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One Day Stakeholders' Consultative Workshop on Yamuna Urban Floods in Delhi with Focus on July 2023 Event



National Institute of Disaster Management
Ministry of Home Affairs, Government of India

One Day Stakeholders' Consultative Workshop on Yamuna Urban Floods in Delhi with Focus on July 2023 Event

Venue
NIDM Campus Rohini, Delhi

Date of Workshop
12 December 2023

Organized By
Flood Monitoring Cell
Geo Meteorological Risk Management Division
National Institute of Disaster Management
Ministry of Home Affairs
Government of India

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Context

The increasing occurrence of urban flooding events has become a serious concern across the globe. Both developed and developing nations are victims of urban flooding. The most affected country is China followed by India, Indonesia, Bangladesh, Vietnam, Thailand and Pakistan. The major urban floods witnessed over the last two decades in India are Hyderabad 2000 & 2020, Chennai 2004 & 2015, Mumbai 2005 & 2017; Kolkata 2017: Bengaluru 2022. Many of these towns and cities are susceptible to repeated instances of flooding.

Delhi is the capital of India. The city has been experiencing floods of various magnitudes in the past due to floods in the Yamuna and the Najafgarh Drain system. The Yamuna crossed its danger level (fixed at 204.83m) twenty five times during the last 33 years. Since 1900, Delhi has experienced 10 major floods in the years 1924, 1947, 1977, 1978, 1988, 1995, 2010, 2013 and 2019 when peak level of Yamuna river was one meter or more above danger level of 204.49m at old rail bridge (2.66m above the danger level) occurred on sixth September 1978. The second record peak of 206.92m was on twenty seventh September 1988.

Due to rapid urbanization in the basin, the runoff has considerably increased. Consequently, the flooding events are now occurring more frequently and with higher magnitudes. A sizeable population of the city of Delhi resides in settlements that have mushroomed in the flood plains of Yamuna River. Large scale urbanization, reduction in holding capacity of the catchment, the confining of the river spread by construction of embankments coupled with the climate change phenomenon are the major contributors for increase in peak flow magnitude. The impacts of which are far and wide.

The unprecedented flood in Yamuna in Delhi witnessed during July 2023 is testament to the increasing trend in urban flooding. Thousands of people abandoned their homes on the Yamuna floodplains as the water level in the river rose to a 45-year high of 208.05 meters on Wednesday i.e. 12th of July, 2023. The water level of the Yamuna touched an all-time high 208.66 m on Thursday i.e. 13th of July, 2023. Bringing with it many woes like water logging, disruption in vital lifelines of Delhi including water supply, rail and road transport, metro and hospitals along with siltation of roads and residential areas, flooding of fields, embankment breaches and threat of vector borne diseases. Many areas in North, North East, East and South East were in deluge for weeks.

Although various reasons for flooding in Delhi are known, even though there has been variability of reasons from one flood to another, yet it is clear that all stakeholders may have to agree upon an action plan to not only collaborate with an integrated and holistic approach with judicious combination of

both structural and non- structural methods for the flood problem of Delhi but also look beyond in the context of risk assessment, early warning systems, response and recovery needs and relief operations and so on.

It is in the context of the Yamuna urban floods of Delhi with focus on July 2023 event that the instant workshop was planned so as to bring into limelight the experiences and lessons learnt and visualize strategies and actions for a way forward. Various stakeholders viz. India Meteorological Department (IMD), Irrigation and Flood Control Department (I&FCD) of Delhi, I&FCD, of UP, I&FCD of Haryana, Central Water Commission (CWC), Delhi Disaster Management Authority (DDMA), Municipal Corporation of Delhi (MCD), Delhi Development Authority (DDA), Health and Revenue Departments of National Capital Territory of Delhi, Delhi Jal Board (DJB), National Disaster Response Force (NDRF), Public Works Department (PWD), BSES, Delhi Urban Shelter Improvement Board (DUSIB), Boat Club and Centralized Accident and Trauma Services (CATS) Ambulance demonstrated enthusiasm in sending delegates and participants to this workshop.

Objectives

- To disseminate the experiences of stakeholders, Administration and Line Departments about urban flooding in Delhi.
- To bring forth all issues and concerns of all Stakeholders, Administration and Line Department for a more coordinated response to the floods in Delhi in future.
- To equip participants with the necessary knowledge, skills, and abilities to respond effectively to floods in Delhi in future.
- To draw a future roadmap for flood mitigation in Delhi.

Contents of the Workshop

Contents of the workshop touched upon following aspects in order to achieve the objectives:

- Problems faced
- Actions taken
- Urban flood vulnerability of Delhi
- Urban Flood (Risk) Management
- Flood Forecasting
- Early Warning System
- Flood impacts
- Response and Recovery Needs
- Relief Operations
- Building System Resilience
- Institutional framework
- Causes of floods in Delhi
- Mitigation and management strategies

Inaugural Session

The inaugural ceremony for the **One Day Stakeholders' Workshop on "Yamuna Urban Floods in Delhi with Focus on July 2023 Event"** was graced with the presence of **Shri Rajendra Ratnoo, IAS,** *Executive Director, National Institute of Disaster Management (NIDM);* **Shri Rajender Kumar,** *Sub-Divisional Magistrate, Preet Vihar, New Delhi.* **Prof. Surya Parkash,** *Head of Geo-Meteorological Risk Management Division, NIDM;* **Shri Surendra Thakur,** *Joint Director, NIDM* and **Shri Manjeet Singh Dhillon,** *Senior Consultant, NIDM.*



Presiding the inaugural of the workshop, **Shri Rajendra Ratnoo, IAS,** Executive Director, National Institute of Disaster Management (NIDM) welcomed the dignitaries on the dais by greeting them and by stating under the Disaster Management Act 2005, NIDM has been assigned nodal responsibilities for human resource development, capacity building, training, research, documentation and policy advocacy in the field of disaster management. He further said that the developing countries like India suffer the greatest costs when a disaster hits – more than 95% of all deaths caused by hazards occur in developing countries, and losses due to natural hazards are 20 times greater in developing countries than in industrialized countries. Since Urban flooding has become a prominent disaster affecting various cities across the globe, increasing trend of urban flooding is a universal phenomenon and poses a great challenge to urban planners the world over. The major urban floods have been witnessed over the last two decades in India in Hyderabad 2000 & 2020, Chennai 2004 & 2015, Mumbai 2005 & 2017; Kolkata 2017: Bengaluru 2022. Challenges and complexities of governance and multiple organizations for flood control and drainage exacerbate the flood problem of Delhi. He went on to say that it is in the context of Yamuna urban floods problems of Delhi with focus on flood during July 2023, this workshop is being held so as to bring forth the experiences and lessons learnt and visualize strategies and actions for a way forward by various stakeholders and resource persons participating in this workshop. He said that it will be worthwhile to bring forth in this forum that besides other concerns, the Prime Minister's 10 Point agenda on Disaster Risk Reduction seeks to ensure that the opportunity to learn from a disaster

is not wasted. After every disaster there is a need to undertake research studies to understand the best practices and learn lessons to improve the policy and disaster governance. It is in accordance with this spirit that today's workshop has been planned by NIDM. He expressed gratitude towards all the stakeholders to converge upon an action plan to not only collaborate with an integrated and holistic approach with judicious combination of both structural and non- structural methods for the flood problem of Delhi but also look beyond in the context of risk assessment, early warning systems, response and recovery needs and relief operations and so on. He stated that alongside, a document entitled "Yamuna Urban Floods in Delhi with Focus on July 2023 Event" is being brought out by NIDM for which data is being collected by NIDM and the conclusions form this workshop will do a value addition to this document. Shri Rajendra Ratnoo, IAS concluded with a wish that all distinguished speakers from India Meteorological Department (IMD), Irrigation and Flood Control Departments (IFCDs) of Delhi, Haryana and UP, Central Water Commission (CWC), Delhi Disaster Management Authority (DDMA), Delhi Jal Board (DJB), National Disaster Response Force (NDRF), Public Works Department (PWD) and Delhi Development Authority (DDA), Indian Institute of Technology, Delhi, SDMs from Preet Vihar and from Sarita Vihar, along with all participants from line departments will demonstrate enthusiasm and make this workshop an interactive and successful event which will equip all with the necessary knowledge, skills, and abilities to respond effectively to floods in Delhi in future.



Shri Rajender Kumar, *Sub-Divisional Magistrate Preet Vihar, New Delhi* in his speech brought up the problems faced by his district during the flood of July 2023. In his speech he emphasized on how the administration tackled the issue of floods and especially for rescue and relief and coordination among different departments involved in floods including NDRF and the army. Many challenges faced by the administration during the flood, suggested measures and way forward was elaborated in his speech.



Shri Surendra Thakur, *Joint Director, NIDM,* acknowledged all the dignitaries on and off the dais. He continued his speech by saying that the National Institute of Disaster Management (NIDM) was constituted under an Act of Parliament with a vision to play the role of a premier institute for capacity development in India and the region. The efforts in this direction that began with the formation of the National Centre for Disaster Management (NCDM) in 1995 gained impetus with its re designation as the National Institute of Disaster Management (NIDM) for training and capacity development. Under the Disaster Management Act 2005, NIDM has been assigned nodal responsibilities for human resource development, capacity building, training, research, documentation and policy advocacy in

the field of disaster management.

He further stated that both as a national Centre and then as the national Institute, NIDM has performed a crucial role in bringing disaster risk reduction to the forefront of the national agenda. The Institute believes that disaster risk reduction is possible only through promotion of a "Culture of Prevention" involving all stakeholders. The Institute works through strategic partnerships with various ministries and departments of the central, state and local governments, academic, research and technical organizations in India and abroad and other bi-lateral and multi-lateral international agencies. Shri Thakur also wished success for the workshop in achieving the objectives for which it has been planned.



Prof. Surya Parkash, Head of Geo-Meteorological Risk Management Division, NIDM; welcomed everyone on and off the dais. He started his speech by setting the tone of the workshop by stating the importance of the workshop on "Yamuna Urban Floods in Delhi with Focus on July 2023 Event" as well as the documentation on this topic being carried out in NIDM. He stated that the document on Delhi Flood will bring forth all aspects of Urban Flooding in Delhi in retrospect as well as the event of July 2023 when the High Flood Level at the Old Railway Bridge touched the all- time high of 208.66 meters above mean sea level, bringing with it many woes like water logging, disruption in the vital lifelines of Delhi including water supply, rail and road transport, metro and hospitals, siltation of roads and residential areas, flooding of fields, embankment breaches and threat of vector borne diseases. He said that the scale of disaster was so much that the Army and the National Disaster Response Force were pressed into service on July 14th as the flood water submerged parts of the capital including parts of the arterial ring road, the busy ITO intersection, Rajghat and even reached periphery of the supreme court. Professor Surya Parkash emphasized that with the active participation by the wide spectrum of Resource Persons, distinguished speakers and the participants from the various stakeholders and the line departments will help to converge on the causes, challenges, vulnerability, mitigation strategies as well as on the rescue, relief and recovery operations of urban flooding in Delhi and he wished successful completion of the workshop and said that he looks forward to a way forward and a road map to the problem of flooding during this workshop. Professor Surya Parkash then invited Mr. Manjeet Singh Dhillon, Senior Consultant, NIDM for a presentation on The "Yamuna Urban Floods in Delhi with Focus on July 2023 Event".



Mr. Manjeet Singh Dhillon, *Senior Consultant, NIDM,* welcomed all distinguished speakers and participants and in order to set the context

of the workshop, gave a comprehensive presentation on "Yamuna Urban Floods in Delhi with Focus on July 2023 Event". He also shared the contents of the document on the same which is being finalized in NIDM. At the outset, it was stated that flooding in Delhi was due to heavy to very heavy rainfall over the city from 8th July to 11th July combined with river Yamuna being in spate and congestion in the drainage network of the city. There have been 9 floods in the past in Delhi when peak level was one meter or more above danger level, however, on 13th July 2023 the Yamuna HFL at the Old Railway Bridge recorded an all- time high of 208.66 meters as a consequence of which many areas of the city were inundated with very widespread impact. The paradox situation arose in Delhi flood of 2023 in that though the outflow from Hathnikund Barrage was only 3.59 Lakh Cusecs which is less than earlier occasions like in 2019, when the outflow from Hathnikund Barrage was of the order of 8.28 Lakh Cusec, while the corresponding HFL of 2019 at the Old Railway Bridge was only 206.60 m. The floods in Delhi are ascribed to lack of storage structures on the upper Yamuna basin, Encroachment of Flood plain, vulnerable stretches in embankment, Reduction in retention capacity of the basin, Lack of flood plain development policy and inherent deficiencies in the drainage system. Many challenges and complexities of governance in Delhi and multiple of flood control and drainage exacerbate the drainage and flood problem of Delhi. It was brought out that a proactive, participatory, well structured, multi-disciplinary and multi-sectoral Urban Local Bodies as envisaged in the National Guidelines on management of Urban Floods by NDMA is called for in Delhi so as to implement catchment based planning and designing for storm water drainage system.

The inaugural session of the workshop was followed by eight sessions.

Session I - Hydro Meteorogical Support for Flood Forecasting

RESOURCE PERSON

Dr. Ashok Kumar Das, *Scientist-"E" Hydrometeorology Division, India Meteorological Department.*

KEY POINTS HIGHLIGHTED

Shri Ashok Kumar Das informed that Hydro meteorological Support for Flood Forecasting is given by IMD in respect of the following:-

- IMD provides observed rainfall and Quantitative Precipitation Forecast (QPF) for 156 river sub- basins for flood forecast (Level Forecast) by CWC.
- Joint advisories on Flood Status of the country is issued by IMD, CWC and NDRF.
- Flash Flood Advisory Services
  - IMD (Presently Regional Centre for South Asia) in Collaboration with WMO jointly implemented South Asia Flash Flood Guidance System (SAsiaFFGS) project and provides flash flood advisories operationally to National Meteorological & Hydrological Centres in Nepal, Bhutan, Bangladesh Srilanka & India since October 2020.
  - Presently, IMD provides location specific Flash Flood guidance advisory up to watershed level (1lakh watersheds) four times a day.
  - Categories of alerts: Threat (6 hr Lead time) & Risk (24 hr. Lead time).

ACTIONS TAKEN

Shri Das elaborated upon some recent initiatives and the future plans of IMD for hydro meteorological support for flood forecasting:

- Lead period of River Sub Basin QPF increased from 5 days to 7 days.
- Initiated issuing Probabilistic QPF.
- Commissioned New FMOs at Srinagar, Bengaluru, Chennai and Thiruvananthapuram.
- Increased rain gauge network to 5896.

- Utilization of more Models for decision making.
- High Resolution dynamical model forecasts operationally provided to Central Water Commission for running their Hydrological modelling.
- Improvement in river Sub-basin wise Quantitative Precipitation Forecasts (QPF) skill by 6% in recent years.
- Joint advisories by IMD, CWC and NDRF on Flood Status of the country.

PROPOSED SOLUTIONS AND ROAD AHEAD

- Enhancement in observational network (AWS/ARG and remotely sensed DWR).
- High Resolution NWP modelling.
- Post processing for NWP rainfall (BIAS Correction/downscaling).
- Improvement in Co-ordination and exchange of information among stakeholders.
- Application of dynamical model in Extended Range Rainfall Forecast in the river sub-basins.

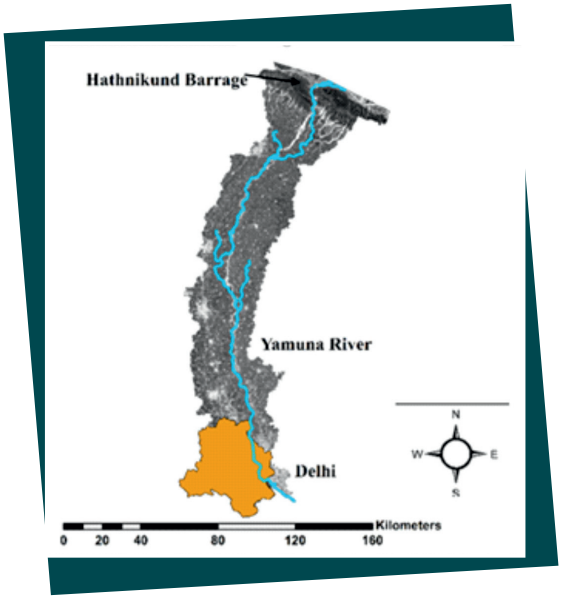
Session II - Simulation of Yamuna Flood of July 2023

RESOURCE PERSON

Dr A. K. Gosain, *Emeritus Professor, IIT Delhi*

KEY POINTS HIGHLIGHTED

Dr Gosain explained that while factors such as river course narrowing, and the construction of multiple bridges in the area have historically influenced peak river levels, however, these alone cannot explain the extreme water level rise observed in 2023. Despite a similar number of inline structures, the maximum water levels recorded during the 2018 and 2019 floods were 206.06 m and 206.60 m, for a discharge of 5.05 and 8.28 Lakh cusecs at Hathnikund respectively. The question is, why the water level reached 208.66 m in 2023, even with peak flow of only 3.59 Lakh cusecs at Hathnikund? The possible answer to this question is sought through hydrodynamic modelling. Dr Gosain made presentation in the context of this objective. Therefore, Hydraulic modeling was conducted along the stretch from Hathnikund barrage in Uttarakhand to Okhla barrage in Delhi.



The Flood of July 2023

The July 2023 flood event in Delhi stands as a significant chapter in the city's history, marked by several notable components:

1. The Hathnikund Barrage, released a peak flood discharge of 3.6 lakh cusecs.

2. ***Highest Flood Level***: The water levels at the Old Railway Bridge, Delhi surpassed the previous highest flood level of 207.49 meters (1978), reaching an unprecedented 208.66 meters on July 13, 2023.

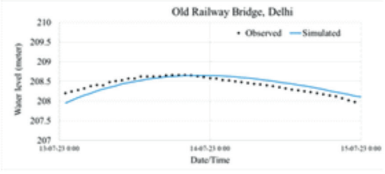


9th July to 19th July 2023, which accommodated a peak flow of **359,760 cusecs** recorded at 11:00 am on 11th July is utilized to work out the dynamics of flow towards Delhi. The highest water levels observed at two critical monitoring points, Wazirabad Barrage, reaching **209.15 meters**, and the ORB, registering an all-time peak level of **208.66 meters** have been utilized as essential reference data.

ACTIONS TAKEN

Simulations of water levels was done for comparison with the observed levels at the Old Railway Bridge (ORB), Palla, Wazirabad Barrage and Okhla Barrage. The model was simulated for two scenarios, first with natural terrain and second by incorporating constant thickness of silt by raising the bed level by 1.8 meters (6 feet) from downstream of Palla to ITO barrage. The model was also simulated with the river width constriction due to a metro bridge. The results of simulations are as below:-

Observed & Simulated level at ORB



R-square	NSE	PBIAS
0.976	0.978	-0.10 %

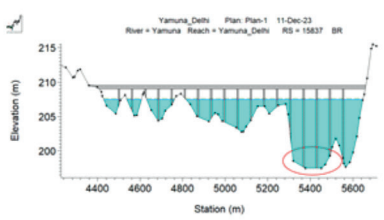
Comparative Analysis of Simulated and Observed Water Levels at Old Railway Bridge over 48 hours from 13th July (Time 00:00) to 15th July (Time 00:00).



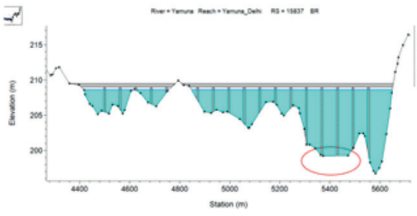
Inundation map of Delhi for highest water level in 2023

Scenario to explain the level attained at ORB

- The Model is simulated for the two scenarios, first with the natural terrain and second incorporate the constant thickness of silt by raising the bed level by 1.8 meters (6 feet) from downstream of Palla to ITO barrage. (source: Delhi Jal Board https://www.hindustantimes.com/cities/delhi-news/delhi-jal-board-to-start-dredging-and-desilting-of-yamuna-riverbed-to-improve-water-holding-capacity-and-quality-101691605394544.html)
- The difference at old railway bridge in the level is found 1.2 m after and before the siltation.



Old Railway bridge section Terrain without siltation

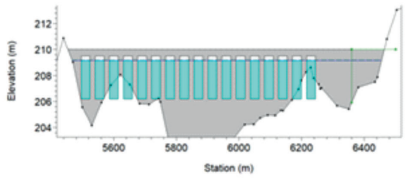


Old Railway bridge section with siltation

Comparison of water level at other locations

Observed and simulated water levels are also compared at Palla, Wazirabad barrage, Old Railway Bridge and Okhla Barrage

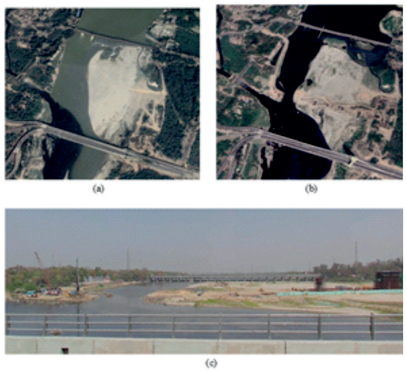
Location	Observed water level (m)	Simulated water level (m)
Palla	212.70	212.72
Wazirabad barrage	209.15	209.15
Old railway bridge	208.66	208.65
Okhla barrage	200.8	200.6



July 2023 Flood Simulation:
Wazirabad Barrage at Water Level 209.15 m

River Width Constriction

- The Yamuna River stretch in Delhi traverses through 22 inline structures, including bridges and barrages, with some currently undergoing construction.
- Additionally, a new construction project has been observed approximately 400 meters downstream of the Wazirabad barrage for a Metro bridge.
- This recent development has significantly reduced the active river width to just 50 meters. The alteration in the river's configuration is evident in March 2022 and November 2019, imageries
- When this constriction is incorporated into the model, it indicates a rise of 42 centimeters in water level upstream of the constriction.



Comparison in Yamuna river width downstream of Wazirabad barrage between (a) Novemb 2019 and (b) March 2022, and (c) Image of construction activity (source: Google image)

Session III - An Overview of Delhi Flood of July 2023

RESOURCE PERSON

Shri Rajender Kumar, *SDM, Preet Vihar and MS Anjali Diwakar, District Project Officer.*

KEY POINTS HIGHLIGHTED

Shri Rajender Kumar, SDM, Preet Vihar and MS Anjali Diwakar, District Project Officer discussed the scenario of Delhi flood during July 2023 and deliberated upon the response of NDRF and army and how it was coordinated in the district. The challenges faced in the wake of flooding, the suggested measures and the way forward was brought out by them.

Challenges

- The highest ever flood in river Yamuna in Delhi was observed with highest water level of 208.66 meters on 13.07.20223 at Delhi Railway Bridge which was 1.17 meter over and above the previous highest water level of 207.49 meters recorded in 1978.
- Leakage / Overtopping of regulator gates was observed at certain locations by I&FC Department. (Matcalf House, Tonga Stand, Ali Drain, Suppl. Drain – 08 nos. and N.G. Drain 04 nos.)
- Overtopping of banks due to rise in water level of the river was observed by I&FC Department at various locations (Neeli Chhatri, Boat Club, DMRC store, Tibbati colony, Monastery Market, Aarti Sthal, Geeta Ghat, Najafgarh Drain).
- Submergence of settlements on the flood plain of River Yamuna in Delhi was observed at some locations (Garhi Mandu, Usmanpur, Badarpur Khadar, Vishwakarma Colony (Jaitpur), Dhobhi Ghat Jhuggies (Okhla)).
- Out of total 32 gates of ITO Barrage, 05 gates were found to be silted up and jammed. Out of these 05 gates, 02 nos. gates were opened with the help of Army.
- Due to breach of embankment at regulator of Drain No. 12 when the water level of river was 208.66 meters at Delhi Railway Bridge the Mild Steel gate at the regulator got dislocated due to sudden surge of water from the river towards the gate.
- At some places, due to lack of effective storm water drainage system, the sewer manholes of DJB had to be punctured to discharge storm water.

- DJB's three Water Treatment Plants (WTPs) were shut down as water entered in their pumping stations and other units. (This caused water scarcity in about one third of Delhi). Most of the tube wells of DJB at Palla region were stopped due to submerged water conditions.
- Sewerage services of DJB at some places in low lying flood plain area like Nigam Bodh Ghat were affected, where Sewerage Pumping Station could not work due to power failure as BSES substation got submerged. As a result thereof, pumping and power supply system dewatering pumps installed at various locations by PWD became non-functional. Operation & repair of dewatering pumps was affected due to disconnection of power supply by BSES in some areas.
- DJB had to increase pumping at Sewage Pumping Stations (SPS) and Sewage Treatment Plants (STPs) as excessive storm water has entered into the sewerage system. Beyond the designed capacity of STPs and SPSs, the influent was partly surpassed without being treated. At few places like Hakikat Nagar, additional pumps were also installed for pumping storm water out of the locality.
- Jetting/ suction machines had to be deployed to clear blockages where stagnation of storm water was anticipated/noticed.
- Multiple Agencies/ departments are maintaining different stretches of Drains/sewers- I&FC, PWD, DJB, MCD resulting in the following issues-
  - Issues of gradient not matching in the interconnecting drains under various departments.
  - Mismatch in Water holding capacity of drains.
  - Co-ordination issues among different departments like desilting of some stretches in a drain.
  - Impediments on drain embankments/ floodplains- encroachments, concretisation, leading to difficulty in desilting and maintenance of drains. Drains are not easily approachable to man and machinery for desilting and other purposes.
- Inadequate pumping capacity and low formation level of pump houses became a problem- several became submerged at Delhi Sectt, Hakikat Nagar, Tonga Stand, Yamuna Bazaar, Vijay Ghat, Jahangirpuri etc.
- The permanent pumping stations of PWD became unapproachable and temporary dewatering pumps installed in these locations could not be utilized to full capacity.
- NDMC area gets flooded due to improper outfall of MCD Drains at various places such as Sunheripul Nala, Purana Quila etc. due to which water logging is observed at certain critical locations like Subramaniam Bharti Marg, Golf Link, Bharti Nagar, Lodhi Colony and adjoining areas.
- At many places, the river flood plains has been encroached in the form of unauthorized settlement and for agricultural activity.
- Inadequate desilting of drains are observed. Backflow in drains is observed in colonies.
- Absence of support system for evacuation of cattle and animals was observed.

- The peak flood days being working days, the movement of general public including students going to school/ university resulted in heavy traffic jam and hindered the moment of essential supply/ emergency vehicles of line departments.
- Coordination among different agencies and with neighboring states could be improvised.
- Few relief camps were erected on the road side which obstructed smooth flow of traffic and could have lead to accident or any other mishap especially in areas where people moved with their cattle and animals.
- Unwillingness and reluctance of people living in flooded areas to leave their habitations inspite of munadis and warning given to them. Even after the water had entered the houses, people were waiting for police and administration to rescue them, their cattles/animals and other belongings rather than moving out on their own after initial warnings.
- Shortage of boats was felt by Delhi Police in the initial phase of rescue/ evacuation operation before arrival of NDRF. Uneven topography coupled with Barbed wire fencing at some places led to obstruction in free movement of boats. NDRF inflatable boats even got punctured due to barbed wire.

MEASURES SUGGESTED

- Flood fighting equipment to be stock piled at easily accessible locations for prompt transportation and supply to the intended sites. Procurement of latest technology emergency response equipment like mobile dewatering pumps of different capacities, quick response vehicles equipped with repairing tools by all agencies i.e. MCD, I&FC, PWD & NDMC is also required.
- Immediate flood fighting measures such as repairs, closing of inlets, plugging of leakages/ breaches etc. to be taken at site by I&FC Department.
- Forest Department should remove uprooted trees immediately which create obstruction in free flow of water in drain/ river.
- Before the onset of monsoon season, all the bundies/ obstructions created by the executing agencies in the river should be removed to give full water way to the river flow.
- For stopping entry of flood water into STPs/ Sewage Pumping Station (SPS)/ Water Treatment Plants (WTPs) located at low lying areas, retaining walls need to be constructed and other methods may also be devised by DJB for the purpose.
- Formulation of Emergency Response Teams for operation and maintenance of STP/SPS/ WTPs and other installations.
- Framing of realistic Annual Action Plan for Desilting so that it is carried out effectively using scientific desilting methods and proper monitoring by use of technology.
- Reconstruction of existing permanent pumping stations near to river Yamuna and large Drains in first phase. The discharge of pumping water should be directly into river Yamuna or in near by drains at a proper height to avoid back flow in case of rising water level in river.

- Standard Operating Procedure for handling the breakdowns of pumping equipment/ regulators/ drain breach needs to be formulated.
- Pumps and panels, diesel pumps, DG sets and BSES supply panel need raising to new Highest Flood Level i.e. 208.66mtr. Dedicated BSES supply lines to be laid/ provided at pumping station so that during power cut/ load shading these crucial installation are not affected.
- Automation of all pump rooms to be done to ensure self- start of pumps as soon as need arises.
- To raise the level of ground adjacent to river banks to prevent early entry of flood water in the low lying areas. As a temporary solution, sand bags shall be stacked at such location. Filled sand bags to be stocked to prevent ingress of water into some walled residential areas.
- Preparedness through creating pool of trolley mounted diesel pumps, DG Sets, sand bags, jetting machines etc. at some strategic locations for fast deployment at affected areas. Provision of portable/ mobile pumping arrangements like tractor mounted pumps, diesel engine pump sets, DG sets, Motor pump sets etc. on trollies for easy movement on roads.
- Coordination and linkages with MCD (Sunehri Pulla and DTC Depot), PWD (Purana Qila Road/ITPO) for redesigning & reconstruction of outfall points/ drains.
- Enhancement of Rain Water Harvesting system– CPWD and Private colonies.
- Every year before onset of monsoon, Delhi Traffic Police shares list of locations where frequent water logging happened in the previous year. Civic bodies and concerned departments can identify these locations and place mobile dewatering pumps to avert water logging.
- Timely Dissemination of information across the agencies in a seamless manner by getting all nodal officers/ Senior officers of stake holders/ departments in a single platforms, thereby facilitating coordination among the nodal officers of all agencies and even with the departments of neighboring states.
- Mock Drills involving situation related to relief and rescue during flooding should also be conducted on regular basis to improve co-ordination among line department.

PROPOSED SOLUTIONS AND ROAD AHEAD

- As 45 years old record of Yamuna water level (207.49 meters) has been breached by 1.17 meter, (208.66 meters). Therefore model study of river is required to be carried out for ascertaining new higher HFL to identify the changes required in design of regulators and embankments. Set up of Permanent pumping stations at all Regulators on a suitable height keeping in mind the new Highest Flood Level i.e. 208.66 meters, with power sources on BSES and DG sets and permanent regiment discharging into river Yamuna.
- Drainage Act for Delhi is required to empower the Government departments to take actions against the encroachments and infringement of rules regarding the flood plains as well as

drains. Legal framework empowering drain owning agencies for protection of embankments like removal of encroachments, clear access to drains.

- Flood plain area should be completely free from illegal settlements/encroachments and a zero tolerance approach on these.
- The Control and Command of ITO barrage and Okhla Barrage may be with the Govt. of NCT of Delhi.
- The executing agencies working in the river flood plain should design their structures so that minimum water way is obstructed and minimum afflux is created in the river.
- After carrying out the ecological and environmental study of the river, the sediment deposits in the form of islands or in the bed may be removed as per the recommendations of the study report.
- All the services/utility lines i.e. water line, sewer line, electric/telephone cables, Gas pipeline, transformers should be outside/below Design Bed Level or above embankment level of drain.
- Development of Green Infrastructure and to design Delhi as Sponge City with artificial recharge using rain water harvesting, constructions of permeable pavements to capture maximum rain water to stop its contribution in flooding. Rejuvenation of water bodies, and implementation of BIOSWALES by road owning agencies (PWD, MCD) etc. Bioswales are channels designed to concentrate and convey storm water runoff while removing debris and pollution and beneficial in recharging ground water.
- Most of the infrastructure have been designed for Highest Flood Level (HFL) of the river at 207.49 meter now needs to be upgraded for new HFL (More than 208.66 reached in this flood) which is to be decided by the concerned authorities (CWC).
- Tube-wells and Sewage Pumping stations located at low lying areas needs to be designed to work even in submerged conditions. DJB may consider enhancing the pumping capacity of sewage system to avoid overflowing of sewers.
- Interlinking of Under Ground Reservoir (UGRs) of critical WTPs with other WTPs. In case of shutdown of any WTP its UGRs can be supplied water from other WTPS.
- DJB has about 10,000 km of sewer lines which are desilted on routine basis, however Desilting has to be more systematic and it should be monitored with the help of latest technology, like cameras and sensors.
- Standard Operating Procedures (SOPs) for WTPs/STPs/SPSs shall be formulated to mitigate the effect of flooding.
- Better coordination among multiple civic agencies i.e. various departments responsible for storm water drainage system in Delhi.
- Larger drains falling in river Yamuna should be with one agency as far as possible. ULBs can look at colony drains and the rest should be with one Department to avoid issues of multiplicity.

- Strengthening of pumping infrastructure by replacing old pumps with higher capacity and improved energy efficiency of remaining permanent pumping stations in second phase that are left in first phase under short term solutions. Installation of high capacity pumping systems at flood gates of I&FC Department to control rise of water level inside city during closure of gates.
- Existing drainage system needs to be redesigned to account for discharge of unauthorised colonies. Slopes of existing drains of all agencies needs analysis and correction as per present scenario in Delhi. Major dredging exercise to be undertaken of all major drains.
- Complete study of NDMC drainage system for long term measures to enhance/augment the NDMC drainage system needs to be taken up.
- Raising of State Disaster Response Force for Delhi to support in undertaking prompt response and immediate relief measures in the wake of any disaster.
- Unity of command at district level officers for each Department. Capacity building of DM office. Augmentation of Disaster Management resources at district level. Procurement of equipment to be used during rescue and relief operation i.e. life jackets, boats, ladder, etc.
- MCD may explore the possibility of constructing dedicated lines of drains/ pipes for their drains entering into NDMC area i.e. MCD drain may not fall in NDMC drain and cross the NDMC area through dedicated drains/ pipe to avoid surcharge in NDMC drain.

Session IV - Role of Delhi Jal Board in the Floods of July 2023

RESOURCE PERSON

Shri Dalbir Singh, *Additional Chief Engineer, Delhi Jal Board*

KEY POINTS HIGHLIGHTED

Shri Dalbir Singh Additional Chief Engineer, DJB informed that DJBs role is to provide Water and Sewerage services through its vast networks. Storm water drainage pertains to drain owning agencies like PWD, MCD & I&FC etc. and none of the drain pertains to DJB. Ideally storm water drains and sewers should not be interconnected, as sewerage system has not been designed to take load of storm water. However at some places, due to lack of effective storm water drainage system, the sewer manholes are punctured to discharge storm water.

Impact of flood on DJBs services DJB's three Water Treatment Plants (WTPs) were forced to close as water entered in their pumping stations and other units. Most of the tube wells at Palla region were stopped due to submerged water conditions. This caused water scarcity in about one third of Delhi, however with its mitigation plans DJB was able to handle it with least inconvenience to public. The treated water was partly diverted from Haiderpur WTP to Wazirabad WTP command area and water tankers from non-affected areas were diverted to areas with water scarcity.

Sewerage services were almost intact as sewerage infrastructure is strong and is efficiently maintained, except at some places in low lying flood plain area like Nigam Bodh Ghat, where Sewerage Pumping Station could not work due to power failure as BSES substation got submerged.

ACTIONS TAKEN

Delhi Jal Board increased pumping at Sewage Pumping Stations and Sewage Treatment Plants as excessive storm water has entered into the sewerage system. Beyond the designed capacity of STPs and SPSs, the influent was partly surpassed without being treated. At few places like Hakikat Nagar, additional pumps were also installed for pumping storm water out of the locality. Jetting/ suction machines were deployed to clear blockages where stagnation of storm water was anticipated/noticed. Broken manholes were urgently repaired to keep the sewerage infrastructure

intact. Regular monitoring of levels of sewage pumping stations through sensors and IOT was done.

He further elucidated that DJB resorts to short term, medium term and long term planning before and after floods which is as follows :-

Before Flooding

Short Term planning

- Desilting and bypassing arrangement of storm water before entering into STPs.
- Protection of STPs/ SPSs/ WTPs/ from flooding – climate sustainable system.
- Identification vulnerable zones and prioritization of mitigating measures.
- Procurement of emergency response tools like mobile pumps of different capacities, quick response vehicles equipped with repairing tools.
- Formulation of Interdepartmental coordination committee with Task Force.

Long Term planning

- Development of water supply scheme GIS mapping of all networks.
- Design for HFL-210m and climate resilient structures.
- To design Delhi as sponge city, artificial recharge using eco blocks.
- Rejuvenation of water bodies, and implementation of bio swales by ROA (PWD, MCD).

After Flooding

Short Term

- Cleaning, desilting and repairing of all the resources.
- Deal with water scarcity caused due to shutdown of some WTPs.
- Deployment of additional water tankers with integrated filters in affected areas/ camps and mobile toilets (WASH).
- Communication with public regarding status of W/S in their areas through social media.
- Emergency response teams.

Mid Term

- Development of GIS maps attributing key features integrating with APP based alert system & identification of damages.

- Automation towards flood with early warning alerts and mitigating measures viz. spare pumps, motors, starters.

Long Term

- Interlinking of major UGRs of all WTPs.
- Mitigating measures based on the GIS mapping and identification of material of pipes and to make them resilient.

PROPOSED SOLUTIONS AND ROAD AHEAD

The following lessons learnt and future plans of DJB were brought out by Shri Dalbir Singh :-

- Desilting of sewer lines to be more systematic and it should be monitored with the help of latest technology, like cameras and sensors.
- Water bodies in Delhi are to be revived, rejuvenated and properly connected with drainage catchment area as these can work as buffers to absorb flood loads.
- To increase implementation of rain water harvesting to make Delhi sponge city to absorb runoff.
- Tubewells and Sewage Pumping stations should be designed to work even in submerged conditions especially which are located at low lying areas.
- The boundary wall of Wazirabad WTP which is located at the bank of river Yamuna shall be raised to prevent entry of flood water in the plant.
- Spare pumps, panels etc should be kept ready in advance specially before the onset of monsoon.
- Standard Operating Procedures (SOPs) for WTPs/STPs/SPSs shall be formulated to mitigate the effect of flooding.
- Better coordination among multiple civic agencies (i.e. 12 departments responsible for storm water drainage system in Delhi).

Session V - Flooding of Roads due to heavy rainfall during July 2023

RESOURCE PERSON

Shri Vijender Singh, *Ex En, PWD, Delhi*

KEY POINTS HIGHLIGHTED

In recent years, rainfall-induced water-logging has become a common hazard in Delhi. During heavy rains. Delhi is facing rampant problem of water logging which plagues the city and causing heavy traffic jams. As it is a recurring problem in every monsoon, a glance in to major causes and some remedial measures was provided by Shri Vijender Singh.

Major Cause

- Road side drains are storm water drains. These drains are meant for rain water only. However in Delhi there is mix flow in drains. Normally household waste water is being disposed of in these drains. PWD drains run with full capacity even during non-rainy season The drains are unable to accommodate the excessive rain water during heavy rains. This is the main cause of water logging in Delhi during rainy season.

Remedial Measures

- The R.C.C. retaining wall up to height of 7 feet may be constructed along the locations like Mukarba Chowk to avoid over flowing of water during excessive rain.
- All the drains which are disposing off water in Yamuna River should have gates so that these can be closed to prevent back flow during excessive rain.
- Sewer Line may be laid properly in entire Delhi & no waste water should be allowed to enter in Storm Water drain.
- All encroachments temporary/permanent should be removed.
- Proper cleaning of Flood Drain & Yamuna River must be ensured to accommodate excessive water during heavy rains.
- Rainwater harvesting can be promoted to reduce storm water runoff to the drainage system

- The green belt may be developed along all the roads which will also improve the ground water table.
- The lakes all over Delhi must be developed and rain water may be stored in these lakes which will not only reduce the problem of flooding but also help in solving water crisis in Delhi.

Session VI - Role of Floodplain Management in Flood Mitigation

RESOURCE PERSON

Shri Rajiv Kumar Tiwari, *Principal Commissioner, Horticulture and Ms Nilima Soni, Director, Landscape, Landscape and Environmental Planning Department, Delhi Development Authority.*

KEY POINTS HIGHLIGHTED

Various achievements of DDA for floodplain management for flood control were emphasized in the presentation.

Restoration and Rejuvenation of the floodplains of River Yamuna is being carried out as an initiative by DDA with the main aim to restore and enhance the ecological character floodplains of River Yamuna and to make them accessible to the citizens of Delhi.

The flood plains of river Yamuna spread over a stretch of 22 kms in the urban Delhi from Wazirabad Barrage to Okhla Barrage on both eastern and western banks. DDA has been working as per the directions of the Hon'ble NGT and recommendations of the Principal Committee of Hon'ble NGT to restore these floodplains.

ACTIONS TAKEN

Ten number of projects on both western and eastern banks were identified to be taken up for restoration based on their physical location. The details are summarized below:

1. Asita- Old Railway Bridge to ITO Barrage (Eastern Bank)
2. Kalindi Aviral - Nizamuddin Bridge to DND Flyway (Western Bank)
3. Kalindi Biodiversity Park- DND to Kalindi By-pass (Western Bank)
4. Yamuna Vatiika- Old Railway Bridge to ITO Barrage (Western Bank)
5. Amrut Biodiversity Park – New Railway Line to Nizamuddin Bridge (Eastern & Western Banks)
6. Ghat Area – Waziraabd Barrage to Old railway Bridge (Western Bank)
7. Yamuna Vanasthali – Wazirabad Barrage to ISBT Bridge (Eastern Bank)
8. Mayur Nature Park – Nizamuddin Bridge to DND Flyway (Eastern Bank)

9. Eco-tourism area – Geeta colony Bridge to ITO Barrage (Western Bank)
10. Hindon Sarovar - Nizamuddin Bridge to DND Flyway (Eastern Bank)

These projects are being taken up with respect for:

1. **Protection of floodplains** - By demarcation of the Yamuna floodplains and repossession of the floodplains under the jurisdiction of DDA.
2. **Restoration of the wetlands** - By deepening and enlarging the existing ones and creating new wetlands.
3. **Connect to the river for the general public** - By means of providing public spaces connected with natural pathways, cycle tracks and seating areas in the Greenways. 'Greenways' which are a belt of about 100 - 150 mts along the existing peripheral roads. Variety of open spaces for passive activities along these trails.

These flood plains are being restored through the universal principles of ecological restoration, via

- Restoration of natural depressions
- Creation of catchment zones
- Revival of floodplain forests and grasslands

Creating favorable habitats, especially for water and terrestrial birds, and

- Identifying target actions to tackle the root cause of degradation through engagement of all stakeholders.

A considerable number of challenges were faced during the process such as:

- Removal of encroachments
- Legal matters
- Protection of floodplains from encroachers, cattle etc.
- Inter-Departmental coordination
- Infrastructure projects
- On-site issues

The same have been tackled through multiple demolitions, reclamation of land, defending in various courts and additionally for securing the same through deployment of guards, placing of sign boards, bollards/flag post, CCTV cameras.

Through layers of ecological planting, DDA has been able to successfully revive the ecosystem

integrity and biodiversity in these Projects.

Till date about **7 lakh native trees**, more than **3.35 million riverine grasses** of floodplain ecology have been planted in these floodplains by DDA.

26 wetlands have been restored covering an area of about **35 hectares** with the capacity of **augmenting** about **1350 million litres** of water during the monsoon season. They not only act as habitat for birds help in improving micro climate and mitigating pollution but also become places of attraction for the general public. This year alone, around 67 species of resident and migratory birds were recorded at Asita and were appreciated by the birding community.

Session VII - Response Mechanism of Yamuna Flood in Delhi during July 2023

RESOURCE PERSON

Shri Neeraj Kumar, *2IC 8, NDRF Ghaziabad and Sh Rakesh Kumar, DC,16 NDRF*

KEY POINTS HIGHLIGHTED

Shri Neeraj Kumar, *2IC 8, NDRF Ghaziabad* and **Shri Rakesh Kumar,** *DC,16 NDRF* presented the Role of NDRF in Delhi Flood.

Role of NDRF:-

- Delivering a prompt and efficient response
- Performing Rescue operation
- Pre-emptive evacuation
- Extended humanitarian aid
- Medical/ Veterinary camp

PROPOSED SOLUTIONS AND ROAD AHEAD

- **EVACUATION OF CATTLE TO BE DONE WELL IN ADVANCE**: In case animals are surrounded by flood water then it is very difficult to evacuate them as the animals like cow, buffalo cannot be accommodated on boat (IRB). Thus its rescue becomes very risky in flood water. Therefore people may be advised to evacuate cattle well in advance if there is forecast of flood water in their area.

- **MEDIA MANAGEMENT**: It was experienced during Delhi flood that media persons were approaching to NDRF team for carrying them in boat to cover the news. Since the prime task of NDRF is to rescue the victims on priority and providing humanitarian aids to the victims and their early evacuation to safer place. But such intervention of media people creates chaos in rescue operation. Thus, civil administration may take care of this issue well in advance and media reps may be advised to make their own arrangement for coverage of news.

- **ROLE OF NGOs**: Although NDRF is mandated to respond in any kind of level-3 disasters except fire incident, but in wide area flooding situation in which large number of people are trapped, there may be shortage of NDRF teams as per requirement then in such condition NGOs may play vital role in evacuating trapped people and also they may help in providing food and distribution of relief materials. The list of NGOs may be kept ready and they may briefed well in advance about their key role during such disasters.

- **USE OF IDRN PORTAL**: District administration and all other stake holders should update information on IDRN Portal so that people can gain information about all resources and the prevailing situations around them. This portal has been developed by NIDM to consolidate the all relevant information on single dashboard.

Session VIII - Flood Situation Arising in Vishwarma Colony, Jaitpur during July 2023

RESOURCE PERSON

Shri Sanjay Jha, *Sub Divisional Magistrate, Sarita Vihar, New Delhi*

KEY POINTS HIGHLIGHTED

Shri Sanjay Jha, *Sub Divisional Magistrate, Sarita Vihar, New Delhi* presented a case regarding Flood Situation Arising in Vishwakarma Colony, Jaitpur during July 2023.

He informed that the District Admiriistration received early warning from various authorities regarding discharge of a large quantity of water from Hathni Kunj Barrage on 11th and 12th July, 2023.

Accordingly District Administration with the help of DDMA and Delhi Police done munadi in Low lying areas like vishwakarma colony, jaitpur from 12th midnight till flood for appealing peoples to vacate the area.

A large no. of persons has shifted from Vishwakarma Colony to shelters home made by the District Administration. Some people were trapped the flood.

ACTIONS TAKEN

NDRF were requisitioned immediately for evacuation of these persons who were stranded in the flood and immediately NDRF has started operations for evacuation. The evacuation process were continued till 14 July, 2023 around 770 people were rescued. Out of 770, 297 were male, 293 were female and 180 children. NDRF has also rescued 07 dogs.

Around 875 people were kept in shelter home situated at SBV Madanpur Khadar, Phase-3 and Sarvodaya Vidyalaya (Middle) Jaitpur. These peoples were provided breakfast, lunch and dinner by the District Administration, CATS Ambulance, Water tankers were provided for smooth livelihood of these peoples.

After receeding of flood, these peoples were shifted to their homes.

Open Forum Discussions

Representatives of Districts and line departments like DUSIB, BSES, Health Department, CATS Ambulance, Boat Club and MCD participated actively in the open forum discussions. Their Participation and role is brought out in the following paragraphs:

(I) DUSIB

DUSIB received communication from District Administration regarding flood affected area for installation of Mobile toilet vans and Portable toilet cubicles. It was requested by District Administration to install Mobile toilet vans and Portable cubicles at the flood relief camp. The difficulties faced during installation of the Portable toilets and Mobile toilets Vans during the floods are as follows:

1. The Mobile toilet vans and Portable cubicles are not engine driven and require recovery van to tow them from one location to other. Therefore, it becomes difficult to move them within a short span of time. Due to heavy traffic on road, it is difficult to move recovery van as it is to be moved with safety precaution. Therefore, District administration shall work out flood relief camp locations well in advance and inform DUSIB for installation of toilets well in time.
2. Due to water logging in the areas, roads etc, the traffic reached its peak and thus the route of Mobile toilet vans and Portable toilet cubicles got blocked due to which DUSIB had to face difficulty.
3. Most importantly, DUSIB was continuously geting the new locations of flood relief camp most of which had no sewer system, which is an important factor for installation of Mobile toilet vans and Portable toilet cubicles.

(II) BSES Rajdhani Power limited



- Power Supply of Approx 3000 Nos. consumers were affected upto 10 days
- Some Line Assets got Weakened during Flood.
- All Safety Measure has been taken while restoring Power Supply in Area.
- Site visit has been done along with CEO, HNO & HEAD O&M and SDM of the area.



✓During the Flood-2023, flood water had entered in the **approx 500 Nos. of households (350 Nos. of households of Janta Camp & Hafeez Camp of Bhairon Road (Opp. Pragati Maidan) and 150 Nos. of households Ali Ki Jhuggi, Behlolpur & Near Jain Mandir area Behlolpur).**

Yamuna Flood impact in BSK Kanchan Kunj & Saurabh Vihar -

- As a result of flood in Yamuna large consumer base in Vishwakarma Colony, Kanchan Kunj, Jaitpur Part 1 & adjoining areas had to be kept in shedding due to safety precaution.
- This resulted in ~4800 nos. No Current Complaints (NCC) in the said period in area referred

– these NCC –on account of Force Majeure` - contribute to more than 35% of the yearly complaints of the said areas.

Challenges Experienced by BRPL Kilokari S/Div. Team

- During the Flood-2023, flood water had entered in the approx 500 Nos. of households (350 Nos. of households of Janta Camp & Hafeez Camp of Bhairon Road (Opp. to Pragati Maidan) and 150 Nos. of households Ali Ki Jhuggi, Behlolpur & Near Jain Mandir area Behlolpur).
- Due water lodged in the area Electricity supply had been Put OFF first in view of safety.
- Advised to all the residents to shift either in flood relief camps or at safe place immediately.
- Wiring held in flood relief camp was laid through ground with multiple joints. This type of wiring are dangerous & it may be chances of current leakage during rainy or flood time. Wiring should be done with proper taping & laid with the support of poles at reasonable height to avoid chances of leakage/accidents.
- All Sewage to be cleaned properly by concern authorities to avoid blockage during rainy season particularly near Janta Camp & Hafeez Camp of Bhairon Road (Opp. to Pragati Maidan).
- Electricity Supply resumed in the of flood area after checking time to time whenever water level go down/ Electricity network free from flood water and simultaneously BSES team also monitor to every flood affected households are using safe electricity or not.
- Whenever there are rise in water level, BSES team put OFF the electricity supply in that area as per site conditions.
- Concern area In-charges with Line staffs had been deputed 24x7 (In Shift) to monitor the water level & take necessary action accordingly.
- Regularly checked & monitored by the field team for identifying the current leakage from Electricity Network e.g. Distribution Transformers, RMUs, ACBs, Poles etc.
- Regular visit in the Flood Relief Camps & checked all wiring & meter for safe using.

Way Ahead

- As a result of co-ordination with District administration and hand holding amongst all counterparts including Flood and Irrigation Department following are the learning and requests from BSES:
- During Disaster management – Often utilities and various departments need power supply for relief provision to effected population – here BRPL need a formal letter from that department to provide electrical power. All departments are requested to keep ready requisition formats and send them to BSES business managers – BRPL; as always shall provide power for relief in shortest time possible.

- More importantly - BSES request identification and intimation of probable points where Flood dept./other dept. may need power supply for relief operations – many times these areas are beyond BSES electrified circuits and as such BSES need distribution lines to cater power supply.
- If BSES receive intimation timely – that shall be ready and try to develop their power lines till those identified points & be disaster ready.
- Switching "on" supply after any disaster needs meticulous planning and time taking execution and safety checks.
- Disasters leading to destroyed/demolished premise needs complete rewiring and safety check of premise following which only BSES may energise that premise.

(III) Health Department

Health department received communication from district administration regarding flood affected areas in North East district. A meeting was held under the chairmanship of District Magistrate on 10th July 2023 regarding flood preparedness in North East district. Health Department was directed to send medical teams to flood affected sites. Initially two Mobile Medical units were sent, one at old iron bridge flood site, Kisan Basti and second to Sonia Vihar relief camps, but later other areas of North East District started getting affected as well and warning message received for Usmanpur, Sonia Vihar and eight other locations. A V.C. meeting was held regarding flood situation under chairmanship of Secretary Health, Special Secretary DGHS and CDMOs regarding arrangements at flood affected sites and flood relief camps. Accordingly medical teams were deployed for each flood relief camp of North East District by O/O CDMO (NED) w.e.f. 09.00 AM to 4.00 PM after 04.00 PM Medical team from MCD was deployed at all locations. A Google sheet was shared by state program officer for ant pregnant female in the camp. There were two pregnant females, one at Kisan Basti and other at Badarpur khadar, both were taken to hospital for specialist medical care and delivery.

Visits of honourable Revenue Minister Ms Atishi, Secretary Health, DGHS and many senior IAS officers in view of arrangements of relief camps was conducted.

Reports were sought from each flood sites through pre shared format on daily basis which comprised of number of patients availed medical care on OPD basis, increased incidence or prevalence of any disease which was compiled at district level and submitted onwards to State authorities and DM office on daily basis.

- A total of 2896 patients were treated for various ailments in flood relief camps by medical teams.
- There was crunch of manpower in North East District. On request of CDMO (NED). Manpower

was deployed from school health scheme by DGHS and Junior Residents from GTB Hospital were deployed.

- Daily duty schedule of Medical Teams was made at district and compliance was ensured.
- The huge task of Flood relief became possible due to relentless pursuit and dedication of the administration and all the staff of District North East.





(IV) CATS Ambulance

The CATS Ambulance were deployed during the floods after receiving calls from DDMA from 11th July till 7th August, 2023. During this period 51 Ambulances (ALS, BLS and PTA) were deployed round the clock with co- ordination with SDMs of various flood affected districts of Delhi. Approximately 121 patients were shifted to various hospitals / camps during this period by CATS Ambulances. CATS Ambulances closely coordinated with the Health camps, SDMs, NDRF, Delhi Police, Delhi Fire Services and other agencies.

With the help of above mentioned agencies, a tremendous work was done and no fatalities were found. CATS Ambulances have done marvelous work of prompt shifting patients from different camps of flood affected areas to nearby hospitals.

Suggestions/ Issues from CATS:

1 Since CATS Ambulance is a major stakeholder of emergencies in Delhi, parking of ambulances at Disaster sites should be localized.

2 Proper coordination between CATS and other stakeholders such as NDRF, Delhi Police, Fire, Health Services and others must be achieved.

3 Proper communication (Single) between CATS and other stakeholders in District as well as State level. Nodal officers at the State level and District level may be appointed in different stake holders so that proper communication and data transfer could be established.

(V) Boat Club

As soon as information was received about the flood all 17 boats of the Boat Club along with 24 boats of I&FC Delhi were deployed in Yamuna for round the clock patrolling and doing Munadi for warning the residents. No person was let drowned. Team of 30 men worked for seven days continuously day and night in the darkness of night as the power was cut off. It is reported that 35000 persons, 950 cattle and 450 dogs were rescued by attending to about 150 calls.

(VI) MCD

During July 2023 Yamuna Flood in Delhi the Government arranged to send the people at the safe places and in camps. Many camps were set up on the Yamuna Pushta and various departments rendered the requisite assistance to the affected people. MCD arranged for fogging machines for spray for killing mosquitoes. Doctors, Nurses and Medicine were arranged for all three shifts. Cleanliness was especially cared for and Safai Karamcharis were put on all three shifts duties. Mobile Toilet van cleanliness was especially cared for. Besides this food, medicines and clothes were arranged for and distributed to the affected population in cooperation with NGOs. The dead animals coming in Yamuna were properly taken to the appropriate places.

Valediction

Valedictory Function took place in the presence of **Dr. Surya Prakash,** *Head of Geo-Meteorological Risks Management Division, NIDM;* **Shri Manjeet Singh Dhillon,** *Senior Consultant, NIDM* and **Dr. Garima Agarwal** *Senior Consultant, NIDM.*

Expressing his satisfaction on the proceedings of the workshop, **Dr. Surya Prakash,** *Head of Geo-Meteorological Risks Management Division, NIDM;* stated that all distinguished speakers and participants have taken part enthusiastically in the workshop and he hoped that the workshop will not only add value to the ongoing documentation ie "One Day Stakeholders' Consultative Workshop on Yamuna Urban Floods in Delhi with Focus on July 2023 Event" but also will go a long way in arriving at a more coordinated effort to mitigate the flood problem of Delhi.

Shri Manjeet Singh Dhillon, *Senior Consultant, NIDM* expressed his happiness that due to the all out efforts by the various stakeholders many lives were rescued and it's a tremendous achievement that there was no casualty. However, there is always scope for improvement in coordination by various stake holders such that the financial losses on account of loss of man hours and hindrance in essential services could be brought down to the minimum.

Dr. Garima Aggarwal, *Senior Consultant, NIDM expressed her gratitude towards all distinguished speakers, participants and representatives of Administration and the line department to respond at very short notice and making the one day stakeholders' workshop a success.*

Summary of Proceedings

Overall Key Points

This concise summary encapsulates the key discussions, presentations, and outcomes of the workshop, providing valuable insights for future flood mitigation strategies in Delhi. The workshop served as a platform for stakeholders to share experiences, challenges, and solutions related to flood Mitigation and disaster management in Delhi. Insights from experts, government officials, and frontline responders highlighted the need for improved coordination, early warning systems, infrastructure development, and community engagement in flood preparedness and response efforts. Discussion were held on the economic, social, and infrastructural repercussions of the flood. Insights were shared by experts on the existing flood monitoring systems and early warning mechanisms in Delhi. Discussions were also held on the effectiveness and challenges of the current systems and suggestions for improvement. Presentation were given by representatives from various departments and agencies on flood preparedness measures and response planning along with emphasis on coordination, resource allocation, and community engagement in flood response efforts. Along with acknowledgment of achievements, identification of areas for improvement, and commitment to continuous collaboration, emphasis was laid upon coordination, communication, safety measures, and infrastructure development. Following are the overall key points of the workshop:-

1. India Meteorological Department provides Hydro meteorological Support for Flood Forecasting by providing observed rainfall and Quantitative Precipitation Forecast for 156 river sub basins. Based on which Joint advisories on Flood Status are issued by IMD, CWC and NDRF.
2. Even though IMD has made several achievements like increase in lead time from 5 to 7 days, increase of rain gauge network to 5896 and use of high resolution dynamical model yet IMD needs to improve upon coordination and exchange of information among stakeholders.
3. According to the study presented by Dr Gosain Professor emeritus IIT Delhi, a model is simulated for the two scenarios, first with the natural terrain and second by incorporating the constant thickness of silt by raising the bed level by 1.8 meters (6 feet) from downstream of Palla to ITO barrage, showed that the actual observed level matched with the simulated

water level which points to dredging the entire channel from downstream of Palla to ITO barrage as a possible solution to the problem. However, dredging the entire channel is not recommended as per extant CWC guidelines.

4. In the wake of July 2023 Yamuna urban floods, a committee has been set up consisting of various stakeholders under the Chairmanship of Chairman, (CWC), to examine and arrive at reasons for the peculiar situation of flood of July 2023 and give its recommendations for flood mitigation in Delhi. The report of the committee is awaited.
5. As per DDMA, major problems faced during the flood event of July 2023 have been leakage or overtopping of regulator gates, over topping of banks due to rise in river water level, submergence of settlements on the flood plains, jamming of some gates due to silting up, breach of embankment and regulator gates, lack of effective storm water drainage system and shut down of three water treatment plants.
6. Even as the peak discharge of water from the Hathnikund barrage upstream in Haryana was not the highest that has been recorded so far. A higher peak discharge of 8 Lakh Cusecs was recorded even in 2019 from Hathnikund. barrage which is larger than the peak of 3.59 Lakh cusecs that was recorded on 12th of July, 2023. However, the highest flood level so attained in 1978 (207.49m) at ORB was not exceeded in 2019, but during the July 2023 event it was exceeded by 1.17m (208.66m) at ORB.
7. As per DDMA the peculiar situation mentioned in the above two points could likely be due to the heavy rainfall downstream of Hathnikund and also due to multiple cross-sectional and longitudinal structures along the Delhi stretch of river due to which, there is silt accumulated and trapped in Delhi stretch of the river. Furthermore, the time of concentration is shorter such that the same amount of rainfall has fallen in a shorter period and has moved downstream quickly. Flood plain encroachments, constrictions due to various bridges in the course of the river, concretization are the other reasons. The gates of ITO Barrage being closed would have also blocked the free flowing water.
8. More effective drainage system, better management of Water Treatment Plants and Sewerage system is called for by improving coordination among different agencies.
9. Standard Operating Procedures for pumping operations, WTPs, STPs and SPSs should be formulated to mitigate the effect of flooding.
10. DJB highlighted that storm water drains and should not be interconnected as sewerage system is not designed to take load of storm water.
11. PWD representative highlighted major causes and remedial measures for road flooding during heavy rainfall. With suggestions including proper drainage management, sewer line maintenance, and rainwater harvesting.
12. Floodplain restoration and rejuvenation initiatives by DDA and Discussion on projects aimed at restoring wetlands, creating green spaces, and enhancing floodplain ecosystems were highlighted by representatives from DDA.
13. Insights were shared by NDRF representatives on the role of NDRF in flood response,

including rescue operations and humanitarian aid and discussion on challenges faced and proposed solutions for effective flood response. Discussion were also made on evacuation, rescue operations, and relief measures implemented during the flood.

14. Case presentation was made by Sh. Sanjay Jha, SDM on the flood situation in Vishwakarma Colony, Jaitpur, and the response efforts undertaken by the District Administration.

15. Active participation from representatives of Districts and line departments, including DUSIB, BSES, Health Department, CATS Ambulance, Boat Club, and MCD with discussion on challenges faced during flood relief operations and suggestions for improvement in the open forum discussion.

LIST OF DELEGATES FOR ONE DAY STAKEHOLDERS' WORKSHOP ON YAMUNA URBAN FLOODS IN DELHI WITH FOCUS ON JULY 2023 EVENT

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Glimpse of Workshop




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About the institute

The National Institute of Disaster Management (NIDM) was constituted under an Act of Parliament with a vision to play the role of a premier institute for capacity development in India and the region. The efforts in this direction that began with the formation of the National Centre for Disaster Management (NCDM) in 1995 gained impetus with its redesignation as the National Institute of Disaster Management (NIDM) for training and capacity development. Under the Disaster Management Act 2005, NIDM has been assigned nodal responsibilities for human resource development, capacity building, training, research, documentation and policy advocacy in the field of disaster management.

NIDM is proud to have a multi-disciplinary core team of professionals working in various aspects of disaster management. In its endeavour to facilitate training and capacity development, the Institute has state-of-the-art facilities like class rooms, seminar hall and video-conferencing facilities etc. The Institute has a well-stocked library exclusively on the theme of disaster management and mitigation. The Institute provides training in face-to-face, on-line and self-learning mode as well as satellite based training. In-house and off-campus face-to-face training to the officials of the state governments is provided free of charge including modest boarding and lodging facilities.

NIDM provides Capacity Building support to various National and State level agencies in the field of Disaster Management & Disaster Risk Reduction. The Institute's vision is to create a Disaster Resilient India by building the capacity at all levels for disaster prevention and preparedness.



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