Main Line Lower and constructing silt and shingle excluder.

The revised project (1971) excluded the cost component from the project for the following works, I) Jagadhari Tubewell Project ii) Dadri Irrigation Scheme and iii) Remodelling Tajewala Headworks; besides dropping the works relating to the construction of silting tanks.

The project cost for new works as per 1971 project was Rs. 1249.15 lakhs, with break up of work component-wise as follows : -

TABLE - 1.4

S.No	Work	Estimated Cost 1959 Project (Lakh Rupees)	Estimated Cost 1971 Project (Lakh Rupees)
1.	Main Branch	66.71	77.35
2.	Hansi Branch	34.86	42.72
3.	Butana Branch	134.57	130.65
4.	Sunder Sub-Branch	27.86	30.80
5.	Delhi Branch	248.43	472.95
6.	Bhalaut Sub-Branch	159.30	399.39
7.	Remodelling & Canalising Main Line Lower	44.14	53.22
8.	Extension of Irrigation to Dadupur area	2.03	2.13
9.	Remodelling of Escapes	34.72	39.94
	Total	**757.28**	**1249.15**

On completion of the project following effective benefits accrued :

I. New area where canal water facilities = 2,61,811 hectares

II. Non-perennial to perennial = 149432 hectares

III. Due to improved Water Allowance

(a) from 0.135 to 0.17 (354817 – 149432)

non perennial = 205385 hectares

(b) 0.163 to 0.17 non-perennial = 65203 hectares

Increase in Irrigation with proposed Intensity 50% (notional)

New Area CCA = 261811 x 50/100 = 130905 hectares

	CCA(Ha.)	Existing Intensity	Proposed	Anticipated Increase
Non perennial to perennial	205385	33%	50%	34915 hectares
	65203	42%	50%	5216 hectares
	149432	17%	50%	49313 hectares
			Total	**89444 ha**

1.7 BIO-CLIMATIC REGIONS

On the basis of annual rainfall amount; number of rainy days and mean monthly temperature; the following six bio-climatic zones have been identified in Haryana and the various parts of WJC tract falling essentially in four zones.

(i) Hot and Arid Zone

Part of Bhiwani distt. Commanded by WJC.

(ii) Hot and Semi-dry South-Western Zone.

Part of Bhiwani; Rohtak; Jind and Gurgaon Districts (fed by Gurgaon Canal through WJC).

(iii) Hot and Semi-dry South Eastern Zone.

Parts of Sonepat and Rohtak districts

(iv) Hot and Semi-dry Central Zone.

Parts of Jind, Kurukshetra, Karnal, Panipat and Ambala Districts.

(v) Hot but less dry Zone adjoining foot hills.

Parts of Karnal, Kurukshetra & Ambala Districts

(vi) Hot, but dry and humid foot hill Zone

Northen-most parts of Ambala and Yamuna–Nagar Districts

1.8 SOIL CHARACTERISTICS

There are three major geological division or soil zones, viz. I) The Shivalik Hills ii) The Indo-Gangetic Alluvial Plain (major part), iii) The Aravalli-Delhi Wedge.

The entire state area can be grouped into ten main soil association groups. Those are following : -

(i) Shivalik hilly terrain (fresh water tertiaries)

(ii) Dissected rolling plain

(iii) Inter fluvial plain
(iv) Active and Recent flood plain (Yamuna & Ghaggar)
(v) Table land water divide
(vi) Ancient Chautang flood plain (WJC)
(vii) Relict Wedge plain
(viii) Pre-cambrian hills and
(ix) Piedmont plain and
(x) Low Land plain

The soils in Haryana have been formed over an alluvial base in the plains; over detrital sediments in the northern-sub-mountain tract and over crystalline rocks in southern Aravalli hill region. Alluvium, though is the parent material of these soils, housing wide variation in their physico-chemical characteristics. These are light to medium textured as about 30 percent soils are loamy sand, 55 percent are sandy loam and 5 percent are sandy. The soils of Western Jamuna Tract are constituted mainly of loam, sandy loam even though some command area of WJC is also loamy sand. Haryana soils have poor nitrogen content as hot and semi-dry climate tends to intensify decomposition rate of the organic matter. The status of available phosphorous is low to medium; in most parts 11-20 kg/ha is available. Potassium is generally high because of the presence and dominance of little clay mineral. Alluvial soil have high content of total Iron, Zinc, Manganese and Copper but only a small fraction is available to crops. Twenty to thirty percent of Haryana Soils are deficient in available Iron and Manganese whereas only 5 percent soils are deficient in available copper.

1.9 GROUND WATER

The groundwater constitutes an important source of supplemental irrigation in areas where canal irrigation facilities are either inadequate or

absent or where plenty of ground water is available with good quality and farmers are growing paddy and supplementing canal water more on reflex to be sure of the ponding of the fields; rather facing the problems of shortage as it occures in Kurukshetra and Karnal districts. The tubewell irrigation is concentrated in Karnal; Kurukshetra, Ambala, Faridabad, Kaithal districts and in other parts which constitute about 60 percent of the state irrigated area. The quality distribution of ground water as delineated into different classes area-wise into good, marginal saline, saline sodic and sodic is summarised in Table 1.5. Approximate area depth-wise, under different categories of ground water has been estimated and shown in Table 1.6.

TABLE - 1.5

Ground Water Quality & its Distribution in Haryana

Quality Class	Chemical Composition			%age waters in Haryana
	EC x 10^6	SAR	RSC (me/l)	
Good Water	<2000	<10	<2.5	37
Normal Water	2000-4000	<10	<2.5	8
Sodic Water	<4000	>10	2.5	18
Saline Water	>4000	<10	Absent	11
Saline Sodic	>40000	>10	-	26

TABLE - 1.6

Approx. Area Depth Wise

Category*	Km^2	Percent
Fresh	13,475	30
Marginal	4,275	10
Saline	5,325	12
Top fresh; down marginal	2,300	5
Top fresh; down saline	1,380	3
Top marginal; down fresh	2,275	5
Top marginal; down Saline	14,897	34
Top Saline; down Fresh/Marginal	325	1

*Fresh EC<2000
Marginal EC in between 2000-6000
Saline EC > 6000

micromhos/cum

Trends in Water Table Fluctuation

The study of ground water contour map of the state shows that ground water flows predominantly from north and south into the Central region except some flow taking place from north-east to north-west direction. Surface contours also indicate that the Central region of the state is like a bowl and surface water accumulates in the area. Owing to such phenomena of surface and ground water flows; the ground water quality, distribution and water table fluctuations (rise /fall) are inter-dependant. Ground water quality map of the state is enclosed as Drg.1.6.

Annex - 1.1

AGREEMENT BETWEEN THE PUNJAB & UTTAR PRADESH GOVTS.
(Regarding Distribution of Supplies at Tajewala Headworks between Western Jamuna Canal & Eastern Jamuna Canal)

Brief : Agreement made on 12th day of March 1954; effective Ist April 1950 held binding on both parties for a period of 50 years form 1/4/1950

In the event of the river discharge being less than the total indent of the two canals i.e. Western Canal & Eastern Canal; Supplies at Tajewala will be distributed as follows :

Total River Supplies at Tajewala (Cusecs) Say "X"	Supplies to W.J.C. (Entitlement) (Cusecs)	Supplies to EJC (Entitlement) (Cusecs)	Remarks
Upto 5890	2/3 x-47	1/3 X + 47	WJC first
From 5890 to 8790	x-2010	2010	WJC first
From 8790 to 9280	6780	x-6780	WJC first
From 9280 to 10900	x-2500	2500	

When the supplies are in excess of 10900 cusecs the Punjab & U.P. to utilise the excess over 10900 cusecs in the ratio of 2:1

This arrangements has been in force since formation of Haryana on 1.11.66.

ANNEX- 1.2

MEMORANDUM OF UNDERSTANDING BETWEEN UTTAR PRADESH, HARYANA, RAJASTHAN, HIMACHAL PRADESH AND NATIONAL CAPITAL TERRITORY OF DELHI REGARDING ALLOCATION OF SURFACE FLOW OF YAMUNA

1. Whereas the 75% dependable notional virgin flow in the Yamuna river upto Okhla has been assessed as 11.70 Billion Cubic Metres (BCM) and the mean year availability has been assessed as 13.00 BCM.

2. And whereas the water was being utilised by the Basin States Ex-Tajewala and ex-Okhla for meeting the irrigation and drinking water needs without any specific allocation.

3. And whereas a demand has been made by some basin states on this account and the need for a specified allocation of the utilisable water resources of river Yamuna has been felt for a long time.

4. And whereas to maximise the utilisation of the surface flow of river Yamuna a number of storage projects have been identified.

5. And whereas the States have agreed that a minimum flow in proportion of completion of upstream storages going upto 10 cumec shall be maintained downstream of Tajewala and downstream of Okhla Headworks throughout the year from ecological considerations, as upstream storages are built up progressively in a phased manner.

6. And whereas it has been assessed that a quantum of 0.68 BCM may not be utilisable due to flood spills.

7. Now therefore, considering their irrigation and consumptive drinking water requirements, the Basin States agree on the following allocation of the utilisable water resources of river Yamuna assessed on mean year availability.

1. Haryana 5.730 BCM
2. Uttar Pradesh 4.032 BCM
3. Rajasthan 1.119 BCM
4. Himanchal Pradesh 0.378 BCM
5. Delhi 0.724 BCM

Subject to the following

(i) Pending construction of the storages in the upper reaches of the river, there shall be an interim seasonal allocation of the annual utilisable flow of river Yamuna as follows :

States	Seasonal Allocation of Yamuna Waters (BCM)			
	July-Oct.	Nov.-Feb.	March-June	Annual
Haryana	4.107	0.686	0.937	5.730
Uttar Pradesh	3.216	0.343	0.473	4.032
Rajasthan	0.963	0.070	0.086	1.119
Himachal Pradesh	0.190	0.108	0.080	0.378
Delhi	0.580	0.068	0.076	0.724
Total	9.056	1.275	1.652	11.983

Provided that the interim seasonal allocations will be distributed on ten daily basis.

Provided further that the said interim seasonal allocations shall get progressively modified, as storages are constructed, to the final annual allocations as indicated in para 7 above.

(ii) Separate agreement will be executed in respect of each identified storage within the framework of overall allocation made under this agreement.

(iii) The allocation of available flows amongst the Beneficiary States will be regulated by the Upper Yamuna River Board within the overall framework of this agreement.

Provided that in a year when the availability is more than the assessed quantity, the surplus availability will be distributed amongst the States in proportion to their allocations.

Provided also that in a year when the availability is less than the assessed quantity, first the drinking water allocation of Delhi will be met and the balance will be distributed amongst Haryana, U.P., Rajasthan and H.P. in Proportion to their allocations.

8. This agreement may be reviewed after the year 2025, if any of the basin States so demand.

9. We place on record and gratefully acknowledge the assistance and advice given by the Union Minister of Water Resources in arriving at this expeditious and amicable settlement.

New Delhi, the 12th May, 1994.

-Sd-	**-Sd-**	**-Sd-**
(Mulayam Singh Yadav)	**(Bhajan Lal)**	**(Bhairon Singh Shekhawat)**
Chief Minister	**Chief Minister**	**Chief Minister**
Uttar Pradesh	**Haryana**	**Rajasthan**

-Sd-	**-Sd-**
(Virbhadra Singh)	**(Madan Lal Khurana)**
Chief Minister	**Chief Minister**
Himachal Pradesh	**Delhi**

In the presence of :

-Sd-
(Vidyacharan Shukla)
Minister (Water Resources)