CS(AR)-127

GROUNDWATER BALANCE STUDY IN PURI DISTRICT OF ORISSA

PART—I

(PROCESSING AND ANALYSIS OF DATA)

DELTAIC REGIONAL CENTRE
NATIONAL INSTITUTE OF HYDROLOGY
KAKINADA
ANDHRA PRADESH
1993—94

PREFACE

Ground water is an important source of water supply throughout our country. Though, the ground water resource of the country is limited, its use in irrigation, industries, municipalities and rural homes continues to increase. The ever increasing demand of this natural resource, therefore, emphasizes the need of its correct estimates, proper development and management.

Ground water is often referred to as the hidden component of the hydrological cycle. It is not directly observable and its existance and characteristics can only be inferred with some degree of uncertainty. The ground water balance study serves as a means of solution to various important theoritical and practical hydrological problems. On the basis of water balance approach, it is possible to evaluate quantitatively individual contribution of various sources of water in the system over diferrent time periods, and to establish the degree of variation in ground water regime due to changes in components of the system. Hence, such studies are very important for understanding the behaviour of the hydrologic system and working out the strategies for development and management of ground water resources.

Keeping the above aspects in mind, the seasonal ground water balance study in Puri district of Orissa has been taken up. The study involves a huge data on various aspects. The data collected from field organisations represent different level of time periods and are recorded in different units. Preliminary processing and proper presentation of data is, therefore,

considered necessary before it is subjected to further detailed analysis. With this view point, it is planned to compile, process and present the voluminous data in one report. The data thus compiled will be helpful for conducting the ground water modelling and other such related studies in future also. The present report is an endeavour in this direction and forms Part-I of the "Ground water balance study in Puri district". The Part-II of the study report deals with the methods of computation of various components of water balance equation and their estimation.

The data for the report have been collected from various departments of Govt.of Orissa such as Orissa Lift Irrigation Corporation Ltd, Irrigation dept., Board of Revenue and also Central Ground Water Board, Bhubaneswar. The cooperation and help provided by these depart ments during the data collection work is fully acknowledged.

The report has been prepard by **Sri J.V. Tyagi, Scientist'C'.** The technical assistance during the course of data collection, processing, and finalization of the report was provided by **Sri S.M.Saheb, SRA, Sri T.Thomas, SRA, and Sri U.V.N.Rao, RA.** The overall guidance was provided by **Dr. P.V.Seethapathi, Scientist'F'.**

(S M SETH)
DIRECTOR

CONTENTS

LIST OF PLATES

1.0 INTRODUCTION

1.1 General :

The study of water balance is defined as the systematic presentation of data on the supply and use of water within a geographic region for a specific period. The water balance of any ground water basin establishes that all waters entering the basin during any given period of time must either go into storage within its boundaries, be consumed or flow out during that period. Clearly, the items of inflow and outflow can include a number of components depending on the geographic and hydrological features of the basin. The concept of ground water balance in its simplest form can be stated as below.

$$\text{Recharge} = \text{Discharge} \pm \Delta S$$

Where, ΔS is the change in the ground water storage.

The ground water balance studies are conducted to assess the quantity of water available for development in a region. Knowledge of water balance assists prediction of the consequences of artificial changes in the regime of ground water basins. In coastal areas where sea water intrusion is a common problem, the quantitiy of fresh water storage in the basin aquifers can be assessed by accomplishing the ground water balance. With water balance data, it is possible to compare individual sources of water in a system over different periods of time and to establish the degree of their effect on variations in the water regime. Further, the initial analysis used to compute individual water balance components and the co-ordination of these components in the hydrologic balance equation make it possible to identify

deficiencies in the distribution of observational stations and discover systematic errors of measurements. Finally, water balance study enables evalution of one unknown component of water balance from all other known components.

Keeping the above aspects in mind, it is intended to take up the seasonal ground water balance study in the Puri district of Orissa. Preparation of ground water balance involves a series of steps i.e., collection and processing of data, identification of the various physical features of the hydrological system involved, their hydraulic characteristics and hydraulic inter-relationships, and finally the estimation of various components of water balance equation.

1.2 Scope of present report :

The ground water balance study involves a variety of data on various aspects such as location of the study area and its extent, topography, climate, meteorology, geology, hydrology, hydrogeology, agriculture and water quality etc. It is, therefore, planned to collect, process and present all the data in one report. The data thus compiled will also be helpful for conducting ground water modelling and other relevant studies in future. The present report is an endeavour in this direction and forms Part I of ground water balance study in Puri District. The data on various aspects have been collected from different government offices and other field agencies with some gaps from 1978 to 1992. Preliminary processing and analysis of data has been carried out and maps and charts wherever necessary prepared and presented in the report for further analysis. While different

components of recharge, discharge and change in storage as involved in the hydrologic system of the study area have been identified in the present report, their estimation and preparation of ground water balance will be discussed in the part II of study report.

1.3 Data requirements for ground water balance study :

The following data are generally required to evaluate the hydrological equilibrium of a ground water basin.

1. Topographical map of the study area
2. Map of the basin with all the rivers marked on it,
3. Map showing type and location of raingauges,
4. Map showing location of observation wells,
5. Map showing canal network in the basin,
6. Monthly rainfall data from a well distributed network of raingauges over the basin,
7. Groundwater levels in observation wells spread over the basin,
8. Record of canal dischharges at different control points,
9. Length, cross-section and other design details for all canals, distributories and minors and their command areas,
10. Total number of wells and average ground water draft per well per year
11. Land use pattern in the basin,
12. Cropping pattern,
13. Unit values of water requirements of different crops,
14. Average river bed gradient and monthly river stages at different points,
15. Location of tanks, reservoirs etc. and their monthly water levels,
16. Data on geology and auifer characteristics,
17. Data on evaporation, temperature, relative humidity, sunshine hours, wind velocity etc.

For all the data which involve time factor, it is required to have information for each time interval of computation and these data are needed for the entire duration for which water balance computations are to be performed.

1.4 Source of data :

The data required for conducting the ground water balance study in Puri district have been collected from various

departments. The Ground Water Survey & Investigation wing of Orissa Lift Irrigation Corporation, Bhubaneswar (GWS & I of OLIC) was the nodal agency for procuring the requisite data for the study. The details of canals and their command area in the Puri district were collected from Irrigaton department of Orissa. The ground water table data of observation wells and piezometers alongwith their location as maintained by Central Ground Water Board, Bhubaneswar were provided by the GWS & I of OLIC. Similarly, the chemical quality of water samples, well logs, pumping test data, agricultural statistics, number of wells and their unit discharges and river discharges in the study area were provided by the GWS & I of OLIC Ltd. The monthly rainfall data for 29 raingauge stations maintained at block headquarters were provided by the Board of Revenue, Cuttack. The data collected alongwith their source are given in detail in chapter 3.

2.0 STUDY AREA

2.1 Location and extent :

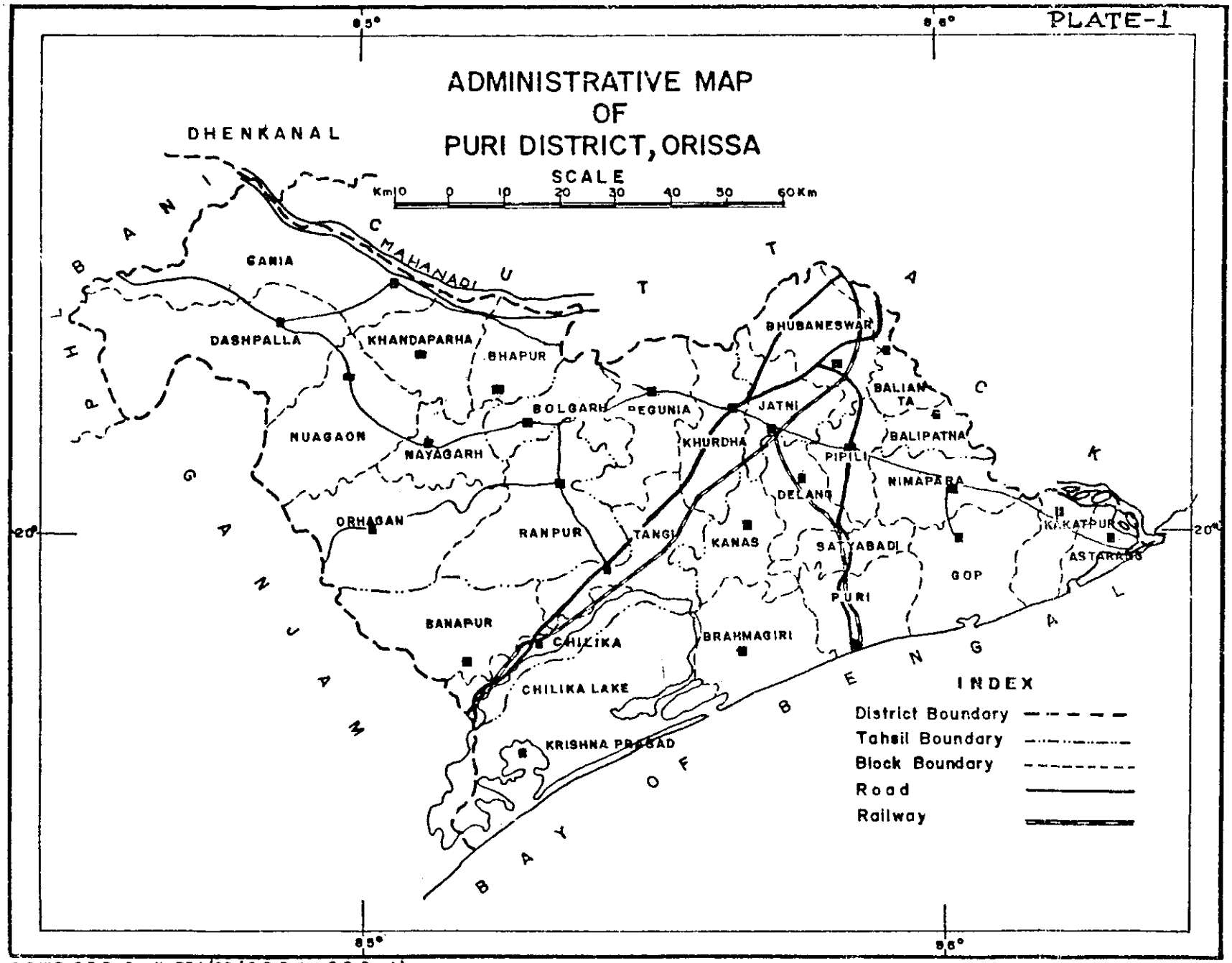
The ground water balance study has been taken up in Puri district of Orissa. The district of Puri forms a part of Mahanadi delta and lies between the latitudes 19°28' to 20° 35'N and longitudes 84° 29'to 86°25' E and largely comes under coastal tract of Orissa. Administratively, the district has been divided into 29 blocks. It has a gross geographical area of 10,182 sq.kms and is featured in the Survey of India toposheet no. 73D,H,L and 74A,E,I. The district boarders Cuttack district in the north, Ganjam district in the south, Phulbani district in the west and the Bay of Bengal in the east. The district has a good network of communications and is well approached by road and railways. The national highway no.5 (Calcutta-Madras) passes through the district in the NE-SW direction through Bhubaneswar and Khurda. The study area (Puri distruct) is shown in plate-1.

2.2 Climate :

The district experiences moderate type of tropical monsonic climate showing significant variation in mean daily temperature observed during summer and winter. The average daily temperature is observed to be greater than 20°C for all the months during a year. The mean daily maximum temperature is observed to be varying from 28°C to 42°C in the months of January and May respectively. Similarly, the mean daily minimum temperature is observed to be varying from 17°C to 25°C in the months of January and June respectively.

Monsoon generally starts from the month of June and lasts till October. The normal annual rainfall of the district, as per

PLATE-1



C.G.W.B. S.E.R. Drg.No 734/69 (S.D.Patra S.R.Reut)

I.M.D, is reported to be 1449.1 mm.

The mean daily average relative humidity is recorded to be 80% (maximum) in the months of July and August and that recorded in the month of December comes in the order of 30% (minimum).

The mean daily evaporation during the month of October is found to be minimum i.e., 65 mm/day. It gradually increases to a peak of 75 mm/day in the month of May and then decreases gradually till the end of October.

The Bay of Bengal being very close to the district, significantly affect the day to day weather condition of the low lying areas of the district.

2.3 Soil and topography :

The district comprises chiefly of alluvial and lateritic deposits of recent to older in origin. Sticky clay is the dominent texture of soil encountered in the district. Besides this, lateritic soil is also marked in older alluvial areas and areas occupied by the sedimentary rocks. Soils like sandy loam and sandy clay are seen in the entire coastal alluvial area (saline tract) occuring in between coast canal and Bay of Bengal and in the flood plain of the rivers flowing in the district. The environmental features of Puri district are shown in Plate-2.

Physiographically, the district can be broadly divided into three distinct zones, almost parallel to the coast line.

(i) Saline marshy tract streching along the coast consisting of unconsolidated sediments of sand and clay with or without

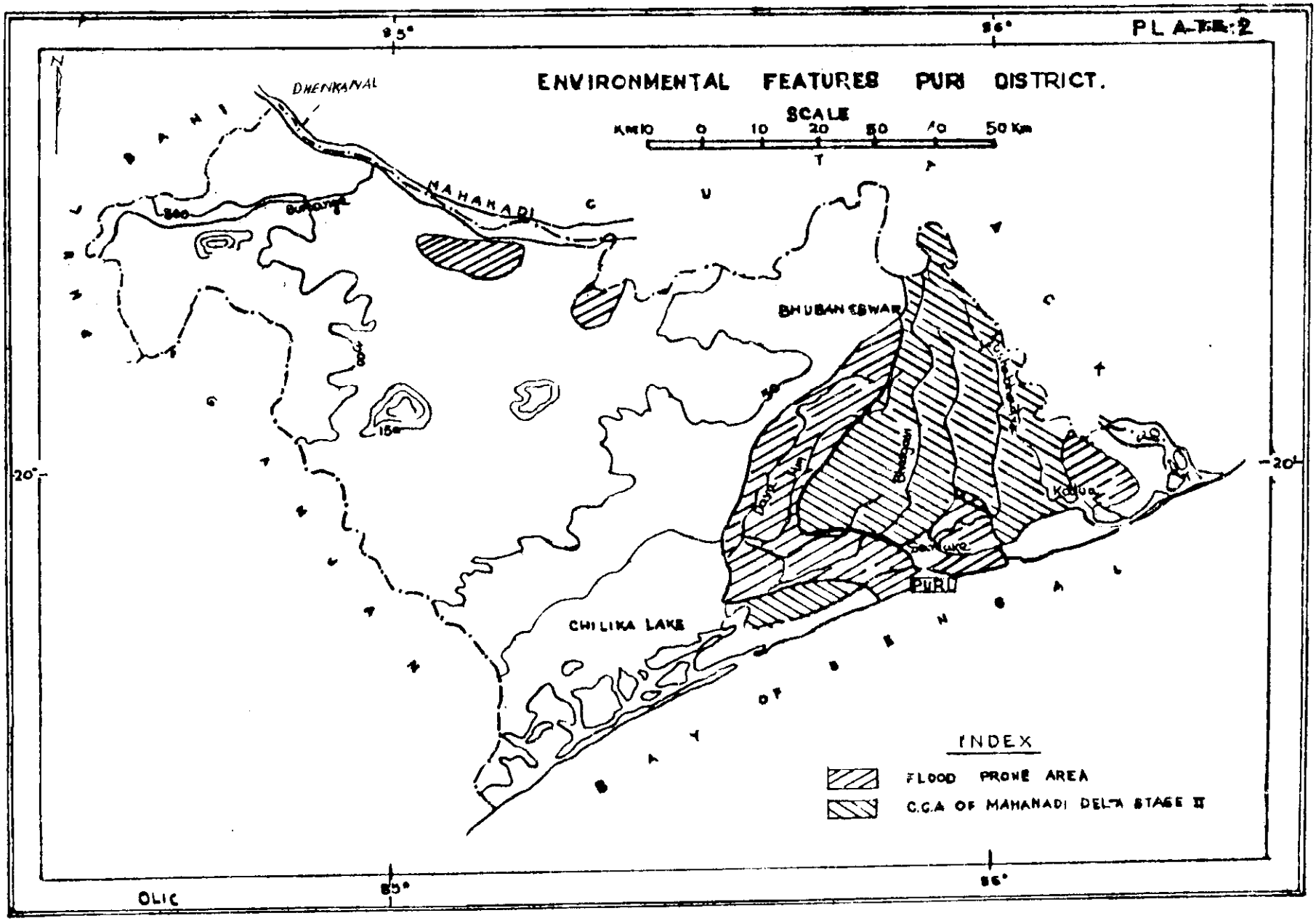


PLATE: 2
ENVIRONMENTAL FEATURES PURI DISTRICT.
SCALE
KM 10 0 10 20 30 40 50 Km
DHENKANAL
MAHANADI
BHUBANESWAR
CHILIKA LAKE
PURI
KONARK
INDEX
FLOOD PRONE AREA
C.C.A OF MAHANADI DELTA STAGE II
85°
86°
20°

salinity occuring within a depth range of 100 meters to 300 meters below ground level. This tract is almost flat in topography having minimum range of plantation.

The Brahmagiri, Puri Sadar, Gop, Pipili, Kanasa, Satyabadi, Delanga, Kakatpur, Astaranga, Nimapura, Balianta, Chilika and Balipatna blocks of the district are covered under this saline tract.

(ii) The Bhubaneswar block and part of Jatni, Khurda blocks of the district form the gently undulating sedimentary tract. In this tract, sand stones of Upper Gondwana Group with laterite capping at the top are mostly encountered.

(iii) The Khurda, Khandapara, Bhapur, Begunia, Gania, Daspalla, Tangi, Ranapur, Banapur, Nuagaon, Odagaon, Bolagarh blocks and parts of Jatni, Nayagarh, Chilika blocks of Puri district comprise the consolidated hard rock terrain. This tract is situated between altitutde 100' to 850' above MSL. The weathered zones alongwith fractured rocks occuring in this tract serve as an ideal space for storage and movement of ground water.

Besides the above, narrow strips of alluvial deposits are also seen in some parts of Khandapara, Nayagarh and Gania blocks. The thickness of such alluvial deposits varies from 10 to 30 meters below ground level. The soil map and geomorphology of study area are given in Plates-3 & 4.

2.4 Drainage :

The district is drained by a network of rivers and nallahs having flow in the South-East direction. The river Mahanadi almost drains the western part of the district. The river Dahuka

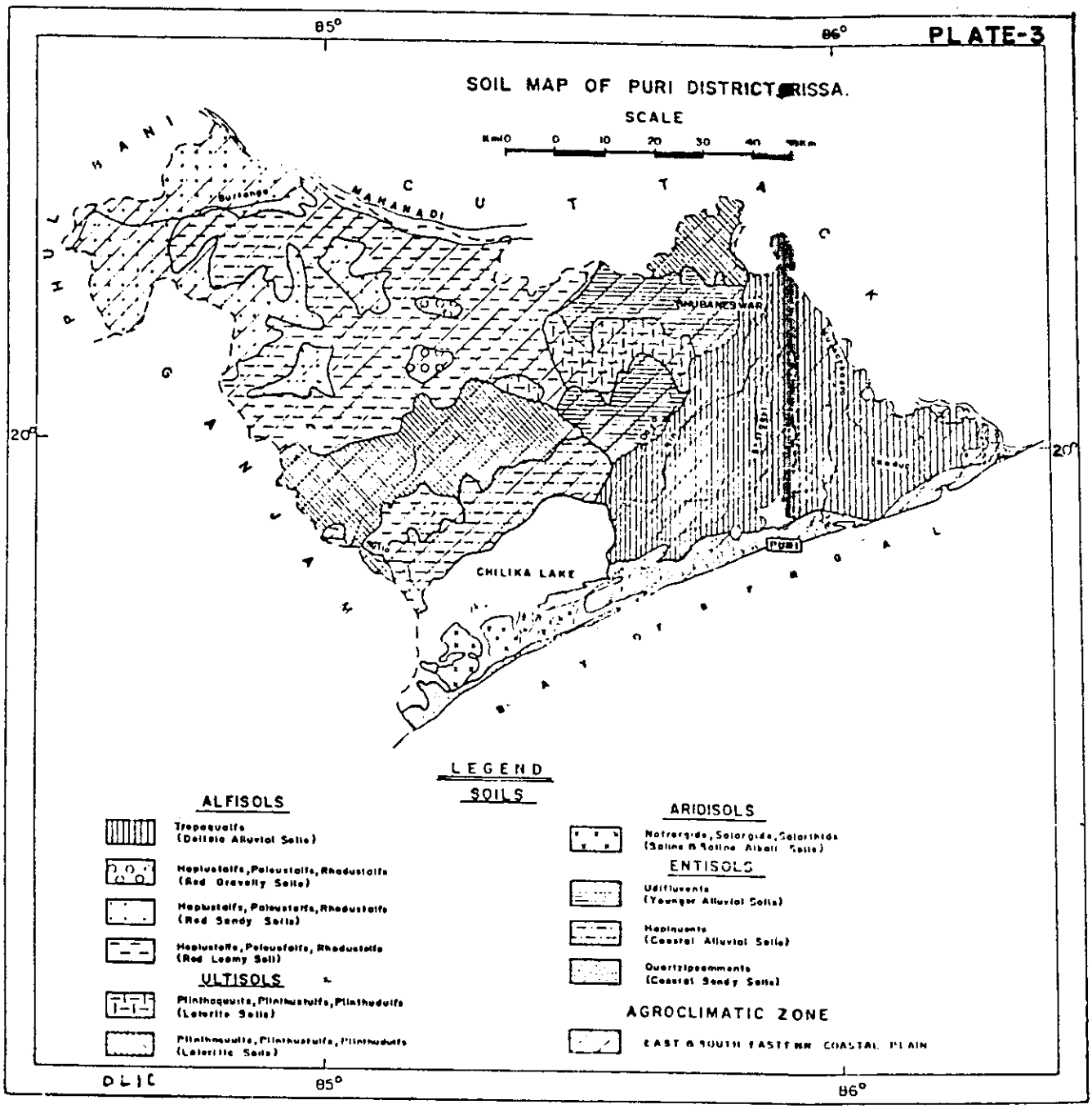


PLATE-3
SOIL MAP OF PURI DISTRICT, ORISSA.
SCALE
85°
86°
20°
MAHANADI
Cuttack
BHUBANESWAR
PURI
CHILIKA LAKE
BAY OF BENGAL
LEGEND
SOILS
ALFISOLS
Tropaqualfs
(Deltaic Alluvial Soils)
Haplustalfs, Paleustalfs, Rhodustalfs
(Red Gravelly Soils)
Haplustalfs, Paleustalfs, Rhodustalfs
(Red Sandy Soils)
Haplustalfs, Paleustalfs, Rhodustalfs
(Red Loamy Soil)
ULTISOLS
Plinthaquults, Plinthustults, Plinthudults
(Laterite Soils)
Plinthaquults, Plinthustults, Plinthudults
(Lateritic Soils)
ARIDISOLS
Natrargids, Solargids, Salorthids
(Saline & Saline Alkali Soils)
ENTISOLS
Udifluvents
(Younger Alluvial Soils)
Haplaquents
(Coastal Alluvial Soils)
Quartzipsamments
(Coastal Sandy Soils)
AGROCLIMATIC ZONE
EAST & SOUTH EASTERN COASTAL PLAIN

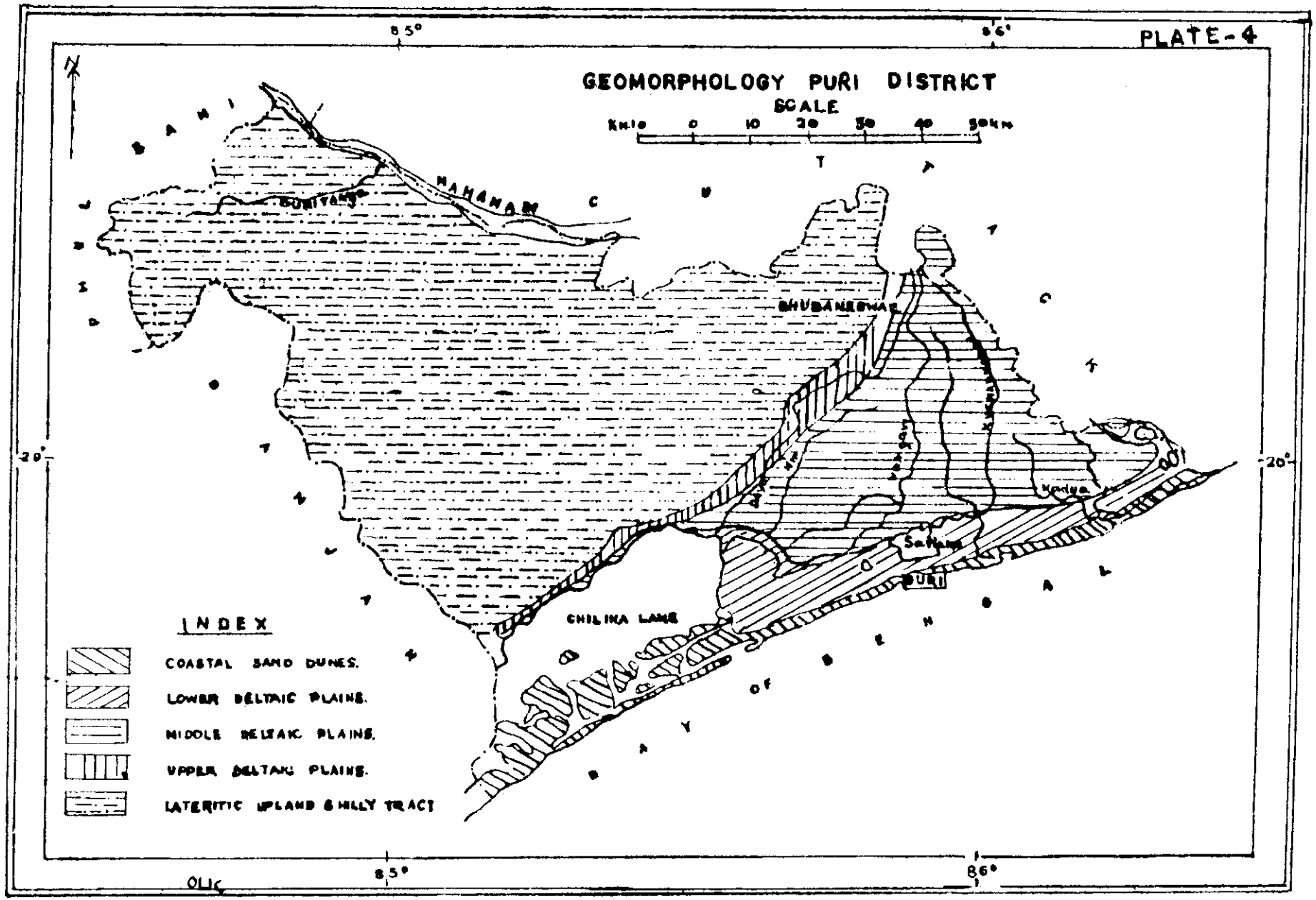


PLATE-4
GEOMORPHOLOGY PURI DISTRICT
SCALE
Km 10 0 10 20 30 40 50 Km
85°
86°
20°
BAY OF BENGAL
MAHANADI
BHUBANESWAR
CHILIKA LAKE
INDEX
COASTAL SAND DUNES.
LOWER DELTAIC PLAINS.
MIDDLE DELTAIC PLAINS.
UPPER DELTAIC PLAINS.
LATERITIC UPLAND & HILLY TRACT

being one of the important trubutaries of river Mahanadi mostly drains the hard rock terrain of the district. The other important rivers flowing in the district are Daya, Mandagni, Bali, Sunamuhi, Kusumi, Rana, Kaligiri, Kuanria, Bhargavi, Kusabhadra, Prachi, Dhanua, Luna, Rajua, etc. These rivers also drain a sizeable part of the district both during monsoon and non-monsoon periods.

Drainage pattern is observed to be dendritic in nature in the hard rock terrain and the drainage density is observed to be moderate to low in the district. The drainage system in the study area is shown in Plate-5

2.5 Irrigation facilities :

The district has a total cultivable area of 4286.55 sq.kms. By the end of March'89 an area of 2818.3 sq.kms. during Kharif and 1904.8 sq.kms. during Rabi season have been extended with assured irrigation facility through installation of different irrigation projects. In other words, nearly 65.75% and 44.44% of the cultivable area have been brought under irrigation facility during Kharif and Rabi season respectively. The irrigation potential created so far through various irrigation projects are enumerated below.

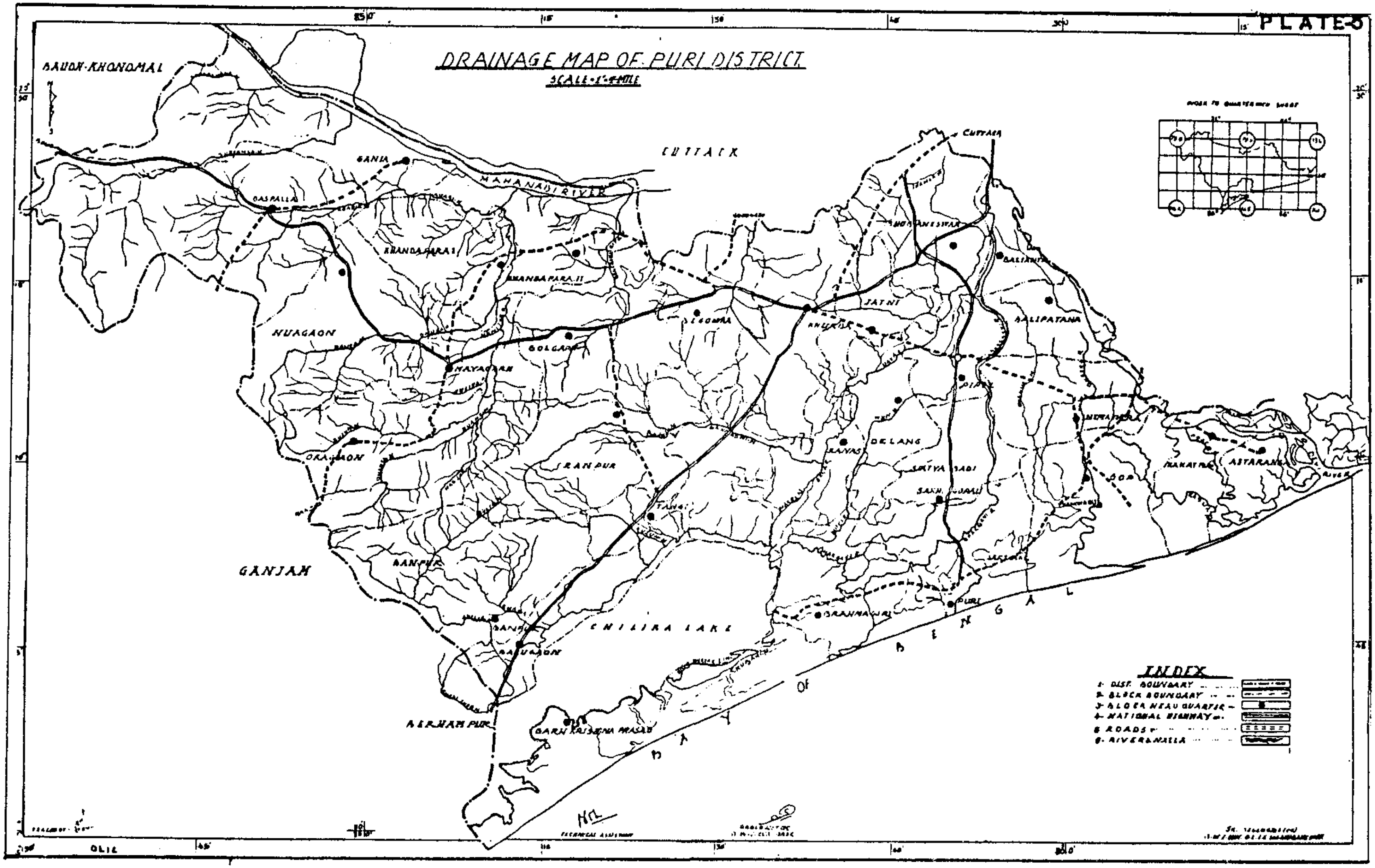


PLATE-5
DRAINAGE MAP OF PURI DISTRICT
SCALE-1"=4 MILE
BAUDH-KHONDMAL
CUTTACK
MAHANADI RIVER
GANIA
DASPALLA
KHANDAPARA I
KHANDAPARA II
NUAGAON
NAYAGARH
GOLGAON
LEOMRA
JATNI
KHURDA
BHUBANESWAR
BALIANTA
BALIPATANA
PIPLI
DELANG
KANAS
SATYABADI
SAKHIGOPAL
NIMAPARA
GOP
KAKATPUR
ASTARANGA
PURI
BRAHMAGIRI
ODAGAON
RANPUR
TANGI
CHILIKA LAKE
BANPUR
BALUGAON
GANJAM
BERHAMPUR
GARH KRISHNA PRASAD
BAY OF BENGAL
INDEX
1- DIST. BOUNDARY
2- BLOCK BOUNDARY
3- BLOCK HEAD QUARTER
4- NATIONAL HIGHWAY
5- ROADS
6- RIVER & NALLA

Sl. No.	Source of irrigation	Area in receipt of irrigation in different seasons(sq.kms) Kharif	Rabi
1.	Medium irrigation project	1685.8	1145.5
2.	Minor irrigation project (flow)	295.5	41.2
3.	Minor irrigation project (River lift projects)	121.0	72.6
4.	Tubewell and Dugwells (Public and Private)	716.0	645.5
	Total :	2818.3	1904.8

It is also observed that out of the net cultivable area, only 2102 sq.kms.(49.05%) is irrigated through surface flow irrigation scheme while about 716 sq.kms.(16.70%) through ground water irrigation schemes.

2.6 Cropping pattern :

Generally two crop seasons are followed in the district i.e. Kharif and Rabi. The crop of paddy is observed to be dominating other crops in both the seasons. Paddy being the prime crop of the district, suits well for the clayey soil as well as the climate. Besides this, Sugarcane and Pulses are grown in the sandy clay area. Groundnuts are raised in patches in the foot hill regions of the district. The other crops grown during Kharif are vegetables only. In Rabi season vegetables, wheat, pulses and oil seeds are generally grown.

3.0 COLLECTION AND PROCESSING OF DATA

3.1 General :

The ground water hydrology is a dynamic and inexact science and as such the analysis of any related problem requires a long term data on various aspects. Further, the reliability of the results obtained depends on the accuracy of the data used in the analysis. The data are collected and compiled by different field organisations. The data compiled by these organisations may represent different level of time periods, i.e. annual, seasonal, monthly, weekly or daily, may be recorded in different units and/or may be organised in inconsistant categories. Preliminary processing and proper presentation of data is, therefore, essential before the data are subjected to further detailed analysis. For the present ground water balance study in Puri district, data from different organisations were collected and after preliminary processing are presented below.

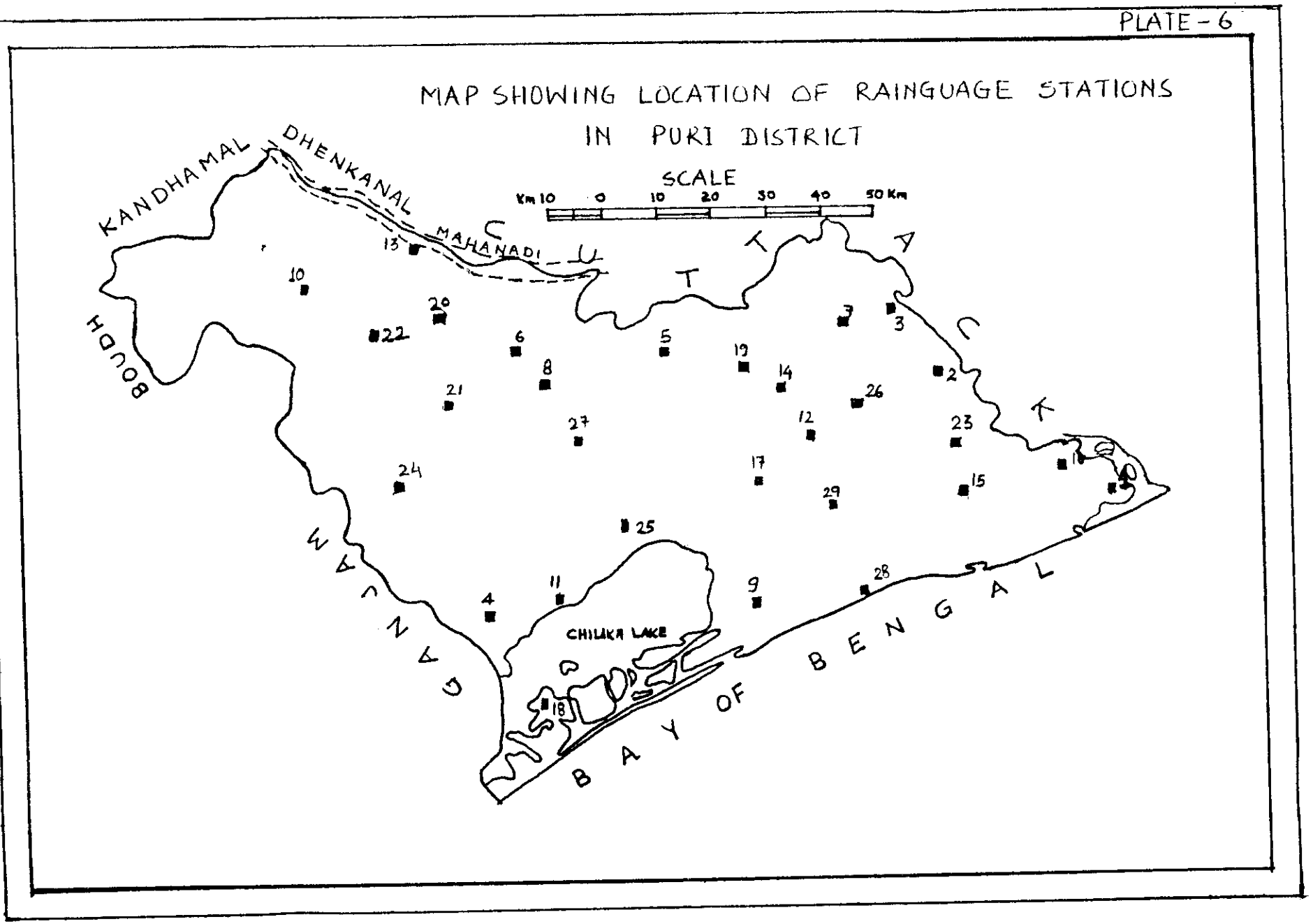
3.2 Climate :

In ground water balance studies, climate data are used principally for estimating the seasonal variations and amount of precipitation which may be available for ground water recharge. The following climate data were collected.

3.2.1 Rainfall :

The raingauge stations in Puri district are maintained at the block headquarters of all 29 blocks. The locations of these stations are shown in Plate-6. Monthly rainfall data of all these 29 stations were collected from Board of Revenue, Govt. of Orissa Cuttack, for 15 years i.e. from 1978 to 1992 and are presented in Annexure-1.

PLATE - 6


MAP SHOWING LOCATION OF RAINGUAGE STATIONS
IN PURI DISTRICT
SCALE
Km 10 0 10 20 30 40 50 Km
KANDHAMAL
DHENKANAL
MAHANADI
BOUDH
CUTTACK
NAYAGARH
CHILIKA LAKE
BAY OF BENGAL
10
13
20
22
6
8
21
27
24
5
19
14
26
12
17
29
7
3
2
23
15
1
25
4
11
9
28
18

The monthly rainfall data from gauges as mentioned above are point values and show considerable spatial variation over relatively short distances. Thiessen Polygon method has, therefore, been employed to estimate the mean areal rainfall over the study area. The Thiessen Polygons drawn for Puri district are shown in Plate-7. The area of each polygon was calculated with the planimeter and is given in Annexure-2. The monthly mean areal rainfall over Puri district is given in Annexure-3.

3.2.2 Temperature, Evaporation, Humidity :

The data on temperature, evaporation and relative humidity were collected from GWS&I, OLIC, Bhubaneswar. The monthly maximum and minimum temperatures for three stations in Puri district from 1976-85 are presented in Annexure-4. Similarly, the data on monthly maximum and minimum relative humidity of five stations from 1976-85 are given in Annexure-5. The mean monthly pan evaporation values are given in Annexure-6.

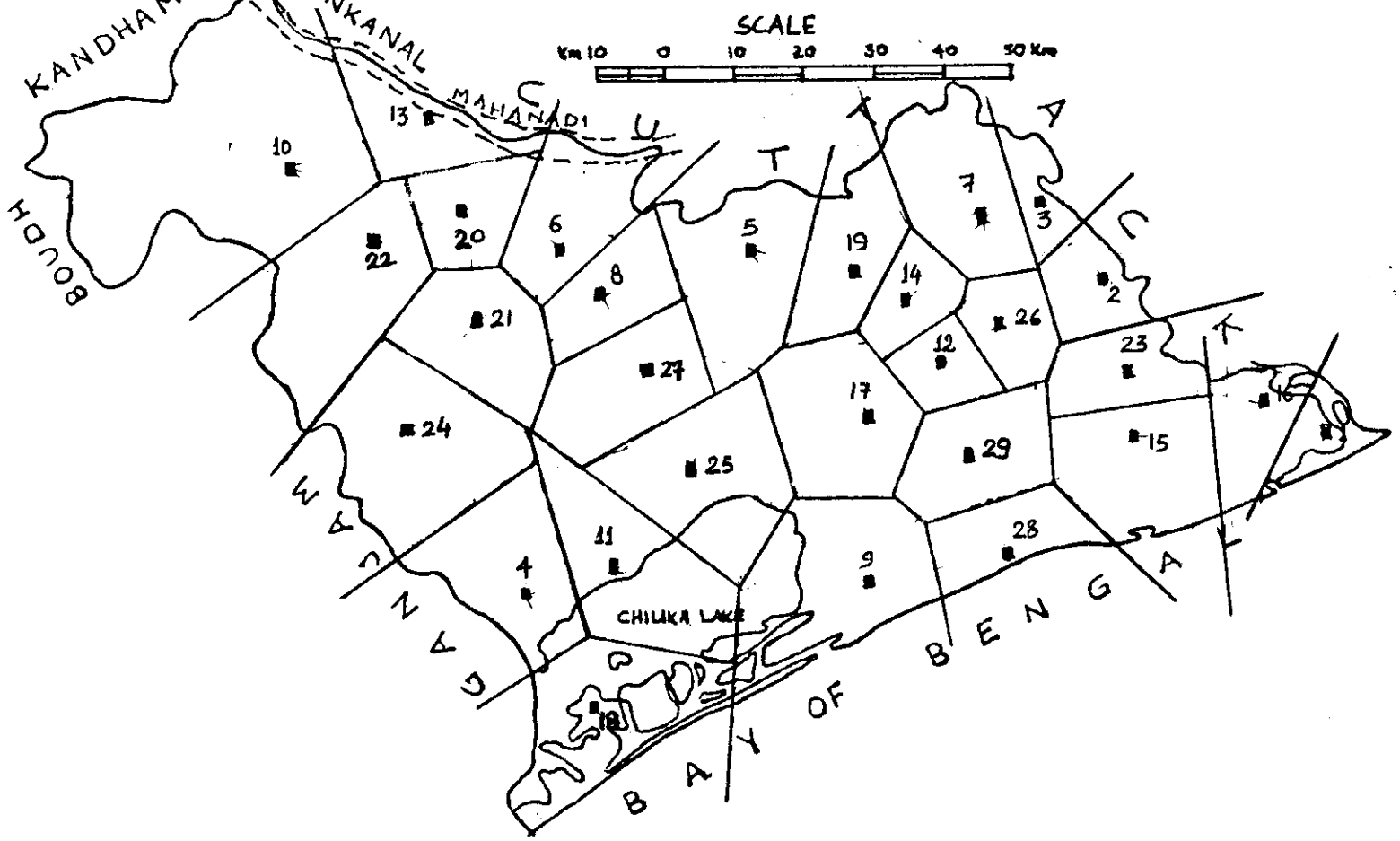
3.3 Ground Water :

In ground water balance studies, the data on ground water structures such as their numbers and seasonal or monthly draft rates are required for estimation of ground water withdrawls. Monthly water table levels of observation wells in unconfined and piezometric levels in confined acquifers are also required for estimating the change in ground water storage.

Different types of ground water structures such as Dug wells, Filter points and Tube wells are being used for irrigation purpose in Puri district. The data on number of various ground water structures and their unit seasonal draft in the district were provided by GWS&I, OLIC, Bhubaneswar for two years i.e,

PLATE - 7

MAP SHOWING THIESSEN POLYGONS OF RAINGUAGE STATIONS IN PURI DISTRICT

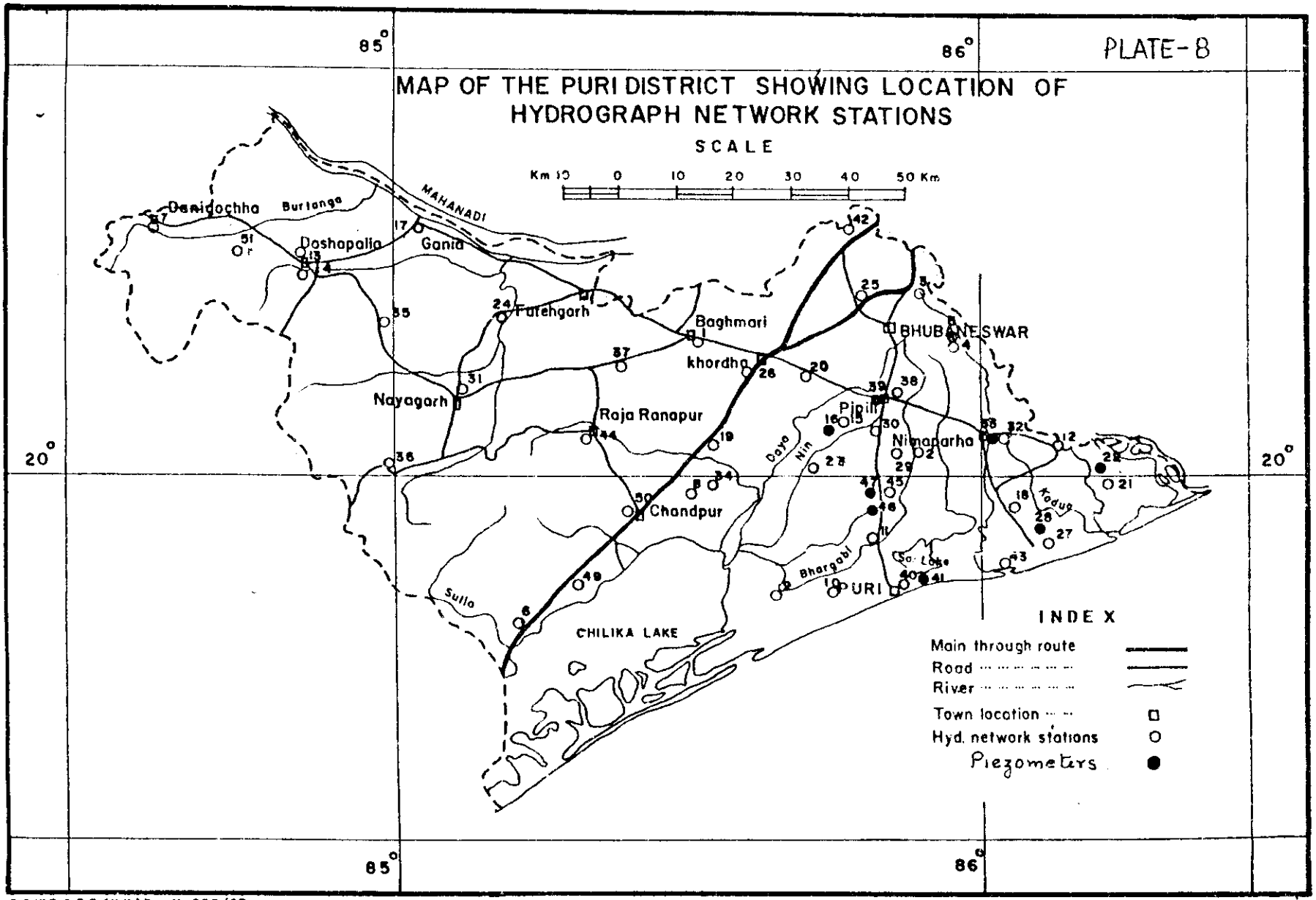


1989-90 and 1991-92. However, This data is not sufficient for conducting the long term study. Therefore, The number of structures for other years have also been estimated with the help of the available data and keeping in view the rate of development. The number of ground water structures so estimated and their unit seasonal draft are presented in Annexure-7.

The Central Ground Water Board, South-Eastern Region, Bhubaneswar has established a network of 35 hydrograph network stations and 7 piezometers (tapping confined acquifer in coastal saline tract) over different years in Puri district. The location of these stations are shown in Plate-8. The water levels are recorded by CGWB in the months of January, April, June, August and November. The depth to water level data of these individual stations are available with some gaps from 1976 or the year of inception of the station and are presented in Annexure - 8. With the available HNS data, the water table contour maps for pre and post monsoon periods i.e. June and November were prepared. Such pre and post monsoon water table contour maps for one year i.e. 1982 are given in Plate 9 & 10. From these maps, it is observed that the water table gradient is in South-East direction. The study of piezometric data also reveals that the hydraulic gradient in the confined acquires of the coastal saline tract varies from 0.3 to 0.4 m/km (Report of GWS&I, OLIC, Bhubaneswar).

3.4 Canal System :

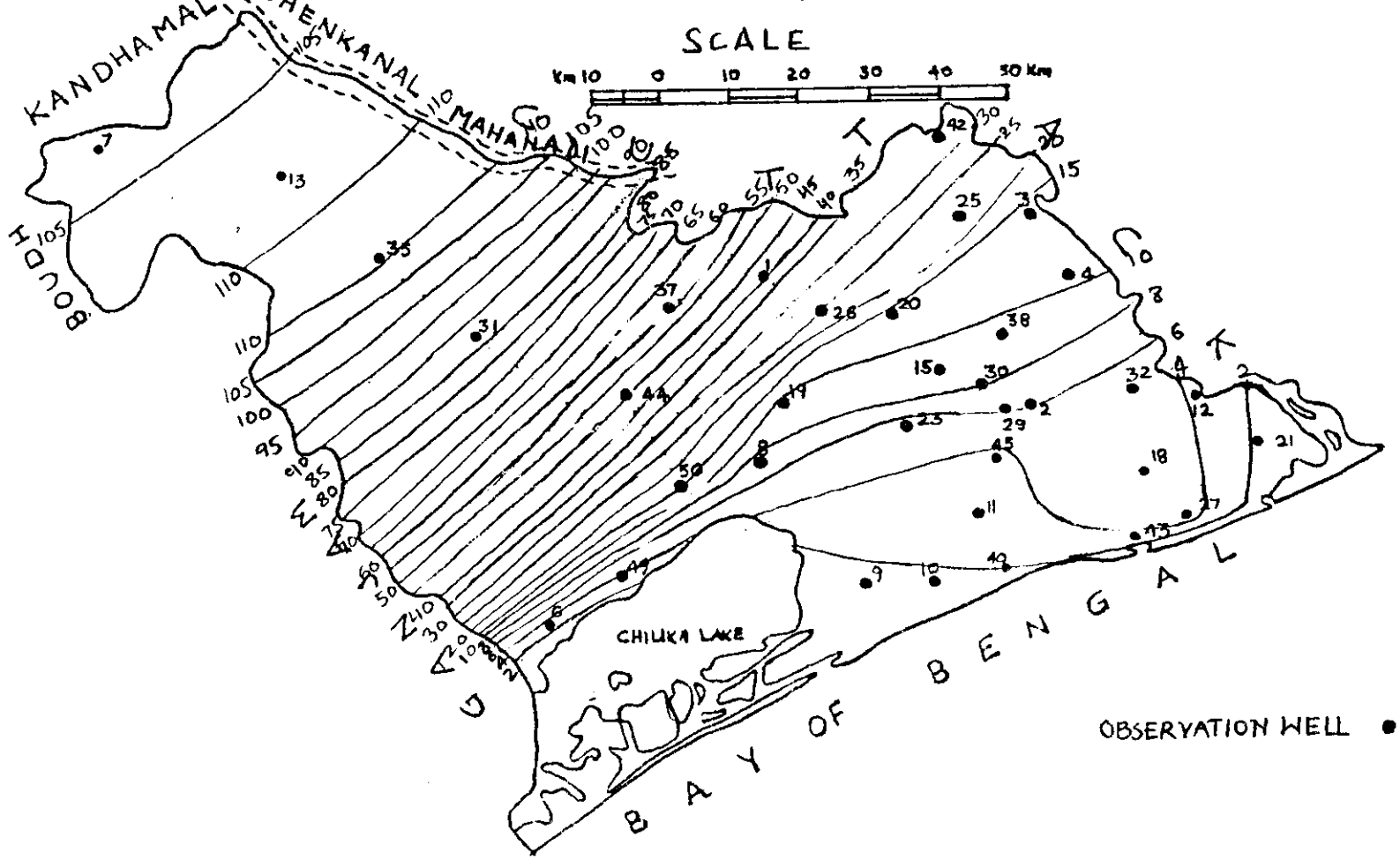
Data on monthly discharge at the head and other control points on the main canal, branch canals and distributories, length and cross-sections of all canals, wetted perimeter and

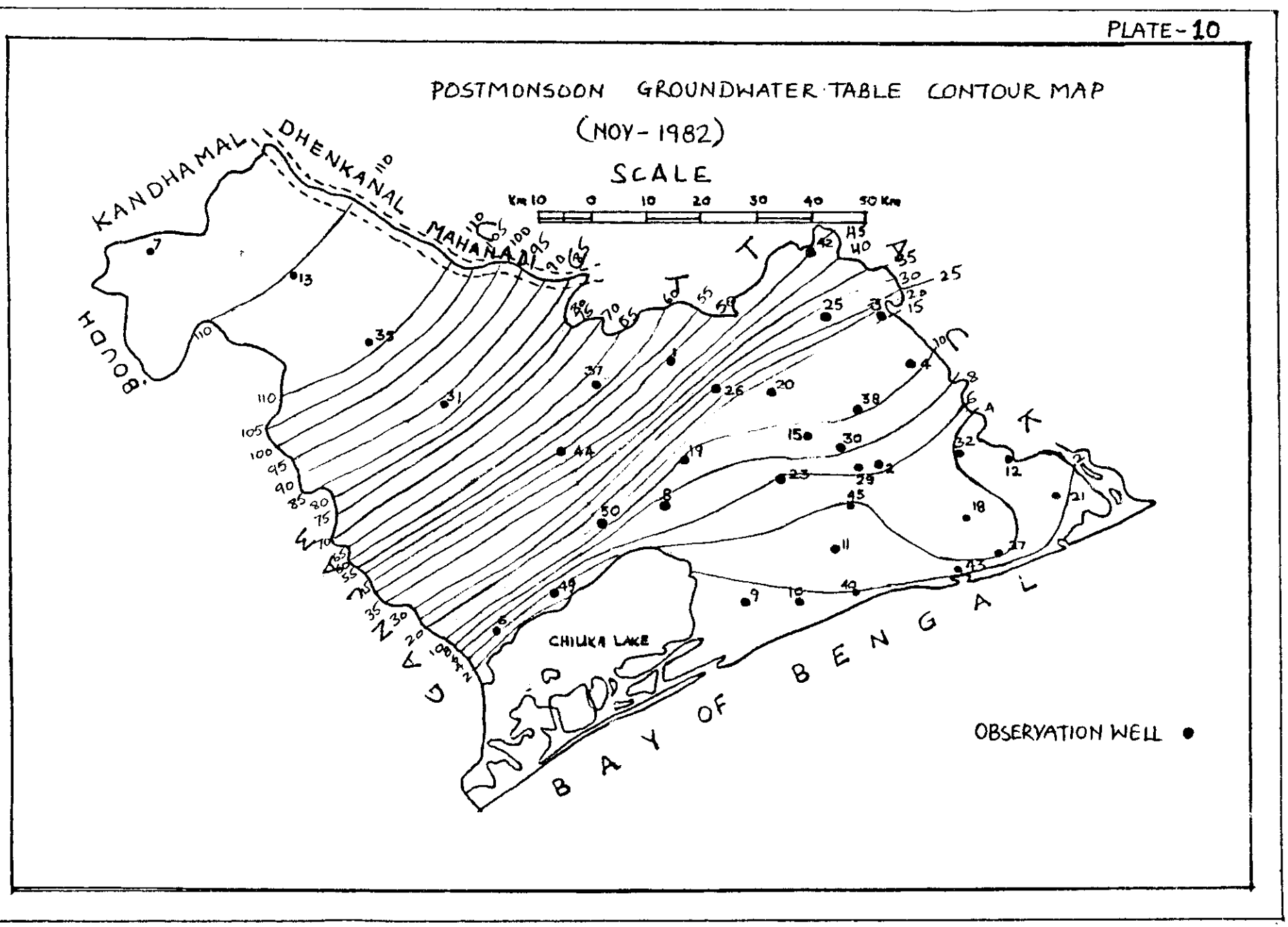


C.G.W.B, S.E.R. (K.K.) Drg. No 250/87

PREMONSOON GROUNDWATER TABLE CONTOUR MAP

(JUNE - 1982)




POSTMONSOON GROUNDWATER TABLE CONTOUR MAP
(NOV-1982)
SCALE
Km 10 0 10 20 30 40 50 Km
KANDHAMAL
DHENKANAL
MAHANADI
BOUDH
CHILIKA LAKE
BAY OF BENGAL
OBSERVATION WELL

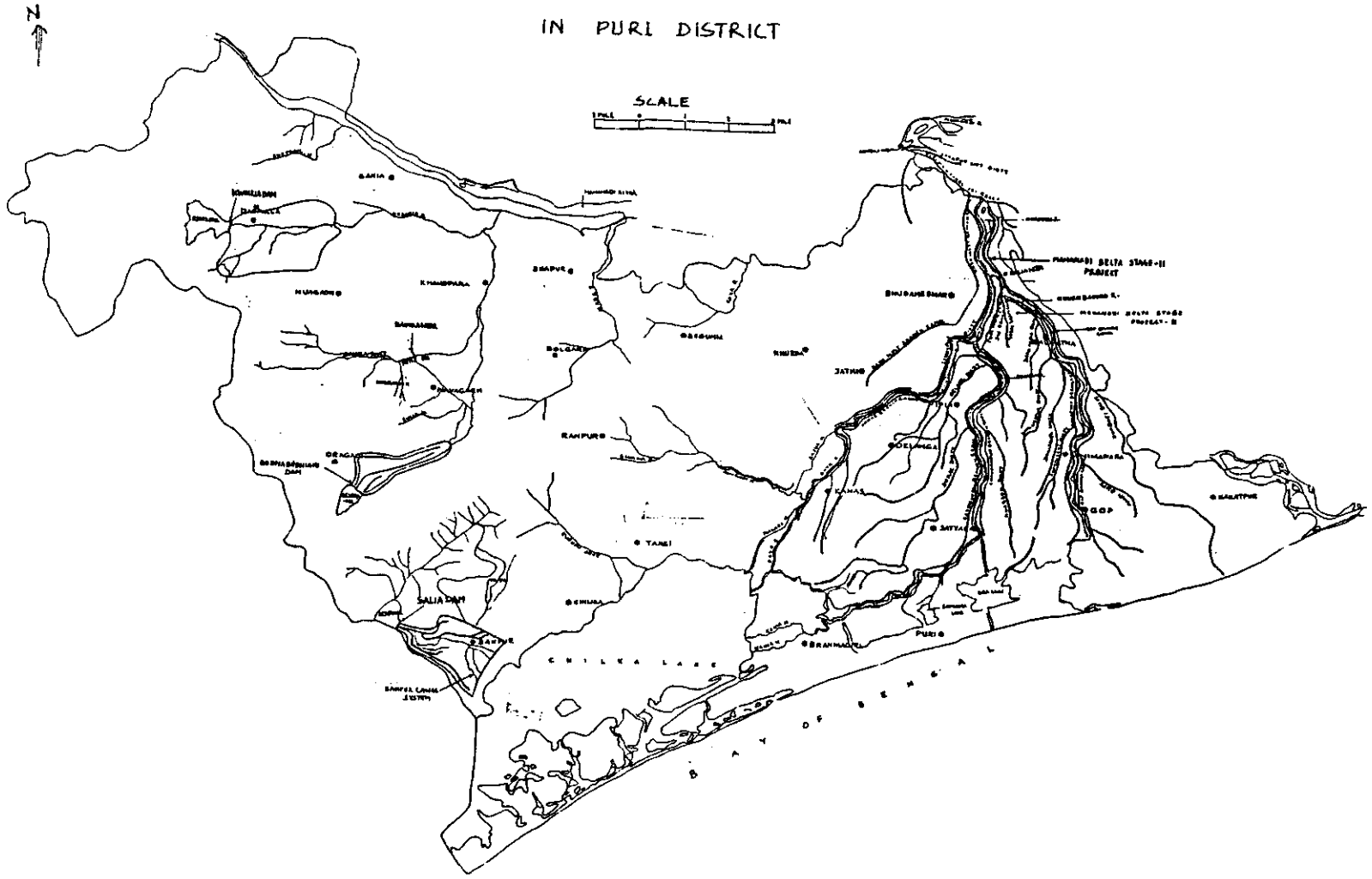
number of running days for each distributory are required to estimate the seepage losses from the canal system.

The irrigation system in Puri district comprises of a major irrigation project i.e, Mahanadi Delta Stage-II, four medium projects namely, Kuanria, Salia, Budha-Budhani and Dahuka Weir, and a number of minor irrigation (flow) and lift irrigation schemes. The Mahanadi delta stage-II project completed in early Ninteen Sixties consists of a Puri main canal which takes off from the Mundali Weir, 6 branch canals namely, Daya West branch, Gop branch, Sakhigopal branch, Kanas branch,Chandanpur branch and Nimapura branch canal, all taking off from the Puri main canal and a number of distributories taking off from the branch canals. The medium projects completed in late Nineteen Seventies also consist main and distributories. The irrigation schemes in Puri district are shown in Plate-11.

The canal discharge data as collected from Irrigation Dept. with some gaps are available only for Puri main canal and are given in Annexure-9. The discharges for other canals and their number of running days are not available. The total length of canals under major & medium projects were also collected from Irrigation Department but their cross-sections could not be obtained. However, the information on average Wetted perimeter of different canals, their number of running days and also length of canals under minor irrigation projects for the year 1989 are available in the report prepared by GWS & I and same have been used in the present report. Since the major and medium projects were started long back, the length of canals under these projects are same throughout the study period. However, there may be some

PLATE - 11

MAP SHOWING IRRIGATION SCHEMES IN PURI DISTRICT



change in the length of canals of minor projects over different years of study period. But, keeping in view the relatively minor changes in the total length and also the small wetted perimeter of canals in minor projects, the data available for 1989 can be used for estimating the seepage losses during other years of study. The total length of canals, their average wetted perimeter and average number of running days in a year are given in Annexure-10.

3.5 Streamflow :

Stream gauging data i.e. river stage, monthly discharge and river cross-sections at few locations are required for estimating interflows between the acquifer and the hydraulically connected rivers.

A good network of streams and nallahs exists in the Puri district. The Mahanadi is a major river in the area and travels along the district boundary for about 80 kms. Besides, the rivers Daya, Bhargabi and Kushabhadra also flow through the district towards Bay of Bengal. Also a few number of streams originating from within the study area , some of which perennial, drain either into the sea or the chilika lake. The OLIC, Bhubaneswar is maintaining gauging sites on some of these rivers and the discharge data for these sites were made available by OLIC for one year only. However, no data on river stages are available. The discharge data for stream gauging sites as collected from OLIC are presented in Annexure-11.

3.6 Agriculture :

The agriculture data especially on land use, cropping pattern and irrigation are required for estimation of various

components of ground water balance equation. Land use data is required for estimating the evapotranspiration losses from the water table through deep rooted trees. Similarly, the data on cropping pattern and irrigated area are important in estimating the consumptive uses in the study area and also for estimating the spatial and temporal distribution of ground water withdrawls and canal releases.

The land use pattern in Puri district as reported in the report of GWS&I, OLIC, Bhubaneswar is presented in Annexure-12. As regards cropping pattern in the district, the crop of paddy is observed to be dominating other crops in both the seasons. About 80% and 10% of the net sown area are occupied by paddy crop in kharif and rabi seasons respectively. As discussed in earlier chapter, the other important crops grown in the area are sugarcane, pulses, groundnut, wheat and vegetables. The district of Puri has good irrigation facilities also. Besides Mahanadi Delta stage-II project, 4 medium irrigation projects, several minor irrigation (flow and river lift) schemes and public and private tube wells are operable in the district. The yearwise gross command area of various irrigation sources are given in Annexure-13.

3.7 Hydrogeological Features :

The GWS&I,OLIC, Bhubaneswar conducted geophysical investigation and detailed ground water survey in Puri district (Report "Hydrogeological setup and ground water development potential of Puri district", GWS&I,OLIC,Bhubaneswar). The investigations reveal that the district has three different hydrogeological set-ups as given below.

i) Semi-consolidted sedimentary
-- Bhubaneswar, Khurda(P), Jatni (P).

ii) Consolidated hard rock terrain
--Khurda(P), Begunia, Bolagarh, Khandapara, Tangi, Gania, Daspalla, Nayagarh, Bhapur, Chilika(P), Ranapur, Nuagaon, Odagaon, Banapur.

iii) Unconsolidated alluvial deposits
--Puri, Gop, Brahmagiri, Astaranga, Kakatpur, Pipili, Nimapura, Krusnaprasad, Satyabadi, Delang, Kanas, Balianta, Balipatna, Chilika(P).

An area of about 617 sq.km. occuring in the North-Eastern part of the district is covered under semi-consolidated sediments. The sedimentary formations include alternative layers of sand stone and shale. The sand stone occuring in the area are highly porous and serve as the main aquifer in the region. The top soil is of sandy loam type and varies from 5 to 15 meters in depth in low and high land areas respectively. The ground water occurs in the weathered sand stones at 20 to 30 meters below ground level. In this formation, clay and lateritic zone occurs in between the top soil and weathered zone with a thickness varying from 10 to 15 meters. At places, there are laterite cappings which also serve as main aquifer for dug wells. The sand stones occuring close to the ground surface serve as aquifer for open wells. The deeply lying thick layer of sand stones is considered suitable for installation of medium duty irrigation tubewells.

The area coming under consolidated hard rock terrain lies in the Western part of the district and comprises nearly 4,636 sq.kms. This area can further be classified into three distinct categories i.e, high land, sloping land and low land. The top soil cover in these erosional plains is found either clayey or lateritic in nature and varies from 0.8 to 5.6 m in depth. The

porous weatherd rock that occurs below the surface soil or lateritic capping extends upto the bed rock. The ground water mostly occurs and stored in porous media of laterite, weathered rock and in the fractures. A well drilled in hard rock area can yield significantly, if adequate thickness of weathered rock and/or potential fractured zones are tapped by the well. The basement rock occurs at 19 meters below ground level.

The unconsolidated alluvial deposits cover nearly 32% of the total geographical area of the district and can be further classified into two categories as,

a) Sub-coastal tract -- Nimapara, Balianta

b) Coastal saline tract -- Kakatpur, Gop, Astaranga, Satyabadi, Kanas, Brahmagiri, Puri, Krusnaprasad

The sub-coastal alluvial tract occuring in between the coastal saline tract and erosional plain comprises about 2782 sq.km. A thick clayey zone of about 10 to 25 m thickness serves as top soil cover in the sub-coastal alluvium. This is followed by alternate layers of sand, clay and sandy clay of varied thickness. The aquifers occur under both unconfined and confined conditions. All the acquifers occuring in this sub-coastal alluvium plain are charged with fresh water and can support installation of public tubewells, filter point tubewells and dug wells.

The coastal saline tract covering an area of about 543 sq.km. boarders the Bay of Bengal in the East. In this tract, thick layers of brackish to saline sandy clay and clay, varying from 100 to 170 m in depth, occur below the top soil mantle. The ground water in these top zone aquifers are generally saline and

considered unsuitable for installation of shallow tubewells. The top soil mantle varying in thickness from 15 to 30 m is generally charged with limited quantity of fresh water and can only sustain installation of shallow filter point tubewells. The deeply confined aquifers occuring within 110 to 220 m below ground level are charged with fresh water and can sustain installation of deep tubewells for irrigation purpose. In coastal saline tract, the sand bars are also observed in parts of Puri, Brahmagiri, Kakatpur and Astaranga blocks. The area covered under coastal sand bars facilitates the recharge of ground water to a great extent. The area is thickly covered with casurina plants.

The hydrogeological features of Puri district are shown in Plate - 12

3.8 Aquifer Characteristics

The OLIC, Bhubaneswar had, by the end of March 1990, installed 10 nos. of medium deep tubewells and 44 nos. of shallow public tubewells in Puri district (Report of GWS&I, OLIC, Bhubaneswar). Lithology of tubewells drilled reveals that a sequence of alternate clayey and grannular zones with occassional presence of thin semi-consolidated layers of arenaceous/calcarious materials are mostly encountered within the drilled depths in the deltaic and coastal plains of the district. In general, argillaceous sediments dominate the arenaceous sediments in the eastern part of the district. Clayey zones encountered at different depths exhibit wide variations in colour shades i.e. light grey, grey, brown to light brown etc. Grannular aquifers encountered in the district mainly comprise of gravel and sand. Such aquifers are fine to coarse in texture, angular

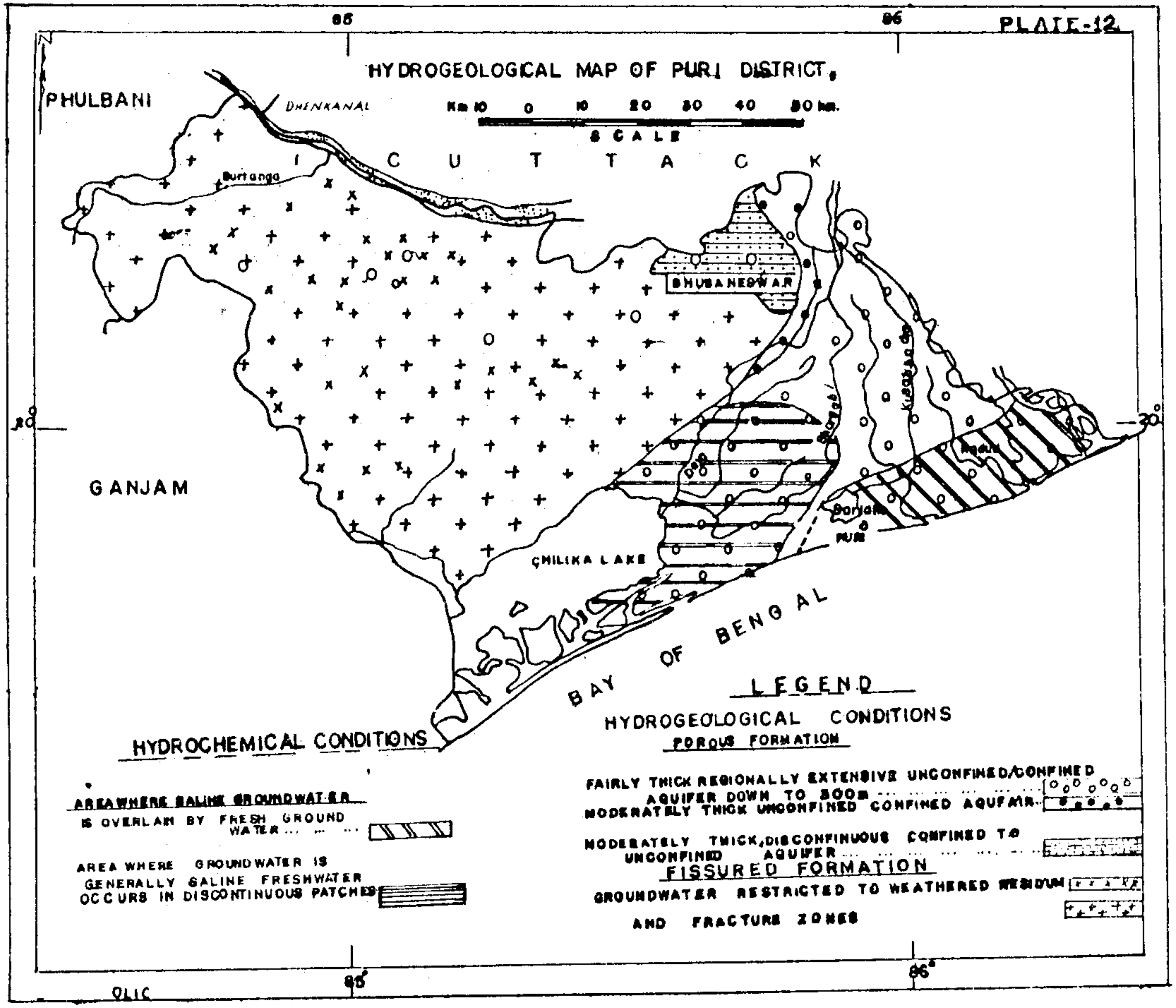


PLATE-12
HYDROGEOLOGICAL MAP OF PURI DISTRICT.
Km 10 0 10 20 30 40 50 Km.
SCALE
85
86
20
85°
86°
PHULBANI
DHENKANAL
CUTTACK
Burtanga
BHUBANESWAR
GANJAM
CHILIKA LAKE
PURI
BAY OF BENGAL
LEGEND
HYDROGEOLOGICAL CONDITIONS
POROUS FORMATION
FAIRLY THICK REGIONALLY EXTENSIVE UNCONFINED/CONFINED AQUIFER DOWN TO 300m
MODERATELY THICK UNCONFINED CONFINED AQUIFAIR
MODERATELY THICK, DISCONFINUOUS CONFINED TO UNCONFINED AQUIFER
FISSURED FORMATION
GROUNDWATER RESTRICTED TO WEATHERED RESIDUM AND FRACTURE ZONES
HYDROCHEMICAL CONDITIONS
AREA WHERE SALINE GROUNDWATER IS OVERLAIN BY FRESH GROUND WATER
AREA WHERE GROUNDWATER IS GENERALLY SALINE FRESHWATER OCCURS IN DISCONTINUOUS PATCHES
OLIC

to subrounded in shape, yellowish/grey/brown/light grey/white in colour. Sand and gravel (mostly quartzofelspathic in composition) often mixed with ferrogenous concretious are encountered at shallow depths and occassionally micacious and fossiliferous at deeper depths. These granular formations serve as the potential water bearing zones of the coastal and sub-coastal tracts of the district. Occurance of coarse granular materials are usually obsered at shallow depths. Deeper granular zones are generally finer in texture. The sequence of sedimentary rocks occuring in the district shows a wide variations in the geological age ranging from Mio-pliocene to Holocene (recent). The lithological data of various locations in Puri district are given in Annexure-14.

The pumping tests conducted by GWS&I, OLIC, Bhubaneswar in some of the tubewells of district indicate a wide range in values of Coefficients of transmissibility (T) and storage coefficients (S) of the grannular aquifers. The data on recuperation tests are presented in Annexure-15. The value of 'T' is found to be in order of 5000 to 5100 sq m/day. The specific yields of aquifers in crystalline, sedimentary and alluvium tracts are reported by GWS&I, OLIC as 0.03,0.05 and 0.125 respectively.

3.9 Ground Water Quality :

Knowledge of ground water quality is very important to assess its suitability for various uses and also to estimate the total quantity of available fresh ground water. The GWS&I, OLIC, Bhubaneswar has conducted the chemical analysis of water samples collected from different parts of the Puri district. The samples were collected from shallow aquifers and deep tubewells. The

range of occurance of various constituents of water samples analysed chemically are enumerated below.

(i) pH - 6.1 to 9.2
(ii) E.C. - 0.04 to 13.4 micromhos
(iii) Cl- - 9.72 to 2000 ppm
(iv) Na+ _ - 15 to 6600 ppm
(v) HCo3 - 12.2 to 965 ppm
(vi) TDS - 80 to 6300 ppm
(vii) S.A.R.- 2 to 8

The blockwise limiting values of water analysis data are given in Annexure-16. The analysis reveals that the ground water available in the shallow aquifers in the western upland areas (erosional plains) of the district is better in quality than that occuring in the deltaic and coastal plain. There is a gradual deterioration in quality of ground water in the shallow aquifers towards sea. In general, it is observed that the ground water available in the district can be used safely both for drinking and irrigation purposes. In few blocks of coastal zone like Puri Sadar, Brahmagiri, Krusna prasad, Kakatpur, Astaranga, Gop, and Satyabadi, the fresh water is contaminated with saline water (Report of GWS&I, OLIC, Bhubaneswar).

4.0 COMPONENTS OF WATER BALANCE EQUATION FOR A GROUNDWATER BASIN

4.1 General :

The water balance or hydrologic balance is a statement of the conservation of matter applied to a groundwater basin. All waters entering an area during any given period of time must either go into storage within its boundaries, be consumed or flow out during that period. This basic concept of water balance can be expressed as below :

$$I = O \pm \Delta s$$

Where, I = Inflow to the system
O = Outflow , and
Δ S = Change in ground water storage

Clearly the items in the equation can include a number of factors which are listed below:

1. Inflow :

A) Natural Recharge:

i) Recharge due to rainfall
ii) Recharge from rivers (influent seepage)
iii) Inflow from other basins
iv) Recharge from tanks & reservoirs

B) Artificial Recharge:

i) Induced recharge from rivers
ii) Recharge due to seepage from irrigation channels
iii) Recharge from deep percolation of irrigation water from fields
iv) Recharge by injection

2. Outflow :

A) Natural outflow:
i) Evapotranspiration
ii) Regeneration in river or effluent seepage to rivers
iii) Outflow to other basins

B) Artificial Outflow:

i) Pumpage through open wells, and tube wells

Considering the above components, the groundwater balance equation can be rewritten as

$$R_i + R_c + R_r + R_t + I_g + S_i + A_i = T_p + E_t + O_g + S_e + A_o + \Delta S$$

Where,

R_i = recharge from rainfall

R_c = Recharge from canal seepage

R_r = Recharge due to deep percolation from field irrigation

$= R_{rs} + R_{rg}$

R_{rs} = Recharge from surface water irrigation

R_{rg} = recharge from groundwater irrigation

R_t = recharge from reservoirs & tanks

I_g = subsurface inflow from other basin

S_i = influent seepage from rivers

A_i = inflow to phreatic aquifer from low lying confined aquifer

T_p = withdrawl from ground water

E_t = evapotranspiration losses
$= E_{tf} + E_{tw}$

E_{tf} = evapotranspiration losses from forested areas

E_{tw} = evapotranspiration losses water logged areas

O_g = subsurface outflow from the basin

S_e = effluent seepage to rivers

A_o = outflow from phreatic aquifer to low lying confined aquifer

ΔS = change in ground water storage (positive for increase and negative for decrease)

Each item of the equation represents a volume of water during any given time interval. For the purpose of study any consistant units of volume and time interval can be adopted. The present study is intended to be carried out on seasonal basis

i.e, for monsoon & non-monsoon seasons. Theoretically, the hydrologic equation must balance but it rarely happens in practice as there may be some inaccuracies in the estimation of various parameters. However, the amount of unbalance should not exceed the limits of accuracy of the basic data. If the amount of unbalance (η) is given as a residual term of the water balance equation and includes the errors in the determination of the components and the values of components which are not taken into account the equation may be written in the following form.

$$R_i + R_c + R_r + R_t + I_g + S_i + A_i - E_t - T_p - O_g - S_e - A_o - \Delta S - \eta = 0$$

In order to avoid huge errors, all the components of water balance equation must be estimated independently and adjustments, if required, should be made in items subject to large errors.

4.2 Description of Groundwater Balance Components

The above form of ground water balance equation includes occurrence of all types of water but there may be situations in which it is possible to eliminate certain items from the equation because either they are negligible or they do not effect the solution. In the present study also, the components which do not play significant role have been dropped and only relevant components are described below.

4.2.1 Recharge from Rainfall (R_i):

Recharge from rainfall is the most important parameter among a variety of inputs used in the groundwater balance equation. The increase in groundwater storage takes place mainly due to recharge of aquifers through deep percolation of rain water. The natural phenomena of rainfall recharge is very complex to study and analyse and any work on the estimation of recharge of

aquifers by rainfall needs a clear understanding of the physical processes of the soil, vegetation and atmospheric system. The rainfall after being affected by vegetation interception reaches the land surface where it fills up the surface depressions and also infiltrates into the soil surface. Infiltration is the term applied to the process of water entry into the soil through the soil surface, vertically as well as horizontally. A portion of the infiltration reaches the groundwater storage and is called ground water recharge. This recharge which is fraction of total rainfall depends upon several factors such as soil characteristics, topography, vegetal cover, land use, soil moisture condition, depth of water table, intensity, duration and seasonal distribution of rainfall and other meteorological factors. The recharge from rainfall, therefore, varies in space and time.

4.2.2 Recharge from Canal Seepage (R_c):

The process of water movement from a canal into and through the bed and wall material is referred to as canal seepage. The seepage losses from canal after percolating deep joins the groundwater table. The recharge from seepage depends on the infiltration capacity of the canal bed and sides, subsurface lithology, extent of wetted perimeter, length of canal, discharge, sediment load, physical and chemical properties of water and relative position of water level in canal with respect to the ground water table. Recharge rates may decline over the years due to water logging, clogging of pores of the bed material or cementation by calcareous precipitation.

4.2.3 Recharge from Field Irrigation (R_r):

When irrigation water is applied to the field crops, a part of it is lost in meeting the consumptive use of crops and the balance infiltrates into the soil and recharges the groundwater aquifer. The infiltration from applied irrigation water, derived both from groundwater and surface water sources constitutes one of the major components of groundwater recharge especially in areas under wet crops like paddy, in view of continuous submergence of soil for long duration. However, in dry crops, where water applied is much less and the soil is saturated for a short duration, the recharge may be insignificant as the maximum part of water applied is abstracted by crops for meeting the consumptive use.

4.2.4 Sub-surface Inflow and Outflow (I_g & O_g):

A ground water basin may also experience flow from or towards the aquifers. If the water table level in the basin aquifers is lower than that of the adjacent basin aquifers, there may be recharge or inflow to the basin. If the water table positions are vice-versa, the flow direction will change forming discharge component. The amount of this flow depends mainly on hydraulic gradient and the transmissivity of the aquifers at the boundary of the basin. Since the hydraulic gradient and the transmissivity may vary from place to place, the net amount of flow should be estimated for different sections seperately by using the transmissivity of the aquifer and the average hydraulic gradient for that section. The length of the section, across which ground water inflow/outflow occurs, is determined from

water table contour maps, the length being measured parallel to the contour.

4.2.5 Effluent and Influent Seepage (S_e & S_i):

Rivers, streams in a basin also affects the groundwater regime in the basin aquifers. The interaction between a river and an aquifer may be of two types- 1) the flow from the aquifer to support river flow, and 2) the flow from river to the aquifer. Depending upon whether water is entering the stream or going out of the stream, the stream is called as effluent or influent respectively. The direction of flow is governed by the hydraulic gradient of the water table in respect to the river stage and the amount of flow depends upon the both hydraulic gradient as well as the transmissivity of the aquifer system. For estimation of the total flow, it is desirable to divide the entire river system into a number of small reaches, each reach having atleast one observation well, and then computations be made for each segment. Adding the flow through all segments will give total flow.

4.2.6 Interflows between Aquifers (A_i & A_o)

Interflow between the aquifers refers to the flow from one aquifer to the another in a multiaquifer system. In a ground water basin having unconfined and confined aquifers, the flow can take place either from the unconfined to confined aquifers or vice-versa. The ground water levels in unconfined aquifers are observed with the help of observation wells while that in confined aquifers through piezometers. The direction of flow in a a multiaquifer system depends upon the phreatic and piezometric water levels. For example, if the phreatic level is higher than

the peizometric level then the gradient of flow will be towards confined aquifer and there will be outflow (A_o) from phreatic zone. However, if the piezometric levels are higher than the phreatic, the reverse conditions will prevail and there will be inflow (A_i) to the phreatic zone. The quantity of flow depends upon the gradient of flow and the transmissibility of the aquifer system.

4.2.7 Draft from Ground water (T_p):

Draft implies the extraction of ground water through shallow tube wells, deep tube wells and dug wells. In order to meet various demands of water, ground water is extracted from the aquifers through different types of water lifting devices. Draft from individual well may vary widely depending upon the yield, type of well, source of lifting, depth of water level, type of water use etc. An inventory of wells and a sample survey of groundwater draft from various types of wells are, therefore, pre-requisites for computation of ground water use.

4.2.8 Evapotranspiration Losses (E_t):

Evapotranspiration, in its simplest form is the loss of water into the atmosphere through evaporation from all surfaces containing water, including evaporation from free water surfaces, soil and man made surfaces and transpiration from plants. The water requirement for evapotranspiration process is met partly by rain water, applied irrigation water and directly from ground water reservoir. In the present context of ground water balance study, only that amount of water which is directly extracted from ground water storage through evapotranspiration process is relevant and needs to be computed. When the water table is very

close to the ground surface, the evaporation from soil and transpiration from plants will be at the maximum possible rate i.e. at potential rate. The potential evapotranspiration losses from the ground water reservoir, thus, may be of two types, 1)in a water logged tract due to rise in water table (E_{tw}) and 2) in a forested or other tree vegetation area which has the roots extending to the water table or upto the capillary zone (E_{tf}). For the purpose of estimating these evapotranspiration losses from an area, the total water logged area with type of vegetation and the area under deep rooted trees needs to be worked out. The unit value of evapotranspiration for the type of vegetation cover times area will give total evapotranspiration losses.

4.2.9 Change in Ground water Storage (ΔS):

As a result of deep percolation losses of rainfall, irrigation water and seepage from surface water bodies, the ground water reservoir experiences an increase in its storage volume. Similarly, there may be a decrease in ground water storage due to outflow of ground water in non-monsoon or dry periods resulting from pumping or subsurface drainage of aquifers. The cumulative effect in terms of net increase or decrease in ground water storage over a given period of time thus depends upon the total recharge to or discharge from the ground water storage during the given period. The change in ground water storage between the beginning and end of the non monsoon season indicates the total quantity of water withdrawn from ground water storage, while the change between beginning and end of monsoon season indicates the volume of water gone to the reservoir. The change in ground water storage is exhibited by the change in

water table levels in the aquifers. The water levels are highest immediately after monsoon in the month of October or November and lowest just before rainfall in the month of May or June. To monitor the water table levels, a number of observation wells with a suitable grid are installed in the basin. Water levels in these wells should be measured under conditions as near static as possible, preferably after the season of heavy draft and again after the season of recharge. A few control wells should be equipped with automatic water level recorders or have their water levels measured monthly to facilitate detailed study of ground water fluctuations.

REFERENCES

1. American Society of Civil Engineers, Groundwater Management, Third Edition, ASCE Manuals and Reports on Engineering Practice No.40.

2. Boonstra, J., N A de Ridder, 'Numerical Modelling of Groundwater Basins'.

3. Bowen, R. 'Groundwater'.

4. Ground Water Survey & Investigation, Orissa Lift Irrigation Corporation Ltd, Bhubaneswar, Report on Hydrogeological set up and ground water development potential of Puri district.

5. Kumar,C.P. and Kamal, Groundwater Balance of Jam Nagar District, Proceedings of Groundwater Hydrology, July 17-18, 1992, New Delhi.

6. Seethapathi, P V. and Jayaseelan, A T, (1982), 'Mean year seasonal groundwater Balance for Upper Ganga Canal command area', NIH Report, CS-1 (Restricted), 1981-82.

7. Seethpathi, P V. and Kumar, C.P., 'Effect of additional surface irrigation supply on groundwater regime in Upper Ganga canal command area, Part-I, Groundwater Balance' NIH Report, CS-2 (Restricted), 1987-88.

8. Todd, D K (1959), 'Ground water Hydrology'.

ANNEXURES

MONTHLY RAINFALL (mm) DATA OF PURI DISTRICT (ORISSA)

1.Name of the station : Astaranga

Year/month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	0.0	0.0	0.0	0.0	0.0	250.0	328.0	53.0	164.0	34.0	22.0	0.0
1979	0.0	8.2	12.5	0.0	27.4	130.0	320.0	213.0	185.0	47.0	0.0	0.0
1980	0.0	64.0	0.0	0.0	0.0	358.0	562.0	250.0	273.0	135.0	0.0	0.0
1981	0.0	22.0	5.0	16.0	85.0	79.4	79.5	169.0	301.0	0.0	0.0	65.0
1982	0.0	0.0	0.0	0.0	5.0	427.0	163.8	338.1	64.0	48.0	30.0	0.0
1983	0.0	57.0	57.5	0.0	0.0	75.0	192.0	214.0	130.5	117.0	24.0	10.0
1984	2.0	0.0	0.0	0.0	18.0	189.5	242.5	345.0	101.0	93.0	0.0	0.0
1985	12.0	10.0	0.0	11.0	12.0	212.0	387.0	689.0	243.0	197.0	0.0	0.0
1986	3.0	16.0	2.0	66.0	71.0	232.0	247.0	234.0	468.6	211.7	193.2	0.0
1987	14.0	0.0	0.0	89.4	18.0	100.2	359.9	179.4	90.0	97.4	133.2	10.0
1988	0.0	38.0	4.0	11.0	104.0	238.0	135.7	154.0	319.0	59.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	268.2	266.1	323.6	321.8	354.2	0.0	0.0	0.0
1990	0.0	194.3	180.3	42.6	223.8	263.5	115.6	430.0	341.0	221.0	208.0	0.0
1991	204.0	0.0	30.0	0.0	19.0	167.0	814.0	377.3	174.0	269.3	43.0	0.0
1992	0.0	165.6	0.0	0.0	215.0	118.0	332.0	300.0	251.2	176.0	0.0	0.0

2.Name of the station : Balipatna

1978	0.0	2.0	72.0	3.0	28.0	89.0	285.1	168.7	148.2	142.7	0.0	11.0
1979	0.0	18.0	0.0	53.0	17.0	179.0	469.0	251.5	169.2	55.0	0.0	0.0
1980	0.0	48.0	5.0	0.0	44.5	552.0	424.0	349.2	323.0	0.0	0.0	0.0
1981	9.0	0.0	62.0	8.0	120.0	133.0	46.3	378.0	406.0	45.0	0.0	26.0
1982	0.0	42.0	31.0	2.0	0.0	305.0	221.0	602.0	245.0	0.0	0.0	0.0
1983	8.4	98.0	13.0	24.0	41.0	261.0	341.0	608.1	277.0	140.2	0.0	12.0
1984	32.5	0.0	0.5	0.0	0.0	273.6	613.0	446.2	193.2	47.2	0.0	0.0
1985	8.0	46.0	0.0	0.0	17.0	80.2	305.0	476.4	316.5	138.0	0.0	0.0
1986	25.4	0.0	0.0	0.0	23.0	169.0	282.2	265.0	163.8	230.0	195.0	0.0
1987	0.0	0.0	4.0	26.40	31.8	79.0	179.0	182.5	102.0	101.0	62.0	0.0
1988	0.0	0.0	0.0	18.0	45.0	158.0	151.8	66.7	194.0	127.0	0.0	0.0
1989	0.0	0.0	142.0	0.0	181.0	205.0	166.0	422.0	136.0	22.0	0.0	0.0
1990	0.0	79.0	99.0	129.6	83.0	143.0	310.0	311.0	122.0	130.0	186.0	0.0
1991	47.0	0.0	12.0	0.0	0.0	16.08	450.0	355.0	190.0	47.0	84.0	0.0
1992	0.0	25.0	0.0	0.0	187.0	122.0	340.4	265.0	269.0	244.0	0.0	0.0

3.Name of the station : Balianta

1979	0.0	0.0	0.0	31.0	28.5	75.2	228.2	328.5	107.7	97.0	0.0	0.0
1980	22.0	24.0	6.5	1.5	8.7	350.3	389.9	4.5	340.3	5541	0.0	0.0
1981	3.6	5.6	62.9	3.4	61.6	82.4	200.4	255.0	114.3	22.7	0.0	0.0
1982	0.0	42.0	15.0	5.4	19.2	188.4	154.4	355.4	245.4	32.0	0.0	0.0
1983	5.4	66.2	25.0	37.1	32.0	172.2	231.5	375.2	200.2	87.0	0.0	10.0
1984	0.0	17.0	0.0	0.0	18.0	221.0	443.0	384.0	215.2	45.4	0.0	0.0
1985	8.0	17.5	0.0	10.0	7.5	159.2	387.2	505.0	296.1	177.0	0.0	0.0
1986	25.4	42.2	10.2	17.2	23.0	304.4	295.2	274.0	215.5	261.0	205.9	8.5
1987	4.0	1.2	4.0	44.2	31.8	43.8	228.8	269.4	122.0	73.0	122.8	2.0
1988	0.0	0.1	0.0	12.0	68.4	135.8	349.9	87.6	206.2	103.8	0.0	0.0
1989	0.0	0.0	7.0	72.4	317.5	137.8	333.8	100.9	11.3	0.0	0.0	0.0
1990	0.0	116.0	100.0	82.0	112.0	172.0	346.3	377.0	45.0	102.0	229.0	0.0
1991	31.0	0.0	21.0	0.0	22.0	218.0	361.5	273.5	173.0	100.0	90.0	2.0
1992	21.0	25.0	0.0	8.0	244.0	137.0	414.0	300.0	251.2	176.0	0.0	0.0

7.Name of the station : Bhubaneswar

Year/month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	0.0	0.0	25.0	22.0	52.0	122.0	259.0	187.0	150.6	89.5	0.0	52.0
1979	0.0	2.0	0.0	71.5	0.0	92.5	233.3	333.5	117.5	77.0	15.0	0.0
1980	0.0	24.0	5.0	0.0	12.0	258.0	321.1	218.5	296.2	120.0	0.0	0.0
1981	0.0	0.0	69.0	39.0	133.0	99.0	252.0	377.0	292.2	36.0	0.0	0.0
1982	0.0	75.0	18.0	3.2	34.5	240.1	336.6	460.1	169.2	51.4	6.0	0.0
1983	0.0	0.0	0.0	39.0	27.1	170.9	106.0	393.9	279.5	170.0	0.0	10.5
1984	0.0	5.5	0.0	0.0	26.0	293.0	519.5	478.4	311.6	41.0	0.0	0.0
1985	0.0	52.0	0.0	2.0	0.0	106.0	432.6	556.6	325.8	240.6	0.0	0.0
1986	40.0	21.0	12.0	52.0	109.0	255.2	455.6	328.3	336.8	200.8	150.5	12.1
1987	0.0	0.0	1.0	30.0	57.0	53.0	280.6	392.2	106.1	76.3	99.5	0.0
1988	0.0	4.0	0.0	45.0	100.7	192.8	347.0	121.7	344.5	85.0	0.0	0.0
1989	0.0	0.0	3.0	0.0	179.5	303.0	129.0	310.8	142.3	27.0	0.0	0.0
1990	0.0	40.6	94.0	12.0	121.6	215.7	318.4	429.0	88.2	87.0	255.8	0.0
1991	49.0	0.0	27.0	20.0	28.0	141.9	519.4	321.8	135.0	116.5	101.0	0.0
1992	0.0	0.0	0.0	0.0	283.3	174.0	429.4	403.5	206.0	153.0	7.0	0.0

8.Name of the station : Bolagarh

1978	0.0	52.5	46.7	21.2	41.2	173.0	196.0	340.7	99.2	10.7	3.5	0.0
1979	0.0	0.0	0.0	0.0	56.5	166.5	361.7	274.7	181.7	50.0	0.0	0.0
1980	0.0	9.2	39.0	32.5	1.0	315.5	236.0	350.0	501.7	167.5	0.0	0.0
1981	0.0	0.0	52.0	9.5	35.0	138.7	77.0	348.0	553.0	23.7	0.0	0.0
1982	0.0	67.0	136.1	47.0	67.0	158.1	209.1	298.1	97.0	27.0	56.0	0.0
1983	0.0	52.2	65.0	35.0	36.0	152.5	233.0	265.8	245.0	48.8	4.0	0.0
1984	0.0	0.0	0.0	34.0	0.0	90.0	240.5	150.0	183.0	0.0	0.0	0.0
1985	0.0	29.0	0.0	3.0	52.0	70.0	193.0	273.0	320.0	160.0	0.0	0.0
1986	25.0	30.0	0.0	3.0	36.0	187.0	266.2	316.0	116.0	161.0	134.0	10.0
1987	0.0	0.0	47.0	113.0	19.5	54.0	238.0	180.0	115.0	88.0	63.0	0.0
1988	0.0	17.0	0.0	27.0	0.0	64.0	270.0	154.0	357.0	82.0	0.0	0.0
1989	0.0	0.0	35.0	2.0	33.0	246.0	141.0	294.0	201.3	68.2	0.0	0.0
1990	0.0	38.2	93.0	30.0	76.0	130.0	243.4	554.8	50.3	77.0	261.0	0.0
1991	42.0	4.0	50.0	5.0	0.0	85.0	215.5	107.5	69.0	84.0	0.0	0.0
1992	0.0	1.0	0.0	0.0	20.0	148.1	191.0	313.5	64.0	52.0	0.0	0.0

9.Name of the station : Brahmagiri

1978	0.0	0.0	0.0	450.0	99.7	136.7	314.2	436.2	125.9	128.9	14.3	0.0
1979	0.0	0.0	1.2	18.0	11.5	90.0	275.2	184.7	289.0	111.8	12.5	11.5
1980	0.0	0.0	0.0	0.0	0.0	287.1	438.2	506.1	407.6	299.2	13.0	0.0
1981	0.0	13.0	62.7	47.2	125.0	141.2	103.8	481.3	370.1	2.5	0.0	21.7
1982	0.0	83.0	15.0	0.0	0.0	212.4	138.8	289.7	224.5	36.2	0.0	0.0
1983	0.0	87.2	92.5	11.7	52.5	77.2	200.6	180.2	168.9	136.2	2.0	12.5
1984	0.0	0.0	0.0	12.5	51.5	228.3	540.5	241.2	132.3	44.0	0.0	0.0
1985	5.0	27.0	0.0	6.0	30.0	188.3	158.5	515.5	316.3	212.6	0.0	0.0
1986	13.0	27.2	0.0	30.0	19.0	137.0	237.0	173.0	170.0	188.5	326.5	6.0
1987	40.0	0.0	0.0	13.0	43.0	22.0	131.0	84.0	106.0	126.0	172.0	0.0
1988	0.0	0.0	0.0	52.0	76.0	107.0	303.0	146.0	377.0	61.0	0.0	0.0
1989	0.0	0.0	14.0	0.0	81.0	388.0	189.0	373.0	105.0	5.0	0.0	0.0
1990	0.0	132.0	89.0	163.0	111.0	113.0	80.0	444.0	225.0	96.0	335.0	0.0
1991	71.0	0.0	20.0	15.0	0.0	250.2	562.0	343.0	264.0	94.0	50.0	15.0
1992	0.0	39.0	0.0	0.0	27.0	311.0	513.0	236.0	281.0	122.0	46.0	0.0

10.Name of the station : Daspalla

Year/month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	0.0	50.0	70.0	20.0	33.0	409.0	366.3	405.0	73.0	143.0	11.0	59.0
1979	0.0	0.0	3.5	0.0	25.0	130.0	293.0	276.0	221.0	49.0	0.0	0.0
1980	14.0	8.0	5.0	15.0	36.5	149.0	240.0	156.0	57.0	78.0	0.0	0.0
1981	0.0	31.0	99.0	24.0	26.0	165.0	245.0	259.0	395.0	2.0	0.0	0.0
1982	0.0	3.0	277.0	23.0	7.0	136.0	249.0	330.0	147.0	1.0	6.0	0.0
1983	0.0	62.0	0.0	87.0	9.0	129.9	423.4	444.4	361.0	56.0	1.0	0.0
1984	0.0	0.0	0.0	117.0	26.6	164.2	314.0	320.3	178.0	0.0	0.0	0.0
1985	0.0	57.0	34.0	4.0	39.0	143.0	339.0	279.5	403.0	104.0	0.0	0.0
1986	26.0	54.0	19.0	22.0	53.0	215.0	175.0	195.0	238.0	97.0	72.0	11.0
1987	4.0	0.0	9.5	39.0	25.0	64.6	207.2	163.4	226.0	86.0	153.0	0.0
1988	0.0	40.0	78.8	56.0	89.0	195.8	322.6	293.4	305.2	86.6	0.0	0.0
1989	0.0	0.0	29.0	14.6	81.6	327.4	222.0	390.4	180.0	28.0	0.0	2.0
1990	0.0	91.0	64.6	167.2	110.0	245.0	364.0	414.0	329.2	295.8	195.0	1.0
1991	46.0	1.4	67.0	21.0	24.0	153.3	498.4	507.2	343.4	129.4	34.0	6.0
1992	30.0	44.0	5.0	35.0	77.0	305.5	478.3	475.4	72.0	113.0	0.0	0.0

11.Name of the station : Chilika

1978	0.0	27.4	12.0	9.0	24.0	99.0	142.0	388.4	160.6	66.2	10.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	183.0	242.5	399.0	230.5	29.4	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	75.4	218.1	221.4	185.5	66.0	54.0	0.0
1981	24.0	0.0	13.0	4.0	42.0	73.0	58.0	294.0	403.0	147.0	0.0	0.0
1982	0.0	14.0	13.0	71.0	35.0	106.0	94.0	215.0	259.0	50.0	29.0	0.0
1983	0.0	38.0	36.0	6.0	13.0	159.9	240.0	349.0	218.0	155.0	7.0	0.0
1984	2.0	0.0	0.0	17.0	3.0	104.0	254.0	190.0	109.0	15.0	0.0	0.0
1985	0.0	127.0	0.0	0.0	50.0	75.0	101.0	333.0	442.5	530.5	0.0	0.0
1986	10.0	40.0	0.0	20.0	165.0	179.4	344.2	152.5	92.2	214.4	216.0	0.0
1987	12.5	0.0	31.0	66.4	17.5	60.5	218.9	204.0	91.5	133.5	164.0	0.0
1988	0.0	15.0	6.0	49.0	34.0	201.0	193.0	265.0	365.0	125.0	0.0	0.0
1989	0.0	0.0	0.0	2.0	110.0	421.0	144.0	303.0	70.0	83.0	0.0	0.0
1990	0.0	130.0	129.0	46.0	85.0	100.0	245.0	343.0	196.0	196.0	336.0	0.0
1991	60.0	0.0	0.0	15.0	0.0	262.0	550.7	326.5	332.0	62.0	66.0	0.0
1992	14.0	4.0	0.0	0.0	71.0	250.0	296.0	261.0	193.8	113.0	15.0	0.0

12.Name of the station : Delang

1978	0.0	15.0	0.0	10.0	53.0	138.6	230.6	162.1	83.9	154.2	11.0	0.0
1979	0.0	38.7	0.0	0.0	0.0	183.5	510.7	309.8	138.5	50.5	0.0	0.0
1980	0.0	0.0	5.0	2.0	0.0	450.7	341.0	366.2	360.5	125.8	0.0	0.0
1981	0.0	0.0	85.0	70.0	68.0	105.0	367.0	467.0	394.0	50.0	0.0	28.0
1982	57.0	19.0	75.0	0.0	0.0	121.0	141.0	605.0	255.0	150.0	0.0	0.0
1983	0.0	55.0	36.0	8.0	83.0	124.0	128.5	55.0	132.0	93.0	0.0	11.0
1984	0.0	0.0	0.0	0.0	8.0	217.5	471.0	279.0	105.0	37.0	0.0	0.0
1985	0.0	86.0	1.0	0.0	23.0	52.0	369.0	408.0	197.0	189.0	0.0	0.0
1986	10.0	3.0	2.0	12.0	29.0	260.0	362.0	253.0	247.0	179.0	221.0	0.0
1987	15.0	4.0	2.0	50.0	47.0	97.1	412.0	201.2	191.0	92.0	211.0	0.0
1988	0.0	3.0	0.0	53.0	114.0	94.0	214.0	201.0	367.0	80.0	0.0	0.0
1989	0.0	0.0	12.0	0.0	178.0	414.0	262.0	395.0	194.0	5.0	0.0	0.0
1990	0.0	114.0	177.0	83.0	152.0	372.0	456.0	439.0	326.0	160.0	227.0	3.0
1991	70.0	0.0	41.0	9.0	42.0	159.0	588.0	354.0	181.0	160.0	110.0	12.0
1992	0.0	94.0	6.0	164.0	143.0	439.0	295.0	126.4	112.0	0.0	0.0	0.0

13.Name of the station : Gania

Year/month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	0.0	44.5	2.0	0.0	32.0	135.5	329.7	442.7	169.9	84.7	39.5	4.5
1979	0.0	0.0	0.0	0.0	18.0	175.0	275.6	287.0	112.7	13.5	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	280.3	326.8	311.2	126.8	81.0	0.0	0.0
1981	0.0	2.0	36.5	21.7	144.5	187.7	131.0	262.2	239.2	0.0	0.0	0.0
1982	0.0	67.0	162.7	7.5	38.7	202.5	310.5	303.5	128.1	2.0	24.0	0.0
1983	0.0	93.6	36.0	36.7	50.3	148.1	341.3	246.4	265.6	92.9	0.0	5.2
1984	0.0	1.3	0.0	15.2	48.8	97.1	209.7	200.1	71.0	25.4	0.0	0.0
1985	16.0	50.0	0.0	0.0	19.0	95.0	203.0	168.0	234.5	186.0	0.0	0.0
1986	5.0	18.0	0.0	27.0	22.0	284.0	408.0	195.0	161.0	131.0	98.0	13.0
1987	0.0	0.0	0.0	32.0	25.0	149.0	254.0	202.0	172.0	51.0	133.0	0.0
1988	0.0	0.0	80.0	4.0	65.0	246.0	331.0	244.0	320.0	85.0	0.0	0.0
1989	0.0	0.0	21.0	0.0	59.5	490.0	321.0	339.0	77.0	6.0	0.0	0.0
1990	0.0	95.0	93.0	108.0	114.0	234.0	257.0	428.0	62.0	264.0	180.0	0.0
1991	35.2	0.0	21.0	0.0	42.0	169.0	679.0	557.0	231.0	154.0	48.0	19.0
1992	19.0	19.0	0.0	5.0	31.0	249.0	435.0	352.0	142.0	110.0	0.0	0.0

14.Name of the station : Jatni

1978	0.0	40.5	50.2	56.0	15.0	36.0	127.0	171.5	79.1	88.7	0.0	0.0
1979	0.0	50.0	0.0	64.0	0.0	71.0	270.0	235.0	252.0	75.0	15.5	0.0
1980	0.0	0.0	2.5	2.6	0.0	252.7	266.2	462.2	349.0	117.7	0.0	0.0
1981	25.0	0.0	123.5	7.5	54.0	134.5	279.2	330.7	343.7	63.0	0.0	0.0
1982	45.5	49.5	75.0	2.5	5.0	195.2	136.2	587.5	210.0	85.2	2.5	0.0
1983	0.0	65.7	18.9	37.5	54.1	238.6	116.9	383.6	250.2	108.5	0.0	0.0
1984	0.0	0.0	0.0	0.0	45.0	133.8	420.8	396.5	119.0	118.5	0.0	0.0
1985	11.0	58.0	0.0	0.0	32.5	232.0	411.3	459.0	360.5	226.0	0.0	0.0
1986	30.0	37.5	12.0	66.0	103.0	229.0	448.0	271.0	426.0	204.0	177.8	0.0
1987	5.0	0.0	45.0	26.0	43.0	83.0	260.7	229.4	82.4	104.0	130.0	0.0
1988	0.0	5.0	0.0	70.0	93.0	233.0	254.0	211.0	207.4	81.0	0.0	0.0
1989	0.0	0.0	6.0	0.0	145.0	300.8	228.8	375.8	136.6	0.0	0.0	0.0
1990	0.0	53.0	127.6	137.4	65.0	220.8	378.2	360.0	144.0	116.0	208.0	4.0
1991	46.0	6.0	29.0	0.0	41.2	189.0	513.8	363.4	356.7	101.1	72.0	5.0
1992	15.0	69.0	0.0	6.0	128.0	77.0	269.4	296.0	213.0	110.0	0.0	0.0

15.Name of the station : Gop

1978	0.0	9.0	0.0	5.0	0.0	34.7	167.8	395.0	36.0	163.0	0.0	0.0
1979	0.0	0.0	75.0	0.0	55.0	0.0	297.3	131.0	153.5	22.0	28.1	0.0
1980	0.0	30.0	0.0	0.0	0.0	375.5	233.8	248.7	179.2	0.0	0.0	0.0
1981	0.0	37.5	42.5	12.7	160.7	36.2	166.7	484.0	247.2	10.0	0.0	0.0
1982	0.0	7.5	25.0	165.0	21.2	145.5	150.8	313.9	171.6	37.5	40.0	0.0
1983	0.0	92.1	31.0	6.0	42.1	127.1	193.1	321.0	169.0	57.1	10.1	10.1
1984	0.0	0.0	0.0	3.0	9.5	208.0	394.6	435.8	179.6	37.7	0.0	0.0
1985	0.0	86.0	0.0	6.2	54.2	135.6	312.6	471.8	476.6	206.0	0.0	0.0
1986	10.0	6.0	0.0	0.0	115.0	158.0	296.4	214.0	272.0	237.0	408.0	0.0
1987	7.0	0.0	3.0	52.0	13.0	106.4	176.3	156.5	89.6	131.8	102.0	0.0
1988	0.0	24.0	0.0	14.2	113.2	237.3	100.6	169.9	400.0	24.0	0.0	0.0
1989	0.0	0.0	13.0	0.0	139.0	391.0	301.5	401.0	268.0	30.0	0.0	0.0
1990	0.0	242.5	90.5	128.0	125.0	156.0	146.0	300.0	138.5	160.0	217.0	0.0
1991	102.0	0.0	0.0	0.0	20.0	161.5	719.0	539.7	289.9	223.5	72.0	0.0
1992	13.0	101.0	0.0	0.0	225.1	226.4	466.0	539.0	291.0	215.0	19.0	0.0

16.Name of the station : Kakatpur

Year/month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	0.0	0.0	0.0	0.0	15.0	103.8	191.2	300.2	143.6	236.2	31.2	20.0
1979	0.0	7.5	0.0	51.2	12.7	141.5	326.0	154.6	291.2	23.5	5.0	0.0
1980	0.0	54.2	8.0	4.5	0.0	273.2	249.2	245.1	147.1	0.0	0.0	0.0
1981	0.0	0.0	26.0	61.0	113.5	171.6	137.6	477.9	253.4	10.8	0.0	0.0
1982	0.0	26.6	5.2	25.3	4.6	367.7	273.6	530.7	206.5	47.0	18.0	0.0
1983	0.0	69.2	71.0	0.0	6.2	117.6	237.2	414.8	136.3	153.3	16.0	15.8
1984	8.0	0.0	0.0	0.0	8.2	141.9	442.3	442.5	139.6	65.2	0.0	0.0
1985	130.0	85.2	0.0	26.0	43.0	281.1	388.7	558.4	344.6	248.6	0.0	0.0
1986	18.8	14.0	0.0	35.7	68.7	293.5	306.5	297.0	431.0	172.0	214.0	0.0
1987	4.0	0.0	0.0	58.0	46.0	99.0	241.9	217.0	155.0	187.0	154.0	0.0
1988	0.0	4.0	0.0	16.0	143.0	209.0	172.0	132.0	375.5	99.0	0.0	0.0
1989	0.0	0.0	8.0	0.0	242.0	184.0	246.0	270.0	195.0	10.0	0.0	0.0
1990	0.0	175.0	61.0	42.0	230.0	282.2	167.0	346.0	339.0	269.0	156.0	0.0
1991	170.0	0.0	65.0	0.0	34.0	128.0	766.0	653.0	285.0	248.0	68.0	0.0
1992	14.0	88.0	0.0	0.0	190.0	156.0	470.0	356.0	157.0	205.0	61.0	0.0

17.Name of the station : Kanas

1978	0.0	5.0	0.0	22.5	0.0	65.0	296.1	310.5	189.7	28.5	0.0	5.0
1979	0.0	0.0	0.0	30.5	0.0	110.0	656.0	788.0	216.0	109.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	530.0	512.2	354.5	233.0	170.0	0.0	0.0
1981	0.0	0.0	32.5	0.0	45.2	203.2	163.0	4.5	344.0	12.0	0.0	18.0
1982	45.0	97.0	0.0	0.0	16.0	182.0	173.0	4.4	211.0	65.0	0.0	0.0
1983	0.0	76.0	31.6	0.0	108.0	105.0	256.4	220.0	142.0	103.0	0.0	9.0
1984	0.0	0.0	0.0	0.0	42.6	8.0	309.5	288.2	118.2	12.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	38.0	141.0	181.0	351.0	255.0	202.0	0.0	0.0
1986	20.0	7.0	0.0	38.0	13.0	239.0	369.0	241.0	150.2	180.0	184.0	3.0
1987	0.0	0.0	0.0	43.0	52.0	87.0	263.0	211.0	227.0	123.0	103.0	0.0
1988	0.0	8.0	0.0	68.0	94.0	264.0	234.0	108.0	333.0	226.0	0.0	0.0
1989	0.0	0.0	2.0	0.0	75.0	370.0	212.0	395.0	137.0	49.0	0.0	0.0
1990	0.0	118.0	96.0	166.0	88.0	288.0	360.0	248.0	227.0	276.0	388.0	0.0
1991	65.0	0.0	33.5	51.0	18.0	183.0	577.6	274.7	152.0	173.0	110.0	10.0
1992	0.0	47.0	0.0	0.0	38.0	247.0	251.0	460.5	297.0	120.0	0.0	0.0

18.Name of the station: Krushnaprasad

1978	0.0	14.8	11.0	0.0	0.2	130.0	338.2	563.6	157.2	132.2	10.2	0.0
1979	0.0	20.0	0.0	2.0	0.0	105.1	233.2	131.0	244.3	51.5	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	173.5	271.5	232.1	181.5	236.4	0.0	0.0
1981	0.0	0.0	4.0	2.5	20.0	102.5	79.0	348.0	367.0	70.0	0.0	0.0
1982	0.0	32.0	17.0	97.0	0.0	65.0	205.0	264.5	202.0	7.0	33.0	0.0
1983	37.0	17.5	32.5	12.0	20.0	97.0	245.5	277.5	178.5	87.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	8.0	129.5	184.2	144.5	178.0	35.0	0.0	0.0
1985	30.0	144.5	0.0	0.0	0.0	77.2	92.5	246.0	370.0	166.0	0.0	0.0
1986	21.8	27.5	0.0	8.5	85.0	162.0	180.0	160.0	110.0	182.0	392.0	6.0
1987	0.0	15.0	10.0	90.0	21.0	37.0	184.0	60.0	90.0	134.0	407.0	0.0
1988	0.0	6.0	0.0	45.0	89.0	134.5	91.0	110.0	304.0	66.0	0.0	0.0
1989	0.0	0.0	7.5	0.0	93.3	286.0	89.0	230.0	40.0	23.0	0.0	0.0
1990	0.0	211.0	106.0	102.0	105.0	178.0	124.0	353.0	79.0	224.0	437.0	0.0
1991	23.0	0.0	0.0	0.0	0.0	97.0	353.0	227.0	196.0	100.0	56.0	9.0
1992	0.0	49.0	0.0	0.0	25.0	266.0	285.0	148.0	173.0	234.0	0.0	0.0

19.Name of the station: Khurda

Year/month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	0.0	22.2	6.2	103.5	24.2	101.0	195.2	308.2	169.5	69.5	8.0	0.0
1979	0.0	0.0	0.0	59.4	18.4	84.2	382.8	184.3	235.7	79.0	1.6	7.2
1980	8.6	14.6	0.0	6.0	5.4	282.2	306.0	201.0	306.5	151.0	0.0	0.0
1981	23.0	6.0	42.0	4.0	18.0	111.5	173.0	241.6	195.5	31.0	0.0	0.0
1982	0.0	70.4	74.2	0.0	10.0	195.2	161.0	698.0	188.0	6.0	0.0	0.0
1983	0.0	68.0	24.0	45.0	22.0	122.0	167.0	483.5	242.0	195.0	0.0	0.0
1984	0.0	0.0	0.0	35.0	60.6	192.0	332.5	302.0	153.5	41.5	0.0	0.0
1985	0.0	32.5	0.0	0.0	7.0	145.0	187.0	246.0	286.0	199.5	0.0	0.0
1986	19.8	20.0	0.0	40.0	44.0	138.0	334.4	176.7	171.5	146.0	115.0	3.0
1987	4.1	0.0	52.3	81.6	55.0	147.0	234.2	160.5	95.3	80.9	137.4	0.0
1988	0.0	13.0	0.0	4.1	48.7	125.2	173.5	100.6	176.8	60.4	0.0	0.0
1989	0.0	0.0	8.0	0.0	112.4	238.7	139.7	221.3	153.4	19.6	0.0	0.0
1990	0.0	37.4	66.9	104.4	88.5	126.0	208.1	442.0	133.8	134.9	197.2	0.0
1991	28.2	11.2	13.2	0.0	5.2	126.4	502.7	401.4	373.8	81.6	62.8	0.0
1992	9.8	3.9	0.0	12.0	9.0	69.0	375.4	337.2	132.4	127.7	0.0	0.0

20.Name of the station: Khandapara

1978	0.0	35.5	1.0	0.0	126.0	165.5	444.5	453.0	212.0	116.7	75.2	0.0
1979	0.0	5.0	0.0	2.0	88.7	175.2	331.5	142.0	197.5	16.0	0.0	0.0
1980	15.0	0.5	16.5	6.2	16.2	193.5	205.0	290.2	226.4	107.6	0.0	0.0
1981	15.6	0.0	64.9	26.4	39.0	127.5	202.1	234.1	251.5	7.6	0.0	0.0
1982	0.0	21.0	8.4	5.0	52.7	77.2	77.1	228.6	68.0	10.6	0.0	0.0
1983	0.0	62.0	36.1	41.5	22.0	122.0	209.9	242.2	133.0	80.0	0.0	4.0
1984	0.0	3.0	0.0	10.5	3.0	64.4	213.5	170.1	133.0	20.5	0.0	0.0
1985	12.0	39.0	0.0	18.0	47.0	66.0	240.0	190.5	332.5	218.0	0.0	0.0
1986	23.5	11.0	11.5	25.0	54.0	305.5	216.0	189.0	85.0	102.0	89.5	14.0
1987	6.0	0.0	53.0	72.0	14.4	104.5	147.1	116.0	109.0	52.0	85.0	0.0
1988	0.0	32.0	16.0	62.0	14.0	159.0	289.0	173.0	181.0	63.0	1.0	0.0
1989	0.0	0.0	18.0	1.0	33.0	209.8	150.0	268.0	192.0	3.0	0.0	1.0
1990	0.0	66.0	115.0	53.0	74.0	156.0	267.0	312.0	144.0	168.0	55.0	1.0
1991	48.0	0.6	24.0	32.0	11.0	115.0	499.6	331.3	295.0	81.0	67.0	12.0
1992	33.0	13.0	0.0	15.0	57.0	165.0	328.0	398.0	115.0	97.0	0.0	0.0

21.Name of the station: Nayagarh

1978	0.0	32.0	29.4	10.2	54.6	192.1	230.2	383.7	214.2	48.9	10.2	0.0
1979	0.0	0.0	5.0	14.8	51.2	183.0	402.5	184.5	151.0	5.0	0.0	0.0
1980	0.0	0.0	156.7	35.0	438.5	18.7	229.2	314.7	371.8	0.0	0.0	0.0
1981	0.0	0.0	156.3	35.0	378.5	136.7	359.7	341.2	366.4	0.0	0.0	0.0
1982	0.0	50.5	41.8	0.0	78.2	122.7	156.7	302.5	127.2	17.0	8.0	0.0
1983	0.0	23.3	35.3	39.1	126.5	242.3	387.5	247.5	260.5	103.5	0.0	0.0
1984	0.0	0.0	0.0	19.0	28.0	159.0	265.1	161.0	110.0	15.0	0.0	0.0
1985	28.0	52.0	17.0	80.0	41.0	95.0	245.0	314.0	276.0	123.0	0.0	0.0
1986	22.0	50.0	13.0	24.0	51.0	179.0	241.0	226.0	209.0	93.0	131.0	12.0
1987	10.0	0.0	31.0	35.0	56.0	170.5	256.6	130.0	233.0	79.0	179.0	0.0
1988	0.0	33.0	0.0	37.0	27.0	243.0	318.0	301.0	483.0	203.0	0.0	0.0
1989	0.0	0.0	28.0	0.0	35.0	355.0	174.0	368.0	184.0	62.0	0.0	0.0
1990	0.0	99.0	89.0	85.0	129.0	168.0	291.0	408.2	78.0	153.0	205.0	0.0
1991	44.0	3.0	13.0	55.0	12.0	117.0	545.0	278.0	279.0	43.0	21.0	0.0
1992	12.0	44.0	0.0	33.0	115.0	345.0	244.0	445.0	59.0	95.0	0.0	0.0

22.Name of the station: Nuagaon

Year/month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	0.0	60.0	0.0	0.0	0.0	162.0	124.0	302.8	231.7	77.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	41.0	198.0	171.0	167.0	147.0	0.0	0.0
1980	0.0	0.0	0.0	20.0	12.0	13.0	232.3	248.8	144.5	22.0	0.0	0.0
1981	0.0	0.0	214.6	50.0	11.5	32.7	148.6	354.2	301.4	19.2	0.0	0.0
1982	0.0	99.0	399.5	5.0	29.0	265.0	211.7	529.5	141.1	2.0	1.0	0.0
1983	0.0	23.8	0.0	240.0	20.0	232.0	348.0	626.5	329.0	227.7	0.0	0.0
1984	8.0	0.0	0.0	60.0	10.0	98.0	274.2	316.0	158.8	49.0	0.0	0.0
1985	20.0	72.0	0.0	25.0	5.0	96.0	242.0	236.0	376.0	186.0	0.0	0.0
1986	3.0	62.0	0.0	85.0	0.0	251.0	174.0	144.0	200.0	132.0	113.0	25.0
1987	0.0	0.0	7.0	86.5	23.0	52.0	275.0	297.5	183.0	82.0	74.5	0.0
1988	0.0	44.0	5.0	5.0	137.0	288.0	424.0	295.0	345.0	86.0	0.0	0.0
1989	0.0	0.0	37.0	33.0	91.0	422.0	311.0	468.0	186.0	33.0	0.0	0.0
1990	0.0	97.0	113.0	91.0	153.0	186.0	389.0	421.0	178.0	277.0	257.0	0.0
1991	69.0	0.0	0.0	0.0	68.0	110.0	408.4	270.0	172.0	39.0	17.0	0.0
1992	50.0	0.0	0.0	13.0	65.0	128.0	509.0	380.6	93.0	97.0	0.0	0.0

23.Name of the station: Nimapara

1978	0.0	14.0	6.0	3.0	72.0	130.5	271.0	208.8	125.5	223.6	44.0	50.0
1979	0.0	51.2	0.0	75.5	4.0	142.2	279.0	337.7	238.5	53.5	31.5	0.0
1980	0.0	50.0	25.0	18.0	10.0	447.8	361.5	268.5	302.5	258.2	0.0	0.0
1981	3.7	21.0	71.5	22.7	83.5	47.0	147.5	475.0	165.0	15.7	0.0	0.0
1982	0.0	53.2	42.2	35.5	31.2	303.2	164.8	363.4	172.0	35.0	42.0	0.0
1983	0.0	34.8	57.5	0.0	0.0	74.0	231.1	328.7	162.8	55.8	0.0	0.0
1984	0.0	0.0	0.0	10.0	16.0	135.0	274.0	316.0	158.0	49.0	0.0	0.0
1985	13.0	76.0	0.0	6.0	40.0	101.0	277.0	396.0	499.0	125.5	0.0	0.0
1986	80.0	11.0	18.0	24.5	55.7	137.8	321.9	122.0	156.9	124.0	237.0	0.0
1987	10.0	0.0	5.0	12.5	96.0	64.0	115.0	158.5	29.3	81.0	77.0	0.0
1988	0.0	13.0	16.0	29.0	83.0	402.2	307.0	196.0	443.0	115.0	0.0	0.0
1989	0.0	0.0	10.0	0.0	188.0	381.0	322.0	382.0	194.0	72.0	0.0	0.0
1990	0.0	184.0	93.0	175.0	223.0	189.0	283.0	335.5	231.0	136.0	251.0	8.0
1991	45.0	0.0	43.0	0.0	31.0	130.0	898.0	539.8	201.2	148.0	134.0	0.0
1992	0.0	37.0	0.0	0.0	307.0	201.0	487.0	347.0	215.0	166.0	30.0	0.0

24.Name of the station: Odagaon

1978	0.0	41.9	14.0	28.8	30.4	155.5	181.8	292.8	149.7	96.4	45.0	0.0
1979	0.0	0.0	0.0	18.0	41.3	123.4	121.8	223.6	73.4	25.5	0.0	0.0
1980	0.0	0.0	62.0	0.0	10.0	105.0	180.0	295.0	77.0	152.0	0.0	0.0
1981	3.7	0.0	0.8	0.6	0.4	67.3	140.1	305.0	107.0	0.0	0.0	0.0
1982	0.0	0.0	100.0	0.0	10.0	75.0	154.0	208.0	108.0	15.0	4.0	0.0
1983	0.0	49.0	111.0	115.0	94.0	54.0	286.0	196.0	206.0	227.0	0.0	0.0
1984	0.0	20.0	0.0	30.0	18.0	331.0	237.0	172.0	177.0	23.0	0.0	0.0
1985	29.0	90.0	18.0	24.0	0.0	67.0	237.0	253.0	376.0	38.0	0.0	0.0
1986	25.0	10.0	8.0	18.0	63.0	176.0	287.0	198.0	85.0	101.0	110.0	14.0
1987	14.0	0.0	29.0	16.0	34.0	138.0	69.0	47.0	118.0	97.0	95.0	0.0
1988	0.0	44.0	39.0	56.0	38.0	90.0	76.0	94.0	224.0	127.0	0.0	0.0
1989	0.0	0.0	33.0	0.0	36.0	218.0	145.0	388.0	99.0	84.0	0.0	0.0
1990	0.0	62.0	219.0	158.0	185.0	148.0	287.0	390.0	52.0	218.0	444.0	0.0
1991	8.0	22.0	22.0	79.0	14.0	92.0	706.0	274.0	79.0	104.0	90.0	0.0
1992	0.0	65.0	0.0	23.0	35.0	282.0	261.0	236.0	80.0	106.0	0.0	0.0

25.Name of the station: Tangi

Year/month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	0.0	44.0	309.2	0.0	0.0	205.2	213.7	560.5	181.5	126.3	46.0	0.0
1979	0.0	34.0	0.0	1.5	16.0	70.0	497.4	209.0	335.5	64.2	25.0	14.0
1980	0.0	0.0	16.0	0.0	27.5	369.2	350.3	466.3	422.7	208.1	0.0	0.0
1981	4.6	45.9	24.9	0.0	50.3	160.2	163.8	334.2	241.0	44.3	0.0	0.0
1982	0.0	18.7	48.3	28.8	4.1	104.0	53.5	213.1	209.3	26.0	0.0	0.0
1983	0.0	106.6	97.6	20.6	121.4	219.7	165.8	234.4	197.5	100.6	1.2	0.0
1984	2.1	0.0	0.0	37.0	14.4	85.4	233.8	164.5	223.2	0.0	0.0	0.0
1985	7.0	72.0	0.0	0.0	19.6	55.0	119.5	255.6	269.1	220.0	0.0	0.0
1986	7.0	22.0	0.0	0.0	27.0	135.3	301.5	231.3	148.4	146.0	163.0	9.0
1987	7.0	0.0	2.0	31.4	20.2	44.0	157.2	128.2	97.2	103.3	122.6	0.0
1988	0.0	23.4	6.0	54.0	79.0	145.0	172.5	191.0	236.1	89.0	7.0	0.0
1989	0.0	0.0	0.0	15.0	25.0	170.0	110.3	212.9	162.0	49.0	0.0	0.0
1990	0.0	81.0	92.0	108.0	89.0	150.0	210.0	363.0	153.0	220.0	143.0	0.0
1991	40.0	19.0	4.0	14.0	15.0	119.0	290.0	193.0	165.0	74.0	59.0	0.0
1992	0.0	28.1	0.0	4.0	66.0	85.5	240.3	245.2	178.0	107.0	17.0	0.0

26.Name of the station: Pipli

1978	0.0	2.5	44.5	0.0	30.0	133.0	471.4	351.4	77.0	178.7	7.5	0.0
1979	0.0	47.7	0.0	104.2	15.2	143.0	436.2	271.3	240.0	58.0	8.0	0.0
1980	0.0	0.0	10.0	0.0	5.0	455.0	621.0	364.0	373.0	98.0	0.0	0.0
1981	0.0	0.0	45.0	33.0	73.0	75.0	197.0	365.0	241.0	23.0	0.0	12.0
1982	27.0	30.0	67.0	5.0	18.0	155.0	169.5	421.0	113.0	36.0	33.0	0.0
1983	0.0	83.0	31.0	3.0	31.0	99.0	157.0	269.0	217.0	47.0	4.0	11.0
1984	1.0	4.0	0.0	0.0	13.0	135.0	290.0	289.0	120.0	26.0	0.0	0.0
1985	13.0	28.0	0.0	0.0	17.0	87.0	219.0	480.0	231.0	123.0	0.0	0.0
1986	2.0	16.0	9.0	27.0	36.0	120.5	382.0	159.0	196.0	124.0	166.0	0.0
1987	8.0	0.0	7.0	13.0	73.0	67.0	233.0	175.0	160.0	87.0	64.0	0.0
1988	0.0	0.0	0.0	46.0	57.0	135.0	156.0	201.0	240.0	61.0	0.0	0.0
1989	0.0	0.0	13.0	0.0	119.0	273.0	194.0	324.0	224.0	21.0	0.0	0.0
1990	0.0	80.0	98.0	182.0	75.0	155.0	311.0	311.0	130.0	177.0	232.0	0.0
1991	55.0	0.0	24.0	0.0	22.0	132.0	402.0	481.0	202.0	136.0	78.0	0.0
1992	2.0	42.0	0.0	11.5	154.0	131.0	298.0	220.0	140.5	46.0	3.0	0.0

27.Name of the station: Ranpur

1978	0.0	29.0	12.0	1.2	33.0	236.2	286.7	497.3	160.1	362.2	28.2	0.0
1979	0.0	9.2	0.0	0.0	30.2	103.2	375.7	245.5	140.2	15.0	0.0	0.0
1980	0.0	0.0	15.0	0.0	7.5	248.5	128.0	120.0	418.0	67.0	0.0	0.0
1981	0.0	0.0	38.0	26.0	70.0	180.0	164.0	205.0	35.2	0.0	0.0	0.0
1982	0.0	65.0	51.5	36.0	26.0	208.0	113.0	169.5	115.0	22.9	0.0	0.0
1983	0.0	60.0	12.0	0.0	5.0	231.0	319.0	344.0	218.1	170.0	6.0	26.0
1984	0.0	0.0	0.0	36.0	50.0	192.0	623.0	158.0	293.0	0.0	0.0	0.0
1985	0.0	17.0	0.0	20.0	0.0	43.0	86.2	98.0	124.0	38.0	0.0	0.0
1986	22.0	8.0	6.0	0.0	13.0	349.0	796.0	332.0	306.0	210.0	243.0	8.0
1987	0.0	0.0	11.0	53.0	8.0	39.0	193.0	245.0	180.0	153.0	204.0	0.0
1988	0.0	39.0	0.0	52.0	137.0	268.0	462.0	223.0	390.0	76.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	42.0	481.0	214.0	397.0	171.0	27.0	0.0	0.0
1990	0.0	80.0	76.0	82.0	175.0	182.0	288.0	693.0	208.0	114.0	323.0	0.0
1991	109.0	0.0	54.0	49.0	0.0	70.0	599.5	326.4	217.2	52.0	82.0	0.0
1992	0.0	19.0	0.0	10.0	48.0	345.0	295.0	478.0	129.0	87.0	0.0	0.0

28.Name of the station: Puri

Year/month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	0.0	0.0	0.0	0.0	0.0	201.0	191.7	211.0	100.0	72.0	35.0	0.0
1979	0.0	0.0	19.1	33.1	21.3	63.8	106.4	147.0	375.0	27.0	42.0	6.0
1980	0.0	0.4	0.9	0.1	7.0	336.1	318.0	481.0	366.8	270.0	41.0	0.0
1981	3.2	36.6	31.3	0.7	100.6	366.5	110.6	509.1	159.6	12.1	0.0	27.0
1982	2.0	24.9	0.0	0.0	16.0	196.0	235.0	397.0	261.0	26.0	53.0	0.0
1983	0.0	87.0	84.0	12.0	65.0	122.0	97.0	362.0	205.0	145.0	9.0	6.1
1984	0.0	0.0	0.0	0.0	84.0	180.0	369.0	251.0	171.0	56.0	0.0	0.0
1985	0.0	48.0	0.0	8.0	22.0	72.1	173.0	386.2	392.0	169.6	0.0	0.0
1986	28.0	37.0	0.0	56.0	96.0	279.0	400.0	224.0	493.0	289.0	358.0	0.0
1987	60.0	0.0	2.0	40.0	82.0	50.0	324.5	144.5	137.0	144.0	155.0	2.0
1988	0.0	16.0	0.0	65.0	46.0	193.0	317.2	264.0	564.0	98.0	0.0	0.0
1989	0.0	0.0	15.0	1.0	236.0	581.0	317.0	520.0	317.0	133.0	0.0	0.0
1990	0.0	297.0	155.0	142.0	238.0	111.0	219.0	500.0	274.0	314.0	435.0	0.0
1991	105.0	0.0	25.0	25.0	0.0	338.0	1158.3	937.5	251.0	413.0	91.3	0.0
1992	0.0	71.7	0.0	15.2	172.0	446.0	453.9	573.2	429.0	222.0	130.0	0.0

29.Name of the station: Satyabadi

1978	0.0	0.0	0.0	0.0	0.0	109.8	273.0	437.3	134.2	122.8	9.8	0.0
1979	0.0	0.0	0.0	131.0	0.0	91.1	416.8	409.3	138.3	66.1	18.8	7.0
1980	0.0	0.0	0.0	0.0	0.0	418.0	504.1	177.9	216.8	0.0	0.0	0.0
1981	3.7	23.0	47.0	30.5	113.0	60.0	121.0	370.0	501.0	0.0	0.0	20.0
1982	0.0	0.0	41.0	0.0	22.0	205.0	292.6	407.2	222.0	30.5	41.0	0.0
1983	0.0	120.2	76.2	0.0	63.2	151.7	243.6	226.2	242.7	91.4	4.0	34.2
1984	0.0	0.0	0.0	20.6	59.0	215.4	379.8	332.8	143.2	30.6	0.0	0.0
1985	16.6	82.0	0.0	0.0	21.2	129.1	292.0	627.9	388.6	276.6	0.0	0.0
1986	0.0	6.0	0.0	57.5	30.5	345.5	395.9	193.0	277.0	200.0	288.0	0.0
1987	25.0	0.0	1.4	4.2	86.3	108.0	206.0	169.5	212.0	187.0	210.0	0.0
1988	0.0	0.0	0.0	15.0	27.0	87.0	88.0	46.0	264.0	17.0	0.0	0.0
1989	0.0	0.0	1.5	0.0	203.6	502.7	268.7	624.8	83.5	46.2	0.0	0.0
1990	0.0	189.4	173.5	252.9	144.9	209.7	307.5	585.2	276.0	325.0	488.0	0.0
1991	68.0	0.0	39.0	30.0	0.0	366.0	798.0	579.4	311.0	170.0	76.0	15.0
1992	0.0	35.0	0.0	0.0	172.0	411.0	321.0	436.0	201.0	216.0	1.0	0.0

Source: Board of Revenue, Govt. of Orissa,Cuttack.

Annexure- 2

AREA OF POLYGONS OF RAINGAUGE STATIONS

Sl.No.	Rainfall Station	Area of the polygon (sq.km)	Weight of the Station
1.	Astaranga	78	0.008
2.	Balipatna	175	0.017
3.	Balianta	119	0.012
4.	Banpur	386	0.038
5.	Begunia	442	0.043
6.	Bhapur	294	0.029
7.	Bhubaneswar	373	0.037
8.	Bolgarh	230	0.023
9.	Brahmagiri	569	0.056
10.	Daspalla	1196	0.117
11.	Chilika	460	0.045
12.	Delang	138	0.014
13.	Gania	266	0.026
14.	Jatni	165	0.016
15.	Gop	414	0.041
16.	Kakatpur	172	0.017
17.	Kanas	442	0.043
18.	Krishnaprasad	505	0.050
19.	Khurda	294	0.029
20.	Khandapara	230	0.023
21.	Nayagarh	359	0.035
22.	Nuagon	488	0.048
23.	Nimapura	238	0.023
24.	Odagon	552	0.054
25.	Tangi	488	0.048
26.	Pipili	183	0.018
27.	Ranipur	359	0.035
28.	Puri	247	0.024
29.	Satyabadi	320	0.031

Annexure-3

MONTHLY MEAN AREAL RAINFALL IN MM

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1978	.0	22.0	39.6	17.0	31.6	152.3	251.9	361.1	143.9	93.5	15.8	11.1
1979	.0	11.1	3.9	22.8	15.9	118.2	295.9	224.3	210.8	70.5	8.7	6.4
1980	2.6	9.2	9.9	12.8	13.7	266.8	301.3	289.2	279.7	160.2	6.6	2.3
1981	5.1	10.0	67.2	20.6	81.9	126.3	167.4	358.3	321.1	25.2	.0	6.9
1982	4.4	33.8	92.3	28.0	19.9	165.5	182.5	359.2	173.1	26.6	13.6	.0
1983	2.0	66.6	38.9	49.6	40.8	148.4	260.0	354.1	236.7	113.9	7.5	6.7
1984	2.4	1.8	.0	35.9	23.4	155.2	345.8	258.5	189.9	25.4	.0	.0
1985	9.8	57.4	5.8	6.4	25.7	107.5	226.3	337.7	335.7	182.0	.0	.0
1986	21.3	28.9	12.3	25.9	57.5	236.2	318.3	228.9	203.1	166.0	195.4	8.7
1987	9.8	.8	17.5	44.2	35.5	77.5	214.9	176.7	143.3	114.4	154.2	.2
1988	.0	23.9	15.1	43.2	74.9	195.9	252.5	187.2	317.9	91.8	.2	.0
1989	.0	.0	17.8	7.3	100.4	346.8	205.6	357.4	148.2	40.4	.0	.3
1990	.0	113.3	107.8	117.5	124.6	186.2	268.4	401.5	179.7	196.6	276.8	.5
1991	55.5	3.6	29.1	19.0	17.3	157.1	550.6	376.5	240.5	122.2	63.1	4.0
1992	10.8	36.3	1.2	12.5	96.5	237.7	363.2	361.7	161.8	128.6	10.9	.0

MONTHLY MAXIMUM AND MINIMUM TEMPERATURES(°F) OF PURI DISTRICT

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bhubaneswar	1976	84/60	90/64	110/70	108/62	111/82	111/82	88/83	90/87	93/77	92/79	91/78	83/69
	1977	82/61	89/67	99/75	103/83	105/81	110/82	92/79	93/78	94/77	92/78	90/77	84/72
	1978	80/60	88/69	97/74	94/76	96/77	102/78	96/78	94/78	96/78	92/84	90/76	86/70
	1979	82/68	89/73	--	97/80	103/89	--	--	93/77	93/82	92/84	92/81	82/76
	1980	79/69	86/72	88/79	98/83	98/80	94/81	86/79	89/79	88/78	90/82	86/79	83/68
	1981	76/66	83/70	91/81	97/82	99/86	99/86	93/85	92/82	93/83	91/84	89/74	79/72
	1982	83/75	88/75	92/82	95/88	99/90	96/84	98/86	91/84	93/85	93/86	89/77	80/74
	1983	78/71	82/70	94/72	93/87	96/86	97/86	94/86	92/80	92/80	94/80	90/76	84/68
	1984	86/72	90/74	98/77	98/85	102/82	100/76	96/78	98/78	98/78	96/75	92/88	83/68
	1985	--	--	--	--	--	--	--	--	--	--	--	--
Brahmagiri	1976	98/77	94/75	93/76	91/80	98/83	96/88	97/80	98/78	96/79	97/88	94/86	87/74
	1977	84/66	90/80	94/80	97/80	98/82	98/84	96/82	96/86	98/82	93/79	84/74	81/65
	1978	79/62	80/69	88/75	91/80	93/84	92/78	87/80	88/80	87/82	86/78	87/72	83/61
	1979	91/62	87/72	89/74	91/79	95/86	94/83	89/82	90/79	92/78	88/79	85/72	83/66
	1980	81/66	83/72	89/79	91/88	92/84	92/81	85/78	87/80	88/82	88/82	85/74	77/68
	1981	74/66	82/70	85/79	89/79	91/85	94/83	89/82	89/81	89/80	88/80	85/69	73/62
	1982	79/61	82/74	87/76	91/80	95/86	92/84	91/82	87/86	88/80	87/80	84/72	76/71
	1983	77/70	84/67	88/78	89/81	92/83	94/88	90/83	88/81	89/82	88/78	79/70	75/66
	1984	77/69	78/70	88/74	90/84	92/84	90/84	90/82	89/84	89/89	87/75	81/72	76/70
	1985	77/70	80/73	87/77	89/82	93/86	94/86	87/80	87/82	87/82	87/79	84/79	76/68
Tangi	1976	90/72	87/73	89/82	--	97/83	--	95/81	87/80	93/80	91/73	88/74	84/67
	1977	82/64	88/68	92/77	93/81	96/80	96/83	90/79	90/80	90/78	90/76	86/77	83/68
	1978	82/66	85/72	90/76	94/82	100/82	98/81	89/80	87/78	88/80	87/77	85/74	81/68
	1979	85/68	87/73	92/72	95/72	97/74	98/80	100/82	94/78	90/80	90/80	88/74	84/67
	1980	86/64	90/78	94/78	100/80	102/86	98/80	90/80	90/80	92/84	92/79	90/70	82/66
	1981	85/65	89/71	95/75	99/81	99/83	97/80	95/81	90/79	91/82	91/82	89/71	82/64
	1982	83/64	90/70	94/72	94/80	100/84	96/80	104/82	90/80	90/82	90/80	88/72	84/66
	1983	82/66	88/68	96/78	98/80	102/78	102/82	96/82	92/82	92/82	90/74	90/70	82/62
	1984	84/64	90/64	96/66	96/78	98/82	98/80	92/80	92/80	90/86	90/70	88/64	84/60
	1985	74/59	86/64	94/76	98/80	98/82	102/80	92/82	90/78	90/78	88/74	88/64	84/64
Nayagarh	1976	74/59	88/62	90/66	96/79	96/31	98/80	92/84	92/80	92/80	92/78	86/80	86/80
	1977	80/73	90/69	100/86	100/88	102/82	104/84	88/78	87/79	87/78	88/78	88/78	86/64
	1978	80/70	84/70	90/76	96/83	109/89	104/83	95/82	91/80	93/83	89/80	89/75	82/67
	1979	88/66	89/66	102/75	105/80	110/84	108/83	98/82	93/79	92/78	90/80	89/75	84/66
	1980	81/63	91/72	95/76	103/82	112/88	99/82	89/80	89/80	90/91	89/79	87/72	78/67
	1981	80/66	90/71	91/78	96/80	96/82	98/83	89/82	89/80	88/80	89/79	87/72	78/67
	1982	81/68	84/73	90/78	95/86	100/84	96/82	98/82	88/79	88/82	89/81	86/72	80/70
	1983	82/65	90/73	96/78	101/75	109/81	113/83	96/76	94/80	96/79	92/70	92/65	83/58
	1984	87/74	98/72	107/74	105/80	109/83	100/78	95/79	95/78	96/77	98/80	89/70	88/65
	1985	83/68	89/73	104/80	114/85	103/83	100/80	93/79	92/82	93/77	88/78	85/76	82/70

(Contd..)

Daspalla	1976	78/63	85/70	90/81	99/82	--	104/85	92/84	90/80	92/82	90/80	88/78	84/66
	1977	82/70	90/74	97/81	102/88	105/88	107/85	93/84	92/82	90/80	88/80	85/76	84/62
	1978	--	--	--	--	--	--	--	--	--	--	--	--
	1979	83/65	85/69	94/75	98/84	106/89	107/85	89/82	91/77	91/82	89/78	88/75	81/68
	1980	83/66	89/73	93/77	103/82	104/88	96/83	90/82	90/81	90/80	90/76	84/70	79/65
	1981	80/59	93/85	94/72	102/76	103/81	103/80	90/80	89/78	90/68	88/66	88/56	84/52
	1982	82/46	88/54	88/50	98/54	103/52	84/54	92/52	84/54	88/56	88/52	88/54	86/54
	1983	82/52	84/64	94/70	101/76	100/78	100/80	91/74	88/75	88/79	98/78	88/62	82/60
	1984	82/60	88/70	93/72	97/72	104/79	116/77	99/81	89/78	98/79	90/72	90/60	88/60
	1985	93/62	93/70	93/69	98/72	104/80	110/80	106/82	90/74	93/78	90/74	86/62	88/64

Source : GWS & I, OLIC Ltd, Bhubaneswar, Orissa

MONTHLY MAXIMUM AND MINIMUM HUMIDITY (%) OF PURI DISTRICT.

Name of the Station	Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1.Bhubaneswar	1976	88/51	83/53	79/57	76/57	82/57	90/57	94/73	95/66	94/59	90/56	90/57	84/44
	1977	--	--	--	--	--	--	--	--	--	--	--	--
	1978	80/60	83/32	91/35	86/43	87/47	92/54	95/76	96/77	91/47	83/53	89/56	78/32
	1979	83/53	80/52	--	96/59	96/70	--	--	96/71	96/74	92/78	96/68	87/66
	1980	90/69	91/70	91/76	89/76	88/75	92/77	91/79	91/79	91/79	92/79	96/83	91/79
	1981	90/75	90/73	87/69	88/66	92/64	92/72	88/70	91/74	92/74	92/69	88/60	86/58
	1982	86/57	91/58	88/67	85/71	85/65	88/66	80/60	84/66	88/59	76/55	72/52	78/49
	1983	72/50	82/54	88/36	88/59	84/54	80/50	92/69	92/83	92/80	92/65	92/74	91/63
	1984	95/70	96/54	96/66	93/65	93/62	96/63	93/68	92/76	93/59	93/54	92/55	91/53
	1985	--	--	--	--	--	--	--	--	--	--	--	--
2.Brahmagiri	1976	91/63	75/60	80/55	85/62	82/59	89/62	87/63	84/58	85/59	90/89	90/58	84/53
	1977	84/53	89/52	85/57	88/57	92/49	88/51	92/65	92/64	91/64	91/67	95/70	91/66
	1978	86/60	91/66	88/59	92/69	92/66	92/67	93/82	96/83	96/76	92/82	91/58	91/44
	1979	86/45	96/51	96/44	91/70	83/67	90/59	90/73	90/77	90/66	95/76	94/64	94/57
	1980	89/74	90/90	95/80	95/85	95/82	95/85	94/79	92/77	92/83	92/83	91/81	90/79
	1981	86/79	87/80	87/83	92/86	92/81	88/80	88/83	92/82	91/83	88/79	83/75	80/65
	1982	81/68	82/73	88/74	79/70	77/67	79/67	79/69	83/79	88/72	87/83	91/78	85/72
	1983	76/68	80/68	79/67	79/69	79/69	79/68	83/69	87/72	87/76	87/76	86/78	--
	1984	80/72	81/69	83/69	83/69	79/69	83/69	87/70	83/72	83/72	87/72	86/72	80/73
	1985	85/73	81/70	79/70	83/72	77/70	77/67	87/72	83/72	83/76	87/72	87/82	86/77
3.Tangi	1976	95/60	94/66	94/69	94/70	95/70	--	95/81	95/81	95/73	95/25	89/45	79/35
	1977	83/30	83/27	94/32	87/47	85/49	91/55	92/74	92/76	91/72	91/65	91/66	85/42
	1978	85/43	85/32	83/36	84/47	84/41	84/42	92/75	92/76	91/72	96/60	87/56	83/46
	1979	86/44	83/33	79/34	--	92/56	83/48	84/45	91/63	91/70	84/62	83/50	82/49
	1980	74/40	83/49	83/46	84/54	77/54	84/59	91/76	84/76	92/70	89/76	92/81	91/65
	1981	80/45	81/38	82/45	83/54	83/58	84/84	84/69	84/71	84/74	83/47	72/53	78/43
	1982	83/47	83/53	86/47	84/57	83/39	84/59	84/33	84/74	84/69	83/69	79/50	75/33
	1983	81/48	83/59	83/57	83/54	83/56	84/56	84/59	84/71	84/71	84/50	84/53	80/42
	1984	80/45	81/38	79/38	83/53	83/58	84/54	84/69	84/71	84/74	83/47	72/53	78/43
	1985	81/50	82/73	82/50	83/54	77/54	84/45	84/69	84/76	84/73	83/61	87/38	83/35
4.Nayagarh	1976	82/54	88/54	90/66	90/58	90/58	90/59	90/69	90/66	90/58	90/58	85/65	85/57
	1977	83/60	84/55	89/57	85/58	90/58	91/58	90/81	94/76	90/73	90/64	90/57	90/53
	1978	89/51	89/54	85/55	85/57	86/58	91/55	86/68	90/66	85/59	85/56	90/36	84/36
	1979	81/30	95/32	77/29	76/15	83/14	87/30	85/59	90/58	85/64	85/58	80/49	84/27
	1980	79/36	80/09	81/16	76/10	70/38	87/35	92/69	91/72	87/66	91/58	82/48	85/48
	1981	81/48	81/34	83/28	83/28	84/45	87/43	91/73	91/73	91/69	87/57	78/40	86/46
	1982	86/48	86/45	87/36	80/38	79/28	87/58	87/38	91/73	92/59	87/56	79/42	77/40
	1983	82/50	86/45	83/28	87/25	83/27	87/26	91/53	96/64	96/59	96/47	86/36	83/37
	1984	84/35	85/34	78/10	79/14	80/10	87/41	92/59	91/59	95/49	91/37	79/35	80/30
	1985	82/37	86/28	64/20	76/23	79/38	87/47	91/58	91/63	91/61	91/46	66/38	66/37

(Contd..)

5.Daspalla	1976	94/83	94/89	95/90	94/85	---	85/69	95/73	95/75	95/73	95/58	95/72	94/52
	1977	94/53	94/56	94/61	91/24	81/36	96/13	93/61	95/69	94/77	94/65	84/55	88/54
	1978	92/38	90/36	94/63	89/27	82/19	84/47	92/69	91/47	94/69	92/63	84/56	87/53
	1979	90/46	90/35	91/29	84/26	78/23	84/33	91/69	92/63	92/67	79/60	83/50	85/45
	1980	82/36	82/28	79/27	77/21	74/19	87/53	92/67	92/73	92/63	91/47	86/47	90/50
	1981	94/43	90/21	87/23	86/18	83/30	87/33	92/69	96/73	92/56	92/68	89/65	88/67
	1982	82/60	83/65	88/68	92/65	93/63	83/65	85/60	83/47	84/63	92/65	84/61	84/61
	1983	83/63	83/48	92/42	86/33	87/33	87/40	96/63	96/64	96/73	96/69	96/73	88/43
	1984	86/48	86/30	90/21	91/35	86/27	77/36	92/40	96/69	96/50	96/69	91/67	96/43
	1985	90/31	86/31	87/23	92/43	87/33	92/33	92/39	96/50	90/69	96/74	83/54	79/45

Source : GWS & I, OLIC, BHUBANESWAR, ORISSA

Annexure - 6

MEAN MONTHLY PAN EVAPORATION (mm) OF PURI DISTRICT

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bhubaneswar	55.57	67.77	88.92	83.46	103.30	91.93	89.22	83.98	103.48	68.61	75.68	72.14
Brahmagiri	105.32	111.35	138.05	139.40	170.44	159.06	114.71	114.98	115.73	104.96	81.13	91.43
Tangi	185.43	184.93	218.46	235.31	263.10	186.16	124.80	113.51	126.40	126.71	129.60	131.30
Nayagarh	120.88	124.73	134.31	160.21	162.97	144.82	111.71	83.06	90.18	100.24	112.22	125.91
Daspalla	147.03	193.90	234.37	263.64	279.76	173.40	145.67	143.31	130.82	117.57	145.13	110.56

Source : GWS & I, OLIC Ltd. Bhubaneswar, Orissa

ANNEXURE - 7

YEAR WISE NUMBER OF GROUNDWATER STRUCTURES AND THEIR UNIT SEASONAL DRAFT

SL. NO.	STRUCTURE	UNIT DRAFT (Ha-M)		NUMBERS													
		MONSOON	NON-MONSOON	1978-79	79-80	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	90-91	91-92
1.	DUG WELL WITH TENDA	0.1	0.2	11977	12701	13469	14283	15146	16062	17032	18062	19154	20311	21539	22841	24222	25686
2.	DUG WELL WITH PUMP SET	0.4	0.6	410	452	500	553	611	675	745	824	910	1006	1111	1228	1357	1500
3.	FILTER POINT TUBE WELL	0.9	2.1	692	713	733	755	777	800	824	848	873	898	925	952	980	1008
4.	SHOLLOW TUBE WELL	3.0	7.0	1	1	1	1	1	2	4	7	12	20	36	63	110	194
5.	MEDIUM DEEP TUBE WELL	4.5	10.5	1	1	1	2	2	3	4	4	6	8	10	10	11	12

SOURCE: 1. THE FIGURES FOR 1988-89 AND 1991-92 WEERE COLLECTED FROM O.L.I.C,BHUBANESWER.
2. THE FIGURES FOR OTHER YEARS ARE ESTIMATED BASED ON THE GROWTH RATE

Annexure - 8

DEPTH TO WATER LEVEL DATA OF PIEZOMETERS (meters) IN PURI DISTRICT , ORISSA

No.	LOCATION WITH CO-ORDINATES	AQUIFER	DIAMETER (mm)	DEPTH	M P ABOVE G L	R L OF M P	R L OF G L	YEAR	JAN	APR	JUN	AUG	NOV	REMARKS
22.	Kakatpur	Alluvium	100	92.00	0.85	6.225	5.305	1985	--	--	--	--	2.50	Estd.in
								1986	3.35	3.43	--	1.76	2.38	Aug'85
								1987	3.28	3.40	--	2.53	2.60	
28.	Konark Lat 19 53' Lon 86 05'	Alluvium	100	31.04	0.71	NA	NA	1986	--	2.45	--	0.38	0.21	Measure
								1987	0.83	1.57	--	2.09	1.00	-ment from Apr'86
33.	Nimapura Lat 19 03' Lon 86 01'	Alluvium	100	75.00	0.80	8.485	8.405	1987	--	--	--	2.09	1.44	Estd.in Apr'87
40.	Puri Lat 19 49' Lon 85 40'	Alluvium	100	229.68	0.07	NA	NA	1986	--	3.76	--	3.45	3.67	Measurement
								1987	3.93	4.00	--	3.99	4.10	from Apr'86
16.	Delang Lat 20 06' Lon 85 46'	Alluvium	100	37.00	0.80	4.911	4.131	1986	--	0.98	--	1.55	0.34	Estd.in
								1987	1.46	1.02	--	0.37	0.40	Apr'86
5.	Balipatna Lat 20 12' Lon 85 57'	Alluvium	100	102.00	0.87	12.553	11.828	1986	--	2.09	--	0.84	1.29	-do-
								1987	2.54	2.09	--	1.98	1.61	
39.	Pipli Lat 20 06' Lon 85 50'	Alluvium	100	40.00	0.72	NA	NA	1985	--	--	--	1.25	1.53	Estd.in
								1986	2.30	1.94	--	1.48	1.31	Jul'85
								1987	2.14	2.26	--	1.41	1.54	

Contd.---

DEPTH TO WATER LEVEL(BELOW G L, METERS) DATA OF HYDROGRAPH NETWORK STATIONS IN PURI DISTRICT (ORISSA) .

1.Location : Balianta (3)
Co-ordinates : Lat 20°18' Long 85°53'
Aquifer : Recent to Sub-recent alluvium
Diameter : 0.50

Depth : 7.24
M P above G L : 1.05
R L of M P : 19.287
R L of G L : 18.287

YEAR	JAN	APR	JUN	AUG	NOV
1976	N.A	4.10	5.36	1.09	2.42
1977	3.20	5.26	4.33	1.78	1.88
1978	2.25	3.68	4.96	1.36	1.81
1979	2.67	4.03	4.91	1.73	2.71
1980	3.16	4.12	3.02	1.15	1.85
1981	2.89	3.51	3.65	1.29	2.93
1982	2.99	3.78	N.A	1.11	2.30
1983	3.06	3.82	3.70	1.30	2.11
1984	2.83	3.72	N.A	1.08	2.33
1985	3.55	4.39	N.A	1.19	1.65
1986	2.67	N.A	N.A	0.87	1.54
1987	2.21	N.A	N.A	N.A	2.38
1988	N.A	N.A	N.A	N.A	N.A

2.Location : Balugaon (6)
Co-ordinates :
Aquifer : Anetheem
Diameter : 1.13

Depth : 4.47
M P above G L : 0.81
R L of M P : 4.373
R L of G L : 3.56

YEAR	JAN	APR	JUN	AUG	NOV
1981	N.A	N.A	N.A	0.83	1.05
1982	1.43	1.63	2.09	1.11	1.73
1983	1.76	2.25	2.83	0.89	0.89
1984	1.34	2.22	N.A	1.62	1.49
1985	1.70	1.91	N.A	0.73	1.23
1986	1.59	1.83	N.A	0.75	1.08
1987	1.25	1.56	N.A	1.02	0.39
1988	1.45	1.44	N.A	N.A	N.A

3.Location : Bhusandpur (8)
Co-ordinates : Lat 19°55' Long 85°30'
Aquifer : Khondalite Archaen
Diameter : 1.86

Depth : 10.915
M P above G L : 0.75
R L of M P : 15.89
R L of G L : 15.145

YEAR	JAN	APR	JUN	AUG	NOV
1976	N.A	9.44	8.44	4.27	7.17
1977	N.A	9.47	N.A	N.A	4.96
1978	7.70	9.13	5.67	2.64	N.A
1979	8.32	7.82	9.89	N.A	6.48
1980	8.81	9.56	6.03	1.80	4.24
1981	7.63	8.83	7.50	4.56	5.40
1982	8.20	8.85	7.70	3.72	7.56
1983	8.59	9.21	9.88	5.38	6.07
1984	8.40	9.77	N.A	3.13	7.01

1985	7.48	9.48	N.A	4.85	3.89
1986	7.60	N.A	N.A	3.35	4.11
1987	6.99	9.17	N.A	6.18	5.15
1988	7.25	9.22	N.A	N.A	N.A

4.Location : Brahmagiri (9)
Co-ordinates :
Aquifer : Recent to Sub-recent alluvium
Diameter : 0.73

Depth : 6.57
M P above G L : 0.91
R L of M P : 4.24
R L of G L : 3.56

YEAR	JAN	APR	JUN	AUG	NOV
1981	1.75	3.06	3.45	1.17	1.33
1982	1.81	3.35	2.71	2.15	2.77
1983	2.94	3.44	3.54	2.80	2.21
1984	2.81	3.48	N.A	0.84	1.74
1985	2.12	3.28	N.A	1.08	0.85
1986	1.56	2.73	N.A	1.14	0.47
1987	1.17	N.A	N.A	2.64	2.10
1988	1.93	2.66	N.A	N.A	N.A

5.Location : Bomigochha (7)
Co-ordinates :
Aquifer : Weathered granite gneiss
Diameter : 1.50

Depth : 11.27
M P above G L : 0.60
R L of M P :
R L of G L :

YEAR	JAN	APR	JUN	AUG	NOV
1982	8.18	8.76	10.19	4.01	7.75
1983	N.A	6.31	9.23	4.71	N.A
1984	6.60	9.26	N.A	5.98	7.30
1985	N.A	N.A	N.A	6.78	4.14
1986	7.15	8.66	N.A	5.83	6.67
1987	7.90	9.50	N.A	9.07	8.15
1988	N.A	N.A	N.A	N.A	N.A

6.Location : Budhibar (10)
Co-ordinates :
Aquifer : Alluvial sand
Diameter : 1.17

Depth : 6.28
M P above G L : 0.94
R L of M P : 3.995
R L of G L : 3.045

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	N.A	N.A	N.A	1.62
1987	2.21	3.63	N.A	2.40	1.96
1988	2.30	3.03	N.A	N.A	N.A

7.Location : Chandanpur (11)
Co-ordinates :
Aquifer : Alluvium sand
Diameter : 1.68

Depth : 8.05
M P above G L : 0.63
R L of M P :
R L of G L :

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	N.A	N.A	N.A	1.62
1987	5.23	5.65	N.A	3.89	1.97
1988	N.A	N.A	N.A	N.A	N.A

8.Location : Charichhak (12)
Co-ordinates :
Aquifer : Coastal Alluvium
Diameter : 0.81

Depth : 5.22
M P above G L : 0.70
R L of M P :
R L of G L :

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	1.96	N.A	1.80	1.40
1987	3.05	2.17	N.A	1.06	1.76
1988	3.02	1.90	N.A	N.A	N.A

9.Location : Daspalla I (13)
Co-ordinates :
Aquifer : Coastal alluvium
Diameter : 1.43

Depth : 6.50
M P above G L : 0.96
R L of M P : 11.983
R L of G L : 11.02

YEAR	JAN	APR	JUN	AUG	NOV
1978	0.62	1.71	0.57	0.45	0.52
1979	0.68	1.98	3.99	N.A	0.65
1980	1.52	3.78	5.61	0.57	0.53
1981	0.67	0.85	0.71	0.45	0.48
1982	0.55	4.12	1.12	0.36	0.43
1983	N.A	11.03	4.19	0.34	1.14
1984	2.09	0.73	N.A	0.40	0.45
1985	0.46	1.52	N.A	0.34	0.35
1986	0.35	0.69	N.A	0.26	0.34
1987	0.42	6.67	N.A	0.31	0.38

10.Location : Delang (15)
Co-ordinates : Lat 20°05' Long 85°30'
Aquifer : Alluvium recent
Diameter : 0.83

Depth : 5.09
M P above G L : 0.66
R L of M P :
R L of G L :

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	1.63	N.A	1.01	0.69
1987	1.48	1.73	N.A	1.10	0.96
1988	1.47	1.00	N.A	N.A	N.A

11.Location : Gop (18)
Co-ordinates :
Aquifer : Alluvial sand recent
Diameter : 0.88

Depth : 8.25
M P above G L : 0.57
R L of M P : 6.76
R L of G L : 6.15

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	N.A	N.A	N.A	3.08
1987	4.50	5.32	N.A	5.00	4.54
1988	5.32	5.51	N.A	N.A	N.A

12.Location : Jankia (19)
Co-ordinates :
Aquifer : Laterire sub-recent
Diameter : 1.33

Depth : 4.79
M P above G L : 0.10
R L of M P : 13.53
R L of G L : 12.43

YEAR	JAN	APR	JUN	AUG	NOV
1981	N.A	N.A	N.A	2.15	2.54
1982	2.89	3.32	2.67	2.04	2.96
1983	3.30	3.50	3.36	2.05	2.85
1984	2.90	4.02	N.A	1.79	2.70
1985	2.95	3.40	N.A	1.70	2.26
1986	2.83	3.35	N.A	1.96	2.28
1987	2.70	3.84	N.A	2.38	2.02
1988	2.68	3.74	N.A	N.A	N.A

13.Location : Jatni (20)
Co-ordinates : Lat 20°10' Long 85°41'
Aquifer : Alluvium
Diameter : 2.45

Depth : 13.05
M P above G L : 0.51
R L of M P :
R L of G L :

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	10.42	N.A	2.20	2.75
1987	8.19	9.79	N.A	4.79	7.46
1988	8.23	11.55	N.A	N.A	N.A

14.Location : Kakatpur (21)
Co-ordinates : Lat 20°00' Long 86°12'
Aquifer : Recent to Sub-recent alluvium
Diameter : 1.22

Depth : 5.54
M P above G L : 0.59
R L of M P : 5.213
R L of G L : 4.613

YEAR	JAN	APR	JUN	AUG	NOV
1976	N.A	4.15	4.33	0.70	2.44
1977	3.00	2.42	2.93	1.71	2.30
1978	2.91	2.27	2.89	1.01	2.23
1979	3.19	6.00	3.34	1.91	2.67
1980	2.94	2.53	2.49	1.40	2.41
1981	3.35	2.66	2.57	1.67	2.37
1982	3.02	2.81	2.66	0.90	2.36
1983	2.48	2.65	2.95	1.74	2.43
1984	2.98	2.28	N.A	0.90	2.36
1985	2.85	2.17	N.A	1.23	2.85
1986	3.09	2.23	N.A	1.61	1.80
1987	2.91	2.11	N.A	1.58	2.08
1988	2.70	2.16	N.A	N.A.	N.A

15.Location : Kanas (23)
Co-ordinates :
Aquifer : Alluvial sand
Diameter : 0.75

Depth : 9.18
M P above G L : 0.83
R L of M P :
R L of G L :

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	N.A	N.A	N.A	0.63
1987	1.47	1.32	N.A	N.A	1.05

16.Location : Khamdagiri (25)
Co-ordinates :
Aquifer : Alluvium
Diameter : 1.45

Depth : 13.80
M P above G L : 0.26
R L of M P :
R L of G L :

YEAR	JAN	APR	JUN	AUG	NOV
1985	10.55	11.84	N.A	6.52	8.80
1986	10.14	11.21	N.A	7.69	7.11
1987	9.22	11.14	N.A	5.49	9.20

17.Location : Khurda (26)
Co-ordinates : Lat 20°10' Long 85°37'
Aquifer : Khondalite pre-cambrine
Diameter : 1.57

Depth : 15.24
M P above G L : 0.92
R L of M P :
R L of G L :

YEAR	JAN	APR	JUN	AUG	NOV
1985	N.A	N.A	N.A	N.A	5.14
1986	5.85	8.25	N.A	3.26	3.36
1987	6.05	7.54	N.A	4.56	5.82
1988	6.68	7.98	N.A	N.A	N.A

18.Location : Konark (27)
Co-ordinates : Lat 19°53' Long 86°00'
Aquifer : Recent to Sub-recent
Diameter : 1.09

Depth : 3.50
M P above G L : 0.47
R L of M P : 7.0327
R L of G L : 6.562

YEAR	JAN	APR	JUN	AUG	NOV
1976	N.A	2.35	2.73	1.12	1.20
1977	2.33	2.52	2.62	1.11	1.36
1978	1.60	2.46	2.60	0.95	1.24
1979	2.10	2.60	2.75	1.36	1.62
1980	2.18	2.63	2.22	0.83	1.06
1981	2.82	2.41	2.64	1.47	1.54
1982	1.90	2.69	2.25	1.17	1.63
1983	1.99	2.20	2.38	1.63	1.22
1984	1.95	2.64	N.A	1.79	1.89
1985	2.35	2.97	N.A	0.85	1.19
1986	1.86	2.69	N.A	1.05	0.85
1987	1.55	2.48	N.A	2.33	2.18
1988	4.22	3.07	N.A	N.A	N.A

19.Location : Kumareswar (29)
Co-ordinates :
Aquifer : Alluvium coastal
Diameter : 1.22

Depth : 4.61
M P above G L : 0.84
R L of M P : 7.551
R L of G L : 6.465

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	0.91	N.A	0.76	0.49
1987	1.73	0.93	N.A	0.64	0.85
1988	1.57	1.13	N.A	N.A	N.A

20.Location : Mangalpur (30)
Co-ordinates :
Aquifer : Coastal alluvium
Diameter : 1.09

Depth : 4.54
M P above G L : 0.44
R L of M P : 6.52
R L of G L : 6.03

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	0.37	N.A	0.32	0.08
1987	0.92	0.99	N.A	0-22	0.37
1988	0.83	1.64	N.A	N.A	N.A

21.Location : Nayagarh (31)
Co-ordinates : Lat 20°07' Long 85°05'
Aquifer : Alluvium recent to sub-recent
Diameter : 1.50

Depth : 7.12
M P above G L : 1.45
R L of M P : 91.687
R L of G L : 90.242

YEAR	JAN	APR	JUN	AUG	NOV
1978	0.67	1.59	0.57	-0.30	0.30
1979	1.12	1.69	1.79	-0.01	0.68
1980	1.55	2.16	2.48	2.05	0.26
1981	0.77	0.80	0.84	0.14	0.50
1982	1.15	1.45	1.03	0.00	0.96
1983	1.75	1.96	5.70	-0.20	0.90
1984	2.40	1.62	N.A	-0.35	0.86
1985	1.32	2.27	N.A	-0.30	0.15
1986	0.91	1.51	N.A	0.00	0.00
1987	0.34	1.23	N.A	0.39	0.27
1988	0.34	1.25	N.A	N.A	N.A

22.Location : Nimapara (32)
Co-ordinates : Lat 20°15' Long 86°00'
Aquifer : Alluvium
Diameter : 0.72

Depth : 3.683
M P above G L : 0.73
R L of M P : 8.517
R L of G L : 7.787

YEAR	JAN	APR	JUN	AUG	NOV
1976	N.A	2.09	2.47	0.46	1.57
1977	2.35	3.38	2.86	0.56	1.44
1978	1.96	2.28	3.04	0.06	1.02
1979	2.33	2.54	2.53	0.79	1.82
1980	2.07	2.53	1.82	0.48	0.72
1981	2.09	2.02	2.34	0.11	1.43
1982	1.79	2.55	2.26	0.84	3.87
1983	2.38	2.38	2.40	0.70	1.47
1984	2.34	2.44	N.A	0.05	1.69

1985	2.33	2.47	N.A	0.02	1.12
1986	2.07	2.32	N.A	0.34	0.67
1987	1.83	2.21	N.A	1.77	1.86
1988	2.97	2.78	N.A	N.A	N.A

23.Location : Nuagaon (35)
Co-ordinates : Lat 20°15' Long 84°58'
Aquifer : Alluvium recent to sub-recent
Diameter : 0.95

Depth : 7.253
M P above G L : 0.95
R L of M P : 117.433
R L of G L : 116.486

YEAR	JAN	APR	JUN	AUG	NOV
1978	3.09	3.60	3.12	2.09	2.73
1979	3.43	4.01	4.31	2.97	3.10
1980	3.63	4.23	4.88	2.51	3.27
1981	3.98	4.36	4.87	2.87	3.30
1982	3.74	3.66	3.69	2.61	3.84
1983	4.86	4.94	6.94	2.47	3.65
1984	4.55	5.00	N.A	2.48	3.43
1985	4.27	5.09	N.A	2.78	3.03
1986	3.51	4.02	N.A	2.21	3.21
1987	3.77	5.28	N.A	3.03	2.91
1988	3.30	4.32	N.A	N.A	N.A

24.Location : Pichukuli (37)
Co-ordinates : Lat 20°11' Long 85°23'
Aquifer : Eastern Ghat Gondwana
Diameter : 1.51

Depth : 10.51
M P above G L : 0.31
R L of M P : 68.385
R L of G L : 68.045

YEAR	JAN	APR	JUN	AUG	NOV
1970	6.86	8.31	8.55	0.78	2.47
1971	6.20	8.44	8.36	-0.25	2.56
1972	4.48	N.A	N.A	N.A	N.A
1973	N.A	8.48	8.55	1.13	N.A
1974	4.66	N.A	8.44	3.75	2.74
1975	6.04	9.03	9.07	3.33	2.36
1976	10.56	8.59	8.08	0.86	3.82
1977	6.51	8.83	9.62	N.A	2.60
1978	4.09	6.84	7.15	3.71	1.91
1979	5.51	8.34	8.18	1.17	2.47
1980	7.13	9.23	8.88	1.06	1.38
1981	4.74	7.61	7.64	5.48	2.57
1982	6.98	7.01	7.45	1.23	5.23
1983	6.35	7.48	7.47	0.86	2.06
1984	3.61	7.47	N.A	0.71	5.14
1985	7.71	9.54	N.A	1.74	1.33
1986	4.90	8.01	N.A	0.85	0.78
1987	2.91	6.92	N.A	5.47	2.29
1988	3.15	7.56	N.A	N.A	N.A

Depth : 6.57

25.Location : Pipli (38)
Aquifer : Coastal alluvium
Diameter : 3.14

M.P. above G L : 0.57
R L of M P :
R L of G L :

YEAR	JAN	APR	JUN	AUG	NOV
1987	N.A	3.06	N.A	2.29	2.33
1988	2.91	3.18	N.A	N.A	N.A

26.Location : Puri Town (41)
Co-ordinates : Lat 19°48' Long 85°49'
Aquifer : Coastal alluvium
Diameter : 1.08

Depth : 5.52
M P above G L : 0.77
R L of M P : 7.345
R L of G L : 6.580

YEAR	JAN	APR	JUN	AUG	NOV
1970	3.86	4.41	3.96	3.20	3.31
1971	3.89	4.49	4.33	3.65	3.20
1972	4.04	N.A	N.A	N.A	3.59
1973	N.A	N.A	N.A	N.A	2.44
1974	3.94	N.A	3.41	4.25	3.50
1975	4.07	4.04	3.80	3.88	3.66
1976	3.78	4.73	5.04	3.21	3.82
1977	4.28	4.80	4.81	3.94	3.96
1978	4.25	4.89	4.39	3.32	1.63
1979	2.19	2.98	3.29	2.47	2.41
1980	3.05	3.06	2.98	11.01	0.98
1981	1.81	2.23	2.07	0.99	1.45
1982	2.00	2.46	2.95	1.46	2.17
1983	6.55	2.37	2.66	1.68	1.79
1984	2.37	2.58	N.A	0.58	1.69
1985	2.06	2.64	N.A	1.54	1.26
1986	1.76	3.86	N.A	1.40	0.76
1987	1.42	2.16	N.A	2.03	1.83
1988	2.07	2.45	N.A	N.A	N.A

27.Location : Raghunathpur (42)
Co-ordinates :
Aquifer : Alluvium
Diameter : 1.21

Depth : 7.54
M P above G L : 0.60
R L of M P :
R L of G L :

YEAR	JAN	APR	JUN	AUG	NOV
1985	1.51	2.05	N.A	1.12	1.11
1986	1.38	1.73	N.A	0.86	0.94
1987	1.41	1.84	N.A	1.13	1.27

28.Location : Ramchandi (43)
Co-ordinates :
Aquifer : Dune sand
Diameter : 1.05

Depth : 6.68
M P above G L : 0.27
R L of M P :
R L of G L :

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	N.A	N.A	N.A	5.37
1987	5.93	5.95	N.A	5.79	5.71

29.Location : Ranpur (44)
Co-ordinates : Lat 20°04' Long 85°20'
Aquifer : Weathered
Diameter : 2.05

Depth : 10.80
M P above G L : 1.01
R L of M P :
R L of G L :

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	5.46	N.A	2.25	2.38
1987	3.86	4.91	N.A	3.59	3.50
1988	4.26	6.55	N.A	N.A	N.A

30.Location : Sakhi Gopal (45)
Co-ordinates : Lat 19°58' Long 85°50'
Aquifer : Recent to Sub-recent alluvium
Diameter : 1.50

Depth : 4.76
M P above G L : 0.85
R L of M P : 5.456
R L of G L : 5.106

YEAR	JAN	APR	JUN	AUG	NOV
1976	N.A	2.40	2.83	0.56	1.05
1977	1.64	2.30	3.40	4.15	1.18
1978	1.57	2.20	1.90	0.61	0.99
1979	1.73	2.41	2.74	0.94	1.22
1980	2.11	2.46	1.70	0.87	1.15
1981	1.84	2.02	2.09	0.85	1.11
1982	1.73	2.35	2.53	0.63	1.20
1983	1.89	2.31	2.44	0.80	1.18
1984	1.80	2.46	N.A	0.50	1.45
1985	1.77	2.74	N.A	0.65	1.20
1986	1.80	2.33	N.A	0.78	0.70
1987	1.48	2.25	N.A	1.14	1.00
1988	1.54	2.45	N.A	N.A	N.A

31. Location : Suna Khala (49)
Co-ordinates :
Aquifer : Weathered granite gneiss
Diameter : 0.85

Depth : 9.19
M P above G L : 0.50
R L of M P :
R L of G L :

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	6.40	N.A	2.03	N.A
1987	4.27	5.97	N.A	3.76	3.63
1988	4.50	6.62	N.A	N.A	N.A

32.Location : Tangi (50)
Co-ordinates : Lat 19°55' Long 85°24'
Aquifer : Laterite
Diameter : 1.80

Depth : 15.20
M P above G L : 0.90
R L of M P : 28.24
R L of G L : 27.34

YEAR	JAN	APR	JUN	AUG	NOV
1969	N.A	N.A	N.A	3.97	7.90
1970	10.08	11.25	11.75	4.40	8.38
1971	10.90	12.19	13.42	3.78	5.50
1972	9.71	N.A	N.A	N.A	7.41
1973	N.A	13.41	12.60	4.14	N.A
1974	10.32	N.A	12.05	5.66	6.35

1975	10.26	11.15	12.79	6.03	5.50
1976	10.00	11.67	11.82	5.10	9.16
1977	10.10	11.94	6.69	2.09	7.75
1978	10.69	12.72	5.13	1.64	5.28
1979	11.02	12.32	14.47	4.20	8.40
1980	11.38	13.29	4.68	1.17	5.03
1981	10.38	10.61	5.58	4.28	7.11
1982	9.38	1.54	8.27	3.77	9.49
1983	10.75	9.93	3.55	3.44	6.35
1984	10.43	12.85	N.A	2.73	9.06
1985	10.43	12.86	N.A	1.88	5.52
1986	10.99	13.12	N.A	3.27	5.16
1987	10.18	12.90	N.A	7.13	4.80
1988	9.93	12.30	N.A	N.A	N.A

33.Location : Balanga (2)
Co-ordinates : Lat 20°03' Long 85°52'
Aquifer : Alluvium
Diameter : 1.85

Depth : 4.96
M P above G L : 0.41
R L of M P : 8.457
R L of G L : 7 892

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	2.96	N.A	1.02	0.76
1987	2.11	3.52	N.A	1.07	1.49
1988	2.24	2.89	N.A	N.A	N.A

34.Location : Baghmari (1)
Co-ordinates :
Aquifer : Laterite
Diameter :

Depth : 8.76
M P above G L : 0.95
R L of M P :
R L of G L :

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	6.38	N.A	1.17	1.20
1987	3.51	5.91	N.A	1.54	1.69
1988	2.61	5.43	N.A	N.A	N.A

35.Location : Balipatna (4)
Co-ordinates :
Aquifer : Coastal alluvium
Diameter : 0.85

Depth : 5.72
M P above G L : 0.62
R L of M P : 12.728
R L of G L : 12 003

YEAR	JAN	APR	JUN	AUG	NOV
1986	N.A	1.75	N.A	N.A	0.55
1987	1.09	1.68	N.A	1.53	0.86
1988	1.24	2.63	N.A	N.A	N.A

Source : Central Ground Water Board, S.E.R., Bhubaneswar, Orissa

ANNEXURE - 9

MONTH WISE DISCHARGES IN PURI MAIN CANAL (IN THOUSAND CUMECS)

SL.NO.	YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1.	1980	N A	N A	N A	N A	N A	NIL	0.708	2.322	0.850	2.662	0.283	N A
2.	1981	N A	N A	N A	N A	N A	N A	1.331	2.690	2.634	3.200	N A	N A
3.	1982	N A	N A	N A	N A	N A	N A	1.218	2.124	N A	N A	N A	N A
4.	1983	N A	N A	N A	N A	N A	NIL	0.850	1.416	1.133	3.002	2.662	1.274
5.	1984	1.529	1.982	2.577	2.294	1.699	NIL	0.510	2.520	1.699	3.710	1.671	0.906
6.	1985	0.368	1.812	2.634	2.124	1.841	NIL	1.133	1.246	0.793	1.643	1.416	1.331
7.	1986	1.331	2.351	3.398	3.398	2.577	0.396	0.821	0.878	3.427	1.416	1.784	1.699
8.	1987	0.736	2.379	2.351	3.710	2.067	NIL	1.416	2.577	3.172	3.427	1.444	0.312
9.	1988	0.736	1.926	2.917	2.889	1.756	NIL	0.850	2.152	2.152	2.917	2.152	0.283
10.	1989	0.595	0.481	0.623	1.558	0.793	NIL	0.651	2.237	2.436	1.926	N A	N A

SOURCE: DEPT. OF IRRIGATION, GOVT. OF ORISSA,BHUBANESHWAR.

ANNEXURE - 10

LENGTH OF CANALS,THEIR AVERAGE WETTED PERIMETER AND NUMBER OF RUNNING DAYS

SL. NO.	PROJECT NAME	TYPE OF CANAL	LENGTH (K.M.)	AVERAGE WETTED PERIMETER(m)	TOTAL WETTED AREA (Sq.m.)	AVERAGE NUMBER OF RUNNING DAYS MONSOON	NON-MONSOON
1.	MAJOR	MAIN	26.0	24.84	0.65 X 10 EXP06	120	180
2.	MAJOR	BRANCH AND DISTRIBUTARIES	694.0	7.25	5.03 X 10 EXP06	120	180
3.	MEDIUM	MAIN AND DISTRIBUTARIES	93.0	7.25	0.67 X 10 EXP06	120	180
4.	MINOR	MAIN AND DISTRIBUTARIES	200.0	3.15	0.63 X 10 EXP06	120	180

SOURCE: DEPT. OF IRRIGATION, GOVT. OF ORISSA,BHUBANESWAR.

ANNEXURE - 11

RIVER DISCHARGE DATA

NAME OF THE RIVER	NAME OF THE DIVISION	TYPE OF THE RIVER	LOCATION OF THE GAUGING SITE	DATE OF MEASUREMENT	METHOD OF MEASURMENT	DISCHARGE (CUMECS) RAINY	WINTER	SUMMER
I.MAHANADI	1. L.I. DIVISION CUTTACK	PERENNIAL	BARANGA (NARAJ)	17-08-84-R 03-11-84-W 02-06-84-S	GAUGE	23389.148	221.066	194.360
	2. L.I. DIVISION SAMBALPUR	PERENNIAL	B.TURUM BLOCK,BHEDAK	MARCH-84 DECEMBER-84	FLOAT METHOD	566.40	28.320	8.496
	3. L.I. DIVISION PHULBANI	PERENNIAL	HIRAKUD P.H.RELEASE		FLOAT METHOD	NA	283.200	226.560 TO 283.200
	4. L.I. DIVISION BHUBANESHWAR	PERENNIAL	KANTILO,BHAPUR BLOCK	27-05-84	FLOAT METHOD	566.40	424.80	283.200
II.MANDAKINI	1. L.I. DIVISION BHUBANESHWAR	PERENNIAL	TANLEALOAF OF TANGI BLOCK	26-04-84	FLOAT METHOD	7.08	5.664	4.673
III.DAHULEA	1. L.I. DIVISION BHUBANESHWAR	SEMI PERENNIAL	UDAYAPUR OF NAYAGARH BLOCK	21-04-84	FLOAT METHOD	0.708	0.423	--
IV.BURTANGA	1. L.I. DIVISION BHUBANESHWAR	SEMI PERENNIAL	RAMCHANDARPUR OF DASAPALLA BLOCK	17-04-84	FLOAT METHOD	0.423	0.283	--
V.BHARGABI	1. L.I. DIVISION BHUBANESHWAR	PERENNIAL	BHANDER PUR NEAR BRIDGE	28-04-84	FLOAT METHOD	5.098	5.098	2.520
VI.KANSARI	1. L.I. DIVISION BHUBANESHWAR	PERENNIAL	PERIKUHSERI OF CHILKA BLOCK	29-05-84	FLOAT METHOD	0.793	0.566	0.340
VII.KUSUMI	1. L.I. DIVISION BHUBANESHWAR	SEMI PERENNIAL	HAMETI BRIDGE OF NAYAGARH BLOCK	20-05-84	FLOAT METHOD	0.850	0.566	--
VIII.RAMA	1. L.I. DIVISION BHUBANESHWAR	PERENNIAL	TULSIPUR OF BEGUNIA BLOCK	18-05-85	FLOAT METHOD	0.850	0.708	0.566
IX.PRACHI	1. L.I. DIVISION BHUBANESHWAR	PERENNIAL	BELARAG OF KAKATPUR BLOCK	28-05-84	FLOAT METHOD	5.381	4.531	3.155
X.DAYA	1. L.I. DIVISION BHUBANESHWAR	PERENNIAL	NAKHARA OF BHUBANESHWAR BLOCK	14-03-84	FLOAT METHOD	6.174	4.956	3.540
XI.GANGUA	1. L.I. DIVISION BHUBANESHWAR	PERENNIAL	SISUPALGARH OF BHUBANESHWAR BLOCK	10-03-84	FLOAT METHOD	5.664	4.390	2.974

SOURCE: O.L.I.C.,BHUBANESHWAR.

ANNEXURE - 12

LAND UTILISATION PATTERN IN PURI DISTRICT

SL. NO.	CATEGORY	AREA IN SQ. KMS.
1.	TOTAL GEOGRAPHICAL AREA	10182
2.	HILLS AND FORESTS	612
3.	URBAN AREA AND LAND PUT TO NON AGRICULTURAL USE	1282
4.	BARREN AND UN-CULTIVABLE LAND	430
5.	PERMANENT PASTURE AND OTHER GRASSING LAND	660
6.	CULTIVABLE WASTE	410
7.	MISC.TREE CROPS AND GRAVES NOT INCLUDED IN NET AREA SOWN	270
8.	CURRENT FALLOWS	200
9.	OTHER FALLOWS	180
10.	CULTIVABLE AREA	4603
11.	CHILIKA LAKE	992
12.	SALINE AREA (NOT SUITABLE FOR AGRICULTURE)	543

SOURCE: "HYDROGEOLOGICAL SET UP AND GROUNDWATER DEVELOPMENT POTENTIAL OF PURI DIST.", REPORT OF GROUNDWATER SURVEY & INVESTIGATIONS,ORISSA LIFT IRRIGATION CORPORATION LTD., BHUBANESHWAR

ANNEXURE - 13

YEAR WISE GROSS COMMAND AREA OF DIFFERENT SOURCES IN PURI DIST.(POTENTIAL CREATED) IN SQ.KMS

SL. NO.	YEAR	SEASON	SOURCE			
			MAJOR AND MINOR IRRIGATION PROJECTS	MINOR IRRIGATION PROJECTS(FLOW)	LIFT IRRIGATION PROJECTS(RIVER LIFT)	C.D. & PRIVATE SOURCES (GROUNDWATER)
1.	1978-79	KHARIF	1662.0	180.0	60.0	95.0
		RABI	1137.0	18.0	36.0	76.0
2	1979-80	KHARIF	1162.0	190.0	70.0	110.0
		RABI	1137.0	18.0	42.0	88.0
3.	1980-81	KHARIF	1662.0	200.0	70.0	110.0
		RABI	1137.0	20.0	42.0	88.0
4.	1981-82	KHARIF	1662.0	200.0	80.0	120.0
		RABI	1137.0	20.0	48.0	96.0
5.	1982-83	KHARIF	1685.1	210.0	85.0	140.0
		RABI	1145.1	20.0	50.0	112.0
6.	1983-84	KHARIF	1685.1	230.0	95.0	160.0
		RABI	1145.1	22.0	57.0	128.0
7.	1984-85	KHARIF	1685.1	230.0	100.0	175.0
		RABI	1145.1	23.0	60.0	140.0
8.	1985-86	KHARIF	1685.1	236.0	106.0	183.5
		RABI	1145.1	23.8	63.6	143.3
9.	1986-87	KHARIF	1685.1	236.0	112.9	183.5
		RABI	1145.1	23.8	67.7	143.3
10.	1987-88	KHARIF	1685.8	240.5	116.8	345.9
		RABI	1145.5	36.0	70.0	143.3
11.	1988-89	KHARIF	1685.8	295.5	121.0	345.9
		RABI	1145.5	41.2	72.6	143.3
12.	1989-90	KHARIF	1811.1	301.3	130.1	345.9
		RABI	1281.6	44.6	92.2	91.2

SOURCES: 1.FROM 1985-86 TO 1989-90 DISTRICT STATISTICAL HAND BOOK 1990-91.
2.FOR PREVIOUS YEARS THE FIGURES ARE ESTIMATED BASED ON THE COMPLETION OF THE SCHEMES

DATA ON GEOPHYSICAL SOUNDING IN PURI DISTRICT

Sl. No.	Name of the village	Type of land	No.of layers present	Resistance in mt.	Thickness in mt.	Type of lithologs	Remarks
1	2	3	4	5	6	7	8
				Kakatpur Block			
1.	Lataharan	Plain land	6	52.0	1.2	Sandy loam	
				96.5	2.16	Sand	
				40.4	2.94	Clay	
				165.0	4.26	Sand fresh	
				44.1	90.75	Sand with clay	
				2.47		Saline sand	
2.	Tarat	-do-	4	50.0	1.8	Sand top	
				250.0	4.5	Sand	
				50.0	22.6	Sand saturated	
				15.3	-	Sandy clay	
3.	Raish	-do-	3	8.3	13.0	Clay	
				157.7	13.0	Sand fresh	
				15.3	-	Sandy clay	
4.	Gokulpur	-do-	3	28.0	1.27	Sandy clay	
				140.0	11.43	Sand	
				27.5	-	Sand with clay	

1	2	3	4	5	6	7	8
5.	Haladi Basanta	Plain land	3	25.0	2.18	Sandy clay	
				100.0	21.8	Sand	
				2.15	-	Saline sand	
6.	Kurujanga	-do-	4	23.2	1.3	Sandy clay	
				208.8	3.5	Sand	
				50.1	35.1	Fresh sand	
				18.3	-	Sand with clay	
7.	Jonofana	Plain land	4	13.7	2.4	Sady clay	
				123.3	7.2	Sand	
				52.3	68.2	Sand fresh	
				7.4	-		
8.	Gopikantapur	-do-	4	11.9	1.3	Sandy clay	
				22.6	3.9	Sand	
				47.5	95.4	Sand fresh	
				2.63	-	Sand saline	
9.	Kotkona	-do-	4	40.05	3.1	Top sand	
				160.2	8.7	Sand fresh	
				68.6	59.16	Sand with clay	
				3.7	-	Saline clay	
10.	Balisirei	-do-	4	11.5	1.6	Top clay	
				57.5	6.4	Sand	
				31.9	92.4	Sand with clay	
				24.9	-	Sandy clay	

1	2	3	4	5	6	7	8
11.	Kajalpatia	Plain land	4	9.6	1.5	Clay	
				38.4	18	Sand	
				21.3	80.0	Sandy clay	
				2.5		Saline sand	
12.	Kundhei Sandy tract	-do-	3	0.6	170.0		
				1.8	850.0		
				12.9	178.0		
13.	Near Kakatpur College	High land	3	36.5	1.9	Sand top	
				328.5	5.7	Sand	
				18.3		Sandy clay	
14.	Kutanga	Plain land	3	2.05	2.1	Top saline sand	
				3.75	33.6	Saline clay with sand	
				1.45		Saline sand	
15.	Swanaro	-do-	3	8.6	0.85	Clay	
				2.15	31.45	Saline sand	
				1.21		Saline sand	
16.	Osolang	-do-	5	35	1.38	Sandy clay	
				52.5	2.5	Sand	
				23	15.4	Sandy clay	
				7.5	63	Clay (Brackish)	
				2.43		Saline sand	

1	2	3	4	5	6	7	8
17.	Nilakanthapur	Plain land	4	66	0.88	Sandy soil	
				6.6	412.5	Clay	
				39	43.8	Sand (fresh)	
				412.5		Sand	
18.	Patsundarpur	-do-	4	8.6	1.37	Clay	
				4.3	1.75	Clay (wet)	
				84	7.8	Sand (fresh)	
				25.6		Sand with clay	
19.	Hasinapur/ Sohagpur	-do-	4	19.5	2.65	Sandy clay	
				5.85	8.55	Clay	
				35.5	3.36	Sand	
				22		Sand with clay	
20.	Kothamula/ Nivaran	-do-	4	11.5	3.3	Top clay	
				40.25	5.94	Sand	
				7.5	70	Saline clay	
				93.1		Sand (fresh)	
21.	Sohagpur	-do-	4	38	3.3	Sandy soil	
				11.4	5.6	Clay	
				76	26.4	Sand (fresh)	
				13.8		Clay (fresh)	

1	2	3	4	5	6	7	8
			Gop Block				
22.	Panchabatia	Plain land	5	4.0	1.45	Top clay	
				6.0	4.35	Brackish clay	
				27.0	13.2	Sand (fresh)	
				7.6	16.5	Sandy clay (fresh)	
				15		Sand with clay	
23.	Fakirpada	-do-	4	2.5	1.6	Saline clay	
				1.62	14.4	Saline sand	
				3.3	41.85	Clay (saline)	
				42		Sand fresh	
24.	Chaurasi	-do-	3	11.6	1.65	Sandy clay	
				116	23.1	Sand (fresh)	
				26.1		Sand with clay (fresh)	
25.	Jogeswarpur	-do-	3	10.0	1.75	Top clay	
				200.0	13.12	Sand (fresh)	
				16.2		Clay with sand	
26.	Baragara	-do-	3	9.4	3.2	Clay	
				94.0	25.6	Sand	
				18.6		Sandy clay	
27.	Bisilipara	-do-	3	19.0	2.0	Sandy clay	
				95.0	50.0	Sand (fresh)	
				27.4		Sandy clay (fresh)	

1	2	3	4	5	6	7	8
28.	Jadupur	Plain land	4	14 70.0 19.2 5.94	1.42 5.68 48.8	Sandy clay Sand (fresh) Sand with clay (fresh) Saline clay	
29.	Koladi	-do-	4	36.5 127.8 55 17.7	1.21 9.68 34.58	Sandy clay Sand fresh Sand with clay Clay (fresh)	
30.	Math Sahi (Bhimpara)	-do-	3	9.0 45 4	1.7 25.5	Clay Sand (fresh) Saline clay	
31.	Desunthi	-do-	4	9.7 14.5 45.85 28	1.9 5.13 29.2	Clay Sandy clay Sand (fresh) Sand with clay (fresh)	
32.	Dandi Kera	-do-	3	3.6 60.2 30.55	2.6 31.2	Clay Sand (fresh) Sandy clay (fresh)	
33.	Olango	-do-	4	4.85 7.27 5.4 11.6	1.7 9.35 19.6	Saline clay Brackish clay Saline clay Clay	

1	2	3	4	5	6	7	8
34.	Somtukula	Plain land	5	3	1	Top saline clay	
				2	4	Brackish clay	
				13.32	2.35	Sandy clay	
				7.35	128	Clay	
				0.81		Saline sand	
35.	Gashsitho	-do-	6	2.42	1.32	Top saline clay	
				4.84	1.32	Saline clay	
				1.056	1.3	Saline sand	
				3.956	3.85	Saline clay	
				1.23	60	Saline sand	
				11.1		Fresh sandy clay	
36.	Biratunga	-do-					
37.	(Nipaniagarh) Narasinghapur Sasan	-do-	5	29.5	1.6	Sandy clay	
				23.6	1.92	Sandy clay	
				91	22.4	Sand	
				25.6	46.5	Sand with clay	
				76		Sand	
38.	Kundra	-do-	4	3.85	1.02	Brackish clay	
				11.55	3.06	Sandy clay (Brackish)	
				2.9	28	Saline sand	
				8.8		Clay	

1	2	3	4	5	6	7	8
39.	Patelia Keutunga	Plain land	4	7 4.62 50 5	1.33 26.6 26	Top clay Brackish clay Fresh sand Brackish clay	
40.	Begunia	-do-	4	7.35 44.1 2.5 12.5	1.25 3.75 6.96	Top clay Sand (fresh) Brackish clay Sandy clay (fresh)	
41.	Begunia Chhak	High land	6	11.5 3.9 11 2.54 7.2 21.6	1.35 1.35 3.1 11.1 21.6	Top sandy clay Brackish clay Sandy clay Saline sand Clay (Brackish) Sand (fresh)	
42.	Sarada	Plain land	4	2.15 1.43 2.4 16	1.02 0.51 13.6	Top sandy clay (saline) Sand (saline) Saline sand Fresh sand	
43.	Gundi	-do-	6	4.5 6.75 1.3 13.8 0.64 6.4	1.7 0.85 1 7.4 8.5	Top clay Clay (Brackish) Saline sand Clay (Brackish) Sand (saline) Clay (Brackish)	

1	2	3	4	5	6	7	8
44.	Bana Khandi	Plain land	5	18	3.1	Sandy clay	
				5.94	24.8	Clay (Brackish)	
				0.62	16.8	Sand saline	
				15.7	10.8	Sandy clay	
				0.78		Saline sand	
45.	Madhipur	High land	4	13000	2.8	Top sand (Dry)	
				858	8.4	Sand	
				607	25.2	Moist sand	
				9.2		Sand with clay	
46.	Konark (Heliped)	-do-	5	2450	1.3	Top dry sand	
				808.5	3.9	Dry sand	
				34	3.075	Moist sand (Aquifer)	
				250	31.2	Sand (fresh)	
				20.8		Sand with clay (fresh)	
47.	From 1 km. away Chandrabhaga	-do-	4	33000	0.55	Top dry sand	
				1320	3.3	Dry sand (fresh)	
				130	25.6	Moist sand (fresh)	
				9.1		Sandy clay (fresh)	

1	2	3	4	5	6	7	8
				Nimapara Block			
48.	Kantilo	Plain land	3	6 100.0 46.0	3.3 42	Clay Sand fresh Sandy clay (fresh)	
49.	Alakunda Brahmakundi	-do-	3	10.0 76.27 33.0	2.0 44.66	Clay Sand fresh Sand mixed with clay	
50.	Nahanfa'a	-do-	3	6.6 14.0 40.0	3.3 26.0	Clay Sandy clay Sand	
51.	Ghanti	-do-	2	3.26 11.6	4.0	Clay (saline) Sandy clay	
52.	Garapada	-do-	4	6.2 30.0 18.96 48.31	8.0 32.0 26.7	Clay Sand mixed with clay Sandy clay Sand fresh	
53.	Bhillagram	-do-	4	8.2 34.0 61.5 34.72	4.7 22.0 26.7	Clay Sandy clay Sand (fresh) Sand mixed with clay	

(Source: ''Hydrological set up and Ground Water Development Potential of Puri District'', Report of Ground Water Survey and Investigation, Orissa Lift Irrigation Corporation Limited, Bhubaneswar.)

Annexure - 15

DATA ON RECUPERATION TESTS CONDUCTED IN PURI DISTRICT

Sl. No.	Name of the Block	Location of the wells	Diameter in metres	Depth in metres	Depth of water table b.g.l. in metres	Type of aquifer tapped by the well	Drawdown imposed in metres	'K' coeffi-cient of permea-bility in m/sec.	Specific capacity in lit/min/ min drawdown
1	2	3	4	5	6	7	8	9	10
1.	Gop	Junia	1.17	5.7	2.69	Sandy clay	1.91	0.67×10^{-3}	11.20
2.	Kakatpur	Kurujang	0.99	4.42	2.896	Sandy clay	1.346	0.417×10^{-3}	64
3.	Satyabadi	Sri Ramachandra-pur	1.24x1.24	4.62	3.12	Sand	1.447	0.205×10^{-3}	32.50
4.	Brahmagiri	Gokhara	0.91	6.71	5.05	Sandy clay	1.33	0.105×10^{-3}	1.55
5.	Astarang	Astarang	0.70	4.86	3.24	Sandy clay	1.56	0.044×10^{-3}	4.71
6.	Nimapada	Gopalpur	1.88	4.72	1.88	Sand	1.73	0.000023	3.18
7.	Kanas	Moduipur	0.965	4.546	3.132	Sandy clay	1.17	0.63×10^{-4}	8.795

1	2	3	4	5	6	7	8	9	10
8.	Puri Sadar	Chalisablia	1.041	7.62	5.079	Sandy clay	2.82	0.016×10^{-3}	1.595
9.	Delang	Sarangoi	0.736	6.603	3.35	Sandy clay	3.05	0.15×10^{-3}	16.52
10.	Chilika	Nimikuta	2.30	4.05	2.20	Black clay with kankar		5.55×10^{-5}	1825
11.	Daspalla	Khalasahi	2.69	7.52	3.66	Weathered granite	3.048	0.133×10^{-3}	51.88
12.	Balianta	Bentapur	0.85	4.6	0.95	Sandy clay	3.55	0.054×10^{-3}	43.98
13.	Khurda	Pllatotopada	1.879	2.539	0.94	Weathered granite	2.438	0.212×10^{-3}	1601.13
14.	Gania	Nangbkanta	1.600	6.400	3.59	Weathered granite	2.438	0.051×10^{-3}	7.26
15.	Balipatna	Orakhand	0.70	4.20	2.00	Sandy clay	2.00	0.2×10^{-3}	21.25
16.	Begunia	Dingar	1.57x1.57	5.070	3.403	Weathered granite	2.64	0.07×10^{-3}	37.87
17.	Odagaon	Angisingi	1.600	3.58	2.235	Sandy clay	1.07	23.54×10^{-3}	790.13

(Source: ''Hydrological set up and Ground Water Development Potential of Puri District'', Report of Ground Water Survey and Investigation, Orissa Lift Irrigation Corporation Limited, Bhubaneswar.)

BLOCK WISE LIMITING VALUE OF WATER ANALYSIS DATA
IN PURI DISTRICT

Sl. No.	Name of the Block	No. of water sample analysed	Nature of well	pH value	Conductivity	Carbonate Co_3.
1	2	3	4	5	6	7
1.	Puri Sadar		T.W.	6.1 to 8.5	0.08 to 10.6	Nil to 60.0
			D.W.	6.4 to 8.85	0.162 to 10.036	Nil to 72.0
2.	Kanas		B.H.	6.75 to 8.5	0.279 to 6.264	Tr to 12.0
3.	Ranapur		D.W.	6.65 to 8.4	0.25 to 1.25	Tr.
4.	Daspala		B.H.	7.2 to 8.85	0.254 to 1.92	Tr. to 24.0
5.	Gania		D.W.	7.1 to 8.4	0.264 to 1.44	Tr to 24.0
6.	Kakatpur		T.W.	7.1 to 8.6	0.04 to 3.7	Tr to 48.0
			D.W.	6.7 to 8.9	0.1 to 6.1	Tr.

Bicarbonate HCO_3	Chloride Cl.	Sulphate So_4.	Sodium Na.	Potassium K.	Calcium $Ca.^+$	Magnesium Mg.	T.S.S.
8	9	10	11	12	13	14	15
12.2 to 702.05	17.75 to 3283.75	Tr to 24.0	15 to 2550	Tr to 62.0	3.2 to 480.0		80.0
48.8 to 919.45	31.95 to 3649.4	Tr to 52.8	17 to 2156.0	Tr to 80.0	8.64 to 564.48		150 to 9659
48.8 to 610.0	69.94 to 3145.58	Tr to 395.7	-	-	16.0 to 430.4		329 to 5245
36.6 to 366.0	12.24 to 266.2	Tr	-	-	6.4 to 164.8		173.4 to 1769.0
96.0 to 414.8	19.44 to 268.95	-	35.0 to 400.0	Tr to 100.0	16.8 to 124.8		192.0 to 1497.0
48.8 to 353.8	17.75 to 196.0	-	9.0 to 600.0	Tr to 47.0	16.0 to 112.0		103 to 823.9
71.98 to 366.0	30.175 to 744.45	-	17 to 765	1 to 66	16.0 to 164.34		182 to 2260.0
46.36 to 651.48	17.72 to 1615.25	Tr to 97.6	18 to 931.4	1 to 73.5	15.04 to 300.8		132 to 3428.7

1	2	3	4	5	6	7
7.	Krushnaprasad		T.W.	7.1 to 8.5	0.20458 to 4.9	Nil to 4.0
			D.W.	6.5 to 8.8	0.15 to 7.8	Tr.
8.	Pipili		B.H.	6.5 to 8.1	0.18 to 1.97	Tr.
9.	Satyabadi		D.W.	7.2 to 8.7	0.42 to 10.9	Tr to 24.0
10.	Banapur		D.W.	7.9 to 9.2	0.138 to 4.88	Tr to 36.0
11.	Khurda		D.W.	6.02 to 8.1	0.09 to 4.246	Tr to 60.0
12.	Balianta		D.W.	6.6 to 8.85	0.16 to 2.94	Tr to 48.0
13.	Gop		D.W.	7.0 to 8.8	0.17 to 7.6	Nil to 48.0
			T.W.	7.0 to 8.7	0.11 to 2.3	Nil to 36.0

8	9	10	11	12	13	14	15
73.2 to 305.0	24.86 to 1366.75	-	to 376.0	to 78.0	3.52 to 104.45		192.4 to 2508.0
9.76 to 480.68	17.45 to 2195.8	Tr to 156.0	-	-	7.68 to 359.68		182.0 to 4389.7
24.4 to 366.0	9.72 to 330.2	Tr to 70.8	41.0 to 402.5	-	9.2 to 105.6		122.0 to 1204.5
61.0 to 965.4	53.25 to 3440.8	Tr to 170.0	40 to 6630.0	4 to 73.0	19.2 to 745.6		308 to 6592.7
24.4 to 463.6	20.64 to 1699.36	Tr to 50.0	39 to 1288.0	5 to 105.0	9.6 to 457.6		114.6 to 3995.6
12.2 to 479.25	17.75 to 1065.0	-	-	-	6.4 to 178.56		110 to 3157.5
48.8 to 585.6	9.72 to 546.0	-	5.0 to 1272.0	Tr to 190	9.6 to 138.0		114.0 to 1806.0
85.4 to 951.6	35.5 to 1701.6	-	11.0 to 122.0	1.0 to 184.0	33.72 to 1064.99		181.0 to 4356.0
48.8 to 475.8	17.25 to 514.01	-	9.0 to 330.0	1.0 to 117.0	6.4 to 160.75		103 to 1175.0

1	2	3	4	5	6	7
14.	Bhapur		D.W.	6.4 to 8.9	0.151 to 3.55	Nil to 36.0
15.	Nimapara		T.W. D.W.	6.5 to 9.09 6.5 to 8.92	0.093 to 1.31 0.142 to 13.4	Nil to 48.0 Nil to 84.0
16.	Astaranga		D.W.	6.79 to 8.9	0.107 to 6.13	Nil to 24.0
17.	Tangi		-	6.5 to 9.2	0.05 to 3.4	6 to 25.5
18.	Astaranga	25	B.H.-8 D.W.-17	7.0 to 9.0	0.01 to 3.13	Tr.
19.	Gop	63	T.W.-19 D.W.-30 B.H.-14	7.00 to 8.7	0.114 to 11.68	6.00 to 24.00

8	9	10	11	12	13	14	15
24.4 to 780.8	19.44 to 674.5	-	15.0 to 440.0	Tr to 70	8.0 to 508.8		198 to 1735.0
36.6 to 536.6	29.6 to 509.6	-	21.0 to 496.0	2.0 to 76.0	3.2 to 61.87		140.0 to 1036.0
36.6 to 890.6	17.72 to 3952.67	-	22.0 to 2125.0	1.0 to 128.0	9.6 to 608.0		186.0 to 6396.0
24.4 to 463.6	26.63 to 2002.92	-	4.0 to 880.0	1.0 to 364.0	16.0 to 243.2		65.0 to 3600.0
18.5 to 353.5	9.18 to 264.6	17.96	-	-	6.4 to 240.3		201.0 to 1891.0
48.8 to 431.6	45.8 to 709.9	15.0 to 62.0	142.3 to 1218.5	11.9 to 523.4	16.0 to 99.2		392.5 to 1891.0
24.40 to 610.0	30.80 to 8164.0	15.0 to 204.0	63.0 to 2530.0	10.00 to 396.0	9.60 to 704.80		36.40 to 13548.90

1	2	3	4	5	6	7
19.	Brahmagiri	-	-	7.30 to 8.95	0.36 to 17.40	3.00 to 48.00
20.	Balianta	41	D.W.-26 B.H.-15	6.6 to 8.7	0.2 to 3.12	12.0
21.	Balipatna	23	D.W.-13 T.W.-1 B.H.-9	6.5 to 9.0	0.33 to 1.97	Tr.

8	9	10	11	12	13	14	15
24.40 to 390.40	48.60 to 7217.10	21.50 to 140.40	-	-	16.00 to 960.00		206.60 to 5263.00
48.8 to 439.2	9.72 to 546	50.0	102.0 to 1272.0	4 to 106	9.6 to 153.6		114.0 to 1956.4
48.8 to 488.0	36.4 to 364.0	Tr to 33.6	102.5	-	19.2 to 102.4		216.7 to 1606.2

(Source: ''Hydrogeological set up and Ground Water Development Potential of Puri District'', Report of Ground Water Survey and Investigation, Orissa Lift Irrigation Corporation Limited, Bhubaneswar)

STUDY GROUP

Dr.S.M.SETH	DIRECTOR
Dr. P V SEETHAPATHI	**SCIENTIST 'F'**
Sri J V TYAGI	**SCIENTIST 'C'**
Sri S M SAHEB	**S R A**
Sri U V N RAO	**R A**