Indicative Action Plan

For

Restoration of Water Bodies

(Lakes, Ponds and Rivers in Tripura)

Compiled and Edited by:

State Level Committee constituted under "Statutory Guidelines for Protection & Preservation of Lakes, Ponds and Water Bodies in Tripura"

[In compliance with the Directions dated 10/05/2019 of Hon'ble National Green Tribunal in connection with M.A. No.26/2019 in OA No. 325/2015 filed by Lt. Col. Sarvadaman Singh Oberoi vs. Union of India and Ors.]

Preface

Hon'ble National Green Tribunal, Principal Bench, New Delhi, while delivering its order dated 10.05.2019 in M.A. No. 26/2019 in O.A. No. 325/2015 filed by Lt. Col. Sarvadaman Singh Oberoi vs. Union of India and Ors. to the state of Haryana, has directed as follows:

> *"13. Thus, to give effect to 'Precautionary' principle and 'Sustainable Development' principle, we direct all the states and UTs to review the existing framework of restoration of all the water bodies by preparing an appropriate action plan. Such action plans may be prepared within three months and a report furnished to CPCB. The CPCB may examine all such plans and furnish its comments to this Tribunal within two months thereafter. The Chief Secretaries of all the States/UTs in the course of undertaking monitoring exercise in pursuance of the order of this Tribunal in O.A. No. 606/2018, compliance of MSW Rules, 2016, may also include restoration of water bodies as one of the items as the same is also incidental to waste management which are covered by orders in O.A. No. 606/2018, Compliance of MSW Rules, 2016."*

Hon'ble NGT, while clarifying about the area of ponds etc. for restoration has also observed that the focus may be on ponds etc. recorded in the revenue records. It has also been observed by the NGT in the order that:

> *"6. …….The threat caused to water bodies is by dumping of waste, discharge of effluents and encroachments. The steps required for restoration will include preparation and implementation of catchment area treatment plans, setting up of green belt and wherever viable setting up of bio-diversity parks around the water bodies, cleaning up of the garbage/ debris and demarcation by the Revenue Department on identification survey and demarcation. Each water body is required to be given a geo-referenced-UID and an action plan is required for restoration and protection of*

each of the water bodies. In this view of the matter, need for conservation and protection of water bodies is not confined to the state of Haryana alone but extends to the whole country"

Hon'ble NGT has also directed CPCB to prepare and place on its website guidelines in the matter of restoration of water bodies in the light of above order within one month.

It is important to note that the State Government has already notified the "Statutory Guidelines for protection and preservation of lakes, ponds and water bodies in Tripura" on 24/05/2017 in pursuance of the Judgment & Order dated 16.08.2016 of the Hon'ble High Court of Tripura in WP(C)(PIL) No. 2 of 2014, . A State Level Committee under the chairmanship of Chief Wild Life Warden (CWLW) as well as Subdivision wise Committees were constituted vide memorandums dated 11.04.2018 by the Government for monitoring and effective implementation of these Statutory Guidelines. First Meeting of the State Level Committee constituted for monitoring and effective implementation of the Statutory Guidelines for Protection & Preservation of Lakes, Ponds & Water bodies in Tripura was held on 5th December, 2018 in the Conference Hall of Aranya Bhavan. Besides making broad outlines to proceed further, following decisions were taken in the meeting:

i. As per the mandate, the Sub-division level Committee (SDLC) should submit abstract of monitoring of water bodies in their jurisdiction by checking of its water quality with the help of TSPCB along with recommendations/ suggestions.
ii. Director, Science, Technology and Environment shall compile the abstract of actions taken and suggestions so made to the State Level Committee (SLC).
iii. Principal Scientific Officer, TSAC and Director, Fisheries shall arrange listing of water bodies district/sub-district/Gram Panchayat/ Village –wise to

the SDLC and Director Science, Technology and Environment and also to Municipal Bodies (in case of Urban Areas).

To discuss the implementation of the directions of Hon'ble NGT passed vide order dated 10/05/2019, a meeting was held on 04.06.2019 under the Chairmanship of the Chief Secretary, Tripura. It was decided in the meeting that that the State Level Committee chaired by the Chief Wildlife Warden, Tripura would prepare the Indicative Action Plan in the light of the directions of the NGT and the guidelines to be issued by the CPCB as per aforesaid order. A sub-committee consisting of the following officers was constituted to assist the SLC for drafting of the action plan:

i. Director, Urban Development Department.
ii. Director, Department of Science, Technology & Environment.
iii. Director, Department of Fisheries.
iv. Member Secretary, TSPCB,

In the meeting dated 04/06/2019 under the chairmanship of the Chief Secretary, decision on assigning geo-referenced UID to each water body by TSAC, compilation of details of all water bodies irrespective of owner department by Director Fisheries, furnishing details of all water bodies in the forest area with GPS co-ordinates by Forest Department besides making Director, Science, Technology and Environment the Member Secretary of the SLC.

In pursuance of the directions dated 10/06/2018 of the Chief Secretary, 2nd Meeting of the State Level Committee constituted for monitoring and effective implementation of the Statutory Guidelines for Protection & Preservation of Lakes, Ponds & Water bodies in Tripura was held on 18th June, 2019 at 11:00 AM in the Conference Hall of Aranya Bhavan to outline the action plan for identification, protection & restoration of water

bodies in the State in pursuance of the Hon'ble Green Tribunal order dated 10th May, 2019 in MA No.26/2019 in original application no. 325/2015. In the said meeting it was decided that –

i. Tripura Space Application Centre (TSAC) will develop protocol for assignment of UID for 1567 nos of Water bodies already identified by the Department of Fisheries.
ii. Identification of remaining Water bodies will be done by the Department of Fisheries and Rural Development Department in time bound manner.
iii. One template for collection of various data/information in MS Excel format was also finalized in the meeting to assess the threats caused to water bodies for which restoration plan is required to be prepared.
iv. Responsibility was given to the Rural Development Department and Department of Fisheries for preparation of tentative restoration plan of water bodies as per guidelines issued by the CPCB for restoration of water bodies.
v. Forest Department was also requested to take immediate step for identification/protection/restoration of water bodies.
vi. The indicative Action Plan will consist of the following components:
    a. Introduction.
    b. Identification of Water Bodies.
    c. Threat to water bodies and their protection status
    d. Restoration of water bodies and
    e. Institutional Framework along with Monitoring and Evaluation.

The 3rd Meeting of the State Level Committee was held on 3rd July, 2019 at 04:00 PM in the Conference Hall of Aranya Bhavan to finalize Indicative Action Plan for identification, protection & restoration of water bodies in the State. In the meeting, certain

modifications were suggested and timeline for submission of write-up / information were given. This plan draws information extensively from the Restoration Plan developed by CPCB on the directions of the Hon'ble NGT. The meeting of Drafting Committee was held on 25/07/2019 to finalize the Action Plan. The instant Indicative Action Plan is the outcome of the hard work by the members of the State Level Committee (SLC) and the Drafting Committee especially Director, Science, Technology and Environment. The assistance by Sh. Bishu Karmakar, Scientist, TSPCB in preparation of this indicative action plan is highly appreciated.

30/7/2019

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Chapter I

INTRODUCTION

Water is the vital factor for sustenance of life. It exists in different forms such as rainfall, river water, ground water, ponds and lakes etc. The management of water resources, therefore, call for integrated management of all these components as a system. As per the information available with the Ministry of Water Resources, River Development and Ganga Rejuvenation about 2.7 per cent of the total water available on the earth is fresh water, of which about 75.2 per cent lies frozen in Polar Regions and another 22.6 per cent is present as ground water. The rest is available in lakes, rivers, atmosphere, moisture, soil and vegetation. At present, our country is sustaining 18 per cent of world population with 4 per cent of global water resources. Therefore management of water resources has assumed great importance.

Water bodies are an integral part of fresh water resources. Traditionally, these water bodies have played an important role in supply of drinking water, water for domestic needs and agriculture purposes etc. besides rivers and ground water. Through the ages, the surface flow system or water bodies traditionally known by different names, either natural or man-made such as lakes, tanks, ponds and similar structures have sustained the Indian agriculture. In urban areas, water bodies play an important role as a source of drinking water, and a conduit for ground water recharge. Water Bodies also serve as storage reservoirs in the monsoon-dependent areas of the economy where there exist a shorter period of rainfall and a long dry spell with high deviation of annual rainfall.

Surface water bodies like lakes, ponds, reservoirs, tanks and rivers are the blessings of nature bestowed on this earth . They were treated as community resource or asset over the centuries. In urban areas also such water bodies played an important role as a source of drinking water, absorption of flood water and a conduit for ground water recharge. They were being nurtured, protected, conserved and managed by the active participation of the local community without any code of conduct or rule. In turn, these water bodies have been catering to the need of the local human and livestock populations. India has had abundant supply of water resources in the past, but in the recent past the country is gradually progressing towards water scarcity due to increasing population pressure, urbanization and uncontrolled growth.

As per MoWR, RD & GR, total number of water bodies have declined in the States which may be attributed to (i) increase in population and density of population per square kilometer; (ii) change in land use pattern; (iii) shift from paddy based agriculture to cash crop cultivation; (iv) depletion of ground water; (v) rapid u rbanization; (vi) unplanned urbanization and development activities; (vii) boom in construction activity. Such degradation of the water bodies were severely neglected as a result of which we are about to face a serious potable water crisis in the most immediate future. So it has become extremely necessary to take up the restoration of the water bodies on a war footing.

In order to revive, restore and rehabilitate the traditional water bodies, the Government of India launched a Scheme for Repair, Renovation and Restoration (RRR) of water bodies, under which funds were made available for irrigation. The Ministry of Environment, Forest and Climate Change is implementing a Centrally Sponsored Scheme of National Plan for Conservation of Aquatic Eco-systems (NPCA) since February, 2013 for conservation and management of identified lakes and wetlands in the country in a holistic and integrated manner. Under the scheme financial assistance is provided to the concerned State Governments for undertaking various activities for conservation of

wetlands and lakes, which also include a small component of lake front development and beautification, especially in urban lakes.

The state of Tripura is endowed with rich water resources in the form of 7 nos. of perennial rivers and about 27000 lakes and ponds at present. These lakes and ponds are used for a variety of purposes like irrigation, pisciculture, drinking and in some cases for household activities also. But due to its continuous use and in some cases, especially in urban areas, dumping of debris, the quality of the ponds and lakes has deteriorated. There has also been a shrinking of size due to encroachments and thereby disturbing the natural waterways. Subsequently there has been a tendency to get the shrinking water bodies filled up for using it for construction purposes. This has further resulted in occurrence of floods. Due to the continued increase in the population pressure, ground water had to be harnessed to fulfill the daily needs of the people. Without proper recharging measures, the ground water level is also getting depleted, which is also a cause of concern. Currently, availability of water resources is a major issue and also a big challenge, which requires drastic measures. Therefore, management of water resources has assumed great importance.

Recent order dated 10th May 2019 of the Hon'ble National Green Tribunal (NGT) focused on the significant role of water bodies, its threats and the need for restoration of all the water bodies and hence it has become extremely necessary for preparation of this action plan. The Action Plan deals with restoration of ponds, lakes, polluted rivers or streams and divided in two parts i.e., stagnated surface water bodies such as ponds, lakes and flowing surface water bodies such as rivers or streams. However, stakeholders concerned are advised to conduct detailed gap analysis to develop site specific action plans for restoration of water bodies.

Chapter II

IDENTIFICATION OF WATER BODIES AND ASSIGNING UNIQUE IDENTIFICATION CODE

All natural or man-made units bounded on all sides with some or no masonry work, used for storing water for irrigation or other purposes (e.g. industrial, pisci-culture, domestic/drinking, recreation, religious, ground water recharge etc.) will be treated as water bodies in the current Census. These are usually of various types known by different names like tanks, reservoirs, ponds and bundhs etc. A structure, where water from streams, springs, rain or drainage of water from residential or other areas, is accumulated or water is stored by diversion from a stream, nala or river will also be treated as water body.

2.1 Following type of water bodies may be included in the survey. (The list is indicative but not exhaustive):

i. **Ponds:** A small body of water usually earthen though masonry dykes are also included and shallow made through excavations which represent a restricted environment. Ponds usually describe small bodies of water generally no one would require a boat to cross.

ii. **Lakes:** A lake is a large area filled with water that is surrounded by land. Lakes lie on land and are not part of the ocean and therefore are distinct from lagoons, and are also larger and deeper than ponds.

iii. **Tanks:** A shallow water unit usually larger than a pond created by constructing earthen or masonry barricades, which receives water either from tube wells or rains.

iv. **Reservoirs:** A large man made impoundment of varying magnitude created by erecting, bunds, dams, barrages or other hydraulic structures across streams or rivers serving one or more purposes such as irrigation, power generation, flood control or other water resource development projects.

v. **Water conservation Structures:** Water conservation schemes are aimed at improving moisture regime of the adjoining fields downstream for raising of post monsoon crops without irrigation. This may include percolation tanks and check dams. Both result in increased percolation of water in the sub-soil with consequent increase of the ground water supply.

vi. Water bodies like oceans; lagoons; swimming pool; covered water tank created for specific purpose; water tank constructed by any factory owner for use at raw material; temporary water bodies created by digging for mining, brick kilns, and construction activities; river, stream, spring, waterfalls, canals etc. which are free flowing; are not covered in the currently considered definition.

2.2 Collection of Information on Water Bodies of Tripura:

Identification of water body and recognition of its problem (encroachment, pollution, diversion etc.); analysis of cause of the problem and its effects would be useful in development of appropriate solutions. Based on the records available / remote sensing data / GIS maps; and interactions with the public living in the vicinity of the water body, following information relating to the water bodies (stagnant / flowing) should be collected and records maintained by the concerned department in the State:

2.2.1 Stagnant water bodies such as ponds/lakes:

i. **Geographical details of the water body: -** GPS Location and address of the

water body, size or dimensions, area, elevation above mean sea level, ownership of the water body, boundaries with earmarking, map of water body (Digital map or remote sensing or satellite map over the years/National Wetland Atlas) with salient features.

ii. ***Hydrological description of the water body: -*** area, category of lake or pond (natural or man-made), average and maximum depth of stored water (during monsoon and non-monsoon period), total storage capacity, main source of water (rainfall/groundwater seepage/catchment runoff/direct or indirect flow from any river or stream or creek), water permanence (permanent or intermittent), destination of excess water from pond or lake, purpose used to serve (like drinking water source, fisheries and agriculture or cultivation of aquatic food plants, recreational and aquatic sports, ground water recharge, act as a sink for sediments, habitat for noteworthy animal species, migratory birds or any other purpose), status of lakes or ponds in terms of % open water and aquatic vegetation.

iii. **Catchment Description:**

- Details on natural drains or flood channels and their flows contributing to water accumulation.
- Major Towns, total population living around the water body, any sewage contribution from the towns, total sewage generation, total no. of existing STPs and their treatment capacities, if any.
- Major industrial clusters or estates contributing to pollution in water body, total no. of industries (sector-wise), sector-wise total industrial effluent generation, existing industrial effluent treatment capacity [(both captive and Common Effluent Treatment Plants (CETPs)], if any.

- Total waste generation (waste like municipal solid waste, plastic waste, industrial hazardous waste, construction and demolition waste), existing provision for collection, transportation, treatment and disposal practices in the vicinity;
- Any other relevant information such as: - (i) Declared Wetland Ramsar sites, (ii) Bio-diversity details such as flora and fauna biodiversity (list of plant species, list of animal species, species of conservation significance (rare, endangered, threatened, endemic species), major plant invasive alien species and extent of invasion, major animal invasive alien species and extent of invasion.

2.2.1 Rivers or streams:

i. Digital map of river under consideration with its tributaries showing salient features.

ii. **Geographical and Hydrological description of polluted river**

Origin of the river and confluence with any other water body, length of travel of the river before confluence with any other water body, velocity of flow (in m/sec), average cross-sectional area (in m^2), average depth of flow (in m) during monsoon and non-mon-soon period, volume of flow or discharge (in m^3 /sec), tributaries of the river under consideration for restoration, GPS location details of all the tributaries and drains confluence with the river or stream; drains or channels contributing to river pollution;

iii. **Catchment description**

- Purpose used to serve by the river or streams
- Major towns along the banks of the river, town-wise total population (with

projection for the next 20 years), total water consumption (both supply by local or urban bodies and the ground water consumption), total sewage generation pattern, no. of STPs and the treatment capacity.

- Major industrial estates or clusters along the banks of the river, Industry-sector –wise no. of industries, total water consumption, total industrial effluent generation and existing mechanism for treatment of industrial effluent.
- GPS location details of STPs, CETPs and their capacities, if any
- Ground water status, its utilization and the quality.
- Agricultural practices and the control measures with respect to agricultural runoff.
- Flora and fauna including biodiversity etc.

Also, water being state subject, the State Government should assign the task of maintaining historical records pertaining to each water body to concerned Department in the State and also to designate one responsible Department to enable to take necessary remedial actions as and when situation demands.

2.3 Digital Mapping of all the collected information:

All the collected information should be located on the map and such details to be periodically updated and maintained by the concerned department in the State.

2.3.1 Steps to be followed for collection of coordinates (LAT/LONG) of water bodies:

i. Handheld GPS to be used for collection of Lat/Long Information.

ii. The Lat/Long data should be collected in Decimal Degrees format (DDD.DDDDD°) format upto five decimal points.
Example: Lat: 23.38941/ Long: 91.45232

iii. During Collection of coordinates in the field substantial time (at least 2 mins) should be given to fix the GPS readings.

iv. The data collection work has to be started from North-West corner of the concerned village and moving in a serpentine way.

v. If any waterbody spreads in more than one village, it will be treated as one waterbody and only one entry has to be made against the concerned village/ward where the greater part of the waterbody lies.

2.4 Allocation of Unique Identification Number to Water bodies:

i. Unique Identification Number should prefix with 1 for Rural and 2 for Urban.

ii. Local Government Directory Codes should be adopted for State/District/Sub district/Block/Village or State/District/Sub district/Urban Local Body/ Ward assigning Unique Identification Number.

For Example:

1 for (Rural) 16 (State Code) 269 (Dhalai District) 1951(Ambassa - Sub District) 6918 (Ambassa Bac - Block) 253802 (Jeolchara)

Hence the Unique Code will be 1 253802*** [001…and onwards for Water body Number)

2. (Urban) 16 (State Code) 272 (West District) 6187 (Agartala Urban - Sub District) 249785 (AMC - ULB) 01 (Ward Number)

Hence the Code will be 2 249785 01*** [001…and onwards for Water body Number)

iii. Codification to be done from the North West Corner of respective Panchayat.

2.5 Data Collection Format: Parameters of the identified water body may be selected and included in the format. An indicative data collection format is given below.

District (LGD code)	Sub-District (LGD code)	Block /ULB (LGD code)	GP/VC /Ward (LGD code)	Water body No	Khasra/ Plot No	Location (Latitude/ Longitude)	Purpose/ Current Use of Water Body	Natural or man made status	Area (Ha)	Depth of water (M)
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**

Waste Disposal in Water body		Encroachment status (Yes/No)	Erosion status	Quality of water (Whichever Measured)					
Solid	Liquid			pH	DO	BOD	MPN	Phosphorous	Turbidity
12	**13**	**14**		**15**	**16**	**17**	**18**	**19**	**20**

2.5.1 Instructions for filling Information in the Format:

District: Name of the District and LGD code to be filled in.

Sub District: Name and LGD code of the Subdivision to be filled in.

Block/ULB: Name and LGD code of the Block or Urban Local Body to be filled in.

GP/VC/WARD: Name and LGD code of the Gram Panchayat/Village Council/Urban Local Body/ Ward to be filled in.

Khasra/Plot Number: CS Plot Number to be filled in.

Location: Latitude and Longitude to be given as per 2.3.1

Purpose /Use of Water Body: Current use of the stagnant water body is to be filled in as per following classification.

A. For Waste water / Sewage disposal
B. For Livestock rearing activities
C. For Pisciculture
D. For Irrigation
E. Soil & Moisture Conservation
F. River/ stream
G. Any other category

Area: Area of Water Body in Hectares upto two decimal places.

Depth of Waterbody: Depth of the water body to be filled in metres upto one decimal place.

Waste Disposal in Water body: Whether Waste is disposed in the Water Body. To be Filled in for Solid Waste and Liquid Waste.

A. For Solid Waste: S
B. For Liquid Waste: L
C. For Both: SL
D. For No Waste Disposal: NA

Erosion Status: Whether the banks of the waterbody is eroded or not. To be filled in as:

A. Wind Activity (WA)
B. Water Erosion (WE)
C. Water Logging (WL)
D. Brick Kiln affected area (BK)

Encroachment Status: Whether the waterbody is encroached or not. To be filled in with Y for Yes / N for No.

Quality of Water:

PH : Value

DO: in ppm

BOD: in mg/L

MPN: per 100 ml

Phosphorous: in ppm

Turbidity: in NTU

Note: All data from field should accompany latitude/longitude information along with other information following due diligence.

Chapter III

THREATS TO WATER BODIES IN TRIPURA

Tripura, a hilly state in the north- east of the country extends from 22°56'N to 24°32'N, and 91°09'E to 92°20'E . The state experiences an average annual rainfall of 2100 mm, and is blessed with both lotic (running) and lentic (standing) rain fed water bodies. Water bodies are valuable features of natural landscape in addition to being valuable sources of water. These water bodies enhance the aesthetics of the landscape, offer space for recreational activities, provide homes for flora and fauna and also influence climate. Most of the lotic water bodies of Tripura are rain dependent in nature. This types of water bodies are river, reservoir, mini barrage, pond and tank. Mini barrage, reservior, pond and tank are mostly manmade. Average unit area of water bodies is 0.10 hac. The soil is mostly acidic red laterite sandy in nature having high load of iron and aluminium. Water holding capacity of the water bodies in the state are poor. The unique water bodies available in Tripura are mini barrages, which are situated mostly between hillocks by allowing rain water to accommodate in the barrage from micro catchment and used for recharge of ground water and fish farming as well as irrigation. Most of the degradation of mini barrages are due to over flooding and hence damage of embankments. Habitat-wise, two types of water bodies are recognised in the state:

i. Rural and forest water bodies

ii. Urban water bodies

The water bodies faces various threats from the surroundings, some of them are listed below

- Rural water bodies are under the threat of eutrophication due to agricultural waste run off.
- Deforestation in watershed is accelerating the aging process of siltation and water holding capacity.
- Siltation in the water bodies results in reduced availability of water, affects ground water recharge and irrigation potential as well as fish farming activities.
- Damage to embankments of tanks and ponds results in inadequate water storage and frequent flood damage in the state of Tripura.
- Entities like panchayats and municipalities have not made sufficient efforts to protect and secure village / urban water bodies.
- Urban water bodies are under extinction threat due to anthropological factors like dumping of city garbage, sewage, gradual shrinkage, polluted water and new constructions. High land value in urban areas and greed of people has led to reduction in area of water bodies.
- Urban developmental agencies have neglected or in some instances actively worked against maintaining the integrity of urban water bodies in the name of developmental projects.

Hence, integrity of water bodies is being actively and increasingly being compromised and in near future urban water bodies under private ownership may become almost non-exitant. Of late, overall negative impact on community, water area, climate, biodiversity, water table, water storage capacity, recharging capacity of ground water, economic activities with water and potable water source is being noticed. The rural water bodies however are under lesser threats in the north east, especially state of Tripura in comparison to other states in the country.

Chapter IV

COLLECTION OF DATA FOR RESTORATION OF WATER BODIES

Restoration Phase includes declaring the 'designated best use' in order to formulate strategies and to decide degree of treatment required for restoration of such water body, if required, selection of best solution to problems identified and application of the solution to the problems of the land which vary from case-to- case, to achieve the designated best use water goals as detailed below: -.

4.1 Designation of water body for its use by the State:

The landscape of India is dotted with large number of lakes, reservoirs and wetlands. Historically, the water bodies such as ponds or lakes have met water demands of the population for centuries and a community management system had sustained them for a long period of time.

In a water body or its part, water is subjected to several types of uses. Depending on the types of uses and activities, water quality criteria have been specified to determine its suitability for a particular purpose. Among the various types of users there is one use that demands highest level of water quality or purity and that is termed as "Designated Best Use" in that stretch of water body. Based on this, water quality requirements have been specified for different uses in terms of primary water quality criteria. The Primary Water Quality Criteria for bathing water already prescribed under Environment (Protection) Rules, 1986**.**

Every pond, lake, river or stream falling under the jurisdiction of the concerned Department of the State is required to declare for its 'designated best use' in order to formulate strategies and to decide degree of treatment required for restoration of such water body, if required. In the absence of such information, it would be difficult for the regulatory authorities to formulate the strategies to be prepared in case restoration of such water bodies is required.

Water being the State subject, such list of water bodies with designated best use with all the relevant information collected by the concerned Department, required to be submitted to the concerned State Pollution Control Board (SPCB)/Pollution Control Committee (PCC), Central Pollution Control Board (CPCB) as well as MoEF&CC, MoWR, RD & GR.

In the state of Tripura, listing of water bodies is being done by Director, Fisheries and Unique ID is being allocated by TSAC. Designated Best use will be declared by the department owning the water body.

4.2 National Restoration Goals (Ponds, Lakes and Rivers)

'Water quality criteria-designated best use' water quality parameters as given at **Annexure-I** is required to be followed as 'National Restoration Goals (for Ponds, Lakes or Rivers)'. However, this national restoration goals or criteria given at Annexure-I is only indicative and national restoration goals issued from time to time need to be followed for restoration of water bodies.

Monitored water quality of the water body (lakes and ponds) for relevant parameters (monitored at least 8 times in a year) (average mean value) is compared with the 'National Restoration Goals'. In case of ponds or lakes, if the monitored water quality of the selected water body is complying at least i.e., 6 out of 8 times to the designated

best use water quality parameters, then such pond or lake is fit for the 'designated best use' and if not then requires remedial measures for its restoration**.** This criterion is applicable only in case of ponds and lakes.

In case of rivers or streams, the criteria issued from time to time by CPCB for categorization of monitoring location need to be followed and accordingly, the strategies to be formulated for its restoration to achieve at least bathing water quality criteria. Criteria for categorization of river monitoring location is given in **Annexure-II.** This criterion is to screen the potential locations having pollution (w.r.t bathing water quality parameters i.e., BOD and Faecal Coliform only) and requires more comprehensive examination to identify all the possible sources of pollution.

4.3 Steps to be followed for restoration of stagnated polluted water body

Conservation and restoration requires a systematic and comprehensive plan to study selective and representative freshwater ecosystems. Details of the study should include the status of ponds or lakes or rivers, their suitable use, management and conservation so that they serve as a good resource for future use and formulation of strategies for long-term management especially in the urban areas.

4.3.1 World Lake Vision

The World Lake Vision has been developed by International Lake Environment Committee (ILEC), Japan (https://www.ilec.or.jp/en/pubs/), in collaboration with UNEP , aiming at illuminating the growing crisis in management of lake ecosystem, articulating principles to guide the transition towards managing lakes for their sustainable use and to provide a practical blueprint for ensuring long- term health of lakes and integrity of their survival and economic development. The Seven

Principles of Sustainable Lake Management are:

- A harmonious relationship between humans and nature is essential for the sustainable use of lakes.
- A lake drainage basin is the logical starting point for planning and management actions for sustainable lake use.
- A long-term, preventive approach directed to preventing the causes of lake degradation is essential.
- Policy development and decision making for lake management should be based on sound science and best available information.
- The management of lakes for their sustainable use requires the resolution of conflicts among competing users of lake resources taking into account the needs of present and future generations and of nature.
- Citizens and other stakeholders should be encouraged to participate meaningfully in identifying and resolving critical lake problems.
- Good governance, based on fairness, transparency and empowerment of all stakeholders, is essential for sustainable lake use.

The restoration of any water body should be considered only based on the needs and its utilities. General steps to be followed for restoration of water bodies includes following: -

4.3.2 Assessment of water quality of the selected water body

Water quality of all the designated best use water bodies are required to be monitored for relevant parameters and as per frequency prescribed under 'guidelines for water quality monitoring 2017' by Ministry of Environment,

Forest and Climate Change (MoEF & CC)**.** Wherever, frequency is not suggested, water bodies are required to be monitored following the standard protocols for collection of samples by the concerned department at least once in a month or but not less than 08 months in a year (covering pre and post-monsoon period)

4.3.3. Need for restoration of water body

The monitored values of the water body is analyzed based on the criteria suggested under these guidelines or criteria issued from time to time by CPCB for identification of polluted lakes or ponds or rivers or streams and decision be taken for restoration of water body. The criteria suggested for river monitoring location is to use for initial screening and identification of potential hotspots on the river. A comprehensive examination of water quality is required for identifying sources.

4.3.4. Identification of sources of pollution, quantification and assessing detailed gap analysis

Following steps to be followed for identification of sources of pollution, its quantification and for carrying out detailed gap analysis

i. Desk Review and Reconnaissance Survey

Identification of various sources contributing to pollution in ponds or lakes need to be carried out based on desk survey (available information or data/ google map/ historical records) and physical reconnaissance survey (based on physical visual observations, interactions with the local public etc.,) for identification and ascertaining the sources of pollution of ponds or lakes. All the possible sources of pollution should be identified which may be

- open channels or drainage channels contributing untreated sewage or untreated or partially treated effluent discharge from existing sewage treatment plant in the vicinity (or)
- any untreated industrial effluent discharges either from the individual industry or any common effluent treatment plant (CETP) located in the vicinity (or)
- Improper disposal of solid waste (plastic waste/ municipal solid waste/industrial hazardous waste/sludges from septic tanks or sewage treatment plants (STPs) or hazardous waste disposal from common effluent treatment plants (CETPs) (or)
- Run off from nearby agricultural fields, if any.
- Social and cultural misuse of ponds or lakes by local communities especially for immersion of idols during festival seasons.
- Any open-defecation around the ponds or lakes by the people living in the vicinity due to lack of sanitary facilities in their dwellings or colonies and fencing all around such water body.
- Physical condition of weed growth and necessity for dredging- Aquatic plants growing in ponds and lakes are beneficial for fish and wildlife as they provide food, dissolved oxygen, and spawning and nesting habitat for fish and waterfowl. Aquatic plants can trap excessive nutrients and detoxify chemicals. However, dense growths (over 25% of the surface area) of algae and other water plants can cause (i) Fish kills; (ii) Fish flavor problems; (iii) Pond water odor problems; (iv) Drinking water taste problem and (v) Stunted fish growth.

- Silting or sediments in the ponds or lakes due to improper disposal of waste including construction and demolition waste or silt contribution from drainage channels which reduces storage capacity and accumulation of contaminated sludges.
- Status of aesthetic conditions around the water body
- Condition of the banks or bunds, spill over (provision to ensure smooth flow of excess floods on downstream especially during monsoon period) or flood channels including obstructions if any.
- Encroachment of waterbodies due to urbanization
- Condition of Eutrophication of lakes or ponds due to inadequate measures (due to indiscriminate discharge of Industrial effluents, run-off from agricultural fields, refuse and discharge of sewage, domestic wastes like food remnants, soaps, detergents cause depleted levels of dissolved oxygen in water lead to a situation where other aquatic life-forms cannot survive).
- Available In-situ available technological options for restoration of ponds or lakes (such as aeration, bio-remediation) in lakes or plants)

ii. Detailed gap analysis

Detailed gap analysis to be made w.r.t municipal sewage, industrial effluent and waste management with a projection of at least 15 to 20 years, existing infrastructure for management of municipal sewage, industrial effluents and waste management in the catchment area of the water body under consideration for its restoration including volumetric flow details of

all the channels or drains contributing to pollution in water body, as detailed below: -

- ***Sewage management:*** **-** Total population (with projected population at least for the next 20 years) living around the water body, total water consumption (taking into account both water supply by local/urban bodies as well as ground water consumption), total sewage generation (with projected generation quantities), total no. of existing STPs and their treatment capacities and the observed gap with regard to the sewage management (gap may be estimated in the catchment of waterbody).
- ***Industrial effluent management:*** **-** Industrial clusters or estates contributing to pollution in water bodies, total no. of industries, estimation of total water consumption by the industries, total industrial effluent generation, existing treatment capacity (both captive and common effluent treatment plants (CETPs), gap in industrial effluent management and the requirement for captive or common effluent treatment plants
- ***Waste Management:*** **-** waste-wise total waste generation, existing provisions for collection, transportation, treatment and disposal (in compliance to the concerned rules) with their capacities and waste-wise gap analysis and the requirements for their management

iii. **Identification of other associated issues which requires attention as a part of restoration of pond or lake**

Apart from identification of all possible pollution sources, detailed gap

analysis, additional measures required on case-to-case basis to be identified especially in case of ponds or lakes w.r.t the following aspects: -

- Buffer Zone development maintenance and the existing activities within the buffer zone.
- Feasibility for Bio-diversity park in case adequate land is available in the vicinity of ponds or lakes.
- Greenery development in the vicinity of the ponds or lakes.
- Introduction of recreation facilities such as paddle boats, building jetty.
- Machinery and the man power requirement for maintenance of the restored water body.
- Existing provision for disposal of waste arising from the de- siltation and de-weeding activity of a pond or lake.
- Removing permanent embankment wherever required
- Awareness and training requirements.
- Any other related measures required also be analyzed for inclusion of such actions while making action plans for restoration of water body (E.g., aesthetic point of view, bins for rubbish management which may be generated due to visitors).

Chapter V

PREPARATION OF ACTION PLAN FOR RESTORATION OF PONDS AND LAKES

Action plans to be prepared based on the historical information collected, desk review, reconnaissance survey conducted, detailed gap analysis for ensuring additional measures required for restoration of water body (vary from case-to-case) covering both direct and indirect measures with specific time targets and the organization responsible for implementation of action plans with budget estimates. Action plans should include following aspects: -

5.1. Restoration Phase:

5.1.1 Sewage Management: - for management of sewage inflow if any (which is causing eutrophication of lake or pond) by having adequate infrastructure for treatment of sewage through adequate capacity of sewage treatment plants (STPs) or combination of other low cost treatment technologies for ensuring discharge norms notified under Environment (Protection) Act, 1986 and same should be ensured by an individual generator of sewage as well as by the concerned local or urban body.

5.1.2 Industrial effluent management: - for management of industrial effluent inflow by having adequate infrastructure for treatment of industrial effluent in the form of captive industrial effluent treatment plants or through common effluent treatment plants by the respective industry contributing to the pollution of water bodies and same also should be ensured by the respective

State Industrial Development Corporations or State Pollution Control Board (SPCB) or Pollution Control Committee (PCC). Adoption of state-of-the technologies for production processes and for ensuring treatment of generated industrial effluent (feasibility adoption of zero liquid discharge).

5.1.3 Management of waste

i. Adequate infrastructure should be ensured for management of wastes (such as municipal solid waste, industrial hazardous waste, construction and demolition waste, plastic waste, e-waste) in accordance with the respective provisions notified under the Environment (Protection) Act,1986, by all the concerned.

ii. Periodic physical removal of improperly disposed wastes (such as municipal solid waste, construction and demolition waste, plastic waste, industrial hazardous waste, human and animal night soils) by the concerned local or urban body.

5.1.4 De-siltation

i. Periodic removal of nutrient enriched accumulated sludges in ponds and lakes helps in ground water recharge potential, removal of contaminated sediments as well as increases storage capacity of lakes or ponds.

ii. Sediments removed from the ponds or lakes should be stored in a designated area (till moisture is completed drained out) at a suitable distance away from ponds or lakes and such dried sediments should be removed immediately so that sediments will not become a part of ponds or lakes once again especially in the event of any rain fall. Depending on the characteristics, such sediments

after draining may be used as manure (complying to the manure quality prescribed under Solid Waste Management Rules, 2016 as amended from time to time or disposed of in accordance with the relevant provisions notified under Environment (Protection) Act, 1986.

5.1.5 De-weeding

i. **Periodic dredging** (once in three months) of 80 % of dense and thickly covered aquatic plants viz., floating plants such as algae, duckweed, watermeal, water hyacinth; submerged plants such as milfoil, hydrilla, water lettuce, curly-leaf pondweed, clasping-leaf pondweed, coontail, sago pondweed, water lilly, water shield etc., bottom sediment, and associated nutrients should be carried out. De-weeding methods include: -

ii. **Preventive measures** such as proper design and construction of ponds or lakes including levelling and smoothing of banks

iii. **Manual or physical control measures**

Manual or physical control measures such as non-chemical and non-motorized measures be taken for removal of weeds (manual harvesting) using hand pulling, rakes, cutters, benthic barriers, drawdown, aeration, shading and weed rollers as these measures are typically very low, however, such measures are labor intensive and are therefore better suited to small, less established weed populations. Hand pulling and raking may result in turbid or murky water and may create plant fragments that can subsequently spread to new sites.

5.1.6 Mechanical control measures

iv. Using motor-driven under water weed cutters or floating weeds, rotovators

essentially large-scale underwater rototillers for tilling up lake or pond sediments as well as to chop and loosen plant roots, or draglines (in case of underwater pond or lake dredging) (or) dry-land excavation machinery such as bulldozers (in case of drained ponds or lakes) shall be used (or)

v. Limiting the amount of sunlight available to aquatic plants by floating black plastic sheeting on the water surface (or) use of dark-colored and nontoxic water dyes (such as nigrosine, aniline and aqua-shade)

5.1.7 Biological controls i.e., introducing aquatic animals and plants that eat or compete with waterweeds. Herbivorous animals (those that eat plants) include a wide variety of insects, snails, crayfish, tadpoles, turtles, fish (sterile, triploid grass carp), ducks, geese, and swans which can be stocked in ponds or lakes to consume aquatic plant.

5.1.8 Application of common aquatic herbicides for control of lake or pond weeds: Use of herbicides is not recommended as it may kill fish in ponds or lakes. Herbicides should be used in a controlled and systematic way under the supervision of the expert and general herbicides that may be used for weed control are as given below-

i. For Algae (microscopic, filamentous, Chara) control- Herbicides such as copper sulfate, copper chelates, endothall,, simazine)

ii. Submerged Plants (coontail, watermilfoil, pondweeds such as sago, curly leaf, leafy) control- Herbicides such as Endothall,
Diquat, simazine, fluridone may be used

iii. Free-floating plants (duckweed, watermeal) control:- Herbicides such as Diquat, simazine may be used

iv. Rooted-floating plants such as (waterlilies, spanerdock) control- Herbicides such as Glyphosate and 2,4,-D may be used

v. Emergent plants (cattails, perennial grasses, and broadleaves) control: - Herbicides such as Glyphosate may be used

5.1.9 Prohibition of discharges or disposal of waste or washing activity and action against violators

i. Ban on discharge of industrial effluent or sewage or waste (such as municipal solid waste or industrial hazardous waste or plastic waste or construction and demolition waste or sludges from septic tanks/ STPs/CETPs) into lakes or ponds or drainage channels connected with ponds or lakes or open defecation in the vicinity as well as washing of clothes or wading of cattle.

ii. Stringent actions be taken against violating industry by the SPCB/PCC as per provisions under Water (Prevention and Control of Pollution) Act, 1974 as well as Environment (Protection) Act, 1986,

iii Levying of fine or Environmental Compensation on the violators for improper disposal of sewage or industrial effluent or wastes into lakes or ponds.

5.1.10 Stabilization of earthen bunds and the drainage channels as well as silt and soil erosion control measures

i. Stabilization of earthen embankments, shore line protection with vegetative or rock riprap to avoid soil erosion and the inflow drainage channels with the stone revetment or pitching so as to avoid rapid seepage or leakages

ii. All the inflow drainage channels should be provided with suitable silt barriers or sediment traps or sediment detention basins at suitable intervals for control of silt especially during monsoon.

iii. Also, at all the outfalls of drainage channels, suitable strains or traps should be provided to control inflow of all the floating materials and periodic removal of floating materials should be ensured.

5.1.11 Protection drainage basin including preservation of drainage channels

A lake or pond drainage basin is the logical starting point for planning and management actions for sustainable lake or pond use. A long-term, preventive approach for preventing the causes of degradation is essential.

i. Historically the drainage channels which used to carry natural runoff from the drainage basin and presently carrying either untreated municipal sewage or industrial effluent or both and contributing to pollution of water bodies eventually due to encroachment in view of urbanization. All such drainage channels need to be restored by interventions such as (i) stoppage of inflow of untreated municipal sewage or industrial effluent. If required, interaction and diversion of untreated sewage or industrial effluent from such drainage channels by routing through properly designed dedicated sewerage network to ensure conveyance and for ensuring treatment and disposal through STPs/CETPs. Feasibility of in-situ treatment of treated sewage and industrial effluent within drainage channels and prior to the inflow into the water bodies also be explored by the concerned authorities.

ii. Major channels running from the larger watersheds should be identified based on the historical data and such drainage channels should be preserved and protected with suitable buffer land without any impervious cover. This aspect should be ensured by the State Local/ Urban Development/Town Planning authorities while planning or expansion of a locality.

5.1.12 Removal of encroachments and blockades

i. The Stat Government or UT Administration should maintain records pertaining to the boundaries of each pond or lake in the respective State/UT and necessary steps should be taken and ensured removal of all encroachments in the water body spread area/water body boundary as and when required.
ii. Removal of encroachments in the drainage channels should be carried out periodically to facilitates enhancement in aeration naturally in the water body
iii. Refrain from granting any consent for establishment for large scale projects in the catchment areas.
iv. Pond or lake boundary should be provided with fence (permanent / temporary fencing) to avoid unauthorized entry.

5.1.13 Flood Control Measures

i. Excess floods from drainage basin be controlled with a provision of properly designed ‘spill way’ with a provision of controlled gates for smooth flow of excess water or run off during monsoon.

ii. Remove all encroachments (lake bed, storm water drains) to prevent

calamities related to floods and to facilitate inter connectivity of water bodies.

iii. Removal all blockades at inlet or outlets should be ensured to avoid stagnation or blockage of storm water.

5.2 Improvement phase that deals with overall improvement in the water body and its uses including resolution of conflicts among competing users of lake resources taking into account the needs of present and future generations and of nature.

5.2.1 Adoption of In-situ techniques for in-situ remediation of ponds or lakes

i. Physical treatment approaches

Aeration (using surface aerators or , submerged aerators or a combination of both may be used to increase the dissolved oxygen in the water body, which is used by microorganisms to degrade the pollutants. Aeration also aids in mixing the different thermal layers of the water body, resulting in de-stratification, exposing the lower-most layers to atmospheric air. The need and extent of aeration is calculated based on the water quality parameters, depth of water body, ambient temperatures, wind conditions etc.). Apart from aeration, methods such as wastewater diversion, periodic de-weeding and sediment dredging, proper maintenance of drainage channels or feeder channels also helps in increase in dissolved oxygen)

ii. **Chemical treatment approaches**

Flocculation using chemicals like alum and neutralizing chemicals especially during acidification (increase in pH level of the stagnated water

body)

iii. In-situ techniques

- *Using aquatic plants* (Macrophytes such as water hyacinth (Eichhornia crassipes) and water lettuce (Pistia stratiotes), Whorl-leaf watermilfoil (Myriophyllum verticillatum), pondweed (Potamogeton spp.), common reed (Phragmites communis), cattail (Typha latifolia), duckweed (Lemna gibba) and canna (Canna indica)
- *Using aquatic animals* such as clams, snails and other filter-feeding shellfish
- *Using biological techniques* may be used to decompose, transform and absorb water pollutants. However, concentration and frequency of dosing of the microbial cultures is decided based on the volume of the water body, water quality parameters, ambient temperatures and extent of algal growth [as per literature (i) an enzyme namely Phycoplus and the nutrients are mixed thoroughly and sprayed into the pond within 2-3 weeks' time significance difference may be seen; (ii) treatment method based on hydroponics technique that cleans the lake by absorbing nutrients dissolved in the water and thereby supporting living species inside the lake; (iii) floating treatment wetlands (FTW) which are artificial islands made of chemically inert materials, gravel having floating characteristics with plants that stay afloat on the lake or ponds such as wetland plants, water hyacinth, mosquito repellents and ornamental plants like cattails, bulrush, citronella, canna, hibiscus, fountain grass, flowering herbs, tulsi and ashwagandha) which helps in cleaning the lake or

pond through hydroponics system, (iv) Introduction of mixture of nutrients to grow algae formed by diatoms (the most basic, single-cell life form found in water bodies) which helps in release of oxygen into water and in turn aerobic bacteria present in water body helps to break down the organic matter and convert the pollutants to base constituents and also reduces odors from the lakes or ponds. The diatoms are eaten by zooplanktons that are, in turn, consumed by fish].

5.2.2 Drainage basin management

- Drainage basin management includes control of non-point sources, structural and land treatment measures (regular monitoring of structures and systems and carrying out necessary rehabilitation and modernization programmes), interception and diversion of nutrients, sediments control (terracing, contour farming, grassed water ways, prior to reaching stagnated water body.
- Crop management, crop residue management and creation of shelter belts, good Irrigation practices, run off control provisions from agriculture runoff laden with excess fertilizers and pesticides.

5.2.3 Green or Buffer Zone

- Buffer Zone around a lake or pond (at least 50 to 100 m periphery) should be maintained as green belt zone or no activity zone and no activity is allowed within the buffer zone by the concerned Departments in the State/UT. In case, any activity presently existing within the buffer zone (50 to 100 m), such as residential or commercial or industrial activity

should take necessary measures to prevent discharge of any wastes into the water body.

- Within the buffer zone, no impervious cover is allowed and mainly plantation with a dense population of deeply rooted plants, trees, shrubs and grasses should be created so as to absorb nutrients (which promotes aquatic plant growth and a shift in the water quality) that comes directly from the anthropogenic activities.

5.2.4 Creation of biodiversity environment

In case the water body happens to be a site for the visit by migratory birds the number and type of trees by the side of the water body and water channels have also to be monitored to ensure adequate shelter as well as suitable environment for egg laying and propagation of bird species.

5.3 Restoration Action Plan for Ponds / Lakes: After having basic information of Ponds and lakes as detailed earlier, Action Plans on each Activity with time-lines can be framed. The key components of action plan may follow the suggested points as given in the table below:

S.no.	Activities/ Tasks	Reference information	Agency to perform Task	Timeline
1.	Identification of water body along with Geo-reference	Chapter II	Owner of Water body/Panchayat/Block and TSAC	
2.	Assigning Unique Code to water body	Chapter II	TSAC	
3.	Collection of Information in respect of water body and source of Pollution/ encroachment	Chapter II	Owner of Water body/ Panchayats	
4.	Declaring Designated Best Use	Chapter IV	Owner of Water body	
5.	Identifying source of Pollution (Solid / Liquid),	Chapter IV	Owner of water body /	

	sedimentation/ encroachments and geo-reference		TSPCB	
6.	Gap Analysis	Chapter IV	Owner of Water body	
7.	Action Plan 7.1 Removing sources of Pollution / Desiltation/ De-weeding/ Encroachement Removal 7.2 Separating Grey (Kitchen waste water) and Black (Sewage) water for ease of treatment 7.3Buffer Development Activities Greenery in Buffer zone/ Bio-diversity Park Recreational Activities Removing permanent structure	Chapter V	 SDLC/ TSPCB Owner of House Forest Department Tourism Deptt.	
8.	Monitoring and Reporting		SDLC/ TSPCB to State Level Committee through Director, Science, Tech and Environment	
9.	Sustenance Action 9.1 Awareness 9.2 Outreach Activities 9.3 Training 9.4 Recreation centre	Chapter VII	Eco-clubs / Owner of Water body	
10	Review (Monthly by SDLC/ Quarterly by SLC)	Chapter VII	SDLC to State Level Committee through Director S,T and E	
11	Funding		Respective Schemes	

5.4 Monitoring of Implementation of action plans for restoration of ponds or lakes

The action plans are to be prepared and submitted to CPCB for seeking approval. The action-plan should include activity-wise action points, specific time lines, organization responsible for implementation, budget estimates as well as Program Evaluation and Review Technique (**PERT**) chart for implementation of action

plans within the specified timelines, Upon approval of action plans for restoration of ponds or lakes, thereafter, execution of action plans to begin and to be mentioned on quarterly basis by the State Level Committee and monthly by Sub-district/ District level Monitoring Committee or any other committee to be constituted by the respective State Government. The monitoring committee should review the progress on implementation of the action plans at least once in three months and apprise the Chief Secretary of the State periodically.

A model lake restoration technique is given at **Figure 1** and a model flow chart for restoration of Ponds or Lakes is given in **Figure 2**.

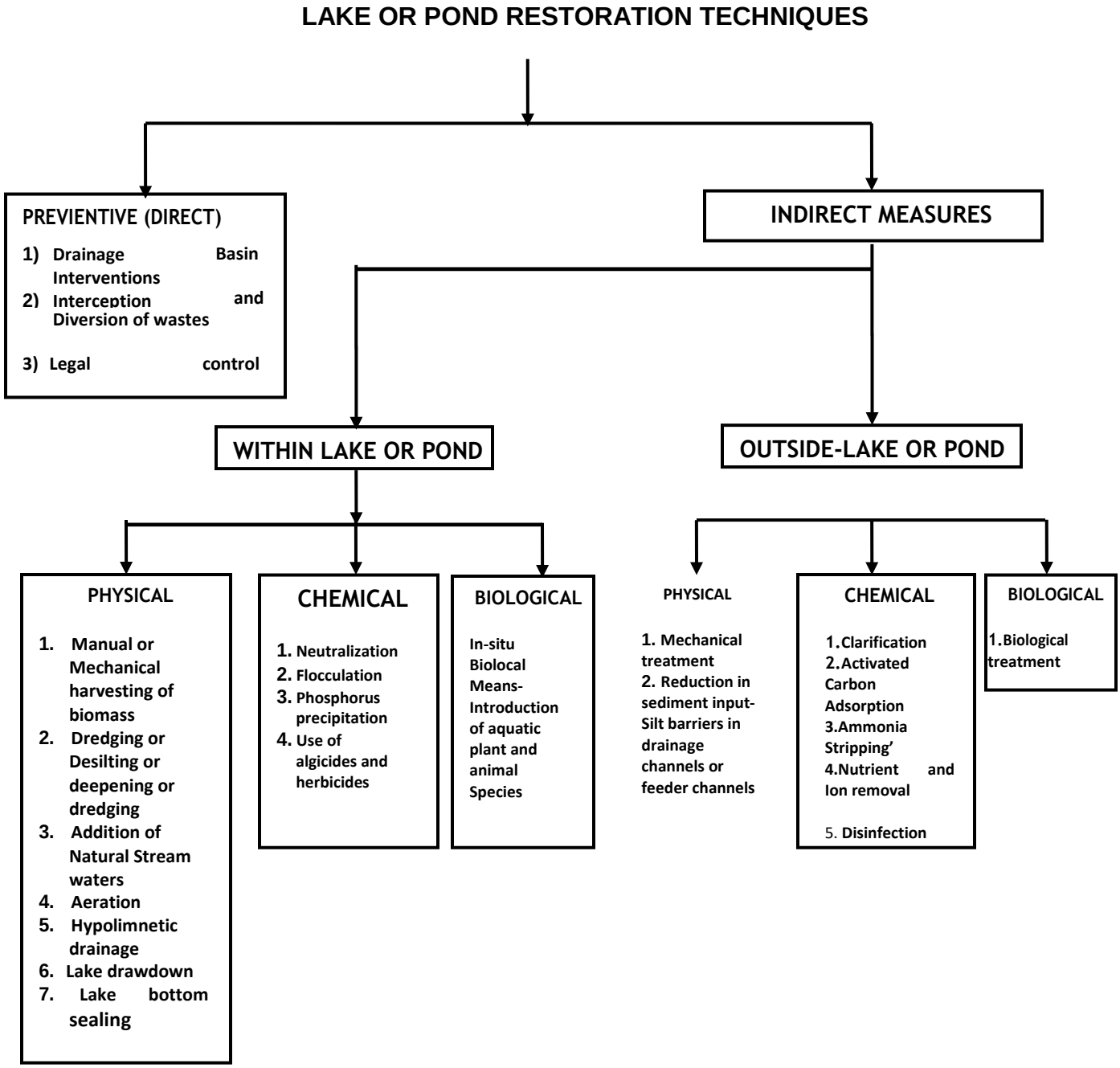

Figure 1. A Model Lake or Pond Restoration Technique

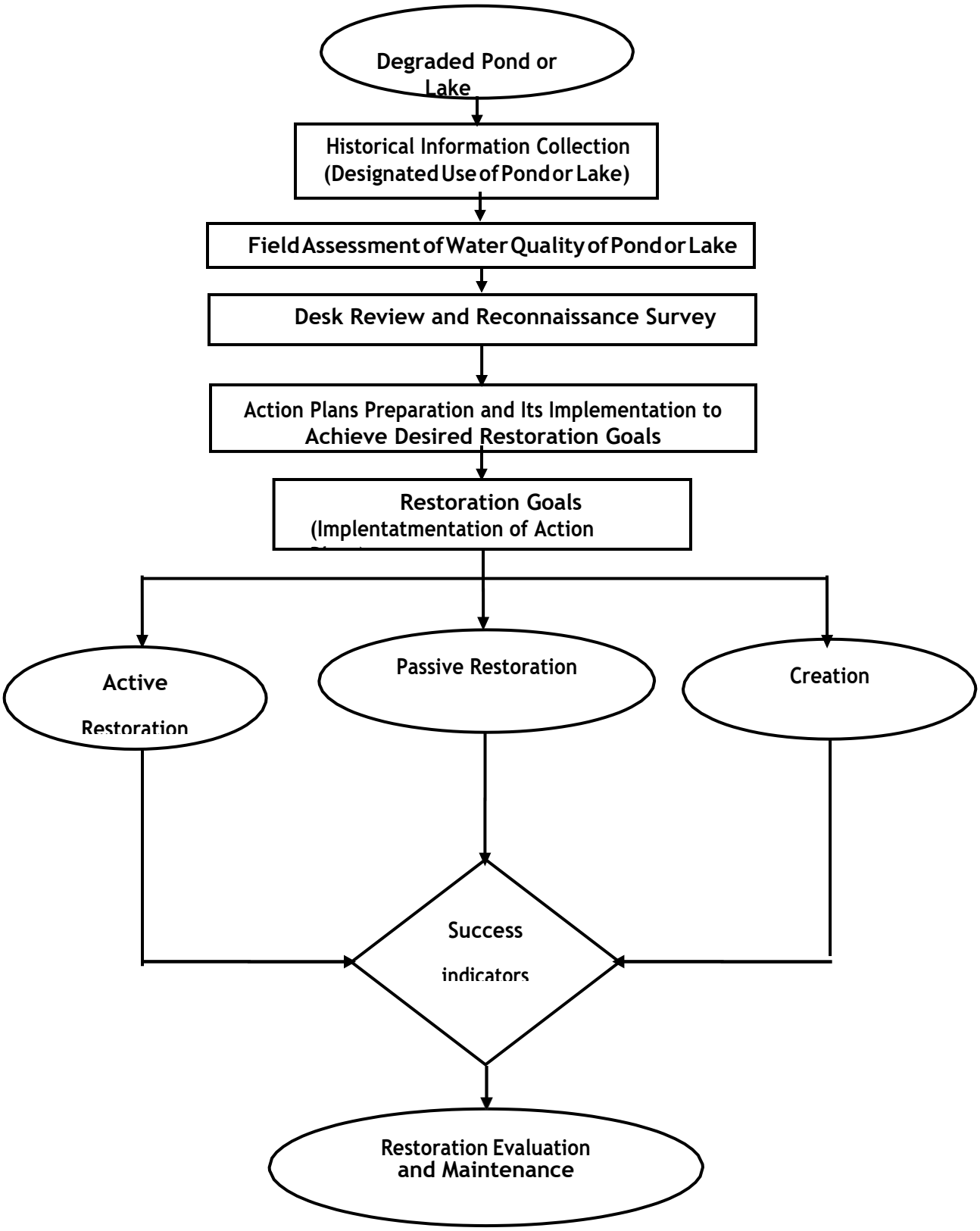

Figure 2. Model Flow Chart for Restoration of Pond or Lake

Chapter VI

PREPARATION OF ACTION PLAN FOR REJUVENATION OF POLLUTED RIVER STRETCHES

The steps involved in preparation of Action Plan for rejuvenation of polluted river stretches would include following information:

6..1 Background Information

i. Digital map of identified polluted river with its tributaries

ii. Geographical and hydrological description of polluted river

iii. Catchment description- uses of river, towns, cities and villages, industries (sector-wise no. of industries), ground water status and its utilisation, agricultural practices, flora and fauna etc.

6..2 Water Quality of River and Its Tributaries

i. Water quality of river and its tributaries (at least for five years)

ii. Quality assigned as per modified Water Quality Criteria **(Annexure-I)**

6..3 Identification of Causes of Pollution in Catchment Area of the River

6..3.1 Industrial Pollution

i. List of water polluting industries, industry sector-wise: water consumption, effluent generation and quantity of industrial effluent discharged into river

ii. Status on granting of Consent under Water (Prevention and Control of Pollution) Act, 1974

iii. Status on granting of authorization under the Hazardous & Other Waste (Management & Transboundary Movement) Rules, 2016 as amended (as applicable)

iv. Compliance status and action taken (Placing in public domain)

v. Final disposal mode of treated industrial effluents (i.e., disposal on land or drain or ZLD or drain connected to CETP etc.,)

vi. Performance status of captive Effluent Treatment Plants (if applicable)

vii. Existing Common Effluent Treatment Plants (CETPs) and their performance status.

viii. Regulation of small scale industries/tiny units'/service units discharging effluents/sludge disposal into drains/landfill or any other mode of disposal

6..3.2 Ground water management

i. Status of ground water level-reserves in the catchment area of river under consideration

ii. Blocks identified as over exploited, critical, semi-critical and safe (as per Central Ground Water Board (CGWB) if any)

iii. Status of permissions granted by Central Ground Water Board (CGWB) to the industries and other Development projects in the catchment area of river.

iv. Compliance of conditions stipulated by CGWB and subsequently by SPCB.

v. Ground water sources (Hand –pumps, Wells, Tube Wells) identified in the catchment area of the river and the characteristics (at least for the period of two years);

vi. Ground water sources (Hand –pumps, Wells, Tube Wells) identified as non-potable for human consumption in river stretch with Geo-genic/or polluted

due to industries.

vii. Compliance on ground water charging imposed by Rain Water Harvesting Mechanism.

viii. Existing mechanism for supply of potable water to the human population in the affected areas.

ix. Health deformities /clinical reports in polluted river stretch areas in view of ground water contamination.

6..3.3 Sewage treatment and disposal: -

i. Cities, towns and villages located on the bank of river stretches discharging sewage effluents through drains into the river.

ii. Quantification and pollution load of sewage generated by a city/town/village.

iii. Status of septage management.

iv. Listing of drains carrying sewage and trade effluents joining river and determining flow and characteristics with details of catchment contributing sources (drainage maps from major /minor irrigation development of State/or local body).

v. Existing sewage treatment capacities and performance of Sewage Treatment Plants and their compliance Status

vi. Final mode of disposal of treated sewage as well as sludge management

6..3.4 Waste management in the catchment area of river: -

i. Area-wise Hazardous waste generation, treatment and final mode of disposal and the existing infrastructure.

ii. Area-wise Status on municipal solid waste generation, treatment and final

mode of disposal and the existing infrastructure

iii. Area-wise Status on bio-medical waste generation, treatment and final mode of disposal and the existing infrastructure

iv. Any other waste generation, treatment and final mode of disposal and the existing infrastructure

6..3.5 River catchment information

i. Regulation of Flood Plain Zone

ii. Encroachment in Flood Plain Zone

iii. Plantation status

iv. Flow data of river/tributary

6..3.6 Gap Analysis and Identification of the problems in the identified polluted river catchment: -

i. Sewage generation, existing infrastructure with treatment capacities and the observed gaps w.r.to infrastructure for sewage management

ii. Industrial effluent generation, existing infrastructure with treatment capacities and the observed gaps w.r.to infrastructure for industrial effluent management

iii. Waste generation, existing infrastructure with treatment capacities, designed life of the treatment and disposal facilities as applicable and the observed gaps w.r.to infrastructure for waste management

iv. Any other relevant issues

(Note: - All the details such as river and its tributaries, area-wise population, sources and water consumption quantities, sewage generation, existing infrastructure for sewage management and the gaps observed, area-wise

industries (industry sector-wise no. of industries), sources of water and water consumption quantities (industry-sector-wise), industrial effluent generation, existing infrastructure for treatment (like Captive ETPs, CETPs), final mode of disposal of industrial effluents, waste generation and its management with existing infrastructure, characteristics of river and its tributaries, identified contaminated ground water resource areas has to be detailed in the map preferably a digital map)

6..4 The River Rejuvenation Action Plan:-

After having complete basic information as detailed under earlier paras 6.3 above, Action Plans on each Activity with time-lines can be framed. The key components of action plan may follow the suggested points as given the Table below:

S. No	Key Activity and Components		Agency to perform the task	Proposed SpecificTime Frame for implement ation of action plan
1	**Industrial Pollution Control**			
	(a)	Inventorisation of water polluting Industries	SPCB	
	(b)	Grant of consents	SPCB	
	(c)	Compliance verification	SPCB/ District Magistrate (DM)	
	(d)	Planning for CETP (as applicable)	SPCB+ State Industries Department or of Industries	
	(e)	Insisting on ZLD measures, recycling/reuse of treated industrial effluents	SPCB	
	(f)	Prohibition of disposal of effluents into drains except during rainy season subject to complying to effluent discharge norms for disposal in surface water.	SPCB + DM	
	(g)	Covering small and tiny units and not allowing discharge of effluents either individually or combined	SPCB+ Local Body/ Urban Body	
	(h)	Publishing list of defaulting industries in local newspapers and involving public in reporting deliberate discharges (without entering in the premises-backyard water and reporting running of industry against the closure orders.	SPCB + DM	
	(i)	Hazardous or Non Hazardous Waste Management Plan and no dumps anywhere except at identified locations	SPCB + DM	
	(j)	Reporting Non-Compliance of CGWB	SPCB +	

		conditions and closure of Non complying units.	CGWB	
	(k)	Levying compensation or fines for non-compliances as empowered to UPPCB under the Hon'ble NGT Order Dtd. 13/07/2017 in Ganga Matter in case of Tanneries.	SPCB	
	(l)	Other Action as relevant	SPCB + Concerned Agency of State	
2	**Ground Water Protection**			
	(a)	Declaration of Polluted Blocks	CGWB	
	(b)	Embargo on Water pollution /over-abstraction of industries as per block Status	CGWB	
	(c)	Rain water harvesting	Local Body + DM	
	(d)	Identification of Geo-genic contamination (as applicable)	CGWB	
	(e)	Identification of industries discharging industrial effluent illegally and levying fine on such industries including closure of such industries	SPCB + CGWB	
	(f)	Remediation of contaminated ground water (due to discharge of industrial /sewage) with the recovered funds from the default industry	SPCB + CGWB	
	(g)	Capping of contaminated tube wells and Potable water supply through alternate measures in the affected areas of groundwater	Water Supply Department	
3	**Sewage Management**			
	(a)	Identification of cities, towns and villages discharging sewage into river/tributary	State Local and Urban Development and Executing Agencies	
	(b)	Identifying drains joining river and their quantification and characterizations of pollution load		

	(c)	Preparation of Detailed Project Report (DPR) for interception and diversion (I & D) of drains to sewage treatment plant (STP) for which suitable site to be identified and plan for utilization of treated sewage.		
	(d)	Execution of STP works and necessary infrastructure and ensuring household sewer connection for full utilization of STP		
	(e)	Regular cleaning of drains and prohibiting disposal of garbage/plastic and filthy material into drains including dairy waste		
	(f)	Restoration of natural drains for carrying only storm water (but not sewage)	Local and Urban Bodies + State Water Resources + State Irrigation Department + SPCB	
	(g)	Ensuring utilization of treated sewage for beneficial use such as agriculture, construction activity, washing/flushing/cleaning, industrial cooling etc.,	Local and Urban Bodies + State Irrigation Department + SPCB	
	(h)	Interception and Diversion of sewage from Drains and connectivity to STPs	Local and Urban Bodies	
4	**Flood Plain Zone (FPZ) Protection**			
	(a)	Demarcation of FPZ and not permitting encroachments	State Irrigation Department	
	(b)	Adopting good irrigation practices to conserve water	State Irrigation Department /DFO	
	(c)	Plantation and bio-diversity parks in FPZ	State Forest Department	
5	**E-Flow**			

	(a)	E-Flow determination/gauging	State Irrigation Department	
	(b)	Regulation of flow from barrages	State Irrigation Department	
6	**Health Impact Assessment Reports- Treatment Services**			
	(a)	Epidemiological survey in the catchment to find out water-born diseases/ health issues	State Health Department	
	(b)	Providing treatment services to the diseased persons in the catchment area		
7	**Education and Awareness**			
	(a)	Regular involvement of educational institutions for creating awareness and conservation programmes	State Education Department with concerned Departments	
8	**Funding for execution of Action Plans**			
	(a)	Pooling of financial resources of state and central assistance	State Finance Commission/ MoUD and MoWR, RD & GR	

6..5 Monitoring of Implementation of Action Plans for Rejuvenation of Polluted River Stretches:-

(i) In compliance with Hon'ble NGT Order dated 20/09/2018 (OA No. 673 of 2018), State/UT Level 'River Rejuvenation Committee (RRC)' constituted firstly has to ensure timely preparation of action plans (before 20/11/2018).

(ii) Prepared actions plans need to be submitted to CPCB for random scrutiny as well as for approvals.

(iii) Thereafter, execution of action plans to begin and to be mentioned on monthly basis by the 'RRC' under overall supervision of the Principal Secretary

(Environment) of the respective State Government or Union Territory Administration.

A model flow chart for rejuvenation of polluted river is given in **Figure 3**

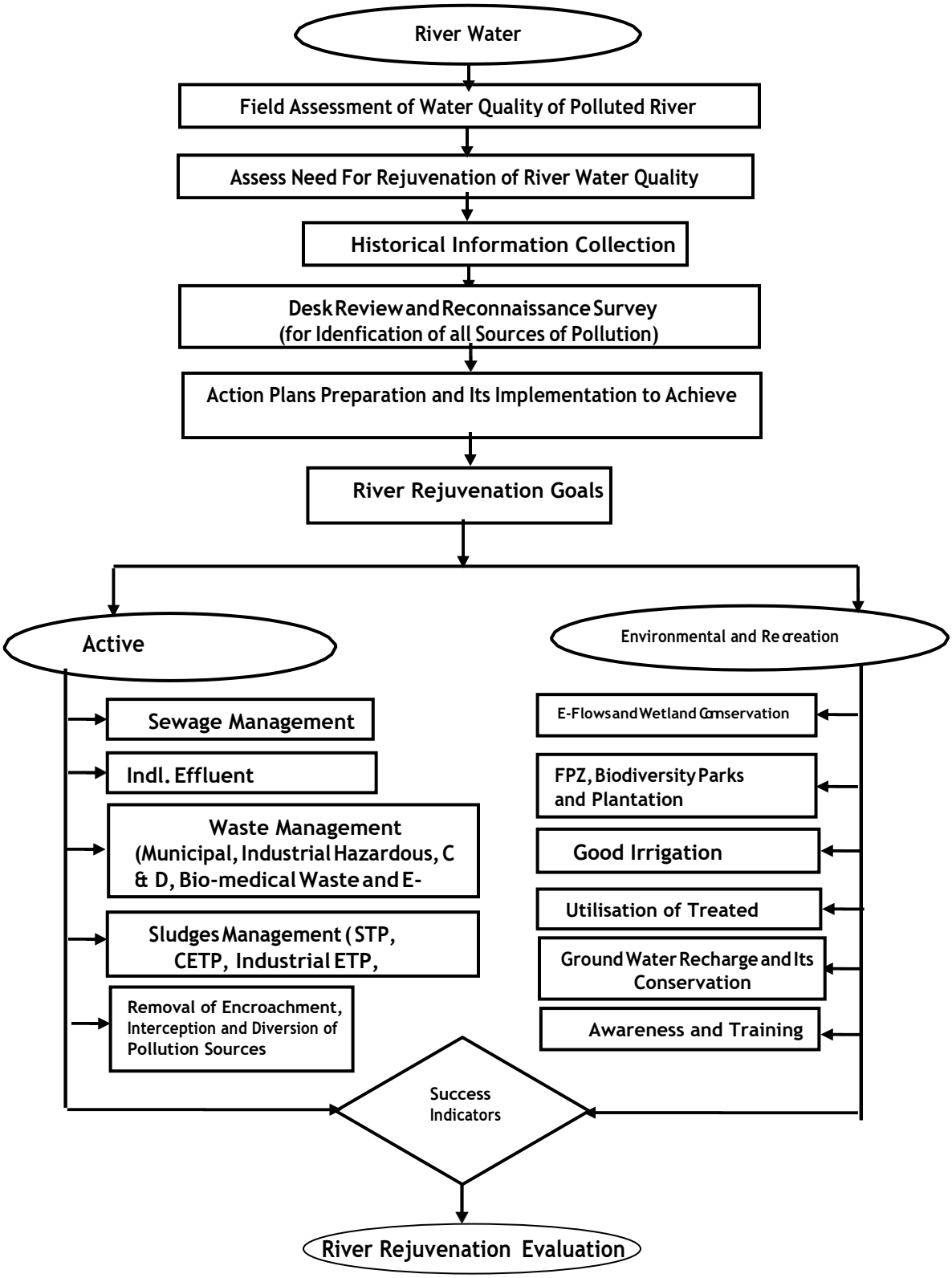

Figure 3. Model Flow Chart for Rejuvenation of Polluted Rivers

Chapter VII

Sustenance Activities

Good governance, based on fairness, transparency and empowerment of all stakeholders, is essential to sustain the restoration efforts. Also, ownership of each water body should be decided, as most of them face indefinite sustenance due to multiplicity of administrative control and/or lack of specific action by singular authority. The in charge authority should treat the water body as 'natural resources', to act as the potential catalysts to better civic health, provide recreation, improve tourism, possibly meet water-needs of local people, etc. Such gains shall be attained only after the water bodies are treated on eco system based approach.

7.1 Awareness

Awareness for citizen's groups, resident welfare associations, local organizations, activist groups, green organizations, political organizations, educational institutions and government agencies in protection of the water bodies should be organized periodically by the concerned authorities through campaigns, electronic media in vernacular languages also be ensured by the concerned authorities

7.2 Training

Organizing periodic trainings through identified and reputed institutions for all the concerned on aspects relating to maintenance during post- restoration phase of the water body.

7.3 Promoting Public Participation

Promoting active public participation (with the help of schools, colleges and universities, NGOs) for identifying and resolving critical lake or pond problems as well as periodic maintenance and restoration of water body from aesthetic and restoration point of view should be organized.

7.4 Dissemination of Information

Water quality of the pond or lake should be displayed at the main entrance of the pond or lake boundary and such water quality data also connected to the servers of concerned custodian State Department (s) as well as State Environment Department, respective State Pollution Control Board (SPCB)/Pollution Control Committee (PCC). Display boards also should be provided at all the salient points on **'Do's and Don'ts'** for the public.

7.5 Recreational Centre

Creation of pond or lakes can be converted into recreational centers with boating activities, walkways and benches for visitors on charge basis so as to generate revenue for operation and maintenance of the lake or pond areas

References

- Parliamentary Standing Committee Report 2016-"Repair, Renovation and Restoration of Water Bodies- Encroachment on Water Bodies and Steps Required to Remove the Encroachment and Restore the Water Bodies" (https://eparlib.nic.in/handle/123456789/65926?view_type=browse)
- Report of Niti Aayog (2018)- COMPOSITE WATER MANAGEMENT INDEX (CWMI) A NATIONAL TOOL FOR WATER MEASUREMENT MANAGEMENT & IMPROVEMENT http://pibphoto.nic.in/documents/rlink/2018/jun/p201861401.pdf
- GUIDELINES FOR REPAIR, RENOVATION AND RESTORATION OF WATER BODIES WITH DOMESTIC SUPPORT (2009) https://www.indiawaterportal.org/sites/indiawaterportal.org/files/Repair%2C%20Renovation%20and%20Restoration_Water%20Bodies_Domestic%20Support_MoWR_2009.pdf
- GUIDELINES FOR REPAIR, RENOVATION AND RESTORATION OF WATER BODIES WITH EXTERNAL ASSISTANCE (2009) https://www.indiawaterportal.org/sites/indiawaterportal.org/files/Repair%2C%20Renovation%20and%20Restoration_Water%20Bodies_%20External%20Assistance_MoWR_2009.pdf
- Advisory on Conservation and Restoration of Water Bodies in Urban Areas published by Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban Development (August 2013)

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Annexure-I

Water Quality Criteria-Designated Best Use

Designated-Best-Use	Class of Water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism in MPN/100ml shall be 50 or less pH between 6.5 and 8.5 Dissolved Oxygen 6mg/l or more Biochemical Oxygen Demand 5 days 20C 2mg/l or less
Outdoor bathing (Organised)	B*	Faecal Coliform in MPN/100ml: 500 (desirable) and 2500 (Maximum Permissible) Faecal streptococci in MPN/100 ml: 100 (desirable) and 500 (maximum Permissible) pH between 6.5 to 8.5 Dissolved Oxygen: 5mg/l or more Biochemical Oxygen Demand 3 Day BOD, 27 ^{O} C: 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more Biochemical Oxygen Demand 5 days 20C 3mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling	E	pH between 6.0 to 8.5 Electrical Conductivity at 25 ^{O}C micro mhos/cm Max.2250 Sodium Absorption Ratio Max. 26 Boron Max. 2mg/l

* ***Class B as per Primary Water Quality Criteria for Bathing Water (Water Used for Organised Outdoor Bathing) as per Environment (Protection) Rules, 1986***

Annexure-II

CRITERIA FOR CATEGORISATION OF RIVER MONITORING LOCATION

1. Introduction

Water Quality monitoring is an essential component to maintain and restore the wholesomeness of resources by way of prevention and control of pollution as prescribed under the Water (Prevention and Control of Pollution) Act, 1974. However, the Water (Prevention and Control of Pollution), Act, 976 does not define the level of wholesomeness to be maintained or restored in different water bodies of the country. In view of the said reason, the Central Pollution Control Board (CPCB) has tried to define the wholesomeness of water in terms of safe human uses, and thus, taken human uses of water as base for identification of water quality objectives for different water bodies in the Country. It is considered ambitious to maintain or restore all natural water body at pristine level which is possible only by taking proper control measures. The level and degree of treatment required can be decided depending on the categorization of the polluted river locations/stretch, as per the criteria detailed below:-

2. Categorization of River Monitoring Location

The water quality data is required to be analyzed and primarily mean or average values of Biochemical Oxygen Demand (BOD) and Faecal Coliform (FC) need to be estimated. Then, based on the total score estimated for the parameters BOD (weightage- 70 %) and FC (Weightage- 30 %), based on the criteria, the monitoring location is categorized as 'polluted' location. The polluted monitoring locations in a continuous sequence are defined as 'polluted river stretch'. However, actual self-purification distance need to be estimated based on the requisite input parameters which depend on the case-to-case and the local conditions.

The monitoring locations may be categorized in five classes from Category I to Category –VI. i.e., critically polluted to Good or Fit for Bathing i.e., Category –I indicates 'critically polluted'; Category-II indicates 'severely polluted'; Category-III indicates 'moderately polluted', Category –IV indicates 'less polluted', Category –V indicates 'Good' or Fit for Bathing'

Above suggested criteria is intended only for categorization of the river monitoring locations. However, if any State/UT desires to identify any other water body such as lakes, tanks may also apply these criteria depending on the need and the requisite achievable goals for rejuvenation of such water bodies.

Table 1 to Table 3 gives the mean or average BOD/Faecal Coliform values or range and the corresponding scores as well as categorization of the monitoring location

Table 1. Observed Mean or Average BOD Value in mg/l and corresponding BOD Score

S. No	*Mean or Average* **BOD (Weightage-70 %)**	
	Mean or Average BOD (in mg/l)	**BOD Score (X)**
1	> 48	100
2	24-48	80
3	12-24	60
4	6-12	40
5	≤ 6	20

Table 2. Observed Mean or Average Faecal Coliform (in MPN/100 ml) and corresponding FC Score

S. No	**Mean or Average Faecal Coliform (Weightage -30 %)**	
	Mean or Average Faecal Coliform (in MPN/100 ml)	**FC Score (Y)**
(1)	> 5,00,000	100
(2)	5000 to 5,00,000	80
(3)	5000 to 50,000	60
(4)	500 to 5000	40
(5)	≤500	20

Table 3. Total Score and corresponding Category of River Monitoring Location

S. No	**Total Score* (Z')**	**Category Priority Class of the Monitoring location**	**Category of Monitoring location**
(1)	81-100	Category –I	Critically Polluted
(2)	61-80	Category—II	Severely Polluted
(3)	41-60	Category –III	Moderately Polluted
(4)	21-40	Category –IV	Less Polluted
(5)	≤ 20	Category –V	Good or Fit For Bathing

Note:

(i) Above criteria must be considered only for the river locations having monitored at least for 2 years and 8 observations in each year covering at least pre-monsoon and post-monsoon period;

(ii) Above criteria is a preliminary screening criteria for categorizing monitoring locations. However, comprehensive assessment needs to be done by States/UTs to arrive at the extent of contamination;

(iii) Please refer to the procedure for estimation of Total Score given in S.No 3.;

1.1 Criteria for Category- I – Critically Polluted: - If the Total score is 81-100, then the monitoring location is categorized as **'Critically Polluted'.**

1.2 Criteria for Category- II – Severely Polluted: - If the Total score is 61-80, then the monitoring location is categorized as **'Severely Polluted'**

1.3 Criteria for Category- III-Moderately Polluted: - If the Total score is 41-60, then the monitoring location is categorized as **'Moderately Polluted'**

1.4 Criteria for Category-IV –Less Polluted: - If the Total score is 21-40, then the monitoring location is categorized as **'Less Polluted'**.

1.5 Criteria for Category -V-Good or Fit for Bathing:-If the Total score is ≤ 20, then the monitoring location is categorized as **'Good or Fit for Bathing'.**

*For easy understanding, flow chart given in **Figure 4** and steps for calculating the total score may also be referred in the subsequent paras:-*

3. Steps for calculating total score and categorizing of monitoring location : -

*(i) Depending on the average BOD measured value, assign the BOD score (X) as given in **Table 1.***

(ii)** Similarly depending on the average FC measured value, assign the FC Score (Y) as given in **Table 2.

*(iii) Total score **(Z)** is estimated as: BOD Score **(X) X** (Weightage of BOD i.e., 70 %) + FC Score **(Y) X** (Weightage for FC i.e., 30 %). and*

*(iv) Now compare calculated Total Score (Z) with the **Z'** Value given in the Table 3 and the monitoring location is categorized suitably.*

For easy understanding following examples may be referred in the subsequent paras.

***E.g. (1):** At a particular monitoring location, the average values of BOD and the FC values are observed as 6 mg/l and 9000 MPN/100 ml respectively. Then, the total score is calculated as*

- *X is the BOD Score corresponding to the mean BOD value of 6 mg/l as per **Table 1** = 20*
- *Y is the FC Score corresponding to the average FC value of 9000 MPN/100 ml as per **Table 2** = 60*
- *Calculated Total Score **(Z)** = **X** X **Weightage of BOD** + **Y** X **Weightage of FC** i.e.,20 X 0.7 + 60 X 0.3 = 14 + 18= 32.*
- *Compare 39 value with the **Z'** values given in **Table 3** to decide on the Priority Category of the Monitoring Location. In this case, monitoring location is Category-IV i.e., 'Less Polluted',*

***E.g.(2):** At a particular monitoring location, the average value of BOD and the FC values are observed as 2 mg/l and 45 MPN/100 ml respectively. Then, the total score is calculated as*

- *X is the BOD Score corresponding to the average BOD value of 2 mg/l as per **Table 1** = 20*
- *Y is the FC Score corresponding to the average FC value of 45 MPN/100 ml as per **Table 2** =20*
- *Calculated Total Score **(Z)** is calculated as = **X** X **Weightage of BOD** + **Y** X **Weightage of FC** i.e., 20 X 0.7 + 20 X 0.3 =20*
- *Compare 20 value with the **Z'** values given in **Table 3** to decide on the Category of the Monitoring Location. In this case, monitoring*

location is Category-V i.e., 'Good' or Fit for Bathing

E.g. (3): *At a particular monitoring location, the average value of BOD and the FC values are observed as 2 mg/l and 550000 MPN/100 ml respectively. Then, the total score is calculated as*

- *X is the BOD Score corresponding to the average BOD value of 2 mg/l as per* ***Table 1*** *= 20*
- *Y is the FC Score corresponding to the average FC value of 550000 MPN/100 ml as per* ***Table 2*** *= 100*
- *Calculated Total Score* ***(Z) = X*** *X* ***Weightage of BOD*** *+* ***Y*** *X* ***Weightage of FC*** *i.e., 20 X 0.7 + 100 X 0.3 = 44.*
- *Compare 100 value with the* ***Z'*** *values given in* ***Table 3*** *to decide on the Category of the Monitoring Location. In this case, monitoring location is Category-III i.e., Moderately Polluted'*

E.g.(4): *At a particular monitoring location, the average value of BOD and the FC values are observed as 45 mg/l and 400 MPN/100 ml respectively. Then, the total score is calculated as*

- *X is the BOD Score corresponding to the average BOD value of 45 mg/l as per* ***Table 1*** *= 80*
- *Y is the FC Score corresponding to the average FC value of 400 MPN/100 ml as per* ***Table 2*** *= 20*
- *Calculated Total Score* ***(Z) = X X Weightage of BOD + Y X Weightage of FC*** *i.e., 80 X0.7 + 20 X 0.3 = 62.*
- *Compare 100 value with the* ***Z'*** *values given in* ***Table 3*** *to decide on the Category of the Monitoring Location. In this case, monitoring location is 'Category-II i.e., Severely Polluted'*

E.g (5): *At a particular monitoring location, the average values of BOD and the FC values are observed as 24 mg/l and 200000 MPN/100 ml respectively. Then, the total score is calculated as*

- *X is the BOD Score corresponding to the mean BOD value of 24 mg/l as per* ***Table 1*** *= 60*

- *Y is the FC Score corresponding to the average FC value of 200000 MPN/100 ml as per* ***Table 2*** *= 80*

- *Calculated Total Score* ***(Z)*** *=* ***X*** *X Weightage* ***of BOD*** *(70 %) +* ***Y*** *X* ***Weightage of FC*** *(30 %) i.e.,60 X 0.7 + 80 X 0.3 = 42 + 24= 66.*

- *Compare 90 value with the* ***Z'*** *values given in* ***Table 3*** *to decide on the Category of the Monitoring Location. In this case, monitoring location is Category-II i.e., 'Severely Polluted',*

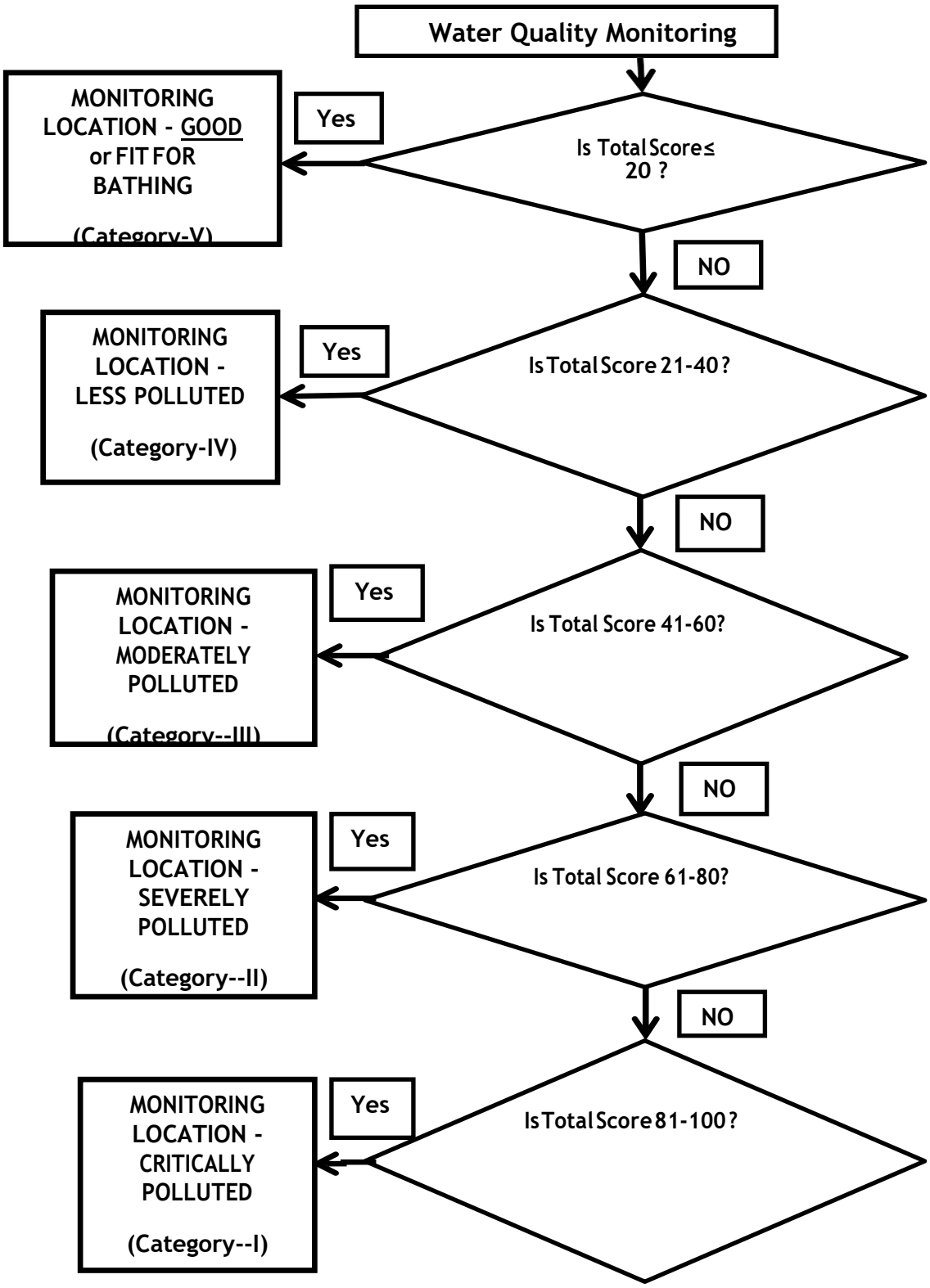

Figure 4. Flow Chart Showing Criteria for Categorization of River Monitoring Location