Action Plan for the Rejuvenation and Restoration of River Varuna and Assi

NGT, Principal Bench, New Delhi,
in order dated 17.06.2021
O.A. no. 128/2021
in the matter of
Saurabh Tiwari vs. Union of India & Ors

Chapter 1. Background

1.1 National Green Tribunal (NGT) order

NGT, Principal Bench, New Delhi, in order dated 17.06.2021 in O.A. no. 128/2021 in the matter of Saurabh Tiwari *vs*. Union of India & Ors related to pollution of rivers Varuna and Assi in Varanasi by discharge of untreated sewage and unauthorized constructions stated the following requisites:

- Remedial measures to be taken for restoration and rejuvenation of River Varuna and River Assi in the Varanasi stretch, Uttar Pradesh.
- Statutory authorities in the State of UP to perform their responsibility in accordance with judgments of the Hon'ble Supreme Court in Paryavaran Suraksha case that stated *industry requiring "consent to operate", can be permitted to run, only if its primary effluent treatment plant, is functional* and other relevant cases as mentioned is O.A. No. 593/2017, *Paryavaran Suraksha Samiti & Anr. vs. Union of India & Ors*., O.A. No. 673/2018, and O.A. No. 200/2014, *M.C. Mehta vs. UOI & Ors* (relating to river Ganga).
- Constitution of an independent Monitoring Committee for the purpose comprising CPCB, State PCB, National Mission for Clean Ganga (NMCG) and District Magistrate, Varanasi. The State PCB will be the nodal agency for coordination and compliance. The Committee may meet within two weeks and review the action plan on the subject in the light of the pre-existing action plans, if any, with such modifications as may be necessary. The Committee will be at liberty to take assistance of any other expert/institution, including an agency dealing in rejuvenating works. It may undertake field visit, including sample collection and analysis as required.
- Preparation of report that may cover status on water quality of Assi, Varuna, action taken on diversion and treatment of sewage, water quality of upstream and downstream of confluence of Assi and Varuna to River Ganga, demarcation of Flood Plain Zones of Assi, Varuna and Ganga (in the said area), in accordance with the River Ganga (Rejuvenation, Protection and Management) Authorities Order, 2016.

1.2. Constitution of an independent Monitoring Committee

A consultative meeting among the representatives of the Monitoring Committee and other experts was held on 30.06.2021 at CPCB *via* vedio-conferencing for discussing the above-mentioned NGT matter. Dr. A. K. Vidyarthi, Additional Director & DH, WQM-II represented CPCB, Sh. Kalika Singh, RO, UPPCB, Varanasi represented State PCB, Sh. Rajat Gupta,

SWM Specialist represented National Mission for Clean Ganga (NMCG) and Sh. Gulab Chand, ADM represented District Magistrate, Varanasi. Also, experts and eminent professors from Delhi University and IIT, Roorkee having expertise on subject matter and from IIT-BHU, Varanasi having knowledge of local issues participated in the consultative meeting.

During the meeting, the **existing action plan by UPPCB for River Varuna** was discussed that was prepared for identified polluted stretch of River Varuna from Rameshwar d/s to confluence with River Ganga. This action plan was prepared in compliance of Hon'ble NGT order in O.A. No. 673/2018 and has been categorized into 5 sections namely Sewage Management, Industrial Waste Management, Solid Waste & Flood Prone Zone Management, Ecological Flow & Ground Water Management and E-monitoring & Evaluation with short/ long-term action plan(s). However, it was apparent that the Action Plan for River Varuna has limitations being exhaustive as well as theoretical in nature and it may not be feasible to implement all short or long-term objectives in timely manner mentioned in the same. Also, it was lacking primary data and ground truthing facts. Also, an immediate action plan is required rather than the present regulatory action plan. Further, for River Assi, there is no action plan or intervention measures present. Therefore, it was concluded that the existing plan could be appropriately modified for feasibility of implementation for both the rivers i.e. River Varuna and Assi.

1.3. Issues identified and recommendations made during the meeting of Monitoring Committee /Present status

After thorough discussions, the committee identified the following inevitable issues and possible gap areas to be addressed in the modified action plan:

i. **Prevention of river water pollution**: Problem of pollution in River Varuna and Assi seemingly pertains more due to sewage rather than industrial pollution. For understanding state-of-the art pollution situation of entire stretch of both the rivers, pollution mapping may be conducted to identify polluting sources such as small-scale industry cluster(s), additional drains as well as help to identify sites for non-conventional treatment (such as constructed wetlands, waste stabilization pond, bio and phytoremediation) that can substitute STPs. Sample collection of the river water, drains and effluents to be done for analysis of selected parameter(s). In this context, analysis of water quality of upstream and downstream of confluence of Assi and Varuna to River Ganga as well as confluence of drains in River Varuna and River Assi be carried out.

ii. **River ecosystem study and groundwater recharge issue**: For identification, Inventorization & geo-referencing of appropriate sites for development of constructed wetlands/in-situ remediation/connecting river channels/water bodies, biodiversity parks, ddemarcation of floodplain zones be performed. Study of topographic feature of rivers, including depth and width, gradient as well as river ecosystems and ecology of adjacent lands and adjacent landscapes may be done along with identifying number of inlets and the quality of sewage / industrial effluents discharging into the rivers and their topographic features and ecology. Further, identification of natural wetlands and their status as well as connectivity to rivers could be done. Possibilities of channelizing the river water to pass through such floodplain wetlands for removal of pollutants should be explored. Massive plantation drive should be undertaken for development of floodplain forests & grasslands. Proposal for catchment and treatment wetlands and their restoration and utilization for recharging rain water / flood water (catchment wetlands) or their use for treatment of polluted water (treatment wetland) be made.

iii. **Sewage and surface runoff management:** The present flow of River Assi is estimated to be about 100 MLD. The recently constructed STP at Ramanna has a 50 MLD treatment capacity that was based mostly on earlier flow measurements of the Assi River. In the present scenario, this treatment capacity is inadequate. Therefore, proper measures have to be undertaken to deal problem of under-treatment. This may include exploring reasons for high discharge in River Assi and managing excess flows, evaluation and gap analysis of existing sewerage masterplan as well as intersection and diversion schemes under present population growth and city expansion scenario. Overall, for both the rivers, evaluation of existing STPs and possible upgradations along with modifications in the existing interceptor and diversion as well as pumping system may be done.

iv. **Encroachment issue:** Encroachment is a pertinent issue especially for River Assi due to unauthorized constructions and such constructions should be removed/demolished before laying interceptor sewers or putting any kind of interventions in effect. It is a matter of long-term workout by the District Administration and Municipal Corporation with likely legal/administrative interventions. However, it was recommended that survey could be conducted to understand the level of existing encroachments in the catchment of both the rivers.

1.4. Methodology

A. Pollution source identification and mapping: For the purpose of pollution mapping, joint monitoring and sampling of River Assi, Varuna as well as Basuhi and Morwa (tributaries of Varuna) was carried out by teams of CPCB and UPPCB during July 12 - 15' 2021. Additionally, officials from Uttar Pradesh Jal Nigam also participated for the survey of River Assi at few locations. The objectives of the pollution mapping were:

a. Tracing and mapping the course of the rivers and identifying major adjoining drains/small streams discharging their content into the mentioned rivers.
b. Characterization of water quality of rivers at various locations (River Varuna, Assi, Basuhi and Morwa).
c. Identification, quantification and characterization of major drains joining the rivers.
d. Quantification and characterization of volume of untreated wastewater discharging to River Ganga through River Assi and River Varuna.
e. Water quality of River Ganga b/c and a/c with River Assi and River Varuna.

Note: The monitoring was done during monsoon period. However, Water quality during non-monsoon period could be slightly different.

Common methodology adopted to study the above-mentioned objectives for River Assi, Varuna, Basuhi and Morwa rivers are:

i. ***Preliminary work*:** The trajectory of the river was mapped for identification of the origin of the rivers and to find out the entire stretch. Major towns and cities along the river, industries, and number of drains discharging into River Varuna, River Assi and River Morwa were identified.
ii. ***Field work***: Each sampling point was chosen on the basis of locational importance, proximity to industrial areas, if any, and discharge points of drains, proximity to major towns and cities, and the ease of access for sampling. River water samples were collected along the River Varuna, River Morwa and River Assi and also at locations representing the water quality before and after confluence of any major drain or tributary into the river. Also, wastewater samples of identified drains discharging into the mentioned rivers were collected. Samples were brought to the CPCB Regional Directorate, Lucknow laboratory for analysis.
iii. ***Laboratory work***: General/Specific parameters (Colour, pH, TSS, TDS, DO, BOD, COD, NO_3-N, NO_2-N, Total Nitrogen, PO_4-P, Total Phosphorus, Cl^-, Phenol, Sulphate),

bacteriological parameters (Total coliforms (TC), Faecal coliforms (FC), and trace/heavy metals (Total Chromium, Pb, As, Zn, Fe) were analyzed in the laboratory.

B. River ecosystem study: For the purpose of river ecosystem study and identification of possible sites for in-situ remediation using Constructed Wetlands, Biodiversity parks, officials from Centre for Environmental Management of Degraded Ecosystem (CEMDE)-University of Delhi, CPCB, UPPCB and UP Irrigation & Water Resource Department, and Local Administration surveyed the riverscapes and landscapes of River Varuna and River Assi from the origin to their confluence with River Ganga from 17th - 19th July 2021.

C. Sewage Management: For the purpose of identification of status and capacity of existing STPs, the issues related to under-utilization of their actual capacities, status of drains tapping as well as sewage generation in and around adjoining areas of River Varuna and River Assi, officials from IIT-Roorkee, CPCB, UPPCB and UP Jal Nigam conducted an intensive survey from the origin of River Assi as well as River Varuna to their confluence with River Ganga from 28th July – 1st August 2021.

1.5. Concept/Objective of the present Action Plan

The concept of river rejuvenation in our country is often considered as achieving the water quality levels that could permit use of such waters for bathing purpose. Traditionally, it's been limited to pollution control, sewage and solid waste management. In view of sewage management, the aspect of sewage generation is equated with the sewage treatment capacity to control pollution. Further, it is believed that controlling industrial pollution discharge into the river is same as restoring the river water quality. However, from the time when the concept of sewage management facility for any river catchment is conceived and DPR is prepared for sewerage network, interception and diversion facilities till the commissioning of STP actually happen, a time-lapse for 4-5 years occur. By then, many demographics as well as land-use factors including infrastructure that affect sewage generation for which the actual facility was planned, undergo surge. This even attracts other economic activities that has a rippling effect thereby, leading further surge in demographics which in turn lead to further sewage generation. Therefore, there is a never-ending gap in sewage generation and the planned or functional

treatment facilities that mostly lead to continuous discharge in public sewers and over-flow of untreated/partially treated sewage into the river system.

Another facet of river pollution mentioned previously is the industrial pollution control that aim to stop discharge of wastewater generated from industrial processes into the river system. Indian industries characterize themselves with low scale of operation, archaic technology, lack of cleaner technology, high freshwater consumption, high effluent generation and inadequate effluent treatment systems, in addition to unskilled personals that lack technical knowhow. Despite of existing regulatory measures, these outmoded systems have resulted in high effluent generation along-with discharge of partially treated or untreated effluent into the river system.

In last few decades, the concept of ecological flow has been popularized for river rejuvenation. It is believed that the river water quality will not improve unless the flow is maintained or increased. However, it must be noted that the rivers of our country may be divided into two broad categories. Some rivers originate in the Himalayas. In addition to rainfall, these rivers also benefit from the melting of the accumulated ice-cap/glaciers of the mountains. The other set of rivers are entirely rain-fed, receiving water from the annual rainfall alone; in non-rainy seasons, their flow is limited to the extent of inflow of water from seepage through the soil mass of its catchment. If the rain fails, the area remains 'thirsty'; rivers remain dry or have less water. Keeping this in mind, the concept of e-flow has limitations for such non-perennial and thirsty, land locked rivers. These rivers have an entirely different ecosystem such as river channel, riparian zone, flood plains and embankments. They receive water during monsoon that is stored for a longer duration and helps in recharging of nearby ground water aquifers, connected channels and wetlands, which in-turn helps in maintaining water availability in river during non-monsoon period. Therefore, for such rivers, the concept of maintenance of different component of their eco-system is more important than the concept for ecological flows.

Keeping in view the above aspects, the present concept of river restoration encompasses 2 prolonged approaches. First priority in water-quality assessment and management is to maintain and restore "the desirable level of general environmental quality or wholesomeness" and thereafter, comes the fulfillment of "requirement for the best designated use" that has to be taken up at the second stage. It is to be realized that merely meeting bathing water quality, doesn't equate with rejuvenation of polluted river or any of its stretch. The rejuvenated river should have functional as well as self-purification systems *i.e.* biological communities that

have trophic cascades. The waters of such rejuvenated rivers have high DO level, low BOD, COD, TDS, SS and coliform density. The rejuvenation of polluted rivers can be easily achieved by: (i) restoration of river ecosystem which includes the channel water ecosystem, the riparian ecosystem, floodplain wetlands, floodplain forests and grasslands and (ii) development of vegetation on embankment. All these can be achieved by establishing a Biodiversity Park covering the polluted stretch of rivers. Another significant component of river rejuvenation is restoration/conservation of wetlands. Wetlands are distinct ecosystems which are flooded with water either permanently or seasonally. Wetlands are neither completely land-based habitats nor completely aquatic habitats but somewhere in-between. They are important for flood management, ecological improvement of urban areas and potential tourism sites. They are natural water purifiers as they act as micro sponges and remove impurities like heavy metal, plastic fibers and in-organic dirt before releasing the water in bigger water bodies. They can be constructed as separate water body or within Biodiversity parks (as constructed wetlands).

Ecological integrity of river ecosystem via interaction leading to ecological processes among five elements of river systems (namely structure, quality and quantity of water, biodiversity and floodplains) is key to the health of whole river system and sustenance of water quality and quantity. Treatment of wastewater and bringing the polluted water to the level of bathing quality is just one among many remediations and/or restoration required for rejuvenation of river systems. Therefore, it is be believed that rejuvenation of polluted rivers cannot be achieved by treating wastewater using STP alone. Anthropogenic-mediated activities on the riverscape have been increasingly disrupting the ecological processes leading to further degradation of riverscapes resulting in loss/degradation in terms of function of river health and deterioration of water quality despite of treating waste water through STPs by spending millions of rupees annually.

One needs an integrated approach for the rejuvenation of polluted rivers as mentioned above that should involve Nature Based Solution. To conclude, bathing quality of water is not true representative of wholesomeness of river ecosystem and should not be equated with rejuvenation of polluted rivers. It may be just considered as one of the indicators, at best. Rejuvenation of polluted rivers requires as integrated approach involving restoration of river ecosystems i.e. bringing back the self-purification system of rivers so that the rivers can sustain the quality of water and start providing ecosystem services, they are destined to provide

workable, cost effective, nature-based solution for restoration and rejuvenation of degraded/polluted rivers of India.

Water quality parameters requirements

Setting high quality objective such as classes A, B for rivers like Varuna and Assi for whole river or significant part may be too ambitious and is not only difficult but practically impossible also. Wholesomeness should take an overall integrated view of water ecosystem and also take into consideration long term impacts and cultural-social perceptions of water quality. It is proposed that with the present action plan following water quality parameters should be achieved:

Sr. No.	Parameters	Water quality
i.	Sanitary Survey	Generally clean neighbor hoods and u/s
ii.	General Appearance	No floating matter
iii.	Colour	No colour of anthropogenic origin
iv.	Smell	No unpleasant odour
v.	Transparency	>0.2 m to 0.5 m depth
vi.	Ecological (presence of Animals)	Fish and insects
vii.	pH	6.5 to 9.0
viii.	DO	Above 3
ix.	BOD mg/l	Below 8
x.	EC, mhos/cm	<500
xi.	NO2+NO3)-N mg/l	Below 1
xii.	Suspended Solid, mg/l	<100
xiii.	Fecal Coliform, MPN/100 ml	<2500 per 100 ml
xiv.	Bio-Assay (Zebra Fish)	No death in 2 days

Chapter 2. River Varuna

2.1. Potamological features and the present state

The River Varuna is a small tributary of the Ganga River system and originates from **Mailhan Jheel** of Phoolpur tahsil of Prayagraj District (25.599873 and 82.107220). After flowing through a length of about 200 km it meets river Ganga just northeast of Varanasi city of Uttar Pradesh. In its entire stretch, it passes through districts of Prayagraj, Bhadohi and Varanasi of Uttar Pradesh. The entire area of the Varuna river basin is composed of unconsolidated flood alluvium of recent age. Although the plain appears as rather a flat alluvial plain, it shows up sandy surfaces at relatively higher elevations (higher level floodplain) and clayey surfaces at lower elevations.

2.2. Water Quality status and stretch characterization

During the pollution mapping and exploratory survey, the course of Varuna river was mapped from present presumed origin till confluence into the River Ganga (**Table 2.1**). River Varuna traverses through the districts of Prayagraj, Bhadohi, and Varanasi in Uttar Pradesh. The River joins River Ganga at Sarai Mohan (Adikeshwar Ghat) in Varanasi (25.329446; 83.044002). The main industrial areas in the catchment of River Varuna are in Bhadohi (Textile cluster), Sidhwan (Jaunpur) and Varanasi (Textile Cluster). Bhadohi textile cluster area falls into the catchment of River Morwa a tributary of R. Varuna. The river Varuna receives wastewater from the industries and sewage from a part of municipal area of Varanasi which contributes to the deterioration of its water quality.

Polluted Stretch of Varuna river originates from district Bhadohi (UP) and flows East-to-Southeast and confluences at Adikeshwar Ghat in Varanasi with River Ganga in the downstream of Varanasi. There are 118 water polluting industries located in the catchment area of river Varuna. Out of these 118 units only 60 units are operational however 29 units are self-closed and 29 are closed by the UP-Pollution Control Board (UPPCB). These operational industrial units have their own effluent treatment plants and treated effluent is being discharged through recipient drains reaching to R. Ganga through R. Varuna.

A total 20 Drains in the catchment of R. Varuna found directly discharging into River. Out of these 20 drains, 02 are in Bhadohi district and rest 18 are found in Varanasi City. Out of these 18 drains, 07 drains are found tapped and 11 found untapped on the day of visit. Waste water coming through these tapped drains are diverted to sewage treatment plant at Dinapur

and Goithaha. The discharge from these untapped drains approximately 88 MLD is directly being discharged in to River Varuna however discharge of three (03) drains namely Orderly, Azadnagar and Khajury colony drain could not be measured because of un approachable path. List of the drains with their flow is tabulated at **Table 2.2.**

Summary of the stretch(s) identified along-with major observations

For the present study, River Varuna is divided into three stretches that have been classified on the basis of comparable values of water quality parameters. They are:

A. Stretch – I: Origin to before confluence with River Basuhi

B. Stretch – II: After confluence Basuhi to U/s Daniyalpur drain/U/s of Varanasi city

C. Stretch – III: D/s of Daniyalpur to River Varuna before confluence with River Ganga

Table 2.1. Sampling Location on River Varuna and stretch identified

S. N.	Stretch	Sample Location	Name of Sampling Location of R. Varuna	Lat. (In Decimal)	Long. (In Decimal)	Description
1	STRETCH - I	R-1	R. Varuna at Varaneshwar Mahadev Mandir, Phulpur, Prayagraj	25.587	82.132	Ponding was observed in R. Varuna
2		--	R. Varuna at Tarhati Bridge (Jaunpur)-Sultanpur Bridge (Prayagraj)	25.579075	82.182999	River water was stagnant therefore sample was not collected
3		R-2	R. Varuna at Sherpur (Prayagraj)-Mobideenpur Bridge, (Bhadohi)	25.497656	82.329900	Mansoon water was found collected the River stretch at this location
4		R-3	R. Varuna at Kusha ghat- Godma Bridge (Bhadohi)	25.494039	82.458646	Mansoon water was found collected the River stretch at this location
5		R-4	R. Varuna U/s of Dhaurahra Drain at Bhadohi-Junpur bypass, Bhadohi	25.417476	82.569282	Lean flow observed at this location
6		R-5	R. Varuna D/s of Nai Bazar Drain at Bhadohi	25.416	82.573	Lean flow observed at this location
7		R-6	R. Basuhi b/c to R. Varuna at Jaunpur	25.394157	82.693641	Observable flow was there at this location. Quantity of water was more than River Varuna
8		R-7	R. Varuna b/c to R. Basuhi at Bhadohi	25.394178	82.692920	Lean flow observed

9	STRETCH - II	R-8	R. Varuna a/c of R. Basuhi at Varanasi	25.392259	82.697942	R. Basuhi contributes more water to R. Varuna at this location
10		R-9	R. Varuna at Rameswaram Mandir, Varanasi	25.387393	82.854172	Some submerged plants were observed floating at this location.
11		R-10	R. Varuna at Koirajpur Bridge, Varanasi	25.361256	82.912625	Lean flow observed
12		R-11	R. Varuna at Pishaura Bridge u/s of Daniyalpur Drain	25.330484	82.940254	Upstream of Varanasi city
13	STRETCH - III	R-12	R. Varuna at Kutchehari Bridge d/s of Central jail Drain	25.341	82.982	Slightly blackish green water observed with slight flow
14		R-13	R. Varuna D/s of Nakhi Drain & U/s of Narokhar Drain	25.341	83.009	-
15		R-14	R. Varuna d/s of Orderly Drain	25.341	82.990	Waste water containing slaughtering activity observed
16		--	R. Varuna d/s of Nai Basti (Bhagawa) Drain	25.343	83.001	Sampled not collected as Barrage at D/s
17		R-15	R. Varuna at Adikeswar ghat	25.329	83.044	R. Varuna b/c to R. Ganga

Table 2.2. Drains existing in the catchment of River Varuna

Stretch		Drains existing in the catchment of River Varuna						
	Drain S. N.	**Name of Drain**	**Latitude (In Decimal)**	**Longitude (In Decimal)**	**Flow in MLD**	**Status**	**Drain meeting River Varuna**	**Description**
Stretch - I	**D1**	Dhaurahara Drain at Dhaurahara, Bhadohi	25.398	82.557	3.2	Untapped	Right Bank	Mix Drain directly meeting in R.Varuna
	D2	Nai Bazar drain at Billaula, Bhadohi	25.416	82.573	28.16	Untapped	Right Bank	Mix Drain directly meeting in R.Varuna
Stretch - II	**D3**	Durga/Lohata/Daniyalpur Drain, Varanasi	25.32104	82.95544	19.99	Untapped	Right Bank	Drain directly meeting in R.Varuna
	D4	Phulwariya drain, Varanasi near 7.6 MLD Phulwariya SPS	25.33968	82.96292	2.58	Untapped	Right Bank	Partially tapped- 7.6MLD flow is diverted to STP Dinapur 140 MLD & excess flow discharging in to R.Varuna
	D5	Sadar Bazar Drain, Varanasi	25.33817	82.97555	Tapped	Tapped	Right Bank	Flow is diverted to STP Dinapur
	D9	Chamaraudha Drain, Varanasi	25.33948	82.96093	8.95	Untapped	Left Bank	Drain is directly meeting in R. Varuna
	D10	Central Jail Drain, Varanasi	25.34317	82.96697	25.66	Untapped	Left Bank	Tapping provision provided but Drain directly meeting in R. Varuna
Stretch - III	**D6**	Raja Bazar Drain, Varanasi	25.33586	82.99138	Tapped	Tapped	Right Bank	Flow is diverted to STP Dinapur
	D7	Teliabagh Drain, Varanasi	25.33481	82.99749	Tapped	Tapped	Right Bank	Flow is diverted to STP Dinapur
	D8	Drain near Chauramata Mandir, Varanasi	25.33589	82.99994	Tapped	Tapped	Right Bank	Flow is diverted to STP Dinapur

	D11	Orderly Bazar Drain, Varanasi	25.34138	82.98486	Not Measurable	Untapped	Left Bank	Tapping provision was found but damaged during inspection for this drain however drain was directly meeting to R. Varuna due to chocking of bar screen.
	D12	Azad Nagar Drain (Banaras Drain), Varanasi	25.3411	82.98626	Not Measurable	Untapped	Left Bank	Sample was not collected & flow was also not measurable as drain was not approachable but discharged into river varuna.
	D13	Khajuri colony Drain, Varanasi	25.34106	82.9894	Not Measurable	Untapped	Left Bank	Tapping provision was available for this drain however drain was directly meeting to R. Varuna due to chocking of bar screen.
	D14	Hukulganj Drain, Varanasi	35.33744	82.9998	Not Measurable	Untapped	Left Bank	Drain was directly meeting to R. Varuna as the tapping provision is in damaged condition.
	D15	Nakkhi Drain, Varanasi	25.3413	83.00858	Tapped	Tapped	Right Bank	Tapped- Flow is diverted to STP Dinapur
	D16	Unnamed Drain 1 at Amarpur/Jalalipura Area	25.340	83.020	Not Measurable	-	Right Bank	Sample was collected but flow was not measured due to closed conduit.
	D17	Narokhar Drain, Varanasi	25.34138	83.03142	Not Measurable	Partially Tapped	Left Bank	Partially Tapped- Flow is diverted to STP Goithaha STP via Intermediate pumping station (7.34 MLD)
	D18	Unnamed Drain 2 at Amarpur/Jalalipura Area	25.341	83.021	0.13	Untapped	Right Bank	Drain directly meeting in R.Varuna
	D19	Nai Basti Drain, Varanasi	25.34338	83.00138	28.35	Untapped	Left Bank	Drain directly meeting in R.Varuna due to chocking of tapping provision.
	D20	Sarang Talab Drain, Varanasi	25.34183	83.00871	Not Measurable	Partially Tapped	Left Bank	Partially Tapped- Flow is diverted to STP Goithaha but currently in damaged condition.

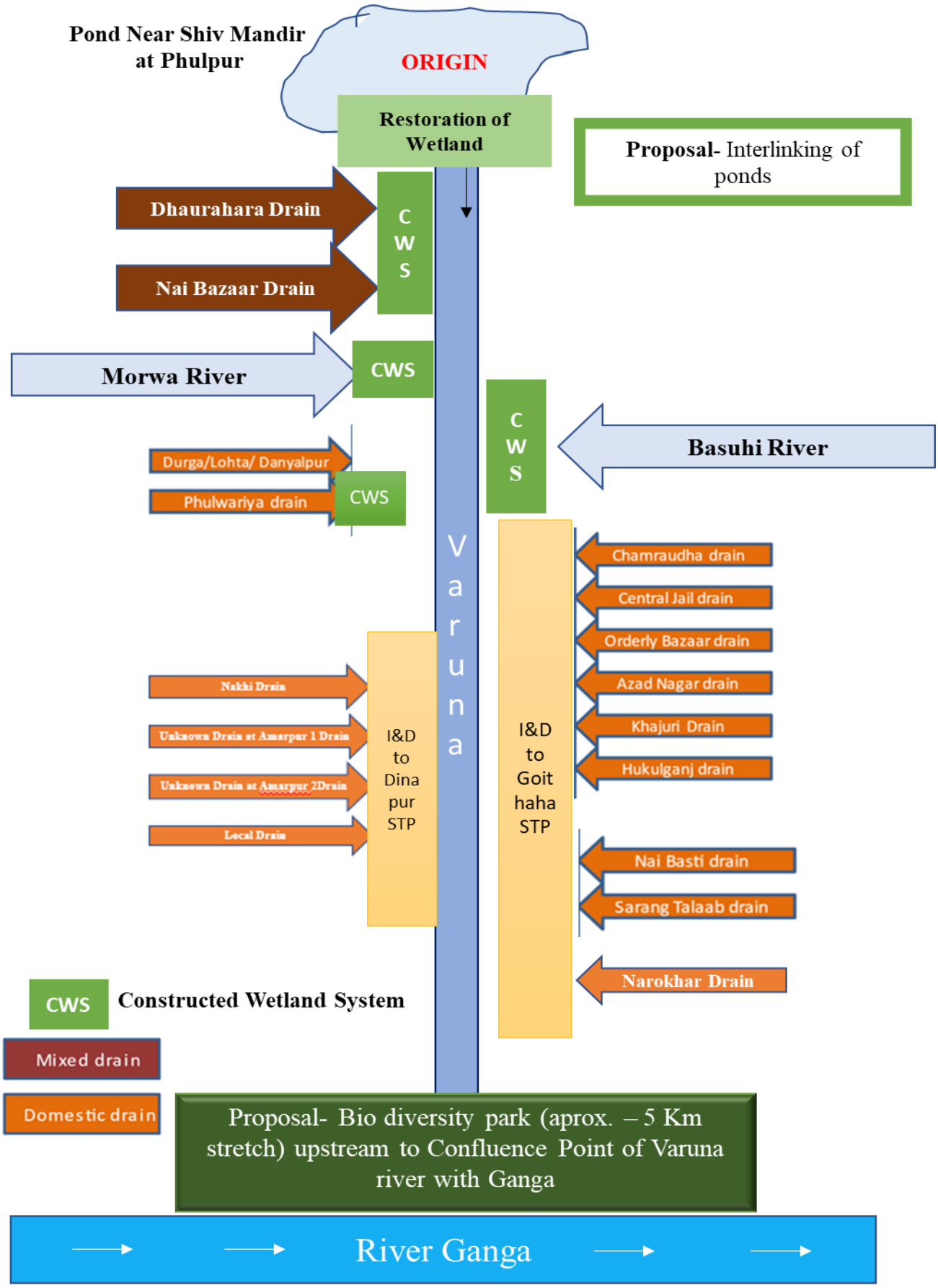


Figure 2.1. Flow diagram of River Varuna and Drains discharging into River Varuna

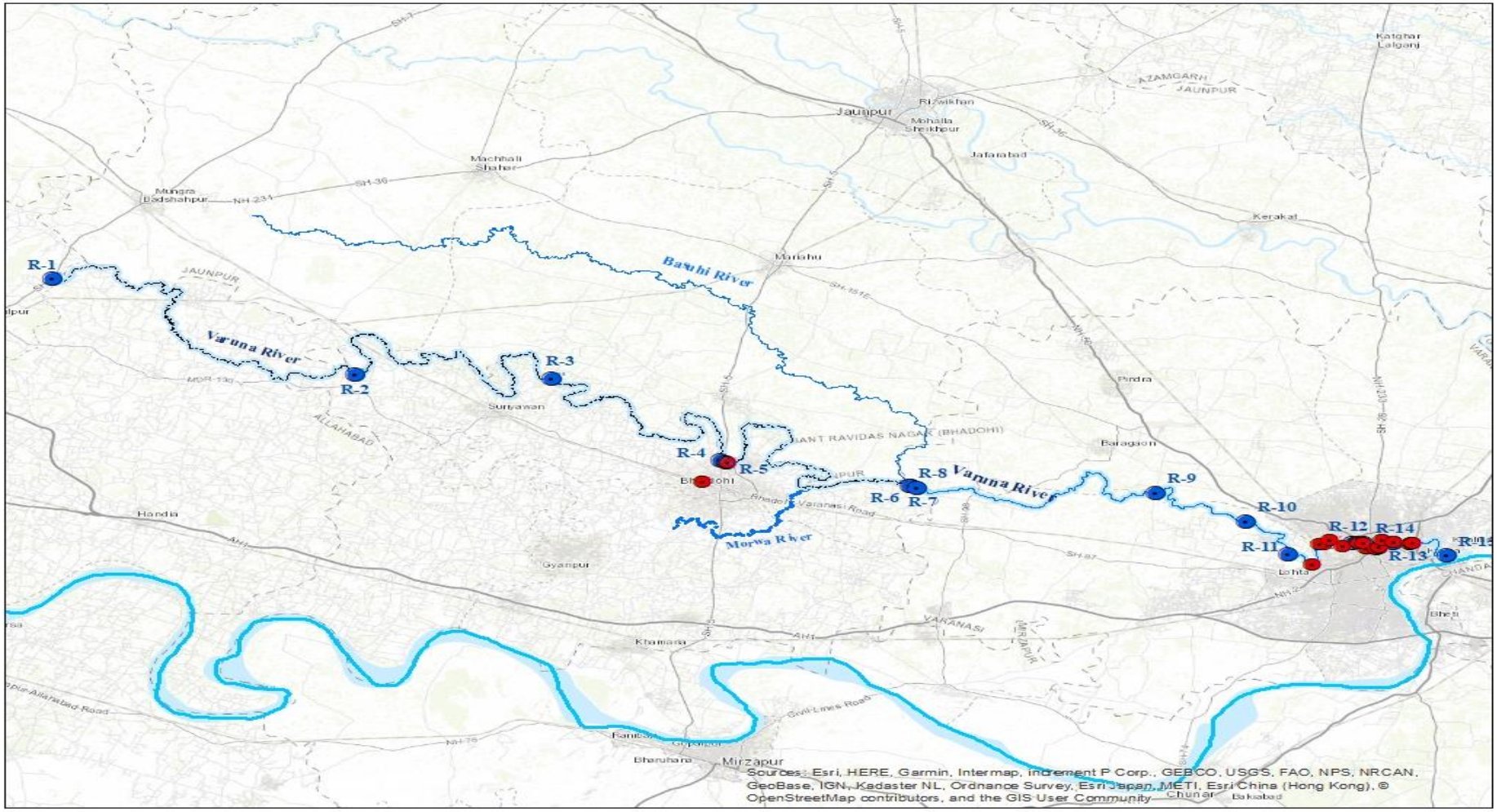


Figure 2.2. River Varuna Base Map

Table 2.3. Water Quality of River Varuna

Parameters		Sampling Locations (as per Table 5.2)														
		Stretch - I							Stretch - II				Stretch - III			
		R-1	R-2	R-3	R-4	R-5	R-6	R-7	R-8	R-9	R-10	R-11	R-12	R-13	R-14	R-15
General Parameters	Temp ^{0} C	32.0	33.5	32.0	34.5	34	36	35	35	34.5	34	34	34.8	35	34	34.0
	pH	6.72	7.02	7.23	7.58	7.66	8.56	8.01	8.24	8.26	8.12	8.03	7.53	7.45	7.48	7.51
	EC (µS/cm)	269	272	306	443	577	316	588	477	479	477	476	711	725	713	925
	Colour (Hazen)	60	50	40	30	35	15	30	25	20	25	20	35	40	40	30
	DO (mg/l)	2.8	5.8	5.6	2.6	2.6	8.9	5.9	6.3	6.0	6.2	7.2	4.1	5.8	2.8	2.5
	BOD (mg/l)	5.16	4.88	2.87	1.05	3.84	2.90	3.62	2.80	1.23	3.62	1.23	6.62	6.62	8.34	12.83
	COD (mg/l)	31.10	18.7	19.1	16.58	22.14	11.87	20.35	13.66	14.22	13.47	17.14	30.24	28.07	31.09	21.48
	TSS (mg/l)	37.1	39.4	76.7	61	37.4	21.9	28.1	32.4	26.6	34.1	27.3	20.7	22.7	16	36.5
	TDS (mg/l)	160	140	169	252	335	177	341	277	274	272	267	419	420	420	546
	Cl^- (mg/l)	3.57	4.36	7.11	19.1	27.4	20.2	29.3	18	19.3	15.6	17.2	31.2	36.6	30.5	53.4
	NH_3-N (mg/l)	.350	<0.1	<0.1	< 0.1	3.45	0.294	< 0.1	0.487	< 0.1	0.349	< 0.1	4.51	2.30	7.03	4.16

	NO_3^- N(mg/l)	<0.5	<0.5	<0.5	< 0.5	< 0.5	0.723	1.16	0.669	0.588	< 0.5	0.511	< 0.5	1.40	< 0.5	0.576
	NO_2^- - N (mg/l)	<0.05	<0.05	<0.05	--	--	--	--	--	--	--	--	--	--	--	--
	Total Nitrogen				BDL	6.44	0.294	BDL	0.487	BDL	0.623	1.22	7.88	6.60	10	4.32
	PO_4-P (mg/l)	<0.06	<0.06	0.056	< 0.06	0.478	< 0.06	< 0.06	0.459	< 0.06	0.775	< 0.06	2.83	1.62	2.73	7.58
	Total Phosphorus				0.167	0.541	0.283	0.473	0.404	0.249	0.243	0.274	1.29	1.74	1.30	2.14
	TKN				< 0.5	6.40	---	--	--	< 0.5	0.623	0.712	7.82	5.20	9.82	0.820
	SO_4^{--}	10.7	9.36	12.4	18	23	28.9	31	30.2	29.0	26.7	27.2	27.6	34.0	28.3	31.6
Biological	**TC (MPN/ 100 ml)**	-	$4.9x10^4$	$1.7x10^6$	$2.0x10^3$	$2.2x10^4$	$1.3x10^5$	$7.9x10^4$	$4.9x10^4$	$7.9x10^4$	$3.5x10^6$	$3.3x10^4$	$7.9x10^4$	$4.9x10^4$	$4.9x10^4$	$3.3x10^4$
	FC (MPN/ 100 ml)	-	$2.3x10^4$	$4.9x10^5$	< 1.8	$1.7x10^4$	$1.4x10^4$	$1.1x10^4$	$2.2x10^4$	$7.8x10^3$	$1.7x10^6$	$1.1x10^4$	$4.9x10^4$	$3.3x10^4$	$2.3x10^4$	$7.8x10^3$
Heavy / trace metals	**Arsenic (As) mg/l**	-	-	-	<0.008	<0.008	0.01	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
	Zinc (Zn) mg/l	-	-	-	0.03	0.11	0.02	0.07	0.02	0.01	0.05	0.03	0.04	0.04	0.03	0.03
	Chromium (Cr) mg/l	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Lead (Pb) mg/l	-	-	-	0.11	<0.05	0.06	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	0.11	0.05	<0.05
	Iron (Fe) mg/l	-	-	-	2.22	0.71	0.62	0.65	0.75	0.67	0.89	0.63	0.30	0.35	0.22	0.74

Table 2.4. Characteristics of Drains joining R. Varuna

Parameters		Sampling Locations (as per Table 5.3)										
		Stretch - I		Stretch - II				Stretch - III				
		D1	D2	D3	D4	D9	D10	D11	D13	D15	D16	D18
General Parameters	pH	7.58	7.74	7.35	7.56	7.36	7.38	7.17	7.93	7.28	7.54	7.23
	Colour (Hazen)	50.0	40.0	50.0	35.0	60.0	30.0	35.0	35.0	50.0	40.0	20.0
	BOD (mg/l)	17.1	31.5	39.3	16.6	29.8	21.8	36.3	17.8	48.9	53.0	18.1
	COD (mg/l)	82.0	114	176	71.4	146	79.9	166	88.0	244	247	77.4
	TSS (mg/l)	70.2	49.6	202	89.8	64.7	68.2	183	74.2	714	815	80.4
	Cl^- (mg/l)	131	124	141	47.3	55.1	73.2	54.7	107	69.2	62.7	46.3
	NH_3-N (mg/l)	9.45	28.8	32.0	13.7	19.3	14.0	17.0	18.9	22.6	20.6	9.45
	NO_3^- N(mg/l)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	NO_2^- - N (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Total Nitrogen (mg/l)	20.25	33.63	23.52	24.08	21.0	26.88	21.56	14.28	26.40	26.32	18.86
	PO_4-P (mg/l)	6.91	7.92	10.9	5.49	7.66	4.89	4.57	6.4	8.63	10.5	3.19

	Total Phosphorus (mg/l)	2.88	2.99	3.98	2.94	3.03	3.18	2.45	2.61	3.29	3.17	1.84
	SO_4^{--} (mg/l)	95.1	96.2	28.4	18.5	16.5	35.6	28.7	30.0	23.7	29.6	20.5
	S^{--} (mg/l)	<1.0	<1.0	<1.0	<1.0	<1.0	1.63	<1.0	<1.0	1.30	1.30	<1.0
	Phenol (mg/l)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Biological	**TC (MPN/ 100 ml)**	7.9×10^6	2.4×10^7	3.5×10^7	2.2×10^5	1.6×10^8	1.1×10^7	1.6×10^8	2.2×10^7	1.7×10^7	2.2×10^7	2.4×10^7
	FC (MPN/ 100 ml)	1.4×10^6	1.3×10^7	1.7×10^7	1.4×10^5	5.4×10^7	1.3×10^6	2.8×10^7	1.4×10^7	7.9×10^6	1.1×10^7	1.3×10^7
Heavy / trace metals	**Arsenic (As) mg/l**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.018	<0.01	<0.01
	Zinc (Zn) mg/l	0.11	0.13	2.23	<0.1	0.16	<0.1	0.17	0.13	0.33	0.28	0.11
	Chromium (Cr) mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Lead (Pb) mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Iron (Fe) mg/l	1.46	1.08	2.64	2.12	0.69	0.71	1.52	0.89	8.06	12.02	0.60

Table 2.5. Major Drains joining R. Morwa

Drain SL No.	Name of Drain	Co-ordinate at Joining to R. Morwa		Observation	Type
		Latitude	Longitude		
D1	Barbaspur	25.36371	82.55382	During visit measured flow was 226.84 m^3/hr (Instantaneous)	It is a mixed type drain carrying domestic & industrial waste water.
D2	Chauri	25.36916	82.60594	During visit flow was not measurable as flow was found restricted due to blockage in drain line & pounding in upstream.	It is also a mixed type drain carrying domestic & industrial waste water.

Table 2.6. Sampling Locations of Morwa River

Location SL No.	Name of River	Co-ordinate		Sampling Location	Observations
		Latitude	Longitude		
MoR-1	Morwa	25.38836	82.29644	Origin (Present) of R. Morwa, Overflow of Pond (known as Kaitihawa Tara)	Appearance- Clear Do- 5.8 mg/l Temp- 32 ^{0}C Flow- Stagnant
MoR-2	Morwa	25.36303	82.5247	R. Morwa Bridge at Munsilaatpur Village	Appearance- Clear DO- 6.5 mg/l Temp- 33 ^{0}C Flow-Stagnant
MoR-3	Morwa	25.36371	82.55348	R. Morwa u/s of meeting point of Barbaspur Drain	Appearance- Mushy DO- 7.5 mg/l Temp- 35 ^{0}C Flow- Very less
MoR-4	Morwa	25.36353	82.55407	R. Morwa d/s of meeting point of Barbaspur Drain	Appearance- Mushy DO- 7 mg/l Temp- 35 ^{0}C Flow- Very less
MoR-5	Morwa	25.3685	82.60579	R. Morwa u/s of meeting point of Chauri Drain	Appearance- Mushy DO- 6.5 mg/l Temp- 37 ^{0}C

					Flow- Very less
MoR-6	Morwa	25.36966	82.60651	R. Morwa Sampling Point 6 d/s of meeting point of Chauri Drain	Appearance- Mushy DO- 6.4 mg/l Temp- 37 ^{0}C Flow- Very less
MoR-7	Morwa	25.3925	82.62663	R. Morwa b/c to R. Varuna	Appearance- Mushy DO- 4.7 mg/l Temp- 32 ^{0}C Flow- Stagnant
VaR-1	Varuna	25.39372	82.62634	R. Varuna b/c to R. Morwa	Appearance- Clear DO- 5.5 mg/l Temp- 35 ^{0}C Flow- Stagnant
VaR-2	Varuna	25.39466	82.63787	R. Varuna a/c of R. Morwa at Anegpur Village Bridge	Appearance- Clear DO- 3.5 mg/l Temp- 36 ^{0}C Flow- Stagnant

Table 2.7. Analysis results of Samples from River Morwa, Drains Discharging into River Morwa and Varuna before and after confluence of river Morwa

Parameters		**Sampling Locations**										
		MoR-1	**MoR -2**	**MoR -3**	**MoR -4**	**MoR -5**	**MoR -6**	**MoR -7**	**VaR-1**	**VaR-2**	**D-1**	**D-2**
General Parameters	Temp ^{0}C	32.0	33.0	35.0	35.0	37.0	37.0	32.0	35.0	36.0	-	-
	pH	7.56	7.64	7.99	7.93	8.63	8.79	7.19	8.14	7.85	7.83	8.23
	EC (µS/cm)	370	340	362	523	516	516	598	692	603	1204	2091
	Colour (Hazen)	20.0	20.0	25.0	30.0	25.0	25.0	30.0	30.0	30.0	45	125
	DO (mg/l)	5.8	6.5	7.5	7.0	6.5	6.4	4.7	5.5	3.5	-	-
	BOD (mg/l)	2.92	4.41	1.51	3.05	1.70	1.21	1.96	5.07	2.90	9.73	31.5
	COD (mg/l)	11.68	14.98	13.38	22.14	17.43	16.11	17.24	27.32	19.69	40.3	109
	TSS (mg/l)	59.4	17.9	47.4	48.2	48.9	25.9	13.7	15.6	18.5	42	44.6
	TDS (mg/l)	207	197	206	308	289	294	341	408	350	675	1150
	Cl^- (mg/l)	18.0	18.0	18.2	28.0	23.9	33.6	27.2	43.7	28.9	68.9	394
	NH_3-N (mg/l)	< 0.1	0.27	< 0.1	1.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	3.07	4.82
	NO_3^- N(mg/l)	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	1.23	< 0.5	0.56	< 0.5	< 0.5
	PO_4-P (mg/l)	< 0.06	< 0.06	< 0.06	0.484	< 0.06	< 0.06	0.54	0.545	0.591	2.08	2.85

	SO_4^{--} (mg/l)	15.6	15.2	17.4	25.6	25.7	34.3	23.5	30.9	53.6	59.5	42.6
	Sulphide as S^{2-} (mg/l)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	Phenol as C_6H_5OH (mg/l)	< 0.1	< 0.1	0.12	0.21	0.42	0.12	< 0.1	< 0.1	0.70	< 0.1	< 0.1
Biological	TC (MPN/ 100 ml)	$1.7x10^4$	$1.6x10^7$	$2.2x10^4$	$3.3x10^4$	< 1.8	< 1.8	$1.3x10^4$	< 1.8	$3.3x10^4$	$2.3x10^5$	$3.3x10^5$
	FC (MPN/ 100 ml)	$2.0x10^3$	$1.7x10^6$	$1.1x10^4$	$1.1x10^4$	< 1.8	< 1.8	$1.7x10^4$	< 1.8	$2.0x10^3$	$4.5x10^4$	$1.1x10^5$
Heavy / Trace metals	Arsenic (mg/l)	< 0.008	0.018	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.008	< 0.01	< 0.01
	Zinc (mg/l)	0.02	0.36	0.02	0.04	0.02	0.05	0.05	0.01	0.01	< 0.1	< 0.1
	Chromium (mg/l)	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.2	< 0.2
	Lead (mg/l)	< 0.05	0.051	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.5	< 0.5
	Iron (mg/l)	0.34	0.12	0.28	0.27	0.33	0.43	0.16	0.26	0.18	0.63	0.61

Table 2.8. Water quality of R. Ganga at u/s and d/s of discharge point of R. Varuna

S. No.	**Parameter**	**Unit**	**Sampling location**	
			R. Ganga U/s of R. Varuna	**R. Ganga D/s of R. Varuna**
1.	pH	--	8.78	8.65
2.	Temp.	^oC	34	34
3.	Colour	Hazen	10	15
4.	Conductivity	µ S/cm	373	420
5.	TSS	mg/L	40.8	87.2
6.	TDS	mg/L	196	202
7.	Chloride	mg/L	21.1	31
8.	Sulphate	mg/L	26	27.6
9.	Phosphate	mg/L	< 0.06	0.666
10.	Nitrate as N	mg/L	< 0.5	< 0.5
11.	NH_3-N	mg/L	< 0.1	0.461
12.	DO	mg/L	9.2	8.5
13.	COD	mg/L	7.92	16.2
14.	BOD	mg/L	1.73	5.35
15.	T-Coliforms	MPN/100 ml	$4.0×10^3$	$5.4×10^6$

16.	F-Coliforms	MPN/100 ml	1.8×10^3	9.4×10^5
17.	Arsenic	mg/L	< 0.008	< 0.008
18.	Zinc (mg/l)	mg/L	0.18	0.08
19.	Chromium	mg/L	< 0.05	< 0.05
20.	Lead	mg/L	< 0.05	< 0.05
21.	Iron	mg/L	0.36	0.58

2.2.1. Stretch – I: Origin to before confluence with River Basuhi

1. **River Varuna at Origin** - The Mailhan Tal is believed to be the origin of this river but no water was observed at this location, however, some ponding was observed in the form of patches. Irrigation canal was observed passing close to this Tal (Mailhan). This Mailhan Tal area is about 100 acres but people have converted its most of the area in agriculture land. As there was no water at this location, sample from this location of the river could not be taken (**Photograph No. – P 1)**.
2. **River Varuna At Varuneshwar Mahadev Mandir -** Some ponding was observed in **River Varuna at Varuneshwar Mahadev Mandir** (Location Code R-1). The location is about 4-5 km from the origin of the River Varuna (Mailhan Taal). A historical temple is situated on the bank of River Varuna (Lat: 25.587 Long: 82.132). Sample was collected from this location of the river.
3. **Morwa River (A tributary of Varuna River) -** Morwa River confluence with River Varuna in this stretch. Morwa river presently originates from Kaitihawa, Tara (a small Pond) nearby Jigna Taal area in Handia, District Prayagraj (U.P). About 30-35 years ago, Morwa river originated from a big Taal/Wetland at Upardaha village in Handia of Prayagraj district. Upardaha Taal/Wetland is situated about 6.1 km away in upstream of present origin. After construction of Sharda Sahayak Canal & its network, Morwa river remained cut off from the Upardaha Taal (old origin).

This river flows through 46 villages in Handia, Prayagraj and Gyanpur, Aurai and Bhadohi blocks of District Bhadohi (U.P.) and receives water from 27 water streams (Surface Runoff/Wetland Overflow/Pond Overflow/Drains) which help the river to sustain its flow downstream. Morwa river confluences with Varuna river after flowing for about 64.68 kms (approx.) from its present origin. The confluence point of these two rivers is located near Malethu village at the boundary of two districts namely Bhadohi and Jaunpur of U.P.

Due to the shallow river depth and uneven slope of River Morwa, it swells up in the monsoon and it becomes dry in summer and winter. The upper stretch of river which is approximately 28 kilometres is generally dry for 08-09 months in a year however, during the present study the upper stretch of river was found filled with stagnant rain water. The lower stretch of the river has received water from Sharda Sahayak sub canal and some drains in Bhadohi District (U.P.).

Morwa River is flowing through textile clusters/ industrial area of Bhadohi and is adversely impacted due to the unplanned industrialization. The wastewater of textile/dyeing/carpet factories are generally discharged into Morwa river through water streams/drains. Kuda Dyeing units (unregistered) are abundant in the district. There are 2 major drains namely Barbaspur Drain & Chauri Drain in Bhadohi District (U.P.) that drains into River Morwa.

About 50 industrial/textile units are inventorized in Bhadohi district discharging their effluents into the river. Water samples were collected by team from 07 locations of R. Morwa and 02 major drains joining to R. Morwa. Beside this, R. Varuna samples were also collected b/c and a/c to R. Morwa.

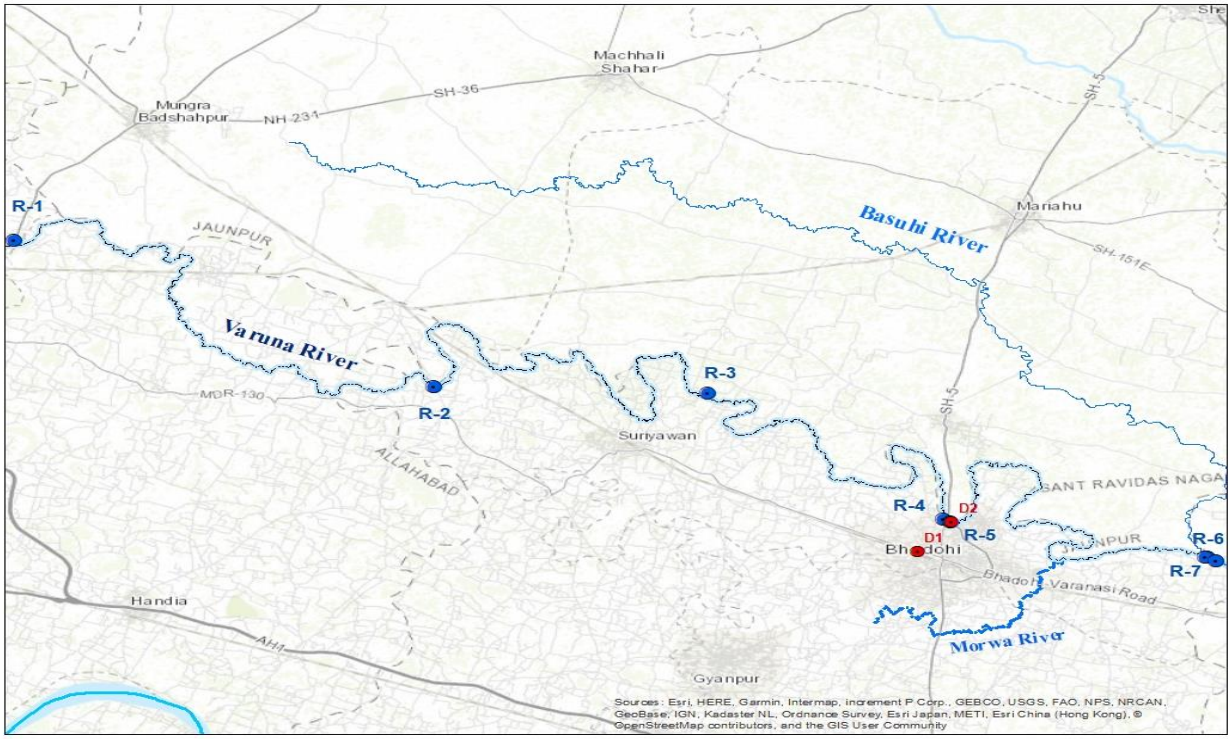


Figure 2.3. Map of Stretch - I of River Varuna

4. **River Basuhi -** Another tributary of R. Varuna is R. Basuhi that contributes significant amount of water in this river. R. Varuna gets fresh breath from this location onwards.

Water Quality of River Varuna in Stretch – I (including River Basuhi)

Water quality of river Varuna at different locations in stretch – I shows that pH, Colour, DO, BOD, COD, TSS, NH3-N and PO4-P varies from 6.72 to 8.01, 30 to 60 Hazen, 2.8 to 5.9 mg/l, 1.05 to 5.16 mg/l, 16.58 to 31.1 mg/l, 28.1 to 76.7 mg/l, <0.1 to 3.45 mg/l and <0.06 to 0.478 mg/l, respectively. The value of important parameters such as BOD, COD as well as NH3-N and PO4-P suggests that the impact of organic as well as nutrient load is insignificant in this stretch of river Varuna. Range of DO is also suggestive that water quality is supportive of certain life forms. Water quality analysis of River Basuhi also indicate similar findings. Infact, the DO of River Basuhi is 8.9 mg/l which adequate and supportive of various hydrological processes and aquatic life-forms. Like Varuna, the impact of organic as well as nutrient load is insignificant in river Basuhi.

Water Quality of River Morwa in Stretch – I

Water quality of River Morwa at different sampling locations shows pH, Colour & DO in the range of 7.19 – 8.79, 20-30 Hazen and 4.7-7.5 mg/l respectively at all the sampling locations of R. Morwa. BOD and COD are in the range of 1.21 – 4.41 mg/l and 11.68 – 17.24 mg/l. The analysis result suggests that impact of organic as well as nutrient load is insignificant in this stretch of river.

These results imply that there is no apparent pollution of this stretch. However, there is lack of flow in this stretch due to water logging and stagnancy.

2.2.2. Stretch – II: After confluence of Basuhi to U/s Daniyalpur drain

1. **River Varuna after confluence of River Basuhi -** Large quantity of water as compared to R. Varuna was observed in R. Basuhi (Location Code R-8). A mega project of broiler/ Egg production was observed at the bank of R. Basuhi close to the confluence to R. Varuna. (**Photograph No. – P 7).** River Varuna was observed narrow as compared to R. Basuhi at this location. Cremation shades was found prepared at the bank of the river at this location.
2. **River Varuna At Rameshwar -** Slow moving water was observed in River Varuna At Rameshwar (Location Code R-9). The historical temple, Rameshwar is situated close to the bank of R. Varuna. Some submerged plant species was also observed floating at this

location. Sample from this location of the river was collected. This location is part of the panch kosi parikrama marg. (**Photograph No. - P 8).** People take holy dip on special occasions at this location. At the downstream of this location cremation activity was observed.

3. **River Varuna At Pissaura Bridge - River Varuna At Pissaura Bridge** (Location Code R-11) may be treated as upstream of the city of Varanasi where presumably no pollution source of the city could be identified.

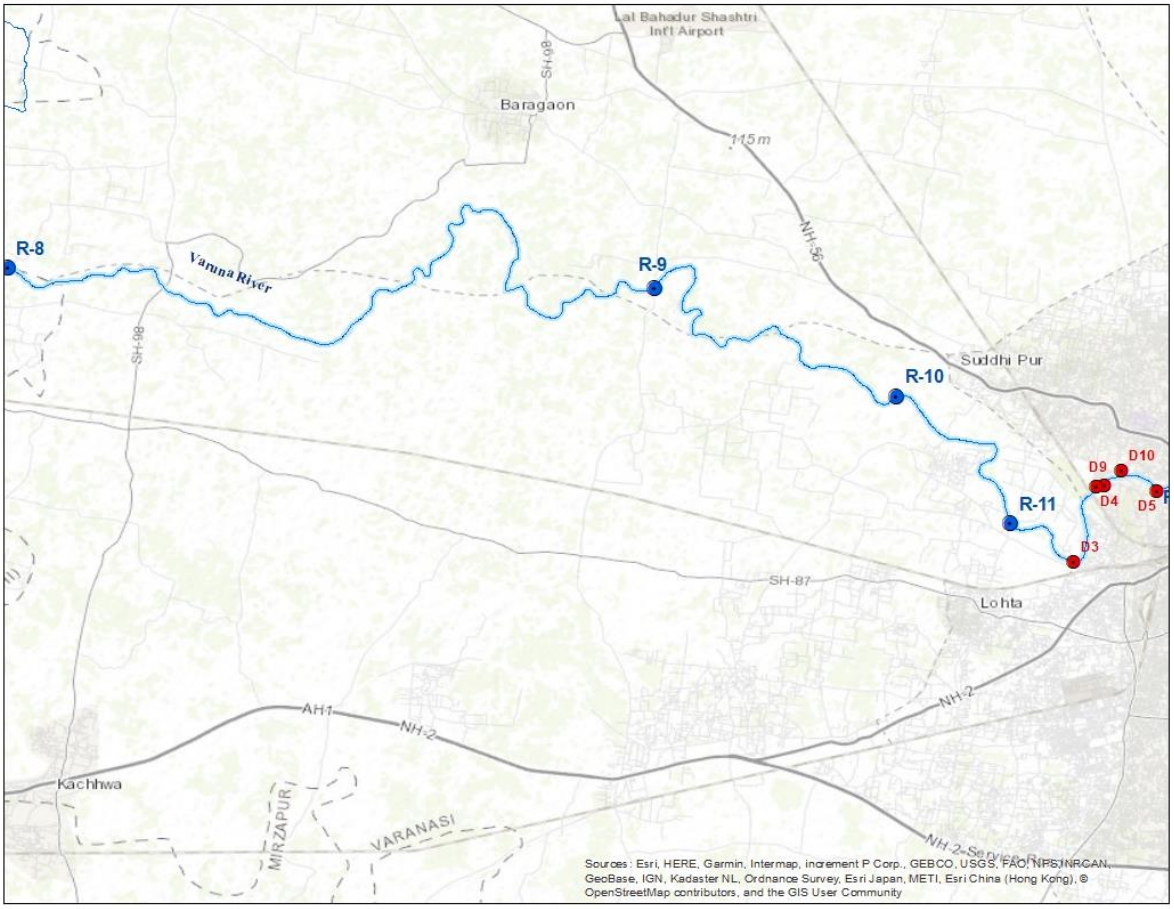


Figure 2.4. Map of stretch - II of River Varuna

Water Quality of River Varuna in Stretch – II

Water Quality of river Varuna in Stretch – II shows pH, EC, Colour, DO, BOD, COD, TSS, NH3-N and PO4-P varies from 7.53 to 8.26, 476 to 711 µS/cm, 20 to 35 Hazen, 4.1 to 7.2 mg/l, 1.23 to 6.62 mg/l, 13.47 to 30.24 mg/l, 20.7 to 34.1 mg/l, <0.1 to 4.5 mg/l and 0.459 to 2.83 mg/l respectively. DO is significantly present which is suggestive that water quality is supportive of aquatic life and biological processes. The low values of most of the parameters in the analysis result suggests impact of organic as well as nutrient load is negligible in this stretch of river Varuna. This is relatively a non-polluted stretch.

2.2.3 Stretch – III: D/s of Daniyalpur to River Varuna before confluence with River Ganga

1. **River Varuna At Kutchehry bridge, Varanasi -** In between Pissaura Bridge location and Kutchehry bridge (Location Code R-12) four drains (Durga/ Daniyalpur/ Lohta Drain, Phulwariya Drain, Chamraudha and Central Jail Drain) are contributing its discharge of about 1898.398 m^3/hr (45.56MLD) in the R. Varuna.
2. **River Varuna before confluence to R. Ganga, Varanasi -** At **River Varuna before confluence to R. Ganga, Varanasi** (Location Code R-15) a well-known Adikeshwar ghat is situated on the bank of R. Ganga at this point. R. Varuna is contributing about 10721.5 m^3/hr (257.32 MLD) to R. Ganga.

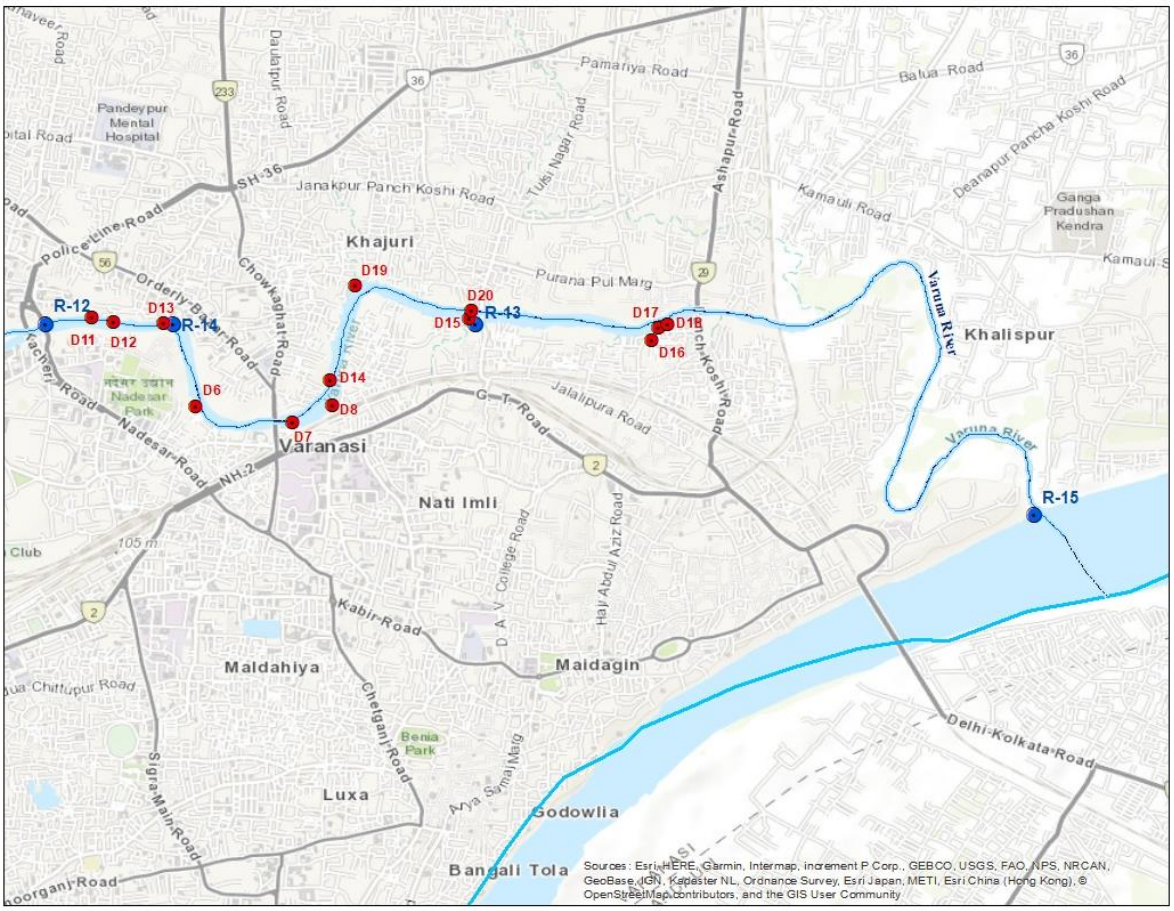


Figure 2.5. Map of Stretch - III of River Varuna

Water Quality of River Varuna in Stretch – III

Water Quality of river Varuna in Stretch – III shows pH, EC, Colour, DO, BOD, COD, TSS, NH3-N and PO4-P varies from 7.45 to 7.51, 713 to 925 µS/cm, 30 to 40 Hazen, 2.5 to 5.8 mg/l, 6.62 to 12.83 mg/l, 21.48 to 31.09 mg/l, 16 to 36.5 mg/l, 2.3 to 7.03 mg/l and 1.62 to 7.58 mg/l respectively. Based on the analyses results, it apparent that nutrient load has been detected in

water samples in this stretch. The value of ammonical nitrogen is typically indicative of presence of fresh raw domestic/organic wastewaters presumably from septic tank, a weak strength sewage. Overall, nitrates and phosphates (nutrient loading) and pesticides are also due to discharge of agricultural runoff as there are catchments having agricultural fields along the length of the river.

Similarly, the values of Bio-chemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) indicate moderate organic load of polluting sources. However, the overall water quality observed in this stretch has characteristics of partially treated or mix sewage of weak strength (Raw sewage has BOD as high as 250 mg/L; COD as 425 mg/L; Ammonical nitrogen as 32.5 mg/L; Nitrate as 5.0 mg/L; Phosphate as 7.1 mg/L) that doesn't necessarily require treatment in STP (CPHEEO Manual on Sewerage and Sewage Treatment Systems, Part A: Engineering, Chapter 5, Page 5-7), but could be treated through constructed wetland system.

Water quality of R. Ganga (upstream & downstream of discharge point of R. Varuna)

R. Varuna joins R. Ganga at the left bank at Adikeshwar Ghat at the downstream of Varanasi city. To assess the impact of R. Varuna on the water quality of R. Ganga, grab samples form u/s and d/s of confluence point of these two rivers were collected and analysed. For u/s and d/s location samples were collected from a distance of approx. 100 m before and approx. 800 m after confluence point. R. Ganga water quality at these locations is presented in Table 9. Comparison of water quality of these two locations suggests adverse impact on water quality of R. Ganga in terms parameters like BOD (3.09 times increment), COD (2.04 times increment), ammonical nitrogen (from <0.1 to 0.461 mg/L) and faecal coliform numbers (~ 522 times increment) at the downstream of discharge point of R. Varuna to R. Ganga.

2.3. Recommendation(s)

A. STRETCH I

Issue: The pollution of Varuna river water in this stretch is insignificant that doesn't require any major intervention. The only problem apparent in this stretch is that a significant portion of the origin (a wetland) is under either cultivation/agriculture land, paddy land as well as fallow land that has changed the not only the land-use but also the landcover of the area. This wetland also receives runoff from vast agricultural fields and is highly silted. This has resulted lack of flow of river from its origin.

Recommendation: The most suitable intervention is to acquire the cultivated land (once wetland at Mailhan village, Phoolpur of Prayagraj district) and convert it back into wetland as well as Biodiversity Park. Also, there are massive wetlands in the downstream (about 60 km from point of origin) and other wetlands located in the unpolluted stretches of the river, where desilting could be carried upto appropriate depth (original bed level). The desilted material can be used for making natural embankments without disrupting natural drainage pattern stream. These wetlands receive water from catchments and feed to the river. Enhanced stream flows not only remove sediments but also dilute the pollution levels in water in the downstream. Further more water will be available for the local communities. Once the origin i.e. Mailhan Taal is restored, the flow and in turn the water quality will further improve downstream this location.

B. STRETCH II

This stretch is seemingly non-polluted and requires **no** intervention.

Additionally, following could be considered for the stretch 1 and 2 with respect to drains that discharges into the river and for the industrial clusters of Morwa river:

i. Two major tributaries namely Basuhi, which joins Varuna at about 100 Km away from the point of origin and Morwa, which joins Varuna at about 150 km away from the point of origin, carry agricultural runoff, excess water from canals and catchments from agricultural fields may contain high levels of nutrients and pesticides. These can be remediated by riparian vegetation along the embankments. Both of them, do not carry any industrial pollutants. However, Morwa receives sewage from Burbuspur drain at Rampur village of Bhadoi district and Chauri drain at Kom village of Bhadohi district. The sewage of Burbuspur drain and Chauri drain should be treated by constructed wetland system at the mouth of the drain that joins Morwa or 100 m away from the confluence point or at any stretch where the width of the drain is maximum. The length and number of units of Constructed Wetland System will depend up on the volume of water and length of the drain.
ii. Setting up of one or more units of Constructed Wetlands Systems (CWS) within each of three drains (Dhoraira, Basti bazar and Durga of above stretches) for in-situ remediation of sewage as well as industrial effluents. It is not possible for in-situ remediation directly of polluted river water of this stretch using CWS because of large volume of water coming from the unpolluted stretch of the river along-with the discharges of drains and the narrow width of the river. Therefore, the best strategy is to setup CWS within each polluted drain.

iii. As a regulatory step, Charter implementation could be emphasized for Textile GPI clusters of Bhadohi based in Morwa catchment.

C. STRETCH III

This stretch is relatively polluted when compared with other two previous stretches based on the values of water quality parameters analysed.

Recommendation(s):

i. This stretch may require desilting, particularly in locations/stretches where the tributaries with polluted water join the river and the desilted material can be used for strengthening embankments.

ii. All the drains (that are presently untapped) should be tapped *via* interception/diversion to the related STPs. With respect to tapping of drains, if overflow exists even after interception/diversion system, that could be tapped into CWS for in-situ remediation. The sewage is mostly of weak strength (partially or mostly digested septic discharge/ domestic wastewater), that does not give prominence to construction of any additional STP is not essential.

iii. At present, the STPs at Dinapur (old and new) as well as STP at Goithala are underutilized given their designed capacities. They should be made fully efficient in terms of utilization. Values of high coliforms can be dealt via ensuring proper optimization of disinfection units as per the outlet flow of the STPs.

iv. There are reported wetlands in this stretch that requires restoration *via* desilting upto appropriate depth (original bed level). Thereafter, CWS could be introduced that can receive water from the catchment and treat it before feeding to the river. The riparian vegetation may help in reducing the nutrient loading.

v. The floodplains on either side of Ganga, particularly the side where Varuna joins Ganga (Adikeshwar Ghat), can be developed into floodplain Biodiversity Park (Adikeshwar Ghat Biodiversity Park). The area between the Ghat and Bridge in the downstream of Ganga from the Ghat can be developed into a Biodiversity Park. It has many ecological functions; (i) enhance water quality of Ganga in the stretch, (ii) the water from Varuna before it is discharged into Ganga can be further purified by passing through treatment wetlands developed in the Biodiversity Park, (iii) provide recreation to visitors, (iv) stabilizes embankments of the channel (v) provide habitat for many births and other fauna, and (vi) revive riparian ecosystems.

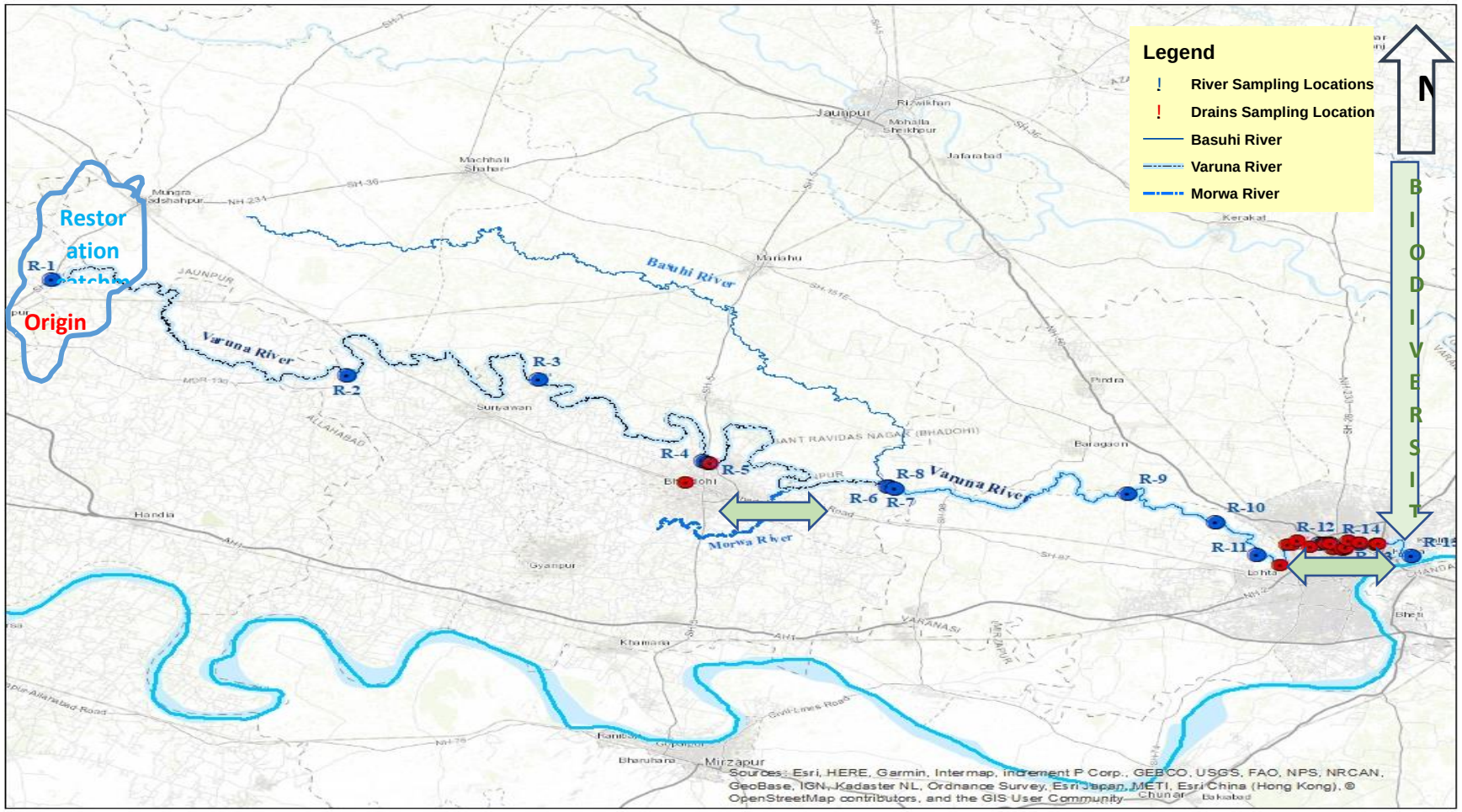


Figure 2.6. Map showing Proposed Plan for Rejuvenation and Restoration of River Varuna

Chapter 3. River Assi

3.1. Potamological features and the present state

River Assi presumably originates from Kardmeshwar Kund from surrounding areas of Kandwa in Varanasi city (situated at north of Assi river) and runs along an approximate length of 8 km through unconstructed channel before falling into River Ganga at left bank (Figure 3.1). Its width varies due to unauthorized encroachments. Previously, it used to confluence with River Ganga at Assi Ghat (the southernmost ghat in Varanasi having historical values). However, at present, River Assi is diverted and passes through Nagwa mohalla (the diversion onwards stretch is also known as Nagwa *Nala*) wherein it drains 300 meters upstream of Assi Ghat from Ravidas Park to protect Assi Ghat from direct impacts of pollution of water/wastewater of the Assi river. A bandh is constructed on the River Assi just before old confluence with Ganga around 25 years ago near the Assi Ghat with a width of around 25-30 meters.

During its overall course of flow, it passes through areas of Awaleshpur, Kanchapur, Indira nagar, Newada, Sundarpur, Saket nagar, Sankat Mochan crossing, Nagwa. Though Assi river is now a small, local, ephemeral stream compared to other major rivers, it is a cynosure of all eyes and an eye-sore as several pollutants flow through it to ultimately enter into the Ganga river. Presently, this river face serious issues such of unauthorized encroachments, degradation of floodplains, diminishing groundwater recharge, lack of ecological flow, discharge of untreated sewage, dumping and direct disposal of solid wastes into the water channel, to name a few.

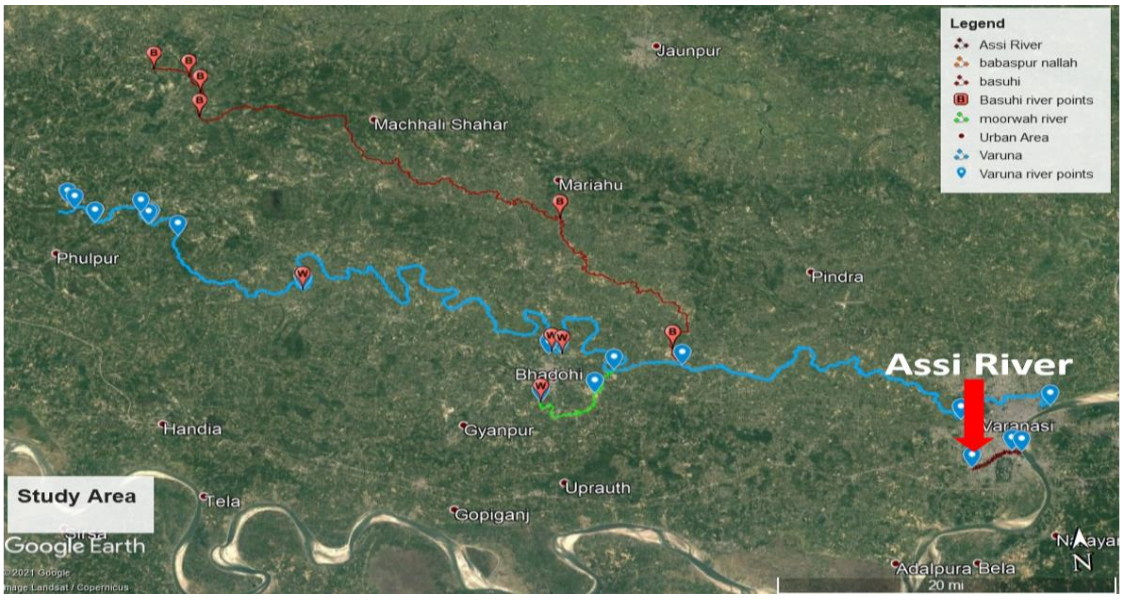


Figure 3.1: Google Map showing location of Assi River

3.2. Water Quality status and stretch characterization

During the pollution mapping and exploratory survey, the course of Assi river was mapped from present presumed origin till confluence into the River Ganga. The details of the same along-with geo-coordinates is presented in Table 3.1 and Figure 3.2. Samples were collected, wherever possible, to analyze the status of river water quality (Table 3.2) and to understand the characteristics of possible polluting sources at different locations along the course of the river.

Table 3.1. Mapped locations of River Assi from *confluence to origin* (AR: Assi River)

Location Code	Location name	Geo-coordinates	Photograph No.	Sample collection
AR-1	Confluence of R. Assi / Nagwa drain with R. Ganga	25.283039 N, 83.009778 E	39 & 40	Yes (composite)
AR-2	Diversion point of R. Assi to Nagwa stretch (near Sant Ravidas Park)	25.282949 N, 83.006714 E	41 & 42	No
AR-3	Sahodya Veer Bridge (near Sanskrit PG College, Assi-Lanka Road)	25.285133 N, 83.003534 E	43 & 44	Yes
AR-4	Ravindra Puri Bridge	25.285474 N, 83.002436 E	45 & 46	No
AR-5	Sankat Mochan, Durgakund Road	25.285141 N, 83.000475 E	47 & 48	No
AR-6	Saket Nagar	25.284126 N, 82.995829 E	49 & 50	Yes
AR-7	Sundarpur Chauraha (near sabzimandi)	25.282343 N, 82.984767 E	51 & 52	No
AR-8	Dhirendra Mahila PG College	25.280229 N, 82.982067 E	53 & 54	Yes
AR-9	Indira Nagar / DLW drain joining R. Assi in Indira Nagar Colony	25.276691 N, 82.971478 E	55 & 56	No
AR-10	Kanchanpur Pokhra	25.274167 N, 82.966970 E	57 & 58	Yes

AR-11	Khandwa Pokhri/Pond near Kardmeshwar Mahadev Inter College, Kandwa (E), Kanchanpur	25.270072 N, 82.960578 E	61 & 62	No
AR-12	Kardmeshwar *Kund*	25.267781 N, 82.958982 E	63 & 64	Yes
AR-13	Pond near Kardmeshwar *Kund*	25.267907 N, 82.957727 E	65 & 66	No

Table 3.2. Water quality status at specific sampling locations of River Assi

S. No.	Parameter	Unit	Sampling locations					
			AR 1	AR 3	AR 6	AR 8	AR 10	AR 12
1.	Flow	MLD	92	--	--	--	--	--
3.	pH	--	7.35	7.06	7.10	7.19	7.93	8.64
4.	Colour	Hazen	35.0	40.0	50.0	40.0	60.0	15
5.	Conductivity	µ S/cm	924	996	1067	980	801	525
6.	Suspended Solids	mg/L	104	177	101	151	44.2	22.8
7.	TDS	mg/L	492	512	567	518	438	273
8.	Chloride	mg/L	54.4	54.3	53.1	45.2	50.1	49.2
9.	Sulphate	mg/L	24.8	23.8	20.2	11.8	19.6	16.1
10.	Phosphate	mg/L	5.06	6.40	6.21	4.89	2.43	< 0.06
11.	Nitrate as N	mg/L	0.818	0.927	< 0.5	< 0.5	0.585	< 0.5
12.	Ammonical nitrogen	mg/L	16.8	17.7	19.8	12.6	6.62	< 0.1
13.	COD	mg/L	113	181	129	77.4	142	40.7
14.	BOD	mg/L	31.6	54.7	44.8	36.7	37.1	12.9
15.	Sulphide	mg/L	< 1.0	1.21	< 1.0	< 1.0	< 1.0	--
16.	Phenols	mg/L	0.25	0.23	0.35	0.20	< 0.1	--
17.	TKN	mg/L	23.5	31.9	35.0	30.8	24.3	--

18.	T-Coliforms	MPN/100 ml	1.3×108	7.9×107	7.9×107	1.3×108	4.5×105	2.3×103
19.	F-Coliforms	MPN/100 ml	3.5×107	3.3×107	1.1×107	1.1×107	2.0×105	1.3×103
20.	Arsenic	mg/L	0.012	< 0.01	< 0.01	< 0.01	< 0.01	-
21.	Zinc	mg/L	0.318	0.324	0.188	0.212	0.162	-
22.	Chromium	mg/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	-
23.	Lead	mg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	-
24.	Iron	mg/L	5.026	2.068	1.81	1.92	0.848	-

***Summary of the stretch(s) identified along-with major observations*:**

3.2.1. STRETCH I

It was identified that the Assi river once originated through an outlet at the south-east corner from Kardmeshwar *Kund*, near Kardmeshwar Mahadev temple (AR-12). Thereafter, the water from the Kardmeshwar *kund* probably joined another pond called Khandwa Pokhri (near Kardmeshwar Mahadev Inter College, Kandwa (E), Kanchanpur, AR-11) *via* Awaleshpur area. As per local information, the depth of this *kund* is about 30 ft. It was also informed that yet another pond exists nearby west of Kardmeshwar *kund* that connects with this *kund* in the Kanchanpur area (AR-13). Continued illegal constructions along the river course and encroachment of the river path, obstructed the flow of the river especially from Kardmeshwar *kund* to pond near Kadmeshwar Inter College. This blockage of the river path led to back flow of wastewater (discharged by nearby households in to the possible river path) into the Kardmeshwar *kund* that caused pollution of the *kund*. Therefore, about 10-15 years ago, the locals with the help of administration sealed the outlet of the Kardmeshwar *kund* that led to change in the origin of River Assi and ultimately effected the flow and pollution status of the river.

***Water Quality status**:* Analysis of sample of Kardmeshwar *Kund* for water quality parameters (AR-12) indicated that there is no visible pollution of this *kund*. The phosphate, nitrate and ammonical nitrogen are undetectable indicating that there is no nutrient pollution. Similarly, the values of Bio-chemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) are significantly low (12.9 mg/L and 40.7 mg/L, respectively) that may be originating from some cattle washing and human interferences (local people were seen using the *kund* for their domestic purpose) indicating insignificant contribution of any organic or inorganic polluting sources. However, high (pseudo) Dissolved Oxygen (DO) i.e. 16.8 mg/L in the *kund* was recorded that may be due to visible algal growth and turbulence due to wind over the *kund.* Even the microbiological pollution estimated in terms of Total Coliforms (TC) and Faecal Coliforms (FC) is 2300 MPN/100 ml and 1300 MPN/100 ml, respectively is suggestively low.

*Based on the water quality being reasonably well for various parameters, these locations were identified in **Stretch 1** for the purpose of preparation of the Action Plan.*

3.2.2. STRETCH II

The present origin of River Assi has been identified as Khandwa Pokhri, a pond near Kardmeshwar Mahadev Inter College, Kandwa (E), Kanchanpur (AR-11). At present, river ceases to exist U/s of this point and becomes untraceable in areas near Kandwa road in Awleshpur area. From this pond, it traverses through Kanchanpur Pokhra, Kanchanpur (AR-10) and enters Indira Nagar after crossing Chunar Road. Here, an open storm **DLW-2** drain (Photograph No. 4.41 & 4.42) coming from DLW (formerly called Banaras Locomotive Works) area and receiving load from Indira Nagar Colony, Newada area, joins River Assi behind H. No. N6/2B-132A (AR-9). Thereafter, the river traverses through the area around Dhirendra Mahila PG College and Indira Nagar area (AR- 8). Further downstream, it crosses Sundarpur Chauraha area (AR-7) and passes through the densely populated and congested areas of Naria Road, Tagore Road, Tilak Road and Gandhi Nagar Road till it reaches Saket Nagar (AR-6). The stretch of the river between Sundarpur *Chauraha* and Saket Nagar is about 1.4 km. It is in this stretch that a major drain **DLW- 1** from DLW joins River Assi near Sundarpur *Sabzimandi* at Saraynandan (Photograph 77 & 78). Another drain discharges into River Assi near the Sundarpur Chauraha bridge. In Saket Nagar area, the width of the river is reduced to about 2-3 meters only and some houses/buildings were constructed in the path of the river itself. River path was diverted by these construction activities and the river was forced to meander at 90^{o} angles at few locations. The Assi river then flows through Durgakund Road near Sankat Mochan Crossing (AR-5) and then through Ravindra Puri Road bridge (AR-4). As informed by UP Jal Nigam, provision for storm water drainage into the River Assi is provided through a conduit pipe under the Ravindra Puri Road bridge. However, domestic wastewater is also discharged through the provided pipe. From Ravindra Puri Road, it flows towards Nagwa Road through Sahoday Veer Bridge on Assi-Lanka Road near Siyaram Dairy (AR-3). Further downstream, the River Assi is diverted through Nagwa ward where it is also known as Nagwa Drain (AR-2) near Sant Ravidas Park. Finally, this River Assi/Nagwa drain confluence with River Ganga (AR-1). The present confluence points of River Assi, behind Ravidas Ghat Park is situated at a distance of around 770 meters upstream of original confluence point at Assi Ghat. As mentioned in the introduction, a bandh is constructed on the River Assi just before the old confluence with River Ganga near the Assi Ghat. The old channel of River Assi now carries household sewage from the point of bandh onwards and is now encroached at diversion point. The original channel from diversion to confluence was of around 780 meters length till Assi Ghat which is now bypassed with short route of just 300 meters (Figure 3.3).

There is a 50 MLD sewage pumping station (SPS) of GPCU, UP Jal Nigam approximately 70-80 meter before confluence point, that has a tapping provision for pumping the sewage from River Assi/Nagwa Nala to Ramana Sewage Treatment Plant (STP). However, due to less pumping capacity, sewage overflows the tapping arrangement and directly discharges into River Ganga.

Water Quality status: Samples were collected for water quality analyses from locations namely, Kanchanpur Pokhra (AR-10), Dhirendra Mahila PG College (AR-8), Saket Nagar (AR-6), Sahodya Veer Bridge (AR-3) and Confluence of River Assi/Nagwa drain with R. Ganga (AR-1). The results suggest that the water quality parameters of River Assi at different locations has identical values with slight variations that is indicative of characteristics of typical sewage (with dilution at some locations). pH is mostly in the decimal values of 7 for all the locations. However, nutrient load has been detected in water samples from these locations. The value of ammonical nitrogen is in the range of 6.62 to 19.8 mg/L which is typically indicative of presence of fresh raw domestic/organic wastewaters presumably from septic tank, a weak strength sewage. In fact, nitrate in samples range from trace to 0.927 mg/L, again a characteristic of weak strength wastewaters. Phosphate is in the range from 2.43 to 6.40 mg/L and its presence is indicative of water discharged from household washing activities. Phenols have been found in the range of <0.1 to 0.35 mg/L indicative of absence of any industrial source in the catchment of River Assi. Similarly, the values of Bio-chemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) are in the range from 31.6 - 54.7 mg/L and 77.4 - 181 mg/L, respectively indicating moderate organic load of polluting sources. However, the microbiological pollution estimated in terms of Total Coliforms (TC) and Faecal Coliforms (FC) is observed as high as 1.3×10^8 MPN/100 ml and 3.5×10^7 MPN/100 ml, respectively, suggesting presence of sewage pollution and surface runoff from nearby land. However, the overall water quality observed in this stretch has characteristics of partially treated or mix sewage of weak strength (Raw sewage has BOD as high as 250 mg/L; COD as 425 mg/L; Ammonical nitrogen as 32.5 mg/L; Nitrate as 5.0 mg/L; Phosphate as 7.1 mg/L) that doesn't necessarily require treatment in STP (CPHEEO Manual on Sewerage and Sewage Treatment Systems, Part A: Engineering, Chapter 5, Page 5-7), and which could be treated through a series of constructed wetland systems.

Based on the values of water quality parameters, these locations were identified in ***Stretch 2*** *for the purpose of preparation of the Action Plan.*

Sub-section 1: DRAINS IN STRETCH 2

It is impertinent to mention that all along the course of River Assi from Kardmeshwar *kund* to confluence with River Ganga, numerous drains/conduit pipes have been observed discharging into the river. The photographs of the same are provided from No. 67 to 76 for reference. However, as mentioned in previous section, 2 major drains i.e. DLW-1 and DLW-2 that empty themselves into River Assi, were identified. DLW 1 drain originates from the DLW campus and carries treated sewage/effluent and other waste water from the DLW campus, ultimately meets river Assi near Sunderpur Sabji Mandi. DLW2 drain originate from Manduadih area and routes towards DLW campus and finally confluence with Assi river near Sunderpur Sabji Mandi. Grab samples were collected from these drains for estimating quantity (instantaneous) and analyses of quality of wastewater discharging from them. The results are provided in Table-3.3. Again, the values of nutrient parameters including low values of BOD/COD indicate that these drains mostly receive sewage of weak strength with possible domestic and surface runoff sources.

Table 3.3. Major drains joining River Assi and their characteristics

S. No.	Parameter	Unit	Sampling location	
			DLW Drain - 1	**DLW Drain - 2**
1.	GPS Coordinates	--	25.2829964 N, 82.9845114 E	25.276691 N, 82.971478 E
2.	Flow (Instantaneous)	MLD	16.04	Flow not measured (unapproachable path)
3.	pH	--	7.17	7.27
4.	Colour	Hazen	30.0	30.0
5.	Conductivity	µ S/cm	938	944
6.	Suspended Solids	mg/L	57.7	114
7.	TDS	mg/L	514	503
8.	Chloride	mg/L	46.5	41.2
9.	Sulphate	mg/L	17.2	10.6
10.	Phosphate	mg/L	5.08	4.84
11.	Nitrate as N	mg/L	< 0.5	< 0.5

12.	Ammonical nitrogen	mg/L	14.7	15.4
13.	COD	mg/L	63.8	69.3
14.	BOD	mg/L	19.9	16.1
15.	Sulphide	mg/L	< 1.0	< 1.0
16.	Phenols	mg/L	0.16	0.16
17.	TKN	mg/L	37.5	35.0
18.	T-Coliforms	MPN/100 ml	1.3×10^8	4.9×10^7
19.	F-Coliforms	MPN/100 ml	4.9×10^7	3.3×10^7
20.	Arsenic	mg/L	< 0.01	0.016
21.	Zinc	mg/L	0.176	0.194
22.	Chromium	mg/L	< 0.2	< 0.2
23.	Lead	mg/L	< 0.5	< 0.5
24.	Iron	mg/L	0.624	3.108

Sub-section 2: **Water Quality of River GANGA (UPSTREAM & DOWNSTREAM of DISCHARGE POINT of River ASSI/NAGWA Drain)**

River Assi discharges into River Ganga at the left bank before the religiously important Assi Ghat. Many important ghats like Harishchandra Ghat, Dasaswamedh Ghat and Manikarnika Ghat are situated in the d/s of the Assi Ghat. Garb samples form u/s and d/s of discharge point of River Assi/Nagwa drain were collected and analysed. For u/s and d/s location samples were collected from a distance of approx. 100 m before discharge point and approx. 800 m (near Assi Ghat) after discharge point, respectively. Water quality of River Ganga at these locations is tabulated in Table 4. Comparison of water quality of these two locations indicate adverse impact on water quality of River ganga in terms of parameters like BOD (4.13 times increment), COD (1.5 times increment), Ammonical nitrogen (from <0.1 to 0.328 mg/L) and Fecal Coliform numbers (3.5 times increment) at the downstream of discharge point into River Ganga.

Table 3.4. Water quality of R. Ganga at u/s and d/s of discharge point of R. Assi / Nagwa Drain.

S. No.	Parameter	Unit	Sampling location	
			R. Ganga U/s of R. Assi/Nagwa Drain	R. Ganga D/s of R. Assi/Nagwa Drain (near Assi Ghat)
1.	pH	--	8.63	8.55
2.	Temp.	^oC	32	32
3.	Colour	Hazen	5	10
4.	Conductivity	µ S/cm	377	402
5.	TSS	mg/L	42.4	55.8
6.	TDS	mg/L	191	212
7.	Chloride	mg/L	18.5	24.1
8.	Sulphate	mg/L	21.8	27.8
9.	Phosphate	mg/L	< 0.06	< 0.06
10.	Nitrate as N	mg/L	< 0.5	< 0.5
11.	NH_3-N	mg/L	< 0.1	0.328
12.	DO	mg/L	8.5	8.8
13.	COD	mg/L	9.0	13.5
14.	BOD	mg/L	1.12	4.63
15.	T-Coliforms	MPN/100 ml	7.9×10^4	7.9×10^4
16.	F-Coliforms	MPN/100 ml	1.4×10^4	4.9×10^4
17.	Arsenic	mg/L	< 0.008	< 0.008
18.	Zinc	mg/L	0.06	0.04
19.	Chromium	mg/L	< 0.05	< 0.05
20.	Lead	mg/L	< 0.05	0.08
21.	Iron	mg/L	0.47	0.15

3.3. Issues in identified/characterized stretch and recommendations for intervention

In the previous section, the 2 stretches of River Assi have been identified and the probable issues that need immediate interventions stretch-wise have been discussed in detail in the present section. A schematic layout for the same is presented in Figure 3.4.

3.3.1 STRETCH I

Issue:

As observed and identified by the experts, 10-15 years back, River Assi used to emanate from two water bodies (a pond and a *kund*) at Kardmeshwar Mahadev Temple, Kandwa, Chitaipur, Varanasi near the Kandwa Panchkosi Marg. It is presumed that from the outlet of the Kardmeshwar *kund*, the river used to begin its flow through the areas around Awaleshpur, Kandwa and joined the Khandwa Pokhri near Kardmeshwar Mahadev Inter College, Kandwa. Presently as the outlet of the kund is sealed, the river downstream is untraceable and the presumed course of the river is lost. **The origin has shifted from Kardmeshwar *kund* to Khandwa Pokhri near Kardmeshwar Mahadev Inter College, Kandwa**. Also, the water quality of the Kardmeshwar *Kund* is reflective of non-polluted condition of the same. Therefore, as such pollution is not the pressing issue in this stretch, but it is restoration of the origin, identification of the lost path of the River Assi and allowing freshwater from the Kardmeshwar *kund* into the channel is a much-required intervention.

Recommendation(s):

The presumed path of the river from **Kardmeshwar *kund* to Khandwa Pokhri near Kardmeshwar Mahadev Inter College, Kandwa** is already identified. This channel is heavily encroached. Therefore, it is required that the encroachment may be removed and channel be restored by excavation/disilting or by any appropriate measure. The outlet of the Kardmeshwar *kund* be opened to allow water into that channel. Once it's done, local administration must ensure that blockage of the river channel should not happen. This will ensure flow of freshwater at the origin of the River Assi.

3.3.2 STRETCH II

Issue:

This stretch is from present origin of River Assi at **Khandwa Pokhri near Kardmeshwar Mahadev Inter College, Kandwa till confluence of River Assi into River Ganga.** Water quality analysis of this river stretch reflect that the river here does not have any fresh water impetus and it continues to have water with drain properties predominantly representing influx of domestic wastewater form nearby households. The river passes from sparsely inhabited areas of Kandwa and Kanchapur, and thereafter, it traverses through the highly encroached and

densely populated areas of Awleshpur / Aditya Nagar, Nagwa, Kanchanpur, Indira Nagar, Chitaipur, Sundarpur, Saket Nagar and Rabindrapur areas. The river is trained by passing it through between RCC wall embankments in such encroached areas. All along the path of the river, untreated wastewater joins the river indiscriminately increasing the pollution load of the river, however, it is difficult to find out the exact number of inlets that discharge raw sewage and or household wastewater. Specifically, 2 major drains i.e. DLW-1 and DLW-2 empty themselves into River Assi in this stretch. Wastewater flowing into River Assi from Kanchapur Pokhra to discharge point in River Ganga is showing characteristics of typical sewage but of weak strength. Therefore, it is evident from the above that the major issues in this stretch are of pollution as well as encroachment.

Recommendation(s):

i. It is recommended that the first step, towards the rejuvenation of this stretch of Assi river, should be the removal of the encroachments (wherever required and possible) through coordinated action by State and district administrations.
ii. The **Khandwa Pokhri near Kardmeshwar Mahadev Inter College, Kandwa,** from which it originates is a wetland and it could be restored by desilting it upto its bed level and the desilted material will be used for making embankments. The embankments should be vegetated. The sewage that enters into this pond should be channelized and treated by Constructed Wetland System that will be setup at the mouth of channel that discharge sewage into wetland.
iii. A series of minimum of 5 Constructed Wetland System units should be setup at stretches where width of Assi river is maximum. If the depth of water is more than 1 meter, it should be channelized in wider stretches of the river to make the depth of water less than one meter. This will help in in-situ treatment of wastewater and will help reducing organic load in terms of BOD, Nutrients and others.
iv. The drains may require desilting all along its channel. Also, Constructed Wetland (CW) could be made at the mouth of DLW-2 drain (an open storm drain) where it empties itself into River Assi. This has a BOD of 16.1 mg/L that could be easily taken care by CW and can help reduce it further.
v. There is an operational DLW STP with designed capacity of 12 MLD and utilized capacity of only 5 MLD. It is observed that the effluent from this STP is discharged into DLW-1 drain. Since, this STP is underutilized, measures must be put in place to augment and utilize the treatment capacity of DLW STP to full extent. Even the DLW-1 drain could be

diverted to this STP for treatment. Even values of microbiological pollution could be lowered to an extent by ensuring proper disinfection in the STP.

vi. A floodplain Biodiversity Park (Assi or Ravidas Biodiversity Park) may be developed concurrently in downstream upto 5 km of the area where once River Assi used to confluence with River Ganga around Assi ghat. Once this biodiversity park is constructed having functional CWS, the channel of River Assi can be restored back by passing the river water through treatment wetlands of Biodiversity Park before it is discharged into Ganga.

vii. As mentioned before, all along the course of River Assi, numerous drains/conduit pipes have been observed discharging into the river. Tapping of all such outlets has feasibility constraints and might not be possible. Likewise, the entire channel of River Assi is predominantly narrow, therefore, laying of interceptor and diversion lines may not be possible. Such provisions are necessary requisite for conveying the sewage from nallah/drains to STPs for treatment. If sewage can't reach the treatment plants *via* proper channel, STPs will not solve the purpose. As an alternative, CWS have an advantage as they can be established within the river channel and resolve the problem *via* in-situ remediation.

viii. Also, there is the 50 MLD sewage pumping station of UP Jal Nigam that has a tapping provision for pumping the sewage from River Assi (Nagwa Nala stretch) to Ramana Sewage Treatment Plant (STP) having treatment capacity of 50 MLD (under trail run). The composite monitoring of River Assi/Nagwa Drain near the confluence with River Ganga was carried out and an average flow of 92 MLD (approx.) of untreated wastewater was found discharging directly to River Ganga. In this case scenario, if this wastewater is diverted to STP, it will only help reducing pollution load of certain area of influence i.e. towards the end of river stretch. However, most of the river stretch upstream will still remain impacted with certain extent of pollution. Implementation of CWS as a remedial measure starting from present origin and throughout the course of river, will significantly help in reducing the pollution load reaching towards the end of Assi river b/c with Ganga river in a systematic manner. Infact, the water/wastewater of River Assi/Nagwa Nala stretch (the stretch after diversion of River Assi through Nagwa mohalla is known as Nagwa drain) will have an already reduced pollution load and in turn could be fully tapped into STP Ramana. This whole process can reduce the overall pollution load along the entire stretch of Assi river. It may further lead to appearance of dissolved oxygen in due course of time that can ultimately support certain life-forms and restore the ecosystem of the river.

This approach may also reduce the burden of removal of encroachment that further legal implications as they are constructed in-situ within the river stretch.

1. Confluence of R. Assi / Nagwa drain with R. Ganga (AR 1)
2. Diversion point of R. Assi to Nagwa drain (AR 2) (near Sant Ravidas Park)
3. Sahodya Veer Bridge (near Sanskrit PG College, Assi-Lanka Road) (AR 3)
4. Ravindra Puri Bridge (AR 4)
5. Sankat Mochan, Durgakund Road (AR 5)
6. Saket Nagar (AR 6)
7. Sundarpur Chauraha (near sabzimandi) (AR 7)
8. DhirendraMahila PG College (AR 8)
9. Indira Nagar / DLW drain joining R. Assi in Indira Nagar Colony (AR 9)
10. Kanchanpur Pokhra (AR 10)
11. Pond near Kardmeshwar Mahadev Inter College, Knadwa (E), Kanchanpur (AR 11)
12. Closed/blocked path afterKardmeshwar kund outlet
13. Kardmeshwar Kund (AR 12)
14. Pond near Kardmeshwar Kund (AR 13)
15. DLW Drain – 1
16. DLW Drain – 2
17. u/s of R. Assi / Nagwa Drain
18. d/s of R. Assi / Nagwa Drain

Figure 3.2. Map showing locations of River Assi mapped during survey and sampling

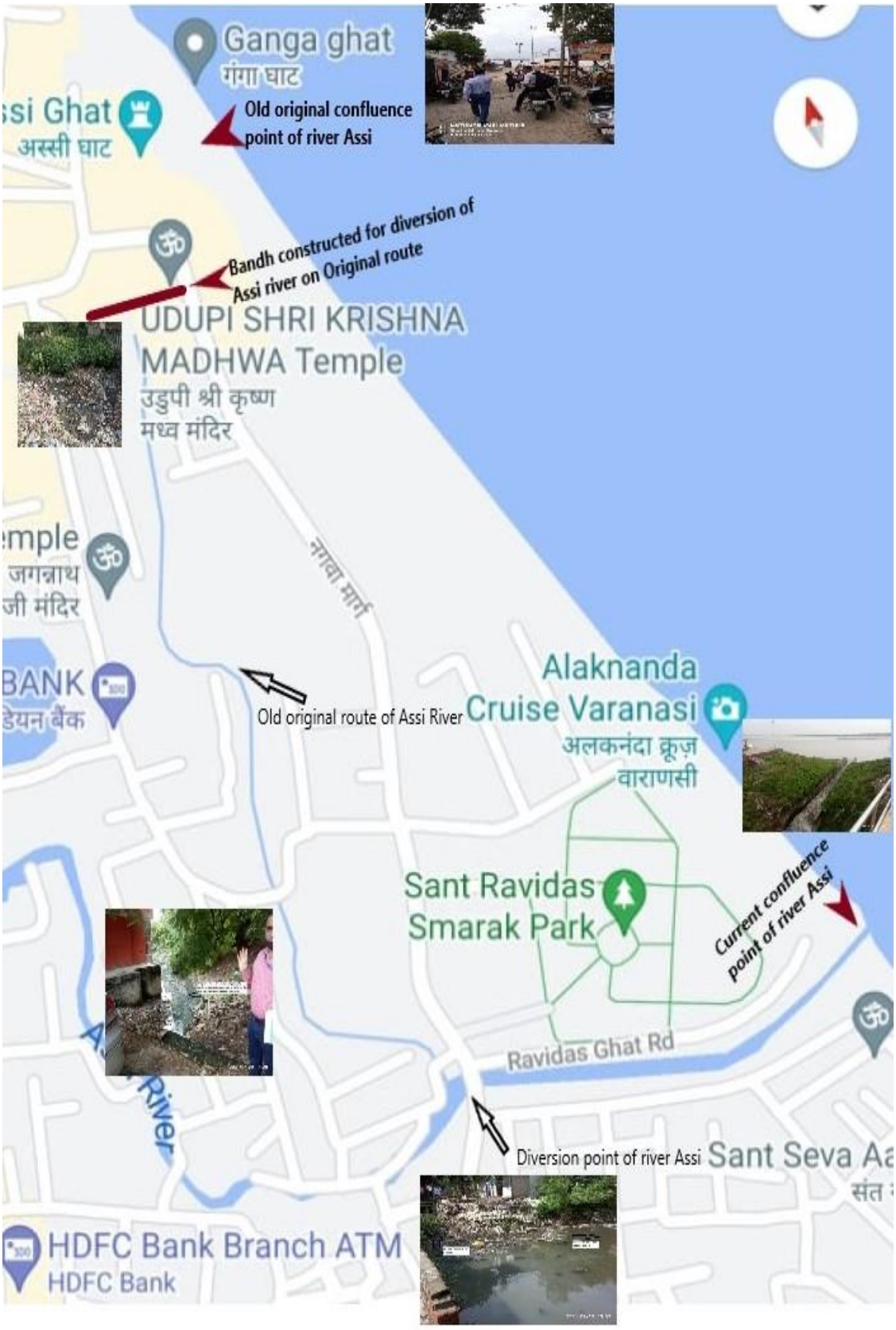


Figure 3.3. Schematic layout showing diversion of River Assi, Old channel and the present Confluence point.

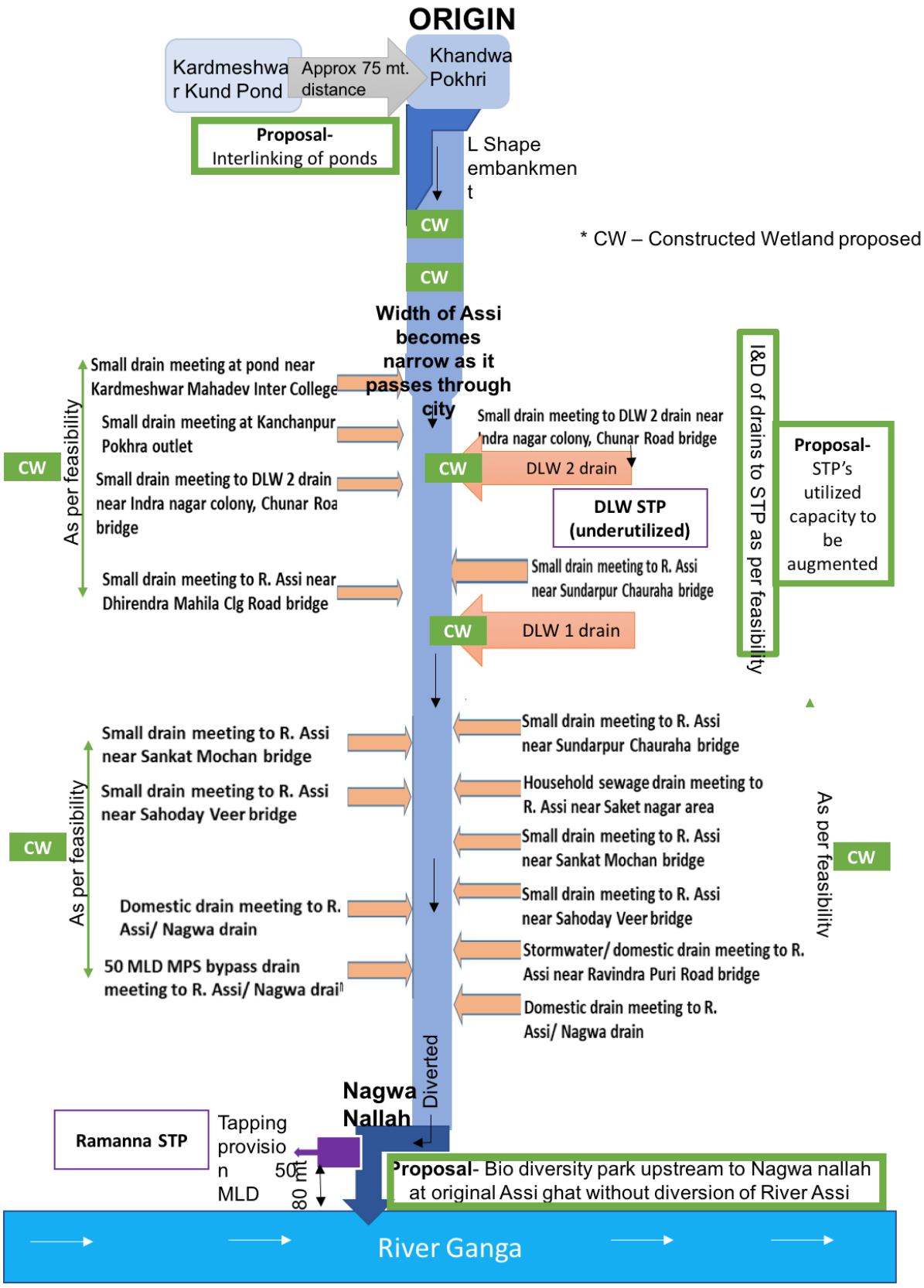


Figure 3.4. Schematic layout of River Assi from origin till confluence with River Ganga showing locations of possible interventions

Chapter 4. Action Plan

Action Plan, Work Plan, Timelines and Implementing Agencies for restoration and rejuvenation of Varuna and Assi Rivers, Varanasi

4.1 Riverscape restoration and rejuvenation of Varuna and Assi

A. Restoration and rejuvenation of Varuna River

Action Plan 1: Restoration of catchment wetlands located at the origin and downstream from the origin before joining Basuhi river (in this stretch the river is not polluted and does not have water in dry season).

Table 4.1 Action Plan for Restoration and rejuvenation of Varuna River

S. No	Work Plan	Timeline	Implementing Agency
1.	Desilting of wetlands upto the bed level and developing embankments with inlets from the catchment Location: i) Mailhan, Phulpur, Prayagraj (25.599571N, 82.107391E) ii) Near bridge at Durgaganj on the border of Bhadohi and Prayagraj (25.497886N, 82.329903E)	10 - 12 months	UP Irrigation and Water Resource Department under the guidance of CEMDE
2.	Development of Biotic Communities (at both the above locations and other sites including embankments.		CEMDE, University of Delhi

Action Plan 2: Restoration of Basuhi and Morwa tributaries. Both the tributaries have clean water. However, two drains meet Morwa having small quantity of discharge which get diluted and carry clean water from their catchments and irrigation canal water to Varuna.

Table 4.2 Action Plan for Restoration of Basuhi and Morwa tributaries

S. No	Work Plan	Timeline	Implementing Agency
i.	Desilting of channels if it is not done during last 10 year Location: I. Upardaha Taal/Wetland in Handia of Prayagraj district II. Kaitihawa, Tara (a small Pond) nearby Jigna Taal area in Handia, District Prayagraj (U.P) (25.38836 and 82.29644)	6 months	Irrigation and Water Resource Department
ii.	Vegetation development along the embankments and restoration riparian zone	2 years	CEMDE

Action Plan 3: Remediation of waste water that is discharged into Morwa (from two drains) and three major drains Dhoraira drain, Durga drain, Basti/ Naya Bazar drain that discharge sewage and industrial waste water into Varuna.

Table 4.3 Remediation of waste water that is discharged into Morwa

S. No	Work Plan	Timeline	Implementing Agency
i.	Remediation of waste water using Constructed Wetland System. A schematic Constructed Wetland System (CWS) is attached. These CWS are set up at the confluence of the drain with the tributary/river and extend upto 100 m in the upstream from the confluence point. The length of CWS and number of units depends on the flow of water, the BoD, CoD, TSS and DO levels of water and width of the drain.	1-2 years	Designed by CEMDE and Implemented by Irrigation and water Resource Department under guidance of CEMDE, water quality will be monitored by UPPCB

S. No	Work Plan	Timeline	Implementing Agency
	Locations: i) Dhoraira drain on Varuna at Bhadohi (25.417900N, 82.567600E) ii) Basti/ Naya Bazar drain on Varuna at Bhadohi (25.415251N, 82.576675E) iii)Durga drain on Varuna at Danyalpur, Varanasi (25.320033N, 82.955642E) iv) Burbuspur drain on Morwa at Rampura, Bhadohi (25.409475 N, 82.556622 E) v) Chauri Drain on Morwa at Kom, Bhadohi (25.369723N, 82.606431E)		
ii.	Desilting of drains upto bed level and strengthening of bunds with desilted material if not done during the last 5 year	1 year	Irrigation and Water Resource Department
iii.	Vegetation development on embankments of restored drain		CEMDE

Action Plan 4: Development of Floodplain Biodiversity Park at Adikeshwar Ghat where Varuna joins Ganga not only to enhance the water quality in Ganga in the stretch but also further enhance the quality of water of Varuna before discharged into Ganga by passing through treatment wetlands. The Biodiversity also help in restoring of riparian ecosystems and in stream community and also provide aesthetic and recreation value to Ganga.

Table 4.4 Development of Floodplain Biodiversity Park

S. No	Work Plan	Timeline	Implementing Agency
i.	Plan, Design and Development of Biodiversity Park. A schematic	5 years	CEMDE

S. No	Work Plan	Timeline	Implementing Agency
	layout of a typical floodplains Biodiversity Park is attached.		Irrigation and Water Resource Department (supporting structure) UPPCB (monitoring water quality)

Action Plan 5: Desilting of river Varuna in stretches where heavy sedimentation has taken place.

Table 4.5 Desilting of river Varuna

S. No	Work Plan	Timeline	Implementing Agency
i.	Desilting of river and strengthening of embankments using desilted material	2 years	Irrigation and Water Resource Department
ii.	Vegetation Development on embankments	5 years	CEMDE

Action Plan 6: Monitoring of water quality at different sampling sites to assess the health of river ecosystems.

Table 4.6 Monitoring of water quality

S. No	Work Plan	Timeline	Implementing Agency
i.	Monitoring of water quality as per CPCB norms for river water before, during and after restoration	5 years	UPPCB

B. Restoration and rejuvenation of Assi River

Action Plan 1: Restoration of catchment wetlands at the point of origin and other wetland in the downstream to enhance the flow rates of water in the river.

Table 4.7 Restoration and rejuvenation of Assi River

S. No	Work Plan	Timeline	Implementing Agency
i.	Desilting of catchment wetlands and use of desilted material for making embankments with inlets Kandwa wetland at Varanasi point of origin (25.273258 N, 82.962083 E) and other wetland located in the downstream from the point of origin.	6 months	Irrigation and Water Resource Department
ii.	Remediation of sewage water that enters into catchment wetland using CWS at the mouth of the inlets before the confluence point. The length of wetland depends upon the flow of sewage and depth of water. A schematic layout of a typical CWS is attached.	1 year	CEMDE and Irrigation and Water Resource Department
iii.	Vegetation Development on the embankment and development of aquatic communities in the wetland.	2-3 years	CEMDE

Action Plan 2: Remediation of sewage + household industrial waste water using Constructed Wetlands at stretches in the river where width is maximum with one largest CWS at 100 m away from the confluence of river with Ganga.

Table 4.8 Remediation of sewage and household industrial waste water using Constructed Wetlands

S. No	Work Plan	Timeline	Implementing Agency
i.	Setting up of CWS at 4 locations where width of river is maximum. The length of CWS depends upon the volume of water, quality of water, width of river. The riparian zones will also be restored.	2 years	CEMDE and Irrigation and Water Resource Department

Action Plan 3: Desiltation of river, if not desilted during the last 5 years and use of desilted material for strengthening of embankments wherever possible.

Table 4.9 Desiltation of river

S. No	Work Plan	Timeline	Implementing Agency
i.	Desilting of river up to the bed level and strengthening of embankment with desilted material	1 year	Irrigation and Water Resource Department
ii.	Development of vegetation on embankment wherever possible and restoration of riparian zone.	2-3 years	CEMDE

Action Plan 4: Development of Floodplain Biodiversity Parks at the Assi Ghat, from the historical confluence of Assi with Ganga, to the point where diverted. About 25 years ago the Assi River was diverted towards Ravidas Park from Nagwa road and it passes through Nagwa Colony and known as Nagwa drain before confluence with River Ganga. The old route of River Assi which is about 700 meters (from the point of interception Udupi Shri Krishna Madhav Temple to Sant Ravidas Park) carries household sewage and discharge into Nagwa drain. This may help in restoring the original Ghat where Assi used to confluence with Ganga and also enhance the quality of Ganga water.

Table 4.10 Development of Floodplain Biodiversity Parks

S. No	Work Plan	Timeline	Implementing Agency
i.	Plan, design and develop Biodiversity Park	5 years	CEMDE, Irrigation and Water Resource Department

Action Plan 5: Monitoring quality of water for sustaining the health of restored river ecosystem.

Table 4.11 Monitoring of water Quality

S. No	Work Plan	Timeline	Implementing Agency
i.	Monitoring of water quality as per CPCB norms before and after restoration	5 years	UPPCB

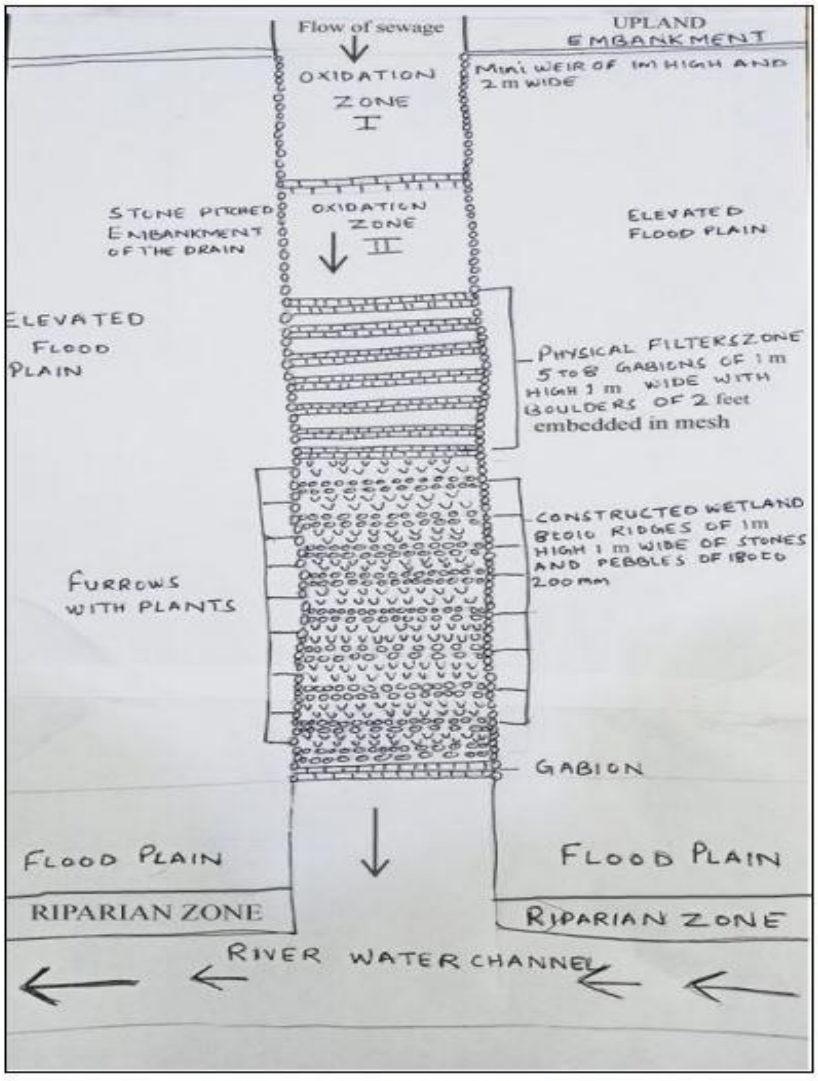


Figure : Schematic layout of a typical Constructed Wetland System for in-situ remediation of sewage/ industrial effluent of the drain that pass through Upland Elevated Floodplain of the riverscape.

Figure 4.1 Schematic Diagram of Constructed Wetland

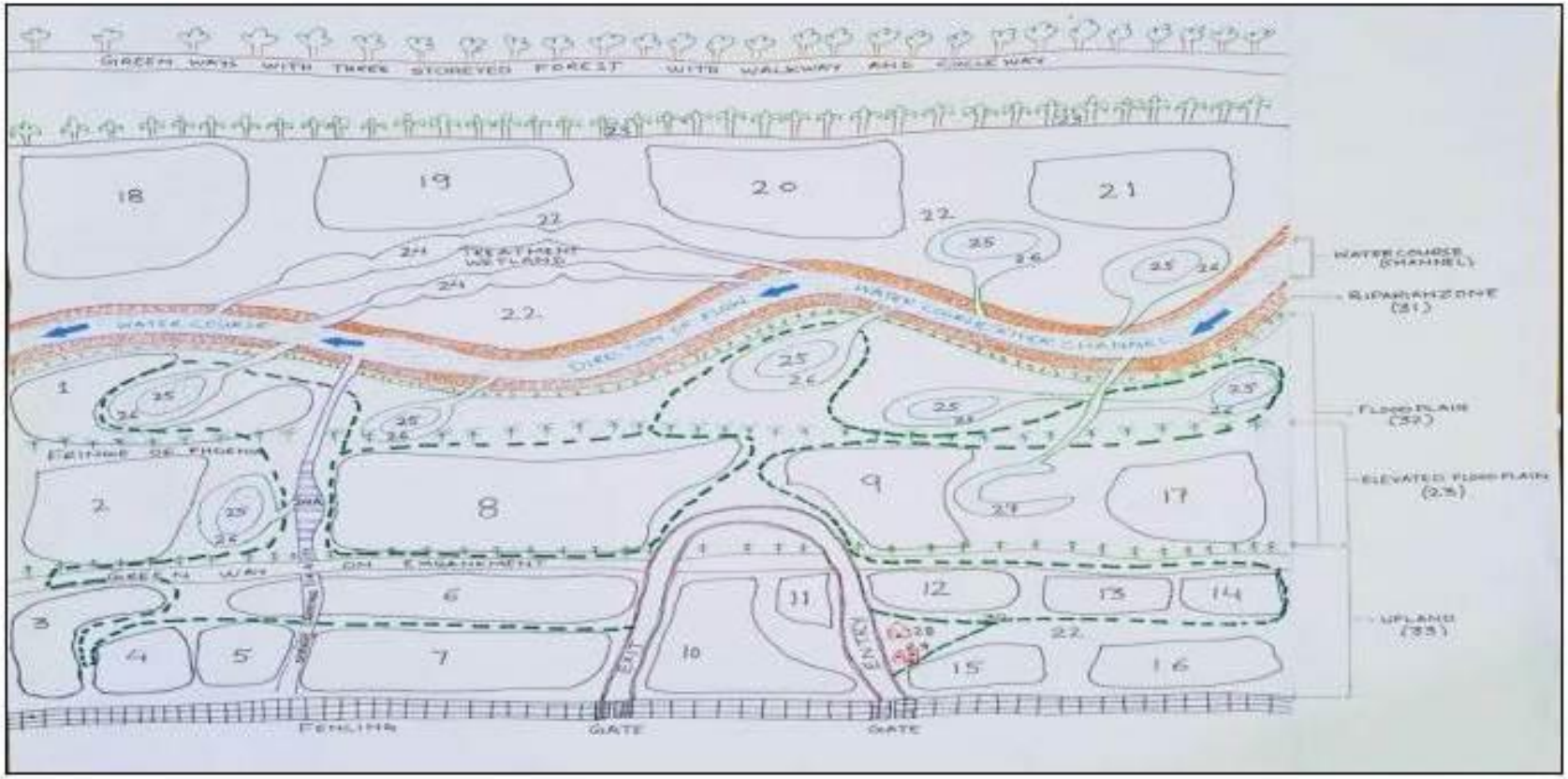


Figure : Schematic layout of a typical Biodiversity Park of the riverscape showing different structural components.

1 – Floodplain forest on the elevated ridge; 2 – Floodplain forest with *Acacia catechu*, *Bombax* and Ber, 3 – Wild fruit-bearing shrubs and trees (Birding Area), 4 – *Phoenix* groove, 5 – Shrubland, 6 – Orchard, 7 – Bamboo thickets, 8 – Grassland with scattered trees, 9 – Aquatic garden, 10 – Recreational Park, 11 – Butterfly Park, 12 – Herbal Garden, 13 – Nursery, 14 – *Sterculia* dominated community, 15 – *Butea* dominated community, 16 – *Holoptelea* dominated community, 17 – *Terminalia arjuna* dominated community, 18 to 21 – Different floodplain forest communities, 22 – Grasslands and marshes, 23 – Elevated floodplain, 24 – Treatment wetlands (natural), 24A – Constructed wetland, 25 – Catchment wetlands, 26 – Marsh, 27 – Oxbow lake, 28 – Nature Interpretation Centre, 29 – Office Campus, 30 – Dotted line (----) indicates trails, 31 – Riparian zone, 32 – Floodplain, 33 – Upland

Figure 4.2 Schematic Diagram of Biodiversity Park

4.2 Sewage Management

A. Introduction

Varanasi city is presently divided into four sewerage districts located within current municipal corporation limits. Under the present sewerage master plan the existing districts are re-aggregated into 4 Districts to correspond roughly with natural drainage catchments. These Districts are described as follows:

District 1: District 1 is the Central City Sewerage District draining to 80 MLD Dinapur STP via 6 no. sewerage pumping stations. This area includes the old city, about 1km in breadth and 5km along the Ganga river from Assi to Raj Ghat. Density in this area is very high.

District 2: District 2 is further bifurcated in 3 zones name 2A,2B,2C & Future Sewerage Area 1 (FSA1). Zone 2A is the Sub-Central District on the cis-Varuna side west of the city centre and zone 2B is a slice of the trans-Varuna district along the Varuna river up to the ridge line defined by the Jaunpur road. Wastewater in these two zones will be collected at 140 MLD Chauka ghat MPS and finally treated in 140 MLD STP at Dinapur

District 2 Zone 2C: Zone 2C is the trans-Varuna District north of the Jaunpur road. Wastewater in this area generally falls to the north and to the east. FSA1 is north of the trans-Varuna District just outside the current Municipal Corporation limit. Wastewater generated in this area tends to flow north and east towards 120 MLD STP Goithaha.

District 3: District 3 is the BHU/Assi District south of the city including FSA 4. At present this area is mainly the Banares Hindu University campus which is fully sewered. Wastewater discharged in this area follows natural drains flowing into river Assi nala and Nakkhi nala. FSA4 is outside the current Municipal Corporation limit and surrounds the area occupied by BHU campus. Wastewater in this area drains to Assi river and Nakkhi nala which discharge to Ganga river upstream of the water supply intake and Ghats.currently 2 STP namely 50 MLD Ramana STP and 8 MLD Bhagwanpur STP are in service in district 3.

District 4: District 4 include FSA-2 and FSA-3 area which is outside the current Municipal Corporation limit. FSA2 is west of the current Municipal Corporation limit, and bounded by North-eastern railway. FSA3 is west of FSA2 and bounded by the Northern railway line. Currently there is no sewage treatment facility available in district 4.

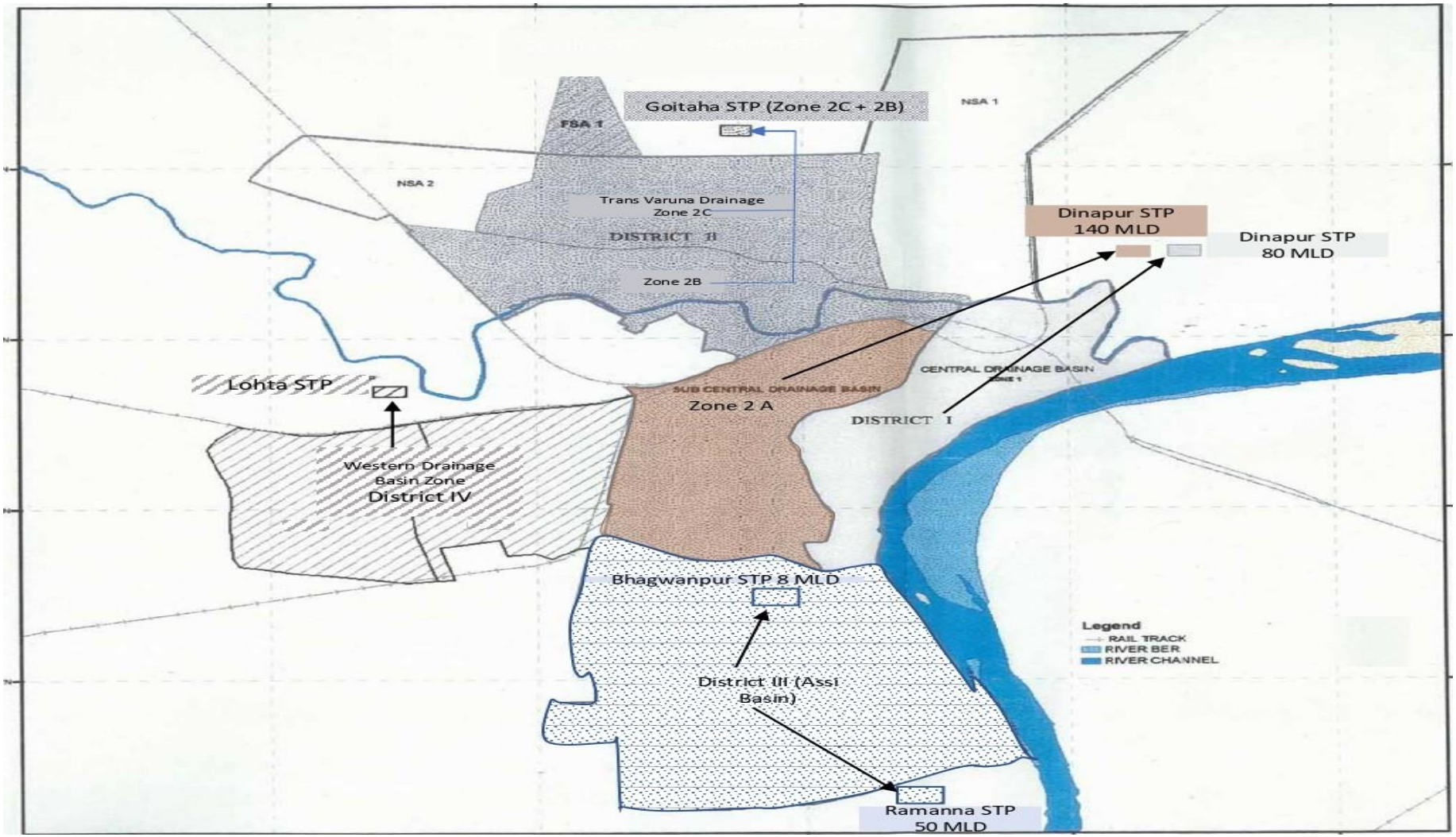


Figure 4.3 Schematic representation of sewerage district of Varanasi city

Non-Sewerage Areas (NSA)

Non-serviced areas are identified as follows:

NSA1: NSA1 is within current Municipal Corporation limits to the east of the Trans-Varuna district. It includes the local community of Sarnath. Wastewater generated in this area drains naturally into Narokar nala which is now diverted to 120 MLD Goithaha via Intermediate Pumping Station.

NSA2: NSA2 is within current Municipal Corporation limits to the extreme north west of the trans-Varuna District. Sewage generation will be diverted to 120 MLD GoithahaVaranasi

B. Sewerage master plan- 2005 (JAPAN INTERNATIONAL COOPERATION AGENCY-JICA)

JICA formulated sewerage masterplan in 2005. The plan for 2015 is explained in (Figure 1)

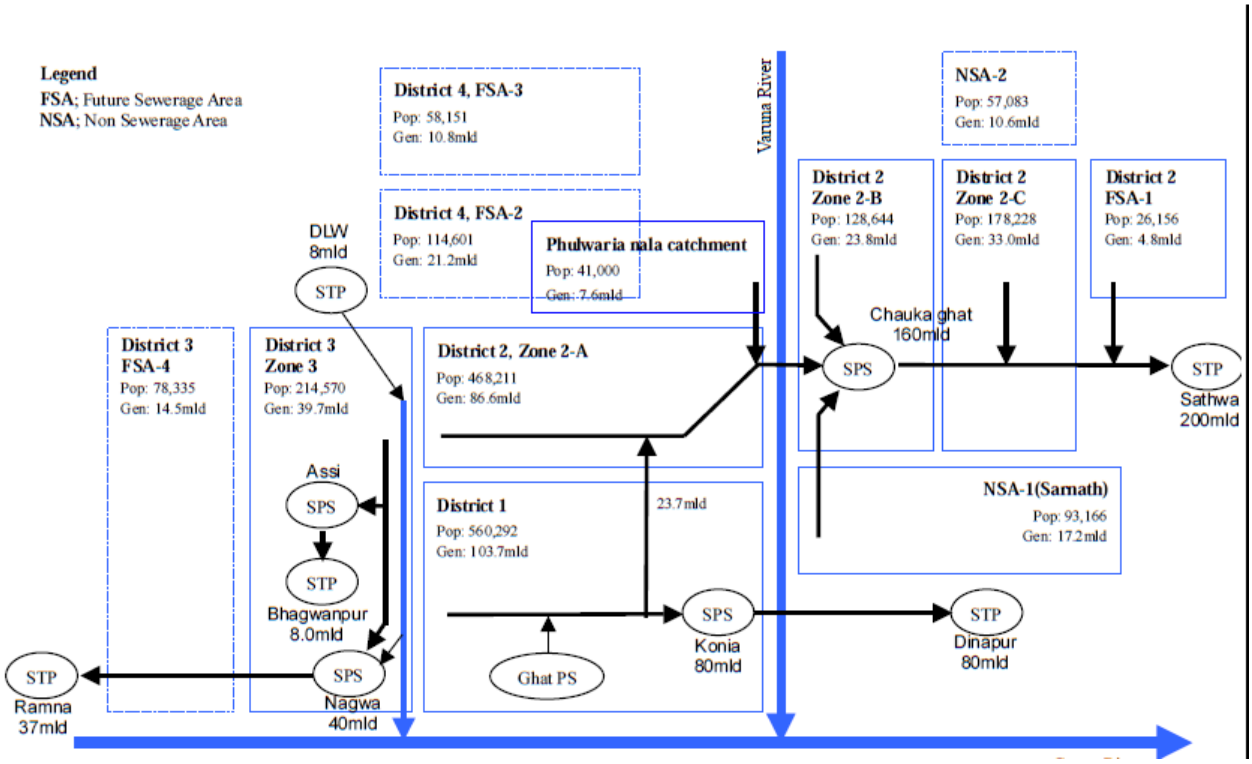


Figure 4.4: JICA Sewerage Plan for 2015

As per JICA masterplan-2005 (figure 1) the projected population in Assi catchment area for the year 2015 is 78335 + 214570 = 292,905. The projected sewage generation was 14.5 + 39.7 = 54.2 MLD. To

cater 54.2 MLD, 8.0 MLD is to be treated by 8.0 MLD existing Bhagwanpur STP and new proposed 37 MLD at Ramna.

The plan for 2030 is explained in Figure 2

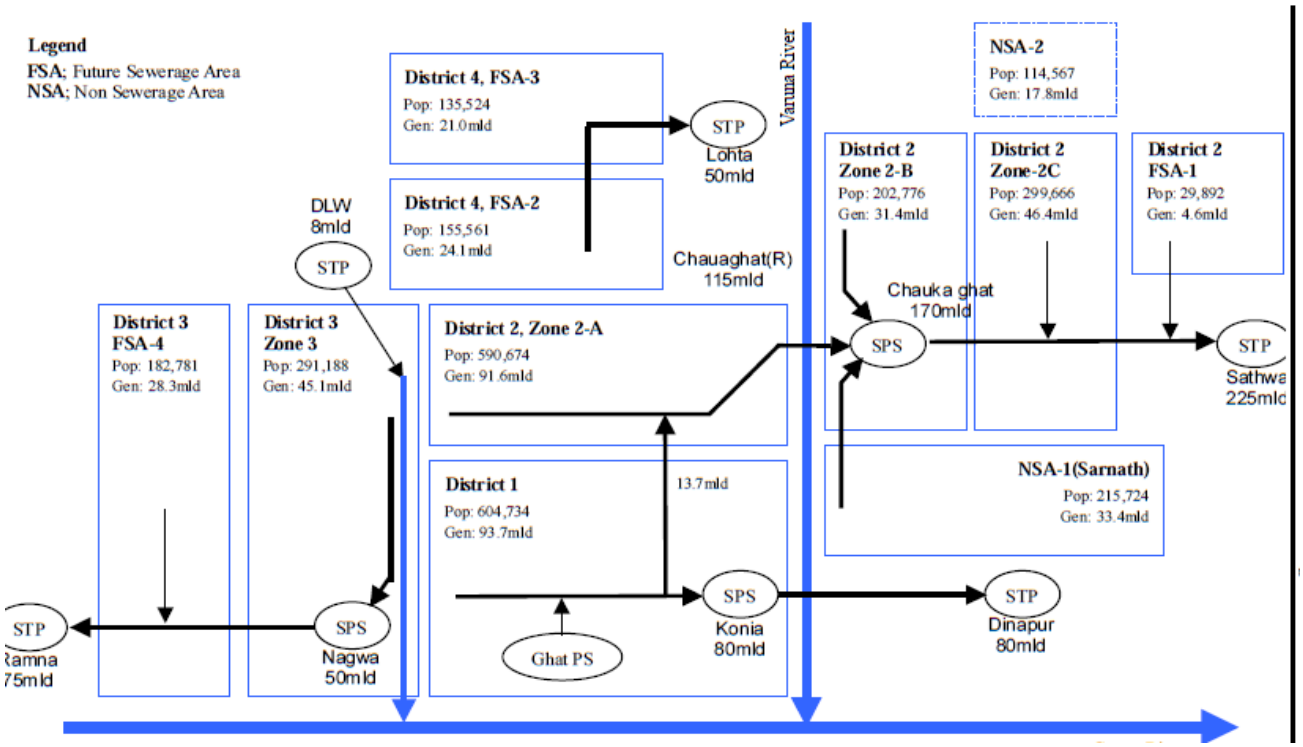


Figure 4.5: JICA Sewerage Plan for 2030

As per JICA masterplan-2005 (above) the projected population for the year 2030 is 182781 + 291188 = 476969. The projected sewage generation was 28.3 + 39.7 = 73.4 MLD. To cater 73.4 MLD, new 37 (2015) + 38 (2030) = 75 MLD was proposed.

However, in 2014 situation, JICA relooked into the sewerage masterplan and revised the capacity of 75 MLD to 59.8 MLD (50 MLD new Ramana STP + Existing 9.8 MLD Bhagwanpur).

4.2.1 Action plan for Varuna catchment

4.2.1.1 Trans Varuna Catchment

It consists of sewage District 2 B and 2 C.A new STP of 120 MLD is constructed at Goitha and working efficiently. Around 40 MLD flow is treated. The STP capacity is sufficient for next 15 years. No new STP or upgradation of existing STP is proposed.

Figure 4.6: 120 MLD STP at Goitaha for catering flow of trans Varuna Region

4.2.1.2 Cis Varuna Catchment

It consists of District 2 A. The present sewage flow from district 2 A is 80 MLD, which is being pumped from Chauka ghat pumping station and treated at Dinapur new 140 MLD STP.

In addition, new 140 MLD STP shall also treat 40 MLD flow diverted from Shahi Nala.

Figure 4.7: Chaukaghat Pumping Station

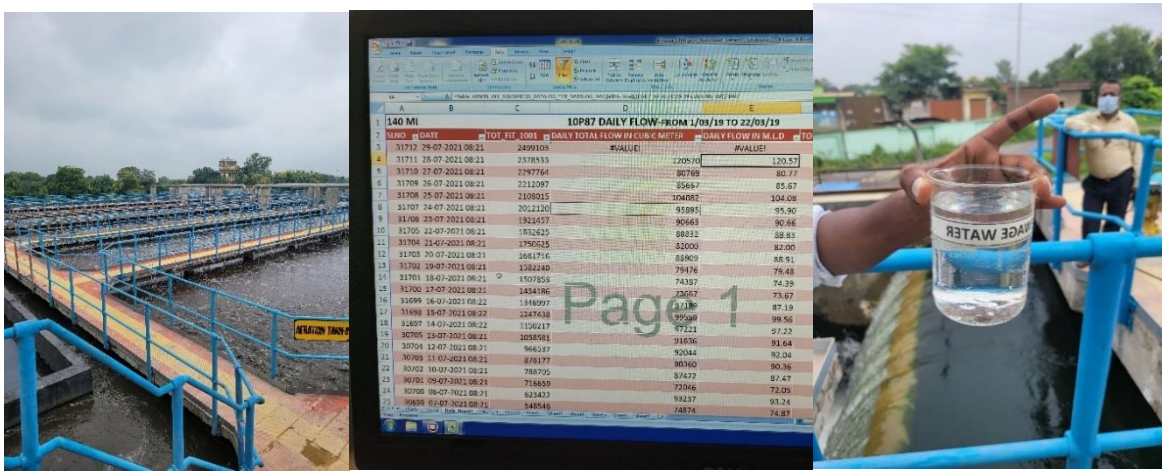


Figure 4.8: 140 MLD New Dinapur STP

4.2.1.3 Recommendations

- 140 MLD Dinapur need to be upgraded to meet discharge standard.
- A new STP is needed to cater the future population for District 2 A.
- Action plan to treat wastewater from Durga drain discharging to Varuna River should be prepared.
- Interceptor drain plan is under execution by UP Irrigation Department. All designs should be checked by expert authorities.

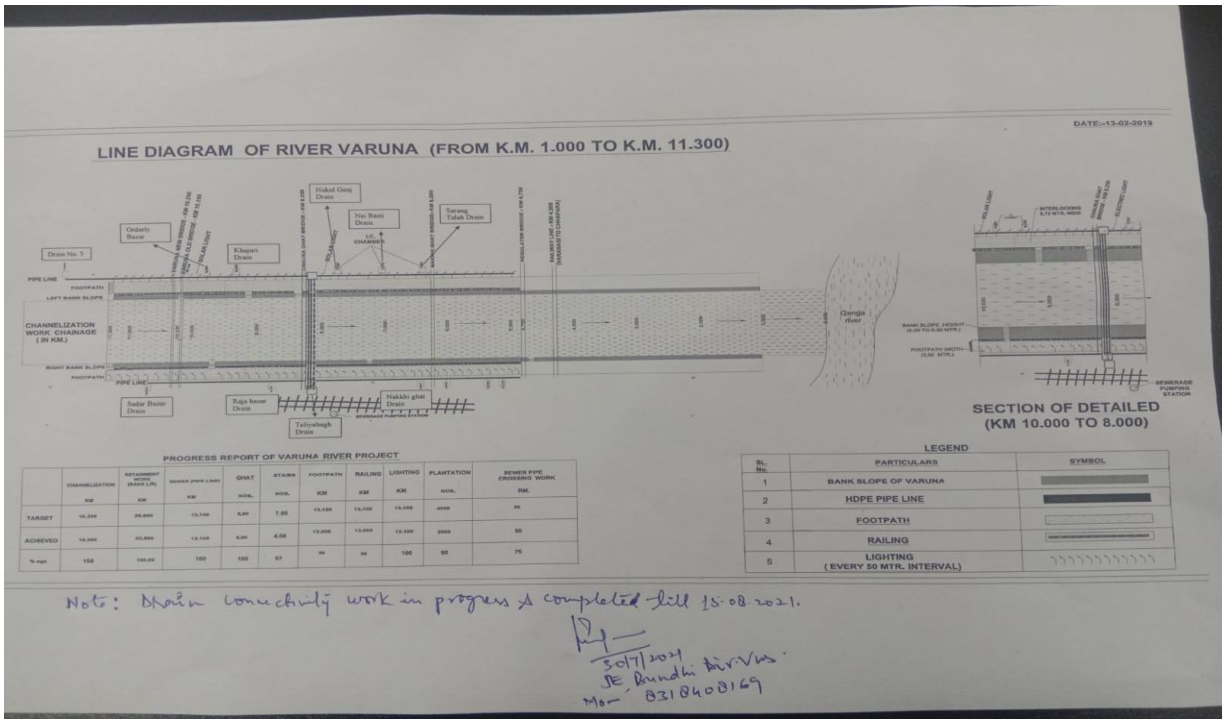


Figure 4.9: Interceptor drain plan of Varuna River

4.2.2 Existing condition in Assi catchment

At present, as per CPCB measurement (12-15th July 2021), the flow in Assi River is around 92 MLD. In addition, STP at Bhagwanpur also treat 8.0 MLD flow and discharges into River Ganga via Nakha drain. Hence total discharge in Assi catchment is 92 + 8 = 100 MLD. However, water supply in municipal area of Assi catchment isonly 26 MLD.

The pumping capacity at Nagwa Pumping Station to cater 50 MLD Ramana STP is only 50 MLD, 8 MLD is treated at Bhagwanpur STP and rest 92-50 = 42 MLD discharges directly into the River Ganga.

Figures 4.10 A & B: Assi River joining River Ganga and 50 MLD Nagwa Pumping Station

Figures 4.11 A & B: 50 MLD Ramana STP and Treated sewage

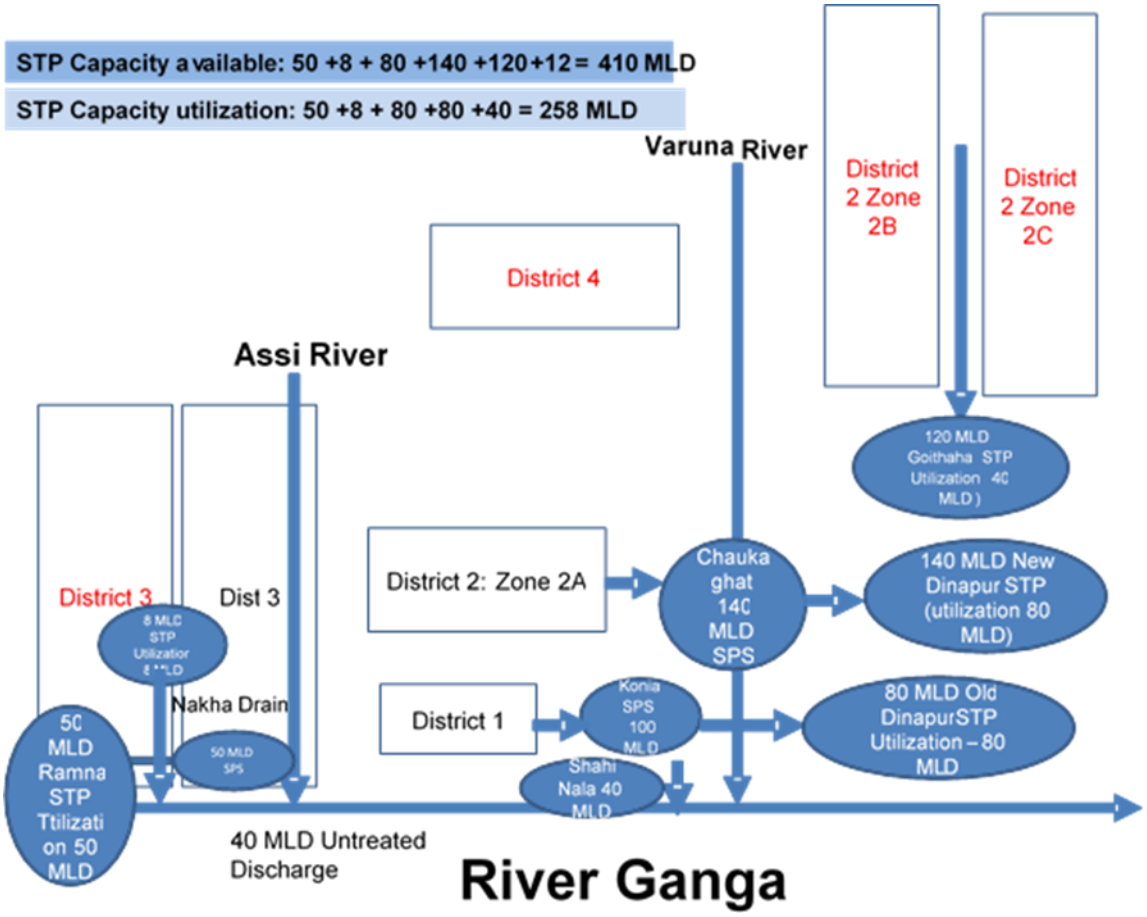


Figure 4.12 Present sewerage Situation of Varanasi City

This rapid increase in flow to Assi River is due to:

1. Unprecedented residential/commercial growth is due to large no. of developmental projects during last 4-5 years owing to VIP constituency, which seems convincing.
2. The growth within the city is limited due to constraint of land availability. Assi-BHU area and Trans Varuna area is vast open for development. Hence, increment significantly in migratory/floating population.
3. Untreated wastewater from Sewerage District 2 & 4.
4. Much higher water consumption than prescribed 135 lpcd because of unregulated water usage i.e., personnel source of water- submersible pumpsetc, which has no control of water usage.

4.2.2.1 Recommendations

A. Short Term plan

1. Presently actual discharge is mixed with rainfall. Actual dry weather flow can only be ascertained after rainy season. Detailed assessment of excess discharge is required to be done and hence future forecasting is to be done accordingly.

2. There should be 24-h proper flow measurement of Assi River by both Area velocity and V notch method after the monsoon season.
3. Controlling wastewater from other sewerage districts.
4. There should be check and control on non-revenue water (NRW). NRW is defined as loss of water through leakages and illegal usage.
5. Based on the flow measurement, water supply and population projection, a new STP need to be proposed either at Ravinder Puri Culvert (on the bank of Assi River around 1km upstream of confluence) or at Ramana existing 50 MLD STP site wherever found feasible. The DPR for additional STP is to be prepared after flow assessment and population projection.

Figure 4.13: Ravinder Puri Culvert as Possible Location for New STP at Assi

B. Long Term Plan

1. Wastewater generation is very high, hence proper 24 x 7 water supply with metering is needed to control wastewater generation and non-revenue water. A JICA project is underway to control non-revenue water
2. Laying of complete sewerage system for the entire city.
3. 9.8 MLD Bhagwanpur STP need to be decommissioned and new STP for higher capacity for future projections with new standards need to be constructed.
4. Banaras Locomotive Works STP should be upgraded to meet discharge standard.

4.2.3 Action plan for Ganga catchment

The sewage from District 1 (Old Varanasi) is treated in old 80 Dinapur STP. It is pumped from Konia

Pumping station.

4.2.3.1 Recommendations

Old Dinapur STP (80 MLD) need to be decommissioned and new STP for higher capacity for future projections (as well as Shahi Nala Flow) with new standards need to be constructed.

Figure 4.14: 80 MLD Old Dinapur STP

4.2.3.2 Action plan for trans- Ganga

One new 10 MLD STP is constructed and treating around 8.0 MLD flow.

Figure 4.15: 10 MLD Ramnagar STP

Recommendations

- It is recommended that due to recent infrastructural development, there shall be rapid increase in population in near future.
- It is assumed that 10 MLD full flow shall be reached within next 1-2 years. Hence, authorities should start planning for the next phase so that no untreated wastewater discharge from the trans Ganga in near future.

Table 4.12: Action Plan for sewage management in catchment of river Varuna, Assi and Ganga in Varanasi

Sl No	Sewerage District	Estimated Sewage Generation 2030 (MLD)	Pumping Station	River catchment	Existing Sewage Treatment Facility	Key issues	Proposed Action Plan	Implementing Agencies	Timeline for Action
1	District 1	93.7	Konia MPS, Saraiya P.S. 3.7 MLD	Cis Varuna	80 MLD STP Dinapur	• District 1 covers the old part of the city Varanasi including most of the markets and tourist destinations • The district has very less scope of further escalation in sewage generation in near future • Approx.80 MLD sewage generated in this district currently reaches 80 MLD Dinapur STP for treatment through Konia and Saraiya Pumping station via Old Trunk Sewer • The rest of the sewage from old trunk sewer is discharged into river Ganga through closed conduit at Shahi Nala Outfall, Rajghat • Dinpaur 80 MLD STP has completed the design life and it was designed as per old discharge standards resulting in non-compliance of STP to norms prescribed by NGT	New STP of higher capacity for future projections with new standard to be constructed after decommissioning of 80 MLD STP at Dinapur.	Uttar Pradesh Jal Nigam & National Mission for Clean Ganga	Preparation of DPR – 3 Month Approval of DPR – 3 Months Award of Work - 6 Months Completion of Work - 2 years **Total Time required – 36 months**
							Management of rest of the sewage from old trunk sewer, presently discharging at Shahi Nala outfall through pumping to 140 MLD STP Dinapur.	Uttar Pradesh Jal Nigam	**Work to be completed – 3 months**

2	District 2A	225.3(including NSA 1&2 & FSA-1	Chauka Ghat MPS (140 MLD), Phulwaria MPS (7.6 MLD)	Cis Varuna	140 MLD STP Dinapur	• Chaukaghat pumping station is currently pumping only 70-80 MLD to Dinapur 140 MLD STP. • The interception and diversion of Shahi Nala outfall at Rajghat to Chaukaghat pumping station through a new rescue trunk sewer is proposed and work is underway • The Cis-interceptor line at Varuna bank will also intercept the untapped drains on the cis Varuna bank to Chauka Ghat pumping station for pumping to Dinapur 140 MLD STP • ASP technology based 140 MLD Dinapur STP without tertiary filtration • No Biological nutrient removal (BNR) system • Under capacity utilization • I&D of drains (mainly Shahi Nala) is not completed • Damaged & non-functional I&D structure	The 140 MLD STP requires upgradation to meet the norms prescribed by Hon'ble NGT including nutrient removal	Uttar Pradesh Jal Nigam & National Mission for Clean Ganga	Preparation of DPR for upgradation – 3 months Approval of Work – 3 months Award of Work for upgradation – 3 months Completion of upgradation – 6 months **Total time required - 12-14 months**
							• Design of interceptor plan needs to be checked by expert agency and tapping shall be executed completely • I&D work of drains falling into Varuna in Cis-Varuna area shall (mainly Shahi Nala) to be completed and tapped to STPs for treatment	Irrigation Department, Uttar Pradesh Jal Nigam & subject expert	Design finalization – 1 month I&D work completion with final tapping and pumping provisions – 2 months **Total time required- 3 months**

3	District 2B		Narokhar IPS (7.6 MLD)	Trans Varuna	120 MLD STP Goitaha	• Trans Varuna area contains zone 2B & 2C sewage districts which has its sewage reaching partially for treatment at Goithaha STP through 7.6 MLD Narokhar pumping station and rest quantity by gravity. • An interceptor line is under commissioning in trans Varuna river bank for interception of 7 drains in the area discharging into Varuna currently and other small minor outfalls from lanes • The interceptor line has not been connected with pumping station currently and the interceptor system is open to flow • This interceptor line will pump the sewage to 140 MLD Dinapur STP for treatment through Chauka Ghat MPS as an interim measure • The Goithaha STP is currently functioning at around 30-40 MLD treatment (Under capacity utilization)	• Design of interceptor plan needs to be checked by expert • Interception and diversion have to be completed at the earliest by the executing agencies	Irrigation Department, Uttar Pradesh Jal Nigam & subject expert	Design finalization – 1 month I&D work completion with final tapping and pumping provisions – 2 months **Total time required- 3 months**

4	District 2C					• Currently the catchment area of Goithaha STP has less population density so the capacity utilization is less and it is targeted to achieve future utilization • I&D of the Trans Varuna area is not completed. • Damaged & non-functional I&D structure meant for intercepting the Trans Varuna bank drains.	A new comprehensive sewage management plan for trans Varuna needs to be developed which can cater all the drains of trans Varuna area in Varanasi.	Uttar Pradesh Jal Nigam, Varanasi Municipal Corporation, Irrigation Department and Urban Development Department	Preparation of DPR – 6 months Approval of Work – 6 months Award of work – 6 months Execution of work – 2 years **Total time required- 36-42 months**
5	District 3	73.5	Nagwa MPS (50 MLD)	Assi River	50 MLD STP Ramana, 8 MLD STP Bhagwanpur	• Estimated much higher water consumption/discharge than prescribed • Unregulated water uses and flow of freshwater from Kanchanpur talab and other water bodies in the low-lying areas joining river Assi shall	• Detailed assessment of excess discharge in dry weather • Control on NRW	Varanasi Municipal Corporation, Urban Development Department and Uttar Pradesh Jal Nigam	

						be identified and fresh water channels shall be separated from the sewerage line/drain • Estimated approximately 50% Non -revenue water (NRW) is consumed of total freshwater usags • Excess wastewater around 40-45 MLD goes directly to Ganga River from the bypass point of Nagwa 50 MLD pumping station • Bhagwanpur STP treats the sewage from Banaras Hindu University campus and treated sewage discharged through the Nakha drain which also carries untreated sewage from the Bhagwanpur local area and nearby areas of disctict 3 • The Bhagwanpur STP is designed to treat 9.8 MLD sewage (8 + 1.8) but currently only 8 MLD plant is operated and 1.8 MLD unit is non-operational • The Bhagwanpur STP treats around 10 MLD sewage working overcapacity • The Bhagwanpur STP has completed its designed life	• A new STP of adequate capacity to treat the excess approx. 50 MLD flow from the Assi river outfall.	Uttar Pradesh Jal Nigam & National Mission for Clean Ganga	Preparation of DPR – 3 Month Approval of DPR – 3 Months Award of Work - 6 Months Execution of work – 2 years
							• New STP at Bhagwanpur of requisite capacity to be constructed as per new norms & flow data to cater the needs of BHU • and nearby municipal areas.	Uttar Pradesh Jal Nigam & National Mission for Clean Ganga	Preparation of DPR – 3Months Approval of DPR – 3 Months Award of Work - 6 Months Completion of Work - 2 years **Total Time required – 32-34 months**
							• Restoration of Origin & stretches of river Assi (with land availability) through constructed wetlands • Separation of freshwater channels/storm water drains and sewerage system	Irrigation Department, Varanasi Municipal Corporation, Urban Development Department and Uttar Pradesh Jal Nigam	Within 6 months

						• Large areas in adjoining district 4 and district 4 has recently been added in Municipal area and has no sewage management system existing which contributes to excess flow from district 2 & 4 reaching river Assi.			
6	District 4	45.1	None	Cis Varuna	Not available	• Most part of the Sewerage district 4 has recently been included in the Varanasi Municpal Area and estimation and planning for the newly added areas is underway • Currently no dedicated treatment facility available • No sewerage networks • Untreated sewage directly discharges in R. Varuna. • The Durga (Lohta) drain is the major drain discharging to River Varuna from the district • Actual discharge status is unknown	In-situ treatment at Durga Drain through Constructed Wetland as interim measure	CEMDE Delhi University, Irrigation Department, Varanasi Municipal Corporation	Preparation of feasibility reports & DPR – 02 Months Approval of Work – 3 Months Award of work and implementation – 3 Months **Total Time required – 8-12 months**
							New STP of requisite capacity to be constructed as per new norms & flow data	Uttar Pradesh Jal Nigam & National Mission for Clean Ganga	Preparation of DPR – 01 Month Approval of DPR – 3 Months Award of Work - 6 Months Completion of Work - 2 years **Total Time required – 32-34 months**

						• Lohta STP (50 MLD) is proposed by 2030 (JICA report)	Detailed assessment of excess discharge in dry weather	Irrigation Department, Uttar Pradesh Jal Nigam, Urban Development department	Within 2 months
7	Banaras Locomotive Work (BLW)	50 Staff colonies		Cis Varuna	12 MLD	• The BLW campus has a STP of 12 MLD installed inside campus to treat the sewage generated in the campus • The BLW campus lies in the Assi river catchment • At least one drain originates from the campus and two drains passes near the BLW campus and ultimately discharges into river Assi • DLW-1 originates from the campus and carries treated sewage and storm water from the BLW campus • DLW-2 originates from the Manduwadih area and flows near the BLW campus • DLW-1 and DLW-2 ultimately meets river Assi near Sunderpur Chauraha	• BLW STP has outlived its designed life • BLW STP shall be upgraded/new STP to be installed to meet norms prescribed by NGT including for coliform count	BLW Engineering Department, UP Jal Nigam, National Mission for Clean Ganga	Preparation of DPR – 01 Month Approval of DPR – 3 Months Award of Work - 6 Months Completion of Work - 2 years **Total Time required – 32-34 months**
							• Reason for weak organic load characteristics of sewage at inlet of BLW STP shall be explored • Water audit of water usage and discharge from BLW campus may be done	BLW Engineering Department, UP Jal Nigam, Uttar Pradesh Pollution Control Board	Within 1-2 Month

						• DLW-3 originates from the Kanchanpur taal area and carries pond water and waste water from nearby low-lying areas • DLW 3 meets river Assi near the DLW campus trans of DLW-Chunar Road. • Around 2-3 MLD wastewater from this drain is treated at BLW STP for sometime • The 12 MLD STP at DLW operates at around 4 MLD only and the inlet raw sewage shows weak sewage characteristics with low organic load • STP has no disinfection system to control Coliform count in treated sewage	Sources of sewage and freshwater in the drains near the BLW campus ultimately discharging into Assi river shall be identified and separated for reducing the flow in Assi river at interception point	BLW Engineering Department, Irirgation Department, Urban Development Department, UP Jal Nigam, Uttar Pradesh Pollution Control Board	• Identification of sources of waste and freshwater – 1 Months • Preparation of action plan for separation of freshwater channels/storm water and waste water carrying drains– 6 Months

Table 4.13: Road map for execution of proposed action Plan for restoration of Varuna & Assi river

Sr. No.	Sewerage District /region	Existing Sewage Treatment Facility	Proposed Action/remedial measure	Project Activity		
				Work Plan	Time line	Implementation Agency
1.	District 1	80 MLD STP Dinapur	Decommissioning of existing STP and construction of new STP of higher capacity for future projections with new standard	Condition assessment & feasibility report (CAFR)	1 Month	UP Jal Nigam/ Other government organization
				Approval of CAFR	1 month	NMCG
				Submission of DPR	2 Months	UP Jal Nigam/ Other government organization
				Administrative approval & estimated sanctioned	2 months	NMCG
				Tendering & award of project	2 months	NMCG
				Basic Engineering Package (BEP) submission	3 months	UP Jal Nigam/ Other government organization /EPC contractor
				Design & Engineering approval	2 months	IIT/MNIT/Deemed university
				Construction & Commissioning	2 years	UP Jal Nigam/ EPC contractor/others
2.	District 2A	140 MLD STP Dinapur	Upgradation of STP as per new NGT norms.	Submission of DPR	2 Months	UP Jal Nigam/ Other government organization
				Approval & Tendering	3 months	NMCG
				Design & Engineering approval	2 months	IIT/MNIT/Deemed university

				Construction & Commissioning	1-2 years	UP Jal Nigam/ EPC contractor/ Other government organization
			Design of interceptor plan needs to be checked by expert	Submission of existing drawing & review proposal	1 month	UP Irrigation department
				Approval & Tendering	3 months	NMCG
				Design assessment of interceptor plan	2 months	IIT/MNIT/Deemed university
				Approval, Tendering and project award	3-4 month	NMCG
				Construction & commissioning	3-4 month	UP Irrigation department/EPC contractor
			I&D work of Shahi Nala	Tapping and diversion of Sahi nala to 140 MLD STP	1-2 months	Project is under execution by UP Jal Nigam
			I&D work of drains in cis Varuna region	I&D work of drains up to 140 MLD MPS Chaukaghat	1-2 months	Project is under execution by UP irrigation department
3.	District 2B	120 MLD STP Goitaha	I&D work of drains in trans Varuna region	I&D work of drains up to 140 MLD MPS Chaukaghat as an interim measure	1-2 months	Project is under execution by UP irrigation department
4.	District 2C		Development of new comprehensive sewage	Condition assessment & feasibility report (CAFR)	1 Month	UP Jal Nigam/ Other government organization
				Approval of CAFR	1 month	NMCG
				Submission of DPR	2 Months	UP Jal Nigam/ Other government organization

			management plan for trans Varuna	Administrative approval & estimated sanctioned	2 months	NMCG
				Tendering & award of project	2 months	NMCG
				BEP submission	3 months	UP Jal Nigam/ Other government organization /EPC contractor
				Design & Engineering approval	2 months	IIT/MNIT/Deemed university
				Construction & Commissioning	1-2 years	UP Jal Nigam/ EPC contractor/others
5.	District 3	50 MLD STP Ramana, 8 MLD STP Bhagwanpur	Assessment of excess discharge of Assi River	Detailed assessment of excess discharge of Assi River in dry weather & Control on NRW	3-4 months	UP Jal Nigam
			Design, construction and commissioning of new tapping arrangement MPS, rising main & STP of requisite capacity as per new norms & flow data.	Condition assessment & feasibility report (CAFR)	1 Month	UP Jal Nigam/ Other government organization
				Approval of CAFR	1 month	NMCG
				Submission of DPR	2 Months	UP Jal Nigam/ Other government organization
				Administrative approval & estimated sanctioned	2 months	NMCG
				Tendering & award of project	2 months	NMCG
				BEP submission	3 months	UP Jal Nigam/ Other government organization /EPC contractor
				Design & Engineering approval	2 months	IIT/MNIT/Deemed university

				Construction & Commissioning	1-2 years	UP Jal Nigam/ EPC contractor/others
			Restoration of Origin & stretches through constructed wetlands	Submission of design details & drawing of CWS	1 month	CEMDE
				Submission of DPR for desilting, civil work etc.	2 months	Irrigation and water resources department/ Other government organization
				Approval, Tendering and project award	3-4 month	NMCG
				Desilting and civil construction	3-4 months	Irrigation and water resources department/ Other government organization
				Vegetation development & commissioning	1-2 years	CEMDE
			Decommission of 8 MLD STP Bhagwanpur And Design, Construction and commission of new STP as per new norms and flow data	Condition assessment & feasibility report (CAFR)	1 Month	UP Jal Nigam/ Other government organization
				Approval of CAFR	1 month	NMCG
				Submission of DPR	2 Months	UP Jal Nigam/ Other government organization
				Administrative approval & estimated sanctioned	2 months	NMCG
				Tendering & award of project	2 months	NMCG
				BEP submission	3 months	UP Jal Nigam/ Other government organization /EPC contractor
				Design & Engineering approval	2 months	IIT/MNIT/Deemed university
				Construction & Commissioning	1-2 years	UP Jal Nigam/ EPC contractor/others

6.	District 4	Not available	In-situ development of Constructed Wetland System in Durga Drain as interim measure	Submission of design details & drawing of CWS	1 month	CEMDE
				Submission of DPR for desilting, civil work etc.	2 months	Irrigation and water resources department/ Other government organization
				Approval, Tendering and project award	3-4 month	NMCG
				Desilting and civil construction	3-4 months	Irrigation and water resources department/ Other government organization
				Vegetation development & commissioning	1-2 years	CEMDE
			Design & construction of new STP of requisite capacity as per new norms & flow data	Condition assessment & feasibility report (CAFR)	1 Month	UP Jal Nigam/ Other government organization
				Approval of CAFR	1 month	NMCG
				Submission of DPR	2 Months	UP Jal Nigam/ Other government organization
				Administrative approval & estimated sanctioned	2 months	NMCG
				Tendering & award of project	2 months	NMCG
				BEP submission	3 months	UP Jal Nigam/ Other government organization /EPC contractor
				Design & Engineering approval	2 months	IIT/MNIT/Deemed university
				Construction & Commissioning	1-2 years	UP Jal Nigam/ EPC contractor/others

7.	Varuna origin	Not available	Restoration of catchment origin of R. Varuna	Submission of design details & drawing	1 month	CEMDE
				Submission of DPR for desilting, channeling etc.	2 months	Irrigation and water resources department/ Other government organization
				Approval, Tendering and project award	3-4 month	NMCG
				Desilting, channeling and other construction work	10-12 months	Irrigation and water resources department/ Other government organization
				Biotic community development & restoration	1-2 years	CEMDE
8.	Along R. Varuna	Not available	Desilting of R Varuna & In-situ development of Constructed Wetland System in Dhoraira, Naya Bazar, Bubuspur and Chauri drains	Submission of design details & drawing of CWS	1 month	CEMDE
				Submission of DPR for desilting, civil work etc.	2 months	Irrigation and water resources department
				Approval, Tendering and project award	3-4 month	NMCG
				Desilting and civil construction	3-4 months	Irrigation and water resources department
				Vegetation development & commissioning	1-2 years	CEMDE
9.	Varuna confluence	Not available	Development of flood plain Biodiversity Park	Demarcation of flood plain of R. Vruna at confluence	3-4 months	Irrigation and water resources department
				Submission of DPR for planning, design & development of Biodiversity park	3-4 months	CEMDE
				Approval, Tendering and project award	3-4 month	NMCG
				Development of Biodiversity park	4-5 years	CEMDE

4.2.4 Performance assessment of STPs and requirement for upgradation/augmentation

The estimated sewage generation of Varanasi (including Ramnagar) is approximately 330 MLD (2017-18) (as per data received from UPPCB). Total 7 STPs (5 commissioned and 2 under trial) with total capacity of 421.8 MLD (361 MLD for commissioned STPs and 60 MLD for under trial STPs) have been installed for the treatment of the generated sewage. Utilized capacity of the commissioned and operational STPs is approximately 210 MLD.

Characteristics of raw sewage received at inlet of STPs located in Varanasi have BOD ranging from 10.5 mg/l to 52.4 mg/l, COD ranging from 45.7 mg/l to 193 mg/l indicating weak sewage as compared to typical municipal wastewater (BOD: 200-250 mg/l, COD: 350-500 mg/l); is received at inlet of the STPs. The weak sewage strength could be due to dilution of the sewage from septic tanks and addition of grey water from households etc.

As per inspections conducted in last 2 years, the treated sewage from STPs is found non- complying with respect to the discharge norms. As per inspection dated 23.06.2021, reduction in BOD was found in range 38% to and 85%. Similarly, reduction in the COD was found in range 39% to 81%. STPs meet the prescribed norm for Total Nitrogen (10 mg/l) only when raw sewage with low Total Nitrogen (around 10 mg/l) is received. This necessitates upgradation and augmentation of these STPs. The measure suggested for the upgradation and augmentation of STPs are mentioned in the table below.

Discharge norm for Fecal coliform (230MPN/100ml) is not achieved in all STPs. Hence to achieve the norms there is requirement of upgradation/optimization of the existing disinfection system or installation of new disinfection system (if no disinfection system is present). The inflow at STP at Bhagwanpur is ranging from 8-14 MLD which is above the designed capacity (9.8 MLD). This STP needs capacity enhancement after detailed study for capacity requirement. STPs at Dinapur and Goithaha are underutilized. The reason for less inflow into STPs should be studied and areas without sewerage network should be provided with sewerage network and connected to respective STP.

Online continuous Effluent System (OCEMS) is installed at 12 MLD STP, BLW only. OCEMS should be installed at remaining 6 (4 operational and 2 under trial) STPs and connected to CPCB/ SPCB server at the earliest for on-line monitoring of the STPs.

Table 4.14: Performance assessment of STPs of Varanasi and requirement for their upgradation and augmentation.

S. No.	STPs	Technology & process used	Designed Capacity (MLD)	Maximum Utilised Capacity (inspection date)	Inlet characteristics (mg/l)	Discharge to river	Operational / Non-operational / Non-Functional	Compliance with respect to discharge standards (2021)	Suggested upgradation and Augmentation
1	Dinapur (Old) STP	TF followed by ASP	80	70 (23.06.2021)	BOD-46.4, COD-160, TSS- 169 TN-7.02 (23.06.2021)	Ganga through open channel	Operational	Mostly found non-complying for FC	1. Installation of Anoxic treatment of adequate capacity before existing ASP. Return activated sludge flow (about 75% of inflow) may be ensured in the existing ASP 2. Optimization of existing disinfection system 3. Installation of OCEMS 4. Provision for sewerage network in uncovered areas
2	Dinapur (New) STP	ASP	140	125 (23.02.2021)	BOD-52.4 COD-161 TSS- 138 TN-16.5 (23.06.2021)	Varuna river through pipeline	Operational	Mostly found non-complying for TN and FC	1. Installation of Anoxic treatment of adequate capacity before existing ASP. Return activated sludge flow (about 75% of inflow) may be ensured in the existing ASP 2. Optimization of existing disinfection system. 3. Installation of OCEMS 4. Provision for sewerage network in uncovered areas
3	Bhagwanpur BHU STP	ASP	9.8	14 (23.06.2021)	BOD-24.9 COD-92.2 TSS- 1242 TN- 8.83 (23.06.2021)	River Ganga through Nakkhi Nala	Operational	Mostly found non-complying for TN and FC	1. Installation of Anoxic treatment of adequate capacity before existing ASP. Return activated sludge flow (about 75% of inflow) may be ensured in the existing ASP. 2. Optimization of existing disinfection system. 3. Installation of OCEMS 4. Capacity Enhancement.
4	Goithaha STP	SBR	120	55 (23.06.2021)	BOD-56.3, COD-193 TSS- 491 TN- 6.49	River Ganga via Sharda Canal	Operational	Mostly found non-complying for FC	1. Installation of Anoxic treatment of adequate capacity before existing ASP. Return activated sludge flow (about 75% of inflow) may be ensured in the existing ASP. 2. Optimization of existing disinfection system.

					(23.06.2021)				3. Installation of OCEMS 4. Provision for sewerage network in uncovered areas
5	BLW (formerly DLW) STP	ASP	12	5 (23.02.2021)	BOD-10.5, COD-45.7, TSS- 19.1 TN- 6.13 (23.06.2021)	Reused (may reach Ganga through Assi river)	Operational	Mostly found Non-Complying for FC	1. Disinfection system of adequate capacity

Note: Compliance status as per Hon'ble NGT order dated 30.04.2019. (pH: 5.5- 9.0; BOD: 10 mg/l; TSS: 20 mg/L; COD: 50 mg/L; Total Nitrogen (TN): 10 mg/L; Total Phosphorus (for discharge into ponds and lakes): 01 mg/L; Faecal Coliform: Desirable limit 100 MPN/100 ml, Permissible limit 230 MPN/100ml)

4.2.5 Sludge Management Plan

Treatment and disposal of sewage sludge are major factors in the design and operation of all wastewater treatment plants. Two basic goals of treating sludge before final disposal are to reduce its volume and to stabilize the organic materials. Stabilized sludge does not have an offensive odour and can be handled without causing a nuisance or health hazard. Sludge management is an issue of great concern due to its potential threat to human health and the environment with necessitated explicit regulations to organize their production and use. Currently adopted sludge management plan practices as provided by UP Jal Nigam for management of generated sludge is tabled below;

Table 4.15: Sludge management plan for generated STPs sludge

Sr No.	Name of STP	Capacity (MLD)	Approximate Generation of Sludge (Tonnes/Yr.)	Disposal of sludge	Remarks
1	Dinapur	80	8250	Being used as ingredient of Fertilizer by local farmers/manufactures	Since, removal of Nitrogen and Phosphorous is not part of the design process, hence the sludge has nutritional value and is being used as an ingredient of fertilizer.
2	Dinapur	140	6500		
3	Bhagwanpur	9.8	275	Being used in Horticulture.	
4	Goithaha	120	4350	Being used in land fill at various locations.	Process design of STPs contains provision for removal of Nitrogen and Phosphorous, hence generated sludge doesn't have nutrients.
5	Ramana	50	5200	Proposed to be used in land fill at STP site itself.	
6	Ramnagar	10	740	Proposed to be used in land fill at STP site itself.	

4.3 Industrial Pollution Control

4.3.1 Industrial Pollution Management

During recent survey, 118 water polluting industries located in Varanasi and Bhadohi having potential to discharge into river Ganga and its tributary Varuna were inventoried which comprised Textile/Yarn (54 units), Sari Printing (33 units), Metal surface treatment (23 units), slaughter houses & meat processing (03 units), food & beverage (03 units) and Heavy engineering & Loco (02). Out of 118, 87 units are from textile/yarn and Sari printing sector.

4.3.2 Action Plan for prevention of pollution from Textile Cluster

Central Pollution Control Board (CPCB) has formulated the 'Charter for Water Recycling and Pollution Prevention in Textile industries" in consultation with experts from the departments of Chemical Engineering & Technology, IIT (BHU), Textile Engineering Department, IIT Delhi, Polymer and Fiber Technology, IIT Delhi, Fibre and Textile Processing, ICT, Mumbai, UP Textile Technology Institute, Kanpur and Textile industries **(Annexure-V).**

Charter is based on participatory approach and one of the important objectives of charter is to setup a bench mark for water consumption & optimize the use of water & chemicals in processing. Charter is formulated, with a view to envisage upgradation of the status of textile industries in sustainable manner in terms of process technology upgradation, adoption of best practices, improved environmental performance, substantial reduction in the fresh water consumption and waste water generation, improvement in effluent treatment including tertiary treatment and optimize water recycling. Compliance with the prescribed standards is mandatory. There will be no compromise with regard to the industry not meeting the prescribed standards.

Charter prepared for textile industries was launched in the workshop with the textile units at Kanpur on 05.04.2019. For implementation of Textile Charter to all River Ganga Main Stem GPIs, UPPCB issued direction under section 33A of Water (Prevention and control of Pollution), 1974 on 08.05.2019.

Charter was discussed with textile mills and experts at a workshop organized by Carpet Export Promotion Council at **Bhadohi on 6th August, 2018**. A workshop was also

organized by UPPCB on implementation of "Charter for water recycling and pollution prevention in Textile industry" was held on **15th Oct, 2019 at Bhadohi**.

As per data available with CPCB, during 2020, there were 31 textile sector GPIs in Bhadohi cluster and out of 31, 22 Textile units have prepared their individual action plan which were reviewed and the suggestions has been communicated to individual unit in the month of March-April, 2020 for implementation of recommendations as per charter.

However, during recent survey 54 yarn/textile and 33 sari printing units have been inventoried in Bhadohi, Jaunpur and Varanasi region in catchment of river Ganga and Varuna. Therefore, it is suggested that charter should be implemented in textile industrial cluster located in catchment of river Ganga and its tributaries in Uttar Pradesh in effective manner which will results in reduction in the fresh water consumption and waste water generation, optimize water recycling and overall improved environmental performance of industrial unit in sustainable manner. A monitoring committee may also be constituted to monitor the implementation status of charter in textile sector in a prescribed time frame.

4.4 Solid waste management

Proper Solid waste treatment system based on Indore or Goa model need to be prepared along with Waste to Energy system

Figure 4.16: Existing Solid Waste Treatment System

The un-segregated solid waste dumped in open plots or ponds/low lying areas within 500 meter of river Varuna in Varanasi contribute air and ground water pollution. The estimated quantity of legacy waste in this dumping site is approximately 30000 MT.

Management of legacy waste having adequate capacities for collecting, transporting and disposing of the municipal solid waste produced on a day-to-day basis as well as legacy waste trapped in the dumpsites is proposed to be done.

Illegal disposal of Construction and demolition waste in floodplain zone of river Varuna and Assi shall be prohibited.

4.4.1 Solid waste management plan of Varanasi City

Varanasi city has an estimated population of 15, 31,458 in 2020 based on projections for population taking 2011 population as base. Owing to its rich tourism potential, the estimated daily flow of tourists and pilgrims to the city is 25,000. The total area within Varanasi Nagar Nigam (VNN) is 82.1 km square for 90 wards and 86 more Villages have been merged with VNN area of 195 Sq km. The average waste generation of Varanasi is 0.400 kg per capita per day. The city at present generates 600 MT (Approx.) of waste per day at the rate of 0.400 Kg per capita per day and decadal population growth of 2.67 per Year (as per trend of rate of population growth in last 10 year: 2001-2011)

Table 4.16: Population Projection and waste generation for Varanasi City

Year	House Hold	Population	Waste generation MT/Day (approx) @ 400 gm per capita per day
2011	**191278**	**11,98,491**	**479.39**
2021 (for 90 Wards)	**248300**	**15,31,458**	**612.58**
2021 (For 86 Newly merged villages-20 wards)	151759	4,76,779	190.71
2035 (for 110 Wards)	512012	29,64,678	1185.87

2050 (for 110 Wards)	655375	40,93,136	1637.25

The Government of India published the Solid Waste Management Rules, 2016, the Rules are now applicable beyond Municipal areas and extend to urban agglomerations, census towns, notified industrial townships, etc.

Administrative setup for MSW Management in Varanasi

The area falling under Varanasi Municipal Corporation is currently divided into 5 zones and 14 Subzone and 90 wards for administrative purposes and 86 newly merged villages. The details are annexed as Annexure VII.

Table 4.17: Manpower Engaged in Varanasi Nagar Nigam (VNN) for MSW Management

Designation	No
Municipal Commissioner	1
Additional Municipal Commissioner	1
Municipal Health officer	1
Executive Engineer's. (Transport & Processing-SWM)	2
Zonal Officers	5
Zonal Health officers	1
Sanitary & Food Inspector	14
Account Clerk	01
Account Officer	02
Safai Supervisors	93 (VNN-38 and Varanasi Waste Solution-40)
Safai Mitra's and drivers	5784 (VNN Safai Mitra's = 4171, VWSPL Safai Mitra-850, VNN drivers = 331, VWSPL Drivers-195, Rag Pickers = 237)

- Currently there are no 100% door to door collections in 90 wards of Varanasi. Most of the households, shops, and establishments throw their waste just outside their premises, on streets, in drains, in open spaces, in water bodies, and in other inappropriate places.
- These litters swept away by street sweeping and lifted by means of handcart or rickshaw trolley by Sweepers and waste collectors of VNN, this led to unsanitary condition across the city.
- Varanasi Nagar Nigam outsourced M/s Varanasi Waste solution Pvt.Ltd. For door to door collection in 90 wards, mechanized road Sweeping approx 22.1 km. daily basis (Sant. Athulananda to BHU) and toilet cleaning work of Varanasi.

- Apart from door to door collection three Ngo's named Anthill Services Pvt. Ltd; career consulting pvt. Ltd, Jan Vikas Kalyan Samiti; Engage for IEC activities for sanitation awareness in their respective wards.
- The length of roads, streets, lanes, bye-lens in the city is approximately 1200 km in the total and approx. length of drains 2400 km area within Varanasi Nagar Nigam of 82.1 km square. Street sweeping starts between 8:00 AM and continues up to 2:00 PM.

The detailed action plan for MSW management in Varanasi city is enclosed as Annexure-VII

4.5 Encroachment

Removal of encroachment from lower floodplain zone of river Varuna and Assi. Demarcation and notification of floodplain zone by introducing pillars to further prevent encroachment in River Varuna and Assi.

4.6 Monitoring Committee

a. **Supervisory Committee** – It may supervise the implementation of proposed action plan for restoration and rejuvenation of River Varuna and Assi. The committee may consist of representative from District Magistrate, Varanasi Vikash Pradhikaran, Irrigation Department, Forest Department, Municipal Corporation, UP Jal Nigam, Urban Development Department, NMCG, UPPCB and CPCB under the chairmanship of Commissioner of Varanasi division, meeting to be held on quaterly basis.

b. **Execution Committee** – The committee may responsible for execution of proposed action plan for restoration and rejuvenation of River Varuna and Assi. The committee may consist Varanasi Vikash Pradhikaran, Irrigation Department, Forest Department, Municipal Corporation, UP Jal Nigam, Urban Development Department, SMCG and SPCB under the chairmanship of District Magistrate of concerned district, meeting to be held on monthly basis.

Annexure-I: Photographs

P 1: R. Varuna at Origin (Mailhan Lake/ Taal)

P 2: R. Varuna at Varuneshwar Mahadev

P 3:R. Varuna at Tarhati, Jaunpur bridge

P 4: R. Varuna at Sherpur Momidin bridge Bhadohi

P 5: R. Varuna at Kushghat Godma Bridge

P 6: R. Varuna at Dhaurahra Bridge

P 7: Confluence of R. varuna to R. Basuhi

P 8: R. Varuna at Rameshwar, Varanasi

P 9: R. Varuna at Koirajpur, Varanasi

P 10: R. Varuna at Pissaura (u/s of Lohta drain)

P 11: R. Varuna at Kutchehry Ghat (Before confluence of Orderly bazar drain)

P 12: R. Varuna with confluence to R. Ganga (at Adikeshwar Ghat)

P 13: Dhaurahra Drain with confluence to R. Varuna

P 14: Nai Bazar Drain, Bhadohi

P 15: Lohta/ Durga drain at confluence with R. Varuna

P 16: Phulwariya Drain at confluence with R. Varuna

P 17: Chamraudha Drain at confluence with R. Varuna

P 18: Central Jail Drain at confluence with R. Varuna

P 19: Orderly Bazar Drain

P 20: Azad nagar/ Banaras Drain

P 21: Khazuri colony Drain

P 22: Nai Basti Drain

P 23: Ponding Near Nakhi Drain

P 24: Unknown Drain d/s Narokhar drain

P 25: Narokhar drain (Tapped)

P 26: Unknown Drain u/s Narokhar drain

P 27: Present Origin of R. Morwa

P 28: R. Morwa at Munsilaatpur

P 29: R. Morwa b/c to Barbaspur Drain

P 30: R. Morwa a/c to Barbaspur Drain

P 31: R. Morwa b/c to Chauri Drain

P 32: R. Morwa a/c to Chauri Drain

P 33: R. Morwa b/c to Varuna

P 34: R. Varuna b/c to Morwa

P 35: R. Varuna a/c to Morwa

P 36: Barbuspur Drain

P 37: Chauri Drain

P 38: Upardaha Taal Area

P 39 & 40: Confluence of R. Assi / Nagwa drain with R. Ganga

P 41 & 42: Diversion point of R. Assi to Nagwa drain


P 43 & 44: Sahoday Veer Bridge (Assi-Lanka road)


P 45 & 46: Ravindrapuri Bridge


P 47 & 48: Sankat Mochan (Durgakund road)

P 49 & 50: Saket Nagar

P 51 & 52: Sundarpur Chauraha Bridge

P 53 & 54: Dhirendra Mahila PG College Road


P 55 & 56: Indira Nagar DLW drain joining R. Assi in Indira Nagar


P 57 & 58: Kanchanpur Pokhra


P 59 & 60: Wastewater logged and stagnated area after Kardmeshwar kund


P 61 & 62: Pond near Kardmeshwar Mahadev Inter College


P 63 & 64: Kardmeshwar *kund* with sealed outlet


P 65 & 66: Pond near Kardmeshwar *kund* & link with *kund*

P 67

P 68

P 69

P 70

P 71

P 72

P 73

P 74

P 75

P 76

P 67 to 76: Several small drains / conduit pipes / wastewater lines from individual houses discharging into R. Assi

P 77 & 78: DLW Drain - 1

P 79 & 80: DLW Drain -2

Annexure – II: Constructed Wetlands (CWs)

CWS also uses principle of Phytoremediation techniques. It integrates microbial bioremediation, phytoremediation and root-zone treatment in addition to providing the benefits of oxidation pond and physical filters.

It is the designed and engineered natural system to treat sewage and other wastewaters. Selective aquatic plants having rich rhizospheric microbial diversity are grown in high density and sewage/wastewater is treated based on its flow by gravity. Not only cost is minimized, various pollutants (organic, inorganic, heavy metals) are remediated at various locations.

At each stage the turbulence generated in the system enriches the oxygen that makes microbial biodegradation of pollutants very efficient. The constructed wetland system can be used as *in situ* bioremediation and also as *ex situ* bioremediation.

The oxidation pond in constructed wetland systems simulates STP. The uniqueness of construed wetland system is the use of diverse aquatic plants together with their rich rhizospheric microbial communities. The diversity of these microbial communities are not found in any other remediation techniques for treatment of sewage.

Constructed wetlands (CWs) are scientifically proven and widely adopted across the world as alternative and complementary technology to conventional technologies for sewage treatment. A well-designed constructed wetland system will work on the same principle as that of STP but with greater microbial diversity associated with diverse plant species that effectively biodegrade organics and other pollutants in sewage and without energy.

A constructed wetland is highly versatile and can be designed for drains that have different topography hydraulics and physical characteristics of the drain (width, length, height). A constructed wetland system can be used as primary/ secondary/ tertiary treatment and can be used for less than 1 MLD to 1000 MLD with continuous flow. Figure 1 depicts schematic flow diagram of Constructed Wetland System.

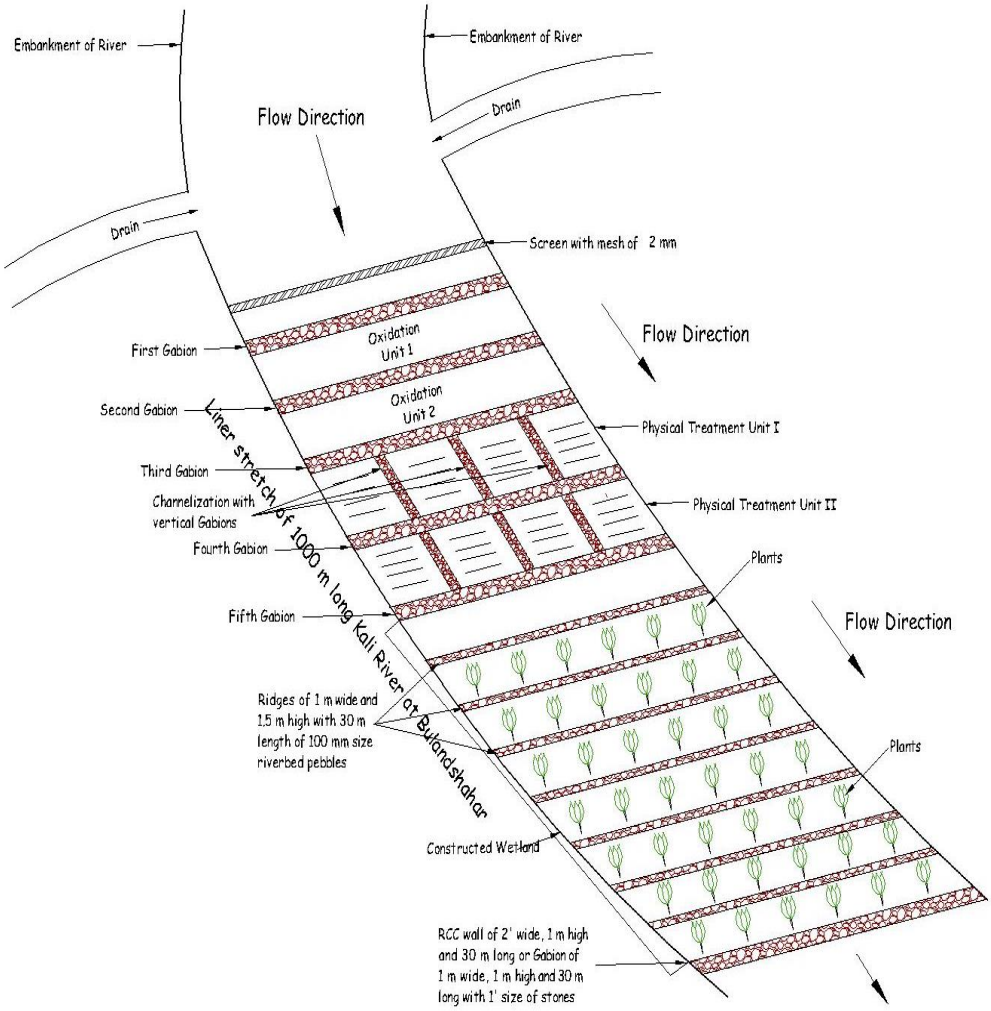


Figure: Schematic Diagram of Constructed Wetland Systems

A typical or ideal CW system should have the following components:

i. An aerobic oxidation pond with depth of water ranging from < 1m to 0.5m; water will be retained at least 8-10 hours and consequently there will be slight rise in the water level (up to 30cm) from the normal water level in the drain.
   (a) there will be a screen (iron mash having 4-10 mm aperture) before the oxidation pond to remove solid waste and there will be another screen (2-4 mm aperature before the water enters into two physical filter tanks / chambers/ zones/ channels) from oxidation pond.

ii. Three physical filter tanks/ chambers/ channels/ zones are ideal for efficient functioning; the physical filters chambers are separated by gabions of boulders of different sizes and embedded in iron mesh.
   (a) the first chamber/ channel/ zone is separated from the second chamber by a gabion made of boulders of 2' within the chamber channel and there will be 3 ridges made of stones/ pebbles of 200 to 250 mm.

(b) The second chamber is separated from third chamber by a gabion made of boulders of 1’ size with 3-4 ridges of pebbles of 180 mm.

(c) The third chamber is separated from the constructed wetland by gabion made of boulders of 1’ size with 3 to 4 ridges of river bed pebbles of 150 -120 mm.

iii. Constructed wetland having 5-10 furrows of 1 to 4 m wide separated by ridges of 1 m high, 0.5m wide and composed of river bed pebbles of 80-50 mm size.

iv. Cascade outlet is made of boulders, stones and pebbles with gentle slope from the overflow of the constructed wetlands. The water comes out from the cascade can be recycled /stored in stagnant water bodies / wetland or channelized into the downstream of the drain or river.

Table: Generic design details of Constructed Wetland System

	OXIDATION POND 1	OXIDATION POND 2	DRAINAGE	TREATMENT TANK 1	TREATMENT TANK 2	TREATMENT TANK 3	TREATMENT WETLAND 1	TREATMENT WETLAND 2	CASCADE	FIRST WETLAND
Length (Meters)	49	36	36.5	3.76	8	4	24	14	4.5	45
Breadth (Meters)	10	29	2	2	2	2	21	10	3	35
Water Depth (Meters)	0.50	0.75	0.25	0.50	0.50	water is flowing over the gravel	0.50	0.60	water is flowing over the rocks and through the plants	Upto 1.5
No. ridges of gravel	-	-	-	-	-	-	8	4	-	-
No of furrows of plants	-	-	-	-	-	-	8	4	-	-

Note:

(I) The height of gabions should be 1.0 m 1.5 m high and usually above the water level in the channels/ chambers/ ponds/ zones.

(II) The typical CW system outlined above is for in situ biological remediation where the sides of the chambers/ ponds/ channels / zones are the embankments of the drains.

(III) For ex-situ biological remediation, the four sides of chambers/ponds/ tanks should be made of stone meshed walls of 1.5 -2 m high and 0.5 m – 1 m wide and all the components should be contiguous with gradient so that water flows on its own. If a gradient does not exist, a gradient channel has to be constructed.

Management of CWs

For the proper management and sustainability of CWs on long term basis, the following precautions have to be carried out:

(I) The oxidation ponds should be desilted once in a month. The sludge, should be dried and used for manure.

(II) If the turbulence is decreased due to filling up the pores in the gabions by sludge, it should be flushed out with a jet. This should be carried out once in 3 months.

(III) The aquatic biomass dried should be harvested once in a year and used for mulching in plantation /horticulture.

(IV) If the river bed pebbles used for ridges are choked up with sludge these may be washed and reused once in a year in phased manner.

(V) If CWs is sediment heavily, it should be desilted carefully without damaging the rooted aquatic plants.

(VI) During monsoon, heavy run off may make CWs not functional because of rapid flows, but dilution of sewage with rain water make the water quality similar to the river water/treated water.

(VII) If gabions and ridges are damaged during heavy flows of monsoon water along with regular sewage, the gabions and ridges should be repaired.

Time required for development of CWs

Depending on the size of CWs, CWs can be developed and make functional within 6 to 12 months

Parameters for feasibility assessment

- Flow and retention time: The construction of wetlands requires large area hence large horizontal foot-print. The retention time within constructed wetland system is about 20 hours.
- Pollution Load: It can be designed for wide range of pollution load and effluent characteristics.
- Knowledge of wetland ecology and native wetland species is a pre-requisite.
- Periodic harvesting of the biomass is essential to maintain consistent performance.
- Design criteria is being developed for different kinds of wastewater under different climatic conditions.
- The constructed wetland system is scientifically proven and widely accepted alternate and/or complimentary technology to conventional technology for sewage treatment.
- It has been used by many countries in the world for the management of wastewater including sewage.
- DBT-CPCB has also brought out a manual on constructed wetland system wherein several designs are described.

Cost of CWs

As compared to STPs, CWs are very cheap and treatment of 1mld sewage with CWs may cost anywhere between 8 to 10 lakhs with annual maintenance cost of Rs 80000/-.

Annexure – III: Biodiversity Parks: A Holistic Approach for Rejuvenation of Rivers

The river ecosystems across the country are highly degraded, and the pollution loads are so high that the water in most of the rivers, particularly in urban stretches are unsuitable even for irrigation. The challenge is how to rejuvenate river ecosystems which are highly complex. To achieve this goal, there is a need for holistic approach. One such approach is the establishment of Biodiversity Parks along the floodplains of rivers of India. The Biodiversity Park approach involves restoration of degraded river ecosystems and recreation of lost ecosystems, biological treatment of waste waters that enter into river, and use of natural wetlands for cleaning channel water and storage of flood water. The Biodiversity Park approach is detailed in the following pages:

Concept of Biodiversity Parks

Biodiversity Parks are unique landscapes/riverscapes of wilderness where ecological assemblages of native species are recreated over marginal/degraded landscapes/riverscapes. Biodiversity Parks are based on the ecological restoration principle and the underlying principle is to establish self-sustaining ecosystems that have biodiversity and function that generate ecological services that contribute to well-being of humans.

Biodiversity Parks in riverscapes include restored/recreated river ecosystems along degraded stretches of rivers for their rejuvenation.

The Biodiversity Parks of floodplains of rivers include the restoration/recreation of diverse landscape elements of floodplains such as wetlands, marshes, swamps, lakes, forests and grasslands, besides riparian ecosystems and in-stream communities. It also includes the development of greenways along embankments, forest communities on adjacent uplands and treatment wetlands for cleaning river water and constructed wetlands for treatment of sewage and industrial effluents that enter into rivers.

The Biodiversity Park concept ensures the original ecological integrity of the landscape/riverscape and prevents introduction of any external element in the landscape/riverscape that might affect native flora and fauna.

The Biodiversity Park approach is innovative approach or model for recreation of lost biodiversity or natural heritage and it is a conservation approach. It involves conservation of ecosystems, communities, species, populations, and simulate National Parks/Wildlife Sanctuaries/Nature Reserves/Wilderness.

Functions of Biodiversity Parks

Biodiversity Parks have wide range of functions and encompass almost all the four categories of ecosystem services rendered by ecosystems, and include: (i) enrich human microbiome as the parks harbour rich environmental microbiome which in turn reduces the human health risks and public health burden; (ii) serve as filters for point and nonpoint source of air pollutants; (iii) store flood water and recharge ground water; (iv) prevent soil erosion and stabilize floodplains; (v) reduce flood water velocity; (vi) serve as hub for conservation, educational and cultural activities; (vii) promote ecotourism; (viii) connect the city and its citizens to nature

and biodiversity; (ix) provide livelihoods to local communities; (x) serve as living museum for understanding ecosystem processes and function; (xi) sequester CO_2 and impart climate resilience, buffer local weather and even cause local precipitation; (xii) serve as habitat for vanishing flora and fauna (xiii) purify water; (xiv) enhance biological productivity; (xv) sustain river ecosystem and, (xvi) rejuvenate rivers.

Biodiversity Parks of riverscapes have many other functions such as:

(i) contribute to self purification system of river water;

(ii) regulation of stream flows;

(iii) prevention of channel bank erosion;

(iv) uniform distribution of sediments;

(v) stabilization of floodplains;

(vi) trapping of sediments;

(vii) reducing flood water velocity;

(viii) immobilization of heavy metals and nutrients such as nitrogen and phosphates, including heavy metals;

(ix) regulation of nutrient cycle leading to enhanced water quality;

(x) storage of flood water;

(xi) recharge of groundwater and enhancement of base flow for sustained riverflow;

(xii) filtration of surface runoff from upland, embankments and watersheds;

(xiii) sink for CO_2 and buffer local weather;

(xiv) reduction in loss of water from surface evaporation;

(xv) provide diverse products to and livelihoods of local communities;

(xvi) provide recreation to the public;

(xvii) preservation and sustenance of diverse river ecosystems and the flora and fauna;

(xviii) promote ecotourism;

(xix) habitat for RET (Rare, Endemic and Threatened) aquatic and terrestrial plant and animal species;

(xx) regulate water temperature leading to enhanced water quality;

(xxi) bioremediate wastewaters that enter into river system; and

(xxii) cleaning of river water through treatment wetlands (natural).

These functions of Biodiversity Parks in riverscapes have already been discussed extensively in Chapters 2 and 3.

Structural Components of Biodiversity Parks

A Biodiversity Park can have wide range of landscape/riverscape elements, and it depends upon the space availability, nature of the ecosystems that used to exist before degradation, topography of the area and what the local communities need, besides the main goal of bringing back the lost pristine glory of the landscape/ riverscape and rejuvenation of rivers. An ideal Biodiversity Park has two zones: (i) the Nature conservation zone and (ii) the visitor zone. The nature conservation zone consists of terrestrial and aquatic ecosystems of the area where the natural forest ecosystems, floodplain wetlands, forests and grasslands, river channels and their interconnections with wetlands of floodplains are located. The visitor zone will have a number of elements such as representative ecosystems of the area, a herbal garden, an aquatic garden to preserve the aquatic resources, wetlands, butterfly conservatory, green ways along the embankment, diverse wetlands that attract diverse group of birds, NIC, constructed wetlands for treatment of wastewater, natural bathing sites for local community on specific festivals and Recreational Parks.

The Biodiversity Parks of riverscapes can have the following structural components:

(i) Forest communities along the river embankment and adjacent upland.

(ii) Greenways with walkways and cycleways long the river embankment/ bunds. The greenways have 3-storeyed native forest communities.

(iii) Greenways with Recreational Parks, where human settlements are located close to the river.

(iv) Floodplain forests and grasslands, marshes, wetlands and lakes on floodplains.

(v) A butterfly conservatory, an herbal garden, a recreational park and forest communities on elevated floodplains.

(vi) An NIC on the elevated floodplains/ embankment/ upland

(vii) Representative riparian ecosystems along the channel banks and riverbeds.

(viii) Natural bathing sites for local communities.

(ix) Natural treatment wetlands for cleaning of river water.

(x) Constructed wetlands for treatment of wastewater that enters into river.

(xi) An aquatic garden for conservation of aquatic flora.

(xii) Infrastructures for promoting awareness, education and training on the conservation of river ecosystems.

Size of Biodiversity Parks

The size of Biodiversity a Park depends upon the amount of land/the stretch of riverscape available. The minimum land required for biodiversity park is 100 acres, but 50 acres patch can also be developed into a Biodiversity Park. 10 patches of 10 acres each that are located in a cluster can also be used for development of Biodiversity Park. The Biodiversity Parks can be developed in linear fashion along Highways or rivers with stretches of 0.5-5.0 km wide. The upper limit of Biodiversity Park is similar to that of National Park, *i.e.* few hundred km^2.

The size of Biodiversity Parks in riverscapes depends upon the stretch (length) of the river available, the extent of floodplain width and the riparian zone, presence of wetlands and the extent of upland area. The stretch can be 1 km to 100 km long and 0.5-5 km or more wide on either side of channel. The Biodiversity Parks in riverscapes should be developed in linear fashion. Some of the major rivers of India, in the plains, have floodplains extending several 100 km stretch and include vast tracts of elevated floodplain forests.

Planning, Designing and Development of Biodiversity Parks in Riverscapes

Step-wise procedures involved in planning, designing and developing Biodiversity Parks in Riverscapes are outlined below:

1. Selection of the riverscape.

   Identify the stretch of river that is at least 1km long (the length may be anywhere between 1 and 100 km) that has lesser gradient, extensive floodplains (anywhere between 0.5 km – 5 km wide or more on either side of the water channel and the embankment/ bund) and an upland area of the size anywhere between 50 m and 500 m wide strip along the embankment/ bund.

   Stretches having threats, connectivity, services offered and potential of enhancing the integrity of the ecosystem considered and the potential of demonstrating an integrated approach for restoration may be preferred.

   The river stretch with high conservation values and under anthropogenic pressure should be identified for the Biodiversity Park. So that conservation of inhabiting species (e.g. Freshwater turtles) could be ensured through community engagement.

   There is a need to undertake the assessment of ecosystems, flora and fauna in the past and present at the site and its upstream and downstream areas. The past information can be obtained from the previous published information including floras and faunas and scientific papers, if any. The present information in the form of biodiversity mapping can be done by floristic and faunastic surveys. These surveys include the listing of kinds of species of plants and animals found, the vegetation types, the phytosociological features (dominance, abundance and frequency distribution of plants and birds), invasive species if found, and use of plant and animal species found in the area. This information is useful in selecting the species for community and ecosystem development.

   Proper environmental and ecological assessment of the proposed site taking into account the needs of local communities and participation of Panchayati Raj institutions should also be carried out.

   Regional Offices of Botanical Survey of India (BSI) and Zoological Survey of India (ZSI) may be approached for identification of plants and animals found in the area/region. Both BSI and ZSI also have databases of the plants and animals of the area/region and such databases are useful in Biodiversity mapping.

   Note: Please select the stretch where there is no agriculture in floodplains and human settlements on embankments and presence of a strip of upland close to the embankments. Location and design should not interfere with the hydrological,

geomorphological and ecological connectivity. Biodiversity Park should follow all existing rules and regulations including those related to social and environmental impacts.

At higher elevations (headwaters zone), the Biodiversity Parks may include the restoration/ recreation of in-stream communities, riparian ecosystems and also adjacent upland ecosystems besides the ecosystems of catchments and watersheds. In these areas, the floodplain is either narrow or absent. In hilly areas, where the riverscapes have extremely narrow floodplains, Biodiversity Parks of such sites include restoration/ recreation of in-stream ecosystems, riparian ecosystems, adjacent upland ecosystems and ecosystems of catchments and watersheds.

2. Secure the area by fencing along the embankment/ upland area and the boundaries of floodplains at the upstream and downstream of the stretch selected.

   It may be noted that identification of wetlands and demarcation of land for interventions should be done based on the study of natural drainage patterns and connectivity analysis along with consultations with the local communities, keeping in view their existing rights and privileges. Restoration of wetlands should be done on the principles of wise use concept.

   Note: No fencing should be done along the water channel front.

3. Survey the vegetation of uplands located in the neighbourhood of the site selected for selection of plant species of trees, shrubs, herbs, and grasses that will be used for the development of terrestrial communities on uplands, embankments and elevated floodplains.

   Note: The propagules of the species selected (seedlings, seeds and ramets/ root slips of grasses) should be collected and raised and multiplied in a Nursery.

4. Development of a Nursery in 2 to 5 acre plot located in embankment/upland area (depending on the size of Biodiversity Park) for the maintenance of saplings and multiplication of saplings.

5. Development of forest plant communities on elevated floodplains, flat floodplains, embankments and uplands:

   (a) Development of grasslands, to start with, on the upland, embankments and floodplains.

   (b) Plantation of saplings of top canopy tree species.

   (c) After 2-3 years of top canopy species plantation, plantation of underwood species should be done.

   (d) After 4-5 years of plant community development, plantation of herbaceous plants should be done.

Note: The vegetation developed will prevent erosion/reduce sedimentation load, enrich nutrients in the aquatic ecosystems and improve the water quality. All plantation activities should be done using native plants only.

6. Survey of floodplains for location of the wetlands, marshes, swamps, lakes, grasslands and forests. A GIS based map of the area may also be developed for planning.

(a) The elevated areas in floodplains should be developed into floodplain forest communities. The shallow and undulating depressions should be used for grasslands.

(b) Different grassland communities should be developed based on the moisture gradient. The grass species required may be collected from already existing floodplain grasslands on undisturbed stretches of river close to the selected site.

Note: Propagules of some grass species may also be collected from upland grasslands located in the neighbourhood of the selected site.

(c) If there are already existing wetlands, marshes, swamps and lakes, these ecosystems should be restored. The first step in the restoration is desilting (in case of marshes and swamps desilting should be done less than 1 m depth; in case of wetland, desilting should be done upto a depth varying from 1 to 3 m; and in case of lakes, the desilting can be done upto a depth of 3 to 5 m). The silted material can be used for landscaping around the waterbodies. These landscaped areas should be grassed with native floodplain grassland species.

After desilting, introduce phytoplankton, zooplankton, benthic fauna, and fishes into the restored floodplain wetland ecosystems. The other vertebrates colonize these ecosystems on their own soon.

(d) If wetlands, marshes and swamps and lakes were vanished at the site, these have to be recreated on the sites where some hydrophytes such as Cattail and *Phargmites* exist.

(e) To provide seed material of animal communities, two nursery ponds should be developed in the elevated floodplains zone/ upland area.

(f) If there are silted connecting channels between water channel and the wetlands and lakes, these silted channels should be desilted upto a depth of 1 m or so and the excavated material should be used for landscaping. The channel should be lined with reeds and cattails.

(g) If channels were vanished, these channels have to be created. These channels should be shallow (4-8 m wide and 1-2 m deep). These channels should be lined with reeds and cattail plants.

(h) If there are habitats that support riparian communities and the habitats are degraded, restore them and introduce the planktonic, benthic and other plant and animal communities characteristic of riparian communities.

(i) If the riparian ecosystems were vanished, the ecosystems have to be recreated in the riparian zone. If such zones cannot be created along the channel, simulated riparian ecosystems have to be developed in the floodplains close to the water channel, using boulders, stones and pebbles.

(j) If the water in the channel has lost in-stream biotic communities, these have to be introduced.

(k) If the water quality is low due to discharge of sewage and industrial effluents, the water from the channel has to be treated by passing it through treatment wetlands to be developed in the floodplains and channels have to be created in a way that channel water pass through these wetlands from the upstream and then enters into the downstream. In fact such treated wetlands and channelization of water all along the river in floodplains may rejuvenate the rivers.

(j) If storm drains carrying sewage is passing through the floodplains, the treatment wetlands have to be developed for in-situ biological remediation of sewage before it is discharged into river.

(m) If natural wetlands do not exist for the treatment of storm drain sewage, constructed wetland system has to be developed. The constructed wetland system has the following units:

(i) One or two oxidation zones / ponds/ units separated by mini weirs of 1 m or 1.5 m high; this is connected to (ii) physical filter zone/pond/ unit that have 5 to 10 gabions of 1m high, 2' wide with boulders of 2' size embedded in iron mesh, and this unit is connected to (iii) constructed wetland unit consisting of 8-15 ridges and furrows; the ridges are 1 m high and 2’ wide and made of stones/ pebbles of 180-200 mm; the furrows are used for plantation. The length and width of each unit depends upon the length and width of drain, hydrological features such flow rate, volume and organic load of sewage.

It is important to prevent pollution at the source, particularly the drains that carry industrial effluent by having a common effluent treatment plant and STP for domestic sewage and then recycle the treated water. In case prevention of pollution at the source is not possible, in-situ remediation of sewage entering into river from clusters of villages should be carried out using constructed wetland as a part of rejuvenation of river.

(n) Aided regeneration/plantation of native species to develop and support native ecology will be undertaken wherever it is necessary.

(o) While designing the restoration/ recreation of wetlands, it is necessary to keep in view the wetland functions so that activities such as development of embankments and other topographic changes should not alter the natural flux of water, sediments and species.

7. Development of Butterfly Park

This should be developed on upland/ embankment, and suitably landscaped. About 70-100 host plants for larvae and 70-100 flowering native herbs, shrubs and trees that produce nectar bearing flowers seasonally and serve as host plants for adult butterflies should be planted. About 50-100 species of butterfly will be attracted to the Butterfly Park. The area required for development of Butterfly Park is about 2 to 5 acres.

There should be 2-3 small shallow waterbodies scattered over the area. Each waterbody should be 10 m X 10 m and 1 m depth. This is needed for maintaining relative humidity. There should be shelter belt around the periphery of Butterfly Park with 1 or 2 rows of bamboo.

8. Development of Herbal Garden

An area of 5-8 acres in the upland/ elevated floodplains can be developed into a herbal garden for the conservation of native medicinal plants. Plants that can be used in home remedies can be grown and can be provided to local communities. About 100-150 species of local plants of medicinal value can be grown. The cultivation practices, medicinal properties of plants grown should be provided on signages and should be also displayed in the Nature Interpretation Centre.

The area should be suitably landscaped depending on the site characteristics.

9. Fruit Yielding Garden (Orchard)

A fruit yielding plant garden can also be developed along embankment/ upland. About 25-30 acres can be used for the development of local varieties of popular fruit yielding species in the region.

10. Birding Area

Besides cultivated fruit bearing plant garden, wild shrubs and trees bearing fresh fruits should also be planted to attract birds. This should be designated as Birding Area. This should be located over an area of 25 -30 acres in upland /elevated floodplains.

11. A Nature Interpretation Centre (NIC) is critical in a Biodiversity Park for promoting awareness among public and students on the need for river conservation and sustenance of river ecosystems to sustain water quantity and quality. It also serves as a platform for undertaking other activities related to Biodiversity Education and training.

A modest building (aesthetically designed with built up area of 10,000-15,000 sq. ft.) is adequate enough. It should have Toilets and a small Seminar Room where visitors can sit to discuss the issues relating to river ecology and management. An office complex of 5000 sq. ft. and a minor laboratory of 5000 sq. ft. may be attached to NIC. This complex should be developed in the upland area.

The Biodiversity Parks, once established, provide opportunities to people to learn from the Park itself. To achieve this objective, the Biodiversity Parks should include the following provisions:

(i) Guided tours;
(ii) Awareness education on Biodiversity and environment among students and people;

(iii) Preparation of leaflets and training modules for different target groups;
(iv) Popular talks by experts; and
(v) Linkages with research centres in local Colleges and Universities, and also with BSI and ZSI.

12. A recreational garden should be developed in and around NIC without interfering with the hydrological and ecological connectivity of the riverscape, landscape or wetlands. The area required will be 1 to 2 acres. The area should be suitably landscaped.

13. A network of trails connecting different structural elements of Biodiversity Park should be developed. The width of major trails should be 8’ wide and secondary trails connecting major trails should be 6' wide and tertiary trails that connect secondary trails should be 4’ wide. This network of trails should pass criss-cross way across the riverscape. No concretization of trails should be permitted; No paver blocks should be used.

14. A field vehicle, a tractor and a golf cart are essential for the Park.

15. A recreational park on 5 acres of upland/ embankment/ elevated floodplains should be developed.

16. Use of nature-based solutions for water and waste management including composting of aquatic weeds/ leaf litter and floating reed beds and floating fountains for treatment of water should also be integral part of the Biodiversity Park.

17. A weather station may also be installed in the Biodiversity Park and also information on hydrology should be collected.

18. The Biodiversity Parks should have a provision for conservation of local fish species, and their importance in ecology and culture should also be displayed in the NIC.

19. The Guidelines is also applicable for the development of Biodiversity Parks in river reaches which are not embanked.

20. Various climatological challenges should be factored in while preparing the project proposal for Biodiversity Parks.

21. Only eco-friendly construction materials should be used in developing the Biodiversity Parks.

22. Biodiversity Parks, once developed, should be sustainably managed so that no solid waste and other waste should be dumped.

23. In case if legacy waste is located in the floodplains and upland areas, the legacy waste should be remediated and restored as a part of rejuvenation of rivers through the development of Biodiversity Parks.

24. Legacy waste is the solid waste dumped in the floodplains of rivers and has become part of elevated and upland zones of floodplains. These legacy waste zones of floodplains are very common along major rivers and its tributaries, particularly in stretches where urban centres are located.

These legacy waste zones can be remediated by the development of grasslands and or site specific forest communities.

Many grass species like *Saccharum, Sporobolus, Vetiveria, Eragrostis, Bothriochloa, Heteropogon, Chrysopogon, Paspalum* and *Panicum* not only uptake heavy metals and immobilize them in by complexing with organic matter/ humus but also biodegraded toxic pollutants with the help of rhizospheric microbial communities.

The broad leaved forest species (trees, shrubs and herbs) with rich and diversified microbial communities biodegrade even Volatile Organic Compounds (VOCs), *i.e.* Polycyclic Aromatic Hydrocarbons (PAHs), emergent pollutants and other toxic chemical pollutants but also uptake and immobilize heavy metals. It may be noted that the forest communities together with grasses play key role in changing the physical features of legacy waste that transform into substratum that hold moisture, recycle nutrients and recharge ground water. In other words the quality of river water is sustained by regulating nutrient cycling. In this way legacy waste over a period of time is biophysically transformed into a substratum that supports biological communities and render ecosystem services including rejuvenation of river.

Schematic Layout of a Typical Biodiversity Park in Riverscape and a Constructed Wetland

To facilitate how to implement the design of Biodiversity Park planned in the riverscape without any difficulty to the stakeholders, a schematic layout of a typical Biodiversity Park in the riverscape showing different structural elements is provided (Figure 28). A schematic layout of a typical constructed wetland for in-situ biological remediation of sewage that enters into the river is also given (Figure 29).

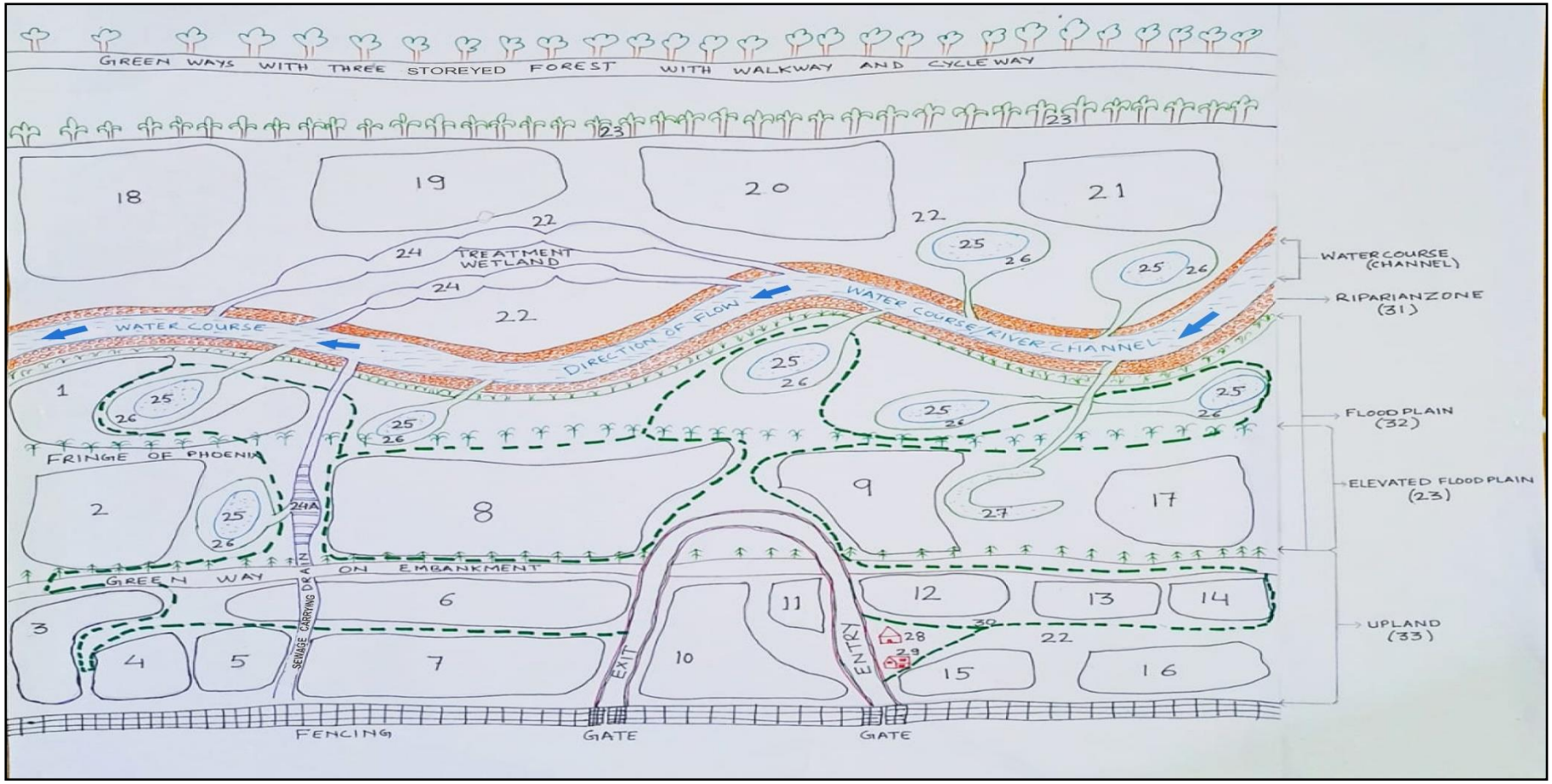


Figure: Schematic layout of a typical Biodiversity Park of the riverscape showing different structural components.

1 – Floodplain forest on the elevated ridge; 2 – Floodplain forest with *Acacia catechu*, *Bombax* and Ber, 3 – Wild fruit-bearing shrubs and trees (Birding Area), 4 – *Phoenix* groove, 5 – Shrubland, 6 – Orchard, 7 – Bamboo thickets, 8 – Grassland with scattered trees, 9 – Aquatic garden, 10 – Recreational Park, 11 – Butterfly Park, 12 – Herbal Garden, 13 – Nursery, 14 – *Sterculia* dominated community, 15 – *Butea* dominated community, 16 – *Holoptelea* dominated community, 17 – *Terminalia arjuna* dominated community, 18 to 21 – Different floodplain forest communities, 22 – Grasslands and marshes, 23 – Elevated floodplain, 24 – Treatment wetlands (natural), 24A – Constructed wetland, 25 – Catchment wetlands, 26 – Marsh, 27 – Oxbow lake, 28 – Nature Interpretation Centre, 29 – Office Campus, 30 – Dotted line (----) indicates trails, 31 – Riparian zone, 32 – Floodplain, 33 – Upland

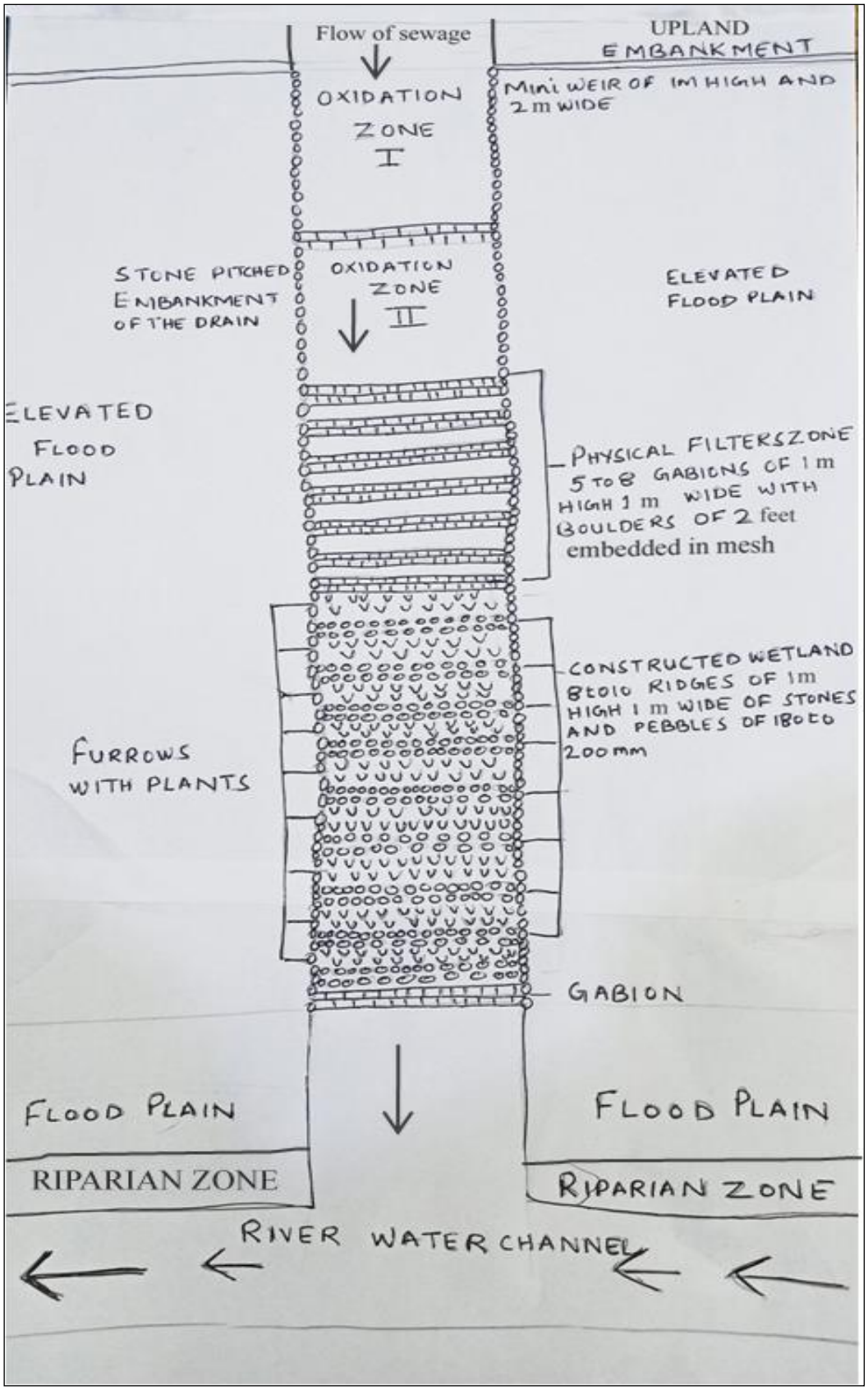


Figure: Schematic layout of a typical Constructed Wetland System for in-situ remediation of sewage/ industrial effluent of the drain that pass through Upland Elevated Floodplain of the riverscape.

Preparation of Detailed Project Report (DPR) for the Development of Biodiversity Parks in Riverscapes

After knowing the detailed procedural steps for planning, designing and developing of Biodiversity Parks in Riverscapes, it is important to know how to prepare DPR for approval of the Project by the Competent Authorities and for implementation.

The DPR should have the following details:

(1) A brief introduction to the Project. This should contain the background on the ecological issues of the stretch of river selected, and how Biodiversity Park would address the issues leading to the rejuvenation of the river stretch, and the benefits that the project can deliver to local communities. It should also include geomorphology and the hydrology of the river reach, in particular inflows and outflows.

(2) Contour map of the selected stretch with details in the upstream and downstream and upland area on either side of river banks; latitude and longitude, and topography of the selected site; demarcation of the area for Biodiversity Park on contour and also on Google Earth maps should be given.

(3) Description of site characteristics including the flora and fauna of upland area and embankment, details of floodplain landscape elements, riparian zone, in-stream characteristics such as flow rate, volume of water, depth of water, water quality, extent of fishing, aquatic flora and fauna, number of storm drains that carry sewage that enters into wetlands/ rivers, presence of wetlands/ swamps/ marshes/ lakes, and if present details of their vegetation and ecology, and land use of the site should be provided.

It should also include information related to: (i) its historical and cultural significance of the riverscape/ landscape/wetland and of that particular site; (ii) its environmental significance in terms of maintaining the balance of a healthy ecosystem; (iii) its ecological significance in terms of dependence of different life forms & abiotic compo**n**ents (the aquatic life, the terrestrial life, riverine flora) on this river and its resources; (iv) its subsistence livelihood dependencies; (v) various climatological challenges the river is facing; (vi) various man-made challenges the river is facing).

Regional Offices of BSI and ZSI can be approached for floristic and faunistic databases.

(4) Estimates for development of Nursery, which include costs of polythene bags, earthen pots, garden implements, a bore well, a polyhouse and fencing etc. and porta-cabin, should be given.

(5) Estimates for desilting or creation of wetlands/ marshes/lakes/swamps and use of desilted material for landscaping around the wetland /marshes/lakes/swamps (no transportation cost except in cases where it will be needed) should be provided.

The depth of wetlands /marshes/ swamps /lakes have already been specified in the earlier chapter; the width and length depends upon the existing wetlands/ marshes/ lakes or patches where hydrophytes (Cattails and *Phargmites*) are found.

(6) Estimation of costs for desilting of channels that connect the river/stream channel with wetland and lakes should be provided. The depth and width have already specified; the length depends upon the distance between the stream channel and the wetland/lake.

(7) Estimation of the cost of fencing as specified in the earlier chapters should be provided.

(8) Estimates for the restoration/recreation of riparian ecosystems, will involve the cost of stones and pebbles to be used in the area for diversification of habitat of the riverbed if the riverbed is not alluvial in nature, and desiltation, should be given.

(9) Estimation for the channelization and creation of treatment wetlands for treating stream water should be given. This depends upon the availability of area which cannot be submerged during low floods. The channelization should be atleast of 500m long and pass through a series of treatment wetlands.

(10) Estimates for the development of constructed wetland system for in-situ remediation of sewage that enters into channel through floodplains should be provided.

(11) Estimates for developing network of trails without concretization and paver blocks but lining on either side with stones should be provided.

(12) Cost of purchase of saplings from Forest Department nurseries and government nurseries for plantation should be given.

(13) Approximate cost of procurement of fish fingerlings of native fish species should be provided.

(14) Wages of atleast 20 Multi-Tasking Staff (MTS) as per the state government wages should be calculated.

(15) Salaries of 4 Scientists at the level of Scientist 'B' (one plant taxonomist, one animal taxonomist, one ecologist and one limnologist) should be included. Atleast 3 Field Supervisors at the level of Technical Assistant and one Administrative officer-cum-Accountant and one Office Assistant are required to develop and manage Biodiversity Parks. The salaries of these staff should be included in the annual recurring expenditure. The Biodiversity Park can hire a hydrologist as a consultant whenever his services are needed.

(16) Contingency and consumables are recurring grants, and these grants are also needed for day to day work and should be included in the budget.

(17) Costs of construction of NIC, toilets, office complex, and laboratory have to be estimated. Specifications have already been given in the earlier chapter.

(18) One Tractor with Accessories (about Rs. 8 lakhs), one field vehicle (about Rs. 4 lakhs) and one Motorbike (about Rs. 1 lakh) will be essential and should be included in the budget.

(19) Equipment for monitoring water quality will be required. This will cost about Rs. 5 lakhs.

(20) Estimates of one or two polyhouses of 20 m long and 10 m wide with exhaust fans should be provided.

(21) Depending upon the size of Biodiversity Parks, atleast 6-9 security staff will be required. The budget for engaging security staff should be provided.

(22) The duration of the project should be initially for 5 years.

(23) The DPRs should also include annual Operational and Maintenance (O&M) costs.

Management and Sustenance of Biodiversity Parks in Riverscapes

Riverscapes are dynamic systems and hence development, management and sustenance of river ecosystems require expertise, and continuous monitoring is a necessity. It is also important to document the lessons learned from the establishment of Biodiversity Parks.

About 4 scientists, 3 supervisors and 20 MTS are essential for the development of Biodiversity Parks in riverscapes. Atleast 6-9 security staffs are required. One Administrative Officer-cum-Accountant, one Office Attendant and one Documentation Officer are also needed.

An officer at the rank of Executive Engineer of Irrigation Department of the area or Divisional Forest Officer of the concerned Forest Division of the State Forest Department or a Special Officer on duty of the Municipal Corporation of the neighbouring town or urban centre should be the Incharge of the Biodiversity Park, and he/she will be responsible for the development and management of Biodiversity Parks. All the staff working in the Biodiversity Park will be reporting to him /her. A Technical Advisory Committee may be constituted with locally available experts (University/ College, BSI and ZSI) for providing technical help from time to time during the development of Biodiversity Parks.

Since the rivers and drains are under the control of State Irrigation Department, the management of Biodiversity Parks should be entrusted to state Irrigation department. Alternatively, the upland areas are mostly forest areas and belong to State Forest Department which has fairly large resources, and hence the state forest department jointly with Irrigation department should manage the Biodiversity Parks.

The State Pollution Control Boards (SPCBs) and CPCB should also be involved, as the Biodiversity Parks have role in improving the water quality and also in situ remediation of sewage that enters into rivers besides cleaning of river water through treatment wetlands.

A management committee consisting of senior representatives of Irrigation Department (Chief Engineer), Forest Department (Conservator of Forest of the concerned Division), Department of Fisheries (senior officer), Department of Tourism (senior officer), State Pollution Control Board (regional officer) and representative from the Municipal Corporation/Village Panchayat should be constituted to oversee the development of Biodiversity Parks.

The Chief Engineer of the Irrigation Department or Conservator of the concerned Forest Division will be the Chairman of the committee and EE or DFO (Incharge of Biodiversity Park) will be the member secretary of the Management Committee. The committee should be empowered one and should take all the decisions on the development and management of Biodiversity Parks.

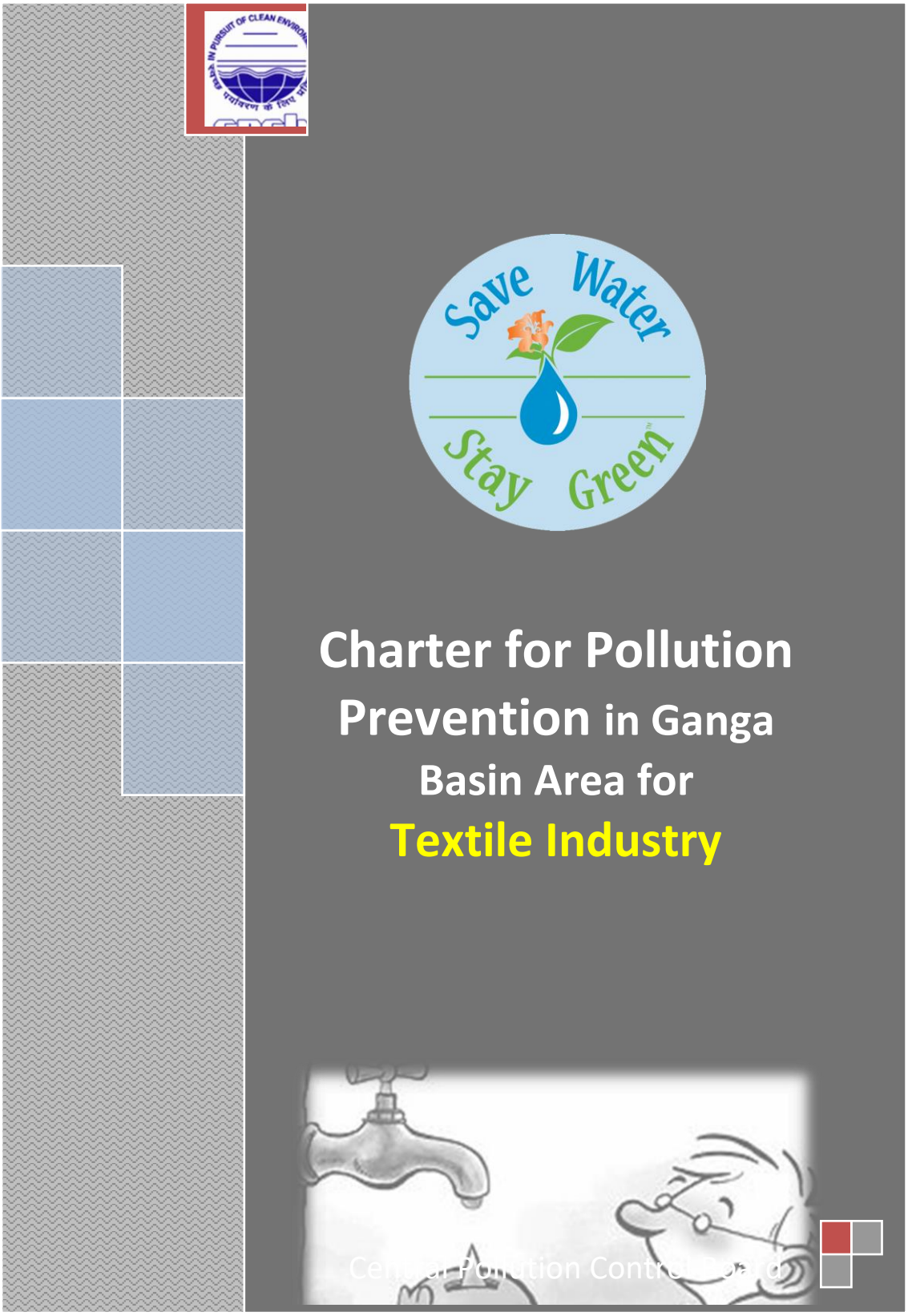
It may be noted that any institutional arrangement to manage the Biodiversity Parks should involve local communities and the stakeholders in the riverscape and landscape because

community driver participatory management of Biodiversity Park will link community livelihoods with the sustenance of the Park.

Periodical appraisal of developed Biodiversity Parks should be done to ascertain their effectiveness. The management should also evolve a financial mechanism to meet the annual O&M costs.

The Guidelines may be revised after a decade, by which time the limitations if any in the present Guidelines is known.

Annexure – IV: Textile Charter



Annexure – IV: Textile Charter

1. Prologue

The Indian textile industry is one of the important and oldest industrial sectors of the country which has shown tremendous growth potential in past few years. This industry is marked with diversity features. Production capacity varies in Indian textile industry. It uses a wide variety of raw materials & processing technology which makes standardization of production process difficult. The industry also uses a wide spectrum of technology, which varies among industries as well as within the industry. The major challenges being faced by this industry are improvement in resource efficiency, sustaining in global competition, natural fibre shortage and addressing the environmental issues & challenges. Although during the last decade, the Indian textile industry has implemented various steps on the upgradation of technology and cleaner production initiatives leading to improvement in various indicators such as specific energy consumption, specific water consumption and specific effluent generation, issues of technological obsolesce and lack of standardization in production process are needed to be addressed urgently in a mission mode for the sustainable growth of textile industry in the new order of environmental compliance and in global competition.

2. Indian Textile Industry & categories

Textile industries in India are in various forms ranging from small scale scattered, hand-looms, to garmenting & in organized clusters, units having automated modern machines for manufacturing fibers to fabrics. It includes different types of fiber such as cotton, silk, wool, synthetic (mainly Polyester, Nylon and Acrylic) as well as mixtures of these fibers (such as cotton + synthetic, cotton + wool) are used in the Indian textile units. Processed textile comprise various processes like –

a) Spinning & Fibre processing
b) Weaving, Knitting
c) Processing
d) Industrial Textile / Garmenting

The process flow diagram for a typical textile mill is shown in Figure 1.

On the basis of raw materials to finished products, the textile mills can be grouped as composite mills where final products (textiles) are produced by the use of raw material (fibers) and these are large units where huge investments are required. In addition to this, there are certain small segments of large industry called as ginning, spinning, weaving, processing, garmenting, laundry etc.

Above processes can be further categorized as under depending upon difference in production lines & raw material involved.

1) Cellulosic Material
- Woven
- Knitting

2) Technical Textiles Manmade Material
- Woven
- Knitting
- Technical Textiles

3) Wool/Silk Material
- Woven
- Knitting
- Technical Textiles

4) Cotton/Synthetic Mixed Material
- Woven
- Knitting
- Technical Textiles

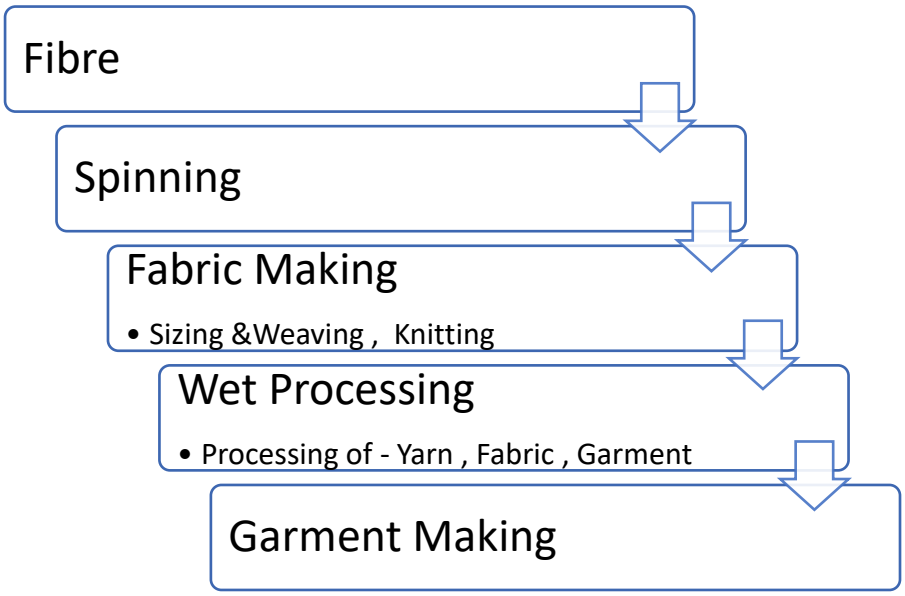


Figure 1 Generalized process flow diagram for a typical textile unit

Above mentioned broad segments may have various processes depending upon the end-product to be produced. For example, typical processing steps involved in producing different end-products from cellulosic, man-made fibers, wool and silk can be categorized as given in Table 1 and 2.

The process flow diagrams for various textile mills including carpet units are shown in Figures 2 to 7 given below. Above all segments have various processes depending upon end product. Processing steps involved in different end products can be categorized as under.

Table 1: General Processing Steps for Cellulosic Fiber, Man-Made Fiber, Cellulosic + Man Made Fiber Blend based, Carpet and Technical Textiles

Steps	Woven	Hosiery	Hosiery	Carpet / Tech Textile	100% Synthetic & others
Fibres used	**Cellulosic & Man-made Blends**	**Cellulosic**	**Cellulosic & Man-made Blends**	**Mix**	**Polyester / Acrylic/ Others**
Ginning Industry	Ginning	Ginning	Ginning	Ginning	
Spinning Industry	Carding/ Combing Blending	Carding/ Combing	Carding/ Combing Blending	Carding/ Combing Blending	
	Spinning	Spinning	Spinning	Spinning	Spinning
Fabric Making – Loom Shed	Sizing			Weaving	Weaving
	Weaving	Knitting	Knitting	Non-Woven	
	De-sizing				

Wet Processing Industry / Process-House	Scouring / Bleaching	Scouring / Bleaching	Scouring / Bleaching	Scouring / Bleaching	Scouring (Removal of lubricants)
	Dyeing / Printing	Dyeing / Printing	Dyeing / Printing	Dyeing / Printing	Dyeing / Printing
	Finishing	Finishing	Finishing	Finishing	Finishing
Garment industry	Garmenting	Garmenting	Garmenting	End Product	Garmenting
Laundry	Garment washing	Garment washing	Garment washing		Garment washes if required

Table 2: General Processing steps for wool & silk industry

Fibre cleaning	Scouring De-gumming, Bleaching
Fibre colouring	Dyeing
Spinning	Blending
	Spinning
Fabric making	Weaving/ Knitting
Wet Processing	Scouring / Bleaching
	Dyeing / Printing
	Finishing
Garment industry	Garmenting / End Product
Laundry	Garment washing

Textile Processing Operations

Typical textile processing operations involve over a dozen unit operations (or steps) and require nearly equal number of machines. Table 3 gives the typical list of various unit operations together with their applications. Table 4 gives the list of typical machines and the operation for which these are used.

In Table 3, various unit operations in textile processing & their applicability is mentioned in table no 3. All processing units may not essentially follow all the operations. Depending upon end-product & desired quality requirement, some operations may be combined or skipped.

Table 3: Textile process operations

S. No.	Process Name	Applicability on Substrate
1.	Desizing (using Enzyme)	Cotton Fabric / Garments
2.	Desizing (using Alkaline medium)	Cotton Fabric / Garments
3.	Kiering	Cotton Fabric
4.	Scouring	Cotton Grey Yarn and / Fabric
5.	Scouring- cum- bleaching	Cotton Grey Yarn and / Fabric
6.	Mercerizing	Cotton Grey Yarn and / Fabric
7.	Bleaching	Cotton Grey Yarn and / Fabric, Silk Fibre / Yarn , Wool Fibre/Yarn ,
8.	Neutralization / souring	Cotton Fabric / Yarn
9.	Carbonization	Blend (Cotton) Fabric
10.	Dyeing	All types of substrates- Cotton , Wool, Polyester, Acrylic, Silk, Viscose
11.	Reduction Clearing	Polyester.

12.	Anti-static finish	Polyester, Acrylic
13.	Soaping	Cotton, Wool, Polyester, Acrylic, Silk, Viscose.
14.	Finishing	Cotton , Wool, Polyester, Acrylic, Silk
15.	Printing (Screen , Rotary , Roller & Block)	Fabric - Cotton , Polyester, Silk, Regenerated cellulose

Table 4 Textile Processing Machines and Operations of their Use

S. No.	Machine Name	Wet Process Operation
1	Kier	Kiering, Boiling, Scouring
2	Desize	Desizing
3	Zero- Zero	Anti –shrinkage
4	Jigger	Desizing, Scouring, Washing, Bleaching, Dyeing, Soaping , Dye fixing, Neutralization / souring
5	Continuous Bleaching and / Dyeing Machine	Bleaching and / Dyeing of fabric
6	Winch	Desizing, Scouring, Washing, Bleaching, Dyeing, Soaping , Dye fixing Neutralization / souring
7	Mercerize	Mercerization
8	HTHP – Carrier	Fibre Dyeing, reduction, Soaping, Antistatic
9	HTHP – Package Dyeing	Yarn Dyeing
10	Soft Flow	Fabric Dyeing
11	HTHP – Jet Dyeing	Fabric Dyeing
12	Cabinet Dyeing	Hank Yarn Dyeing
13	Printing	Screen , Rotary , Roller & Block printing
14	Continuous Yarn Dyeing	Denim Yarn Dyeing (Continuous)
15	Stenter	Finishing

Figures 2 through 4 show the flow diagrams for typical composite cotton, silk and woolen textile mills for processing of raw cotton, silk and wool to finished textile products, respectively. Figures 5 and 6 show the process flow diagrams for garment manufacture from 100% grey cotton fabric and grey polyester + cotton and polyester+ viscose fabric, respectively. Figure 7 shows the typical process flow diagram for carpet manufacture. In each case, the operations requiring fresh water and generating wastewater are also indicated.

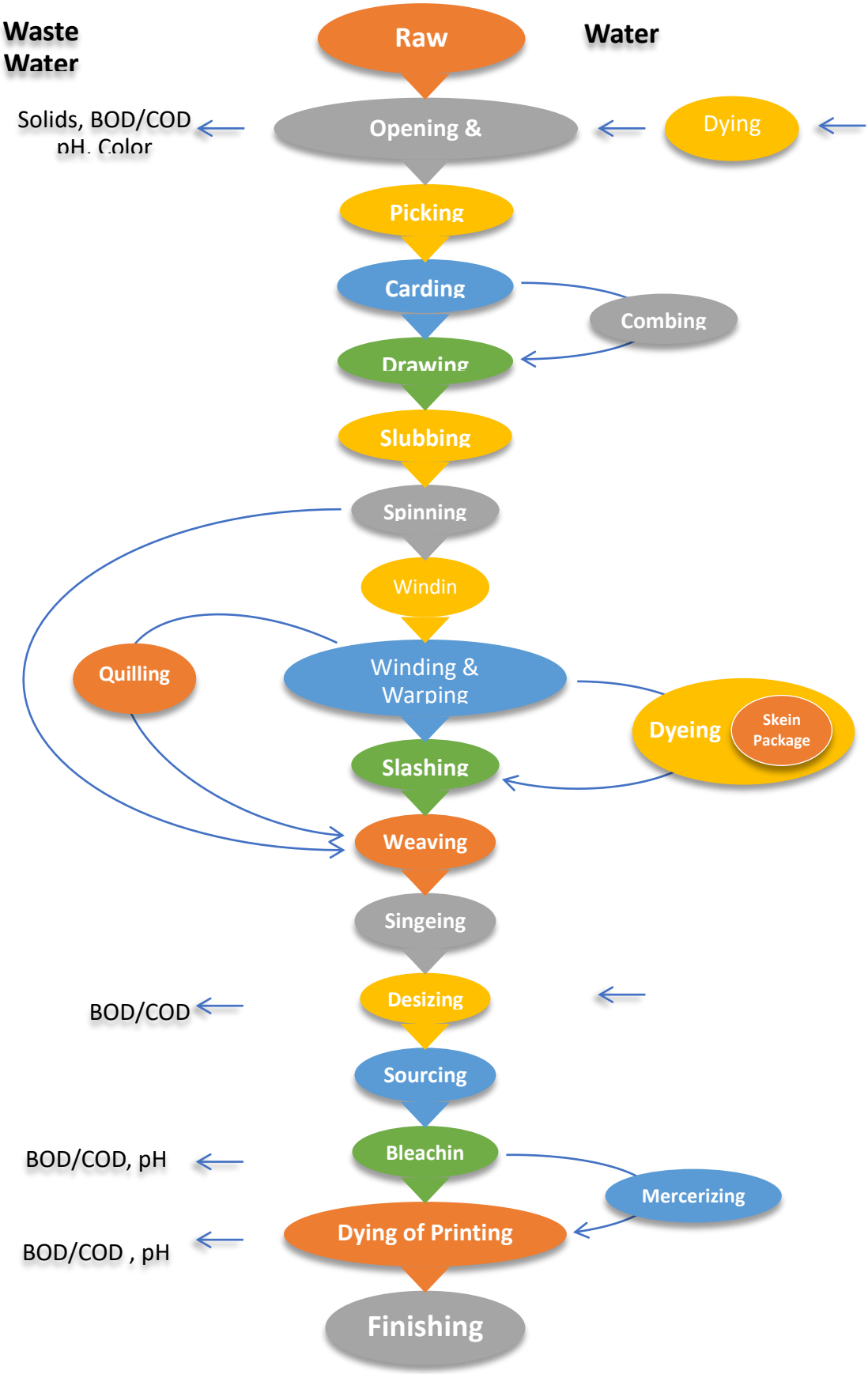


Fig. 2 Schematic flow-sheet of a typical cotton textile mill

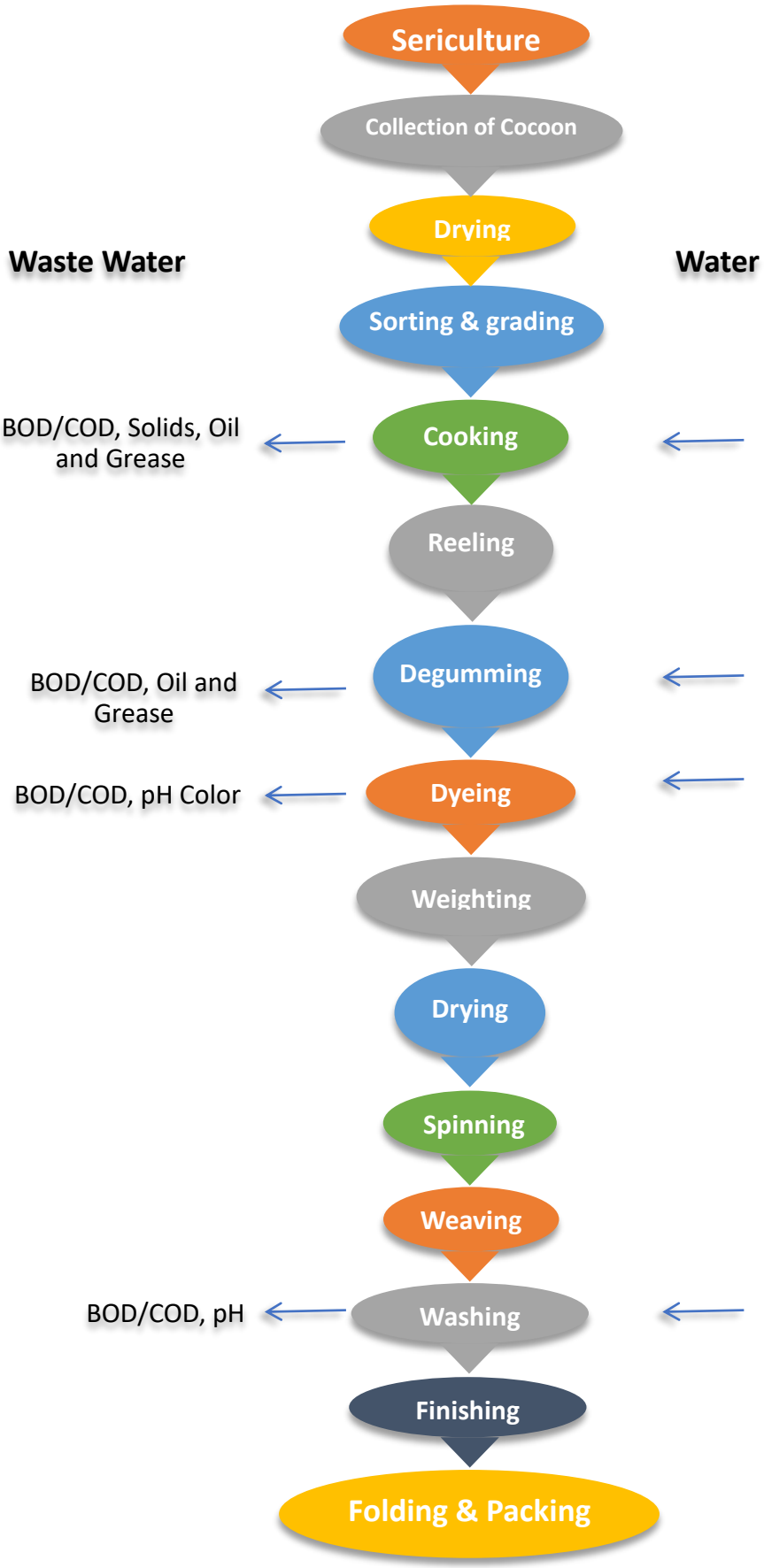


Fig. 3 Schematic flow-sheet of a typical silk textile mill

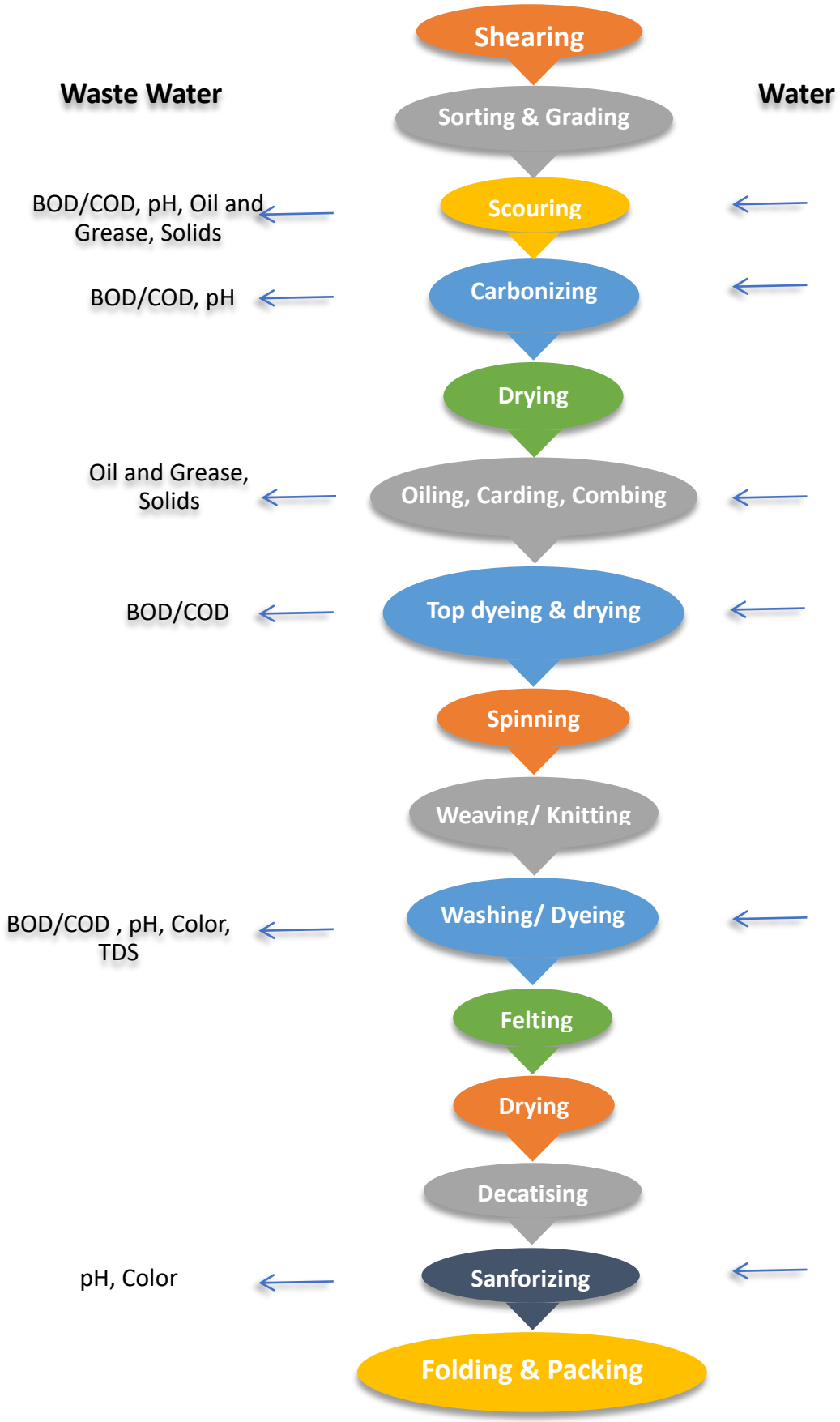


Fig. 4 Schematic flow-sheet of a typical wool fabric manufacture mill

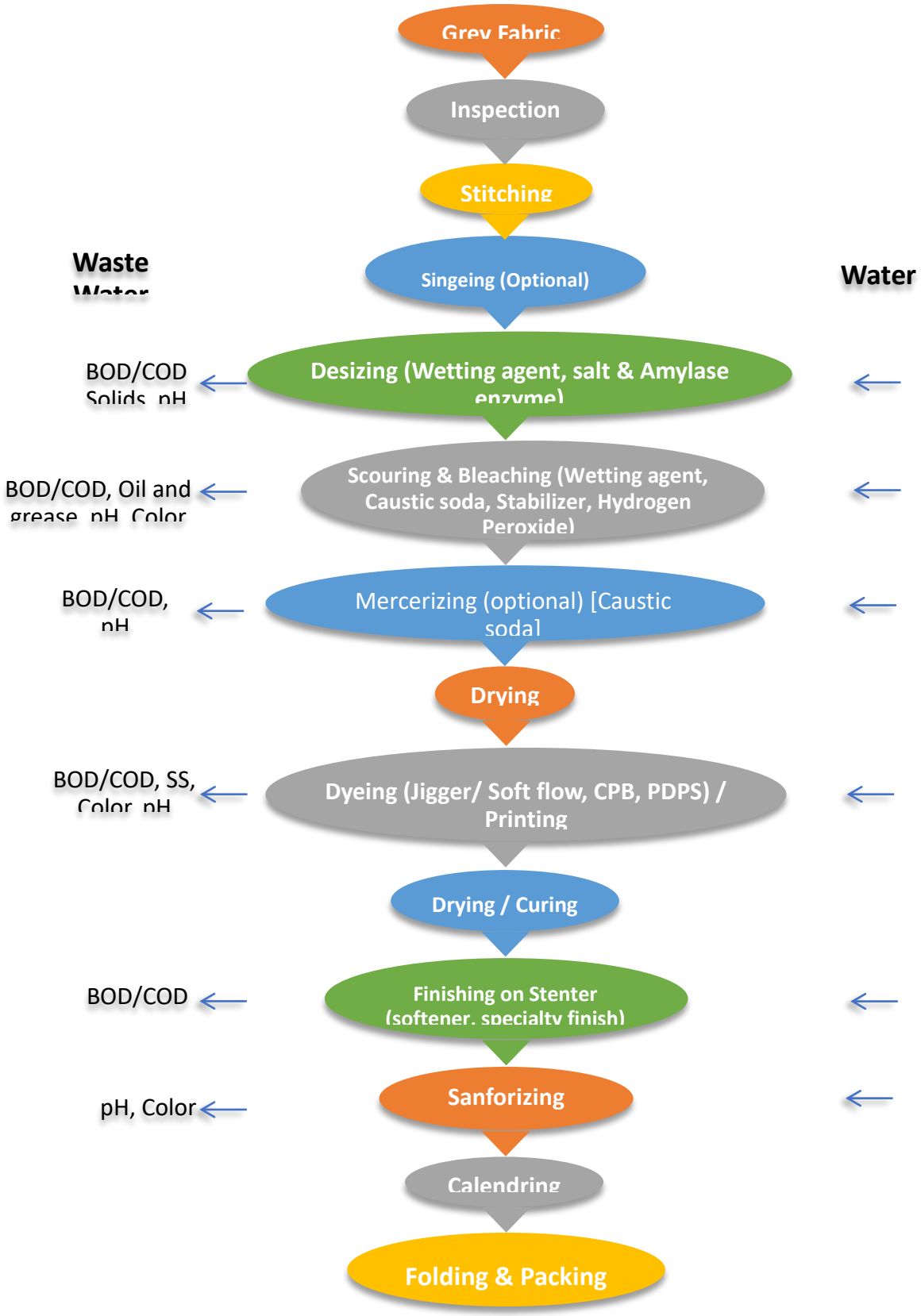


Fig. 5 Schematic flow-sheet of garment manufacture from 100% grey cotton fabric

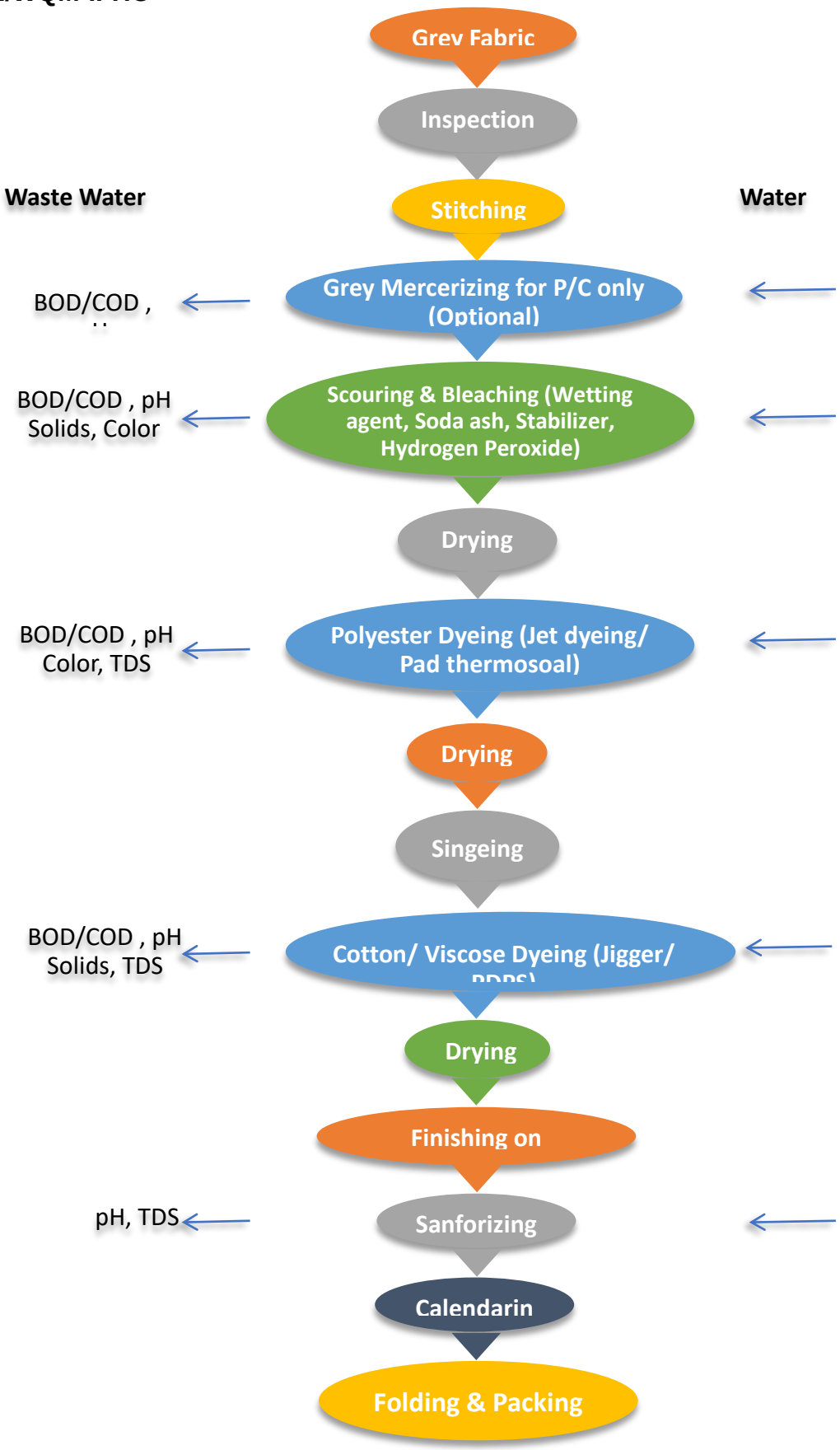


Fig. 6 Schematic flow-sheet of garment manufacture from gray polyester + cotton & polyester + viscose

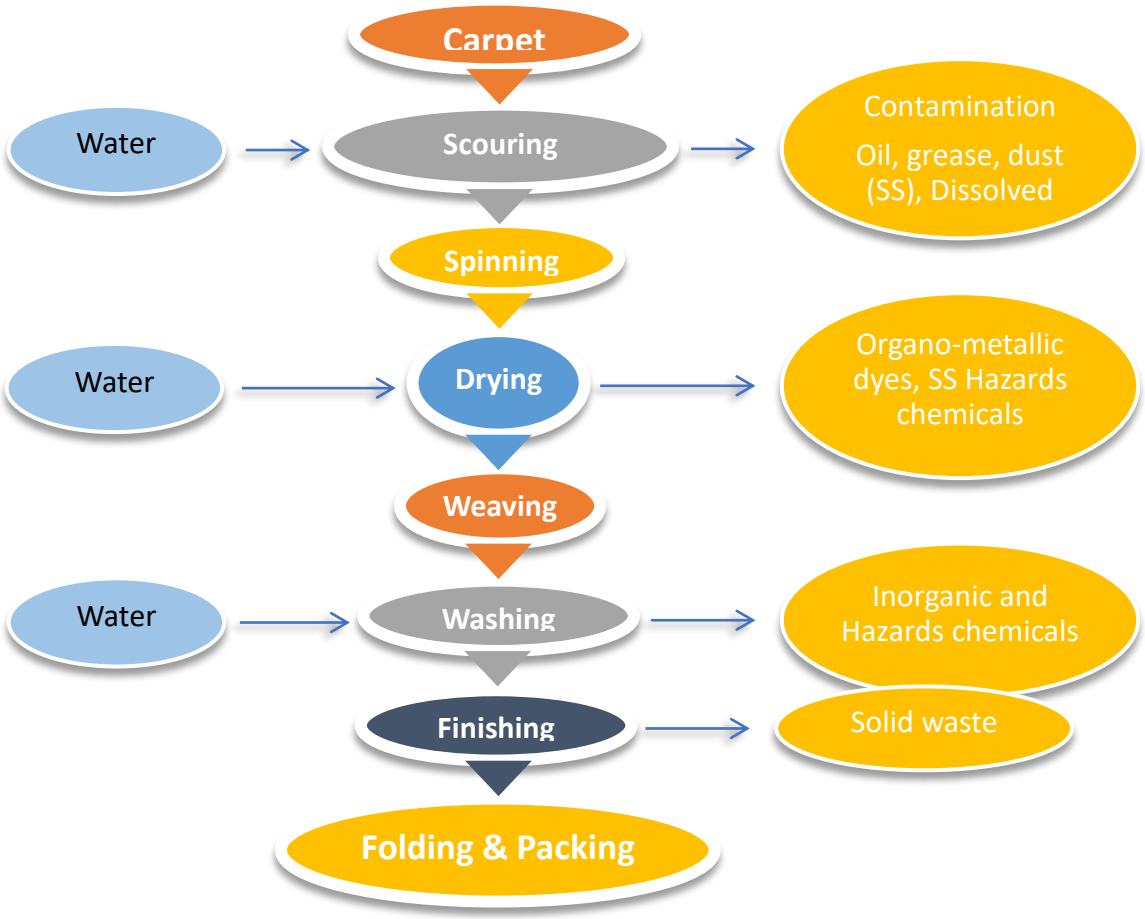


Fig. 7 Schematic flow-sheet of a typical carpet manufacturing process

Various processes being carried out in above mentioned textile industries that generate liquid pollutants together with their possible impact on receiving water bodies like river Ganga (and its tributaries) are listed in Table 5.

Table 5 Processes Generating Pollution Load and level of their Impact on Ambient Water Quality

Process	Steps	Impact	Remarks / Comments
Cleaning of fibre	Wool, Silk, Jute, Raw cotton package dyeing	Major	Effluent generation
Ginning Industry	Raw cotton mechanical cleaning	Minor	Major solid waste generation
Spinning Industry	Yarn making	Minor	Major solid waste generation
Fabric Making – Loom Shed	Sizing	Major	Effluent generation
	Weaving	None	
Wet Processing Industry / Process-House	De-sizing	Major	Effluent generation
	Scouring / Bleaching	Major	Effluent generation
	Dyeing & Printing	Major	Effluent generation
	Finishing	Minor	Effluent generation
Garment industry	Garment making	Minor	Solid waste generation
Laundry	Garment Washing, Dyeing, Printing	Major	Effluent generation

From Table 5 and Fig. 3 to 7, it is clear that almost all operations of textile industry generate varying volumes wastewater loaded with various pollutants that are likely to have varying levels of impact on receiving water bodies like river Ganga and its tributaries

From the basic processes discussed above for various textile industries and from the current practices adopted by the industry, it is evident that large volume of water and a variety of chemicals including dyes are used in textile mills at various stages from fiber processing to finished product manufacture. There is a need to understand the characteristics of effluent generated from textile mills to plan for effective and efficient waste water treatment. Characteristic parameters of typical textile mill waste water are as under:

1) Total Suspended Solids (TSS)
2) Total Dissolved Solid (TDS)
3) pH
4) Temperature
5) Color
6) Chemical Oxygen Demand (COD)
7) Biological Oxygen Demand (BOD)
8) Oil & Grease
9) Sodium Absorption Ratio (SAR)
10) Other Substances such as:
11) Total chromium as ‘Cr’
12) Sulfide as ‘S’
13) Phenolic compounds as ‘C_6H_5OH’
14) Ammonical nitrogen as ‘N’

NOTE: The parameters should be as per notified standards.

The liquid effluent thus generated is required to be treated for recycle and reuse in the process to minimize the discharge. It is also emphasized that efforts have to be made to use best practices and the processes to minimize water consumption besides using appropriate technology for wastewater treatment.

Specific norms for treated effluent have been notified under the Environmental (Protection) Rules, 1986 that must be strictly monitored before discharge outside the mill premises

It is understood that textile industry is one of the important and growing industries in India. Chemical wet processing of textile consumes approximately 10000 chemicals, dyes and auxiliaries and some of them are banned due to their carcinogenic nature and adverse impact on biota. It is imperative to produce quality goods at economical price but not at the cost of environment and human health and hygiene. Due to the hazardous nature of chemicals used in textile production, many adverse impacts are seen on human beings, animals / plantation and atmosphere which are a matter of global concern. To overcome this concern, it is essential to understand the matter in depth especially in textile production areas by using eco-friendly techniques right from fiber procurement and processing (cotton growing, jute growing, sheep rearing, sericulture and synthetic fiber manufacture) to finished marketable products manufacture. Especially the Indian textile processing industry being major consumer of water for processing and hence major polluter, from pre-treatment to finishing, needs to concentrate on selection of chemicals and process parameters. Self-assessment of chemical inventory and chemical management systems will further help to comply with global chemical legislation, Retailer & Brand Restricted Substance Lists (RSL's) and Manufacturing Restricted Substance Lists (MRSL's) not only in adhering to environmental norms but in getting fair share of global business.

Textile industries use different chemicals in different processes like De-sizing, Scouring, Bleaching, Dyeing, Printing, Finishing, Softening, Washing, etc. The textile processing industries consume large quantity of water and produce large volume of effluent from different steps of various processes. Waste water from textile processing and dye containing residues requires appropriate treatment before being released into environment.

Recent consciousness about eco-friendly processing in textile industry has increased awareness of environmental issues. Implementation of effective Chemical Management System CMS) can help to reduce NPO (Non-Productive Output) and hence the pollution load on ETP in addition to conforming to the quality of products right since beginning as per the customers' requirements.

2.1 **List of Chemicals used in Textile Industry**

There are various chemicals used in textile industry. These chemicals are categorized in to 11 priority groups as under;

1) Phthalates
2) Alkyl-phenol Ethoxylates (APEO),
3) Azo Dyes
4) Brominated & Chlorinated Flame Retardants
5) Chloro-phenols
6) Chlorinated Aromatics
7) Chlorinated Solvents
8) Organotin Compounds
9) Short Chain Chlorinated Paraffin's (SCCPs)
10) Heavy Metals
11) Per-fluorinated Chemicals (PFCs)

Process wise list of harmful constituents and related pollution parameter along with their characteristics and level of impact on environment is as given in Table 6.

Table 6
Major Constituents Involved in Various Textile Processes, their Characteristic Parameters and Pollution Impact

Process	Major Constituents	Characteristics	Pollution impact Low, Medium, High
Cleaning of Raw Fibres	- Oil, - Fats Waxes, - Proteins & Pectines	COD, BOD, Turbidity	H
Sizing	- Starch derivatives - Semi-synthetic sizing agents (CMC, CMS) - Synthetic sizing agents (PVAs, polyacrylates) - Additives : - Urea - Glycerin - Waxes and oils - Preserving agents	BOD COD Temperature	H M L M
Desizing	- Acids or Enzymes	BOD (30-40% of total) COD Temperature (60-70^{o}C)	H H
Scouring	- Saponified waxes, oils, fats - Surfactants - Alkali - High temperature	Oil, fats BOD (30% of total) pH (high) Temperature (70-80^{o}C) Dark colour	H H H H H
Bleaching	- Residual bleaching agents - Stabilisers - Surfactants - Wetting agents - Mild alkalinity		 M
Mercerisation	- Alkali (NaOH) - Surfactants - Dissolved matter	BOD pH (high) TDS	H H H
Dyeing	- Dyestuffs (direct, vat, reactive, sulphur, pigment) - Electrolytes - Carriers - Acids and alkali - Heavy metals - Oxidising agents - Reducing agents - Surfactants and levelling agents	Toxicity BOD Suspended solids pH Strong colour	H H H H H

L= Low, M= Moderate, H= High

Pollution load from textile mills differ widely depending upon the nature of fibre used and the level of processing employed. Organic ingredients in the waste water undergo bio-degradation and reduce dissolved oxygen content (DO) of the receiving water body and thus destroy the aquatic life. Phenolic chemicals impart bad odour and taste to the water mass. The organics should be removed to prevent any chances of stream water becoming unsuitable for agricultural, domestic and industrial use.

Solids in textile mill wastewaters come from fibrous substrate and process chemicals. These affect oxygen transfer capacity and reduce light penetration and thus affect photo-synthetic activity in the waterbody.

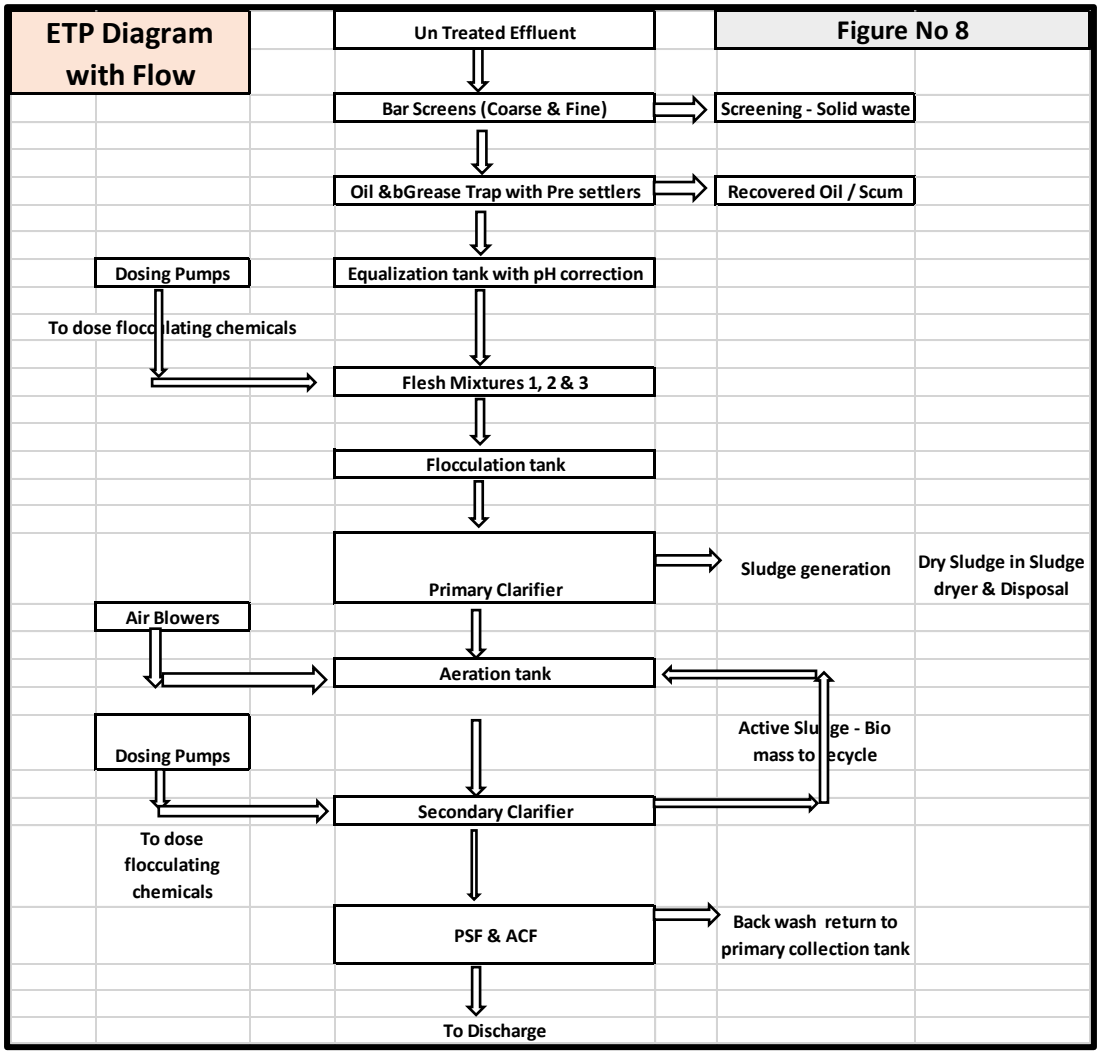
Soluble inorganic salts may make the receiving water bodies unfit for domestic and industrial use. Heavy metals are toxic to aquatic life.

Proper treatment of waste water will reduce the concentration of these chemicals and pollutants as well as their harmful effects and prevent environmental degradation and provide opportunities for further use of the treated water through recycle. Some measures may also need to be adopted to reduce pollution load (both in terms of concentration and volume) e. g.; strong rinse waters from dye houses may be used to prepare fresh dye-baths whereas dilute waste waters may be recycled after appropriate treatment within the plant. Saving of chemicals in the first situation may be enough to pay for the cost of treatment in the second situation.

After taking all possible steps to reduce pollution load and volume of waste water, the remaining pollutants still do not permit the disposal of wastewater in to a water body. These pollutants may be removed or reduced to an un-harmful level (conforming to the effluent disposal norms) by treating the waste water using a variety of treatment steps and combination of sequences. The best treatment sequence, however, may vary from mill to mill.

Figure 8 shows a typical treatment scheme for treating waste water from a standard textile mill. The waste water from various units is brought to a holding/equalization tank for evening out the concentration and flow. It is then passed across a screen to remove floating substances like fibres, etc. The screened effluent is then taken to a grit-chamber –cum-primary settling chamber where heavier and relatively lighter settleable inorganic and organic solids are rem ved by settling. The clarified effluent is then passed to a biological reactor (usually an activat sludge plant or ASP) coupled with a secondary settling chamber. Most of the biodegradabl organic pollutants are removed through biological reaction in ASP and the excess bacterial mass thus formed is settled out in secondary clarifier. The clarified effluent from the secondary clarifier may be further treated by passing it through a tertiary treatment unit (a series of activated carbon filters + sand bed filters). The treated effluent may now be discharged onto land or into a receiving water body. If its recycling is required within the plant itself, it may have to be subjected to further treatment using ultra-filtration/nano-filtration/and/or reverse osmosis units. The sludge produced in primary and secondary settlers and tertiary treatments units is separately collected and suitably disposed of after appropriate treatment. In case it contains toxic chemicals, it has to be disposed of at land-fill sites built specially for such wastes.

Figure 8 The treatment scheme for treating waste water from textile mills



3. Problem Analysis

3.1 Focal Problems to be Solved

Textile industries have been put under the categories of grossly polluting industries. These industries have high water pollution potential. The major environmental issues related to Indian textile industries include high volumes of fresh water consumption and waste water discharge, adverse impact on receiving streams due to high pollution load, high color in effluents due to presence of dyes, ETP sludge disposal and management, and poor performance of ETPs. The effluent discharge standards implemented so far are based on the premises that the back-ground river water quality is very good and at least 10 times dilution is available. However, these conditions are not being met in most of the Indian rivers in which treated / partially treated / untreated industrial and domestic effluents are being discharged in increasing amounts. As such it is essential that treatment up to tertiary level be made mandatory.

In addition to this, there is a need to reduce water usage in textile industry. This will reduce the requirement of fresh water by the industry that can in turn lead to reduced consumption of natural resources like water, fuel & power.

The reduction of water input can be done by two ways;

1) Optimization of process parameters: Optimization of process parameters will

result in reduced water consumption which is quite possible by the use of latest developments in process technology and machinery manufacturing with low liquor ratio, smart washing cycle, and immaculate controls.

2) Water recycling - Water recycling between several processes is possible, but its potential has not been exploited by textile units. This is possible at two stages:
   - Recycling of water internally in selective processes.
   - Recycling of treated effluent by setting a UF/RO/Nano filters at the end-of- pipe line

Such reduction in fresh water consumption within processing units at various stages will reduce the pollution load on ETP and improve the quality of treated effluent.

Present scenario indicates that the ETPs of most of the textile units perform much below the expected level and the effluent discharge norms are violated quite often. Several reasons including lack of knowledge and expertise to manage the ETPs are cited by the industry for poor performance of ETPs. It is suggested that each textile unit must have properly qualified trained employees to run and maintain the ETPs. The industry must employ graduates with degrees in Environmental Science or Technology and/or B Tech. (Chemical/Civil/Textile Eng.). The B Tech (Civil/Textile) engineering graduates must have studied courses in environmental pollution control. All such persons should be periodically subjected through refresher courses/workshops/practical training programs of about a week duration.

At present there seems to be inadequate control on the quantity of fresh water used and waste water discharged from the textile industries due to use of obsolete process technology and age-old practices and lack of implementation of polluter pays principle. These coupled with the lack of awareness and typical mind set are the main de-motivating factors responsible for indiscriminate use of precious natural resources in general and fresh water in particular in most of the industries.

It would be appropriate to decide standard norms for usage of water by the textile industry with time bound commitments in a phased manner. The time line for this is described in Table 7 given below:

Table 7 - Time Line for Water consumption in Textile Industry

Process Category	Within six months	Within one year	Within two years
Unit	**L/kg**	**L/kg**	**L/kg**
Raw Wool	**250**	**200**	**170**
Scoured Wool	**100**	**80**	**68**
Polyester	**60**	**48**	**41**
Acrylic	**50**	**40**	**34**
Woven	**120**	**96**	**82**
Raw Silk	**200**	**160**	**136**
Processed Silk	**85**	**68**	**58**
Knit	**85**	**68**	**58**
Canvas	**45**	**36**	**31**
Carpet	**50**	**40**	**34**
Woven cotton	**120**	**96**	**82**
Blend PC	**120**	**96**	**82**
Blend PV	**90**	**72**	**61**
100% Poly	**60**	**48**	**41**

	100	**80%**	**68%**

Important Note: - The effluent generation will be calculated as 85% of water consumption in all the categories which can be calculated against Table No 7.

Table 7.1 - Time Line for Effluent Generation in Textile Industry

Process Category	Within six months	Within one year	Within two years
Unit	**L/kg**	**L/kg**	**L/kg**
Raw Wool	**213**	**170**	**145**
Scoured Wool	**85**	**68**	**58**
Polyester	**51**	**41**	**35**
Acrylic	**43**	**34**	**29**
Woven	**102**	**82**	**70**
Raw Silk	**170**	**136**	**116**
Processed Silk	**72**	**58**	**49**
Knit	**72**	**58**	**49**
Canvas	**38**	**31**	**26**
Carpet	**43**	**34**	**29**
Woven cotton	**102**	**82**	**70**
Blend PC	**102**	**82**	**70**
Blend PV	**77**	**61**	**52**
100% Poly	**51**	**41**	**35**
	100	**80%**	**68%**

This chart shows water consumption / effluent generation at various stages of textile industries. Water consumption per kg of product for within six months from charter implementation has been frozen as upper limit. The next reduction targets have been kept within one year from charter implementation (20% reduction) and within two years from charter implementation (15% reduction), respectively for reduction in water consumption.
Effluent generation allowance limit will be considered as 85% of water consumed.

3.2 Root Cause of the Problems

Most of the textile-industries-are using obsolete technologies with average age of equipment/ machines much higher than obsolescence. This has resulted in high raw material, energy and water consumption and less efficient operations, causing high volume and concentration of waste streams.
Though most of the textile mills have enhanced their production capacity over the period of time but the augmentation and up-gradation of ETPs have not been adequately addressed to. Moreover, most of ETPs have been set up by mills themselves and are quite often based on improper design without being subjected to adequate performance assessment.

Presently, ETPs consist of two main stages physical and biological treatments and are not adequate to provide requisite level of treatment to the effluent to comply with the prescribed effluent norms and/or to meet the process water quality for wastewater recycling within the process.

The operation and maintenance of ETPs are not always satisfactory. Mills avoid operation of air blowers installed in the aeration tanks of ETPs regularly. More often than not, most mills neither have trained manpower for operating ETP nor proper laboratory facility for measuring and analyzing various performance parameters. Mills also lack proper record keeping and a sound system for monitoring of water consumption and effluent discharge.

SPCBs have inadequate resources for intensive performance monitoring and surveillance activities for compliance verification of these mills. There is a need for strengthening of institutional network to meet the technical requirements of textile industries such as technical knowhow for process and ETP up-gradation, training programmers and monitoring.
Most important thing is the mind set of mill owners and ETP officials that needs to be changed.

The upgradation in technology and process is therefore necessary for improved performance and competitiveness through quantifiable increase in productivity, quality improvement with reduced cost, better energy efficiency and environmental compliance. High cost of energy (specially fuel) and the consequent environmental implications, make it imperative for the textile industry to adopt energy efficient and eco–friendly technologies, increase automation and control, optimize process operations, increase reuse and recycling wherever possible of process water and treated effluent, upgradation / modification of ETPs, adoption of Chemical Management System (CMS) and Chemical Recovery System (CRS) for chemical and dye bearing waste water in textile mills (individual / common) and promotion of biotechnological applications.

3.3 Challenges

- The current practices adopted by the industry, it is evident that large volume of water and a variety of chemicals including dyes are used in textile mills at various stages from fiber processing to finished product manufacture. There is a need to understand the characteristics of effluent generated from textile mills to plan for effective and efficient waste water treatment.

- It is also emphasized that efforts have to be made to use best practices and the processes to minimize water consumption besides using appropriate technology for wastewater treatment.
- Waste water from textile processing and dye containing residues requires appropriate treatment before being released into environment.

- Most of the textile-industries are using **obsolete technologies** with average age of equipment/ machines much higher than obsolescence. This has resulted in high raw material, energy and water consumption and less efficient operations, causing high volume and concentration of waste streams.
- Though most of the textile mills have enhanced their production capacity over the period of time but the **augmentation and up-gradation of ETPs** have not been adequately addressed to. Moreover, most of ETPs have been set up by mills themselves and are quite often based on improper design without being subjected to adequate performance assessment.
- Presently, ETPs consist of two main stages physical and biological treatments and are not adequate to provide requisite level of treatment to the effluent to comply with the prescribed effluent norms and/or to meet the process water quality for wastewater recycling within the process.
- 'Charter for Water Recycling and Pollution Prevention in Textile Industries' (here in after referred to as 'the Charter') is formulated, with a view to **envisage upgradation of the status of textile industries** in terms of process technology, practices and environmental performance, besides substantial reduction in the fresh water consumption and waste water generation and compliance with the prescribed environmental norms to achieve desired level of environmental protection and to meet objectives of the National Mission for Clean Ganga.

- The Charter suggests **Bare Minimum Technology (BMT)** as an indication of the set of desired technologies or its appropriate alternatives required for implementation by the Textile industries operating in the Ganga River Basin States.
- the importance of resource conservation, water reuse and recycle, and efficient functioning of ETPs, it is essential to create an environmental management cell (EMC) (or strengthen it if already existing) and **establish laboratory facilities** for evaluating basic pollution parameters capable of indicating the functioning of ETPs will be mandatory.

4. Objectives of the Charter

Central Pollution Control Board (CPCB) has formulated the 'Charter for Water Recycling and Pollution Prevention in Textile industries in consultation with experts from the departments of Chemical Engineering & Technology, IIT (BHU), Textile Engineering, IIT Delhi, Polymer and Fiber Technology, IIT Delhi, Fiber and Textile Processing, ICT, Mumbai, UP Textile Technology Institute, Kanpur and Textile industries.

One of the important objectives of charter is to setup a bench mark for water consumption & optimize the use of water & chemicals in processing.

'Charter for Water Recycling and Pollution Prevention in Textile Industries' (here in after referred to as 'the Charter') is formulated, with a view to envisage upgradation of the status of textile industries in terms of process technology, practices and environmental performance, besides substantial reduction in the fresh water consumption and waste water generation and compliance with the prescribed environmental norms to achieve desired level of environmental protection and to meet objectives of the National Mission for Clean Ganga.

The Charter suggests Bare Minimum Technology (BMT) as an indication of the set of desired technologies or its appropriate alternatives required for implementation by the Textile industries operating in the Ganga River Basin States. The Charter takes a holistic approach for pollution prevention by emphasizing on process technology up-gradation, adoption of best practices, besides desired improvement in effluent treatment including tertiary treatment to reduce fresh water requirement, improve effluent quality and optimize water recycling. Compliance with the prescribed standards is mandatory. There will be no compromise with regard to the industry not meeting the prescribed standards.

4.1 All Time Compliance with Environmental Norms

The Charter envisages upgradation of the status of textile industries in terms of process technology, practices and environmental performance to the prescribed level, besides substantial reduction of fresh water consumption, waste water generation and compliance with the prescribed environmental norms on continuous basis.

4.2 Water Conservation

The ultimate objective of the Charter is to envisage the possible reuse & recycling of treated effluent into production process & to minimize fresh water consumption.

4.3 Increased Productivity

The Charter emphasizes on the installation of minimum impact technology to ensure better environmental performance, improved relation between various stakeholders (mills, regulatory

authorities and common people), increased productivity, cost savings and competitive market advantages. Increased productivity could ultimately amount to achieving the same production levels with lesser specific consumption of any or all of the resources involved in mill operations.

5. Proposed Strategy

In order to improve the health of the surface water bodies and ambient environment, discharge of pollutants in the river channels needs to be minimized. The effluent, appropriately treated, could be viewed as a source of water that can be used for various processes. Management of water in the textile mills need a four-stage action plan as given in Table 8.

Table 8 Time Frame and Target/Goals for Implementing the Charter

Objective Hierarchy	Time Frame	Target / Goal
Immediate action	Within six months of Charter Implementation	Meet notified discharge norms. Plan for installation/ upgradation of ETP as per charter
Short term objective	Within one year of Charter Implementation	Meet notified for discharge norms. Reduce Water consumption by 20% per kg of product Completion of installation/ upgradation of ETP as per charter
Long term objective	Within two years of Charter Implementation	Meet notified discharge norms. Reduce Water consumption by 15% in addition to last year's 20% per kg of product Completion of installation/ upgradation of ETP & water recycle as per charter
Ultimate overall objective	Within two years of Charter Implementation	Confirmation of 30% water recycle against total input (In other words, water consumption per kg should be reduced by 30% minimum)

1) Immediate plan is to meet the desired levels of effluent discharge as per notified effluent discharge norms, exhibit commitment to augment/establish ETP as per the charter and also plan to reduce water consumption through process improvement and implementation of recycle and reuse of water. A strict metering of the water used and waste water generation is recommended. Several technological and process improvement options are available to reduce net water consumption and thereby reduce the amount of effluent generated. Suggested technological up-gradation / measures for reduction in water consumption for achieving the benchmark / overall goal are mentioned in the Charter.

2) Second action plan (within one year of Charter Implementation) is to have quantum improvement on the individual ETPs by adding tertiary treatment units. This would result in producing industry grade water from waste water discharged from various processes for reuse within the industry. Extensive and regular monitoring protocol is to be followed by regulatory authorities for improved environmental performance. Monitoring and recording of inlet water consumption and reduction by 20% per kg of product within one year of Charter Implementation is mandatory.

3) Third action plan (within two years of Charter Implementation) is to have full working of ETP

with water recycling system and industry must be able to reduce input water consumption over and above that of the previous year's achievement of 20% reduction per kg of product.

Third party involvement is recommended for planning, assessment, design and monitoring of implementation of measures as prescribed in the Charter for process technologies as well as ETP up-gradation. Various export promotion councils (such as Carpet Export Promotion Council, Indian Silk Export Promotion Council, Wool Industry Export Promotion Council (WOOLTEXPRO), Wool and Woolens Export Promotion Council, The Synthetic & Rayon Textiles Export Promotion Council, The Cotton Textiles Export Promotion Council, Apparel Export Promotion Council, various Textile Research Associations (such as ATIRA, BTRA, SITRA & NITRA) Local textile mills association (such as Textile Association of India (TAI)) can take initiative. Educational institutes like IITs, ICT, DKTE, SASMIRA-Mumbai etc. can give technical support for meeting ultimate goal of charter.

Concerned SPCBs and CPCB should act for implementing the Charter in a time bound period and efficient manner. State Department of MSME may also facilitate textile mills for implementation of the charter.

6. Stake Holders

Several stake holders are involved in environmental pollution control programs. These include central and state level regulatory agencies (pollution control boards and the like). In case of Ganga Basin states, textile manufacturing other stake holders like textile mills, textile mill associations, concerned academic and professional organizations and experts are also to be included as stake holders. Thus, the various stake holders concerned with the proper implementation of the Charter are as under:

- National Mission Clean Ganga (NMCG)
- Ministry of Environment, Forests and Climate Change (MoEF &CC)
- Ministry of Textile
- Central Pollution Control Board (CPCB)
- State Pollution Control Boards (SPCBs) and Pollution Control Committees (PCCs)
- Department of Micro Small and Medium Enterprises, State Government
- Textile Mills operating in Ganga River Basin States,
- Textile Mills Associations- AICMA, TAI, etc
- Experts & Resource Institutes (IITs/ ICT, Mumbai / DKTE Ichalkarangi, /ATRA, BTRA, SITRA, NITRA, NEERI/SASMIRA – Mumbai/UPTTI/TITS, Bhiwani/NITS and other consulting organizations)
- Carpet Export Promotion Council, Indian Silk Export Promotion Council, Wool Industry Export Promotion Council (WOOLTEXPRO), Wool and Woolens Export Promotion Council, The Synthetic & Rayon Textiles Export Promotion Council, The Cotton Textiles Export Promotion Council, Appearal Export Promotion Council

7. Plan of Activities

For effective and successful implementation of the Charter a set of activities are required to be planned and carried out. This will require phase wise planning of activities, steps to be initiated for the facilitation of the charter, process and technological improvements, water conservation and recycling methodologies, performance assessment of ETPs and their up-gradation, monitoring and surveillance of environmental compliance, strengthening of laboratory facilities, operation and maintenance of ETPs, and creation of environmental management cell. Actions to be taken and steps to be initiated for realizing the goals envisaged under above mentioned activities are elaborated in following tables 9:

Table 9 Time Frame for realizing Various Objectives		
Objective Hierarchy	Time Frame	Target / Goal
Immediate action	Within six months of Charter Implementation	Meet notified discharge norms. Plan for installation/ upgradation of ETP as per the charter
Short term objective	Within one year of Charter Implementation	Meet notified discharge norms. Reduce Water consumption by 20% per kg of product Complete of installation/ upgradation of ETP as per the charter Meet CPCB guidelines for discharge norms.
Long term objective	Within two years of Charter Implementation	Reduce Water consumption by 15% in addition to last year's 20% per kg of product Completion of installation/ upgradation of ETP & water recycle as per the charter
Ultimate Goal	Beyond two years of Charter Implementation	Confirmation of 30% water recycle against total input (In other words, water consumption per kg should be reduced by 30% minimum.

7.1 Facilitation of Charter

Following actions as enumerated in Table 10 need to be undertaken and completed within the dates as specified by the stakeholders as indicated:

Table 10: List of Activities and Related Action to be undertaken with Dead Line			
Sr No	**Activities**	**Action by**	**Completion date**
1)	**A) Self- assessment: Identification of third party, such as Export Promotion Councils, CTRI, industry associations, IITs etc. by mills to facilitate the charter implementation and coordination.** **B) Give commitments (Intent letter) for meeting the guide lines as per CPCB charter along with recommended areas of improvements from nominated agency – Third Party.** **C) CPCB / SPCB to collect letter of intent & confirm the association of mill & supporting agencies.**	**A) Textile Mills** **B) Textile Mills** **C) SPCB/CPCB**	**Immediate -** Within six months of Charter Implementation
2)	**A) Complete augmentation of ETP/Water recycling project** **B) Achieve 20% reduction in water consumption per kg of product by internal implementation of technology.**	**A) Textile Mills** **B) Textile Mills** **C) Submit status report by third party**	**a)** Within one year of Charter Implementation **b)** Within one year of Charter Implementation

	C) Monitoring agencies (Third party) to generate detailed reports with all supporting documents & submit to committee after 6 months (First progress status & finally target completion status)		**c)** Within six months of Charter Implementation & Within one year of Charter Implementation
3)	**A) Full working of ETP Project & submit water balance reports** **B) Reduction in water consumption by further 15% in addition to previous year's saving of 20% (to be calculated in L/kg of product)** **C) Monitoring agencies (Third party) to generate detailed reports with all supporting's & submit to committee after every 6 months (First progress status & finally target completion status)**	**A) Textile Mills** **B) Textile Mills** **C) Textile Mills** **D) Submit reports by third party**	**A)** Within two years of Charter Implementation **B)** Within two years of Charter Implementation **C)** Within six months of Charter Implementation **D)** Within two years of Charter Implementation

7.2: Technological & Process Improvements

Mills will be required to initiate a set of process and technological improvement steps to improve efficiency and reduce chemicals, energy, and water consumption and reduce pollution load. These initiatives and stipulated deadlines are listed in Table 11.

Table 11

Process and Technological Improvement Activities to be initiated with respective Deadlines

Sr No	**Activities**	**Action by**	**Completion date**
1)	**Self-Assessment:** Policy statement with details of inventory of existing process technologies & practices. Identification of augmentation requirements & preparation of action plan for upgradation with supporting documents & pert chart	Mills	One Month
2)	**Third Party Evaluation &Validation:** Evaluation / validation of the reports on inventory, upgradation requirements and action plan	Mills to submit reports from nominated third party.	Two Months
3)	**Implementation of action plan:** Envisaged as per document of individual mills	Mills	As per Schedule
4)	**Monitoring & Assessment:** Submitting status / Progress reports on reduction in water consumption & effluent generation	Mills to submit progress reports to SPCB	Quarterly (Once).

		SPCB to submit verification reports.	
5)	**Verification of Progress** SPCB/CPCB will assess the progress once in 6 months & submit status reports.	SPCB/CPCB	Semi-annually (Once)

7.3: Water Conservation & Water Recycling

Measures to conserve water and carryout water recycling wherever possible results in substantial reduction in water consumption and volume of wastewater generation. Table 12 lists a set of activities to be carried out by mills and the time frame for the same.

Table 12

Water Conservation and Water Recycling Practices to be adopted by Mills and their respective Time fames

Sr No	**Activities**	**Action by**	**Completion date**
1)	Installation of sealed flow meter and running hours meter on bore wells and inlet pipeline of different process section i.e. textile mill, textile production area, boiler etc.	Mills	One Month
2)	Colour coding of pipe lines carrying recycled process water and fresh process water	Mills	Two Months
3)	Maintenance of log book to record daily water drawn from bore well and water consumption unit wise after installation of meter. Record of power consumption – meter readings for inlet water pumps	Mills	Daily monitoring & recording
4)	Self-Assessment: Preparation of report of existing water consumption- section wise, reuse/ recycle practices; Preparation of work plan to achieve fresh water requirement targets	Mills	One month

7.4 Assessment, Augmentation and Up-gradation of ETPs for Improved Environmental Performance

Periodic assessment of ETPS should be routinely carried out. This helps in pinpointing units that are not working properly and deciding about the possible strategies for up-gradation and augmentation of the ETP. The activities to be carried out and responsible organizations with time frame are listed in Table 13.

Table 13

Improved Environmental Performance Parameters through Assessment, Augmentation and Up-gradation of ETPs

Sr No	**Activities**	**Action by**	**Completion date**

1)	**Self-Assessment:** Preparation of ETP adequacy assessment report & proposed augmentation & up-gradation report with design & drawing with monthly pert chart.	Mills	One Month
2)	**Third Party Evaluation & Validation:** Evaluation / validation of adequacy, and proposed augmentation / up-gradation plan, design / drawings	Mills	Two Months
3)	Implementation of action plan submitted	Mills	As per Schedule
4)	Submission of monthly progress report with evidences	Mills	One Month
5)	Verification of Submission- Progress reports	Third party	Quarterly (Once)
6)	Verification of Progress	SPCB	Quarterly (Once)

7.5 Monitoring & Surveillance of Environmental Compliance

Monitoring and surveillance of the environmental compliance by the textile mills as stipulated in the Charter should be carried out at several levels- such as self-monitoring and periodic report submission by the mills to SPPCB or a third party. The strategies to be adopted and the time frame are listed in Table 14.

Table 14: Strategies and Time Frame for Monitoring & Surveillance of Environmental Compliance

Sr No	Activities	Action by	Completion date
	Self-Monitoring & Reporting:		
1)	ETP performance monitoring by individual Mills and maintenance of Log Book as per the prescribed format	Mills	Daily
2)	**Submission of the performance report**: Reports to be submitted by Individual mill to SPCBs	Mills	Monthly
3)	**Review meetings**: Review meetings between Mills / Third party & SPCBs to help mills to improve ETP performance & sample analysis quality	Third party / SPCB	Quarterly
4)	**Regulatory Monitoring:** Periodic / Surprise monitoring and review meetings	SPCB	Quarterly
5)	**Training & Knowledge upgradation:** Organization of training programmes on process technology, best practices, ETP operation & maintenance, Sample analysis, Troubleshooting etc….	SPCB / CPCB	Periodically to organize & all mills must send their officials to attend.
6)	**Employment of Trained team: T**o make mandatory requirement - to employ one staff at every ETP with **Environmental Proficiency Certificate** or minimum 5 years	Mills	Periodic

of handling ETP plant.

7.6 Environmental Management Cell (EMC) and Laboratory Facility

In view of the importance of resource conservation, water reuse and recycle, and efficient functioning of ETPs, it is essential to create an environmental management cell (EMC) (or strengthen it if already existing) and establish laboratory facilities for evaluating basic pollution parameters capable of indicating the functioning of ETPs will be mandatory.

7.6.1 Setting up of Laboratory Facility at Textile Mills for Effluent Analysis

It would be worthwhile to have basic laboratory facilities for measuring all indicator pollution parameters as stipulated in the notified norms of CPCB for textile mills. These facilities and instruments will be over and above those incorporated in the **continuous online monitoring system.**

(a) As per the Environment (Protection) Rules, 1986 pH, DO, TSS, TDS, BOD, COD, Color, Oil & Grease, Total Cr, Phenol, Total Sulfide, Ammoniacal-Nitrogen and SAR (Sodium Absorption Rate) are mandatory to be measured for textile mills. Thus, the mills should have minimum analysis facilities for measuring these parameters. The list of basic laboratory equipment for a standard laboratory coupled with ETP is given in Table 15

Table 15
List of Equipment for ETP Laboratory

Instruments	No of pcs
pH Meter+ Paper strip	1+ Full set
pH Pen	3
TSS Meter	1
TDS Meter	1
DO Meter	1
BOD testing kits with Incubator	1 set
COD testing kits	1 set
Oven	1
Digital weighing balance: With 0.1 mg accuracy With 10 mg accuracy	 1 1
Necessary Glass ware	As per test procedures mentioned in
Chemical reagents	"Standard test Methods"

(b) The ETP and its laboratory should have properly qualified adequate scientific officials and technical staff for smooth its smooth operation. Details of such staff with their cadre and qualifications are given in Table 16.

Table 16 Scientific and Technical Staff for ETP and Laboratory

Minimum strength in ETP		
Post	Education / Experience	No of employees
Environment Officer	Graduate in Science / B.E. with 5 years' experience	1
Shift Supervisor cum Lab Technician	Graduate in Science	1
Fitters cum operators	ITI pass	3 (1 per shift)
Helpers	Adult workers	As per requirement
Necessary strength of relievers to be maintained for working on 7 days a week (Continuous process)		

(c) Training of the Staff
Necessary training to be given to each employee with minimum 8-man days in year by professional trainers from reputed organizations.

(d) Frequency of the analysis
A particular time schedule should have to be followed for measuring various pollution parameters. This frequency of such measurements is listed in Table 17.

Table 17
Frequency of Wastewater Analysis

Parameters	Frequency of Testing
pH	**Once in a shift of 8 Hours**
TSS	**Once in a Shift of 8 hours**
TDS	**Once in a Shift of 8 Hours**
Dissolved Oxygen	**Once in a shift of 8 hours**
Treatability study	**Once in a Day**
MLVSS/MLSS	**Once in a Day**
COD	**Once in a day**
BOD	**Once in a week**

Treatability study: -
Daily once this study to be done

Collect 10 Ltr of untreated effluent in Bucket.
Add dosing chemicals with correct measurement & check for flocks' generation & settling of flocks with various dosages of chemicals.

Note dosage of chemicals for best generation of flocks & also lowest settling time.

Continue with same amount of dosages for coming 24 hours with intermittent checking in actual process.

7.6.2 Operation & Maintenance of ETP

To achieve the designed performance from ETP, it is necessary to operate it under optimum conditions so as to meet the environmental discharge standards for which regular analysis of various process and pollution parameters and maintenance of records are necessary. For proper and optimum operation of ETPs, the mills should ensure that the plant is well maintained and

all equipment are in good working condition. Following guidelines must be religiously followed for proper operation and maintenance of ETP.

Key Guidelines for Operation & Maintenance

- Ensure proper and optimum conditions of each section of ETP as per the designed specification and manufacturer's instruction.
- Avoid fluctuation in effluent flow and pollution load so as to reduce the shock load to bio-mass and the system as a whole.
- Ensure proper addition of nutrients in aeration tank
- Maintain required level of MLSS/MLVSS concentration during biological treatment. It is cheaper, faster and also eco-friendly.
- Maintain desired level of DO in the aeration tank (1.5 to 2.2 mg/l).
- Ensure periodic & timely withdrawal of sludge from the clarifiers & settled bio mass from aeration tanks.
- Ensure proper maintenance of electric motors, pumps & blowers with diffuser system. etc.
- Use power saving technique in ETP operation as suggested below:
    - Optimization of blower speed (by VFD) in aeration tank linked with DO in aeration tank
    - pH control (Dosing of acid) to be linked with pH meter reading of effluent.
- Introduce the practice of proper documentation & record keeping
- Maintain proper record of fresh water consumption, effluent discharge, effluent analysis, and consumption of chemicals in ETP and utility (like steam and power)

For the benefit of Mills formats for daily monitoring & record keeping are provided as under. The Mills are required to prepare a proper log-book using these formats.

Water Consumption, Wastewater & Sludge Generation Data					
Date	Inlet Water, kL	Effluent Generated, kL	Sent to CETP/ ETP, kL	Sludge Generated, kg	Sludge Disposal, kg
1 Feb					
2 Feb					
3 Feb					

Wastewater and Treated Effluent Characteristics												
Date	Inlet Effluent at ETP						Outlet quality from ETP (To CETP)					
	pH	TDS	TSS	COD	BOD	Color	pH	TDS	TSS	COD	BOD	Color
		PPM	PPM	PPM	PPM	visual		PPM	PPM	PPM	PPM	visual
1 Feb												

2 Feb												
3 Feb												

Date	Biological treatment							
	pH	DO	MLSS	MLVSS	COD	BOD	Color*	Effluent flow
		PPM	PPM	PPM	PPM	PPM	visual	kL/h
1 Feb								
2 Feb								
3 Feb								
* Color can be mentioned as Dark, Medium, light, no								

Electric Power & Man Power utilization				
Date	Power consumption in ETP in units		Strength of Man power (staff + operator) Std Strength = ____	
	Meter Reading	Units	Staff	Operators + Helpers
1 Feb				
2 Feb				
3 Feb				

Mill must maintain supporting (date wise) documents for energy strength of work force per day

Chemical Consumption data						
Date	ETP					
	1	2	3	4	5	6
	kg	kg	kg	kg	kg	kg
1 Feb						
2 Feb						
3 Feb						

Record of Mal-functional/Non-functional ETP Units

ate	ETP equipment							
	1	2	3	4	5	6	7	8
Date	Yes							
1 Feb		No	No					
2 Feb								
3 Feb								

ETP in-charge will be required to maintain data of non-working / under repair status on daily basis. This will help to know the non-functional sections and management can attend same on priority. Moreover, any deviation in outlet results can also be analyzed.

7.6.3 Creation of Environmental Management Cell (EMC)

Every mill will compulsorily setup an Environmental Management Cell (EMC) to effectively monitor the environmental compliance. The Environmental Management Cell will constitute of:

- Unit /Business Head
- ETP In-charge & staff
- Process Operations Heads
- Factory Manager
- Safety officer

Duties of Environmental Management Cell (EMC)

- The Environmental Management Cell (EMC) shall review the water consumption, measures taken and identify the areas for water conservation, resource recovery and pollution reduction every week.
- The detailed minutes of the decisions taken will be recorded and circulated to all members of (EMC) and follow up of the decisions will be monitored by the Unit Head & ETP In-charge.
- Review to be made in case of non-compliance by mill.
- Internal Audit to be done by the EMC on quarterly basis.
- EMC should arrange for External Environmental Audit on an annual basis.

8. Resource Planning and Implementation of Charter

Implementation of the Charter and the compliance with the prescribed norms / standards shall be the sole responsibility of the textile mills. The entire cost towards implementation of the Charter as per the Plan of Activities shall be borne by the individual textile mill. Textile Mills shall carry out all the activities related to self-assessment, preparation of action plan, including PERT Chart,

implementation of the Charter and self-compliance reporting. Participating mills may take technical / logistic assistance of experts or industry associations for carrying out various activities as per the plan of activities. Some of the activities to be carried out by the individual mills are as under:

1. Preparation of inventory of existing process technologies and practices.
2. Identification of process and technological up-graduation requirements w.r.t. the Charter.
3. Preparation of Action Plan, including monthly PERT Chart for implementation of the Charter for technological and process up-gradation.
4. Implementation of technological up-gradation action plan and submission of monthly progress report.
5. Preparation of ETP adequacy assessment report w.r.t. environmental compliance, actual production, pollution load generation and targeted water consumption; and design, drawing and preparation of proposed augmentation and up-gradation plan, including monthly PERT Chart in accordance with the Charter.
6. Implementation of ETP up-gradation action plan and submission of monthly progress report.
7. Installation of sealed flow meter along with running hours meter on inlet water (bore wells/ wells/ another source).
8. Installation of flow-meters at individual inlet pipe line of different process operation.
9. Setting up of online effluent monitoring system to monitor final effluent discharge. Those connected to CETPs can have common system installed at CETP discharge.
10. Color coding of pipelines carrying recycled process water and fresh process water.
11. Maintenance of logbook to record daily water drawn from bore wells.
12. Maintenance of logbook by individual process unit for recording daily water consumption.
13. Setting up of maximum water consumption targets for individual unit operation.
14. Report preparation of existing water consumption-section wise, reuse / recycle practices, strategies/work plan to achieve fresh water consumption targets.
15. Implementation of water recycling action plan and submission of monthly progress report.
16. Self-monitoring and reporting: Daily ETP performance monitoring and maintain log book as per the prescribed format.
17. Participation in periodic review meeting to be held by Third Party.
18. Strengthening of Environmental Cell and Laboratory facilities
19. Organizing training programme for their personnel (minimum 32 hours/person/year)

8.1 Third Party: Resource Institutes

Each of the participating mills may identify either any one of the identified Third Parties for evaluation and validation of their technical reports (self-assessment and planning reports: Preparation of inventory, ETP adequacy & upgradation, and action plans to implement the Charter) and physical verification of individual mills' progress reports under the Charter implementation programme. Third parties, after verification / validation of the progress reports, shall forward these reports to concerned SPCBs & CPCB on quarterly basis. However, regulatory verification shall be carried out by the concerned SPCB/CPCB to ensure timely implementation of the Charter and compliance with the prescribed norms.

The Third Party shall perform following activities as per the Plan of Activities:

- ✓ ETP adequacy assessment report, design / drawings and proposed augmentation / upgradation plan as per Charter
- ✓ Inventory, upgradation requirements and action plan for process upgradation
- ✓ Work plan by mills for reduction in water consumption/ effluent generation

8.1.1 Initial Phase

1. Evaluation & validation of individual mills Action Plan, including PERT Chart for implementation of the Charter for technological and process up-gradation.
2. Evaluation & validation of individual mills ETP adequacy assessment report w.r.t. environmental compliance, actual production, pollution load generation and targeted water consumption; and design, drawing and proposed augmentation and up-gradation plan, including PERT Chart in accordance with the Charter.
3. Evaluation & validation of individual mills assessment report of existing water consumption – section wise, reuse/recycle practices; and their strategies /work plans to achieve fresh water consumption targets.
4. Submission of validated individual mills action plans to concerned SPCBs and CPCB.

8.1.2 Quarterly Activities

Following activities will have to be carried out on quarterly basis:

a) Verification of progress made by individual mills on process technology / ETP upgradation as per their action plans
b) Verification of individual mills fresh water consumption, effluent generation and water recycling achievement etc.
c) Verification of progress reports submitted by participating mills
d) Compilation of Implementation Status Report for submission to SPCBs/ CPCB
e) Compilation of ETPs performance report for submission to SPCBs/ CPCB
f) Organizing Quarterly review meetings with participating mills/ SPCBs/ CPCB
g) Organizing quarterly review meetings with participating mills/ SPCBs/ CPCB
h) Periodic organization of training/ workshop programmes on process technology
i) & best practices, ETP operation & maintenance, sampling & analysis, etc. for mill personnel.

Cost of engaging third party / expert will be borne by the member mills. Participating Mills shall pay / reimburse fee to their selected Third Party towards meeting the expenditure for carrying out various activities / responsibilities assigned / to be assigned from time to time to the Third Party under the Charter. Each of the identified Third Parties shall provide the estimated project cost as per the scope of work to member mills willing to join them, who shall also be responsible for ensuring the payment of the services to Third Party.

8.2 State Pollution Control Boards (SPCBs)/Pollution Control Committees (PCCs)

The concerned SPCBs / PCCs shall ensure proper implementation of the Charter by the individual mills. They shall be responsible for monitoring and surveillance activities to ensure environmental compliance. Participating Textile Mills will not be allowed, under any circumstances for bypassing of ETPs system and discharge of partially / un-treated effluent or episodic discharge. In case of any violation of the prescribed norms, concerned SPCBs will take appropriate actions, including issuance of closure notices, under the Water /Air Acts/ E (P) Act.

Each of the participating mills shall have option to join either Third Party for evaluation & validation of their technical reports (Self-assessment and Planning Reports, Preparation of Inventory, ETP Adequacy & Upgradation, and Action Plans to Implement the Charter), and Physical Verification of their progress reports under the Charter implementation programme.

Some of the activities identified for SPCBs/PCCs are as under:

- ✓ To ensure proper implementation of the Charter by the individual mills
- ✓ To carry out monitoring and surveillance activities to ensure environmental compliance
- ✓ To take appropriate actions under the Water/ Air Acts /E(P)Act in case of any violation of prescribed norms

- ✓ To participate in evaluation/validation of the status assessment reports, action plan for Charter implementation / process /ETP upgradation
- ✓ To conduct quarterly review meetings of Mills, Third Parties& CPCB to facilitate mills in timely implementation of the Charter
- ✓ To constitute Expert Committee for Evaluation & Validation of following reports directly submitted by the participating Mills to SPCBs (Mills have to decide whether to submit the action plans /progress reports to SPCB/ CPCB directly or through the third party).
  - ETP adequacy assessment report, design / drawings and proposed augmentation /upgradation plan as per Charter
  - Inventory, upgradation requirements and action plan for process upgradation
  - Work plan for reduction in water consumption/ effluent generation

- ➢ Surveillance Activities
  - ✓ Verification of progress reports (On quarterly basis in case of direct submission by participating mills, and on random basis in case of submission through Third Party)
  - ✓ Compilation of Implementation Status Report for submission to CPCB on Quarterly basis
  - ✓ Extensive surprise monitoring

- ➢ Organizing Quarterly Review meetings of participating Mills, Third Parties & CPCB to assess status of implementation of Charter and environmental compliance by mills.

8.3 Central Pollution Control Board (CPCB)

The CPCB shall supervise and co-ordinate with stake holders namely participating textile Mills, Third Parties, Expert Institutions, and SPCBs /PCCs. CPCB shall periodically review the progress of implementation of the Charter and carry out environmental compliance assessments. Based on findings of the review meetings, CPCB shall take necessary actions namely modification in the Charter/Action Plan /roles & responsibilities of participating agencies.

Some of the activities identified for CPCB are as under:

a) Participation in review meetings organized by third parties/ SPCBs
b) Organizing quarterly/ half-yearly review meetings of participating mills/ third parties/SPCBs to review the progress of the Charter implementation programme
c) To supervise, co-ordinate and provide support to stakeholders
d) To take necessary actions namely modification in the Charter/Action Plan / roles & responsibilities of participating agencies, interpretation of the provisions prescribed under the Charter, approval for any state-of-the-art technology, etc
e) Surprise Monitoring

9. Industry Specific Standards Notified under the Environment (Protection) Rules, 1986

Under the Environmental (Protection) Rules of 1986, the maximum limit of various pollution parameters as notified for textile mills is given in Table 19. It should be the responsibility of the mills to maintain & operate their ETP to get a treated effluent conforming to these norms, besides following other guidelines for reducing their energy, raw materials and water consumption.

Table 19 Existing Treated Effluent Quality Standards for Textile Mills

Parameters	Maximum Limits All values in Mg/Ltr (PPM) except pH, Color, SAR
pH	6.5 to 8.5
Suspended Solids (TSS)	100
Color (PCU- Pt-Co. Unit)	150
BOD (3 Days -27° C)	30
Oil & Grease	10
COD	250
Total Chromium as "Cr"	2.0
Total Sulphide as "S"	2.0
Phenolic Compounds as (C_2H_5OH)	1.0
Total Dissolved Solids (TDS)	2100
Sodium Absorption Ratio (SAR)	26
Ammonical Nitrogen (as N)	50

NOTES:

1) In case of direct disposal into rivers and lakes, the Central Pollution Control Board (CPCB) or State Pollution Control Boards / Pollution Control Committees (SPCBs / PCCs) may specify more stringent standards depending upon the quality of the recipient system.

2) Standards for TDS and SAR shall not be applicable in case of marine disposal through proper marine outfall.

3. The treated effluent shall be allowed to be discharged in the ambient environment only after exhausting options for reuse in industrial process / irrigation in order to minimize freshwater usage.

4. Any textile unit attached with the Common Effluent Treatment Plant (CETP) shall achieve the inlet and treated effluent quality standards as specified in serial number 55 of Schedule-I to the Environment (Protection) Rules, 1986 and shall also be jointly and severally responsible for ensuring compliance.

5. The standalone Micro, Small and Medium Enterprises (MSMEs) as per the MSME Development Act, 2006 shall meet the values specified above.

6. The standalone large-scale units shall meet the values specified above; however, CPCB or SPCBs / PCCs with the approval of CPCB, may mandate Zero Liquid Discharge in Large scale units in environmentally sensitive / critical areas.

7. The TDS value with respect to treated effluent shall be 2100 milligrams per litre; however, in case where TDS in intake water is above 1100 milligrams per litre, a maximum contribution up to 1000 milligrams per litre shall be permitted provided the maximum value of 3100 milligrams per litre is not exceeded in the treated effluent.".

10. Charter on Water Recycling & Pollution Prevention in Textile Industry

Textile mills are required to initiate following action plans to meet the requirements of the Charter for water recycling and pollution prevention.

Stage	Action to be taken by mills
1	Plan to reduce water consumption by implementation of new techniques. Within one year of charter implementation
2	Plan to start internal recycling methods depending upon selective re-use in process. Up to Within two years of charter implementation
3	Within two years of charter implementation, mill should plan to reduce water consumption by 30%.

10.1 Best Manufacturing Practice (BMP)

The Best Manufacturing Practice (BMP) is indicative of the systems, equipment, processes and practices that are generally considered essential to achievement of the objectives of this Charter.

Technology actually required or implemented by individual mills to achieve the same documented level of environmental protection may differ on account of their unique set of circumstances like scale of operations, equipment and system configuration, product portfolio, raw material mix, etc.

Ultimate aim is to (A) meet specified standards of discharge effluent and (B) Reduce water consumption by selection of technology and recycle of water.

Water saving techniques listed as under which can reduce water consumption (Mill can adopt below techniques & also can identify other methods to save water consumption. Aim is to achieve reduced water consumption target given in Table 20.

Table 20

Action to be taken for Reducing Water Consumption in Various Process Operations

Process	Suggested Action	Steps to be Taken by Mill
Pretreatment (Desizing, Scouring & Bleaching)	1) Try to recycle internally	○ Can explore possibility to use bleaching water in scouring & desize. ○ Can use water from washes of each process wherever possible through counter current method in soaper & also by storage in tank & re use.
	2) Avoid overflow rinses	○ Overflow rinses consumes 40% more water as compared to smart washing techniques.

	3) Combined Scouring & Bleaching process (Single bath scouring & Bleaching)	○ This will save water by 40% ○ Use counter current system for washing machines
	4) Use enzyme base technology	○ One can reduce water & energy consumption by reduction in temperature & number of washes.
		○ One can recycle this water back to process by topping-up of chemicals
Dyeing	1) Use single bath dyeing for PC blends	○ Saving of water, power, energy & time
	2) Use low salt dyes, 3) Use high exhaustion dyes, 4) Use of pad dry method instead of exhaustion method.	○ Approx. 205 to 60% water can be saved.
Finishing	1) Use of standing bath for batch wise application of finishing chemicals	○ Can save 15% of water. ○
	2) Can use hi suction slit on stenter	○ Can save 15% of water with compared to padding mangle. This also can reduce energy used in drying.
	3) To recycle cooling water on sanforise finish	○ 80% of water saving (Used in cooling)
New techniques	Use equipment's with low MLR	○ Can save 15% to 20% of water
	Recycle chiller plant water	○ Can save 80% of water
	Auto control of humidification room	○ Can save 25% to 30% of water
	Auto level control in processing machines	○ Can save 30% of water.
	Use nozzle with stop motion at the end of pipe during cleaning	○ Can save 25% of water
	Use of sensor for water flushing in toilets	○ Can save 50% of water.

The bare minimum technology (BMT) is indicative of the systems, equipment, processes and practices that are generally considered essential to achievement of the objectives of this Charter. BMT is suggestion for improvement & industry can decide as an optional (It is not mandatory)

Technology actually required, or implemented, by individual mills to achieve the same documented level of environmental protection, may differ on account of their unique set of circumstances like scale of operations, equipment & system configuration, product portfolio, raw material mix, etc.

Ultimate aim is to A) meet specified standards of discharge effluent and B) Reduce water consumption by selection of technology & recycle of water.

1) Textile is one of the profits making and sunrise industries in India. Chemical wet processing of textile consumes 8000-10000 chemicals, dyes and auxiliaries and some of them are banned due to their carcinogenic and other health impacts. It has been imperative to produce quality goods at economical price but not at the expense of environment, health & hygiene. To combat the difficulties raised by people who are in the business of textile; specially wet processors are compelled to employ eco-friendly wet processing right from pre-treatment to finishing ensuring good quality and reducing overall cost.
2) Textile industries use different chemicals in different processes like Desizing, Scouring, Bleaching, Dyeing, Printing, Finishing, Softening, Washing etc. The textile processing industries consumes large quantity of water and produce large volume of waste water from different steps in various processes. Waste water from textile processing and dyeing containing residues requires appropriate treatment before being released into environment.
3) Interest in eco-friendly processing in textile industry has increased with the awareness of environmental issues. Chemical management System can help to reduce NPO (Non-Productive Output) & reduces pollution load on ETP and also conform to the quality of product as per customer's requirements.
4) To overcome pollution issue and reduce its impact on environment, mill technocrats must understand CMS (Chemical Management System) to:
    - List out total chemicals being used in plant and know its impact on environment.
    - Select chemicals which are less harmful to environment as well as human beings. This can be done by adding environment related check point while selection of new chemical.
    - Follow instructions given in the Manual for Storage, Disposal and Safety (MSDS) and Technical Data Sheet (TDS) of chemical and know their pollution impact.
    - Follow standard process parameters as per TDS for best usage of chemical.

11. Chemical Management System (CMS)

The Textile Supply Chain is composed of several tiers as we go down the ladder from the consumer to the fiber manufacturer. Across this stream, chemicals are used at different stages. Maximum use of chemical and therefore risks – is in the processing section i.e. the garment laundries and the fabric dye-house (Fig. 9).

It is essential to manage the chemicals with proper understanding right from purchase, usages & up to disposal.

Looking towards seriousness of subject & need of an hour, CMS is developed. There are many consultants who work on CMS & guide industries for better outputs by reducing NPO's.

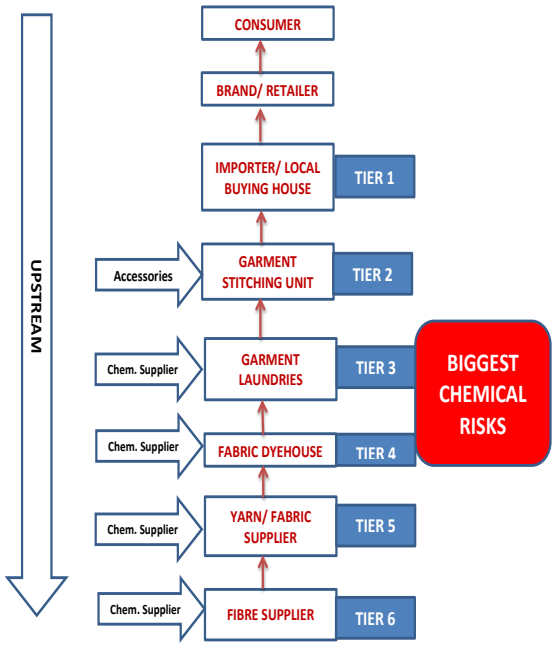


Fig 9: Textile supply chain

(A) Objectives of CMS

- Quality & performance of end product,
- Compliance to prescribed norms
- Productivity improvements.

(B) Advantages of CMS

- Cost savings
- Improve quality of end product
- Compliance in outputs (Product & effluents)
- Saving in water & energy
- Reduce accidents & improves Health & Safety

(C) How to Implement CMS

- Commitment for CMS
- Development of CMS team
- Development of CMS Policy
- Deciding authorities & responsibilities of team member from CMS team.
- Training to CMS team & work force
- Providing necessary formats for implementation of CMS in facility
- Development of MIS System - Daily / Monthly check points & reporting system to Top Management
- Self-grading system for future self-assessment.

(D) Examples for action

- Reduce chemical consumption by automation (pH control, Temp control, etc…)
- Use of Enzyme base technology in pre-treatments.
- Techniques to Reduce Salt consumption
- Replace Soda ash by Liquid alkali
- Know chemicals & its parameters for application
- Reuse
  - ✓ Water (standing bath technique, Counter current washing)
  - ✓ Water from Pre-treatments to be reused in to other baths like desizing.
  - ✓ Salt from Dye bath drain by Nano filter technology
  - ✓ Heat from Heat Recovery Unit
  - ✓ Water by using Vacuum slit instead of regular squeezing for better squeezing
  - ✓ Caustic recovery from mercerize wash liquor
  - ✓ PVA recovery system.

- ✓ Reuse of cooling water at various stages of processing (Cooling water from sanforise), Cooling towers etc….
- Single bath dyeing of PC blends for selective shades
- Use of Low salt dyes.
- Reduce MLR by various techniques
- Replace overflow rinse by normal washes.
- Use of standing bath for finishing.
- Auto dosing system for chemicals
- Use of laser techniques in place of Potassium Permanganate

12. BARE MINIMUM TECHNOLOGY (BMT)

BEST MANAGEMENT PRACTICES (BMP)

BMT is indicative of the systems, equipment, processes and practices that are generally **considered essential to achievement** of the objectives of this Charter in eco-friendly manner. Technology actually required, or implemented by individual mills to achieve the prescribed standards may differ on account of their unique set of circumstances like scale of operations, equipment & system configuration, product portfolio (cellulose, wool/silk/jute, polyester etc.).

However, in addition to the requirement of good manufacturing technology, the mills can also reduce their contribution in pollution load by resorting to Best Management Practices and good house-keeping measures. In the following pages a summary of the Bare Minimum Technologies and Best management Practices (BMP) are listed for effluent and emission control.

BMP is suggested practices which can reduce the consumption of natural resources like fuel, power & water. It also reduces overall load of pollution. This is **not considered as mandatory** as it can be applied depending upon the availability of technology (equipment & process) & also on quality of end product requirement.

Table 21: Bare Minimum Technologies (BMT) – Mandatory
Best Management Practices (BMP) - Optional

Measures to Be Taken by Facility			
Sl. No.	**Functional Area**	**BMT / BMP**	**Type of Action / Facility (Generic)**
1	**Raw Material Storage**		
1.1	**Storage of raw material**	**BMT**	Covered storage area with proper lighting, ventilation, and access to every stack. The storage area must have all requirements as per the current Factories Act.
1.2	**Storage of Dyes & Chemicals**	**BMT**	• Dyes & chemicals must be stored: - In a covered area – away from direct sun light. - In a place having good ventilation - With proper labeling • All storage / handling & first aid conditions to be maintained as per MSDS guidelines • First aid & firefighting equipment must be located as per the current Factories act. • Provision of containment area for storage for every chemical. • Provision of proper drainage lines so that seepage/spills of dyes and chemicals must reach to ETP. • Should follow storage conditions as per the current Factories act.

			• Correct system to measure mass or volume (kg or Liter). • Proper record of available stocks at any point of time.
		BMP - Optional	• To use stackers for vertical storage of material in racks • To display handling & safety measures for each chemical at storage area. • Display first aid measures in case of accident. • Provision of PPE • Install eye wash & shower with easy approach.
	Water storage	**BMT**	• Covered storage tanks for water with minimum capacity to store for 2 days of water consumption. • Measurement and record of water input & consumption in m^3/d.
		BMT	• To have a separate water tank as a reserve for any accident in premises.

Bare Minimum Technologies (BMT) - Mandatory Best Management Practices (BMP) - Optional			
Measures to Be Taken by Facility			
Sl. No.	**Functional Area**	**BMT / BMP**	**Type of Action/Facility (Generic)**
2	**Processing - (Pre-treatment / Cleaning, Dyeing /Printing, Finishing/Laundry etc...) & Laboratory**		
2.1	**Processing**		
2.1.1	**Pre-treatment / Cleaning**	**BMT**	1. All equipment with required inbuilt safety measures 2. Correct weighing balances to measure the material to be processed & also chemicals required to be issued exactly as per issue slip 3. Digital temperature measuring devices. (Optional auto control of temperature) 4. Measurement of water consumption during each process. 5. System to maintain process parameters as per MSDS guidelines / Technical Data Sheet. 6. Use of environmentally hazardous chemicals in process to be avoided (refer MSDS / CPCB guideline of hazardous nature) 7. Availability of PPE & First Aid boxes as per guidelines given in MSDS 8. Must follow the current Factories act guidelines for all equipment
		BMP - Optional	1. To use auto dosing system for dyes & chemicals. 2. pH measuring devices (auto control acid dosing to maintain pH)
2.1.2	**Dyeing & Printing**	**BMT**	1. Dyeing equipment with required inbuilt safety measures. 2. Correct weighing balances to measure the material to be processed & also chemicals required to be issued exactly as per issue slip

			3. Digital temperature measuring devices (Optional auto-control of temperature) 4. Light boxes for shade matching (Optional CCM along with light box) 5. Measurement of water consumption during each process (Optional auto control of water level). 6. System to maintain process parameters as per MSDS guidelines / Technical Data Sheet. 7. Use of environmentally hazardous chemicals in process to be avoided (refer MSDS for guideline of Hazardous nature) 8. Availability of PPE & First aid boxes as per guidelines given in MSDS 9. Must follow the current Factories act guidelines for all equipment.
		BMP - Optional	1. To use auto dosing system for dyes & chemicals. 2. pH measuring devices (auto control acid dosing to maintain pH)
2.1.3	**Finishing**	**BMT**	1. Finishing equipment with required inbuilt safety measures. 2. Correct weighing balances to measure the material to be processed & also chemicals required to be issued exactly as per issue slip 3. Digital temperature measuring devices (Optional auto control of temperature). 4. Measurement of water consumption during each process (Optional auto control of water level) 5. System to maintain process parameters as per MSDS / Technical Data Sheet. 6. Use of environmentally hazardous chemicals in processing to be avoided (refer MSDS for guideline of Hazardous nature) 7. Use of PPE & First aid treatment as per guidelines given in MSDS 8. Must follow the current Factories act guidelines for all equipment.
		BMP - Optional	1. To use auto dosing system for dyes & chemicals. 2. pH measuring devices (auto control acid dosing to maintain pH)
2.2	**Laboratory**		
2.2.1	**Incoming Raw material**	**BMP - Optional**	○ Testing of raw material for Count/Denier, GSM & other necessary parameters ○ Checking for impurities & contaminants in raw material (e.g. Oil % in polyester, size% for woven fabrics etc.)
2.2.2	**Dyes / Chemicals**	**BMP - Optional**	○ Testing of % purity of every dye & chemical.
2.2.3	**Finished Product**	**BMP - Optional**	○ Testing of finished goods for color fastness to washing & rubbing. ○ Testing for home laundering.

Bare Minimum Technologies (BMT) for ETP (Mandatory) Best Management Practices (BMP) for ETP (Optional)			
Measures to Be Taken by Facility			
Sl. No.	**Functional Area**	**BMT / BMP**	**Type of Facility (Generic)**
3	**Effluent Treatment Systems:** **One of the following combinations of effluent treatment technologies should be used to comply with treated effluent discharge standards notified under the Environment (Protection) Rules, 1986.** **1. ETP must have Primary/Secondary & Tertiary Treatment units** **2. Capacities of treatment tanks should be as per guide line given in below table for ETP** **3. Online measurement for pH, effluent flow, DO, TDS at various treatment tanks (optional online control- auto dosing for pH control & auto control of DO by invertor drive).** **4. Proper sludge drying system with separate sludge storage area with containment area.** **5. Laboratory for testing of inlet & outlet effluent for pH, TDS, TSS, BOD, COD & flow. These must be recorded on daily basis.** **6. Daily record of sludge generation & disposal**		
	The following individual plants are used for above schemes in different combinations.		
4.1	**Biogas generation**	**BMP - Optional**	• Anaerobic digestion is the biological decomposition of organic matter in absence of oxygen. It is the conversion of organic acid into methane and carbon dioxide by consortium of bacteria. This is generally applicable where sizing & desizing processes are carried out. This bio gas can be used in canteen. • COD reduction is around 60 to 70 %. The organic load in the digester is in between 5.0 to 8.0 kg/m^3/day. • One of the following biogas technologies are used as CSTR, UASB, Fixed Film and Thermophilic digester. **These processes can be used for treatment of effluent generated from sizing /desizing processes (in a volume)**
4.3	**Incineration of Bio-Sludge**	**BMP - Optional**	• Bio-sludge can be used as fuel along with supporting fuel such as coal, bagasse or other biomass whereas chemical sludge shall be taken to TSDF sites. • Bio sludge is generated in aeration tank & can be used as a fuel along with normal fuel in boilers.
4.4	**Membrane filtration /Reverse osmosis**	**BMP - Optional**	• Advance filtration technic (UF / Nano / RO) has been used commonly for advanced treatment of wastewaters to remove dissolved inorganic solids and some recalcitrant compounds. • The majority of the dissolved salts, low molecular weight organic materials, heavy metals, bacteria, viruses and suspended solids etc. are separated by the series of right membranes and are separated from the system as a brine

			which can be recycled back to dyeing process & reject to be dried in MEE. In this process, care to be taken in selection of pore size of Nano / RO.

Below is the BMT for each ETP (as per effluent volume generated). Facility should follow the suggestive guidelines mentioned below for getting desired results.
ETP should be operated by trained operators.
Operator should have recognized degree in Environmental Science/Engineering

Industry type		**Minimum design required depends on effluent generation L/day**		
Water consumption L/day	**Function/Description of Equipment**	**Upto 50000 L/day**	**50000- 2 Lac L/day**	**Above 2 lac L/day**
Primary collection tank/ Equalization tank	○ **To make homogeneous mixing of inlet effluent so that constant quality can be available for further process.** ○ **To maintain pH between 6.0 to 8.0** ○ **To maintain the ambient +/- 3ºC temperature**	○ **Minimum tank capacity with retention time of 36 hours with air mixing facility** ○ **Chemical Dosing tanks to maintain pH**	○ **Minimum tank capacity with retention time of 30 hours with air mixing facility** ○ **Chemical Dosing tanks to maintain pH (Online meter)** ○ **Surface aerators can be used to mix the effluent which can help to maintain the temperature.**	○ **Minimum tank capacity with retention time of 30 hours with air mixing facility** ○ **Chemical Dosing tanks to maintain pH (Online meter)** ○ **Surface aerators can be used to mix the effluent which can help to maintain the temperature.**
Flocculation/ Coagulation tank	○ **Dosing tanks for 3 chemicals to generate flocks. (de-colorant 1 tank & flocculating/ coagulating chemicals – 2 tanks**	○ **Tank capacity: for 30 min retention time** ○ **Low speed stirrer with regulator.**	○ **Tank capacity: for 30 min retention time** ○ **Low speed stirrer with regulator.**	○ **Tank capacity: for 30 min retention time** ○ **Low speed stirrer with regulator.**
Flocks settling Tank	○ **Effluent entry from bottom & exit from top.** ○ **Sludge removal valve at the bottom**	○ **Tank capacity: for 2 hours retention time.**	○ **Tank capacity: for 2 hours retention time**	○ **Tank capacity: for 2 hours retention time**
Primary clarifier	○ **Clarifier to separate & remove solid chemical sludge from top & bottom.**	○ **Storage capacity of clarifier should be 6 hours**	○ **Storage capacity of clarifier should be 4 hours**	○ **Storage capacity of clarifier should be 4 hours**
Aeration tank	○ **Aeration tank with biomass dosing system** ○ **Air blow with diffusers**	○ **Retention time in aeration tank - 24 hours**	○ **Retention time in aeration tank - 24 hours** ○ **Spare air blower**	○ **Retention time in aeration tank - 24 hours** ○ **Spare air blower** ○ **Online meters are essential**

	○ Online DO meter, pH meter	○ Not required if connected to CETP & fulfilling inlet norms of CETP. ○ Online meters are essential	○ Online meters are essential	
Secondary Clarifier*	○ Clarifier to separate & remove Biological sludge from top (scrapper) & bottom.	○ Storage capacity of clarifier should be 8 hours ○ Not required if Aeration tank is not installed.	○ Storage capacity of clarifier should be 8 hours	○ Storage capacity of clarifier should be 8 hours
Pressurized Sand Filter & Activated Carbon Filter	○ Sand Filter is required to remove fine particles from treated effluent ○ Activated Carbon Filter is required to adsorb bad smell gases from effluent.	○ Suitable for effluent volume	○ Suitable for effluent volume	○ Suitable for effluent volume
Micro Filter (Optional)	○ Two Bag Filters first 25 Micron & 5 Micron	○ Not required if connected to CETP	○ As per effluent volume	○ As per Effluent volume
Ultra-Filter (Optional)**	○		○ Sufficient capacity as per design	○ Sufficient capacity as per design
RO (Optional)**	○		○ Sufficient capacity with three stage RO - as per approved design	○ Sufficient capacity with three stage RO - as per approved design
Sludge Settling Tank	○ To settle the sludge from clarifier or drain from any section of ETP. This will thicken the sludge which can be dried quicker.	○ 10000 L	○ 30000 L	○ 50000 L
Sludge Press / Drying System [NOTE: Both should be there- Filter press for primary sludge and	○ To get thick sludge which will be dried in sunlight or sludge dryer (Sludge Press / Decanter)	○ Sufficient capacity as per design		
		○ Hazardous sludge should be stored properly in a covered area to avoid contact with rain water/air till the authorized vendor takes it away for final disposal through landfill or incineration.		

sand drying beds for secondary sludge]		
***. There are various types of clarifiers facility can select any & decide retention time of effluent for treatment.**		
****. Auto back wash to be designed to improve life of membrane.**		
ETP / Water recycling system must be getting approved. **Facility officials must meet the desired conditions & standards as per valid consent to operate.**		

It is suggested to keep a control on water consumption depending upon the categories mentioned in chart. Industry should confirm time bound action plan to reduce water consumption per kg of product generated.

4. Air Pollution Control

Settling Chamber	○ **To remove coarser particulates from flue gas**	**Stack dimensions (height and diameter should be as per norms of CPCB to ensure sufficient dilution**
		Settling chamber of suitable size (rectangular cross-section) should be close to the ground level.
Multi-cyclone	**To remove finer particulates with high efficiency**	**Dimensions of individual units and number of units in sequence to achieve the required removal efficiency**
Bag filters (Alternative to cyclones)	○ **To remove finer particulate matter** ○ **Fabric of bag should be able to bear high temperature**	**Sufficient capacity and number per bag house as per flow, particulate load and required removal efficiency**
Ash ponds	**To hold the boiler ash till disposal**	**Having sufficient capacity to hold ash generated during 2-3 months** **There should also be a stand by pond.**
Fuel & Energy source	○ **From renewable sources as much as possible**	**Facility should switch over to renewable energy source (rice husk, agro-biomass, solar)**
		Use of wood should be stopped to avoid/reduce deforestation

Annexure-V: List of Industries in the catchment of River Ganga and tributaries located in Varanasi & Bhadohi

S. No	District	Name & Address of Industry	Category/ Sector	Name of Main Tributary of River Ganga
1	Bhadohi	A R S Dyeing, Himmatpur Bakuchiya, Bhadohi.	Yarn/Textile Processing	Varuna/Ganga
2	Bhadohi	Ashoka Dyeing Centre, Ghosiya, G.T. Road, Bhadohi	Yarn/Textile Processing	Ganga
3	Bhadohi	B.C. Yarn Dyers, Morh Road, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
4	Bhadohi	Bee kay woollens (P) Ltd, By pass Road, Bhadohi.	Yarn/Textile Processing	Varuna/Ganga
5	Bhadohi	Bhadohi Carpets, BIDA Carpet City, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
6	Bhadohi	Bhikhoo Ram Yarn Dyers Harirampur, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
7	Bhadohi	Carpet International, Hariyon bypass Road, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
8	Bhadohi	Carpet Palace dyeing division, P.No.- 67-79, 79 A Carpet city BIDA Carpet City, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
9	Bhadohi	Champa Dyeing Pvt. Ltd., Gyanpur Road, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
10	Bhadohi	Chandra Wollen Pvt. Ltd.Ogapur Aurai, Bhadohi	Yarn/Textile Processing	Ganga
11	Bhadohi	D N Yarn Dyers Rayan Bhadohi	Yarn/Textile Processing	Varuna/Ganga
12	Bhadohi	D.P. Woollen Mills, Babu Sarai Maharajganj, Bhadohi	Yarn/Textile Processing	Ganga
13	Bhadohi	D.P. Yarn Dyers, Babu Sarai Maharaj Ganj, Bhadohi	Yarn/Textile Processing	Ganga
14	Bhadohi	Deepak Dyeing House, BIDA Carpet city, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
15	Bhadohi	Delight Dyeing Centre, Gopiganj, Bhadohi	Yarn/Textile Processing	Ganga
16	Bhadohi	Dewnathpur woollen mills pvt. Ltd., Laxman Patti Devnathpur Bhadohi	Yarn/Textile Processing	Ganga
17	Bhadohi	E Hill & Company Khamriya, Bhadohi	Yarn/Textile Processing	Ganga

S. No	District	Name & Address of Industry	Category/ Sector	Name of Main Tributary of River Ganga
18	Bhadohi	Eastern Export, Fattupr Suriyavan Road, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
19	Bhadohi	I.S. Dyeing Division, Ram Raypur, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
20	Bhadohi	Ideal Carpet Limited, Gopiganj, Bhadohi	Yarn/Textile Processing	Ganga
21	Bhadohi	Jai Bajarang Yarn Dyers, Khamriya Road, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
22	Bhadohi	Kas Carpet, Station Road, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
23	Bhadohi	Kohinoor woollen carpet industry, G.T. Road Ghatampur Aurai, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
24	Bhadohi	M S Trading Company, Main Road, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
25	Bhadohi	Mamb woollens Ltd., Jamunipur, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
26	Bhadohi	Manoj Dyers, Ahemadpur, Phulwariya, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
27	Bhadohi	O A C Woollen Mills, Fattupur, Morh Road, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
28	Bhadohi	Obeetee, Limited, Gopiganj, Bhadohi	Yarn/Textile Processing	Ganga
29	Bhadohi	Parkash dyeing centre Khamaria, Bhadohi	Yarn/Textile Processing	Ganga
30	Bhadohi	Pee Sons, Mariyad Patti, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
31	Bhadohi	Prasad Carpet Emporlium, Khamaria, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
32	Bhadohi	Bhadohi Dyers (Olde Name R R Dyers) Naya Bazar Zahid pur jaypur bypass road, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
33	Bhadohi	R.H. Dyers, Main Road, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
34	Bhadohi	Radha Dyeing Corporation, Carpet city BIDA, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
35	Bhadohi	Rainbow Woollens, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
36	Bhadohi	Raj Dyers, Mamdevpur, Bhadohi	Yarn/Textile Processing	Varuna/Ganga

S. No	District	Name & Address of Industry	Category/ Sector	Name of Main Tributary of River Ganga
37	Bhadohi	Rupesh kumar & brothers, BIDA Carpet City, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
38	Bhadohi	S.S. Dyers, BIDA Carpet City, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
39	Bhadohi	Sad woollens mills, Hariyaon Bhadohi	Yarn/Textile Processing	Varuna/Ganga
40	Bhadohi	Shesh Sons Pvt. Ltd. Bhadohi	Yarn/Textile Processing	Varuna/Ganga
41	Bhadohi	Home Flooring & Decor (P) Ltd. (Olde Name Shiekh Bhullan Carpet Pvt. Ltd.), Goppur Joharpur gopiganj, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
42	Bhadohi	Shobha woollens Pvt. Ltd., Hari Rampur Gyanpur Road Bhadohi	Yarn/Textile Processing	Varuna/Ganga
43	Bhadohi	Shubham Dyeing Centre, Aurai, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
44	Bhadohi	Shyam Lal (Dyeing Division), Hari Rampur, Aurai Road, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
45	Bhadohi	Sunny carpet pvt. Ltd., Khamaria, Bhadohi Sant Ravidas Nagar.	Yarn/Textile Processing	Ganga
46	Bhadohi	T S Dyers & processors, khanpur Bhadohi	Yarn/Textile Processing	Varuna/Ganga
47	Bhadohi	Taj Mahal Dyeing and spinning, Jalapur Bhadohi	Yarn/Textile Processing	Varuna/Ganga
48	Bhadohi	Unique Dyers, Lala Nagar, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
49	Bhadohi	Varanasi Carpet Exports Pvt. Ltd. Madhosingh, G.T. Road, Bhadohi	Yarn/Textile Processing	Ganga
50	Bhadohi	Zamaniya Dyers, Fattupur, Morh Road, Bhadohi	Yarn/Textile Processing	Varuna/Ganga
51	Jaunpur	Kas Carpet Yarn dyers, Industrial Area Sidhwan, Jaunpur	Yarn/Textile Processing	Varuna/Ganga
52	Jaunpur	Art Palace Export Pvt Ltd, Industrial Area Sidhwan, Jaunpur	Yarn/Textile Processing	Varuna/Ganga

S. No	District	Name & Address of Industry	Category/ Sector	Name of Main Tributary of River Ganga
53	Jaunpur	Bhokhara Industries Pvt. Ltd., Industrial Area Sidhwan, Jaunpur	Yarn/Textile Processing	Varuna/Ganga
54	Varanasi	Aishwarya Crations G.T. Road, Chandpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
55	Varanasi	Amarlata Prints S-15/243 Shamsher Singh Compound, Shivpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
56	Varanasi	Ananya Electroplators H.N.-26/20 Nawalpur, Meerapur Basahi, Varanasi	Metal Surface Treatment	Varuna/Ganga
57	Varanasi	Ashish Electroplators H.N.-S-26/42 K-24 Ashokpuram Colony, Meerapur Basahi, Varanasi	Metal Surface Treatment	Varuna/Ganga
58	Varanasi	Ashok Kalwani Prints P-4, I/S, Chandpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
59	Varanasi	Baijnath Sahu Electroplators H.N.-45/32 Luxa Nai Basti Varanasi	Metal Surface Treatment	Varuna/Ganga
60	Varanasi	Bajaj Hoisery Pvt. Ltd., Vyas Baag, Harhauwa, Varanasi	Yarn/Textile Processing	Varuna/Ganga
61	Varanasi	Balaji Prints, N-9/26-3 Patiya, Bajardiha, Varanasi.	Sari Printing & Washing	Ganga
62	Varanasi	Basant Chauchan Electroplators, Banarasi Ka Bara, Shivpurva, Varanasi	Metal Surface Treatment	Ganga
63	Varanasi	BHEL, Varanasi	Heavy Engineering	Varuna/Ganga
64	Varanasi	Bhumi Electroplators H.N.-S.H.-3/21 B, Nawalpur, Meerapur Basahi, Varanasi	Metal Surface Treatment	Varuna/Ganga
65	Varanasi	Bind Electroplators Shivpurva, Nirala Nagar, Lane No.-6 Varanasi	Metal Surface Treatment	Ganga
66	Varanasi	Brijesh Prajapati Electroplators, 10/5-1-A, Parmanandpur, Maheshpur, Varanasi	Metal Surface Treatment	Varuna/Ganga
67	Varanasi	Britech (Nikil wala) Lahartara, Bauliya, Varanasi	Metal Surface Treatment	Ganga

S. No	District	Name & Address of Industry	Category/ Sector	Name of Main Tributary of River Ganga
68	Varanasi	Chauhan Electroplators H.N.-45/145 Luxa Nai Basti, Varanasi	Metal Surface Treatment	Ganga
69	Varanasi	Chitra Kala Prints 8 A.E. Industrial Area, Chandapur, Maheshpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
70	Varanasi	Chitra Nirman Industrial Area, Chandapur, Varanasi	Sari Printing & Washing	Varuna/Ganga
71	Varanasi	Chitranashi S-15/243, Shivpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
72	Varanasi	D.L.W., Varanasi	Loco Engineearing	Varuna/Ganga
73	Varanasi	Devraj Prints S-15/243 Shamsher Singh Compount, Shivpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
74	Varanasi	Fauji Prints, S-22/1 Mall Godam Road, Cantt, Varanasi	Sari Printing & Washing	Varuna/Ganga
75	Varanasi	Golden Pecock Saree Pvt. Ltd., S-22/1 Mall Godam Road, Cantt, Varanasi	Sari Printing & Washing	Varuna/Ganga
76	Varanasi	Gupta Electroplators H.N. D-59/237 Madhopur, Sigra, Varanasi	Metal Surface Treatment	Ganga
77	Varanasi	Hanuman Crations, N-9/26-3 Patiya, Bajardiha, Varanasi	Sari Printing & Washing	Ganga
78	Varanasi	Hindustan Coca Cola Beverages Pvt. Ltd., Rajatalab, Varanasi	Soft Drink	Ganga
79	Varanasi	Indian Dyeing & Manufacturing J-12/63-102 Bunkar Colony, Chaukaghat, Varanasi	Sari Printing & Washing	Ganga
80	Varanasi	Kala Nidhi S-15/243 Shamsher Singh Compount, Shivpur, Varanasi	Sari Printing & Washing	Ganga
81	Varanasi	Laakhi Creations Industrial Area, Chandapur, Maheshpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
82	Varanasi	Manisha Electroplators H.N.-SH-3/26 K-5 M Rajeev Nagar, Nawalpur, Meerapur Basahi, Varanasi	Metal Surface Treatment	Varuna/Ganga

S. No	District	Name & Address of Industry	Category/ Sector	Name of Main Tributary of River Ganga
83	Varanasi	Manpasand, Karkhiyaon,Agropark, Varanasi	Food & Beverages	Naad River/Ganga
84	Varanasi	Mazda Prints, N. 10/60 DLW Road, Varanasi.	Sari Printing & Washing	Ganga
85	Varanasi	Mazeed Prints, C-26/3 Nawabganj, Varanasi.	Sari Printing & Washing	Ganga
86	Varanasi	Meera Prints C-3 Big Industrial Area, Chandpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
87	Varanasi	Mishra Electroplators Pishach Mochan, Lallapura, Varanasi	Metal Surface Treatment	Ganga
88	Varanasi	Nidhi Prints S-15/243 Shamsher Singh Compount, Shivpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
89	Varanasi	Nike Energy, Tarna, Varanasi	Metal Surface Treatment	Varuna/Ganga
90	Varanasi	Nilesh Chauhan Electroplators P.N.-S-341 Meerapur Basahi, Varanasi	Metal Surface Treatment	Varuna/Ganga
91	Varanasi	Parle Agro Ltd., Karkhiyaon, Agropark,Varanasi	Food & Beverages	Naad River/ Ganga
92	Varanasi	Pooja Prints S-15/243 Shamsher Singh Compount, Shivpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
93	Varanasi	Prahlad Electroplators Shri Ramnagar Colony, Maduadih, Varanasi	Metal Surface Treatment	Varuna/Ganga
94	Varanasi	Pushpanjali Sarees Pvt. Ltd. A-6 Industrial Area, Chandpur, Vaanasi	Sari Printing & Washing	Varuna/Ganga
95	Varanasi	Pushpanjali Sarees Pvt. Ltd. Unit-2 B-1, B-2, B-1E, B-2 E, Industrial Area, Chandpur, Vaanasi	Sari Printing & Washing	Varuna/Ganga
96	Varanasi	Raju Chauhan Electroplators H.N.-D-59/236, Shivpurva, Nirala Nagar, Varanasi	Metal Surface Treatment	Ganga
97	Varanasi	Ramji Electroplators H.N.-S-2/51 Nawalpur, Meerapur Basahi, Varanasi	Metal Surface Treatment	Varuna/Ganga

S. No	District	Name & Address of Industry	Category/ Sector	Name of Main Tributary of River Ganga
98	Varanasi	Rangoli, Mahamandal Nagar, Lahurabeer, Chandauli	Sari Printing & Washing	Ganga
99	Varanasi	Rangsan Shamsher Singh Compount, Shivpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
100	Varanasi	Rattilal Electroplators Aaraji No.-10 Nawalpur, Meerapur Basahi, Varanasi	Metal Surface Treatment	Varuna/Ganga
101	Varanasi	Riyaz Electroplators H.N.-S-2/301 B, Gilat Bazar, Varanasi	Metal Surface Treatment	Varuna/Ganga
102	Varanasi	S.N.D. Dyieng & Processing Co. Pvt. Ltd., A-7 Industrial Area, Chandpur, Varanasi.	Sari Printing & Washing	Varuna/Ganga
103	Varanasi	Sakeel Print, S-15/243 Shamsher Singh Compound, Shivpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
104	Varanasi	Saurabh Saree Pvt. Ltd. S-17/3 C-4 Krishna Nagar Colony, Pahariya, Varanasi	Sari Printing & Washing	Varuna/Ganga
105	Varanasi	Shaheen Prints, B-26/27, A-2, A-1 Nawabganj, Varanasi	Sari Printing & Washing	Ganga
106	Varanasi	Sheetals S-15/243 Shamsher Singh Compount, Shivpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
107	Varanasi	Shiv Kumar Electroplators H.N.-S-27/14 K.H., Nawalpur, Meerapur Basahi, Varanasi	Metal Surface Treatment	Varuna/Ganga
108	Varanasi	Shyam Creations S-15/243 Shamsher Singh Compount, Shivpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
109	Varanasi	Silpi Print, S-15/243 Shamsher Singh Compound, Shivpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
110	Varanasi	Sinar Electroplating (Nikil Ghar) D-65/421 K, Lahartara, Bauliya, Varanasi	Metal Surface Treatment	Varuna/Ganga

S. No	District	Name & Address of Industry	Category/ Sector	Name of Main Tributary of River Ganga
111	Varanasi	Slaughter House, Beniyabaag, Varanasi	Slaughter Houses & Meat Processing	Ganga
112	Varanasi	Slaughter House, Kamal gadaha, Varanasi	Slaughter House and Meat Processing	Varuna/Ganga
113	Varanasi	Slaughter House, Ramala Kuchehry, Varanasi	Slaughter Houses & Meat Processing	Varuna/Ganga
114	Varanasi	Suresh Chauhan Electroplators H.N.-S-26/23 K.H., Nawalpur, Meerapur Basahi, Varanasi	Metal Surface Treatment	Varuna/Ganga
115	Varanasi	Swastik Dyieng & Processing Co. Pvt. Ltd., P-3, Big Industrial Area, Chandapur, Maheshpur, Varanasi	Sari Printing & Washing	Varuna/Ganga
116	Varanasi	V.K. Electroplators H.N.-L-2/63 Nawalpur, Meerapur Basahi, Varanasi	Metal Surface Treatment	Varuna/Ganga
117	Varanasi	Vijay Laxmi Criations J-13/93 Cotton Mill Compound, Chaukaghat, Varanasi	Sari Printing & Washing	Ganga
118	Varanasi	Vishal Industries A-4 Industrial Area, Maheshpur, Varanasi	Sari Printing & Washing	Varuna/Ganga

Annexure – VI: Encroachment

कार्यालय कलेक्टर एवं जिला मजिस्ट्रेट, वाराणसी

पत्रांक– 332/NGT OA No 128/2021 दिनांक 07-07-21

आदेश

मा0 राष्ट्रीय हरित अधिकरण, नई दिल्ली में योजित ओरिजिनल एप्लीकेशन नं0 128/2021 सौरभ तिवारी बनाम यूनियन ऑफ इण्डिया एवं अन्य में पारित आदेश दिनांक 17.06.2021 जो **गंगा की सहायक नदियों वरूणा व अस्सी पर अतिक्रमण हटाये जाने के सम्बंध में है,** का अनुपालन कराये जाने हेतु निम्नलिखित टीम का गठन किया जाता है–

1. उपाध्यक्ष, वाराणसी विकास प्राधिकरण, वाराणसी द्वारा नामित प्रतिनिधि।
2. नगर आयुक्त, नगर निगम, वाराणसी द्वारा नामित प्रतिनिधि।
3. सम्बंधित उपजिलाधिकारी/अपर नगर मजिस्ट्रेट (प्रथम/द्वितीय/तृतीय/चतुर्थ)।
4. अधिशाषी अभियंता बंधी प्रखण्ड, सिचाई विभाग, सिगरा, वाराणसी।
5. क्षेत्रीय अधिकारी, उ0 प्र0 प्रदूषण नियंत्रण बोर्ड, भेलूपुर, वाराणसी द्वारा नामित प्रतिनिधि।

उपरोक्त टीम को निर्देशित किया जाता है कि **वरूणा नदी व अस्सी नदी पर हुये अतिक्रमण का चिन्हिकरण एवं हटाये जाने** सम्बंधी कार्यवाही करते हुये दिनांक 20.07.2021 के पूर्व अधोहस्ताक्षरी को प्रेषित करना सुनिश्चित करें, जिससे मा0 राष्ट्रीय हरित अधिकरण, नई दिल्ली में योजित ओरिजिनल एप्लीकेशन नं0 128/2021 सौरभ तिवारी बनाम यूनियन ऑफ इण्डिया एवं अन्य में पारित आदेश दिनांक 17.06.2021 का ससमय अनुपालन कराया जा सके। मा0 राष्ट्रीय हरित अधिकरण में याचिका की अग्रिम सुनवाई दिनांक 04.08.2021 निर्धारित है।

(कौशल राज शर्मा)
कलेक्टर एवं जिला मजिस्ट्रेट
वाराणसी

संख्या एवं दिनांक–उपरोक्त।

प्रतिलिपि–अपर जिलाधिकारी (नगर), वाराणसी को इस निर्देश के साथ प्रेषित कि सम्बंधित अधिकारियों से समन्वय स्थापित कर अनुपालन कराया जाना सुनिश्चित करें।

(कौशल राज शर्मा)
कलेक्टर एवं जिला मजिस्ट्रेट
वाराणसी

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मा0 राष्ट्रीय हरित अधिकरण, नई दिल्ली में योजित ओरिजिनल एप्लीकेशन नं0 128/2021 सौरभ तिवारी बनाम यूनियन ऑफ इण्डिया एवं अन्य में पारित ओदश दिनांक 17.6.2021, जो गंगा की सहायक नदियों वरूणा व अस्सी पर अतिक्रमण हटाये जाने के सम्बन्ध में है, के क्रम में कृत कार्यवाही का विवरण :-

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(अ) वरूणा नदी :-

क्र0सं0	तहसील	ग्राम	परगना	आ0नं0	रकबा(हे0 मे)	वर्तमान स्थिति
01	सदर	कोटवां	कसवार राजा	102	2.6240	मौके पर नदी है। कोई अतिक्रमण नही है।
02		कोटवां	कसवार राजा	1426	0.8700	मौके पर नदी है। कोई अतिक्रमण नही है।
03		टड़िया	कसवार राजा	359	2.5820	मौके पर नदी है। कोई अतिक्रमण नही है।
04		छितौनी	कसवार राजा	465	3.3030	मौके पर नदी है। कोई अतिक्रमण नही है।
05		भरथरा	कसवार राजा	213	2.3830	मौके पर नदी है। कोई अतिक्रमण नही है।
06		बेदौली	कसवार राजा	1	3.1160	मौके पर नदी है। कोई अतिक्रमण नही है।
07		फुलवरिया	देहात अमानत	537/1	4.8480	मौके पर नदी है। कोई अतिक्रमण नही है।
08		बड़ागांव प्रथम	देहात अमानत	1	0.7450	मौके पर नदी है। कोई अतिक्रमण नही है।
09		बड़ागांव द्वितीय	देहात अमानत	1	0.7330	मौके पर नदी है। कोई अतिक्रमण नही है।
10		कैण्टोमेन्ट	देहात अमानत	1	2.120	मौके पर नदी है। कोई अतिक्रमण नही है।
11		आराजी लाईन	देहात अमानत	1	0.684	मौके पर नदी है। कोई अतिक्रमण नही है।
12		नदेसर	देहात अमानत	1/1	3.003	मौके पर नदी है। कोई अतिक्रमण नही है।
13		चौका	देहात अमानत	1	3.4350	मौके पर नदी है। कोई अतिक्रमण नही है।
14		अलईपुर	देहात अमानत	1	2.1160	मौके पर नदी है। कोई अतिक्रमण नही है।
15		सरायहेड	देहात अमानत	150	0.4700	मौके पर नदी है। कोई अतिक्रमण नही है।
16		कोनिया	देहात अमानत	1/2 व 1/4	4.4440	मौके पर नदी है। कोई अतिक्रमण नही है।
17		किला कोहना	देहात अमानत	1/18	0.1010	मौके पर नदी है। कोई अतिक्रमण नही है।
18		सरैताबाद	देहात अमानत	1/3	0.2430	मौके पर नदी है। कोई अतिक्रमण नही है।
19		पिसौर	शिवपुर	1605	7.0900	मौके पर नदी है। कोई अतिक्रमण नही है।
20		दानियालपुर	शिवपुर	298	7.4750	मौके पर नदी है। कोई अतिक्रमण नही है।
21		इन्द्रपुर	शिवपुर	465 445	0.858 1.700	मौके पर नदी है। कोई अतिक्रमण नही है।
22		सिकरौल	शिवपुर	1042	2.3550	मौके पर नदी है। कोई अतिक्रमण नही है।
23		खजुरी	शिवपुर	168	3.2420	मौके पर नदी है। कोई अतिक्रमण नही है।
24		दानियालपुर	शिवपुर	164	1.9230	मौके पर नदी है। कोई अतिक्रमण नही है।
25		हाल	शिवपुर	54	1.9700	मौके पर नदी है। कोई अतिक्रमण नही है।
26		पुलकोहना	शिवपुर	152	1.5830	मौके पर नदी है। कोई अतिक्रमण नही है।
27		सलारपुर	शिवपुर	529	2.0480	मौके पर नदी है। कोई अतिक्रमण नही है।
28		खालिसपुर	जाल्हूपुर	136/306	3.6420	मौके पर नदी है। कोई अतिक्रमण नही है।
29		सराय मोहना	जाल्हूपुर	18/1	0.4050	मौके पर नदी है। कोई अतिक्रमण नही है।
30	पिण्डरा	महिमापुर	पन्द्रह	1	0.874	मौके पर नदी है। कोई अतिक्रमण नही है।
31				267	0.117	मौके पर नदी है। कोई अतिक्रमण नही है।
32				1023	0.676	मौके पर नदी है। कोई अतिक्रमण नही है।

33				1050	0.154	मौके पर नदी है। कोई अतिक्रमण नही है।
34				1051	0.478	मौके पर नदी है। कोई अतिक्रमण नही है।
35		सरावा	पन्द्रह	64	1.963	मौके पर नदी है। कोई अतिक्रमण नही है।
36				992	0.223	मौके पर नदी है। कोई अतिक्रमण नही है।
37		अकोढ़ा	पन्द्रह	1243	3.763	मौके पर नदी है। कोई अतिक्रमण नही है।
38		कुरू	पन्द्रह	492	2.023	मौके पर नदी है। कोई अतिक्रमण नही है।
39		पतेर	पन्द्रह	358	3.015	मौके पर नदी है। कोई अतिक्रमण नही है।
40		बलुआ	पन्द्रह	1190	3.076	मौके पर नदी है। कोई अतिक्रमण नही है।
41		हरेहू	पन्द्रह	209	1.497	मौके पर नदी है। कोई अतिक्रमण नही है।
42		चिलविला	पन्द्रह	360	2.023	मौके पर नदी है। कोई अतिक्रमण नही है।
43		कुडी	पन्द्रह	210	4.334	मौके पर नदी है। कोई अतिक्रमण नही है।
44		ईसीपुर	अठगांवा	72	1.668	मौके पर नदी है। कोई अतिक्रमण नही है।
45		गोरी	अठगांवा	262	0.717	मौके पर नदी है। कोई अतिक्रमण नही है।
46		इन्दरपुर	अठगांवा	1	0.372	मौके पर नदी है। कोई अतिक्रमण नही है।
47		मनियाकोन	अठगांवा	82	0.728	मौके पर नदी है। कोई अतिक्रमण नही है।
48		नेवादा	अठगांवा	323	2.274	मौके पर नदी है। कोई अतिक्रमण नही है।
49		सालवाहनपुर	अठगांवा	891	1.091	मौके पर नदी है। कोई अतिक्रमण नही है।
50		खलिया	अठगांवा	124	1.490	मौके पर नदी है। कोई अतिक्रमण नही है।
51		रसूलपुर	अठगांवा	799	2.829	मौके पर नदी है। कोई अतिक्रमण नही है।
52		चक्का	अठगांवा	187	0.458	मौके पर नदी है। कोई अतिक्रमण नही है।
53		अवसानपुर	अठगांवा	858	4.476	मौके पर नदी है। कोई अतिक्रमण नही है।
54		गहरवारपुर	अठगांवा	268	1.445	मौके पर नदी है। कोई अतिक्रमण नही है।
55		गोसाईपुर	अठगांवा	99	2.225	मौके पर नदी है। कोई अतिक्रमण नही है।
56		भगतपुर	अठगांवा	460	1.999	मौके पर नदी है। कोई अतिक्रमण नही है।
57		कैलहट	अठगांवा	99	0.706	मौके पर नदी है। कोई अतिक्रमण नही है।
58		कोईराजपुर	अठगांवा	1012	3.529	मौके पर नदी है। कोई अतिक्रमण नही है।
59		शहाबुद्दीनपुर	अठगांवा	360	0.048	मौके पर नदी है। कोई अतिक्रमण नही है।
60		पश्चिमपुर	अठगांवा	596	8.117	मौके पर नदी है। कोई अतिक्रमण नही है।
61		चमांव	अठगांवा	571	0.729	मौके पर नदी है। कोई अतिक्रमण नही है।
62		कोइरान	अठगांवा	460	0.611	मौके पर नदी है। कोई अतिक्रमण नही है।
63		अहिरान	अठगांवा	653	1.643	मौके पर नदी है। कोई अतिक्रमण नही है।
64		खेवली	कसवार राजा	01	1.9230	मौके पर नदी है। कोई अतिक्रमण नही है।
65		लच्छीपुर कुरौना	कसवार राजा	132क	1.3880	मौके पर नदी है। कोई अतिक्रमण नही है।
66		पतरेचक	कसवार राजा	1	0.849	मौके पर नदी है। कोई अतिक्रमण नही है।
67		बीरसिंहपुर	कसवार सरकारी	1	1.4930	मौके पर नदी है। कोई अतिक्रमण नही है।
68			कसवार सरकारी	2	0.5260	मौके पर नदी है। कोई अतिक्रमण नही है।
69			कसवार सरकारी	140	0.2670	मौके पर नदी है। कोई अतिक्रमण नही है।
70			कसवार सरकारी	141	0.2310	मौके पर नदी है। कोई अतिक्रमण नही है।
71	राजातालाब	तेन्दुई	कसवार राजा	1	1.0340	मौके पर नदी है। कोई अतिक्रमण नही है।
72		भिटकुरी	कसवार राजा	1	2.5490	मौके पर नदी है। कोई अतिक्रमण नही है।
73		भतसार	कसवार राजा	1	5.110	मौके पर नदी है। कोई अतिक्रमण नही है।
74		कुरौना उर्फ रामेश्वर	कसवार राजा	295	1.3840	मौके पर नदी है। कोई अतिक्रमण नही है।
75			कसवार राजा	105	1.4730	मौके पर नदी है। कोई अतिक्रमण नही है।
76		जगापट्टी	कसवार राजा	1	0.802	मौके पर नदी है। कोई अतिक्रमण नही है।
77		परसीपुर	कसवार राजा	1क	1.8010	मौके पर नदी है। कोई अतिक्रमण नही है।
78		बजरडीहा	कसवार राजा	1	1.0110	मौके पर नदी है। कोई अतिक्रमण नही है।
79		इसवार	कसवार राजा	1	2.1690	मौके पर नदी है। कोई अतिक्रमण नही है।

80		ओदरहा	कसवार राजा	365	0.526	मौके पर नदी है। कोई अतिक्रमण नही है।
81		गैरहा	कसवार राजा	1	0.4860	मौके पर नदी है। कोई अतिक्रमण नही है।
82		गोगवा	कसवार राजा	1	0.656	मौके पर नदी है। कोई अतिक्रमण नही है।
83		लोहरापुर	कसवार सरकारी	1	3.733	मौके पर नदी है। कोई अतिक्रमण नही है।

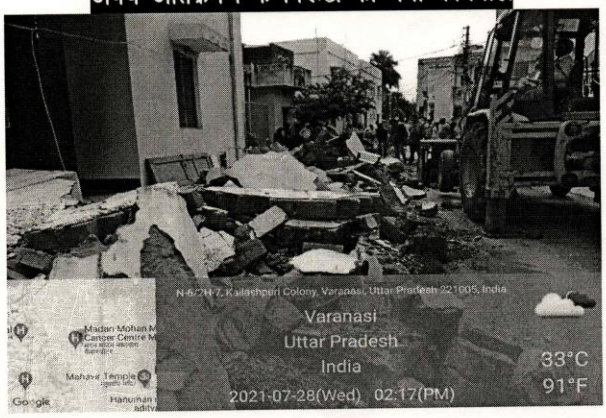
(ब) अस्सी नदी :-

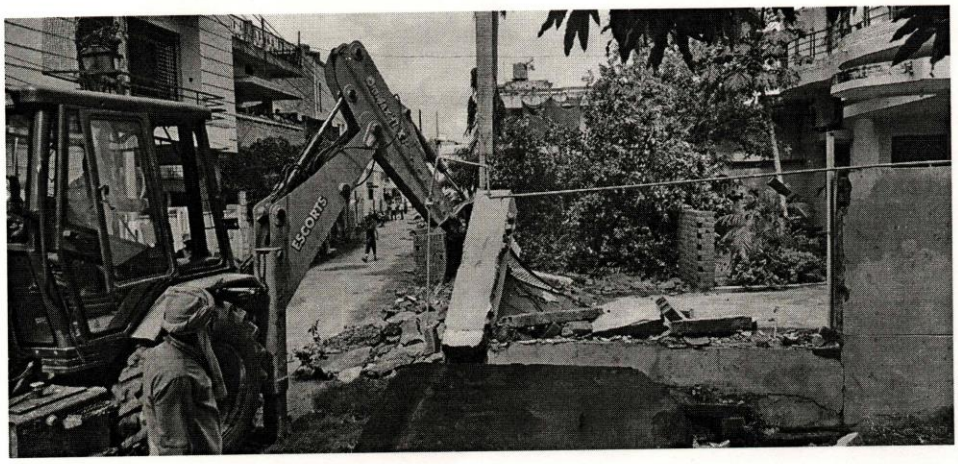
कथित पौराणिक अस्सी नदी/नाला उद्गम स्थल ग्राम कंचनपुर से विभिन्न राजस्व ग्रामों के विभिन्न सरकारी व व्यक्तिगत भूखण्डों से होकर अपने अन्तिम बिन्दु अस्सी घाट पर पहुँचती है। स्थलीय निरीक्षण के आधार ग्रामवार वर्तमान में निम्न भूखण्डों से होकर बहाव जारी है, उसका विवरण निम्नवत् है :-

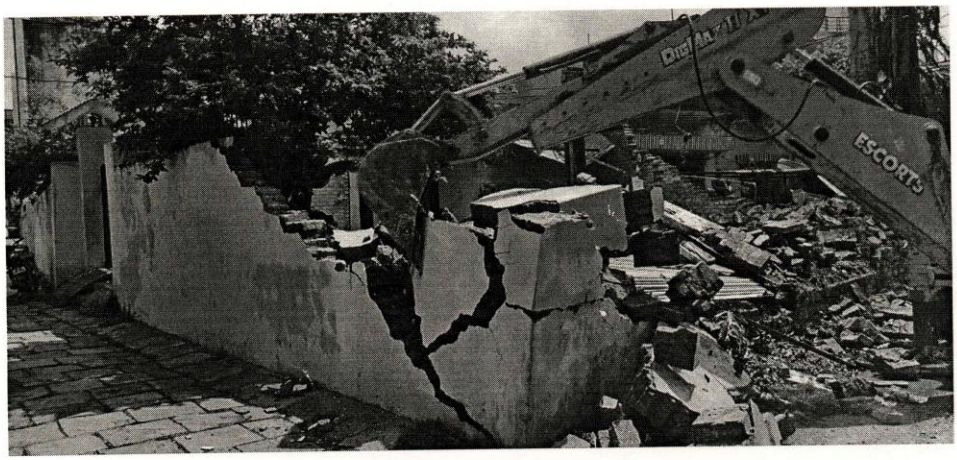
क्र0सं0	तहसील	ग्राम	आ0नं0	रकबा (हे0 मे)	नवयइत	वर्तमान स्थिति
01	सदर	कंचनपुर	मि0 134/6	0.406	पोखरी	मौके पर नाला स्थित है।
02			134/3	0.101	पोखरी	
03			133/2	0.032	नाली	
04			358मि0	0.486	सड़क	
05		चितईपुर	62	0.210	भूमिधरी	आ0नं0 17/2 रकबा 0.257 हे0 भूमि नाली के खाते की भूमि है, जिस पर दौरान सर्वेक्षण 11 व्यक्तियों का अवैध अतिक्रमण पाया गया, जिसे दिनांक 28 जुलाई, 2021 को हटवा दिया गया। सूची एवं फोटोग्राफ्स संलग्न है।
06			91	0.564	भूमिधरी	
07			17/2	0.259	नाली	
08			16	0.295	भूमिधरी	
09			15	0.368	भूमिधरी	
10		कर्माजीतपुर	1/1	0.352	नाली	इस ग्राम के आ0नं0-1 से होकर नदी/नाला बह रहा है। उक्त आराजी 1/1 रकबा 0.352हे0 वर्तमान में नाला खाते में अंकित है। आ0नं0-1 के अलावा आ0नं0-7 के भाग को भी बहार प्रभावित करता रहा है, जो सं0भू0 खाते की भूमि है।
11			1/2	0.040	भूमिधरी	
12			1/3	0.040	भूमिधरी	
13			1/4	0.068	भूमिधरी	
14			1/5	0.065	भूमिधरी	
15		करौंदी	4	-	मतरूक	नदी/नाला बह रहा है।
16			44	0.012	नाला	
17		सरायनन्दन	495/1	0.259	नाली	आंशिक रकबे में नाला बह रहा है।
18			495/2	0.028	बंजर	
19			505/1	0.494	नाली	
20			505/2	0.040	-	
21			505/3	0.243	बंजर	
22			526/1	0.263	-	
23			526/2	0.115	-	
24			526/3	0.115	-	
25			575/1	0.093	-	
26			575/2	0.020	-	
27		भदैनी तृतीय	2417	0.324	नाला	नदी/नाला बह रहा है।
28			2490	0.053	नाला (ना0जेडए)	
29			3283	0.162	नाला (ना0जेडए)	
30		नगवां	192/1	0.089	भूमिधरी	ग्राम के आ0सं0 175,193,194,195 व

31			192/2	0.034	भूमिधरी	196 तथा आ0नं0 236,244,245 होकर गुजरता है। जिसमें आ0नं0 175, 196 195 का सम्पूर्ण क्षेत्रफल खातेदारों के नाम अंकित है तथा आ0नं0-194 में रकबा 0.061हे0 भूमि नाले खाते में अंकित है और इसी क्षेत्रफल से नाला बह रहा है शेष रकबा खातेदारों के नाम है। आ0नं0 236, 244, 245 अभिलेख में उ0प्र0 सरकार विकास प्राधिकरण के नाम अंकित है। इन आराजीयत से वर्तमान में अस्सी नदी/नाला का मुड़ाव प्रवाह/बहाव गंगा नदी में रविदास पार्क से हो रहा है। नाले व आबादी के मिलान बिन्दु पर एस0टी0पी0 बांध है।
32				0.061	नाला	
33			193	0.486	भूमिधरी	
34			194/1	1.040	भूमिधरी	
35			194/2	0.295	भूमिधरी	
36			194/3	0.061	नाला	
37			195	0.409	भूमिधरी	
38			196	0.809	भूमिधरी	
39			236/1	0.340	उ0प्र0स0	
40				0.728	भूमिधरी	
41			244	0.121	उ0प्र0स0	
42			245	0.267	उ0प्र0स0	
43		भदैनी द्वितीय	3300 (बटा 1-6 तक)	0.537	भूमिधरी	इस ग्राम के भाग-2 के आराजी नम्बर 3300,3303,3304,3314,3315 से पूर्व में होकर गुजरता था। वर्तमान में अभिलेख के अनुसार यह सभी आराजियां विभिन्न खातेदारों के नाम संक्रमणीय भूमिध के रूप में अंकित है। वर्तमान में नदी सीधे गंगा की ओर प्रवाहित हो रही है।
44			3300(बटा 1-4 तक)	1.263	भूमिधरी	
45			3304	0.202	भूमिधरी	

अवैध अतिक्रमण के विरूद्ध की गयी कार्यवाही







कर अधीक्षक/,
प्रतिनिधि नगर आयुक्त
नगर निगम, वाराणसी।

संयुक्त सचिव/प्रतिनिधि उपाध्यक्ष,
वाराणसी विकास प्राधिकरण,
वाराणसी।

अधिशासी अभियन्ता,
बन्धी प्रखण्ड,
सिचांईविभाग-वाराणसी।

क्षेत्रीय अधिकारी,
उ0प्र0 प्रदूषण नियंत्रण बोर्ड
वाराणसी।

अपर नगर मजिस्ट्रेट (प्रथम)
वाराणसी।

अपर नगर मजिस्ट्रेट (तृतीय)
वाराणसी।

अपर नगर मजिस्ट्रेट (चतुर्थ)
वाराणसी।

उप जिलाधिकारी (पिण्डरा)
वाराणसी।

उप जिलाधिकारी (राजातालाब)
वाराणसी।

उप जिलाधिकारी सदर,
वाराणसी।

सेवा में,

जिलाधिकारी
वाराणसी।

महोदय,

आप द्वारा दिये गये आदेश के कम में पौराणिक अस्सी नदी के उद्गम स्थल से लेकर अस्सी घाट पर अन्तिम बिन्दु तक का स्थलीय एवं अभिलेखीय परीक्षण व निरीक्षण राजस्व विभाग व नगर निगम वाराणसी एवं वाराणसी विकास प्राधिकरण वाराणसी एवं सिंचाई विभाग बन्धी प्रखण्ड की संयुक्त टीम द्वारा किया गया, जिसका विवरण निम्न प्रकार है:—

कथित पौराणिक अस्सी नदी/नाला उद्गम स्थल ग्राम कंचनपुर से विभिन्न राजस्व ग्रामो के विभिन्न सरकारी व व्यक्तिगत भूखण्डों से होकर अपने अन्तिम बिन्दु अस्सी घाट पर पहुचती है। स्थलीय निरीक्षण के आधार ग्राम वार वर्तमान मे निम्न भूखण्डो से होकर बहाव जारी है उसका विवरण निम्नवत है:—

1—ग्राम कंचनपुर—ग्राम कंचनपुर के आराजी नम्बर 134 से ही अस्सी नदी का उद्गम हुआ है जैसा कि स्थलीय स्तर पर प्रचलित है और निरीक्षण से भी स्पष्ट हुआ। वर्तमान अभिलेख में इस भूखण्ड का रकबा 0.507हे0 पोखरी खाते की भूमि है तथा आंशिक रकबा विभिन्न खातेदारो के नाम भिन्न खाते में संकमणीय भूमिधर के रुप में अंकित है। आगे इसी ग्राम के आराजी नम्बर 358 से होकर गुजर रही है। आराजी नम्बर 358 व वर्तमान समय में सडक, आबादी व खातेदारो के नाम अंकित है। आराजी नम्बर 358 में कुछ भूमि पर मकान आदि बने है। उस स्थान पर बहाव थोडा उपर उत्तर तरफ से हो रहा है जो विभिन्न खातेदारो की भूमि है। उनकी सहमति के आधार पर ही ग्राम प्रधान कंचनपुर द्वारा निर्माण कराया गया है। संलग्न नक्शे में उस स्थान को लाल स्याही से दर्शाया गया है, बहाव परिवर्तित है। सम्बन्धित भूखण्ड सं0134 व 358 के उद्धरण संलग्न है।

क्रमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0
1	2	3	4	5	6	7
1	कंचनपुर	मि.134/6 134/3 133/2	0.406हे 0.101हे0 0.032हे0	पोखरी पोखरी नही		मौके पर नाला स्थित है।

	358मि	0.486हे0	सड़क	

2–चितईपुर– ग्राम कंचनपुर के बाद नदी /नाला ग्राम चितईपुर में प्रवेश करता है और ग्राम चितईपुर के आराजी नम्बर 15, 16, 17 62, 91 से होकर गुजरती है अभिलेख के अनुसार आराजी नम्बर 15 विभिन्न खातेदारो के नाम अंकित है। आराजी नम्बर 16, 62, 91 भी विभिन्न खातेदारो के नाम संकमणीय भूमिधर के नाम अंकित है। आराजी नम्बर 17/2 रकबा 0.257हे0 भूमि नाली के खाते की भूमि है। प्रभावित भूखण्डों के उद्धरण संलग्न है।

कमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0
1	2	3	4	5	6	7
2	चितईपुर	62	0.210हे0	भूमिधरी	कमला देवी व ब्रिजेश कुमार व डा0 वन्दना घोष व	
		91	0.564हे0	भूमिधरी	ओप्रकाश वगैरह	
		17/2	0.259हे0	नाली	रत्नेश्वर प्रसाद नरायण सिंह वगैरह	
		16	0.295हे0	भूमिधरी	.....	
		15	0.368हे0	भूमिधरी	पन्नालाल वगैरह	
					विमल कुमार व फौजदार वगैरह	

3–कर्माजीतपुर– ग्राम चितईपुर के बाद ग्राम कर्माजीतपुर से प्रवेश करता है। इस ग्राम के आराजी नम्बर 1 से होकर नदी/नाला बह रहा है। उक्त 1/1 रकबा 0.352हे0 वर्तमान अभिलेख में नाला खाते में अंकित है। उद्धरण खतौनी संलग्न है। आराजी नम्बर 1 के अलावा आ0नं07 के भाग को भी बहाव प्रभावित करता रहा है जो सं0भू0खाते की भूमि है।

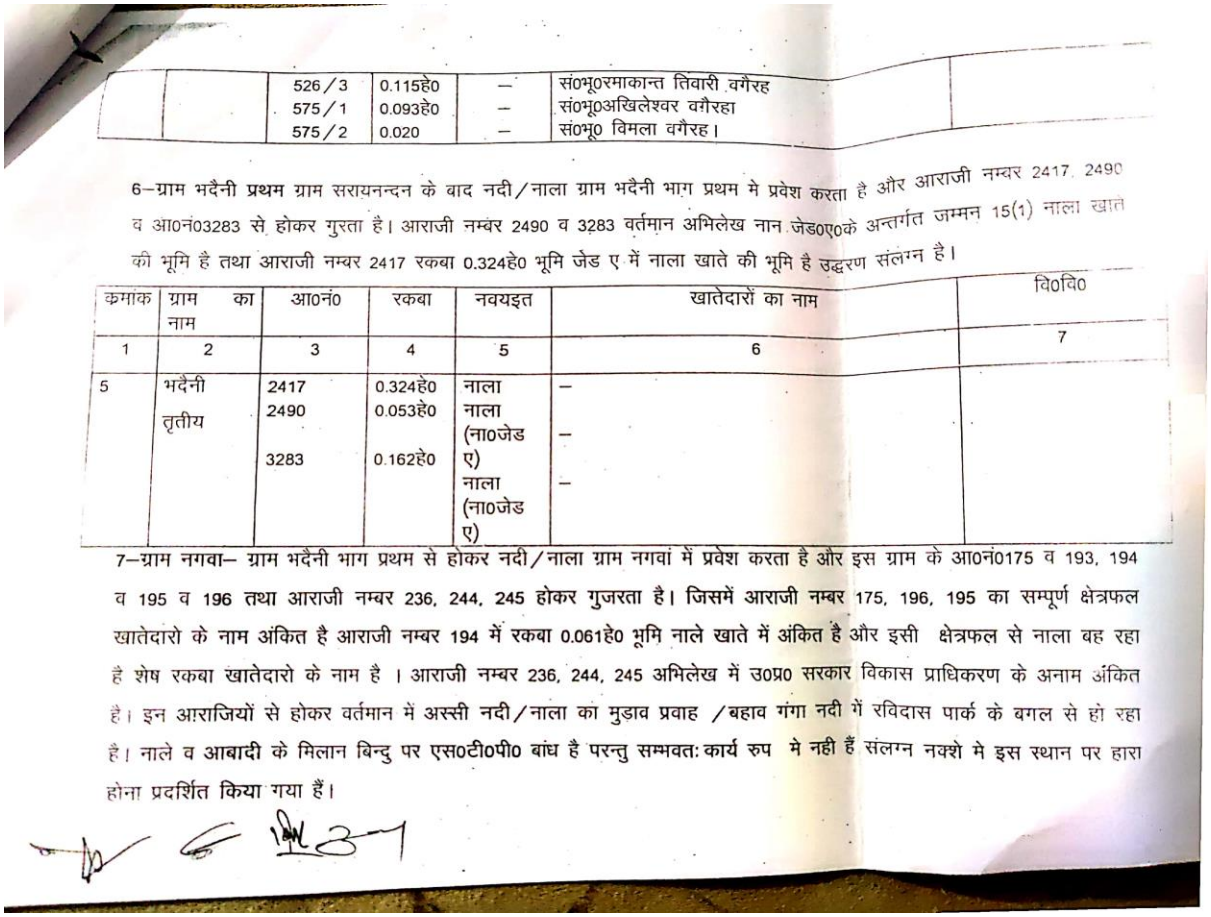
कमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0
1	2	3	4	5	6	7
3	कर्माजीतपुर	1/1	0.352हे0	नाला	.....	
		1/2	0.040हे0	भूमिधरी	राजाराम व मिठाई लाल वगैरहा	
		1/3	0.040हे0	भूमिधरी	गोपीनाथ वगैरह	
		1/4	0.068हे0	भूमिधरी	नन्दू व बसन्तु व राजकुमार व राधेश्याम वगैरह	
		1/5	0.065हे0	भूमिधरी	गौरीशंकर वगैरह	

4–**करौदी**–ग्राम कर्माजीतपुर के बाद नदी/नाला ग्राम करौदी में प्रवेश करता है और ग्राम करौदी के आराजी नम्बर 4 व 44 से होकर गुजरता रहता है उपर से आराजी नम्बर 4 व 44 बन्दोबस्त के समय से ही नाला खाते की भूमि है और वर्तमान में भी नाला खात मे ही अंकित है।

क्रमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0
1	2	3	4	5	6	7
4	करौदी	4 44	– 0.012	मतरुक नाला	– –	

5–**ग्राम सरायनन्दन**– ग्राम सरायनन्दन में आ0नं0495 व 505 व 575 व 526से होकर गुजरता है। अभिलेख के अनुसार आराजी नम्बर 495/1 रकबा 0.257हे0 व आराजी नम्बर 505/1 रकबा 0.494हे0 भूमि नालीके खातेमें अंकित है। इसके आसपास के आराजियो के आंशिक क्षेत्रफल पर खातेदारो के नाम अंकित है तथा आराजी नम्बर 526 व 575 भिन्न–भिन्न खातेदारों के नाम विभिन्न खातों के सं0भू0के रुप में अंकित है संलग्न ग्राम के भूचित्र में नदी/नाले के मूलस्वरुप में परिवर्तन मौके पर है जिसे लाल स्याही से दर्शाया गया है। उद्धरण संलग्न है।

क्रमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0
1	2	3	4	5	6	7
1	सरायनन्दन	495/1	0.259हे0	नाली	–	
		495/2	0.028हे0	बंजर	–	
		505/1	0.494हे0	नाली	–	
		505/2	0.040हे0	–	सं0भू0कन्हई वगैरहा।	
		505/3	0.243हे0	बंजर	–	आंशिक रकबे मे नाला बह रहा है।
		526/	0.263हे0	–	सं0भू0 कौशिक मिश्रा वगैरह	
		526/2	0.115हे0	–	सं0भू0जगदीश प्रसाद विश्वकर्मा वगैरह	



		526/3 575/1 575/2	0.115हे0 0.093हे0 0.020	— — —	सं0भू0रमाकान्त तिवारी वगैरह सं0भू0अखिलेश्वर वगैरहा सं0भू0 विमला वगैरह।	

6—ग्राम भदैनी प्रथम ग्राम सरायनन्दन के बाद नदी/नाला ग्राम भदैनी भाग प्रथम मे प्रवेश करता है और आराजी नम्बर 2417, 2490 व आ0नं03283 से होकर गुरता है। आराजी नम्बर 2490 व 3283 वर्तमान अभिलेख नान जेड0ए0के अन्तर्गत जम्मन 15(1) नाला खाते की भूमि है तथा आराजी नम्बर 2417 रकबा 0.324हे0 भूमि जेड ए में नाला खाते की भूमि है उद्धरण संलग्न है।

क्रमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0
1	2	3	4	5	6	7
5	भदैनी तृतीय	2417 2490 3283	0.324हे0 0.053हे0 0.162हे0	नाला नाला (ना0जेड ए) नाला (ना0जेड ए)	— — —	

7—ग्राम नगवा— ग्राम भदैनी भाग प्रथम से होकर नदी/नाला ग्राम नगवां में प्रवेश करता है और इस ग्राम के आ0नं0175 व 193, 194 व 195 व 196 तथा आराजी नम्बर 236, 244, 245 होकर गुजरता है। जिसमें आराजी नम्बर 175, 196, 195 का सम्पूर्ण क्षेत्रफल खातेदारो के नाम अंकित है आराजी नम्बर 194 में रकबा 0.061हे0 भूमि नाले खाते में अंकित है और इसी क्षेत्रफल से नाला बह रहा है शेष रकबा खातेदारो के नाम है । आराजी नम्बर 236, 244, 245 अभिलेख में उ0प्र0 सरकार विकास प्राधिकरण के अनाम अंकित है। इन आराजियों से होकर वर्तमान में अस्सी नदी/नाला का मुडाव प्रवाह /बहाव गंगा नदी में रविदास पार्क के बगल से हो रहा है। नाले व आबादी के मिलान बिन्दु पर एस0टी0पी0 बांध है परन्तु सम्भवतः कार्य रुप मे नही हैं संलग्न नक्शे मे इस स्थान पर हारा होना प्रदर्शित किया गया हैं।

कमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0
1	2	3	4	5	6	7
6	नगवा	192/1	0.089हे0	भूमिधरी	श्रीमती बनारसी देवी	
		192/2	0.034हे0	भूमिधरी	श्रीमती सोनपत्ती व श्यामप्यारी	
			0.061हे0	नला	–	
		193	0.486हे0	भूमिधरी	श्रीमती कुलवनि सिंह राणा, श्रीमती कपूरथली शुक्ला	
		194/1	1.040हे0	भूमिधरी	वगैरहा	
		194/2	0.295 हे0	भूमिधरी	अपराजिता व आत्मनन्दन वगैरह	
		194/3	0.061 हे0	नाली	श्रीमती आशा तिवारी व राजेश वगैरह	
		195	0.409 हे0	भूमिधरी	–	
		196	0.809 हे0	भूमिधरी	अवध बिहारी व आषा तिवारी वगैरह	
		236/1	0.340 हे0	उ0प्र0स0	अवध बिहारी सयव कलावती देवी वगैरह	
			0.728हे0	भूमिधरी	उ0प्र0 सं0 वि0प्रा0	
		244	0.121 हे0	उ0प्र0स0	कपिल देव तिवारी व महेन्द्र वगैरह	
		245	0.267हे0	उ0प्र0स0.	उ0प्र0स0वि0प्रा0	
					उ0प्र0सं0विकास	

8–ग्राम भदैनी द्वितीय– ग्राम नगवा के बाद नदी/नाला पुनः ग्राम भदैनी भाग 2 में प्रवेश करता है और इस ग्राम मे भाग 2 के आराजी नम्बर 3300, 3303, 3304 ,3314, 3315 से होकर गुजरता है। वर्तमान अभिलेख के अनुसार यह सभी आराजियां विभिन्न खातेदारो के नाम संकमणीय भूमिधर के रुप में अंकित है। स्थलीय जांच के समय ग्राम भदैनी के भाग 2 के शजरे में इन भूखण्डो में चिन्हित नाले का मिलान बिन्दू पर करने पर पाया गया कि मौके पर नाले का स्वरुप तो है परन्तु बहाव अवरुद्ध है, केवल अलग–बगल के आबाद लोगो द्वारा अपने घरो का सीवर का पानी बहाया जाता है वह पानी आता है और स्थिर है। स्थानीय लोगो द्वारा बताया गया कि पहले इसी रास्ते होकर अस्सीघाट पर अस्सी नदी व गंगा का संगम होता था, बल्कि ग्राम भदैनी का भूचित्र भाग दो पर अस्सी संगम शब्द लिखा है। इससे भी स्पष्ट होता है काफी पहले इसी स्थान पर अस्सी नदी/नाला गंगा नदी मे मिलता था परन्तु वर्तमान में इस स्थान पर पक्का अस्सी घाट , मन्दिर , साईकिल स्टैण्ड आदि बना हुआ है। संलग्न नक्शे में ग्राम नगवा में जिस स्थान से नदी/नाले के मुख्य बहाव को रविदास पार्क के बगल से गंगा नदी में मिलाया गया है। उस स्थान से आगे ग्राम भदैनी के भाग–2 के अवरुद्ध नाले को लाल स्याही से इंगित किया गया है।

कमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0

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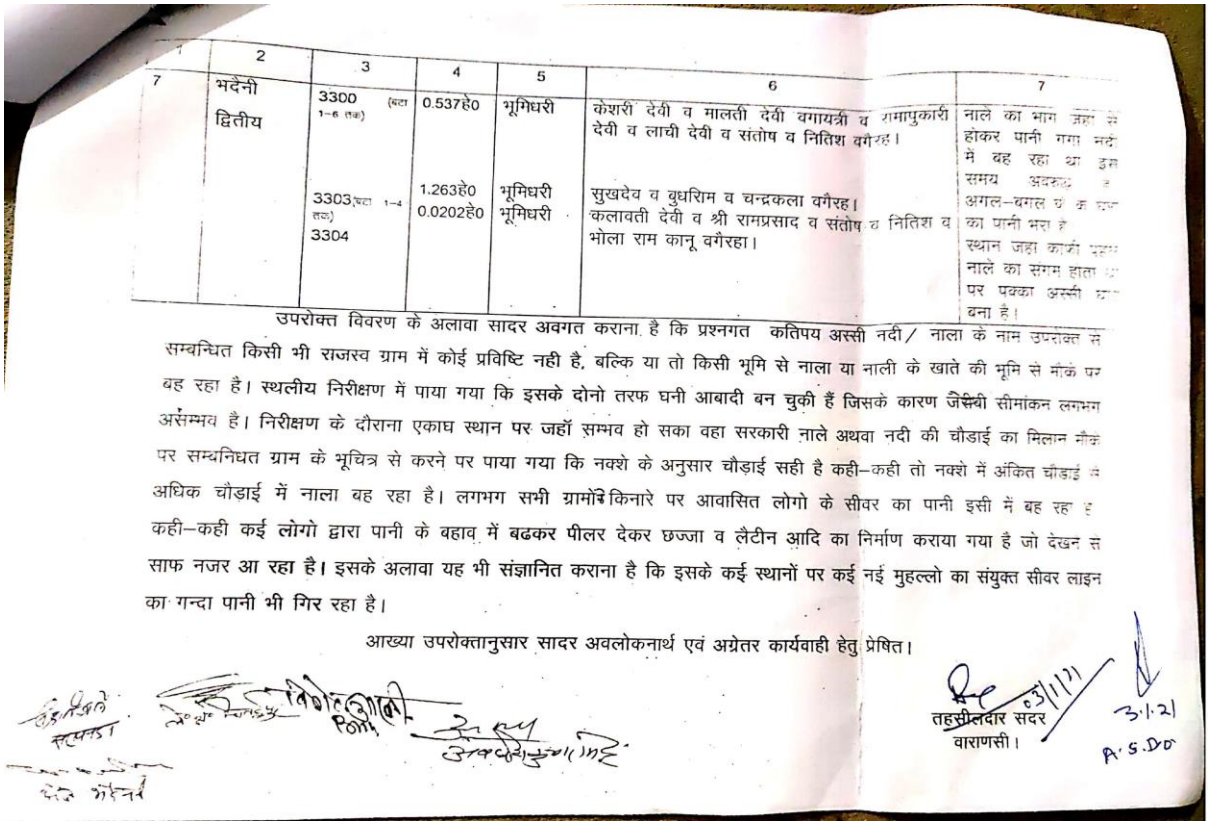

1	2	3	4	5	6	7
7	भदैनी द्वितीय	3300 (खंड 1–6 तक)	0.537हे0	भूमिधरी	केशरी देवी व मालती देवी वगायत्री व रामापुकारी देवी व लाची देवी व संतोष व नितिश वगैरह।	नाले का भाग जहां से होकर पानी गंगा नदी में बह रहा था इस समय अवरुद्ध है अगल–बगल के घर का पानी भरा है स्थान जहां काफी पुराना नाले का संगम होता था पर पक्का अस्सी घाट बना है।
		3303 (खंड 1–4 तक)	1.263हे0	भूमिधरी	सुखदेव व बुधरिम व चन्द्रकला वगैरह।	
		3304	0.0202हे0	भूमिधरी	कलावती देवी व श्री रामप्रसाद व संतोष व नितिश व भोला राम कानू वगैरहा।	

उपरोक्त विवरण के अलावा सादर अवगत कराना है कि प्रश्नगत कतिपय अस्सी नदी/ नाला के नाम उपरोक्त से सम्बन्धित किसी भी राजस्व ग्राम में कोई प्रविष्टि नही है, बल्कि या तो किसी भूमि से नाला या नाली के खाते की भूमि से मौके पर बह रहा है। स्थलीय निरीक्षण में पाया गया कि इसके दोनो तरफ घनी आबादी बन चुकी हैं जिसके कारण जैसी सीमांकन लगभग असंम्भव है। निरीक्षण के दौराना एकाघ स्थान पर जहॉ सम्भव हो सका वहा सरकारी नाले अथवा नदी की चौडाई का मिलान मौके पर सम्धनिधत ग्राम के भूचित्र से करने पर पाया गया कि नक्शे के अनुसार चौड़ाई सही है कही–कही तो नक्शे में अंकित चौड़ाई से अधिक चौड़ाई में नाला बह रहा है। लगभग सभी ग्रामोंके किनारे पर आवासित लोगो के सीवर का पानी इसी में बह रहा है कही–कही कई लोगो द्वारा पानी के बहाव में बढकर पीलर देकर छज्जा व लैटीन आदि का निर्माण कराया गया है जो देखने से साफ नजर आ रहा है। इसके अलावा यह भी संज्ञानित कराना है कि इसके कई स्थानों पर कई नई मुहल्लो का संयुक्त सीवर लाइन का गन्दा पानी भी गिर रहा है।

आख्या उपरोक्तानुसार सादर अवलोकनार्थ एवं अग्रेतर कार्यवाही हेतु प्रेषित।

तहसीलदार सदर
वाराणसी।

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सेवा में,

जिलाधिकारी
वाराणसी।

महोदय,

आप द्वारा दिये गये आदेश के कम में पौराणिक अस्सी नदी के उद्गम स्थल से लेकर अस्सी घाट पर अन्तिम बिन्दु तक का स्थलीय एवं अभिलेखीय परीक्षण व निरीक्षण राजस्व विभाग व नगर निगम वाराणसी एवं वाराणसी विकास प्राधिकरण वाराणसी एवं सिंचाई विभाग बन्धी प्रखण्ड की संयुक्त टीम द्वारा किया गया, जिसका विवरण निम्न प्रकार है:—

कथित पौराणिक अस्सी नदी/नाला उद्गम स्थल ग्राम कंचनपुर से विभिन्न राजस्व ग्रामो के विभिन्न सरकारी व व्यक्तिगत भूखण्डों से होकर अपने अन्तिम बिन्दु अस्सी घाट पर पहुचती है। स्थलीय निरीक्षण के आधार ग्राम वार वर्तमान मे निम्न भूखण्डो से होकर बहाव जारी है उसका विवरण निम्नवत है:—

1—ग्राम कंचनपुर—ग्राम कंचनपुर के आराजी नम्बर 134 से ही अस्सी नदी का उद्गम हुआ है जैसा कि स्थलीय स्तर पर प्रचलित है और निरीक्षण से भी स्पष्ट हुआ। वर्तमान अभिलेख में इस भूखण्ड का रकबा 0.507हे0 पोखरी खाते की भूमि है तथा आंशिक रकबा विभिन्न खातेदारो के नाम भिन्न खाते में संकमणीय भूमिधर के रुप में अंकित है। आगे इसी ग्राम के आराजी नम्बर 358 से होकर गुजर रही है। आराजी नम्बर 358 व वर्तमान समय में सडक, आबादी व खातेदारो के नाम अंकित है। आराजी नम्बर 358 में कुछ भूमि पर मकान आदि बने है। उस स्थान पर बहाव थोडा उपर उत्तर तरफ से हो रहा है जो विभिन्न खातेदारो की भूमि है। उनकी सहमति के आधार पर ही ग्राम प्रधान कंचनपुर द्वारा निर्माण कराया गया है। संलग्न नक्शे में उस स्थान को लाल स्याही से दर्शाया गया है, बहाव परिवर्तित है। सम्बन्धित भूखण्ड सं0134 व 358 के उद्धरण संलग्न है।

कमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0
1	2	3	4	5	6	7
1	कंचनपुर	मि.134/6 134/3 133/2	0.406हे 0.101हे0 0.032हे0	पोखरी पोखरी नाली		मौके पर नाला स्थित है।

	358मि	0.486हे0	सड़क	

2–चितईपुर– ग्राम कंचनपुर के बाद नदी /नाला ग्राम चितईपुर में प्रवेश करता है और ग्राम चितईपुर के आराजी नम्बर 15, 16, 17 62, 91 से होकर गुजरती है अभिलेख के अनुसार आराजी नम्बर 15 विभिन्न खातेदारो के नाम अंकित है। आराजी नम्बर 16, 62, 91 भी विभिन्न खातेदारो के नाम संकमणीय भूमिधर के नाम अंकित है। आराजी नम्बर 17/2 रकबा 0.257हे0 भूमि नाली के खाते की भूमि है। प्रभावित भूखण्डों के उद्धरण संलग्न है।

कमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0
1	2	3	4	5	6	7
2	चितईपुर	62	0.210हे0	भूमिधरी	कमला देवी व ब्रिजेश कुमार व डा0 वन्दना घोष व	
		91	0.564हे0	भूमिधरी	ओप्रकाश वगैरह	
		17/2	0.259हे0	नाली	रत्नेश्वर प्रसाद नरायण सिंह वगैरह	
		16	0.295हे0	भूमिधरी	.....	
		15	0.368हे0	भूमिधरी	पन्नालाल वगैरह	
					विमल कुमार व फौजदार वगैरह	

3–कर्माजीतपुर– ग्राम चितईपुर के बाद ग्राम कर्माजीतपुर से प्रवेश करता है। इस ग्राम के आराजी नम्बर 1 से होकर नदी/नाला बह रहा है। उक्त 1/1 रकबा 0.352हे0 वर्तमान अभिलेख में नाला खाते में अंकित है। उद्धरण खतौनी संलग्न है। आराजी नम्बर 1 के अलावा आ0नं07 के भाग को भी बहाव प्रभावित करता रहा है जो सं0भू0खाते की भूमि है।

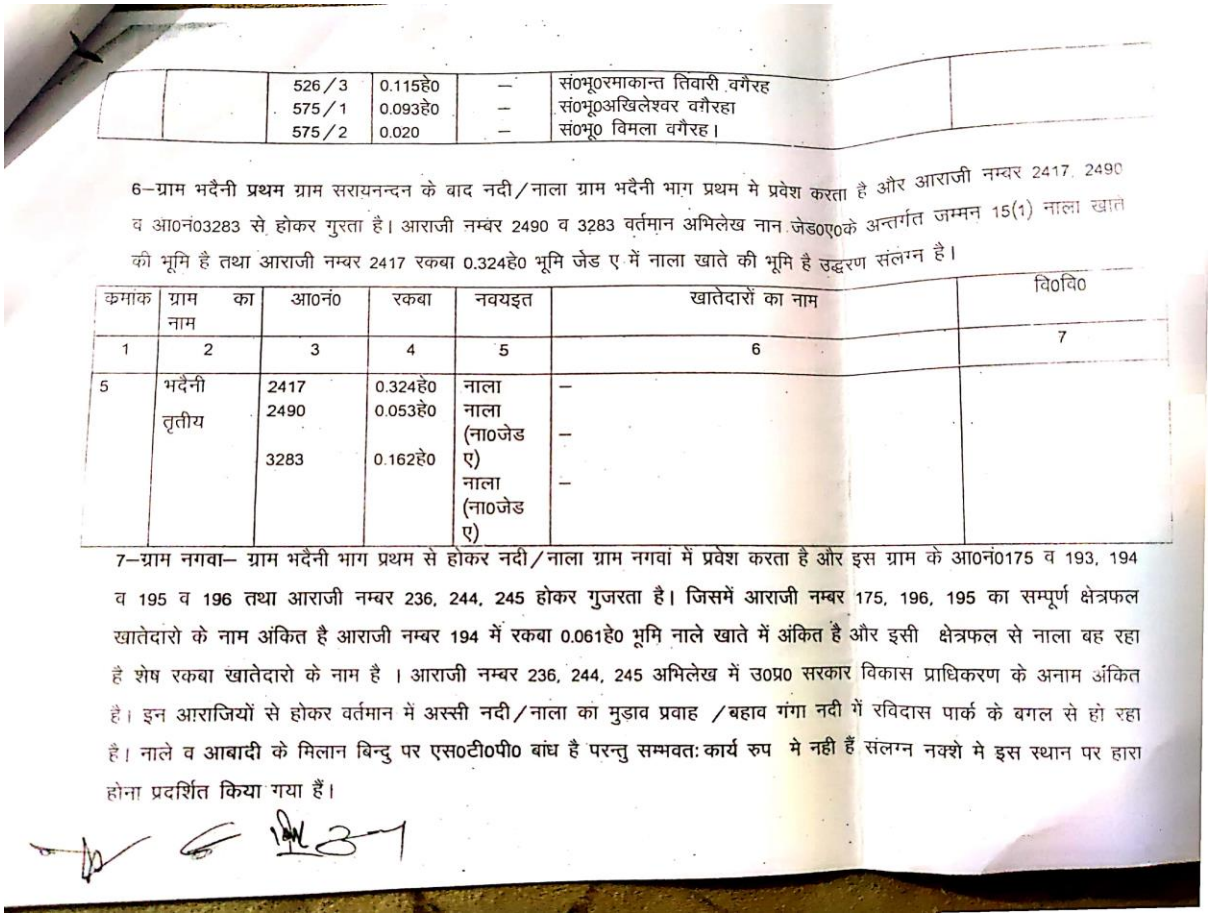
कमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0
1	2	3	4	5	6	7
3	कर्माजीतपुर	1/1	0.352हे0	नाला	.....	
		1/2	0.040हे0	भूमिधरी	राजाराम व मिठाई लाल वगैरहा	
		1/3	0.040हे0	भूमिधरी	गोपीनाथ वगैरह	
		1/4	0.068हे0	भूमिधरी	नन्दू व बसन्तु व राजकुमार व राधेश्याम वगैरह	
		1/5	0.065हे0	भूमिधरी	गौरीशंकर वगैरह	

4–**करौदी**–ग्राम कर्माजीतपुर के बाद नदी/नाला ग्राम करौदी में प्रवेश करता है और ग्राम करौदी के आराजी नम्बर 4 व 44 से होकर गुजरता रहता है उपर से आराजी नम्बर 4 व 44 बन्दोबस्त के समय से ही नाला खाते की भूमि है और वर्तमान में भी नाला खात मे ही अंकित है।

क्रमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0
1	2	3	4	5	6	7
4	करौदी	4 44	– 0.012	मतरुक नाला	– –	

5–**ग्राम सरायनन्दन**– ग्राम सरायनन्दन में आ0नं0495 व 505 व 575 व 526से होकर गुजरता है। अभिलेख के अनुसार आराजी नम्बर 495/1 रकबा 0.257हे0 व आराजी नम्बर 505/1 रकबा 0.494हे0 भूमि नालीके खातेमें अंकित है। इसके आसपास के आराजियो के आंशिक क्षेत्रफल पर खातेदारो के नाम अंकित है तथा आराजी नम्बर 526 व 575 भिन्न–भिन्न खातेदारों के नाम विभिन्न खातों के सं0भू0के रुप में अंकित है संलग्न ग्राम के भूचित्र में नदी/नाले के मूलस्वरुप में परिवर्तन मौके पर है जिसे लाल स्याही से दर्शाया गया है। उद्धरण संलग्न है।

क्रमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0
1	2	3	4	5	6	7
1	सरायनन्दन	495/1	0.259हे0	नाली	–	
		495/2	0.028हे0	बंजर	–	
		505/1	0.494हे0	नाली	–	
		505/2	0.040हे0	–	सं0भू0कन्हई वगैरहा।	
		505/3	0.243हे0	बंजर	–	आंशिक रकबे मे नाला बह रहा है।
		526/	0.263हे0	–	सं0भू0 कौशिक मिश्रा वगैरह	
		526/2	0.115हे0	–	सं0भू0जगदीश प्रसाद विश्वकर्मा वगैरह	



		526/3	0.115हे0	—	सं0भू0रमाकान्त तिवारी वगैरह	
		575/1	0.093हे0	—	सं0भू0अखिलेश्वर वगैरहा	
		575/2	0.020	—	सं0भू0 विमला वगैरह।	

6—ग्राम भदैनी प्रथम ग्राम सरायनन्दन के बाद नदी/नाला ग्राम भदैनी भाग प्रथम मे प्रवेश करता है और आराजी नम्बर 2417, 2490 व आ0नं03283 से होकर गुरता है। आराजी नम्बर 2490 व 3283 वर्तमान अभिलेख नान जेड0ए0के अन्तर्गत जम्मन 15(1) नाला खाते की भूमि है तथा आराजी नम्बर 2417 रकबा 0.324हे0 भूमि जेड ए में नाला खाते की भूमि है उद्धरण संलग्न है।

क्रमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0
1	2	3	4	5	6	7
5	भदैनी तृतीय	2417	0.324हे0	नाला	—	
		2490	0.053हे0	नाला (ना0जेड ए)	—	
		3283	0.162हे0	नाला (ना0जेड ए)	—	

7—ग्राम नगवा— ग्राम भदैनी भाग प्रथम से होकर नदी/नाला ग्राम नगवां में प्रवेश करता है और इस ग्राम के आ0नं0175 व 193, 194 व 195 व 196 तथा आराजी नम्बर 236, 244, 245 होकर गुजरता है। जिसमें आराजी नम्बर 175, 196, 195 का सम्पूर्ण क्षेत्रफल खातेदारो के नाम अंकित है आराजी नम्बर 194 में रकबा 0.061हे0 भूमि नाले खाते में अंकित है और इसी क्षेत्रफल से नाला बह रहा है शेष रकबा खातेदारो के नाम है । आराजी नम्बर 236, 244, 245 अभिलेख में उ0प्र0 सरकार विकास प्राधिकरण के अनाम अंकित है। इन आराजियों से होकर वर्तमान में अस्सी नदी/नाला का मुडाव प्रवाह /बहाव गंगा नदी में रविदास पार्क के बगल से हो रहा है। नाले व आबादी के मिलान बिन्दु पर एस0टी0पी0 बांध है परन्तु सम्भवतः कार्य रुप मे नही हैं संलग्न नक्शे मे इस स्थान पर हारा होना प्रदर्शित किया गया हैं।

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क्रमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0
1	2	3	4	5	6	7
6	नगवा	192/1	0.089हे0	भूमिधरी	श्रीमती बनारसी देवी	
		192/2	0.034हे0	भूमिधरी	श्रीमती सोनपत्ती व श्यामप्यारी	
			0.061हे0	नला	–	
		193	0.486हे0	भूमिधरी	श्रीमती कुलवनि सिंह राणा, श्रीमती कपूरथली शुक्ला	
		194/1	1.040हे0	भूमिधरी	वगैरहा	
		194/2	0.295 हे0	भूमिधरी	अपराजिता व आत्मनन्दन वगैरह	
		194/3	0.061 हे0	नाली	श्रीमती आशा तिवारी व राजेश वगैरह	
		195	0.409 हे0	भूमिधरी	–	
		196	0.809 हे0	भूमिधरी	अवध बिहारी व आषा तिवारी वगैरह	
		236/1	0.340 हे0	उ0प्र0स0	अवध बिहारी सयव कलावती देवी वगैरह	
			0.728हे0	भूमिधरी	उ0प्र0 सं0 वि0प्रा0	
		244	0.121 हे0	उ0प्र0स0	कपिल देव तिवारी व महेन्द्र वगैरह	
		245	0.267हे0	उ0प्र0स0.	उ0प्र0स0वि0प्रा0	
					उ0प्र0सं0विकास	

8–ग्राम भदैनी द्वितीय– ग्राम नगवा के बाद नदी/नाला पुनः ग्राम भदैनी भाग 2 में प्रवेश करता है और इस ग्राम मे भाग 2 के आराजी नम्बर 3300, 3303, 3304 ,3314, 3315 से होकर गुजरता है। वर्तमान अभिलेख के अनुसार यह सभी आराजियां विभिन्न खातेदारो के नाम संकमणीय भूमिधर के रुप में अंकित है। स्थलीय जांच के समय ग्राम भदैनी के भाग 2 के शजरे में इन भूखण्डो में चिन्हित नाले का मिलान बिन्दू पर करने पर पाया गया कि मौके पर नाले का स्वरुप तो है परन्तु बहाव अवरुद्ध है, केवल अलग–बगल के आबाद लोगो द्वारा अपने घरो का सीवर का पानी बहाया जाता है वह पानी आता है और स्थिर है। स्थानीय लोगो द्वारा बताया गया कि पहले इसी रास्ते होकर अस्सीघाट पर अस्सी नदी व गंगा का संगम होता था, बल्कि ग्राम भदैनी का भूचित्र भाग दो पर अस्सी संगम शब्द लिखा है। इससे भी स्पष्ट होता है काफी पहले इसी स्थान पर अस्सी नदी/नाला गंगा नदी मे मिलता था परन्तु वर्तमान में इस स्थान पर पक्का अस्सी घाट , मन्दिर , साईकिल स्टैण्ड आदि बना हुआ है। संलग्न नक्शे में ग्राम नगवा में जिस स्थान से नदी/नाले के मुख्य बहाव को रविदास पार्क के बगल से गंगा नदी में मिलाया गया है। उस स्थान से आगे ग्राम भदैनी के भाग–2 के अवरुद्ध नाले को लाल स्याही से इंगित किया गया है।

क्रमांक	ग्राम का नाम	आ0नं0	रकबा	नवयइत	खातेदारों का नाम	वि0वि0

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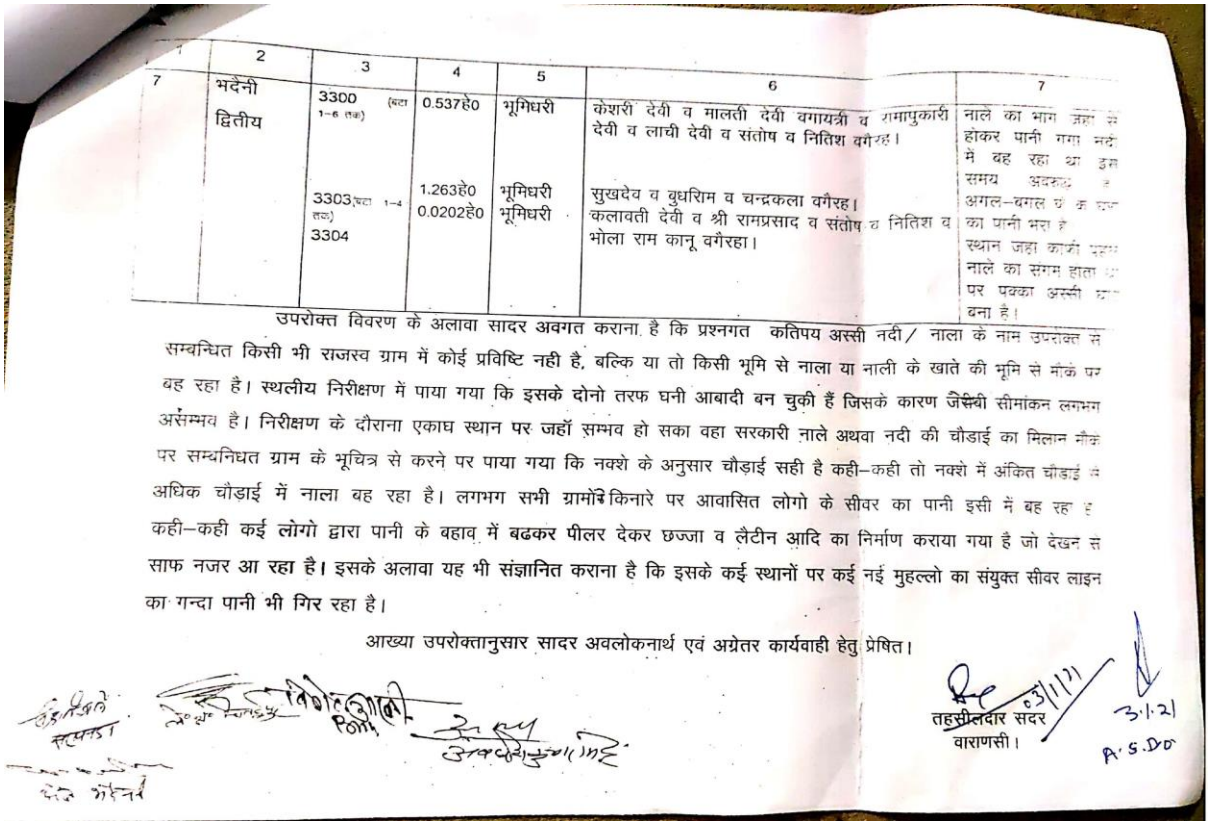


1	2	3	4	5	6	7
7	भदैनी द्वितीय	3300 (खंड 1–6 तक)	0.537हे0	भूमिधरी	केशरी देवी व मालती देवी वगायत्री व रामापुकारी देवी व लाची देवी व संतोष व नितिश वगैरह।	नाले का भाग जहां से होकर पानी गंगा नदी में बह रहा था इस समय अवरुद्ध है अगल–बगल के घर का पानी भरा है स्थान जहां काफी पहले नाले का संगम होता था पर पक्का अस्सी घाट बना है।
		3303 (खंड 1–4 तक)	1.263हे0	भूमिधरी	सुखदेव व बुधरिम व चन्द्रकला वगैरह।	
		3304	0.0202हे0	भूमिधरी	कलावती देवी व श्री रामप्रसाद व संतोष व नितिश व भोला राम कानू वगैरहा।	

उपरोक्त विवरण के अलावा सादर अवगत कराना है कि प्रश्नगत कतिपय अस्सी नदी/ नाला के नाम उपरोक्त से सम्बन्धित किसी भी राजस्व ग्राम में कोई प्रविष्टि नही है, बल्कि या तो किसी भूमि से नाला या नाली के खाते की भूमि से मौके पर बह रहा है। स्थलीय निरीक्षण में पाया गया कि इसके दोनो तरफ घनी आबादी बन चुकी हैं जिसके कारण जैसी सीमांकन लगभग असंम्भव है। निरीक्षण के दौराना एकाघ स्थान पर जहॉ सम्भव हो सका वहा सरकारी नाले अथवा नदी की चौडाई का मिलान मौके पर सम्धनिधत ग्राम के भूचित्र से करने पर पाया गया कि नक्शे के अनुसार चौड़ाई सही है कही–कही तो नक्शे में अंकित चौड़ाई से अधिक चौड़ाई में नाला बह रहा है। लगभग सभी ग्रामोंके किनारे पर आवासित लोगो के सीवर का पानी इसी में बह रहा है कही–कही कई लोगो द्वारा पानी के बहाव में बढकर पीलर देकर छज्जा व लैटीन आदि का निर्माण कराया गया है जो देखने से साफ नजर आ रहा है। इसके अलावा यह भी संज्ञानित कराना है कि इसके कई स्थानों पर कई नई मुहल्लो का संयुक्त सीवर लाइन का गन्दा पानी भी गिर रहा है।

आख्या उपरोक्तानुसार सादर अवलोकनार्थ एवं अग्रेतर कार्यवाही हेतु प्रेषित।

तहसीलदार सदर
वाराणसी।

Annexure – VII: Municipal Solid waste management Action Plan

Action Plan

Varanasi City Solid Waste Management
For 15th Finance commission

Varanasi Nagar Nigam,
Front of Saheed Udyan Park,
Sigra, Varanasi-221010
Email- mcvns1@gmail.com & nagarnigamvns@gmail.com

INTRODUCTION TO SOLID WASTE MANAGEMENT

Solid Waste Management (SWM) is an organized process of storage, collection, transportation, processing, and disposal of solid waste in a manner that is not detrimental to the environment. Today Solid Waste Management is an aggravating problem in urban areas of our country due to rapid population growth, coupled by an economic boom that encourages the consumption of goods and hence waste generation.
The local governing bodies namely municipalities and municipal corporations are responsible for providing SWM services in the urban areas. In most of the urban areas, insufficient funds, use of obsolete and/or inefficient technologies, lack of public awareness, and proper infrastructure had resulted in poor state of SWM. All this is changing with launching of new initiatives such as the Swachh Bharat Mission-Urban, publishing of Solid Waste Management Rules, 2016 and organizing Swachh Survekshan.

Swachh Bharat Mission-Urban was incepted in 2014 with the aim to modernize the SWM practices and augment the capacities of ULBs. The mission is actively engaging ULBs to take measures to keep the city clean by eliminating open dumping spots, promoting door to door collection of segregated waste, setting up scientifically designed solid waste management infrastructure and also reclamation of land from dumpsites.

Solid Waste Management Rules, 2016 were published by MOEFCC replacing the Municipal Solid Waste rules 2000. The new rules stresses on waste segregation, decentralized waste management, roles of Bulk Waste Generators and involvement of informal sector in solid waste management. Swachh Survekshan is a ranking exercise taken up by the Government of India to assess urban areas for their levels of cleanliness and active implementation of Swachh Bharat Mission initiatives in a timely and innovative manner. The objective of the survey is to encourage large scale citizen participation and create awareness amongst all sections of society about the importance of working together towards making towns and cities a better place to live in.

Varanasi City Profile

Varanasi is a city in the Indian state of Uttar Pradesh dating to the 11th century B.C. regarded as the spiritual capital of India, the city draws pilgrims who bathe in the sacred waters of River Ganges and perform funeral rites. Along its Vending streets are some 2,000 temples, including Kashi Vishwanath, dedicated to the Hindu God Shiva. The ancient city of Varanasi was not built in a day. The city has two remnants of a holy past: the first being Rajghat plateau, where the archaeological findings of wards date back to the period of very existence of urban settlement and the second being Sarnath, where Buddha gave his first sermon, “Turning the wheel of law” in 528 BC. Later during 3rd century King Ashoka built a monastery township there, which continued its existence till 12th century and was later destroyed. Since ancient times the natural and cultural landscapes of the city have retained an active social role in contemporary society closely associated with the traditional way of life.

The city is a place of pilgrimage and a holy site for sacred baths in the Ganga River, to have a good death, to get relief from transmigration, to learn and receive spiritual merit, etc. The city has still maintained its traditions. In spite of several downfalls and upheavals, traditions are fully alive even today. Being the holiest city of Hinduism, the impact of the religion is found everywhere in the city – the chanting bells and the monotonous but oddly soothing, chant of Sanskrit hymns, in the fragrant flower offerings, and the colored powders that are sold in a myriad roadside shops which decorate the foreheads of the devout, in the tens of thousands of worshippers and the thousands who offer them salvation or services. Ghats with stairways along the Ganga with presence of “dying homes”, charitable homes, pilgrims’ rest houses, are some of the city’s unique characteristics.

Apart from that, silk weaving and sari making, metal, wood and terracotta handicrafts, toy making, particular painting forms, etc., comprise the continuity of historical and cultural tradition. Varanasi is famous for its fairs and festivals with respect to variety, distinction, time, sacred sites, performers, viewers and sideshows.

Demographic Profile

The total population of Varanasi is 1198491 as per Census 2011. This population is 0.115% of total India population. If population growth rate would be same as in period 2001-2011 (2.67%year), Varanasi population in 2020 is estimated to be 15, 31,458. Owing to its rich tourism potential, the estimated daily flow of tourists and pilgrims to the city is 25,000. Varanasi shows a constant increase in the population with varying rate of increase from decade to decade. The population density of the city is considerably high at 14598 persons per sq km (i.e. 150 persons/ha). These data indicate the immensely overcrowded habitat conditions in the city. (As per trend of rate of population growth in last 10 year: 2001-2011), there was 4, 76,779 lakh households & population in Varanasi with nearly 15, 31,458. Varanasi is the historical cultural capital of India and an international tourist destination. Varanasi is one of the largest urban centres and fast-growing cities in the state of UP. The total area within Varanasi Nagar Nigam (VNN) is 82.1 km square for 90 wards and 86 more Villages have been merged with VNN area of 195 Sq km.

Varanasi City at a Glance:-

The over view of Varanasi city given in the table below:-

Varanasi City at a Glance		
S.No.	Name and Address	Varanasi Nagar Nigam, Sigra Varanasi
1	No. of Zones	5
2	Sub Zones	14
3	No. of wards	90
4	Population (census 2011)	11,98,491
5	No of House Hold (census 2011)	1,91,278
6	Population 2021	15,31,458
7	No of Household 2021	2,48,300
8	Area under Jurisdiction	82.1 sq km
9	Newly Merged Villages	86 Villages (20 wards approx)
10	Newly Merged Villages HH	151759
11	Newly Merged Villages population	476779
12	Location	Between 25.3176° N & 82.9739° E
13	Boundaries	Ganga River & Ram Nagar in East, Chandauli in East, Jaunpur Road in West, Azamgarh Road in North, Chunar Road in South
14	No. of Slums	210

15	No of Schools	507
16	No .of Hospitals	52
17	No .of Hotels	132
18	Market Complexes /Malls	4
19	RWAs	29
20	Commercial area	153
21	Mandi-Fruit	02
22	No. of Vegetables Markets	05
23	No. Fish Market	02
24	No. Agriculture Market	01
25	No. Dhalao / Kudaghar	23
26	No of PCTS	03
27	No of slums (current)	108
28	No. of Parks	110
29	MRF Collection Center Available	3
30	Space available for MRF with Location	14
31	No of vending Zones	15
32	Parks	136
33	Nullahs/Drains	93
34	Temple/tourist Places	20
35	Major Banquet Halls	55

STATUS OF EXISTING SWM SYSTEM AND GAP ANALYSIS

The total waste generated in Varanasi Municipal Area each 600 TPD. The Most of the waste generated comprises biodegradable, compostable, and recyclable materials. This is due to the high quantum of religious and vegetable waste the city generates along with a high amount of plastic waste. The major component of the waste is organic in nature, constituting almost 41.95%. The average waste generation of Varanasi is 0.400 kg per capita per day. The city at present generates 600 MT (Approx.) of waste per day at the rate of 0.400 Kg per capita per day and decadal population growth of 2.67 per Year (as per trend of rate of population growth in last 10 year: 2001-2011)

Population Projection and Waste generation for Varanasi City

Solid Waste Management Rules 2016

Year	House Hold	Population	Waste generation MT/Day (approx) @ 400 gm per capita per day
2011	**191278**	**11,98,491**	**479.39**
2021 (for 90 Wards)	**248300**	**15,31,458**	**612.58**
2021 (For 86 Newly merged villages- 20 wards)	151759	4,76,779	190.71
2035 (for 110 Wards)	512012	29,64,678	1185.87
2050 (for 110 Wards)	655375	40,93,136	1637.25

The Government of India published the Solid Waste Management Rules, 2016, the salient features of which are given below.

- The Rules are now applicable beyond Municipal areas and extend to urban agglomerations, census towns, notified industrial townships, etc.
- Source segregation of waste has been mandated.
- Responsibilities of Generators have been introduced to segregate waste in to three streams, Wet, Dry and domestic hazardous wastes and handover segregated wastes to authorized rag-pickers or waste collectors or local bodies.

- Integration of waste pickers/ rag pickers and waste dealers/ Kabadiwala in the formal system should be done by State Governments, and Self Help Groups.
- Generator will have to pay 'User Fee' to waste collector and a 'Spot Fine' for Littering and Non- segregation.
- Used sanitary waste like diapers, sanitary pads should be wrapped securely in pouches provided by manufacturers or brand owners of these products or in a suitable wrapping material and shall place the same in the bin meant for dry waste / non- bio-degradable waste.
- All manufacturers of disposable products such as tin, glass, plastics packaging etc. or brand owners who introduce such products in the market shall provide necessary financial assistance to local authorities for the establishment of waste management system and all such brand owners who sale or market their products in such packaging material which are non-biodegradable should put in place a system to collect back the packaging waste generated due to their production.

Duties of Local Bodies:-

It has emphasized that is duty of local bodies (as a prime responder of Solid Waste Management) to carryout of Collection, Transportation and Disposal of solid waste of scientific Manner on day to day basis. The rule further facilitates the local bodies to apply the penalty clause for the effective enforcement of the rule apart from the user charges accordingly bylaws has been framed by the Varanasi Nagar Nigam and published in district gazette.

Administrative Setup for MSW Management:

The area falling under Varanasi Municipal Corporation is currently divided into 5 zones and 14 Subzone and 90 wards for administrative purposes and 86 newly merged villages the details of which are as below:-

Sl. No.	Zone	Subzone	Ward No.	Ward's Name
1	Adampur	Adampur	56	Omkaleshwar
2			42	Nawapura
3			46	Pathani Tola(Salempura)
4			82	Chhittanpura
5			66	Saraiya
6			39	Jalalipura
7			43	Konia
8			49	Naya mahadev (Prahladghat)
9			8	Rajghat
10		Jaitpura	89	Basania (Bandhukacchibagh)

11			78	Kamalgarha
12			70	Katehar
13			36	Alaipura
14			58	Dhupchandi
15			90	Kamalpura
16			86	jamaludinpura
17			80	Kajisadullapura
18			75	Jaitpura
19			87	Agaganj
20			88	Rasulpura
21	Bhelupur	Bhelupur	55	Bhadaini
22			68	shiwala
23			63	Bagahara
24			64	Rewari Talab
25			51	Tilbhandeshwar(Pandeyhaveli)
26		Khojwa	29	Sunderpur
27			11	Nagwa
28			14	Nawabganj
29			13	Newada
30			31	Naria
31			40	khojwa
32		Nagwa	19	Tulsipur
33			9	Sarai Surjan
34			25	sudamapur (Jolha Uttari)
35			48	Bajardiha
36			23	Jolha (jolha South)
37			45	Bhelupur
38			27	Birdopur
39			59	Ranipura
40	Dashashwamedh	Chetganj	37	Jagatganj
41			24	Habibpura

42			28	Senpura(Chetganj)
43			61	Lahangpura
44			67	Sarai Gowardhan
45			73	Lallapura Kala
46		Dashaswamedh	77	Ramapura
47			72	Pandariba
48			62	Luxa
49			69	Jangawadi
50			81	Dashaswamegh
51			71	Bangalitola
52			83	Madanpura
53		Sigra	2	Loco Chhitupur
54			3	Lahartara
55			41	Lallapura Khurd
56			4	Shivpurwa
57			52	kazipura
58			32	Ghandhi nagar (Sigra)
59	Kotwali	Chowk	60	Piyari Kala
60			76	Hadaha
61			65	Beniya
62			84	Ganawasi Tola
63		Kotwali	54	Katuapura
64			79	Baluaveer
65			74	Daranagar
66			47	Iswargangi
67			50	Madhyameshwar
68			57	Goladinanath
69			53	Raj Mandir
70			44	Kameshwar Mahadev
71			85	Kal Bhairav
72	Varunapar	Nadeshar	21	Chaukaghat, Dhelwariya
73			18	Inglishiya line(Nadesar)
74			20	Rajabazar

75			12	Puranapul (Daniyalpur)
76			35	Ramrepur
77		Sarnath	30	Mawaiya(Akatha)
78			33	Proper Sarnath
79			26	Paharia
80			1	Indrapur
81			17	Narayanpur
82		Shivpur	10	Tarna
83			6	Sarsauli
84			22	Shivpur
85			34	Khajuri
86			15	Sikraul
87		Sikraul	7	Nai Basti
88			16	Pandeypur
89			5	Hukulganj
90			38	Dithori Mahal

86 Newly Added Village Details:-

Sr. No	Village Name	Added Zone Name
1	Bhikharipur khurd	Bhelupur Zone
2	Bhikharipur Kala	Bhelupur Zone
3	Kanchanpur	Bhelupur Zone
4	Chaitaipur	Bhelupur Zone
5	Avaleshpur	Bhelupur Zone
6	Nunwan	Bhelupur Zone
7	Kakarmatta	Bhelupur Zone
8	Suswahi	Bhelupur Zone
9	Sheergowardhanpur	Bhelupur Zone
10	Chittupur	Bhelupur Zone
11	Bhagwaanpur	Bhelupur Zone
12	Kandwa	Bhelupur Zone
13	Karaundi	Bhelupur Zone

14	Dafi Annshik	Bhelupur Zone
15	Tulsipur	Bhelupur Zone
16	Chooramanpur	Dasaswamedh Zone
17	Mandauli	Dasaswamedh Zone
18	Naathupur	Dasaswamedh Zone
19	Ganeshpur	Dasaswamedh Zone
20	Pahadi	Dasaswamedh Zone
21	Pogalpur	Dasaswamedh Zone
22	Naashirpur	Dasaswamedh Zone
23	maheshpur	Dasaswamedh Zone
24	Jalalipatti	Dasaswamedh Zone
25	Fulwariya	Dasaswamedh Zone
26	Shivdashpur	Dasaswamedh Zone
27	Lahartara	Dasaswamedh Zone
28	Manduwadih	Dasaswamedh Zone
29	Chandpur Anshik	Dasaswamedh Zone
30	Badagao Pratham	Varunapaar Zone
31	Aedhe	Varunapaar Zone
32	Harballampur	Varunapaar Zone
33	Vanvaripur	Varunapaar Zone
34	Lamhi	Varunapaar Zone
35	Soyepur	Varunapaar Zone
36	Rasulpur	Varunapaar Zone
37	Manjhmitiya	Varunapaar Zone
38	Mandwa	Varunapaar Zone
39	Hasimpur	Varunapaar Zone
40	Ramdattpur	Varunapaar Zone
41	Hariharpur	Varunapaar Zone
42	Sarsawan	Varunapaar Zone
43	Ahmadpur	Varunapaar Zone
44	Kanudih	Varunapaar Zone
45	Dandupur	Varunapaar Zone
46	Holapur	Varunapaar Zone
47	Parmanandpur	Varunapaar Zone
48	Lodhan	Varunapaar Zone

49	Hatiya	Varunapaar Zone
50	Ganeshpur	Varunapaar Zone
51	tarna	Varunapaar Zone
52	Basdevpur	Varunapaar Zone
53	Chuppepur	Varunapaar Zone
54	Baksada	Varunapaar Zone
55	Chattripur	Varunapaar Zone
56	Deenapur	Varunapaar Zone
57	Hasanpur	Varunapaar Zone
58	Singhpur	Varunapaar Zone
59	Mugdarpur	Varunapaar Zone
60	Khajuhi	Varunapaar Zone
61	Faridipur	Varunapaar Zone
62	Hridaipur	Varunapaar Zone
63	Rajanhiyan	Varunapaar Zone
64	Goithaha	Varunapaar Zone
65	Sandaha	Varunapaar Zone
66	Rustampur	Varunapaar Zone
67	Heramanpur	Varunapaar Zone
68	Tilmapur	Varunapaar Zone
69	Rasoolgarh	Varunapaar Zone
70	Raghunathpur	Varunapaar Zone
71	Khalispur	Varunapaar Zone
72	Ledhupur	Varunapaar Zone
73	Aashapur	Varunapaar Zone
74	Kotwan	Varunapaar Zone
75	Salarpur	Varunapaar Zone
76	Saraimohan	Varunapaar Zone
77	Kharagpur	Varunapaar Zone
78	Domri	Aadampur Zone
79	Soojabad	Aadampur Zone
80	Baniyapur	Varunapaar Zone
81	Bhawanipur	Varunapaar Zone
82	Pisaur	Varunapaar Zone
83	Daniyalpur	Varunapaar Zone

84	Bhitari	Bhelupur Zone
85	Bedauli	Bhelupur Zone
86	Lohta	Bhelupur Zone

The Municipal Commissioner heads the whole Varanasi Municipal Corporation and the department of Solid Waste Management comes under the ambit of the four Additional Municipal Commissioners. One Additional Commissioner looks after the Sanitation & Solid Waste Management. There is one Municipal Health officer to look after sanitation work. At the zone level five zonal officer one for each zone. Apart from this there is five Zonal officer,& fourteen Sanitary and Food Inspector (One inspector looking after Infectious area spry fogging work) AND Two of Executive Engineer's. Looks after Transportation & Processing and Disposal of the solid waste.

Wards are grouped in Subzone & Sanitary and Food Inspector (SFI) In charge of subzone. Under whom sanitary supervisor/beat in charge manages the Safai Mitra's. The Safai Mitra's are either direct, contractual or outsourced through outsourced agencies. The details of the manpower deployed for SWM in the Varanasi Municipal Corporation are as given below:

Manpower Engaged in VNN for MSW Management	
Designation	No
Municipal Commissioner	1
Additional Municipal Commissioner	1
Municipal Health officer	1
Executive Engineer's.(Transport & Processing-SWM)	2
Zonal Officers	5
Zonal Health officers	1
Sanitary & Food Inspector	14
Account Clerk	01
Account Officer	02
Safai Supervisors	93 (VNN-38 and Varanasi Waste Solution-40)
Safai Mitra's and drivers	5784 (VNN Safai Mitra's = 4171, VWSPL Safai Mitra-850, VNN drivers = 331, VWSPL Drivers- 195, Rag Pickers = 237)

Solid Waste management Problem and Gap analysis

The existing SWM practices prevalent in Varanasi city. The various sources of waste generation, the current primary & secondary waste collection practices, waste transportation & disposal mechanisms and gaps in the existing SWM system have been presented.

Characteristics of waste

Solid waste is generally classified in three major categories i.e. biodegradable, recyclable and other.

- Biodegradable waste includes flower waste, garden waste, fruit waste, vegetable waste, food waste, cattle waste etc.
- Non-Biodegradable waste includes plastic, glass, polythene, metal, paper etc.
- Domestic Hazardous & Biomedical waste, sanitary napkins, slaughter waste, electronic waste, construction & demolition waste etc. In that, the waste can be categorized by physical characteristics such as organics, paper, plastic, glass, metal, cloths and other residual wastes.
- Waste characterization of Varanasi shows 51.25% biodegradable waste, 15.30% recyclable waste and 33.45% other waste. Recyclable category includes Paper (32.80%), polythene (25.60%), plastic (7.30%), glass (5.70%), metal (5.80%) and others (22.80%). Source Provided by International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)

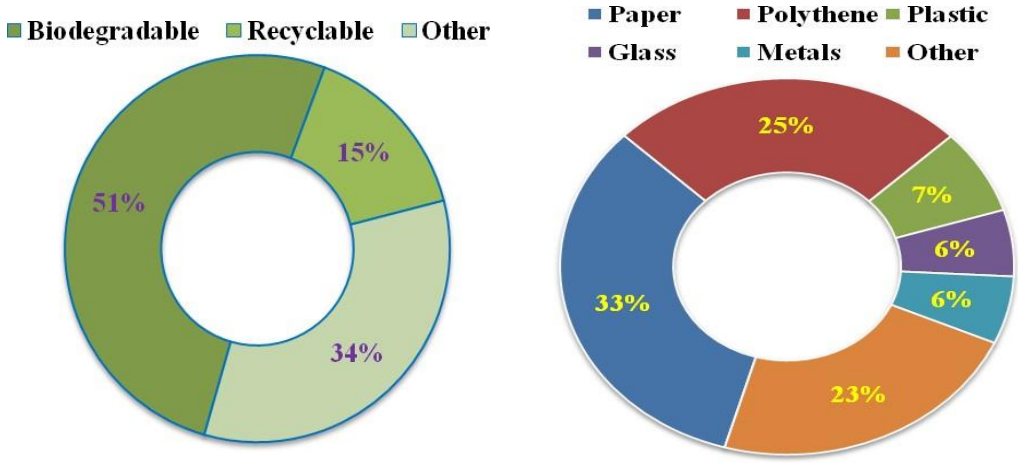


Figure-1a and 1b: Composition municipal solid waste

Problem Area, Gaps and challenges:-

Problem Area	Gaps	Challenges
Door to door collection	• Waste collectors are very less in number than required. • Limited vehicles for waste collection. • No proper waste collection route planning.	• Citizens deny for paying user fees for waste collection facility. • Fund for door to door collection facility is not sufficient. • Due to narrow street/lanes. • Timing issue.
Segregation at source level	• Lack of awareness in public regarding SWM rules 2016. • Lack of training in VMC/private waste collector regarding segregation. • Lack of twin compartment vehicles. • Lack of imposition of fine. • Lack of twin bin for primary collection. • Citizens are not willing to segregate their waste.	• No proper dissemination of SWM 2016 rules amongst citizens by Municipal Corporation. • Citizens find confusing and difficulty in segregating their waste at source. • No proper monitoring done by corporation staff.
Street sweeping	• No machine sweeping system. • Sweepers often skip sweeping in narrow lanes/streets. • Lack of monitoring by supervisor on sweepers.	• After sweeping, citizens again mess up on streets. • Lack of appropriate resources • Open and overflow drain
Improper Loading & unloading of waste	• Lack of automated vehicle. • Lack of proper strategy. • Lack of infrastructure.	• Require high capital cost like static Compator.
Domestic hazardous waste management	• No domestic hazardous waste collection center in the city. • No separate collection of HHH by	• Citizens mix their domestic hazardous waste with other wastes.

	waste collectors. • Lack of awareness amongst people regarding the management of domestic hazardous waste.	
Bio-medical waste	• Lack of biomedical waste collection facility. • Disposal of biomedical waste along with MSW. • Lack of biomedical waste collection vehicle than required. • Imposition of fine on hospitals/labs for disposing it with MSW is not strictly followed by VMC.	
Management of BWG wastes	• Lack of training and education on responsibilities of BWG according to SWM 2016 rule. • No regular inspection for SWM system in their premises by VMC staff. • Lack of imposition of fine who are not managing their waste.	• Lack of private vendor who can manage their wastes. • Limited space in their premises. •
Generation of garbage vulnerable points.	• Due to lack of waste management facility in respective areas. • Dustbins are less than required in an area. • Lack of imposition of fine.	
Burning of MSW	• Lack of municipal waste management facility nearby area. • Lack of awareness amongst people. • No impose of fine that burn their MSW. • Lack of monitoring by staffs.	
Plastic waste management	• No separate collection facility of plastic waste by waste collector. • Only a single plastic treatment facility in the city and lack of dissemination of work of this facility throughout	

	citizens of the Varanasi. • Lack of awareness amongst the citizens. • Existing of banned plastic in the city. • Collection of non-recyclable single used plastic.	
Processing of MSW	• Lack of decentralized processing facility. • Unsegregated MSW. • No proper strategy for managing MSW of the city. • Lack of decentralized community composting in the city. • Not practicing of source segregation of waste by citizens. • Collection of un-segregated waste by waste collectors. • Lack of material recovery facility for dry waste in the city.	• Require very high capital cost.
Construction and demolition waste	• No separate collection and disposal of C&D waste. • Limited collection centre in the city. • Lack of awareness amongst the citizen regarding their responsibility and management of C&D waste. • No treatment facility in the city. • Lack of imposition of fine who are not managing their waste.	• Collection & segregation of concrete, soil, steel and others and storage of construction and demolition waste generated. • To collect transportation charge from waste generators.

Goals /Objectives/Guiding principles/Strategy: -

Our objective is to set up the small goals so that the city can get high level of cleanliness including MRF centers and waste processing plants because as the number of tourist and population of city will increase, there would be high chances of getting the most of the municipal solid waste in mixed form and the chances of making the environment unhealthy will also increase. Our goals and objectives are not limited to the Municipal Corporation. This will also cover the activities from where the waste is directly generated. It also covers the IEC activities so that maximum people should aware the consequences of mixing up the waste and the city corporation can get the maximum waste in sorted form. Our vision also covers to build a centralized system to city level and make the solid waste management system more cost effective.

For converting the vision plan in real, we have some guiding principles that is also based on the six basic elements of Solid Waste Management; waste generation, onsite handling, collection, transfer & transport, recycling & processing and disposal. We will also cover how to reduce the volume of waste by composting and to generate the energy from the waste. The vision plan will also discuss how to sustain the cleanliness by making zero garbage vulnerable point in the city and how to engage with the society to follow sustainability.

Here are some bullets that will enlighten our guiding principles:

- Source segregation, processing and recycling.
- Composting
- Energy generation
- Zero vulnerable point
- Maintaining sustainability
- Waste reduction
- Engaging with societies etc.

This vision plan for Varanasi city in solid waste management:

- *Source segregation in three streams:* will educate the community by doing IEC for separating the waste in three categories; biodegradable waste, non-biodegradable waste and hazardous waste.
- *Promoting the 3R's:* by promoting the 3R's; reduce, reuse and recycle, we will be able to reduce the volume of waste right from its generation point and many useful things can be done by reusing & recycling the waste.
- *Composting:* by this strategy, people we learn how the compost is useful for soil rejuvenation and gardening.
- *Energy Generation:* energy can be generated from municipal waste by treating the organic waste in biomethanation plants and by gasification techniques for solid waste.
- *Developing MRF and processing unit for hazardous waste.*
- *Converting landfill into sanitary/engineered landfill.*
- *Linkage with formal sector in a systematic manner.*
- *Reduction of greenhouse gas emissions.*

Goal and Objectives

- Achieving high level of cleanliness in city.
- Waste reduction, reuse, recycling, recovery and optimum utilization of MSW for minimization the waste going to landfill
- Minimization its bad impact on environment and human health.
- Converting centralized system into decentralized system. (Optimum neutrization
- Making cost effective solid waste management.
- Sufficient awareness among the public and all stakeholders, organizations and institutions understand their role and responsibilities

Guiding principles

- Reduction and reuse of waste at source
- Waste recycling
- Waste to composting
- Waste to energy
- 100% collection and Segregation
- No any Garbage vulnerable point
- Engage of community
- Ensure system capacity
- Follow sustainability and waste management hierarchy
- Public Private Partnership (PPP)

Strategy:

- Segregation of waste at source in three streams
- Promoting home composting or community level
- Door to door Segregated collection
- Three bin system at secondary collection point
- Developing MRF for non-biodegradable, composting/Bio-meth nation unit for biodegradable and processing unit for household hazardous waste.
- RDF sends to the waste to energy project.
- Converting landfill into sanitary or engineered landfill.
- Linkage of informal sector in a systematic manner.

Waste Generation, Collection & Transportation

This section describes the various sources of waste generation, characteristics of waste, existing waste handling & management methods in Varanasi city. In a city, Solid waste gets generated at various places. Primary source of solid waste is household. The waste generated at household level is known as domestic waste. Domestic waste comprises leftover food, kitchen waste, packaging waste, electronic waste, sanitary waste, etc.
The other places where waste gets generated includes shops, markets, malls, parks, gardens, hotels, schools, temples, offices, hospitals and construction sites.

Currently there are no 100% door to door collections in 90 wards of Varanasi. Most of the households, shops, and establishments throw their waste just outside their premises, on streets, in drains, in open spaces, in water bodies, and in other inappropriate places. These litters swept away by street sweeping and lifted by means of handcart or rickshaw trolley by Sweepers and waste collectors of VMC. This led to unsanitary condition across the city. Varanasi Nagar Nigam outsourced M/s Varanasi Waste solution Pvt.Ltd. For door to door collection in 90 wards, mechanized road Sweeping approx 22.1 km. daily basis (Sant. Athulananda to BHU) and toilet cleaning work of Varanasi. Apart from door to door collection three Ngo's named Anthill Services Pvt.Ltd; career consulting pvt. Ltd, Jan Vikas Kalyan Samiti; Engage for IEC activities for sanitation awareness in their respective wards.

All the Commercial area/public/tourist's area street sweeping also done in two times including night shifts and residential area swept in once in time. The length of roads, streets, lanes, bye-lens in the city is approximately 1200 km. Street sweeping starts between 8:00 AM and continues up to 2:00 PM. Though, the street sweeping starts at the stated time but the reporting of male workers starts at 7.30 AM while woman workers are relaxed for 30 minutes. The sweepers are provided with jhadoo (brooms), pans, favda, hand-carts, panji (bamboo stick used to clean nalas [drains]), gayti (pointed favda to clean roads), and buckets to clean nalas. During the sweeping process one sweeper The total area within Varanasi Nagar Nigam (VNN) is 82.1 km square and total road length including all street approx 1200 km, Bituminous road length 597 km, lane length 603 km, on both side of the bituminous road is 350 km and total approx length of drains 2400 km. Cover an area of 2400 km of roads and adjacent drains. They collect the waste on road sides.

Centralized and De-Centralized waste Processing & Disposal facility

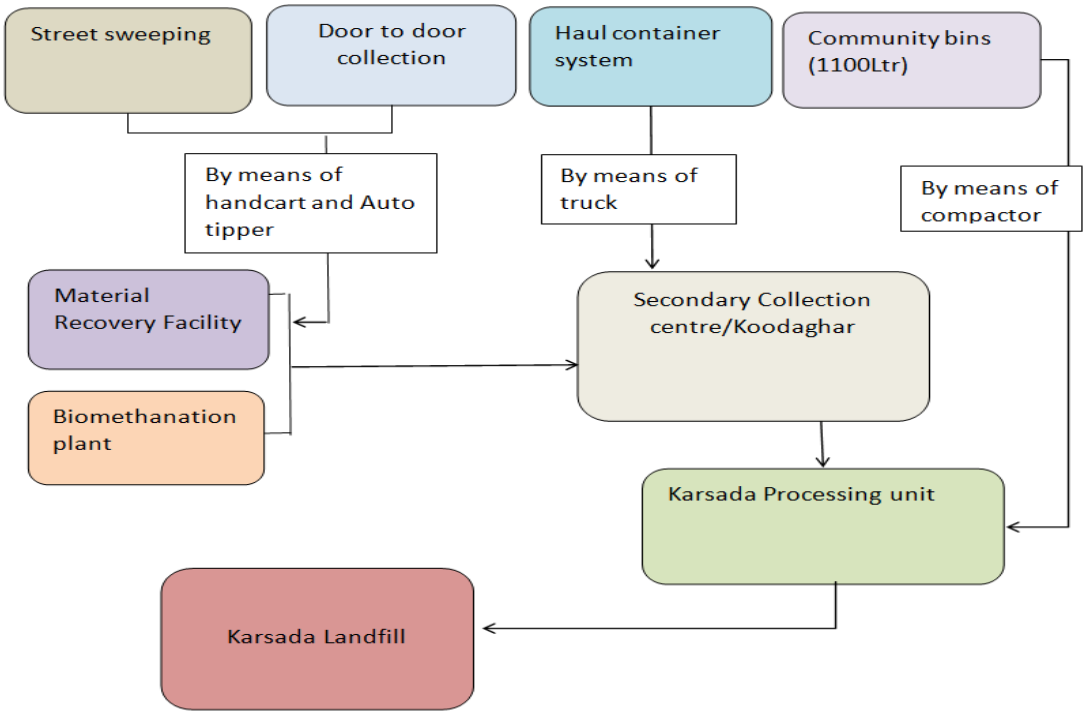
Varanasi generates around 600 Tons of Municipal Solid Waste daily which is collected and transported to Processing Plants. VNN has the following Processing Plants: -

Waste to Compost Plant: - Karsada Waste to Compost Plant capacity of 600 MTD. Constructed on CSR funds of NTPC this Plant produces Compost and Refuse Derived Fuel/RFD. The Compost is sold in bulk to fertilizer Plants and in small quantity to neighboring farms. The RFD is sold to Cement Plants. This Plant was under the Operation and Management of M/s. IL & FS till December 2019. From January 2020 Operation & Management has been in charge of M/s. Excel Industries Pvt. Ltd; Mumbai.

24 TPD KARSADA WASTE TO ENERGY PLANT: - This Plant constructed on CSR funds of NTPC and under O & M of M/s Ankur Scientific, Ahmadabad is functioning since 22nd November 2020. It processes waste to produce electricity.

De-Centralized Waste to Energy plants: - Three Waste to Energy Plants each of 5 Ton Per Day Capacity (Total 15 Ton Per Day) located at Bhawaniya Pokhri at Bhelupura; IDH at Adampur; and Pahadiya Mandi at Pahadiya established on CSR funds of M/s. IOCL and under O & M of M/s. ORSPL, Mumbai. All three Plants were functioning between 2017 to December 2019. The Plants produces Bio Gas, Electricity and Compost. The Bio-Gas is used in production of electricity which is used for running the plant. Excess electricity is used for street lightings. The Compost is supplied free of cost to municipal parks via Horticulture Department of VNN. Since January 2020 the Plants are non-functional due to ongoing renovation work before being handed over to VNN.

Flow Chart – D2D Collection & Transportation, processing and disposal



Material Recovery Facility: -

The Daily generation of the dry waste is 100. TPD approx as of now. The dry waste collected from the waste generators mainly contains used plastic material, plastic carry bags, plastic pouches, and rubber materials like tyre, chappal, resin material, glass, and tin boxes. Apart from the domestic hazardous waste such as discarded paint container, electronic waste and electrical waste are also collected and deposited in this material recovery facility centre.

The bailing machine is provided by UNDP and GIZ India. The recyclable material is being disposed to the vendors. The Non-recyclable material, but the calorific values are disposed to the Cement factories for furnace fuel usage. The records and registers are being maintained and documented.

At Present, MRF Centre is integrated as a part in the existing 1 Nos. of MRF Collection Centre and 2 Nos. of MRF facility Centers and 14 Nos. are being proposed.

The vehicle used for collection solid waste of households and market places to be served, right of way of the road

as well as traffic conditions on the road. Depending on the above factors, manual rickshaw, e-rickshaw or mechanized vehicles such as Tata Ace, tractor trolley etc. are used are given below: -

Sr. No	Vehicles Details	Nos.
1	Dumper	**18**
2	Compactors	**21**
3	Hopper	**12**
4	Tata ace hopper	**71**
5	Garbage H.P. Container (D.P. Container)	**10**
6	Tractor	**21**
7	Tata Ace CNG	**147**
8	Hook loader	**3**
9	Encroachment Vehicle	**2**
10	JCB	**9**
11	Skid Loader	**2**
12	JCB Chain Mounted Hydraulic Excavator	**1**
13	Tata Lander	**2**
14	Road Sweeping Machine	**3**
Total Mechanized Vehicles		**215**
1	Trolley	**1200**
2	Handkart	**800**
Operational manual Vehicle		**2000**
Total manual and Mechanized Vehicles		**2215**

Details of Manpower for collection of solid waste management facilities: -

Sr no	Details of employees working in cleaning and transport works	No. of employees
1	For Involved in sanitation work	4171
2	For transportation facilities	331
3	Rag pickers	237
4	VWSPL Employee	1100
	Total	5839

Cleaning of Ghats: -

Apart from cleaning of 90 wards 84 Ghats' cleaning work is going on by ILFS Environment Pvt.Ltd.

- Sweeping twice a day on general days.
- Need based cleaning/washing on festivals.
- Washing/mopping at least once every day.
- Lifting of garbage every day and transporting it to the dumping site.
- Removal of silt as and when required.
- Placing of twin bins and Shraddha Kalash (for Pooja waste material) after every 30m-50m.

Picture's for activities: -

Door to Door Collections



Covered transportation of Garbage in streets.



Collection and transportation of drain silt:-


Garbage Bins:-


Cleaning of Ghats:-



Processing Disposal:-


User Charges, Penalties and Spot fines and Enforcement of ban on Plastic

- Affordable User charges are being collected from residential, commercial, Institutional, BWG. Necessary By laws framed & notified in the state.
- Penalties & spot fine are notified in gusset for none segregated, anti-littering and non-compliance of SWM rule 2016.
- Implemented in 100% premises including littering in storm water drains and water nodes through the Enforcement committee formed exclusively for this purpose.
- Notified on complete ban on all plastic bags in the Varanasi city.
- Enforcement came to force as per SWM rule 2016

C&D Waste Management: -

Facilitation of use/processing or recycling of C&D waste (primarily for bulk waste generators). Gazette notification related to the management of C&D waste already published. At Present, There 31 nos. of designated places for the collection of C&D Waste.

At Ramna, the site belongs to corporation has been proposed to established C&D waste processing unit is under construction by IL&FS. The project cost is Rs. 10 Crore.

Citizen Grievance Redressal and SWM Activities monitoring mechanism: -

- **Integrated Smart Solid Waste Management System Software**
- Volume and Bin-Collection monitoring system
- Vehicle Tracking, fuel and Inventory Management System
- Attendance Management System
- Citizens Grievance Redressal System
- Community and Public Toilet Cleaning Monitoring system
- CCTV Surveillance of Koodaghar

- Weighbridge Integration at Waste treatment Plant

- **Mobile apps for:**
- Attendance
- Grievance Redressal
- Toilet Cleaning
- Door to Door Collection
- Mechanized Sweeping
- Vehicle on-route weight monitoring

Additional requirement of Monitoring Mechanism in Solid Waste :-	
Storage of MSW	• Total expenditure spent on storage facilities. • Cost used in maintenance of bins. • Distance between community bins.
Collection and Segregation of MSW	• Amount of mixed waste collected. • Amount of dry waste collected. • Amount of organic waste collected. • Amount of C&D waste collected. • Amount of plastic waste collected. • Amount of primary collection by private contractor (in tonnes) (if any) • No. of manpower used by private contractor. (if any) • Revenue per unit (tons) of MSW collected by corporation. • Revenue per unit (tons) of MSW collected by private contractor (if any). • Cost spent on maintenance of vehicles. • Frequency of waste collection.

	• Distance from primary collection center to secondary collection centre • Expenditure incurred on awareness programme per capita. • No. of personnel for door to door collection. • Suitable containers for collection of waste from doorstep.
Transportation of MSW	• Distance from secondary collection centre to Processing unit. • Distance from secondary collection centre to landfill • Total expenses used for transferring and transporting of waste from secondary collection centre to processing units. • Total expenses used for transferring and transporting of waste from secondary collection centre to landfill. • Total expenditure spent on maintenance of vehicles. • Type of transfer operation used in transfer station. • Availability of equipment and accessory requirements in transfer station.
Processing of MSW	**Bio-methanation Facility-** • Amount of MSW received daily. • Amount of organic waste separated. • Amount of rejected MSW. • Total manpower used. • How much electricity consumed in the facility? • How much electricity generated from per ton of waste? • Revenue generated per tonne of waste treated. • Quantity of digestate produced. • Total expenditure used for running the facility. • Revenue generated from per tonne of compost. • Total expense used for composting. **Material Recovery Facility-** • Total MSW received. • Amount of recyclables separated from MSW. • Amount of rejected MSW. • Amount of recyclables collected other than MSW. • Income from selling out recyclables. • Number of manpower used. • Total electricity consumed in the facility. • Total expenditure used for the facility.

Disposal of MSW	• Amount of waste disposed in tonnes /day • Revenue generated from recovery of landfill gas. • Operation and maintenance cost spent on landfill. (including leachate / gas treatment system) • Availability of technical personnel. • Availability of appropriate land. • Availability of institutional capacity. • Availability of financial resources.

Achieving Zero Land Fill Status

The level of carbon dioxide released into the atmosphere is increased and further increasing day by day, this is because of burning the fossil fuels such as coal, oil, gasoline and natural gas which is the major contributor of global warming and greenhouse effect. The emissions due to this forcefully keep the heat close to the earth's surface that leads to a rapid increase in the earth's temperature and climatic problems such as high sea level and storms. This emission can be reduced by reducing the demand of fossil fuels.

There are several ways to reduce the emission:

For the households:

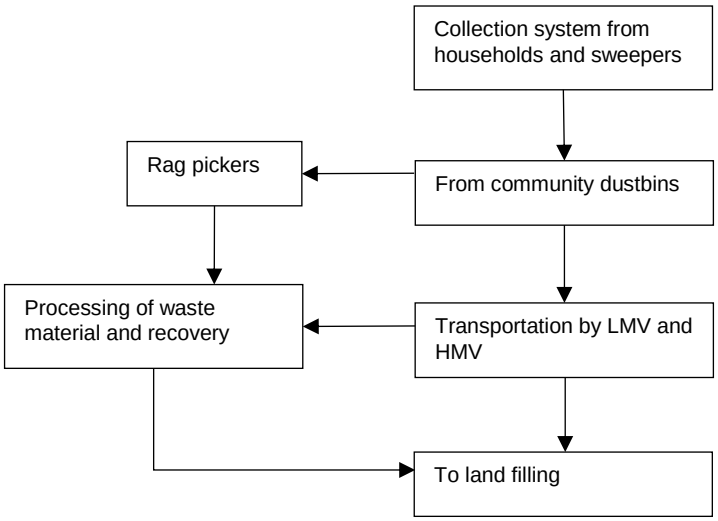
- Reduce, reuse and recycle: when the people learn the concept of reducing, reusing and recycling and start applying from their waste, they can save around 1 tons of carbon dioxide (CO2) each year.
- Buying energy efficient product: every electronic product has the Bureau of Energy Efficiency (BEE) rating, try to purchase the product which have the maximum rating. Use LED bulb instead of other standard bulbs because they use very less energy.
- Try to purchase hybrid vehicles instead of fuel vehicles: first try to use public transport but if there is a need to purchase of vehicle, try to avoid normal vehicles which run on fuels and buy a CNG of HYBRID vehicle. This will help to reduce the carbon footprints.
- Plant a tree: planting tree is the most important thing towards the reduction of emission because they absorb CO2 and in turn release oxygen (O2) in the atmosphere which is essential for living and also a tree absorbs around 1 ton of CO2 in whole of its life time.
- Using less hot water to reduce the energy consumption. This can also save the CO2 around 200 kg each year.
- Try to avoid the product of excessive packaging because the part of packaging will go to the waste and will increase the volume of waste.
- Don't use the energy to dry up the clothes and don't iron the wet clothes because it will generate unnecessary heat which will emit into the atmosphere that will result into increase greenhouse gases.
- Make a habit of switch off the electricity after use.
- Enhance the knowledge and spread it with the community.

For the Corporation:

- Removing or converting landfills into sanitary or engineered landfills.
- Use of Mechanized Sweeping Machines.
- Promoting bio-methanation plants, MRF centres, home composting etc.
- Awareness program to spread the knowledge of 3R's and 6 basic elements of MSW.
- Improving in collection and transportation structure.

Employment

From waste collection to its disposal, the formal and informal sector needs to work in a systematic manner and as the population is growing rapidly the volume of waste will also increase. So, the demand of workforce in formal and informal waste division to handle the waste will surely increase.



Handling of MSW

Additional Equipment's required for newly added 86 Villages

Sr No	Primary Collection & Transportation	No's	Costing	Total
1	Comparmental Mini Tipper (Capacity 2.2 Cu.M)	170	802390	136406300
2	Compactor (16 Cu.M)	15	3925000	58875000
3	Excavator Front end backho loader 96 H.P.	6	31735000	190410000
4	Road Sweeping Machine	4	18000000	72000000
5	Water Sprinkler (12 kld)	20	1800000	36000000
6	Tractor's (35 H.P.)	15	600000	9000000
7	Tricycle with 8 compartmental bins 40 ltr capacity each bin capacity	460	14328	6590880
8	Bins (100 ltrs) (for dry/wet/hazardous/sanitary waste) with Stand	1200	13500	16200000

9	PCTS 16-ton Capacity each	60	2300000	138000000
10	Hook loader 16 Ton carrying Capacity	15	4500000	67500000
11	**Total**	**1965**	**63690218**	**730982180**

15th CFC Action Plan to Achieve Baseline

Abstracts

Sr No	Name of the projects	Project Cost (Rs in Cr.)	2021-22 (Rs in Cr.)	2022-23 (Rs in Cr.)	2023-24 (Rs in Cr.)	2024-25 (Rs in Cr.)
1	Engaging outsourced Workers 1065 Rs. 336 for 312 working days for year	44.64	11.16	11.16	11.16	11.16
2	Engaging Outsources drivers 765 Nos Rs 415 per day for 312 working days for year..	39.6	9.9	9.9	9.9	9.9
3	Proposing of Newly added 86 villages Vehicles requirement for Solid Waste facilities.	73	15	17	20	21
4	Existing C&D plant O&M	15.32	3.83	3.83	3.83	3.83
5	Existing Karsada Waste to Compost plant O&M	2.88	0.72	0.72	0.72	0.72
6	Proposing for Plastic Waste Management Plant	5	0	5	0	0
7	Proposing for Plastic Waste Management Plant O&M	2.4	0.6	0.6	0.6	0.6
8	Proposing for Establishment of Dry Waste MRF Centre's Installation and O&M	4.68	2.4	1.56	0.36	0.36
9	SLF 3 Nos (2 lakh Cu.M)	0.6	0.2	0.2	0.2	0
10	SLF O&M	0.96	0.24	0.24	0.24	0.24
11	Existing Biomethanization 3 Waste to Energy Plant O&M	2.16	0.54	0.54	0.54	0.54
12	Newly Ramna W2E Plant O&M	1.8	0	0.55	0.6	0.65
13	LTP O&M	0.96	0.24	0.24	0.24	0.24

14	Collection Charges of newly added area (86 Villages) paid to Agency	72.96	18.24	18.24	18.24	18.24
	Total	**266.96**	**63.07**	**69.78**	**66.63**	**67.48**

Nodal officer

Nagar Nigam Varanasi