

भारतीय मानक
नदी-बेसिन के सम्पूर्ण नियोजन की निर्देशिका

Indian Standard

**GUIDELINES FOR OVERALL PLANNING OF
RIVER BASIN**

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the River Valley Planning, Project Reports and Progress and Completion Reports Sectional Committee had been approved by the River Valley Division Council.

A basin development is a co-ordinated programme to develop the use of water and land resources of a river basin to obtain a greater efficiency of use than would be possible, if were developed by unco-ordinated multi purpose projects or a series of unco-ordinated single purpose project.

In the formulation of this standard due weightage has been given to international co-ordination among the standards and the practices prevailing in different countries in additions to relating it to the practices in the field of this country.

The guide for overall planning of the basin has been divided into two sections:

- a) Section 1 Basin characteristics and inventory of resources, and
- b) Section 2 Overall planning of the basin.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GUIDELINES FOR OVERALL PLANNING OF RIVER BASIN

SECTION 1 BASIN CHARACTERISTICS AND INVENTORY OF RESOURCES

1 SCOPE

1.1 This section broadly covers the characteristics and resources of basin, present status of resources utilization.

2 INTRODUCTION

2.1 This section includes the information on the following:

- a) Physical features of the basin;
- b) Plan of the basin;
- c) Brief description of climate, precipitation, run off and availability of ground water;
- d) Irrigable land area;
- e) Economics of the basin including the population trends, agriculture, forests, mining and industrial raw materials, industry transportation and power needs; and
- f) Priority of water use.

3 BASIN CHARACTERISTICS

3.1 Basin Setting

This includes the information on the following:

- a) Basin boundaries with longitude and latitude,
- b) Area covered under the basin,
- c) The percentage of the area of the basin compared to the total geographical area of the state and the country,
- d) Political sub-division with respect to inter-state basin,
- e) State-wise distribution of the drainage areas and their total, and
- f) Description of physical and economic sub-regions.

3.2 Physiography

Brief description of the following should be given:

- a) Various ranges and ridges; and
- b) Topography, its plateau, the general shape of the basin and its delta;
- c) Glaciers; and
- d) Lakes.

3.3 River System

Brief description of the following should be given:

- a) The main river, its main tributaries and the sub basins; and
- b) Drainage areas of the sub-basins, their identification and their percentage as compared to the main basin and their total.

3.4 Climatic Characteristics

- a) *Climate* — This shall cover commencement and duration of the following:
 - i) Cold,
 - ii) Hot, and
 - iii) Rainy.
- b) *Rainfall* — This shall cover the information on the following:
 - i) Mean annual rainfall,
 - ii) Seasonal, weighted average rainfall in various sub-basins and the standard deviation, and
 - iii) Rainfall variations during different months and periods.
- c) *Temperature* — This shall cover the following:
 - i) Mean annual temperature in various parts of the basin and the sub-basins, and
 - ii) Average minimum and maximum monthly temperature in various parts of the basin and the sub-basins.
- d) *Evaporation and evapo-transpiration* — Standard ETO's for various important stations of the basin,
- e) Humidity,
- f) Wind velocity, and
- g) *Solar radiation* — Cloudy and sunny days.

3.5 Physiography Geology

This shall include the information on the following:

- a) Detailed description of the topography,
- b) Geology of the area dealing with stratigraphy and description of various formations, and
- c) Geological structures and their characteristics.

3.6 Soils

This shall cover the information on the following:

- a) General,
- b) Principal soil type and their location/distribution,
- c) Drainage characteristics of soil,
- d) Effect of rainfall on soil formation,
- e) Behaviour of different soil types under irrigation conditions, and
- f) Crops grown in relation to soil type.

4 RESOURCES OF THE BASIN

4.1 Land

This shall include information on the statewise and total area of the following along with their proportions.

- a) Gross area,
- b) Reporting area,
- c) Area under different types of forests,
- d) Area not available for cultivation,
- e) Culturable areas,
- f) Uncultivated culturable area,
- g) Net area sown,
- h) Area sown more than once,
- j) Total cropped area,
- k) Net area irrigated,
- m) Gross area irrigated,
- n) Percentage of net area sown to culturable area,
- p) Percentage of net area irrigated to culturable area, and
- q) Percentage of net area irrigated to net area sown.

NOTE — The area sown under forests is not necessarily all wooded as some areas classified as forests were denuded and have not been replanted.

4.1.1 Land holding patterns — analysis of trends.

4.2 Water Resources

4.2.1 Surface Water

The following data shall be collected:

- a) Description of catchment;
- b) Rain gauge stations and rainfall data;
- c) Historical stream flow;
- d) A report giving the details of the sites in the basin where gauge, discharge, and sediment observations are made and their reliability along with the observed data;

- e) Average annual run off of the basin and its method of determination;
- f) 50, 75, 90 and 100 percent dependable yield of the basin;
- g) Flood estimation;
- h) Whether gauging and discharge sites are evenly distributed over the catchment for proper assessment of water resources and whether more gauge and discharge sites be set up so that more representative discharge data is available;
- j) Key gauge discharge sites at all important projects in operation as well as for planned projects;
- k) A report giving the details of the sites measuring discharge on each important tributary of the river; and
- m) Existing usages of the established rights.

NOTE — Reconstructed flows, in case stream flow data is affected by diversions, storage, or other regulations shall be given.

4.2.2 Ground Water

This shall include the information on the following to describe geology with respect to the availability of water. Systematic geohydrological studies of the basins and the sub-basins if made with a view to assess the ground water resources, should be reported in detail:

- a) Statistics of existing number of government or private tubewells and their use with details of areas irrigated by them;
- b) Existing usages and rights;
- c) Sub-surface exploration carried out so far to determine extent, thickness, capacity, hydraulic characteristics, economics and dependable yield of the aquifer;
- d) Results of the test wells;
- e) Description of the area for further exploration;
- f) Brief description about activities in the basin with regard to minor irrigation such as improvement of wells and digging of new wells; and
- g) Recharge statistics.

4.3 Mineral

Brief description of the following shall be given:

- a) Principal minerals found in the basin with statewise location, and
- b) Minerals found in small quantities in different parts of the basin.

4.4 Forests and Resources

This shall include the following information:

- a) Area covered under forests in the basin as compared to the total area of the basin,
- b) Type of forests and their distribution,
- c) Description of forest and its exploitation,
- d) Communication in the forest area, and
- e) Flora and fauna.

4.5 Demography

Information of the following may be collected:

- a) On the basis of the latest census, district wise population of the basin;
- b) Names of the cities with population of more than one lakh persons;
- c) Variation of density of population from densely populated areas to thinly populated area. Rate of increase/decrease in population;
- d) Density of population of basin in terms of persons per sq km;
- e) Percentage of population belonging to scheduled tribes and their social, economic conditions and mode of cultivation adopted by them;
- f) Percentage of population living in the rural areas in the basin and the remaining percentage living in cities and towns;
- g) Percentage of working force (comprising the census categories of self-supporting persons and earning dependents of the population); and
- h) Percentage of working force engaged in cultivation, agriculture, mining, cottage industries, manufacturing and tertiary activities.

5 PRESENT STATUS OF RESOURCE UTILIZATION

5.1 Agriculture

This shall include information on the following:

- a) Cultivable area;
- b) Areas under crops;
- c) Description of general grouping pattern of irrigated areas, statewide;
- d) Agriculture practices;
- e) Land suitability areas under irrigated agriculture;
- f) Dry land farming;
- g) Irrigation practices and their limitations;

- h) Irrigation facilities from various sources like canals, tanks, tubewells, wells, etc and areas irrigated by each source;
- j) Chemical and bacteriological analysis of available water;
- k) Statewise description about the major and medium schemes taken up during the plans and areas irrigated by each scheme; and
- m) Brief description of minor schemes such as tanks, wells and tubewells in operation, and under construction and the areas irrigated there from and which would be developed, and
- n) Water requirements of crops.

5.2 Drainage

Description of any existing surface drainage system, drainage of irrigable area and sanitary problem, if any shall be given.

5.3 Industry

Description of the following shall be given:

- a) Industrial potential in the basin,
- b) Existing heavy cottage and agro-based industries with their location, estimation of their water utilization and sources of supply,
- c) Mining of ores, and
- d) Export potential of raw and finished materials.

5.4 Power Generation

Description of the following shall be given:

- a) Installed capacity of Hydro, Thermal, Gas based and Nuclear Power Generating Plants in operation and under construction and their water requirements, and
- b) Steps for harnessing solar and wind energy.

5.5 Municipal and Domestic Water Supply

Information on the following shall be given:

- a) Location of urban centres, source of water supply and its utilization; and
- b) Sources of water supply and utilization by rural population.

5.6 Navigation

This shall include information on the following:

- a) Present status of inland navigation giving details of navigable water base and areas served,
- b) Maximum capacity of country boats and its barges which ply in the navigable areas, and
- c) Water required for navigation.

5.7 Recreation and Fishery

This shall include the information on the following:

- a) Existing recreation facilities in the region,
- b) State of fishery in the region,
- c) Water requirements, and
- d) Existing operational adjustments for such uses.

5.8 Flood Control

Description of the following shall be given:

- a) Analysis of hydrological data to determine flood potential;
- b) History of floods in the basin with their causes, history and economic study of the past and potential flood damages, trends in the affected area; and
- c) Existing flood control works such as:
 - i) Improvement of river channel,
 - ii) River diversions,
 - iii) Constructing dikes,
 - iv) Reservoirs, and
 - v) Flood protection regulation.

5.9 Watershed Management

The information of the following shall be given:

- a) Extent and gravity of erosion problem,
- b) Silting of reservoirs and drainage,
- c) Existing soil conservation practices and their efficiency.

5.10 Environmental Control

This shall include information on the following:

- a) Changes in the water regime of the river;
- b) Pollution of river water from industry and watershed;
- c) Major intake to check pollution;
- d) Waterlogged and saline affected areas. Steps taken such as surface drains, providing pumps and tubewells as anti-water-logging measures be indicated; and
- e) Salt water intrusion in the coastal ground water resources.

5.11 Soil Conservation

A brief description of the topography slopes, rainfall intensity and erosion of soil of the basin shall be given. It may be reported, if any of the following steps are being taken for conservation of the storage capacities of reservoirs:

- a) Afforestation,

- b) Terracing and contour bunding,
- c) Pasture development and development of marginal and submarginal lands,
- d) Stream control measures including fringe afforestation and stream bank control, and
- e) Desilting works like check dam, etc.

Specific steps taken for soil and water conservation measures in the basin be dealt with.

Sedimentation survey of the reservoirs under operation be reported. It may be stated if the loss of reservoir capacity is in accordance with the loss stipulated or is excessive. If loss of storage capacity is excessive, steps proposed to arrest soil erosion in the catchment area be dealt with.

6 PROBLEMS OF BASIN

6.1 History of famines, drought and flood in the basin.

6.2 Information on chronically flood, draught and flood prone area and salinity shall be given.

SECTION 2 OVERALL PLANNING OF THE BASIN

7 SCOPE

7.1 Section 2 of this standard covers future trends of development of basin and resources utilization within the constraints, water resources accounting and developmental plan of the basin.

8 FUTURE TRENDS OF RESOURCES UTILIZATION

8.1 Economic Base

Economic base projection for the future should extend at least over the useful life of the projects that are considered, that is, for a period of 50-100 years. It is obvious that any extrapolation of population based on past trends, over such a long future period of say 100 years, is of a highly speculative character and would lead to completely erroneous results. It should be kept in mind that the population growth is related to economic activity, which in turn is related to resource development. Due allowance shall be made for the likely increase in the standard of living of the backward and poverty stricken area, which are under-developed.

It may be possible to develop an ultimate water plan by a different approach. Instead of estimating the size of the future population with their economic base, and then preparing a resource development plan to suit their needs, apprise first all available resources in the region and then estimate how many people and what economic activity could be supported by these resources. If

such an approach is successful, it shall be taking into consideration not only the available water resources, but also the resources of the region, including space for living and recreation. After having developed a tentative plan to make the most effective and continued use of available resources, then roughly determine how many people could live in the area without competing with one another for the use of the same resources. The last step would be to prepare a water development plan that would meet the demands of such a regional development.

8.2 Agriculture

This shall include information on the following:

- a) Soil and moisture condition of the areas proposed for irrigation,
- b) Actual development,
- c) Change in cropping pattern from the existing pattern,
- d) Use of fertilizers and high yielding varieties of crops,
- e) Crop rotation,
- f) Proposals for development of irrigation,
- g) Scientific management of irrigation supplies,
- h) Estimation of proposed water requirements of crops and total water requirements for irrigation,
- j) Total output of various crops expected, and
- k) Marketing facilities and development of roads in commanded areas.

8.3 Industrial Development

This shall include brief description of the following:

- a) Factors influencing industrial development like space for industry, supply of raw materials, finance, power, marketing facilities, etc.
- b) General scope of development in the region, and
- c) Projected water needs.

8.4 Municipal and Domestic Water Supply

This shall include brief description of the following:

- a) Anticipated growth of urban and rural population,
- b) Per-capita requirements of water for household use in urban and rural population depending upon standard of living,
- c) Projected needs of urban and rural population,

- d) Water required for dilution of municipal industrial effluent so that adequate sanitary river conditions are maintained, and
- e) Identification of additional sources of water supply.

It should be noted that the total domestic and industrial water requirements are usually small compared to the available water supplies in the drainage basin. Moreover, only 5 to 10 percent of the total intake is consumptively used, the remaining returning to the river system. Although, the total requirements are relatively small, it shall be emphasized that they are of the highest priority and good quality of water is needed.

Associated with the domestic and industrial water requirements are the waste disposal requirements. The stream flow requirements to dilute municipal and industrial effluent so that adequate sanitary conditions are maintained. This requirement may be 10 or even 100 times larger than the pure water intake. The exact amount depends largely upon the degree of treatment that industries and municipalities will apply to their wastes.

8.5 Power Generation

This shall include information on the following:

- a) Power supply position,
- b) Future needs and proposals for generating additional power, and
- c) Projected water requirements for additional power generation.

8.6 Navigation

This shall include information on the following:

- a) Scope of navigation development,
- b) Proposed development,
- c) Estimated water requirements for navigation, and
- d) River training works needed for maintaining a defined navigation channel and possible effect of such works on floods in the river.

8.7 Recreation and Fishery Development

This shall include information on the following:

- a) Potentiality of utilizing reservoir for public recreation,
- b) Problems of fish conservation,
- c) Prospects of fishery development, and
- d) Operational adjustment to mitigate adverse effect of pisciculture.

8.8 Flood Control

This shall include brief description of the

following:

- a) Whether comprehensive plan of flood management for the particular river system has been prepared or not,
- b) Recent approaches to the problem of the flood control,
- c) Needs of the region, and
- d) Proposals for new flood control works, such as,
 - i) Improvement of river channel,
 - ii) River diversions,
 - iii) Constructing dikes,
 - vi) Reservoir,
 - v) Flood plain regulation, and
 - vi) Evaluation/assessment report on performance of some completed schemes and improvements suggested in such reports.

8.9 Watershed Management

This shall include information on the following:

- a) Recognition of watershed management as a pre-requisite in river basin plan, and
- b) Proposals for conservation like soil improvement, sedimentation, abutment, forests and grass land equipment, run off retardation, etc.

8.10 Environment Control

This shall include description of the following:

- a) Dangers of environment pollution and identification of sources and nature of possible pollution,
- b) Proposals for controlling and protecting land, and
- c) Water storages and drainage channels against pollution.

9 WATER RESOURCES ACCOUNTING

9.1 Availability of Water

9.1.1 Surface Water

This shall include brief description of the following:

- a) Criteria for irrigation, power generation, industrial uses, etc;
- b) Dependable surface water availability for various performances of water;
- c) Rate of availability of water at various project sites at particular time within a year; and
- d) Distribution of available water in a river basin.

9.1.2 Ground Water

This shall include the information on the following:

- a) Estimation of economic and dependable yield of ground water for future use,
- b) Distribution of ground water in the basin, and
- c) Chemical and bacteriological analysis of ground water.

9.2 Utilization of Water in the Basin

This shall include information on the following:

- a) Existing consumptive uses of water like irrigation, industrial, domestic uses;
- b) Non-consumptive uses of water like hydro power, navigation, etc;
- c) Requirements of water in the basin; and
- d) Requirements at various times and pattern of demand.

9.3 Water Losses

This shall include the information on the following:

- a) Permanent losses occurring in the basin and its estimation like evaporation from water bodies, deep percolation, leakage from reservoirs, hydro-electric plants, and
- b) Return flow from irrigated areas, sewages and industries.

9.4 Projected Utilization

This shall include information on the following:

- a) Future requirements for consumptive uses,
- b) Non-consumptive uses,
- c) Requirements of water in the basin, and
- d) Requirements at various times.

9.5 Surpluses and Shortages

This shall include information on the following:

- a) Comparison of present demand with the available supply at various locations,
- b) Surpluses and shortages, during various periods of the year,
- c) Comparison of future demand with available supply at various location, and
- d) Diversion of water from one sub-basin to another sub-basin to meet shortages.

10 PROBLEMS AND RESTRAINTS IN WATER RESOURCES DEVELOPMENT

10.1 Constitutional Aspects

This shall include description of the following:

- a) Constitutional provisions with regard to

various developments like agriculture, industry, power, transport, etc,

- b) Protection of established water rights and uses;
- c) Special interest of existing works and plans envisaged by different state governments under various sectors in the basin;
- d) Need for coordination between conflicting interests;
- e) Existing riparian use and quantum of water presently used;
- f) Commitments for identified projects such as those included in the Tribunal award; and
- g) Proposed utilization under development of overall river basin with break up of utilization under each state.

10.2 Projection Assumption and their Limitation

This shall include information on the following:

- a) Availability and authenticity of the basin data;
- b) Assumed trends in economic growth;
- c) Employment opportunity;
- d) Life of project and period considered for basin planning; and
- e) Character, sequence and rate of development and distribution of benefit.

10.3 Technological Aspects

This shall include information on the following:

- a) Unified operation of water resources projects;
- b) Inter agency cooperation;
- c) Need for augmenting water resources and its scope;
- d) Schemes for inter basin transfer of water; and
- e) Scientific advancement in water utilization like pumped storage use of sprinklers, reuse of industrial and domestic waste water, etc.

10.4 Submergence of Land, Habitats, etc

10.5 Environmental Aspects

This shall include description of the following:

- a) Preservation of cultural heritage,
- b) Problem of land conservation and control,
- c) Problem of floods,
- d) Protection of basic resources,
- e) Disposal of pollutants and pollution of water bodies,

- f) Problem of water logging, and
- g) Water quality.

11 DEVELOPMENTAL PLAN OF THE BASIN

This shall include description of the following:

11.1 Priority Uses of Water

- a) Immediate needs of the region,
- b) Priority of the immediate needs
- c) Long range needs and reservation of water for such uses,
- d) Types of structures required,
- e) Alternative proposals for immediate and long needs, and
- f) Alternative proposals for rehabilitation of population and environs.

11.2 Multiple Reuse Recycling of Water

This shall include information on the following:

- a) Possibility of integrating various uses of water,
- b) Resolution of conflicts between competitive uses like (space allocation time discharge),
- c) Adjustment of local and state water utilization plans, and
- d) Reuse/recycling of non-consumptively consulative used resource.

11.3 Project Economics and Financial Feasibility

This shall include information on the following:

- a) Identification and evaluation of costs of various projects,
- b) Identification and evaluation of benefits and pattern of occurrence with respect to various projects,
- c) Conversion of costs and benefits to a common time data,
- d) Computation of benefit costs ratio including intangible benefits,
- e) Allocation of costs to various purposes, and
- f) Costs reimbursement policy.

11.4 Optimum Water Plan of the Basin

This shall include information on the following:

- a) Inventory of selected water control and utilization works,
- b) Co-relation of existing projects in a basin,
- c) Co-ordination of system reservoirs,
- d) Co-ordination of ground water and surface water projects,
- e) Co-ordination of water plan with other developments, and
- f) Outline of a phased programme of water resources development.

11.5 Rehabilitation Settlement

Standard Mark

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