



4. DRAINAGE MANAGEMENT

4.1 Introduction

Drainage is removal of surplus rainwater or irrigation water from the land. Surplus water is as harmful to crops as inadequate water. Excess water in the root zone of crops reduces the essential air circulation affecting the growth of the plant as well as the yield. Water logging may also lead to salinity of soil making it unfit for cultivation. In addition, sustained water logging degrades environment and is also a health hazard. Further, urban drainage also suffers from flooding and poor maintenance of sewerage system as whenever the sewerage system gets blocked, the sewage is diverted to the nearby drains. It is imperative to study morphology in the river basin and also the existing drainage system and its management in NCR.

4.2 Morphology

Morphologically National Capital Region can be divided into two divisions:

- i) Ganga-Yamuna Doab
- ii) Area West of the Yamuna river

4.2.1 Ganga-Yamuna Doab

Ganga-Yamuna Doab comprises of six districts of UP sub-region, namely Meerut, Ghaziabad, Bulandshahr, Baghpat and Gautam Buddha Nagar and Hapur. This seemingly featureless plain lacks topographic prominence and the monotony of physical landscape is broken at places by the river bluffs, leaves, dead arms of river channels and the river channels. The area is covered by new alluvium (Khadar) and older alluvium (Bhanger). Bhanger is found all over Doab while there are finger like extension of khadar along with main rivers/streams. Due to presence of fertile soil, level land and canal irrigation, the area is intensively cultivated and supports a high density of population.

4.2.2 Area West of the Yamuna River

The slope of the alluvial plains from the Shiwaliks is towards the southwest upto Najafgarh drain and then towards the north. North of Delhi, the old high bank of Yamuna forms the summit level of the plain. In the extreme south of these plains, are the out layers of the Aravali's, which are intensely folded and eroded. One arm of the Aravali forms a continuous range terminating in Delhi and in between there are only low hills to the west of Bawal and Rewari towns. North of Aravali extensions, the whole tract are traversed by the number of sand ridges, which mostly run north-south and form higher prominences in the physical landscape. The only major river in this extension is the Sahibi, which flows, in a south-west, north-east direction. It is ephemeral and ends up in the sandy region of Haryana, but sometimes during heavy rains, it drains into the Najafgarh depressions and joins the Yamuna.

The region in general is a part of well-integrated drainage system of the Ganga. Almost all streams follow northwest, southeast course concomitant with the slope of the land. The extremely gentle gradient almost all over the region restricts the de-gradational activities of the



streams. Wide flood plains and high bank are common features in the course of the Ganga and the Yamuna along with silt and clay deposits.

4.3 Drainage System of U.P. Sub-Region

The entire U P Sub-region falls in Ganga-Yamuna Doab division. Gravity drainage is available throughout the region due to the gentle slope of the sub- region from north to southeast, which acts as deterrent to the drainage/flood problem created by vagaries of the river Ganga, Yamuna and their tributaries. Entire area is generally well drained by a good network of natural and man-made channels. Ground elevation falls from about 230 m above MSL in the north to almost 190 m above MSL near the south end of the sub-region. Besides the Ganga and Yamuna, other important rivers/streams in the area are Hindon, Kali Nadi, Neem Nadi, Karwan Nadi and Chhoiya Nadi. The Existing Drainage System of U.P. Sub-region is given in Map No.4.1. (Drainage Master Plan of U.P. Sub-region).

Natural drainage is provided by numerous drains, which flow from north to south. Within this region there are low lands called “Khadar” formed due to meandering of rivers in the past. The existing good network of the surface drains in the area is sufficient to drain out excess of rainfall during even heavy precipitation of monsoon season.

4.3.1 Flood Plains and adjoining area of river Ganga

Ganga flood plain in UP Sub-region is confined well within the Ganga River and Anoopshahr branch of Upper Ganga Canal from Garmukteshwar upto the border of district Bulandshahar - Aligarh. In the upper portion in the districts of Meerut and Ghaziabad, the flood plain extends upto Madhya Ganga canal. Few drains taking water of this area to Ganga River are Sota Nala, Bhuri Ganga, Paswara, Jharina nala, etc.

Between Anoopshahr Branch and Madhya Ganga canal; and in the lower part between Anoopshahr Branch and Ganga flood plains, there are large patches of land where the density of drainage channel is very low. However, drainage channels like Mehalwala Naalah, Buklana Naalah, and Phuladhara naalah are draining the area.

4.3.2 Kali Nadi Basin

Nagin Nadi originates at some distance north of Meerut and after joining Khatauli drain and Chandsumad drain, it becomes Kali Nadi. It flows southwards for some distance and then southeast further down to join river Ganga. It has Chhoiya Nadi as its important tributary. It caters drainage area lying between Upper Ganga Canal and Anupshahr branch in the districts of Meerut and Ghaziabad. The remaining area lies between UGC and Lakhoati branch upto the Border of Bulandshahar-Aligarh districts.

There are numerous other drains existing in this basin that help in draining the excess water. Some of the important drains are Udaipur drain, Dadri drain, Daulatpur drain, Abu nala 69, Abu nala 73, Bahadurpur drain, Fazilpur drain, Jalagarh drain, Pathanpur drain, Jajokhar drain,



Jani drain, Shekupur drain, Kadrabad drain, Deorala drain, old Bahal drain, Chhoiya nadi, etc. Total length of drains in this system is 388.68 km.

4.3.3 Chhoiya Nadi Sub-Basin

It forms a sub-basin in Kali nadi basin. It originates by joining of Niloha drain, Chhoiya drain and Gagsauna. It joins the Kali nadi near Hapur. It has several tributaries like Phalaoda drain, Gagsauna drain, Gadina drain, Chhoiya drain, Miloha nala, Kaula drain, Mawana drain, Bali drain, Kithore drain, Rajdhana drain, Ikla drain, etc.

4.3.4 Neem Nadi Basin

Neem Nadi originates from north of Ghaziabad-Bulandshahr boundary and flows through the Bulandshahr district and the basin confines between the Lakhaoti branch and Anupshahr branch. Several drains outfall into the Neem nadi, which are Dhanpur drain, Ratapur drain, Ladpur drain, Siyana drain, Sankhari drain, Barauli drain, Bajsara drain, Deogawan drain.

4.3.5 Hindon River Basin

Hindon river rises on the southern slopes of the Shivalik in Saharanpur district and after traversing a distance of almost 265 km, it outfalls into river Yamuna. Its main tributaries Kali (West) and Krishni. The catchment area of the Hindon River is 7083 sq km in which 5512 sq. km. falls in UP sub-region of NCR. The river Hindon and Krishni are not perennial and carry water during monsoon and remains dry during the summer. A part of Hindon channel called Hindon Cut acts as a link between Yamuna and Upper Ganga Canal through Jani Escape, main drains in the Hindon Basin are Kandal drain, Quasinpur drain, Tera drain, Dhakauli drain, Siwal drain, Patholi drain, Sarhana drain, Ujhera drain, Pala drain etc.

4.3.6 Karwan Nadi Basin

In between the Kali nadi basin and the Yamuna River, there is Karwan nadi which is a tributary of river Yamuna. Upper reach of the Karwan nadi basin falls in the NCR Subregion of UP. The drainage basin is bounded by Mat branch and Upper Ganga canal. Some important drains are Jarcha drain, Koanora drain, Nizampur drain, Sikandarabad drain, Kanaripur drain, Aliabad drain, Gangrauli drain, Siryal drain, Sonda drain, Hazrat drain, etc.

4.3.7 Yamuna Sub-basin in UP Sub-Region

In Uttar Pradesh, Yamuna catchments extends up to eastern Yamuna canal in the upper reach (upto Delhi border) and there after Mat branch forms the boundary of Yamuna catchment upto southern end of NCR UP sub-region. There are 14 main drains out falling in the Yamuna in UP Sub-region. They are Tuguna drain, Kurri lumb drain, Chhapraul drain, Sonali drain, Baraut drain, Barauli drain, Alwalpur drain, Surajpur drain, Nodia main drain, Bilaspur drain, Usmanpur drain, Pathwal drain, Sobara drain, Hirnoti drain, etc.



4.3.8 Status of existing drainage system

In Uttar Pradesh, so far drainage plans have been prepared considering the area lying in an administrative district as a unit. This has been done largely from the point of view of administrative convenience. A good network of surface drains consisting 41 major drains have been developed in different drainage basins to drain off excess run off during heavy precipitation in monsoon season. In UP Sub-region the intensity of natural drainage system is about 0.054 km/ km² to 0.227 km/ km². As per the information provided by Irrigation Department, Govt. of UP, there are 41 trunk drains falling into the river Yamuna, Hindon and Kali. Detailed information relating to length, catchment area and head discharge of the seven trunk drains directly falling in river Yamuna, eleven trunk drains falling in Hindon river and eighteen trunk drains falling in Kali Nadi are given in Table nos.4.1, 4.2 and 4.3 respectively. There is no river or major drains falling into Ganga River in NCR since most of the part of UP Sub-region falls in Yamuna Sub-basin.

Table 4.1 Details of Trunk Drains falling in Yamuna River in UP Sub-Region

Sl. No.	Name of Trunk Drain	Length (km)	Catchment area (Sq Mile)	Head Discharge (Cusec)
1	Lumb	20.51	30	300
2	Chhaproli	3.62	2	20
3	Sanoli	11.36	14	140
4	Badot	6.28	25	200
5	Surajpur	8.04	25	125
6	Noida Main Naala	17.10	70.34	3210
7	Pathwaya Naala	33.00	49	245

Source: Irrigation Department, Govt. of UP

Table 4.2 Details of Trunk Drains falling in Hindon River in UP sub-region

Sl. No.	Name of Trunk Drain	Length (km)	Catchment area (Sq Mile)	Head Discharge (Cusec)
1	Teda	20.51	55	275
2	Dola	22.53	24	172
3	Sanoli	11.36	14	140
4	Radhana Naala	4.50	9	48.3
5	Sardhana Naala	17.60	50.65	446
6	Sivaal Naala	16.60	17	170
7	Saunda Naala	13.80	11.5	115.1
8	Mortha Naala	8.10	4.1	41
9	Dasna Naala	19.31	30	150
10	Aloda Cut	2.80	2	10
11	Thasraana Cut	1.90	1.6	8

Source: Irrigation Department, Govt. of UP

**Table 4.3 Details of Trunk Dains falling in Kali Nadi River in UP sub-region**

Sl. No.	Name of Trunk Drain	Length (km)	Catchment area (Sq Mile)	Head Discharge (Cusec)
1	Aabu Naala-71	33.8	53	462
2	Aabu Naala-73	30.8	50.76	191
3	Pathanpura Naala	4.2	6.37	14
4	Kaadrabad Naala	54.4	201.2	2010.5
5	Nagin Nadi	22.4	114	1137.3
6	Jainpur Drain	5.86	4	20
7	Bulandshahr Drain	4.22	3	15
8	Neemkhera Drain	2.61	2	10
9	Bhatola Drain	5.18	6	30
10	Devraala Drain	4.82	6	30
11	Fatehpur Cut	1.31	0.5	2.5
12	Mohmadpur Drain	6.9	4	20
13	Kazimpur Devali Drain	2.81	1.5	7.5
14	Chandpur Drain	0.4	0.5	2.5
15	Taalivpur Drain	0.48	0.5	2.5
16	Chhoiya Naala	59.8	280.8	280.6
17	Neem Nadi Naala	94	136	-
18	Baraal Drain	36	65	325

Source: Irrigation Department, Govt. of UP

Major drainage features in Uttar Pradesh sub-region are shown in **Map 4.1**.

4.4 Drainage System of NCT-Delhi

The only river, which flows in Delhi, is Yamuna. It originates from Yamunotri Glacier in Himalaya. It covers a large distance and emerges into the plains of Uttar Pradesh in Saharanpur district. In this reach the river is trapped for irrigation through the Eastern and Western Yamuna Canal taking off from Hathni Kund Barrage (old Barrage – Tajewala head works). It then flows for about 230 kms forming the boundary between Haryana and UP until it enters the NCT of Delhi near the village Palla. It traverses through the NCT of Delhi covering a distance of about 50 kms and then its water is diverted at Okhla weir into the Agra Canal and from thereon into Gurgaon Canal for irrigating large fertile tracts in Uttar Pradesh and Haryana states.

In the NCT-Delhi; the Delhi ridge forms the main watershed. The drainage in the area east of the ridge is towards the Yamuna. In the west of the ridge the drainage water passes in the Najafgarh drain that again joins the Yamuna near Wazirabad barrage.

4.4.1 Drainage basins of NCT-Delhi

The drainage system of Delhi is such that all waters collected through main drains, link drains and small rivulets are discharged into Yamuna. On the basis of the topographical characteristics



NCT Delhi has been divided into five drainage sub-basins namely; Najafgarh, Alipur, Shahdara, Kushak Barapulla and Mehrauli.

i) Najafgarh Sub-Basin

In addition to a large tract of land in Haryana State, the Najafgarh basin covers the southwestern part of the NCT-Delhi. Najafgarh basin has been further classified in four sub-basins i.e. Najafgarh block, Kanjhawala sub-basin, MCD area and Delhi Cantonment area. There are three major drainage systems in Najafgarh basin i.e. Najafgarh drain, Mangeshpur drain and Palam drain. Details of drains are given below:

Najafgarh drain: Najafgarh drain together with its branches serves a catchment area of 1,315 km². It starts from Dhansa bund where it is called Dhansa outfall channel and joins Yamuna downstream of Wazirabad. Mangeshpur and Palam drain outfall in Najafgarh drain. Total length of the drain in NCT Delhi is 62 km. Najafgarh Jheel is a natural depression and it is having catchment area 567 km² and it receives some water during the heavy rainfall in Haryana and Rajasthan through link drains connected from Jahajgarh Jheel and Sahibi Nadi.

Mangeshpur Drain: This drain starts from Mundrola village in Haryana and joins Najafgarh drain at about 0.8 km below Kakraola regulator. With the construction of diversion drain No. 8 in Haryana part of the upstream catchment of West Jua drain, Thana Khurd drain and Mandrolla drain have been diverted into diversion drain No. 8 which directly flows into the Yamuna. At present the total catchment area served by Mangeshpur drain at its outfall is 288.08 km².

Palam Drain: Palam drain rises from hilly areas of south Delhi and after running through cantonment joins Najafgarh Drain. Palam link drain, Nasirpur drain & Palam pond drain outfall in Palam drain. It collects discharge from hilly, urban & rural areas having total catchment of 51.78 km².

Karari Suleman Nagar Drain: It starts from a Pond near Puthkalan village and after running in west and south directions joins Najafgarh drain. Two link drains i.e. Mubarakpur and Mithari outfall in this drain.

Nangloi Drain: This drain takes off from a pond near village Puth khurd in Alipur Block. It is about 19.31 km long. It joins Najafgarh drain from left. Total catchment area of the drain is 68.87 km².

ii) Alipur Sub-Basin

The basin is situated on the western bank of river Yamuna and on the northern part of NCT Delhi. The basin is bounded by the Delhi tail distributary of the Western Yamuna canal on its west, Shahalam Bund on its south, river Yamuna on the east and diversion drain No-8 of Haryana on the north. The Najafgarh basin is adjacent to the Alipur Basin on the west. The total area of this basin is 170 km² and is generally sloping towards river Yamuna in the east. Storm water from adjacent catchments north of Delhi-Haryana boundary directly comes to the



Alipur Basin. The discharge from 49.2km² of area, is being catered by the drain No. 6. The area is drained by Bawana Escape, Drain No. 6 and Burari drain and other minor drains.

Details of drains are given below:

Bawana Escape: The Bawana escape is the major drain for Alipur Basin. The catchment area is about 181 km². The link drains through which the basin is linked into the Bawana escape are Ghaga link, Sanoth link, Narela link, Nayabans link and Alipur link. In addition to functioning as drain to dispose off storm water, Bawana escape also functions as escape for Delhi Tail distributary.

Drain No. 6: Drain No. 6 which was originally the tail end of a drain from Haryana which carried large volume of discharge. The diversion through drain No. 8 has reduced the discharge considerably. Presently the drain No. 6 has a length of 13 km and a total catchment area of 93.50 km². The link drains outfalling in this drain are Bankner, Tikrikhurd and Hamidpur.

Burari Drain: Another important system of drains in Alipur basin is Burari creek and Burari drains. Considerable urban discharge from Model Town area is discharged into this drain.

iii) **Shahdara Basin**

Shahdara Basin area is located on the eastern bank of river Yamuna and bound by river Yamuna on the west, Hindon on the east and UP on north and south. Shahdara basin is below the high flood level of Yamuna and rise of water level in Yamuna causes problem of water logging. Marginal embankments (Shahdara Marginal bund and left marginal bunds) were constructed in 1955 -56 to protect the area from flooding.

Earlier most of the run off from North of GT Road used to be pumped into Yamuna during average flood stage and failure of pumps used to result in flooding. Modified drainage system with arterial drains No. I & II were constructed to improve the situation. Drain No. 1 starts from North of arterial highway and drain No. II starts from North of GT Road near UP Border. Later Drain NO. I & II join and the combined drains run parallel to Hindon cut canal and then fall into river Yamuna down stream of new Okhla Barrage.

iv) **Kushak Nallah- Barapulla Nallah System**

This basin drains mainly the discharge from Mehrauli block and part of urban area of Delhi. The drains carry flashy discharge on account of considerable run off coming from urbanized areas and sloppy, hilly areas. The total length of Kushak drain and Barapulla drain is 12.87 km and 2.23 km respectively. Most of the drainage channels in NDMC area fall into this system. The Kushak Nallah enters MCD area near INA market and Defence Colony Nallah joins it.

v) **Mehrauli Basin**

It is located on the southern part of NCT Delhi and covers an area of 160 km². It can be further divided into three units as given below:



Hard rocky area on the ridge: Southern boundary of NCT Delhi has a rocky ridge. In the south quartzites are exposed near Chirag Delhi, Kalkaji, Tughlakabad & Chattarpur area.

Alluvial plain: Alluvial plain is in the north-eastern side of Mehrauli ridge extending up to Agra canal. The general slope is towards river Yamuna. The alluvial plain on northern side of Mehrauli ridge extends up to Najafgarh Jheel on the west.

Submergible Khadar Land: It is situated between left bank of Agra canal and river Yamuna. Drainage is not a problem in this area. However, soil erosion and maintenance of soil fertility are the major concerns from cultivation point of view.

Several nallas start from the ridge. During monsoon these nallas carry rainwater from rocky terrain and agriculture area. Mainly there are six sub-basins of drainage system as given below:

- i) Drainage into Najafgarh Jheel
- ii) Drainage from North West corner draining into Najafgarh drain.
- iii) Drainage from the northern slope discharging into Chirag Delhi drain.
- iv) Drainage direct to Agra canal
- v) Drainage above Ali Super Passage

Delhi has natural and man-made drains. The total length of man-made drains is 700 km spread over 12 municipal zones. All drains of Delhi ultimately out fall into Yamuna River. The Existing Drainage System of NCT-Delhi is given in Map No. 4.2 (Drainage Map of NCT Delhi).

Major drainage features in NCT-Delhi sub-region are shown in **Map 4.2**.

4.5 Drainage System of Haryana Sub-Region

There are two drainage catchments in Haryana, one drains through river Yamuna and the other through river Ghaggar. The area being drained through river Yamuna originally had only two outlets, first through Najafgarh drain in Delhi and second through Goverdhan drain in U.P. The Existing Drainage System of Haryana Sub-Region is given in Map No.4.3 [Drainage System NCR (Haryana and Rajasthan Sub-region)] In order to improve the situation in NCT -Delhi and also to provide relief in Haryana, diversion drains were constructed in Northern part of this catchment namely Chautang diversion, diversion Drain no. 2 and diversion Drain no. 8. Although these have reduced the pressure on Najafgarh drain, still there is a considerable pressure from Sahibi Nadi and Drain no. 8, which joins at Surethie. Haryana sub-region has been divided into following sub-basins:

i) Main Drain No. 2 Sub-Basin

The Drain no. 2 with its tributaries like Munak drain, Panipat main drain, Begumpur drain and Pundri drain caters the area falling between western Yamuna canal on the western side and the Yamuna River on the eastern side. In the upper reach Drain no. 2 is known as Indri drain which gets the discharge from Phurlak drain, Nahar Kuna Hansi Nadi. Drain no. 2 has its outfall in



Yamuna River near village Khozkipur. The total length and capacity of this drain is 59.30 km. and 6325 cusecs respectively.

ii) Nai Nallah Drain and Diversion Drain No. 8 Sub-Basin

Nai Nallah drain off takes from Anta Syphon under Hansi Branch near village Chachrana. It flows down and passes by the side of Gohana town. Just south of Gohana tributary drain no. 4 joins it. Nai Nallah drain outfalls into drain no. 8. This drain caters to part of Jind and Sonapat district up to Gohana town. Some of the drains falling into Nai Nallah drain and diversion drain no. 8 system are tributary drain nos. 1, 2, 3, Dobetta drain, West Jua drain, Khanda drain etc. Diversion drain no. 8 originates from drain no. 8 near Gohana town and ultimately outfalls into the river Yamuna just upstream of northern border of Delhi.

iii) Main Drain No. 8 Sub-Basin

Nai Nallah near village Mahra is named as main drain no. 8 from where diversion drain no. 8 off takes. Drains falling in the main drain no. 8 are Ishapur Kheri, Bandheri, Dhanana, Chhapra, Makroli, Jasia, Kanheli, Bishan, Wazirpur, Dubal Dhan, Garhwal, Bhambewa etc. Water of drain no. 8 outfalls into Jahajgarh jheel which is low lying depression in Haryana.

iv) Kultana-Chudania-Bhupania (KCB) – Bahadurgarh Drainage Sub-Basin

KCB drainage system drains Bahadurgarh area of Jhajjar district. The tributary and link drains falling in KCB system are Mattan link drain, Kassar drain, Sankhol link drain, Mandothi link drain. KCB drain outfalls in to Mangeshpur drain, which ultimately outfalls in river Yamuna through Najafgarh drain. The total length of KCB drain is 45.91 km and its catchment is 143 km².

v) Nuh-Kotla-Ujina and Ujina Diversion Drainage Sub-Basin

This drainage system caters for Mewat district and southern part of Faridabad district. Ujina drain off takes from Ujina Lake. Kotla, Nuh and Chandeni drains out fall into Ujina drain. The other drains joining this system are Ter, Badli, Hingan Pur, Neem Khera, Kherli Kankar, Kawaja Kalan, Ribber. Landoha nala flows into Haryana from Rajasthan and is joined by Nuh drain and then flows to Rajasthan through Ujina drain. The only exit of the flood water is through drainage system of Ujina in Haryana, Pahari in Rajasthan and Goverdhan in U.P.

vi) Gaunchi- Drainage Sub-Basin

Gaunchi main drain starts from Gurgaon canal and traverses a distance of 70 kms catering to a catchment of 671 km² before it outfalls into Yamuna. This caters to the drainage of small part of Mewat district and major part of Palwal district. The important drains out falling into this system are link drain No. 1, Bijapur Link drain, Extension Badha link drain, Palwal drain, Ranika link drain, Gehlab link drain, Mitrol link drain, Khatela link drain, Gudrana link drain, Banchari link drain, Khirbi link drain, Bhanguri link drains etc.



vii) **Urban Drainage System in Haryana**

The urban drainage system of various towns in Haryana Sub-region is as follows:

Panipat: The urban drainage of Panipat town falls into Panipat drain originating from Panipat and having ultimate outfall into river Yamuna near village Jalmana.

Sonepat: The urban drainage of Sonepat town falls into drain No. 6 originating from Smalkha and passing through Sonepat town. The Drain No. 6 having outfall into Drain No. 8 which originates from Nai Nala near Gohana. The Drain No. 8 ultimately falls into river Yamuna near Delhi border.

Gurgaon: The storm water drainage of Gurgaon is divided into six zones having outfall into Najafgarh Jheel falling on the western part of the town having further outfall into river Yamuna through Najafgarh drain.

Faridabad: The drainage of Faridabad is through two drains. The eastern & northern Faridabad is covered by Buria Nallah having initial capacity of 280 cusecs which outfall into river Yamuna near village Manjhawali having capacity 1700 cusecs. The South-west part of the town is connected with Gaunchi drain originating from village Gaunchi near Ballabhgarh having initial capacity of 900 cusecs which ultimately falls into river Yamuna near village Maholi after covering the catchment area of district Palwal. The outfall capacity of Gaunchi drain is 6000 cusecs.

Palwal: The drainage of Palwal town is mainly through Palwal link drain falling on which is further connected with Gaunchi drain near village Kairaka having ultimate outfall into river Yamuna.

Rewari: The storm water drainage of Rewari is through escape channel constructed by Irrigation Department having outfall into Sahibi Nadi near Khalilpur Railway station.

4.6 Drainage System of Rajasthan Sub-Region

There is no perennial river system in Rajasthan sub-region. Sahibi, Ruparel and Chuharsidh are the main seasonal rivers, which flow through the sub-region. Several other rivers and tributaries have been impounded at suitable sites which are used for irrigation. Sahibi Nadi rises from hills of Bairath near village Barijori about 8 km north-west of Shahpura in Jaipur district of Rajasthan. After flowing almost southwest to north-east direction about 145 km in Rajasthan, it enters Haryana state beyond Kot Qasim. One of its major tributaries in Rajasthan joining it on its left bank at 88 km is Sota. On its right bank a number of small hilly streams join it at Masani (National Highway No.8) in Rewari district. The Ruparel River also known as the Barah or Loswari, rises from Udainath hills, Thana. Ghazi tehsil and passes through southern part of sub-region terminating in Bharatpur district. It passes through Alwar sub-division. There are number of bunds like Baleta, Siliserh and Jai Samand on its tributaries. Chuhar Sidh Nadi rises from Chuhar Sidh hills in Alwar tehsil and flows from west to east up to Piproli from where it changes its course towards north and finally enters in Haryana. On



Chuhar Sidh and its tributary several bunds are situated, i.e. Vijay Sagar, Training Bund and Chandali. There is no natural lake in Sub-region. However, there are a large number of artificial lakes and tanks. The major lakes are Jai Samand, Siliserh, Balota bund, Mansarowar, Vijay Sagar, Kuduki.

Major drainage features in Haryana and Rajasthan sub-regions are shown in **Map 4.3 & 4.3(A)**.

4.7 Existing Inter-state Drains in NCR

The Study Group has identified 11 existing inter-state drains flowing through the territories Haryana, UP, NCT-Delhi and Rajasthan states in NCR. The NCR participating States required to interact with concerned states during design, construction and maintenance of these drains.

The major identified inter- state drains of NCR are given below:

i) Between Delhi and Haryana

- (a) Drain No 6, which originates near Ganaur town of Sonapat district of Haryana sub-region and flows mostly in the North-South direction and outfalls into Diversion Drain No. 8 (which originates from Nai Nallah near Gohana town in Sonapat district and joins Yamuna River).
- (b) Drain No 8, which originates from the junction point of Nai Nallah and Diversion Drain No. 8 near Gohana and flows through Rohtak, Jhajjar and Gurgaon districts of Haryana sub-region and outfalls into Najafgarh lake (which is spread both in NCT-Delhi and Haryana sub-regions), from which the Najafgarh drain originates and outfalls into Yamuna river.
- (c) Mungeshpur drain, which originates near Kharkhoda in Sonapat district of Haryana sub-region; flows mostly in the North-South direction through Jhajjar district; enters in NCT-Delhi sub-region near Bahadurgarh and thereafter outfalls into Najafgarh drain.
- (d) Kultana-Chudania-Bhupania (KCB) Drain, which originates near Rohtak town (South of Rohtak, near Rohtak-Jhajjar Road); flows through Jhajjar district; enters in NCT-Delhi sub-region near Bahadurgarh and thereafter outfalls into Mungeshpur drain.
- (e) Bhuria Nala, which flows through Faridabad town in Haryana sub-region and outfalls into Yamuna River near Okhla in NCT-Delhi sub-region.
- (f) Ali Drain, flows through Faridabad district of Haryana sub-region and NCT-Delhi sub-region and outfalls into Yamuna River.

ii) Between Delhi and Uttar Pradesh

- (g) Relief Drain along S M bund near Khajuri/ Karawal Nagar in Ghaziabad district of Uttar Pradesh sub-region and flows mostly in North-South direction and joins Ghazipur drain near Ghazipur village of NCT-Delhi sub-region.
- (h) Drain near Maharajpur outfalling into trunk Drain no 2, which originates near Ghaziabad district in Uttar Pradesh sub-region and flows mostly in North-South



direction and outfalls into Yamuna River near Ghazipur in NCT-Delhi sub-region. .

iii) Between Haryana and Rajasthan

- (i) Sahibi Nadi flows through Alwar district of Rajasthan sub-region and Jhajjar, Gurgaon and Rewari districts of Haryana sub-region.
- (j) Londoha Nallah flows through Bharatpur district of Rajasthan sub-region and Firozpur Jhirka in Mewat district of Haryana sub-region and thereafter joins Ujina Lake in Mewat district.
- (k) Ujina Drain flows mostly in the North-South direction and originates from the Ujina Lake on its Southern part (on the Northern side of the Ujina Lake, lies the Nuh drain, which is an extension of the Ujina drain) and joins the Pahari Kaman Goverdhan Drain in Bharatpur district.

Major existing drainage features at NCR level are shown at **Map 4.4**.