EXECUTIVE SUMMARY

Background

National Capital Region Planning Board prepared the Regional Plan with the perspective year 2021(RP-2021) for the National Capital Region(NCR) as per the provisions of Section 10 of the NCR Planning Board Act, 1985 for balanced and harmonized development of the National Capital Region covering an area of 34,144 sq. km. which was notified on 17th September, 2005. Presently NCR covers an area of 53,817 sq. km. comprising of NCT Delhi, thirteen districts of Haryana sub-region, seven districts of U.P. sub-region and two districts of Rajasthan sub-region.

Drainage is the natural or artificial removal of surface and sub-surface water from an area. It is an important element of physical infrastructure and constitutes removal and disposal of surplus rain/irrigation water from the land. It has two aspects, namely, flood protection and removal of storm water. Topography, rainfall intensity, soil characteristics, irrigation methods, crops and vegetative cover are important factors for deciding the type and design of drainage system. Since urban expansion is inevitable, increased run off would require remodelling of the existing drains as well as provisions of new/supplementary drains, implementation of appropriate flood protection measures, protection of natural drainage course, improved ground water recharge, and other environmental improvement measures. National Capital Region is a part of well integrated drainage system of the Ganga basin. Extremely gentle gradient spreads almost all over the region and storm water discharge in any basin/sub-basin of NCR has regional bearing covering areas of States of Haryana, Rajasthan, Uttar Pradesh and NCT Delhi. Regional Plan-2021 has proposed policies for improvement of drainage in NCR, but a need was felt to examine various guidelines/design parameters and elaborate so that policy guidelines could be proposed. Board in its 29th meeting held on 24.5.2006 decided to prepare a Functional Plan on Drainage for NCR.

Methodology and Limitations

As per Seventh Schedule of Constitution of India, drainage is a state subject and Irrigation Departments of the State Governments have responsibility for drainage, irrigation and flood control. At the national level, Central Water Commission (CWC) is associated. Therefore, it was imperative to associate the representatives from CWC and NCR participating State Government Departments dealing with the drainage of NCR for the study.

A Study Group was constituted under the Chairmanship of Engineer-in-Chief, Department of Irrigation, Government of Haryana, Chief Regional Planner, and NCR Planning Board Co-chairman with Director (UT), Central Water Commission and Chief Engineers of UP Jal Nigam, Delhi Jal Board, Departments of Irrigation and Chief Town Planner/ Chief Coordinator Planners of NCR participating States as members with the mandate to identify the drainage system of NCR, collect data, review norms, analyze data, formulate strategies and to prepare Functional Plan on Drainage for NCR. Six meetings of the Study Group were held to discuss, finalize the strategies and prepare the Functional Plan for Drainage for NCR. The study has been conducted in-house on the basis of secondary data and is limited to regional drainage system. The Study Group observed that there is lack of uniformity in maintaining the data base by different NCR participating States. Data on carrying capacity of the drains was available

with Irrigation Departments but data on flow of drains was not available. Similarly, data on pollution levels of Ganga and Yamuna Rivers was available at a few selected locations.

Subsequent to the notification of the RP-2021 in 2005, Mahendragarh and Bhiwani districts of State of Haryana and Bharatpur district of State of Rajasthan have been added in NCR vide Notification dated 01.10.2013. Further, Jind and Karnal districts of State of Haryana and Muzaffarnagar district of State of Uttar Pradesh have subsequently been added in NCR vide Notification dated 24.11.2015. The RP-2021 for NCR includes the then area of NCR which is 34,144 sq. km. and comprises of NCT-Delhi, nine districts of Haryana sub-region, six districts of U.P. sub-region and one district of Rajasthan sub-region. Since the Regional Plan including the newly added districts is still under preparation, the scope of the Functional Plan on Drainage for NCR is limited to the area of NCR as per the RP-2021.

Hydro Meteorological Aspects

Detailed hydrological investigation of the catchments of the river system traversing NCR and its adjoining States is of paramount importance for proper assessment of water resource potential and extent of flood and drainage problems. It has been observed from the meteorological data that about 79% of the rainfall in the National Capital Region occurs during monsoon and remaining 21% is accounted for by seasonal rain. The area receives average annual rainfall of about 614mm. Rainfall is caused by depressions/cyclonic storms and low pressure systems that form in the Bay of Bengal and Arabian Sea during monsoon season and travels over NCR area, Punjab, Haryana, Rajasthan, West UP, Uttrakhand and Himachal Pradesh and yield very heavy rainfall over these areas resulting in flooding in Yamuna and Ganga basins. It has been observed from the IMD data that there are 56 rain-gauge stations in NCR.

Density of Rain-Gauge stations is 610 km^2 per station area in NCR and meets the World Meteorological Organization (WMO) recommended density of 600 to 900 km^2 area per Rain Gauge Station.

Recommendations

Functional Plan examined various aspects related to geology, geo-morphology, physical features, hydro-meteorology, drainage system of various sub-regions, design criteria of drainage system in the participating states, CPHEEO norms, pollution, recommendations of National Disaster Management Authority (NDMA) on drainage, etc. and analysed various aspects and the recommendations made are given in the following paragraphs:

i) *Protection of Natural Drainage System:* Natural drainage system should be protected from all kind of encroachments, obstructions, dumping of solid wastes etc. and whenever diversions are inevitable, they should be properly designed and executed.

ii) *Promotion of recreational use along nallah land:* The land around nallahs should be developed as public open space i.e. gardens, parks, playgrounds, etc. so that residents of the city are encouraged to visit these lands for entertainment, jogging, morning walk, etc. This will minimize misuse by encroachment, etc. The treated effluent can be used for maintenance of greenery.

iii) *Reservation of adequate width for drains:* Development in urban areas increases the impervious surfaces, leading to increased run-off which results in higher flow of storm water in the drains. This requires increase in the section (depth & width) of drains. In addition to this, additional space is required to operate modern machines for cleaning of drains such as JCBs, bulldozers, dumpers, etc. The National Disaster Management Guidelines: Management of Urban Flooding-2010 prepared by National Disaster Management Authority, Govt. of India recommended that recreational/green buffer zone of different width may be adopted and adequate land should be earmarked in the Master/Development Plans for urban areas and in the revenue records in rural areas.

iv) *Parameters for Design of storm water drain:* Rational Method is widely used for design of urban drainage system and the same would continue to be used for designing Storm Water Drain in NCR. The Plan has recommended basic parameters to assess the quantum of surface run-off. Methods prescribed in CPHEEO Manual should be followed for designing of the channel dimensions.

v) *Preparation of Master Plan of Inter-State Regional Drainage:* Integrated planning and design of drains for the region should be done well in advance to fix the invert levels of the drains. Since regional drains pass through more than one District/ State, their agencies should come together for designing the drain as a single project. However, construction could be taken up by the concerned agencies of the District/ State maintaining the designed invert levels. It would be important to prepare the Master Plan for Drainage for a basin or sub basin and integrate it with higher order plans. The land requirement should be made available to the agencies responsible for reservation of the land.

vi) *Preparation of Master Plan for Drainage for Cities/Towns:* In order to ensure planned development of a city/town, Master Plan for drainage is required to be prepared incorporating/addressing the aspects such as identification and delineation of watersheds, sub-watersheds and catchment areas at "notified Planning Area" level and analysis of their slope and fluvial characteristics. Master Plan for drainage of a Towns/or a city should be prepared within the framework of Master Plan for Regional Drainage within which it falls. The catchment area should be the basis for planning and designing the storm water drainage system in all urban areas of NCR. Master Plan for Drainage should be prepared for towns and cities by the concerned State Government /Departments/ Agencies in close collaboration with Urban Local Bodies, Urban Development Authorities, River Basin Organization, and Scientific Institutions in a time bound manner. Master Plan for Drainage to be prepared for all Class-I towns of NCR in the First Phase.

vii) *Construction of roads to start from Edge:* It has been observed that even if adequate right of way (ROW) is provided for proposed roads in the Development Plan, the land is not available at the time for the construction/widening of roads. At the initial stage of development, road space requirement is less, therefore, construction of roads is undertaken up in parts and generally it is constructed in the centre of ROW and drains are developed. Major part of the ROW of the road is left unused and drains and footpaths are dismantled and reconstructed at the time of widening of the roads. This increases the cost of construction when the drain is being re-constructed. The land on either side

of the road kept for expansion is encroached and it becomes difficult to retrieve the encroached land. This problem can be addressed by starting the construction of the road from edge and outermost part of the road is constructed first by constructing footpath, service road, drain and carriageway depending upon the requirement and land for widening of the road is left in the center merged with median. The roads can be widened towards the median depending upon the requirement. This will help in reducing the multiple expenses of constructing and re-constructing drains and footpaths along the roads on one side and appropriate slopes in the drains would be maintained as per Drainage Master Plan based on invert levels.

viii) *Regulation for Covering of Drain:* In urban areas, drains along the roads are allowed to be covered in front of gates to derive access from roads or otherwise which makes their cleaning difficult and ultimately leads to blockage of drains and flooding on roads. A standard design for removable drain covers at regular interval should be incorporated in building byelaws so that this problem can be avoided. It should be checked by the agency while granting building permission or at the time of providing occupancy certificate. A provision for recovering the demolition costs from the property owners, if any, should be integral part of Bye-laws.

It is recommended that the practice of covering the drains for construction of roads be discouraged. Even bridges/elevated road running over drains or along the alignment of drains should also be discouraged as pillars obstruct the flow of storm water and movement of cleaning equipment.

ix) *Construction of Bridges/Elevated Roads over Drains:* Where it is unavoidable and when all other options are exhausted, construction of bridges/elevated roads over drains should be permitted. However, efforts should be made to ensure that the construction be undertaken by the agency responsible for drain maintenance after taking into account the L-section and discharge capacity. The process of giving NOC to other Departments for road construction over drains should be discouraged, since after obtaining NOC, paying sufficient attention to the invert level and discharge capacity by other construction agencies may pose as a matter of concern. Once the bridge is constructed it becomes difficult to rectify the mistakes. The practice of bridge construction by RCC Hume pipes should also be discouraged as it also reduces the effective cross sectional area of drain.

x) *Segregation of sewage and drainage:* The major problem of urban drainage is mixing of sewage with storm water in drains. Drains are neither designed nor expected to carry the sewage. Urban areas should have separate sewerage and drainage network.

xi) *Treated waste to flow in drains:* Sewage should be treated in the Sewage Treatment Plants to desired level as specified by Central Pollution Control Board, Ministry of Environment, Forest & Climate Change (MoEF&CC), Government of India and then only it should be discharged into the drains. There should be a provision of penalty for agencies discharging un-treated sewage into the drains.

xii) *Industrial waste to be treated in CETP*: The characteristics of industrial wastes are different from domestic wastes. It is highly toxic and acidic compared to the domestic

waste. Treatment of industrial wastes requires more efforts and the technology of treatment depends upon the type of industry and its waste. It is desirable that the industrial wastes are treated separately. If there are several industries, a Common Effluent Treatment Plant (CETP) should be developed.

xiii) *Decentralized Treatment Plants (Treat and Use Approach):* The traditional approach of conveying the sewage over long distances, treat and then dispose of in the natural stream find priority among Urban Local Bodies. It is recommended that sewage is treated locally and treated water is utilized for non-drinking purposes e.g. horticulture, gardening, car wash, air conditioning etc.

xiv) *Cleaning of Sewerage System:* It has been observed that in case of blockage, sewers are cleaned with using rope-cum-bucket machine which damages the skin of pipes thus exposing reinforcement. This reinforcement is corroded due to presence of H_2S gas in sewers ultimately causing crown collapse of the sewers (subsidence of sewer). In view of this, it is recommended that agency should clean the sewerage system using modern machines i.e. jetting-cum-suction machines. Age-old method of using rope-cum-bucket machine for cleaning of sewerage systems should be discontinued.

xv) *Regular Maintenance of Drain (cleaning):* The authorities responsible for maintenance have a cleaning schedule which needs to be adhered. Annual maintenance of drains being carried out before monsoon is very important and be completed before arrival of monsoon. The work should be started well in advance to ensure its completion in time. Since this work is repetitive in nature, standard tender document may be prepared and kept ready to save time. The Plan has suggested a desirable schedule and important actions required to be taken by concerned authorities.

xvi) *Institutional Arrangement*: It is observed that each NCR participating State has its own institutional arrangement for handling drainage system. There are multiple departments/agencies responsible for drainage management in urban areas. As there are several agencies there is lack of coordination in management in the drainage system. It is recommended that there should be a single coordinating Body for planning, design, construction and maintenance of drainage system in urban areas.

xvii) *Provision for Funds*: Poor financial condition of local bodies results in poor maintenance of drains. Local bodies need to look for innovative methods for resource generation.

xviii) *Capacity Building:* Presently, there is no formal training for the staff engaged in the maintenance (cleaning). Absence of any formal training has left them to learn while working. With the introduction of modern technology, the staff also needs to be trained to cope up with the technology. It is recommended that regular capacity building programmes for the staff be carried out.

xix) *Rain water harvesting:* It is recommended to harvest the surface run off by increasing recharge from the basins through various techniques, including natural as well as induced techniques, such as placing recharge structures in the drains; recharge trenches/wells; harvesting by means of reviving/recharging lakes and ponds; roof top harvesting, etc. as proposed in the Functional Plan for Ground Water Recharge and draft Functional Plan for

Water in NCR. Both the Functional Plans have also proposed to amend Municipal Acts, Building Bye-laws and other relevant provisions to promote rain water harvesting by all multi-storeyed complexes, commercial buildings and group housing societies and to maintain them for efficient recharge, which should be adopted.

xx) *Mass Public Awareness:* There is a need to create mass public awareness about the consequences of dumping plastic, domestic waste and street cleaning into drains. This should be campaigned via media and other awareness programmes to make people more responsible. Efforts should be made to encourage public to become proactive in reporting the events that need the attention of the public authority to keep the city drains clean. A system for such reporting should be developed which could be either via e-mail or toll free telephone number or SMS. Persons who participate in such system could be felicitated by the agency.

xxi) *Service Level Benchmarks*: As part of the ongoing endeavour to facilitate critical reforms in the urban sector, the Ministry of Urban Development has prepared "Hand Book of Service Level Benchmarking" in four key sectors namely, Water Supply, Sewerage, Solid Waste Management and Storm Water Drainage. The Ministry of Urban Development would facilitate the adoption of these benchmarks through its various schemes and would also provide appropriate support to ULBs that move towards the adoption of these benchmarks. It is recommended that all the NCR participating states and local level functionaries should use "Handbook of Service Level Benchmarking" in achieving the goal of improved service delivery.