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GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER YEAR BOOK 2013-14 of GOA STATE

CENTRAL GROUND WATER BOARD
SOUTH WESTERN REGION
BANGALORE
AUGUST 2014

GROUND WATER YEAR BOOK 2013-14 OF GOA STATE

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FOREWORD

Groundwater is a dynamic and replenishable precious natural resource; it requires to be monitored regularly and also to be appraised of the changes that are taking place in its regime. In this regard, Central Ground Water Board collects the groundwater level and quality data from the National Hydrograph Network stations. The water levels are monitored four times a year during the months of May, August, November and January and the samples for determination of the quality of the groundwater are collected once a year during the month of May. This report consists of the water level of ***Goa state*** *for the year 2013-14 and chemical quality data collected during the year 2013. Maps showing the depth to groundwater level in different parts of Goa and the changes observed in the water level in the last one-year and last one decade are included and discussed in the report. The report also consists of the discussions on distribution and variation of rainfall in the state for normal period. Chemical quality of groundwater on the basis of the samples collected during May 2013 and the interpretation of the data is included in the report.*

The data has been compiled, interpreted and presented by Shri.H.P.Jayaprakash, Scientist 'C', Smt. Rakhi U.R., Sientistc 'B', Smt.Bijmol Jose, Asst. Hydrogeologist, Smt. Hemalatha, STA(Hydrogeology), Shri. T.Murthy, Asst.Chemist, and Shri. Rahul Vashist, STA (Chem.), for the groundwater regime and quality aspects. A lots of effort have been put in by various personnel of SWR, Bangalore and WKSU, Belgaum office for the collection of timely and reliable field data. The water samples were analysed in the Regional Chemical Laboratory to bring out the aspects of groundwater quality. Shri .S. S .Hegde, Scientist 'C' and J. Sivaramakrishnan, Asst. Hydrogeologist of Report Processing Section have carried out the necessary processing of the report to bring to the final stage.

It is hoped that the information contained in this yearbook will be useful for planners and all the user agencies associated with development of water resources in the State.

(G.SUDARSHAN)
Regional Director

ABSTRACT

***Goa** state has a geographical area of 3702 sq.kms and is divided into 2 districts with 11 taluks. Central Ground Water Board has collected water level data of the phreatic aquifer from 92 National Hydrograph Network Stations during the months of May, August, November, 2012 and January 2013. This report contains the analysis and interpretation of the collected data.*

Thematic maps depicting the groundwater scenario during this period are prepared and discussed. Average annual rainfall of the State is 320 cm, increasing from 270 cm in the west (on the coast) to 400 cm in the east. Similarly, rainfall decreases from south to north along the coast as well as interiors. While the annual rainfall in the North Goa district averages 316 cm, it is 330 cm in the south Goa district. The months of June and July are the wettest months with around 100 cm rainfall each month. Rainfall during the months of January and February is negligible. Valpoi in the north Goa and Quepem in the south Goa, the both in interior hilly areas, are the wettest places in the State.

The pre-monsoon depth to water level recorded in the State reveals that about 82% of the wells have water level less than 10 mbgl and the rest show in the range of 10-20 mbgl. During post-monsoon season about 94% of the wells recorded less than 10 mbgl water level and the remaining 6% wells have water level of 10-20 mbgl. Results of chemical analysis of the groundwater samples show that all the samples are suitable for domestic, irrigation and industrial purposes.

GROUND WATER YEAR BOOK 2013-14
GOA STATE

1. GENERAL FEATURES

1.1. Introduction

Central Ground Water Board, South Western Region, Bangalore, is monitoring water levels in the State of Goa from the established network of 92 monitoring stations, as a part of 'Ground Water Regime Monitoring'. This monitoring is done four times in a water year during i.e. May, August, November and January for water level. Water samples from these stations are collected once in a year during the month of May to assess the ground water quality.

The State of Goa located between 14°53'54" and 15°48'00" north latitudes and 73° 40' 33"and 74° 20' 13" east longitudes is situated on the western coast of Peninsular India. It is bounded in the north by Maharashtra State, in the east and south by Karnataka State and in the west by the Arabian Sea. The State has a total geographical area of 3702 sq. km., which is administratively divided into two districts with 11 taluks. The talukwise distribution of the number of Hydrograph Stations being monitored by the Region is given in Table1.1.

Table 1.1: District wise distribution of Hydrograph Stations

Sl.No.	Taluk	Geographical Area (Sq. km)*	No. of NHS Stations
District: North Goa			
1	Tiswadi	213.6	6
2	Bardez	264.0	11
3	Pernem	251.7	6
4	Bicholim	238.8	7
5	Satari	495.1	11
6	Ponda	292.8	5
District: South Goa			
7	Sanguem	873.7	18
8	Cancona	352.0	10
9	Quepem	318.3	4
10	Salcete	292.9	13
11	Mormugao	109.1	1

** Source: Statistical Pocket Book of Goa 1993-94, Directorate of Planning, Statistics and Evaluation, Government of Goa*

1.2 Physiography

Goa State forms part of coastal tract of the west coast of India. Physiographically, the State is divided into four morphological units, viz. 1.**Costal plains** with dominant Marine land forms on the west, followed successively towards the east 2. **Vast stretch of plain**. 3. **Low dissected denudation hills and table land** and 4. **Deeply dissected high Western Ghats,** denududational hills occurring all along the eastern part of Goa rising to a maximum of 832 m amsl. The Alluvial landforms are limited in areal extent.

1.3 Drainage

The State of Goa is drained by the west flowing rivers, Terekhol, Chapora, Mandovi and Zuari. The Sahyadri hill ranges in the east form the main watershed. The streams originating here flow in westerly and northwesterly direction to join the Arabian Sea. Major portion of the State is drained by the two rivers, viz. Mandovi and Zuari. The river Terekhol forms the northern boundary of Goa State and separates it from the Maharashtra State. The other smaller rivers draining the State are the rivers Chapora, Baga, Saleri, Sal, Talpona and Galgibaga (Table1.2). The underlying rocks primarily control the drainage system in the area. The drainage pattern is generally dendritic type. The major river Zuari follows the major NW synclinal axis. The river valleys are 'V' shaped in the western high hill ranges, but broaden in central midlands and become 'U' shaped in the low lands and coastal plains (Fig - 1.1).

Table 1.2: Details of the Major/Minor river Basin area in Goa State

Drainage Basin / Sub-Basin	Area		Taluks
	Sq. km.	%	
Terekhol	71	1.93	Pernem
Chapora	255	6.88	Pernem, Bicholim, Bardez
Baga	50	1.35	Bardez
Mandovi	1580	42.68	Bicholim, Bardez, Satari, Sanguem, Tiswadi & Ponda
Zuari	973	26.28	Tiswadi, Ponda, Salcete, Quepem, Mormugao Sanguem & Cancona
Sal	301	8.13	Mormugao, Salcete, Quepem, & Cancona
Saleri	149	4.03	Quepem, & Cancona
Talpona	233	6.29	Cancona & Sanguem
Galgibaga	90	2.43	Cancona
Total	3702		

1.4 Hydrogeological Conditions:

Major part of the Goa State is underlain by rocks of Pre-cambrian age comprising banded biotite gneisses, Meta volcanics, phyllites, biotite and chlorite schists, greywacke, conglomerate (tilloid), pink phyllites with associated banded ferruginous quartzite and chart breccia. These rocks are intruded by ultra basic, basic sills and dykes, followed by granites and pegmatites. Dolerite dykes and quartz veins form the youngest intrusives in the area (Table1.3).

The Deccan Trap basalts of Late Cretaceous to Early Eocene age occupy a small portion in the northeastern part in the high altitudes.

Almost all formations in the State have undergone lateritisation to various degrees depending upon the climate and rock type. The lateritisation is more pronounced in the coastal areas than in the hilly regions. Phyllites, Schists and Meta volcanics are more susceptible to lateritisation and the gneissic / granitic rocks are least susceptible. In general, the thickness of laterites varies from about 3 m to 30 m. Laterites are highly porous due to the process of leaching and weathering. Hence, they have very good capacity to hold and transmit groundwater. Groundwater in laterites occurs under phreatic condition.

Major portion of the State is occupied by crystalline rocks and consolidated metamorphosed sedimentaries, which do not possess primary porosity. Secondary porosity, introduced through weathering, fracturing and jointing, produces the void spaces to hold and transmit ground water. Groundwater in these rocks occurs under water table condition in the weathered zone and under semi-confined to confined conditions in the deeper fractured zones.

Beach sands along the coast and alluvium along major rivers have limited occurrence and the ground water occurs in the primary porosity under water table condition.

FIG.1.1

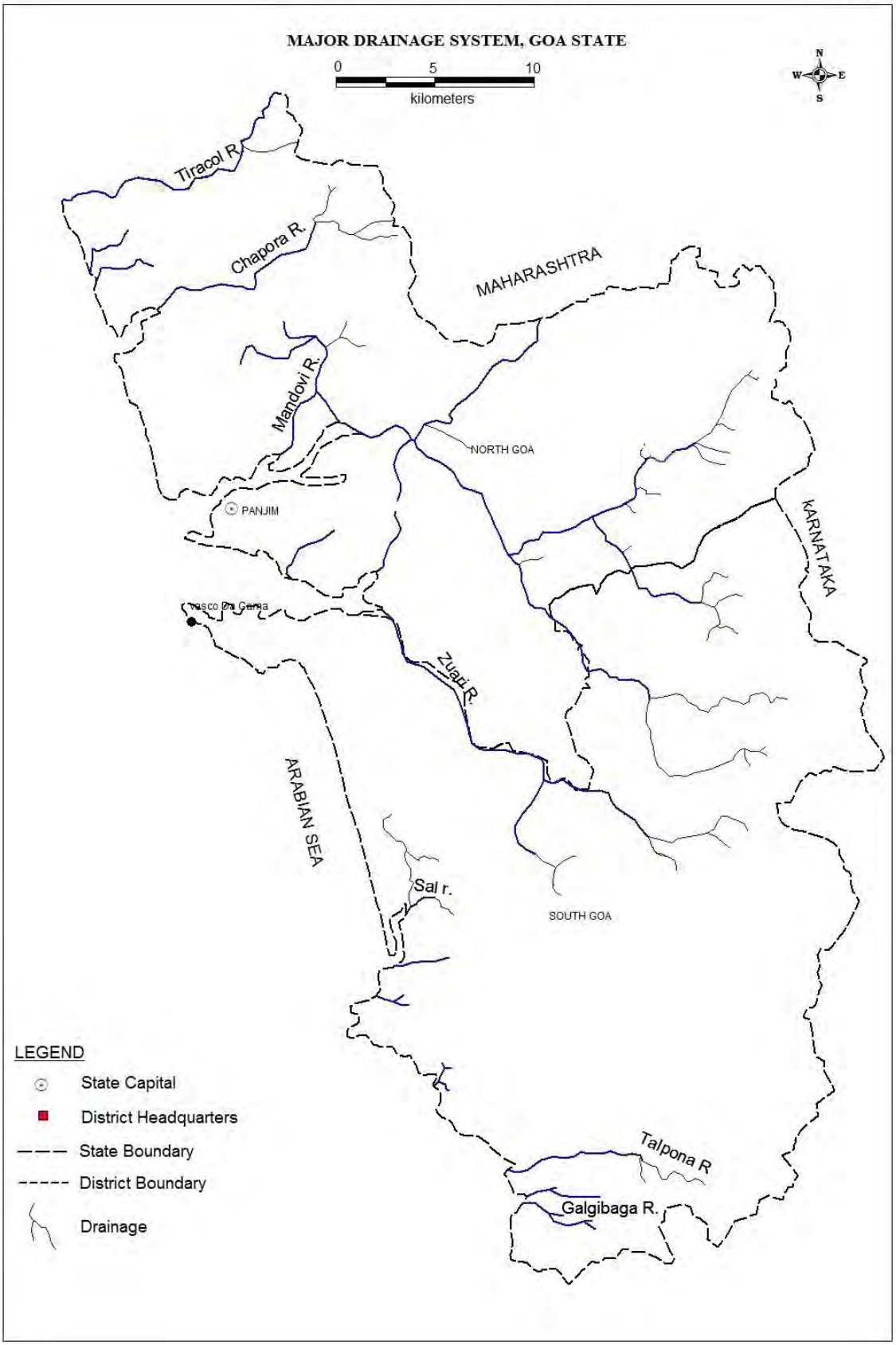

MAJOR DRAINAGE SYSTEM, GOA STATE
0
5
10
kilometers
N
W
E
S
Tiracol R.
Chapora R.
MAHARASHTRA
Mandovi R.
NORTH GOA
PANJIM
KARNATAKA
Vasco Da Gama
Zuari R.
ARABIAN SEA
Sal r.
SOUTH GOA
Talpona R
Galgibaga R.
LEGEND
State Capital
District Headquarters
State Boundary
District Boundary
Drainage

FIG 1.2

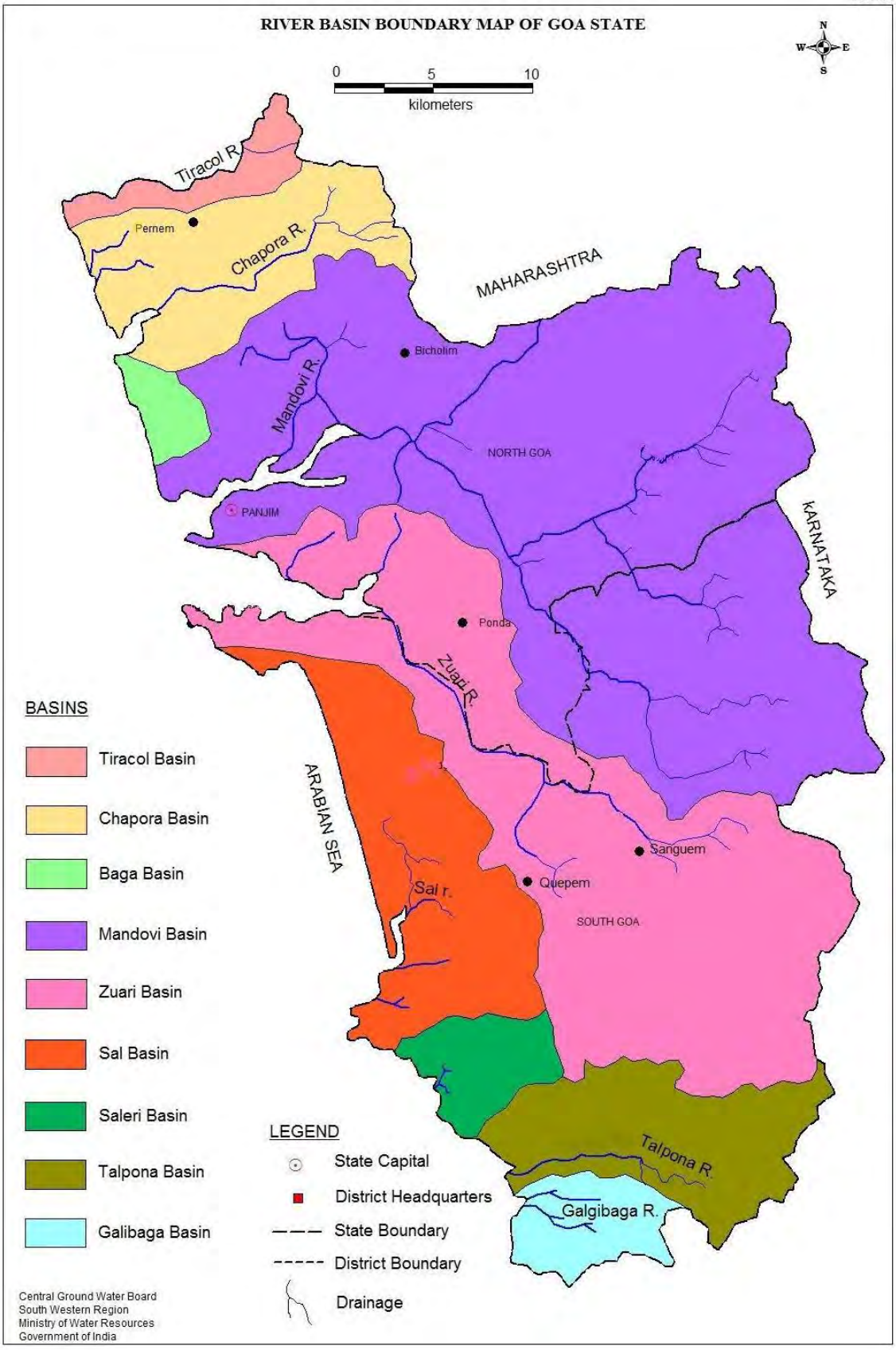
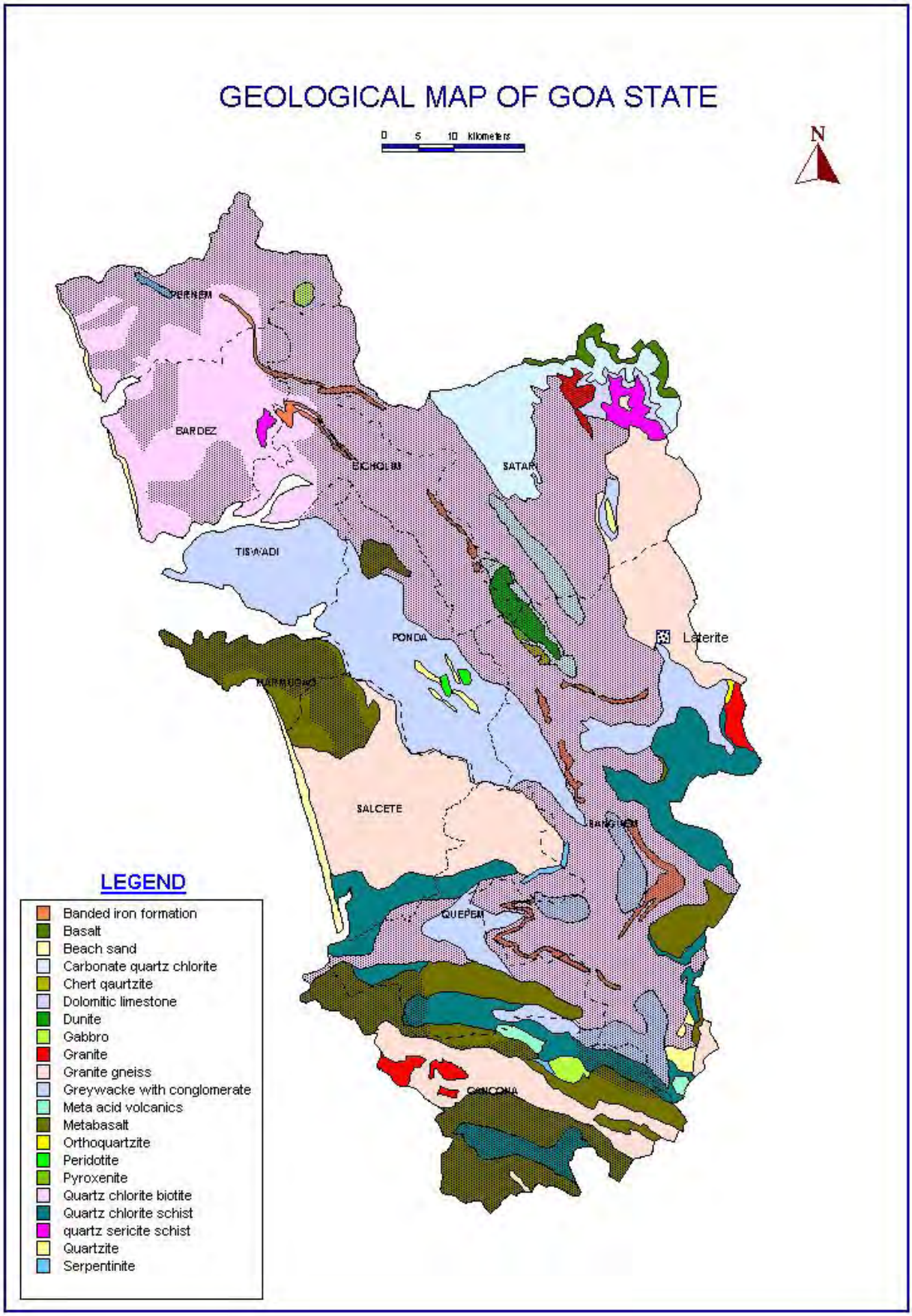

RIVER BASIN BOUNDARY MAP OF GOA STATE
N
W
E
S
0
5
10
kilometers
Tiracol R.
Pernem
Chapora R.
MAHARASHTRA
Bicholim
Mandovi R.
NORTH GOA
PANJIM
KARNATAKA
Ponda
Zuari R.
ARABIAN SEA
Sanguem
Quepem
Sal r.
SOUTH GOA
Talpona R.
Galgibaga R.
BASINS
Tiracol Basin
Chapora Basin
Baga Basin
Mandovi Basin
Zuari Basin
Sal Basin
Saleri Basin
Talpona Basin
Galibaga Basin
LEGEND
State Capital
District Headquarters
State Boundary
District Boundary
Drainage
Central Ground Water Board
South Western Region
Ministry of Water Resources
Government of India

FIG.1.3.


GEOLOGICAL MAP OF GOA STATE
0 5 10 kilometers
N
PERNEM
BARDEZ
BICHOLIM
SATARI
TISWADI
PONDA
Laterite
MORMUGAO
SALCETE
QUEPEM
SANGUEM
CANACONA
LEGEND
Banded iron formation
Basalt
Beach sand
Carbonate quartz chlorite
Chert qaurtzite
Dolomitic limestone
Dunite
Gabbro
Granite
Granite gneiss
Greywacke with conglomerate
Meta acid volcanics
Metabasalt
Orthoquartzite
Peridotite
Pyroxenite
Quartz chlorite biotite
Quartz chlorite schist
quartz sericite schist
Quartzite
Serpentinite

2. CLIMATE AND RAINFALL

Goa state has a tropical-maritime monsoonal type climate with distinct orographic influence. The climate is equable and humid throughout the year. Due to the maritime climate, the diurnal variation in temperature is not pronounced. The months of January and February are dry with clear skies and generally pleasant. May is the hottest month with temperature around 30°C and January the coolest month with temp 25°C.

2.1 Rainfall

Rain occurs during the monsoon period from June to September in Goa state. Over 90 percent of the annual rainfall occurs during monsoon period. The balance of 10 percent occurs during the pre-monsoon period from March to May and post-monsoon period from October to December. However, the rainy period extends from May to November.

The analysis of Rainfall data for the period of 1970 to 2000 from 12 stations over the State indicates that the monsoon rainfall is in the order of 3160.06 mm (90.74 % of annual rainfall), 218.1mm (6.26%) during post-monsoon period of October to December and 104.42 mm (3.99%) are from January to May months. The overall annual rainfall over the Goa state based on 30 years rainfall data is 3483.3 mm. The minimum rainfall of 2611.7 mm is recorded at Mormugao station in South Goa and maximum of 5090 mm is in Sanguem station which also falls in South Goa.

The annual normal rainfall in North Goa ranges from 2766.9 mm at Panaji along the west coast and the highest at Volpoi in the east (Ghats section) indicating increase in rainfall from west to east. Average rainfall in North Goa is 3400.1mm and in south Goa. Similarly, the average rainfall in South Goa is 3733.13 mm. It ranged from2611.7 mm at Mormugao on west coast and maximum at Sanguem in the east which indicates that in South Goa also the rainfall increases from west to east.

The months of June (840.7 mm) and July (1246.9 mm) are the wettest months with around 2187.6 mm (62.80% of annual normal rainfall) rainfall. Rainfall during the months of January and February is negligible. Valpoi in the north Goa and Sanguem in the south Goa, both in the interior hilly areas, are the wettest places in the State. Isohyetal map of Goa State for the period 1970 to 2000 has been presented in figure 2.1 and the Isohyetal map of monsoon rainfall is in figure 2.2. Normal monthly rainfall of in respect of 12 stations of Goa State is presented in Annexure-II.

Fig 2.1

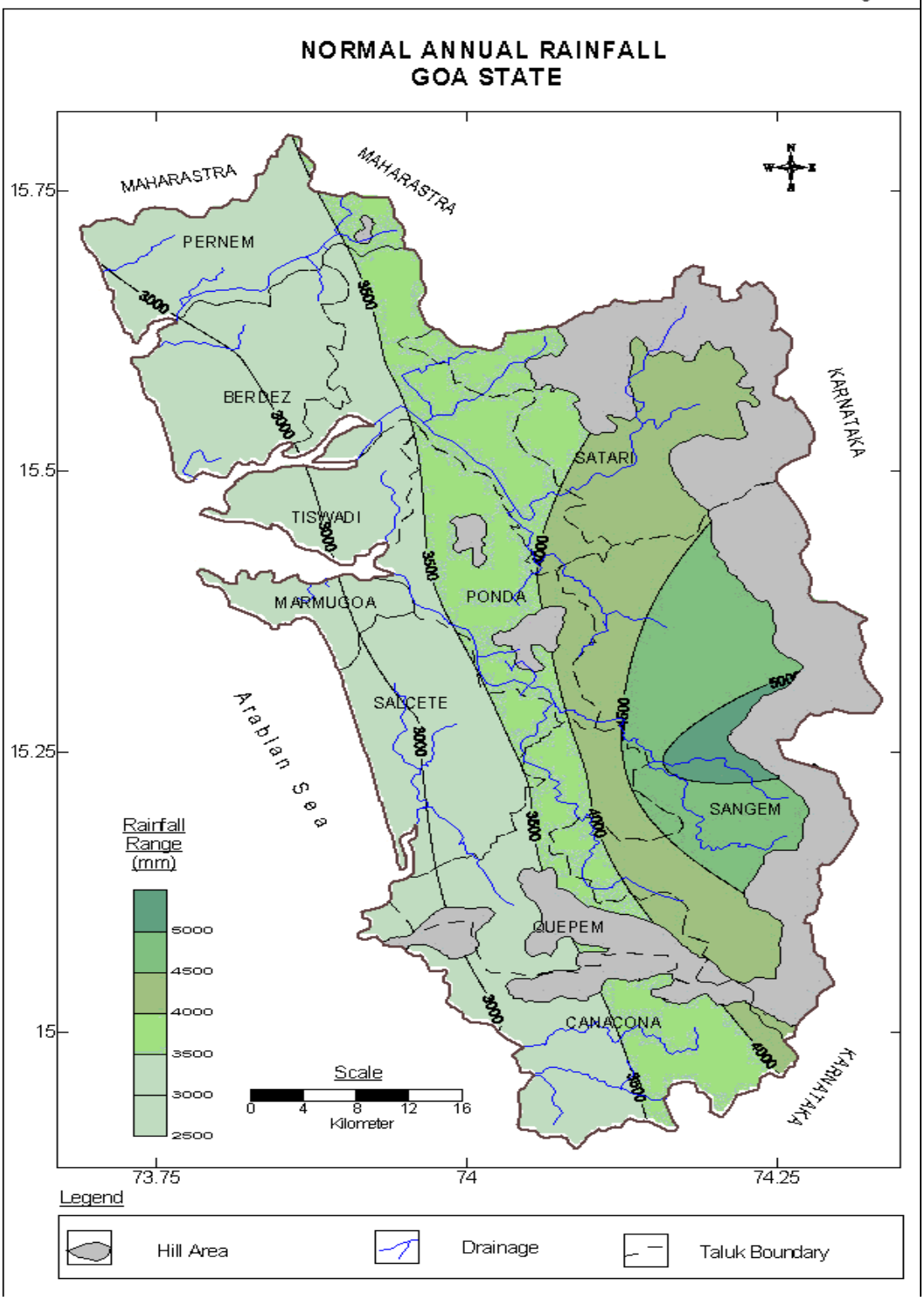
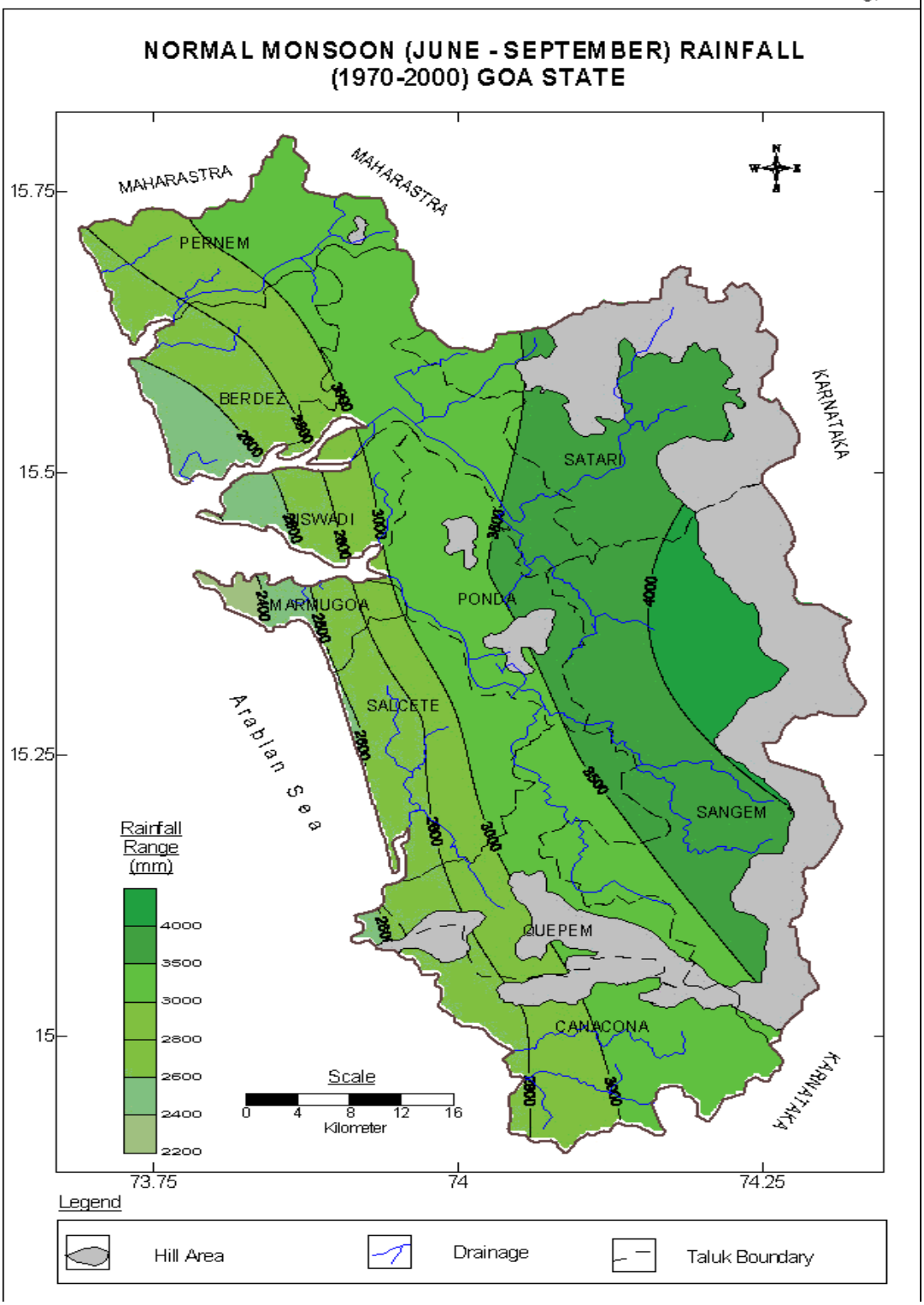

NORMAL ANNUAL RAINFALL
GOA STATE
MAHARASTRA
MAHARASTRA
PERNEM
BERDEZ
TISWADI
MARMUGOA
SALCETE
PONDA
SATARI
SANGEM
QUEPEM
CANACONA
KARNATAKA
KARNATAKA
Arabian Sea
3000
3500
4000
4500
5000
15.75
15.5
15.25
15
73.75
74
74.25
Rainfall Range (mm)
5000
4500
4000
3500
3000
2500
Scale
0 4 8 12 16
Kilometer
Legend
Hill Area
Drainage
Taluk Boundary

Fig , 2.2


NORMAL MONSOON (JUNE - SEPTEMBER) RAINFALL
(1970-2000) GOA STATE
MAHARASTRA
MAHARASTRA
PERNEM
BERDEZ
SATARI
KARNATAKA
ISWADI
PONDA
MARMUGOA
SALCETE
Arabian Sea
SANGEM
QUEPEM
CANACONA
KARNATAKA
15.75
15.5
15.25
15
73.75
74
74.25
Rainfall Range (mm)
4000
3500
3000
2800
2600
2400
2200
Scale
0 4 8 12 16
Kilometer
Legend
Hill Area
Drainage
Taluk Boundary

3. GROUND WATER LEVELS IN GOA DURING WATER YEAR 2013-14

Central Ground Water Board, South Western Region, Bangalore has a network of 92 Ground Water Monitoring stations in Goa under the Programme 'Ground Water Regime Monitoring' of the Board which works out to be one GWMS in 70 sq.km.

The above network comprises 92 stations, which are predominantly domestic dug wells and are monitored four times a year during the months of January, May, August and November for water levels and once a year for quality during the month of May. These wells are monitored between 1st to 10th during the months of January and November and between 20th and 30th during the months of May and August. General details of Goa State GWMS are furnished in Annexure I.

3.1 Depth to Ground Water Levels

Monitoring of Ground Water Monitoring Stations in Goa was carried out during May, August, November 2013 and January 2014. The analysis/findings are as below:

Depth to Water Level - May 2013

The depth to water level recorded in the State of Goa during May 2013 ranged from 1.68 mbgl to 18.86 mbgl. It is seen that out of 81 stations analysed during the month, 4% wells have water level less than 2 mbgl, 33% wells have 2 to 5 mbgl water level, 50% wells have 5 to 10 mbgl water level, 13% wells have 10 to 20 mbgl water level (Table.3.1).

A map showing the depth to water level in the ranges of <2, 2 to 5, 5 to10 and 10 to 20 mbgl is enclosed as Fig 3.1. The depth to water level map shows that the water level in the range of 2 to 5 and 5 to 10 m bgl is the general water level in the State. Water level in the range of 10 to 20 m bgl is seen in Bicholim, Satari, Ponda, Bardez, Cancona and Sanguem taluks as patches. Small patches of water level less than 2 mbgl is noticed in Tiswadi, Quepem and Pernem taluks of North Goa.

Depth to Water Level - August 2013

The depth to water level recorded in the State of Goa during August 2013 ranged from 0.03 mbgl to 16.15 mbgl. It is seen that out of 76 stations monitored during the month, 42% wells have less than 2 mbgl water levels, 41% wells have 2 to 5 mbgl water level, 13% wells have 5 to 10 mbgl water level and the remaining 4% wells have 10 to 20mbgl water level (Table.3.2).

A map showing the depth to water level in the ranges of <2, 2 to 5, 5 to10 and 10 to 20 mbgl is enclosed as Fig.3.2. It is observed from the map that, general water level in the State is between 0 – 2 and 2 – 5 mbgl. 5 – 10 mbgl water level is noticed in parts of Pernem Satari, Ponda, Salcete, Sanguem, Quepem and Cancona taluks. Further, more than 10 m water level is seen in parts of Bicholim, Ponda and Cancona taluks.

Depth to Water Level - November 2013

The depth to water level recorded in the State of Goa during November 2013 ranged from 0.27 mbgl to 15.24 mbgl. It is seen that out of 75 stations monitored during the month, 22% wells have less than 2 mbgl water levels, 41% wells have 2 to 5 mbgl water levels, 29% wells have 5 to 10 mbgl water level and the remaining 8% wells have 10 to 20 mbgl water level (Table.3.3).

A map showing the depth to water level in the ranges of <2, 2 to 5, 5 to10 and 10 to 20 mbgl is enclosed as Fig 3.3. Major part of the State shows depth to water level in the range of 2 to 5 mbgl. Depth to water level of 0-2 mbgl is observed in parts of Bardez, Pernem, Tiswadi, Mormugao, Salcete and Cancona and 5-10 mbgl is observed as isolated patches in Pernem, Satari, Bicholim taluks and more than 10 mbgl noticed in few places of Bicholim, Cancona and Sanguem taluks.

Depth to Water Level - January 2014

The depth to water level recorded in the State of Goa during January 2014 ranged from1.28 mbgl to 18.45 mbgl. It is seen that out of 85 stations monitored during the month, 11 % wells have less than 2 mbgl water levels, 48 % wells have 2 to 5 mbgl water levels, 31 % wells have 5 to 10 mbgl water level and the remaining 10 % wells have 10 to 20 mbgl water level (Table.3.4).

A map showing the depth to water level in the ranges of <2, 2 to 5, 5 to10 and 10 to 20 mbgl is enclosed as Fig 3.4. Water level of less than 2 mbgl is observed in parts of Pernem, Bardez, Tiswadi and Mormugao taluks. Depth to water level in the range of 2 to 5 mbgl is observed in major part of the State covering almost all the taluks. Depth to water level more than 10 mbgl noticed as small patches in Pernem, Bicholim, Satari, Ponda, Sanguem, Quepem and Cancona taluks.
Water level data for all the seasons for water year 2013-14 has been furnished in Annexure-III.

3.2 Fluctuations in Ground Water Levels

Analysis of fluctuation / rise and fall of ground water levels measured during the different periods was carried out. Pre-monsoon water levels measured during May 2013 are compared with water levels during August 2013, November 2013 and January 2014 to know the seasonal fluctuations. Water levels measured for a given month during consecutive years are compared to know the annual fluctuation. Further water levels of each measurement are compared with the mean water levels pertaining to the same months of the preceding decade to know the long-term changes. The fluctuation details are given in Annexure-IV. Summary of the analysis is given below:

Change in Groundwater Level - May 2013 to August 2013

Water levels from 72 stations were compared to know the change in groundwater level in August 2013 as compared with May 2013 in the State of Goa. On the whole 70 wells accounting for

98% of the analysed wells have recorded a rise in water level during August 2013 as compared with the period May 2013.The remaining 2 wells (2%) has recorded a fall (Table.3.5).

In the rise category, the rise of water level in the range 0-2 m is observed in 18 wells accounting for 25% of the analysed wells. Rise in water level in the range of 2 to 4 m. and >4m is recorded in 29 wells (41%) and 23 wells (32%) respectively. In the fall category, 2 wells (2 %) have recorded a fall in water level in the range of 0 to 2 m.

A map depicting the change in groundwater level in August 2013 as compared to May 2013, showing rise/fall in the ranges of 0 to 2 m, 2 to 4 m and >4 m is enclosed as Fig 3.5. The water level rise in the range of 0 to 2 m, 2 to 4 m is observed in almost all the taluks and more than 4 m rise of water level is observed in the parts of Bardez, Pernem, Bicholim, Satari, Sanguem, Salcete, Quepem and Cancona taluks.

Change in Groundwater Level - May 2013 to November 2013

Water levels from 71 stations were compared to know the change in groundwater level in November 2013 as compared with May 2013 in the State of Goa. On the whole, 61 wells accounting for 86% of the analysed wells have recorded a rise in water level during November 2013 as compared with the period May 2013. The remaining 10 wells (14%) have recorded a fall in water level (Table.3.6).

In the rise category, the rise of water level in the range 0-2 m is observed in 22 wells accounting for 31% of the analysed wells. Rise in water level in the range of 2 to 4 m and >4m is recorded in 28 wells (39%) and 11 wells (16%) respectively. In the fall category, 8 wells (11 %) have recorded a fall in the range of 0 to 2m and 2 wells (3%) has recorded a fall in the range of >4 m.

A map showing the change in groundwater level in November 2013 as compared to May 2013, showing rise/fall in the ranges of 0 to 2 m, 2 to 4 m and >4 m is enclosed as Fig 3.6. Major part of the State is showing rise in water level except few patches of water level fall in the range of 0-2 m as noticed in Cancona, Quepem, Sanguem, Salcete and Satari taluks. More than 2 m fall is observed as isolated patches in Cancona and Salcete taluks.

Change in Groundwater Level - May 2013 to January 2014

Water levels from 79 stations were compared to know the change in groundwater level in January 2014 as compared with May 2013 in the State of Goa. On the whole, 72 wells accounting for 91% of the analysed wells have recorded a rise in water level during January 2014 as compared with the period May 2013. The remaining 7 wells (9%) have recorded fall in water level (Table.3.7).

In the rise category, the rise of water level in the range 0-2 m is observed in 55 wells accounting for 70% of the analysed wells. Rise in water level in the range of 2 to 4 m is

recorded in 15 wells (19%) and rise more than 4 m is recorded in 2 (2%) wells. In the fall category, 6 wells (8%) have recorded a fall in the range of 0 to 2 m. Fall in water level in the range of 2-4 is recorded in 1 well (1%) and fall of more than 4 m has not been recorded.

A map showing the change in groundwater level in January 2014 as compared to May 2013, showing rise/fall in the ranges of 0 to 2 m, 2 to 4 m and >4 m is enclosed as Fig 3.7. Major part of the State is showing rise in water level in the range of 0 to 2 m and 2-4 m of rise as observed in Satari, Sanguem, Cancona, Quepem, Salcete and Bardez taluks. Fall in water level in the range of 0-2 m is observed as patches in Pernem, Salcete and Sanguem taluks. However, a small patch in water level fall of 2-5m is noticed in Salcete taluk.

Change in Groundwater Level - May 2012 to May 2013

Water levels from 41 stations were compared to know the change in groundwater level in May 2013 as compared with May 2012 in the State of Goa. It is seen from the table that, 49% of the stations monitored have recorded a fall in water level during May 2013 as compared to May 2012 and 51% have shown rise in water level. Further, it is seen that 16 wells accounting for 39% of the analyzed wells have recorded a fall in water level in the range of 0 to 2 m, 3 wells accounting for 7% of the analyzed wells have recorded a fall in water level in the range of 2 to 4 m and 1 well accounting for 3% has recorded a fall in water level in the range of >4 m. Rise in the water level in the range of 0-2 m has been recorded in 20 wells accounting for 49%, 1 well accounting for 2% has recorded rise in the range of 2-4 m (Table.3.8).

A map depicting the change in groundwater level in May 2013 as compared to May 2012, showing rise/fall in the ranges of 0 to 2 m, 2 to 4 m and >4 m is enclosed as Fig 3.8. Fall in water level in the range of 0-2 m is observed in major part of the State covering all the taluks and noticed in Pernem, Quepem, Ponda, Tiswadi, Satari, Mormugao and Cancona taluks. Fall in water level in the range of 2-4 m and >4 m is observed in Bardez and Bicholim taluks. Rise in water level in the range of 0-2 m is noticed in Pernem, Bicholim, Ponda, Salcete, Sanguem, Cancona taluks. Rise in water level in the range of 2-4 m is observed a small patch in Salcete taluk.

Change in Groundwater Level - August 2012 to August 2013

Water levels from 36 stations were compared to know the annual change in groundwater level in August 2013 as compared to August 2012 in the State of Goa. It is seen from the data that, 12 stations accounting for 33% of analysed wells have recorded a fall in water level in the range of 0 to 2 m. The remaining 24 wells (67%) are showing a rise in the range of 0 to 2 m of water level (Table.3.9).

A map depicting the change in groundwater level in August 2013 as compared to August 2012, showing rise/fall in the ranges of 0 to 2 and 2 to 4m, and > 4m is enclosed as Fig. 3.9. It is observed that water level fall in the range of 0 to 2 m is observed in western parts of the State covering Pernem, Bardez, Tiswadi, Ponda, Mormugao, Salcete and Cancona taluks. Whereas, rise in water level is noticed in almost all the taluks, except in Mormugao taluk.

Change in Groundwater Level - November 2012 to November 2013

Water levels from 40 stations were compared to know the annual change in groundwater level in November 2013 as compared to November 2012 in the State of Goa. It is seen from the data that, 18 stations accounting for 45% of analyzed wells have recorded a fall in water level in the range of 0 to 2 m and no well recorded fall in the range of 2-4 m and >4 m. In the rise category 21 wells (53%) that have recorded water level fall in the range of 0-2 m and 1 well accounting for 2 % recorded fall in the range of 2-4 m (Table.3.10).

A map showing the change in groundwater level in November 2013 as compared to November 2012, showing rise/fall in the ranges of 0 to 2 m, 2 to 4m, and > 4m is enclosed as Fig 3.10. Fall in water level in the range of 0 to 2 m is noticed in almost all parts of Bardez, Bicholim, Pernem, Tiswadi, Ponda, Quepem and Sanguem taluks and as isolated patches in Satari, Cancona and Mormugao taluks. Rise in water level in the range of 0 to 2 m noticed in Bardez, Cancona, Sanguem, Satari, Bicholim, Quepem, Mormugao and Salcete taluks. Water level rise in the range of 2- 4 m is noticed as a small patch in Salcete taluk.

Change in Groundwater Level - January 2013 to January 2014

Water levels from 78 stations were compared to know the annual change in groundwater level in January 2014 as compared to January 2013 in the State of Goa. It is seen from the data that, out of 78 stations of analyzed wells have recorded a rise in water level in the range of 0 to 2 m accounting for 57%. Rise in water level of 2-4 m is recorded in 4 wells (5%). Fall in water level in the range of 0 to 2 m, 2 to 4 m and more than 4 m is observed in 24 (31%), 5 (6%) and 1 (1%) respectively (Table.3.11).

A map showing the change in groundwater level in January 2014 as compared to January 2013, showing rise/fall in the ranges of 0 to 2 and 2 to 4m,and > 4m is enclosed as Fig 3.11. Major part of the State shows rise in water level in the range of 0-2 m in all most all taluks. Rise in water level of > 2 m is observed as small patches in Bicholim, Quepem and Sanguem taluks. Fall in water levels in the range of 0-2 m is recorded major part of in Satari, Ponda, Bicholim, Pernem, Bardez, Cancona, Salcete taluks and as patches in Mormugao, Sanguem and Quepem taluks. More than 2 m fall noticed as isolated patches in Pernem, Sanguem, Quepem and Cancona taluks.

Change in Groundwater Level - Mean (May 2003 to May 2012) – May2013

Mean groundwater level for the period May 2003 to May 2012 was compared with the groundwater level in May 2013 in the State of Goa. It is seen that, out of the 42 stations compared, 19 stations accounting for 45% of analyzed wells have shown a rise in water level. The remaining 23 wells accounting for 55% have shown a fall in water level.

In the rise category, 16 wells accounting for 38% of the analysed wells are in the range of 0 to 2 m and 3 wells accounting for 7% are in the range of 2-4 m rise in water levels. In the fall category, 19 wells accounting for 45% of the wells, recorded in the range of 0 to 2m, 3 wells accounting for 7% are in the range of 2 to 4 m and 1 well accounting for 2% is showing more

than 4 meter water level fluctuation during May 2013 as compared to preceding decadal mean (Table.3.12).

A map showing the change in water levels, with rise/fall in the ranges of 0-2 m, 2-4m and >4m is enclosed as Fig 3.12. Rise in water levels 0-2 m is observed in major parts of Salcete, Sanguem, Satari, Bardez, Pernem, Tiswadi and Ponda taluks, a small patches of 2-4 m of water level rise is observed in Bardez, Salcete, Quepem and Tiswadi taluks. Fall in water level less than 2 m is observed in major parts of Cancona, Quepem, Salcete, Sanguem, Mormugao and Ponda taluks. 2-4 m of fall in water levels is found in Quepem, Pernem and Bardez taluks and more than 4 m of fall is also observed in Bardez taluk.

Change in Groundwater Level - Mean (Aug 2003 to Aug 2012) – August 2013

Mean groundwater level for the period August 2003 to August 2012 was compared with the groundwater level in August 2013 in Goa State. It is seen that, out of the 42 stations compared, 16 wells accounting for 38% have shown a rise in the range of 0 to 2 m and 3 wells accounting for 7% show water level rise in the range of 2 to 4m. In the fall category, 0 – 2 m is observed in 19 stations (45%), 2 – 4 m in 3 stations (7%) and >4 m in one station (2%) respectively during August 2013 as compared to proceeding decadal mean **(**Table.3.13).

A map showing the change in water levels, with rise/fall in the ranges of 0-2 m and 2-4 m and >4 m is enclosed as Fig 3.13. Fall in the water level in the range of 0-2 m is observed as patches in Pernem, Mormugao, Salcete, Quepem and Sanguem taluks. Rise in water level in the range of 0 -2 m is covering all the taluks. Rise in the range of 2 – 4 m is noticed in small patches in Bardez and Satari taluks.

Change in Groundwater Level- Mean (Nov 2003 to Nov 2012) – Nov 2013

Mean groundwater level for the period November 2003 to November 2012 was compared with the groundwater level in November 2013 in the State of Goa. It is seen that, out of the 40 stations compared, 23 wells accounting for 56% of analysed wells have shown a rise in the range of 0 to 2 m, 2 wells (5%) shown a rise in the range of 2 to 4 m and 1 well (2%) shown a rise in the range of >4 m. The remaining 14 wells accounting for 35% showed a fall in water level of 0 to 2 m during November 2013 as compared to preceding decadal mean (Table.3.14).

A map showing the change in water levels, with rise/fall in the ranges of 0-2 m and 2-4 m and >4 m is enclosed as Fig 3.14. Major part of the State is showing rise in the range of 0 to 2 m water level. Rise in the range of 2 to 4 m is observed as isolated patches in Bardez, Salcete and Quepem taluks. Fall in water level in the range of 0 to 2 m is observed in Sanguem, Satari, Cancona, Bicholim and Pernem taluks.

Change in Groundwater Level- Mean (Jan 2004 to Jan 2013) – Jan 2014

Mean groundwater level for the period January 2004 to January 2013 (decadal mean water level) was compared with the groundwater level in January 2014 in the State of Goa. It is seen that out of the 44 stations compared, 26 wells accounting for 59% of analysed wells have shown a rise in the range of 0 to 2m and 2-4m water level rise is observed in 2 stations (4%) is noticed as a small patch in Bardez taluk. 14 wells accounting for 32% showed a fall in water level of 0 to 2m and 2- 4 m water level observed in 2 wells (5%) during January 2014 as compared to proceeding decadal mean (Table.3.15).

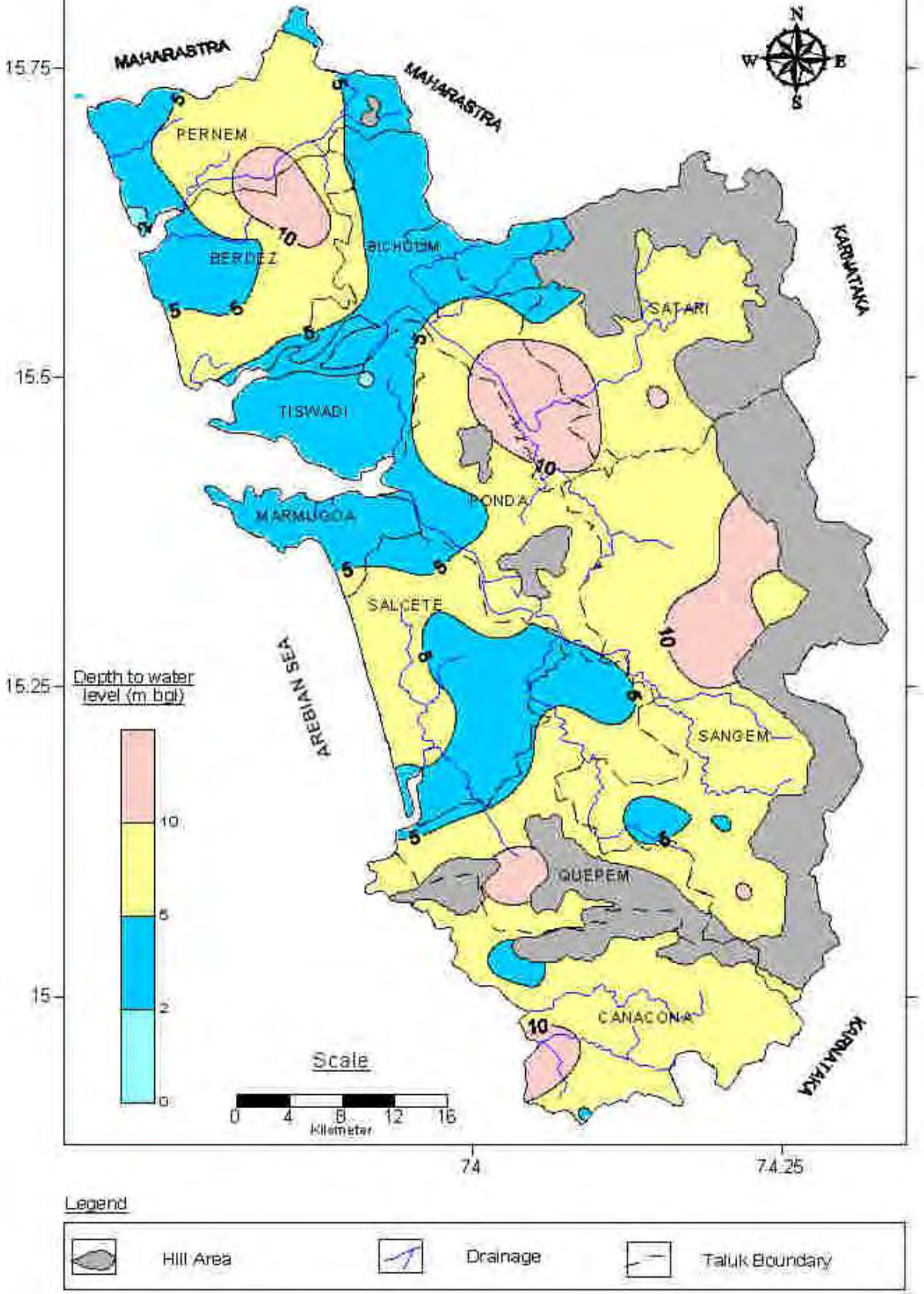
A map showing the change in water levels, with rise/fall in the ranges of 0-2 m and 2-4 m and >4 m is enclosed as Fig 3.15. Major part of the State is showing rise in water level in the range of 0 to 2 m. Rise in water level in the range of >2 m is observed as an isolated patch in Bardez taluk. Fall in water level of 0 to 2 m is noticed in major portions of Pernem, Satari, Mormugao, Salcete, Quepem, Cancona and Bicholim taluks and as small patches in Sanguem, Ponda and Tiswadi taluks. Fall in water level of more than 2 m is noticed as patches in Pernem and Salcete taluks.

3.3 Depth to Water Level – Piezometers

CGWB has a network of 49 piezometers drilled in Goa State under Hydrology Project II. These piezometers are also monitored for manual water level along with the dug well four times in a year. The water level data of these piezometers during the water year 2013-14 is given in Annexure-V. However, the piezometers water levels are not used in the preparation of water level and fluctuation maps.

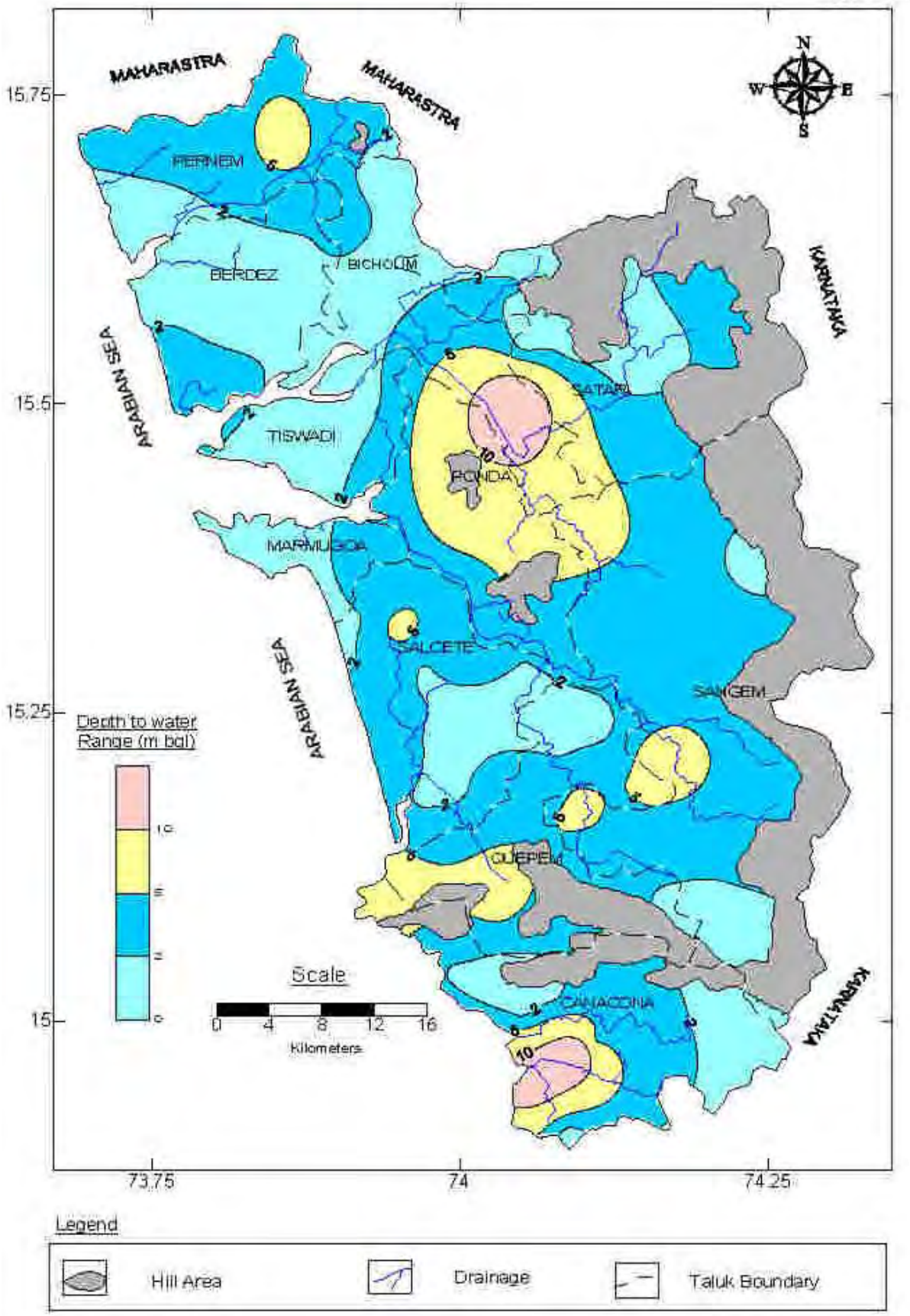
DEPTH TO WATER LEVEL MAP MAY 2013, GOA STATE

Fig - 3.1



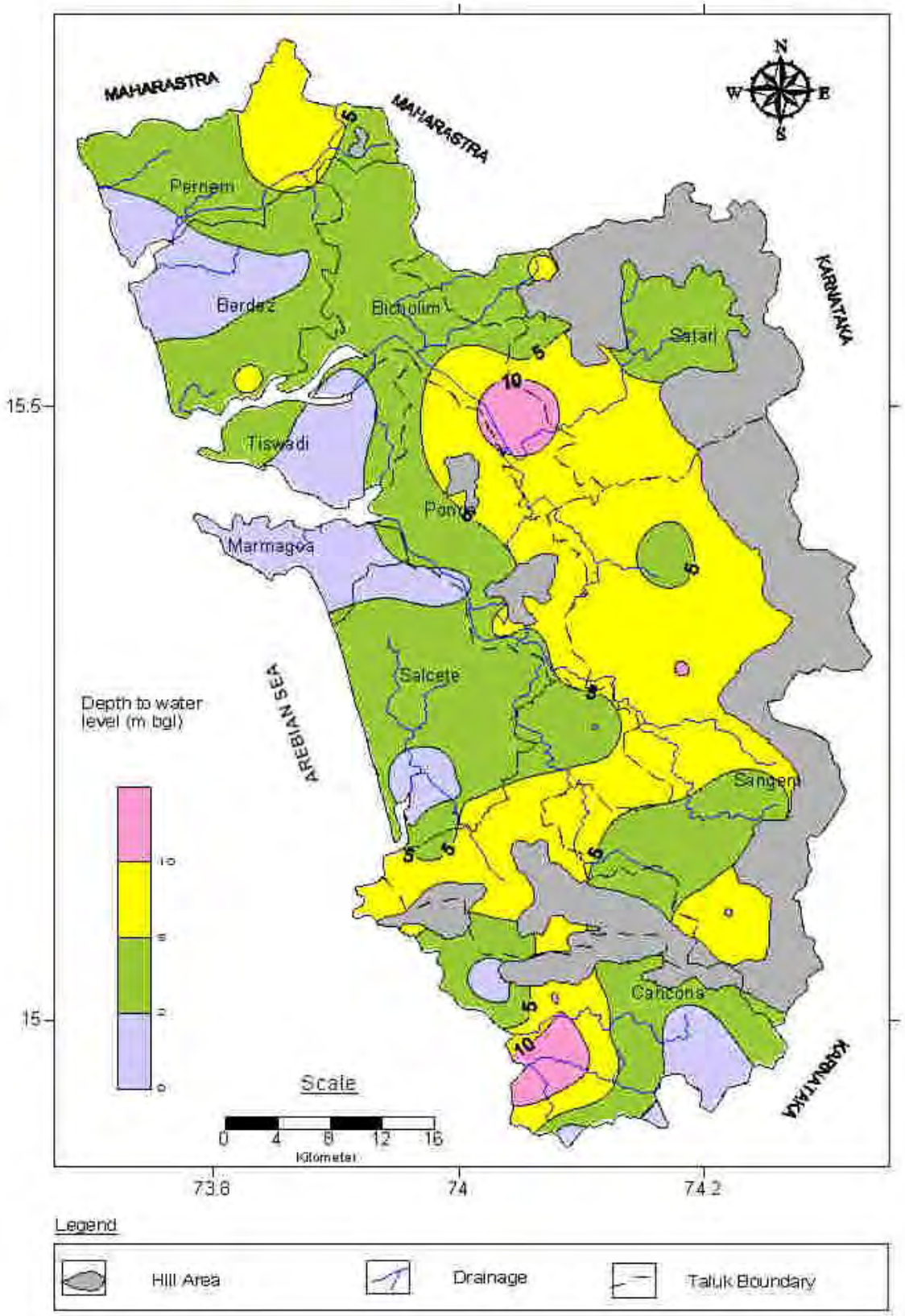
DEPTH TO WATER LEVEL MAP AUGUST 2013, GOA STATE

Fig - 3.2



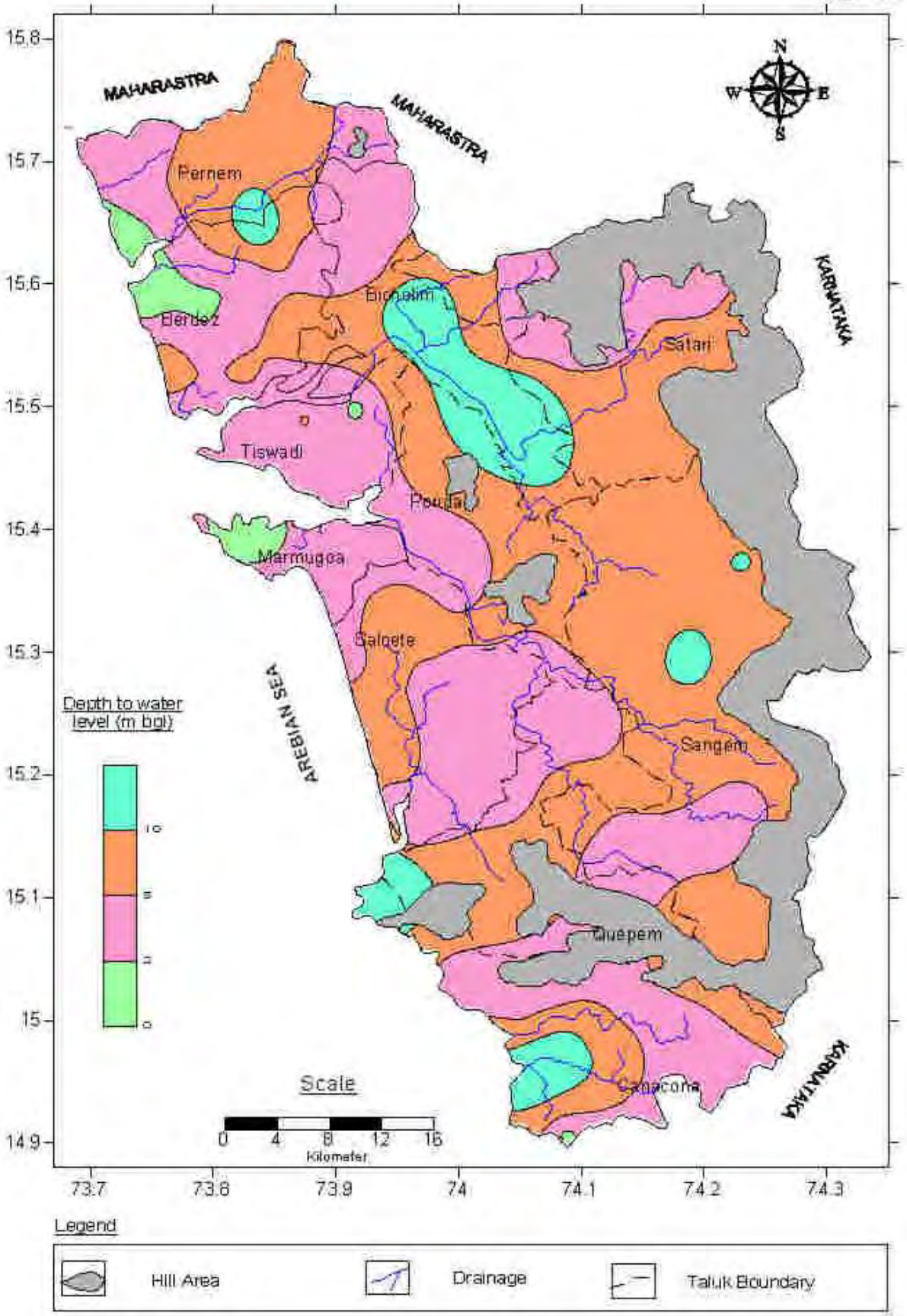
DEPTH TO WATER LEVEL MAP NOVEMBER 2013, GOA STATE

Fig 3.3



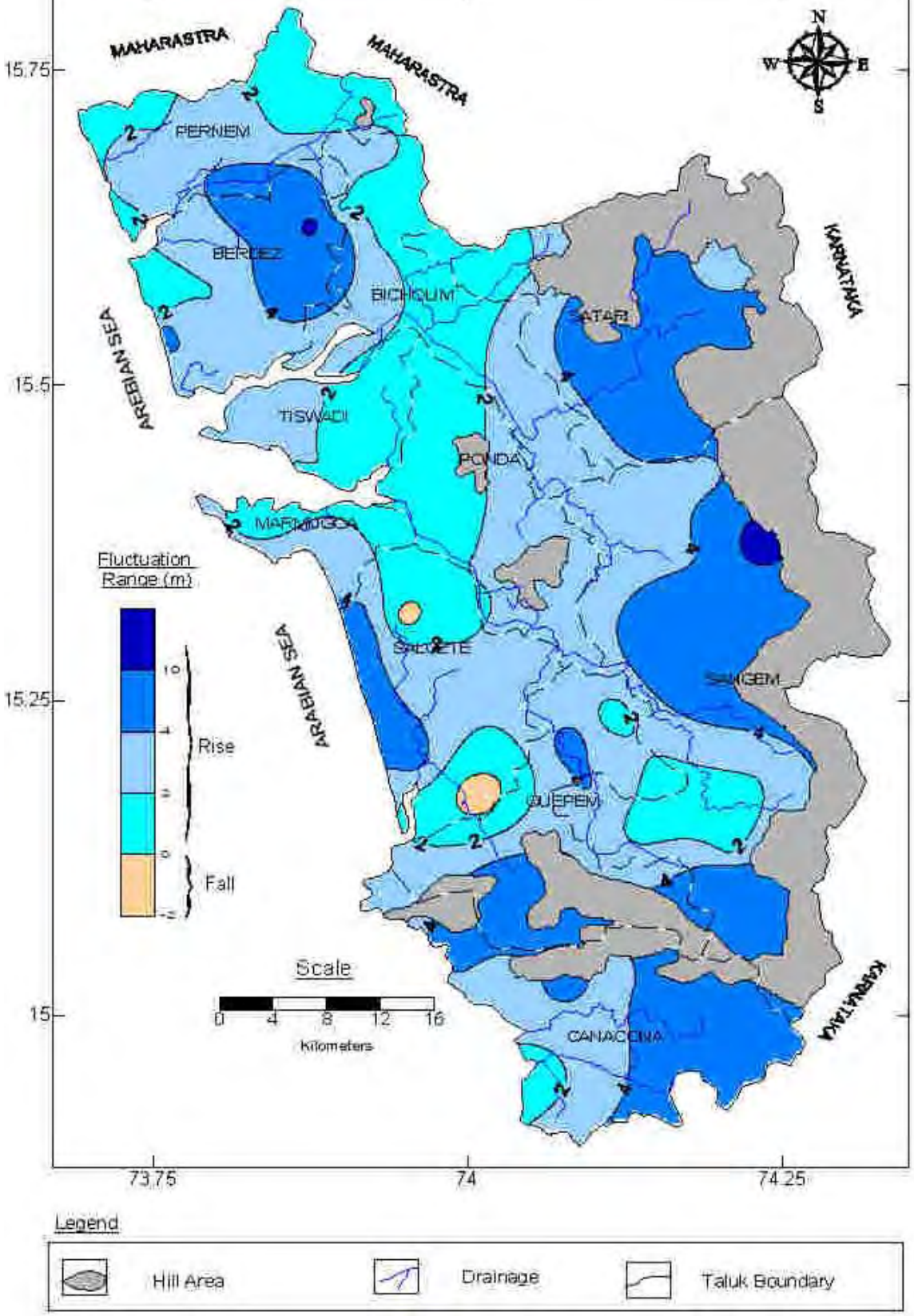
DEPTH TO WATER LEVEL MAP JANUARY 2014, GOA STATE

Fig - 3.4



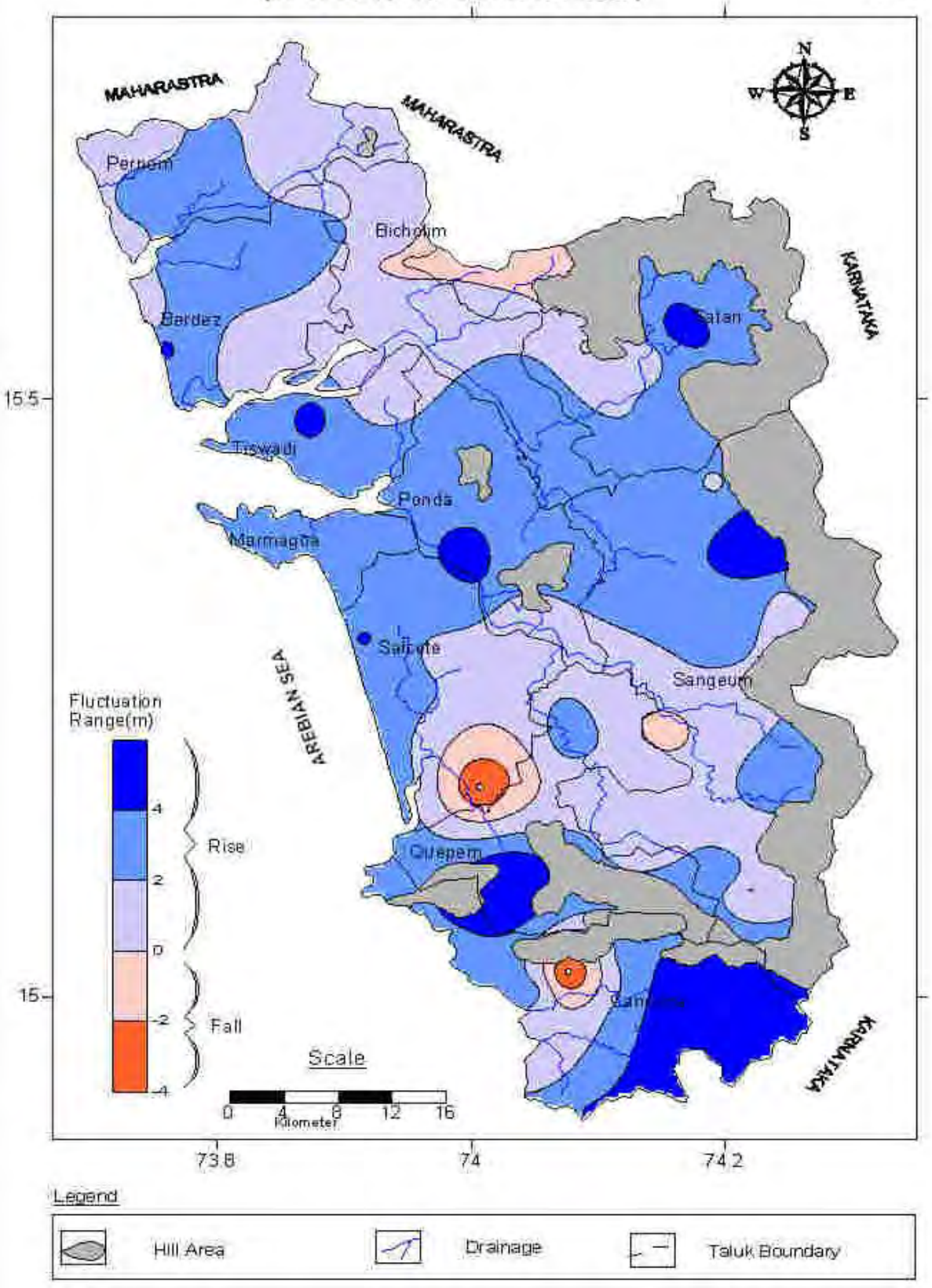
WATER LEVEL FLUCTUATION MAP OF GOA STATE
(MAY 2013 - AUGUST 2013)

Fig - 3.5



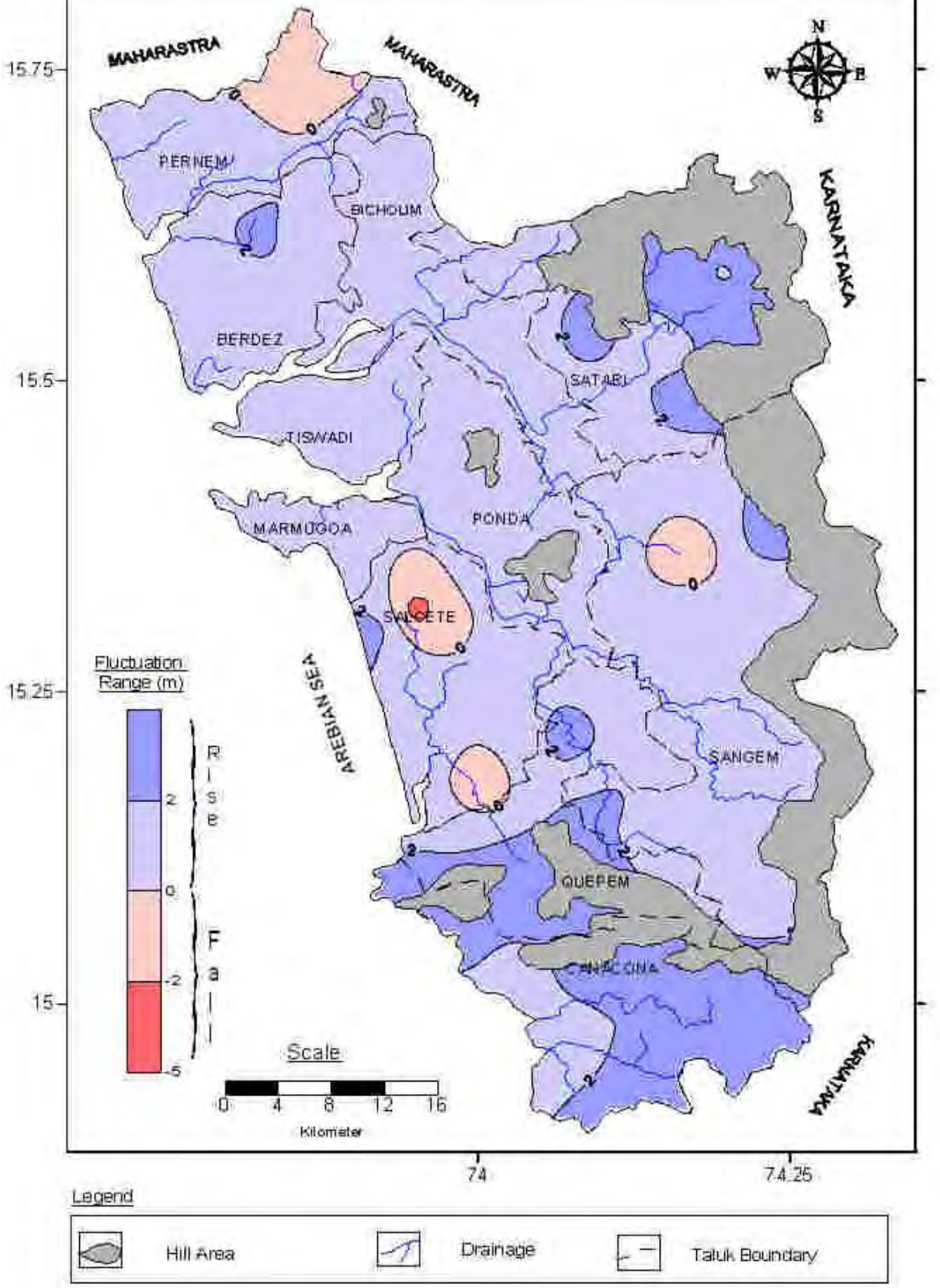
WATER LEVEL FLUCTUATION MAP OF GOA STATE
(MAY 2013- NOVEMBER 2013)

Fig- 3.6



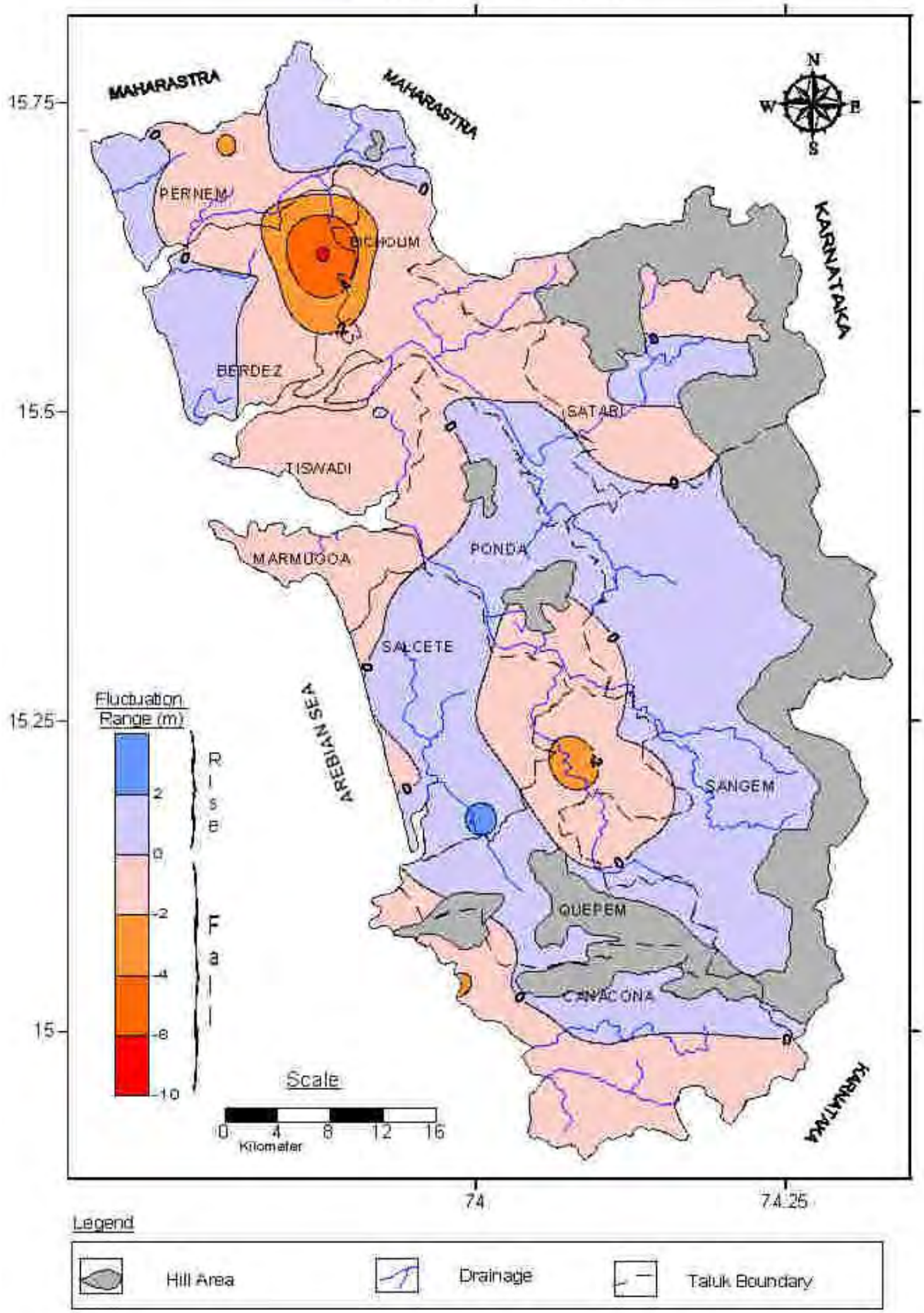
WATER LEVEL FLUCTUATION MAP OF GOA STATE
(MAY 2013 - JANUARY 2014)

Fig - 3.7



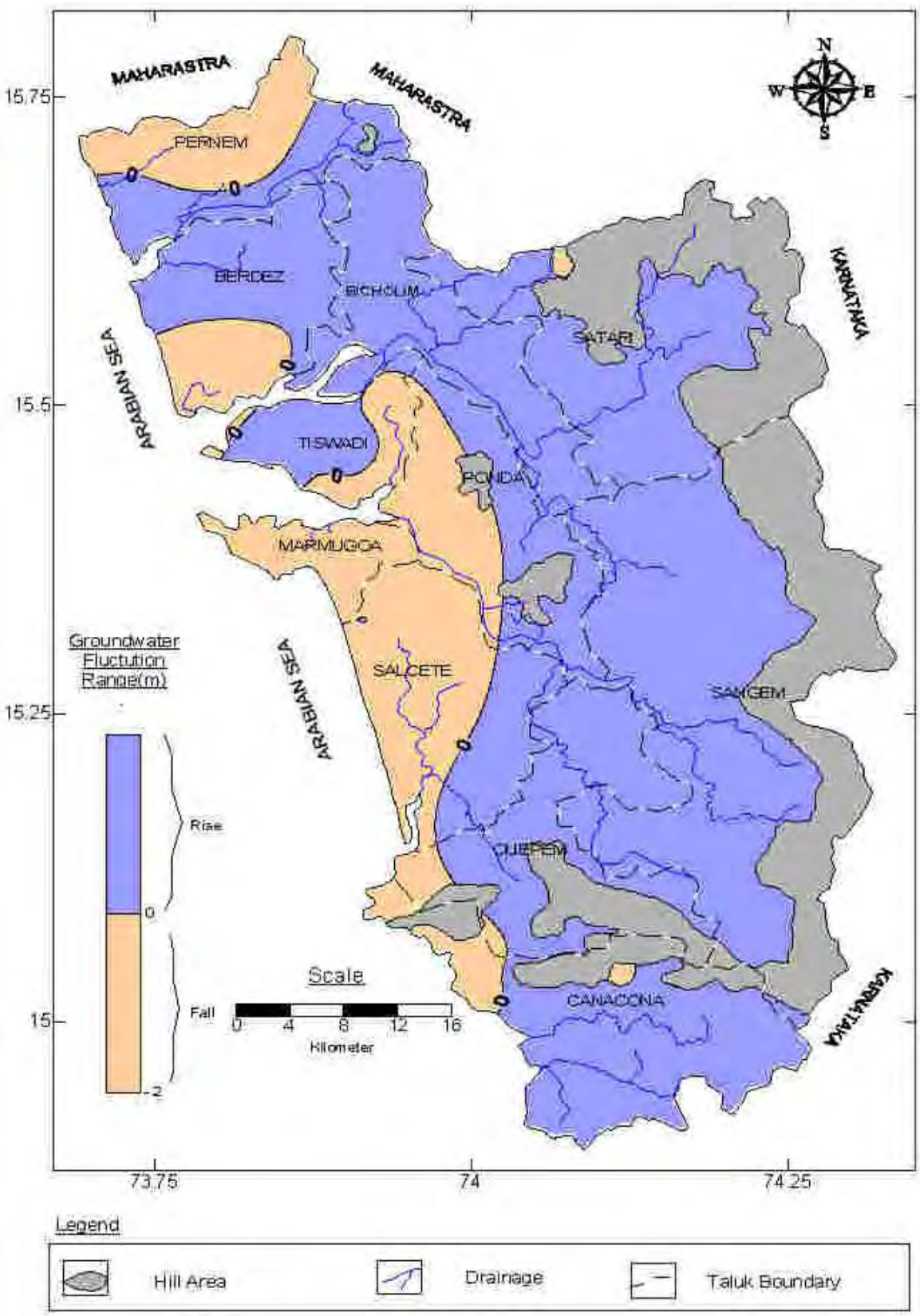
WATER FLUCTUATION MAP OF GOA STATE
(MAY 2012 - MAY 2013)

Fig - 3.8



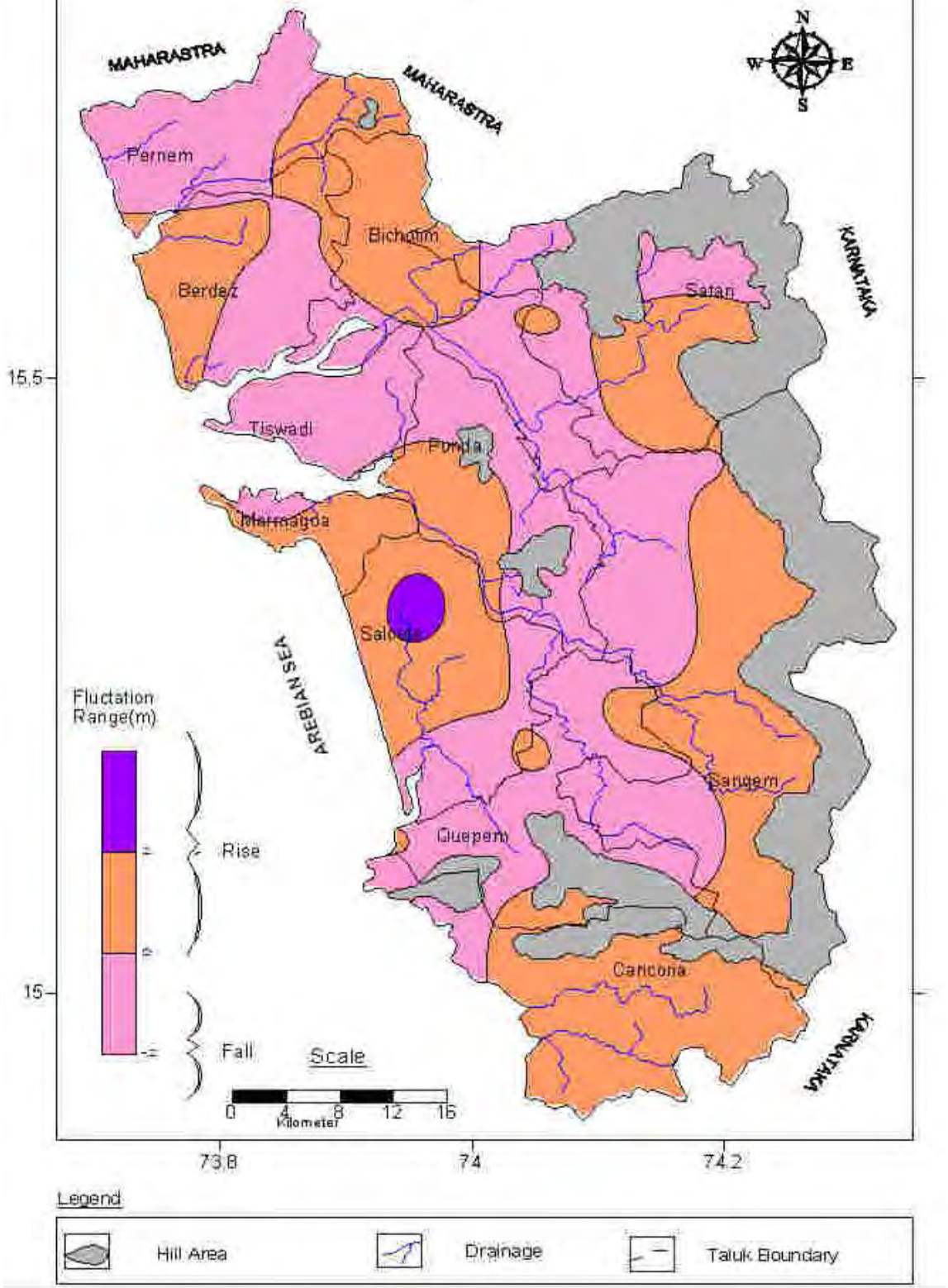
WATER LEVEL FLUCTUATION MAP OF GOA STATE
(AUGUST 2012 - AUGUST 2013)

Fig - 3.9



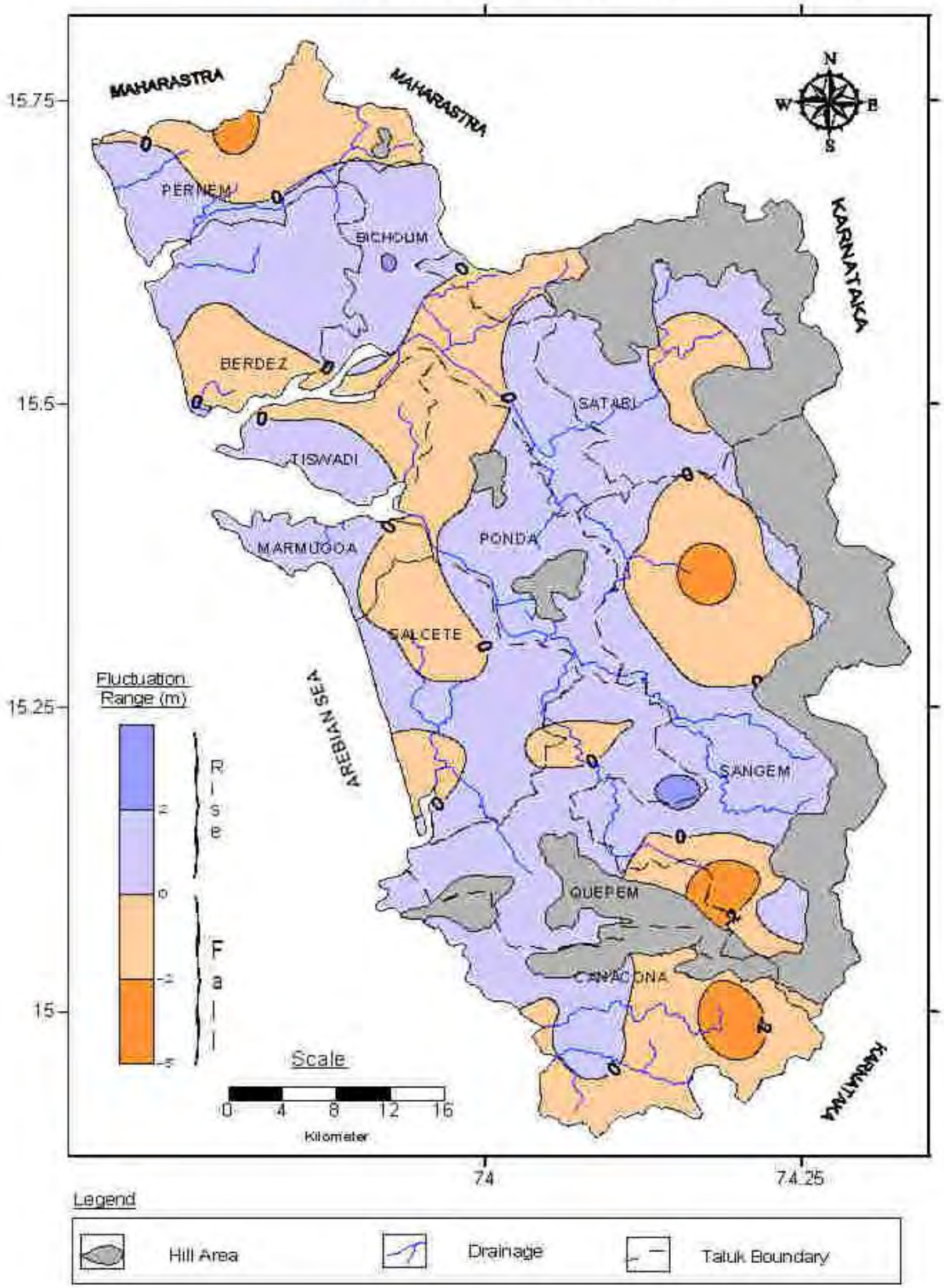
WATER LEVEL FLUCTUATION MAP OF GOA STATE
(NOVEMBER 2012- NOVEMBER 2013)

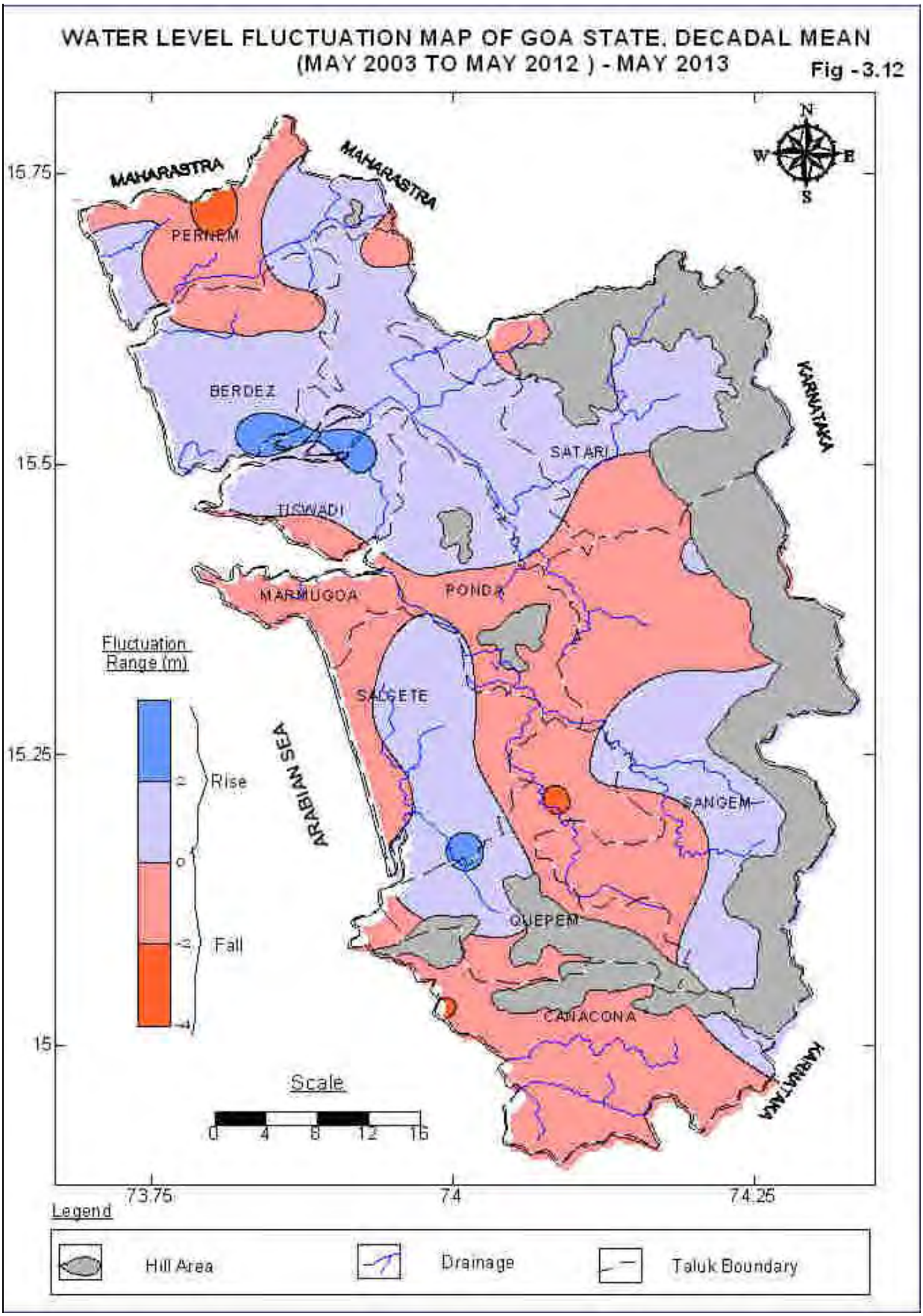
Fig 3.10



WATER LEVEL FLUCTUATION MAP OF GOA STATE
(JANUARY 2013 - JANUARY 2014)

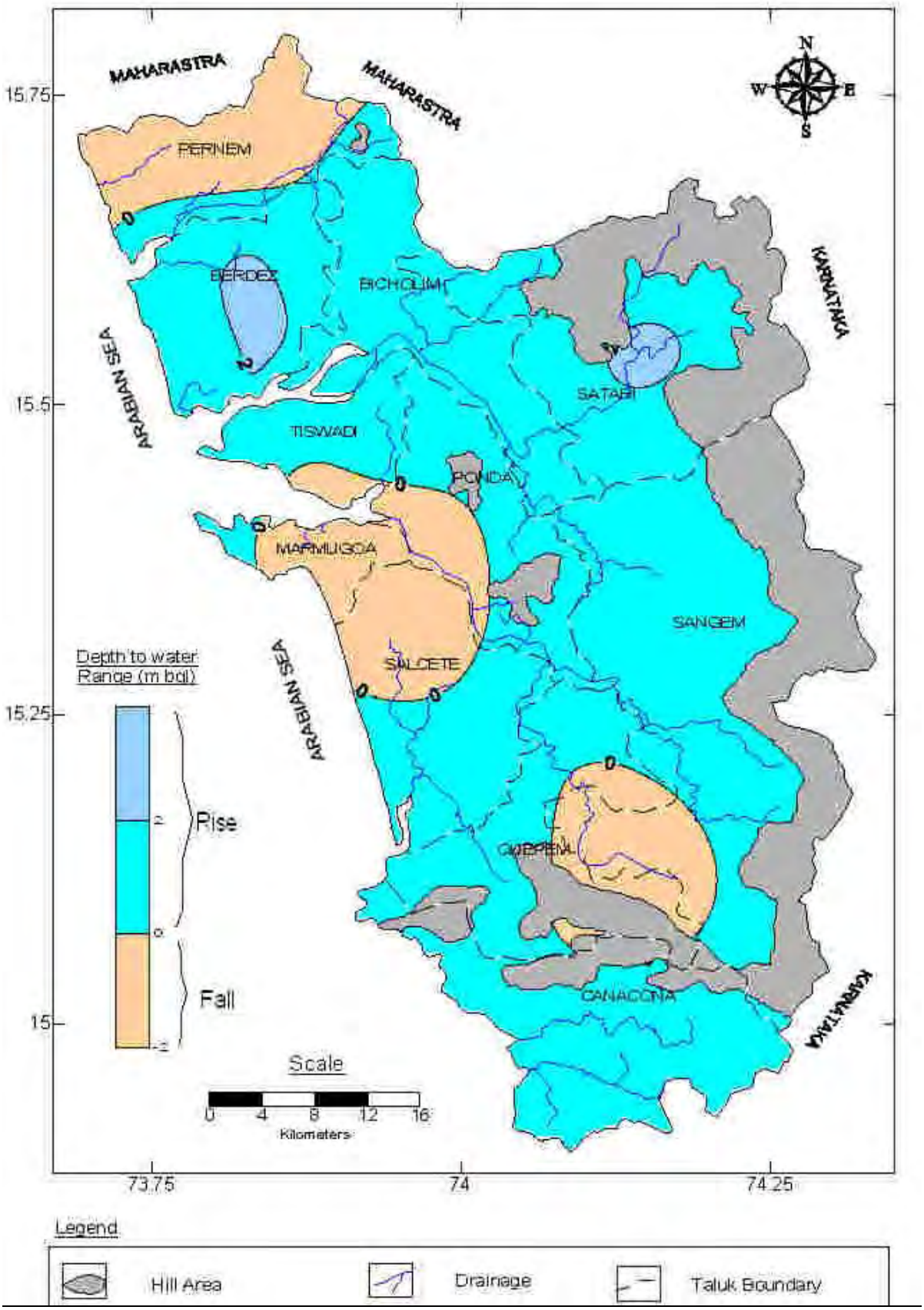
Fig - 3.11

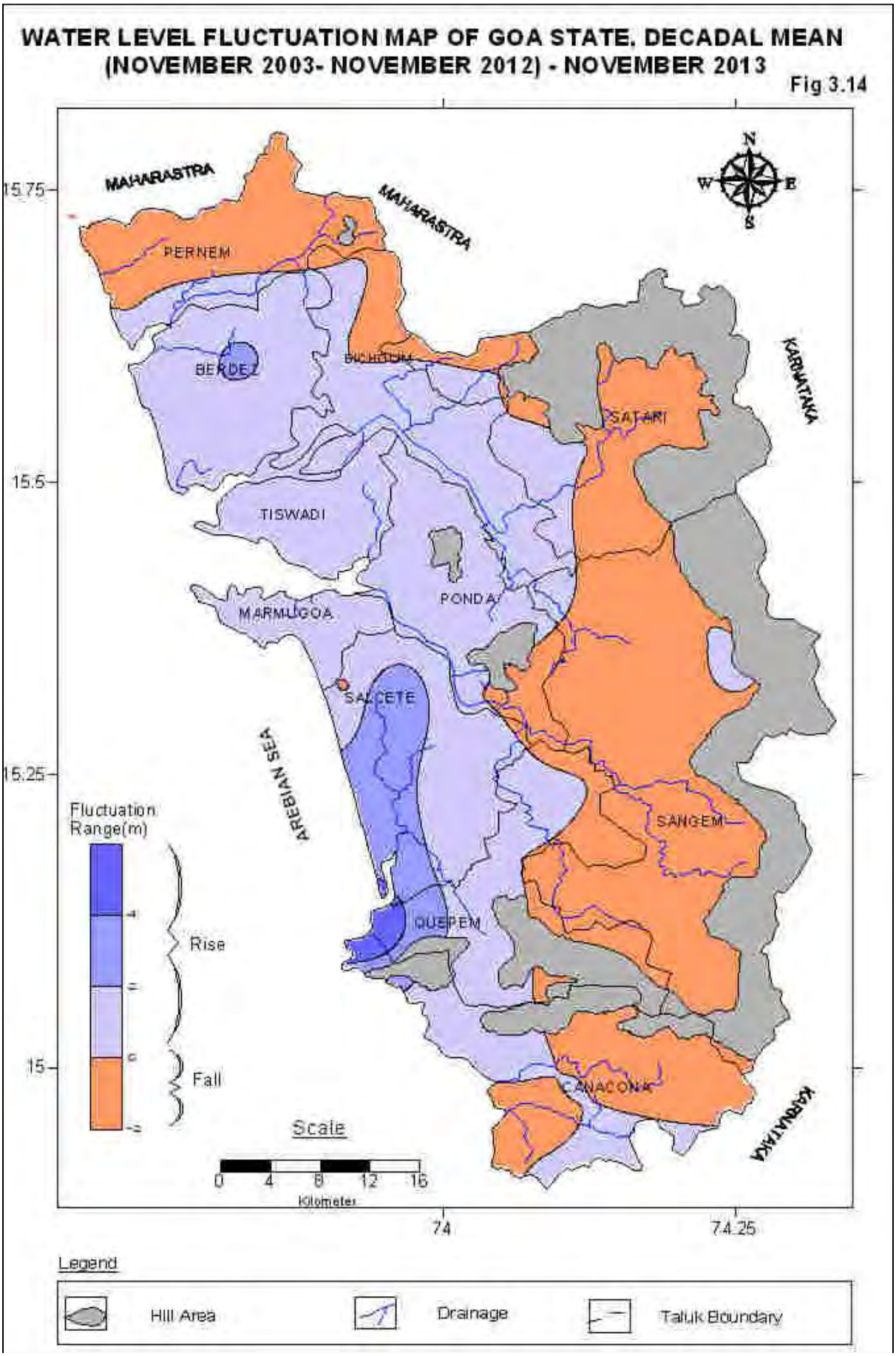


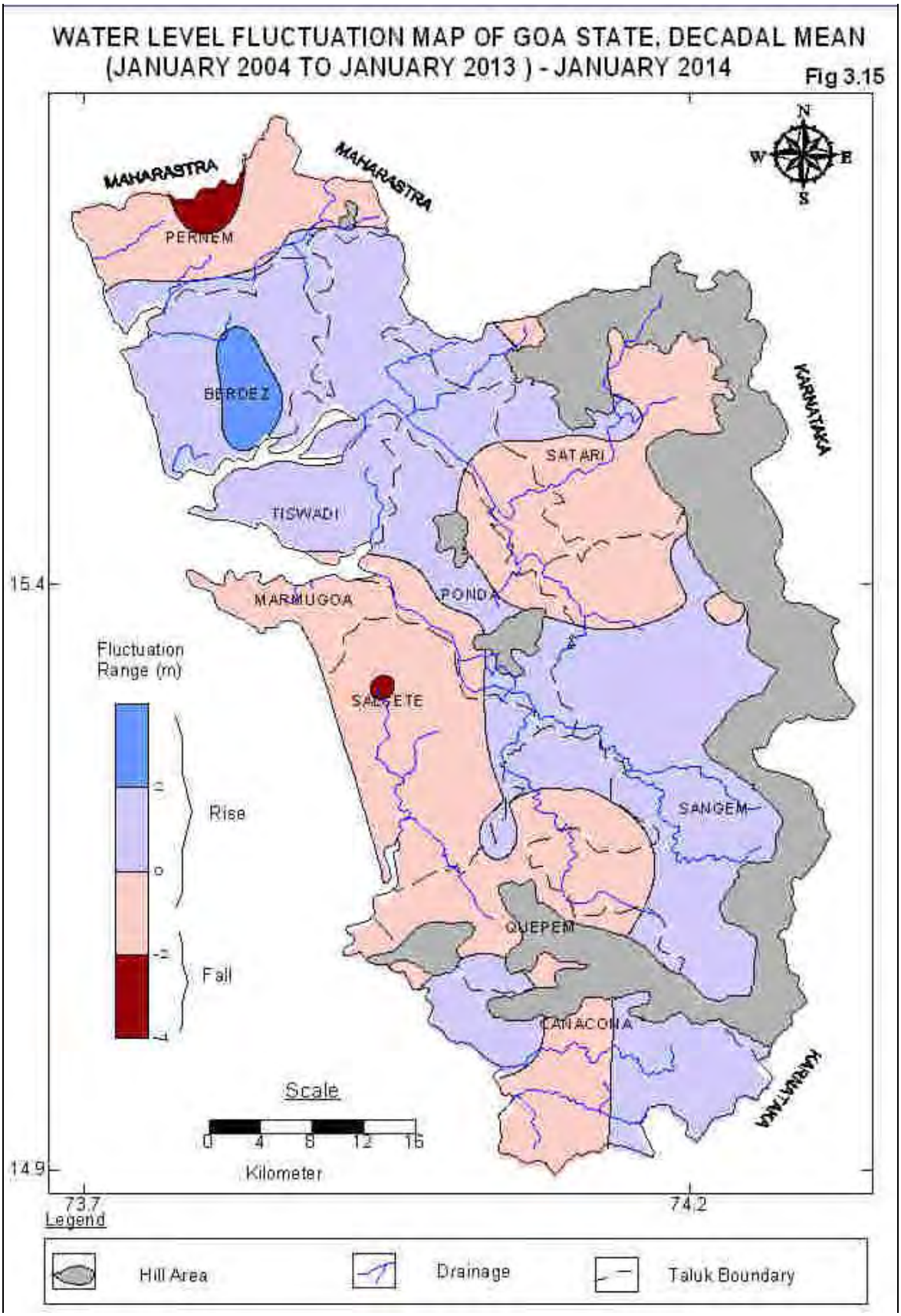

WATER LEVEL FLUCTUATION MAP OF GOA STATE, DECADAL MEAN
(MAY 2003 TO MAY 2012) - MAY 2013
Fig -3.12
MAHARASTRA
MAHARASTRA
PERNEM
BERDEZ
SATARI
TISWADI
KARNATAKA
MARMUGOA
PONDA
SALCETE
ARABIAN SEA
SANGEM
QUEPEM
CANACONA
KARNATAKA
Fluctuation Range (m)
2
0
-2
-4
Rise
Fall
Scale
0 4 8 12 16
N
W
E
S
15.75
15.5
15.25
15
73.75
74
74.25
Legend
Hill Area
Drainage
Taluk Boundary

WATER LEVEL FLUCTUATION MAP OF GOA STATE, DECADAL MEAN (AUGUST 2003 TO AUGUST 2012) - AUGUST 2013

Fig - 3.13




WATER LEVEL FLUCTUATION MAP OF GOA STATE, DECADAL MEAN
(NOVEMBER 2003- NOVEMBER 2012) - NOVEMBER 2013
Fig 3.14
MAHARASTRA
MAHARASTRA
PERNEM
BERDEZ
BICHOLIM
SATARI
KARNATAKA
TISWADI
PONDA
MARMUGOA
SALCETE
ARABIAN SEA
SANGEM
QUEPEM
CANACONA
KARNATAKA
15.75
15.5
15.25
15
74
74.25
N
S
W
E
Fluctuation Range(m)
Rise
Fall
Scale
0 4 8 12 16
Kilometer
Legend
Hill Area
Drainage
Taluk Boundary


WATER LEVEL FLUCTUATION MAP OF GOA STATE, DECADAL MEAN
(JANUARY 2004 TO JANUARY 2013) - JANUARY 2014
Fig 3.15
MAHARASTRA
MAHARASTRA
PERNEM
BERDEZ
TISWADI
SATARI
KARNATAKA
MARMUGOA
PONDA
SALCETE
SANGEM
QUEPEM
CANACONA
KARNATAKA
N
W
E
S
Fluctuation
Range (m)
Rise
Fall
Scale
0 4 8 12 16
Kilometer
15.4
14.9
73.7
74.2
Legend
Hill Area
Drainage
Taluk Boundary

4. HYDROCHEMISTRY

Water samples from the NHS are collected once a year during the month of May. The assessment of chemical quality of ground water samples from Ground Water Monitoring Stations (GWMS) of Goa State for the year 2013 is presented in the following sections.

The water samples from 69 monitoring stations of shallow aquifers from 2 districts were collected during the month of May 2013. These samples were analysed in the Regional Chemical Laboratory for 15 parameters (EC, pH, major cations (Ca^{+},$^{+}$ Mg^{++}, Na^{+}, K^{+}), major anions (Cl^{-},CO_3^{-} HCO_3^{-},SO_4^{-}) and also Nitrate, Fluoride, Phosphate and Boron) by employing Standard methods. Based on the hydrochemical data, the potability of these samples has been assessed as per the standards prescribed by the Bureau of Indian Standards and classified into 'Desirable', 'Permissible' and 'Unsuitable' classes. The details of chemical samples analyzed are presented in Annexure-VI.

4.1 Distribution of pH.

It is a measure of how acidic/basic water is. The distribution varies from 7.0 to 7.8 which indicates that all are mildly alkaline in nature.

4.2 Distribution of Electrical Conductivity.

The perusal of the data indicates that the distribution of electrical conductivity in the State shows wide variations (90–650 µS/cm at 25˚C). The maximum value for the parameter was recorded in the samples collected from Karanjhalen of South Goa district. The EC values of samples collected all over the State were generally below 650 µS/cm at 25˚C rendering the samples suitable for drinking. The majority of the samples were also found suitable for drinking. Distribution of Electrical Conductivity during may 2013 in Goa state is presented in Fig 4.1.

4.3 Distribution of Chloride.

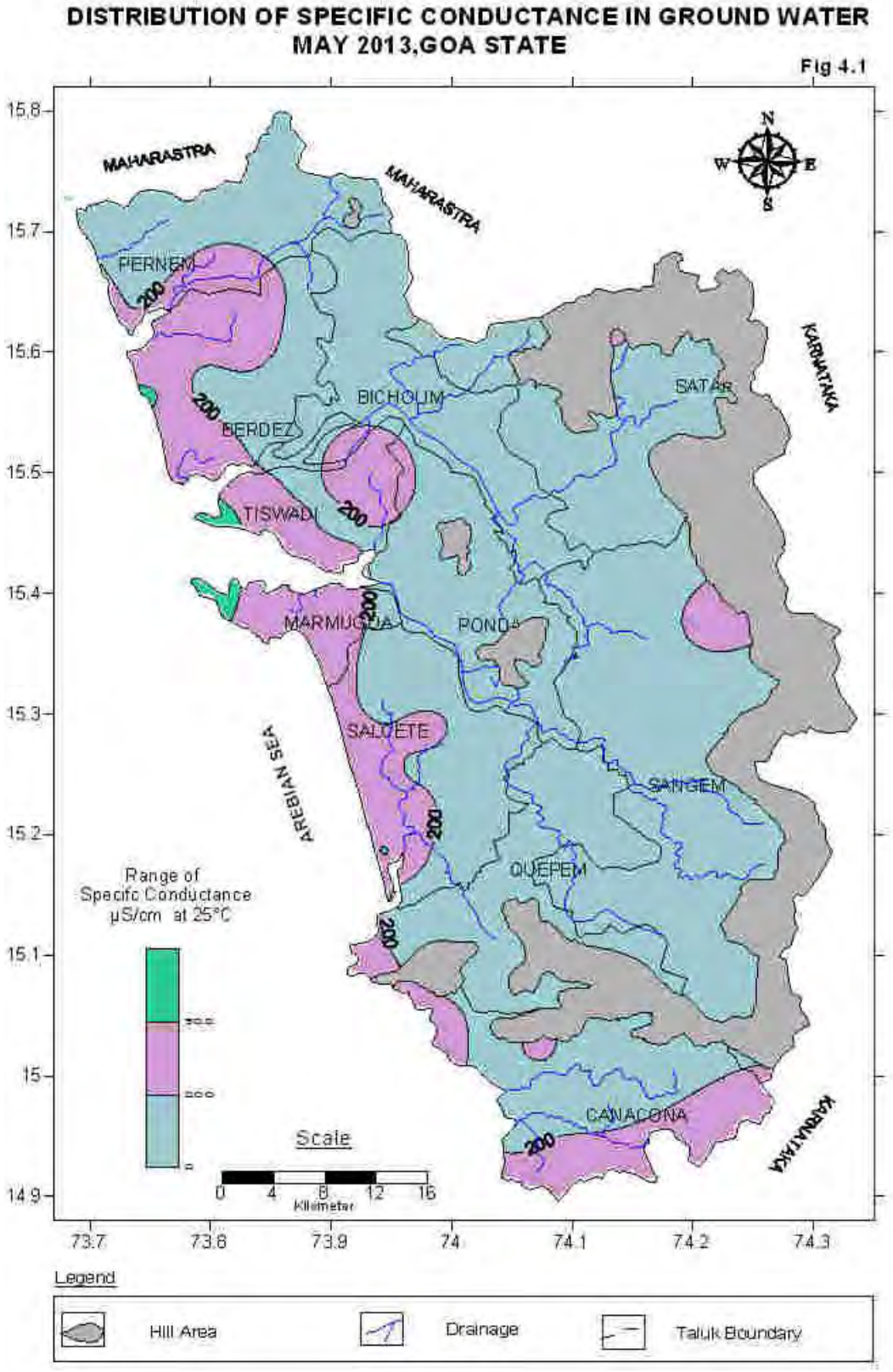
The distribution of chloride followed similar trend as that of EC and the values were in the range of 14.0 to 78 mg/l. The highest value recorded is for the samples collected from Baga, Mapuca, of North Goa district, which showed Chloride value of 78 mg/l. The data indicated that all of the samples were in the 'desirable' limits of Drinking Water Standard. Distribution of Chloride during may 2013 in Goa state is presented in Fig 4.2.

4.4 Distribution of Nitrate.

The distribution of nitrate in the State indicated that the values were in the range of 0.3 to 31 mg/l and the highest value was recorded in the samples collected from Calangute of North Goa district. The data indicated all of the samples were found to be falling under 'permissible limit' and suitable classes of BIS Standards (IS 10500:2012). Distribution of Chloride during may 2013 in Goa state is presented in Fig 4.3.

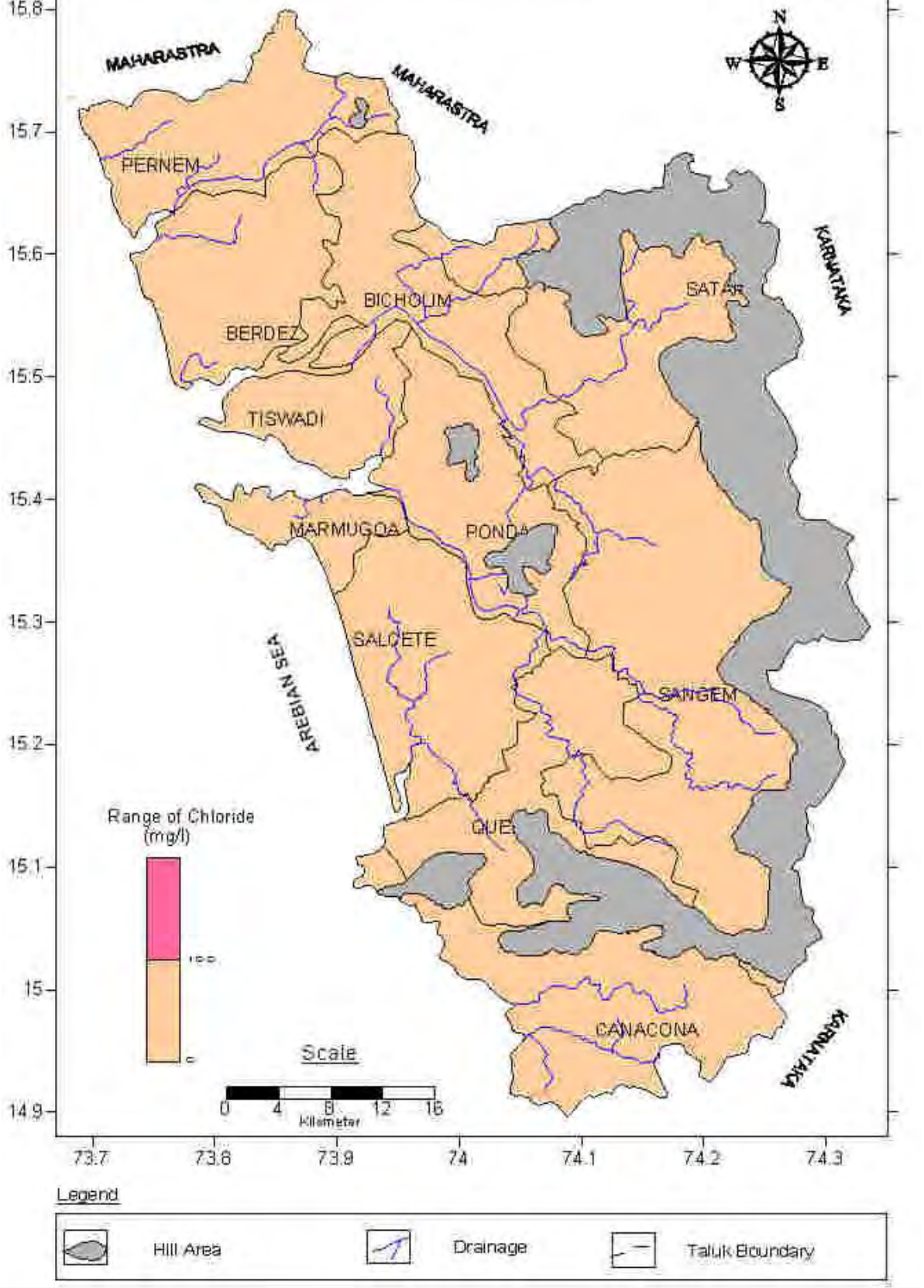
4.5 Distribution of Fluoride

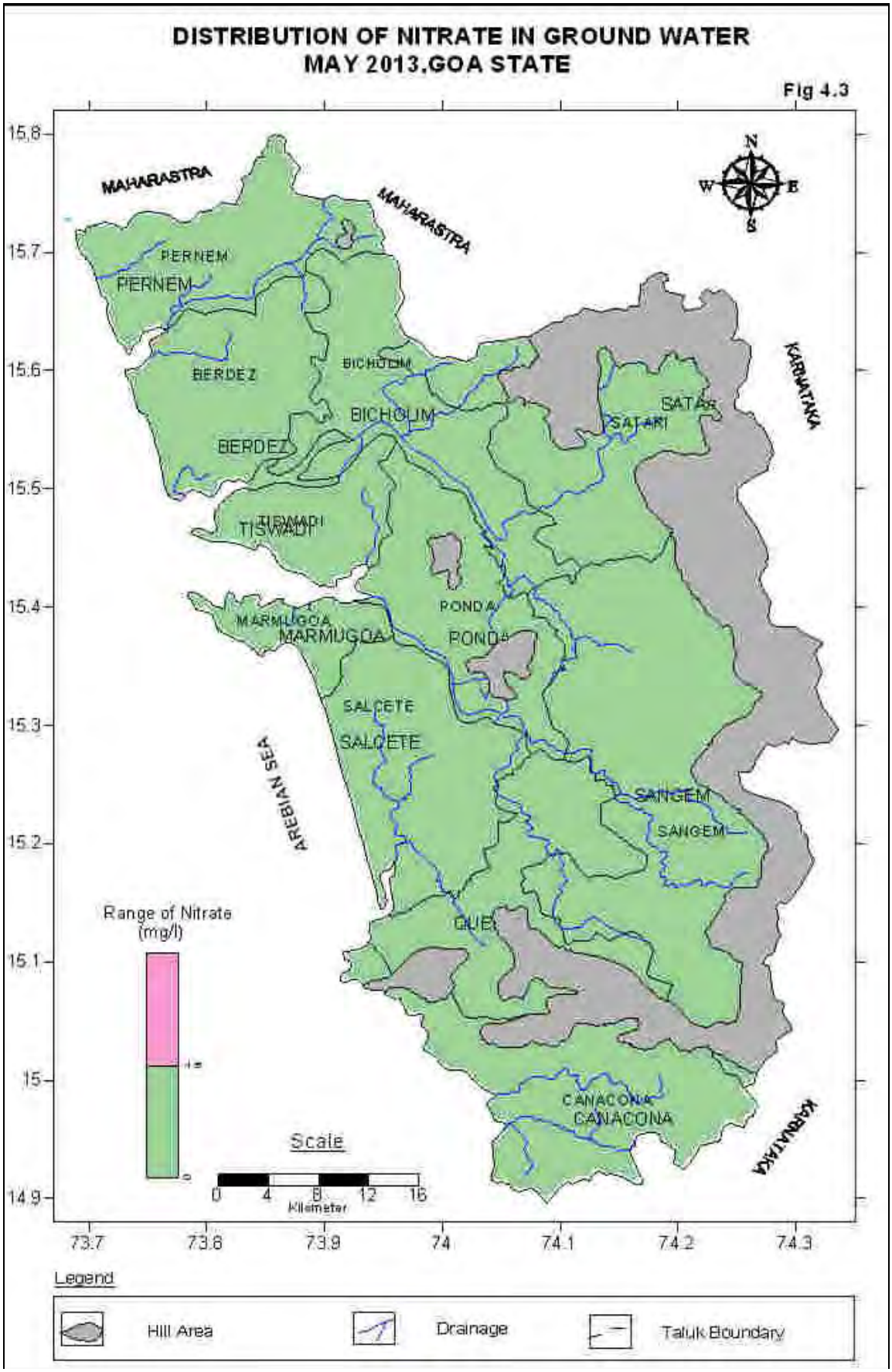
The occurrence of fluoride in ground water in the State exhibited wide variations from 0.02 mg/l to 0.80 mg/l. All the samples are in well within permissible limit. The occurrence of Phospahte, and Boron are also within the permissible limits.



DISTRIBUTION OF CHLORIDE IN GROUND WATER MAY 2013,GOA STATE

Fig 4.2




DISTRIBUTION OF NITRATE IN GROUND WATER
MAY 2013,GOA STATE
Fig 4.3
MAHARASTRA
MAHARASTRA
KARNATAKA
KARNATAKA
PERNEM
PERNEM
BERDEZ
BERDEZ
BICHOLIM
BICHOLIM
SATARI
SATARI
TISWADI
TISWADI
PONDA
PONDA
MARMUGOA
MARMUGOA
SALCETE
SALCETE
SANGEM
SANGEM
QUEPEM
CANACONA
CANACONA
ARABIAN SEA
Range of Nitrate (mg/l)
Scale
0 4 8 12 16
Kilometer
15.8
15.7
15.6
15.5
15.4
15.3
15.2
15.1
15
14.9
73.7
73.8
73.9
74
74.1
74.2
74.3
Legend
Hill Area
Drainage
Taluk Boundary

5. CONCLUSION

The present report includes results of a study on the behavior of the Ground Water Regime in the State of Goa through a network 92 National Hydrograph Network Stationstapping the phreatic aquifer.

Out of the 92 stations, 33% of the stations fall in the Mandovi basin, 26% fall in the Zuari basin, 16% fall in the Sal basin, and the remaining 25% fall in the West flowing minor river basins.

Quartz Chlorite Biotite occupies the largest area in the state and 49% of the network stations fall in these areas. This is followed by Metabasalt rocks and Granite gneiss, in which 16% and 11% respectively of the network stations are located. The remaining 24% of the stations are in Greywack, Carbonate quartz chlorite and recent alluvium.

The data of depth to water levels shows that during the pre-monsoon period of 2013 about 87% of the analysed wells have water levels within 10 mbgl. Moderately deep water levels of 10 to 20 mbgl are seen in about 13% wells. No well shows deep water levels >20mbgl. During post-monsoon period of 2013, about 92% of the analysed wells have water level within 10 mbgl. Moderately deep water levels of 10 to 20 mbgl are seen in 8% wells.

The chemical quality of ground water collected from 69 NHS stations representing the shallow aquifers during May 2013 indicated that quality of all the samples are very good and suitable for domestic irrigation and industrial purpose.

Table 3.1

Talukwise Well Frequency for Different Ranges of Depth to Water Level

Month / Year : May-2013

Taluk	No of WL measured	D.T.W. (m bgl)		0 - 2 (m)		2 - 5(m)		5 - 10(m)		10 - 20 (m)		> 20 (m)	
		Min.	Max.	No.	%	No.	%	No.	%	No.	%	No.	%
Tiswadi	6	1.68	8.95	1	16.7	3	50.0	2	33.3	0	0.0	0	0.0
Sattari	10	3.75	11.24	0	0.0	3	30.0	6	60.0	1	10.0	0	0.0
Sangeum	15	3.21	13.80	0	0.0	2	13.3	9	60.0	4	26.7	0	0.0
Salcete	12	2.05	13.60	0	0.0	5	41.7	6	50.0	1	8.3	0	0.0
Quepem	3	1.97	6.70	1	33.3	1	33.3	1	33.3	0	0.0	0	0.0
Ponda	4	3.75	7.05	0	0.0	1	25.0	3	75.0	0	0.0	0	0.0
Pernem	6	1.93	7.73	1	16.7	2	33.3	3	50.0	0	0.0	0	0.0
Canacona	9	3.62	15.00	0	0.0	3	33.3	5	55.6	1	11.1	0	0.0
Bicholim	5	2.93	18.86	0	0.0	2	40.0	2	40.0	1	20.0	0	0.0
Bardez	11	2.72	16.30	0	0.0	6	54.5	3	27.3	2	18.2	0	0.0
Total	81			3	3.7	28	34.6	40	49.4	10	12.3	0	0.0

Table 3.2

Talukwise Well Frequency for Different Ranges of Depth to Water Level

Month / Year : Aug-2013

Taluk	No of WL measured	D.T.W. (m bgl)		0 - 2 (m)		2 - 5 (m)		5-10(m)		10 - 20 (m)		> 20 (m)	
		Min.	Max.	No.	%	No.	%	No.	%	No.	%	No.	%
Tiswadi	4	0.48	3.80	2	50.0	2	50.0	0	0.0	0	0.0	0	0.0
Sattari	10	0.90	3.50	7	70.0	3	30.0	0	0.0	0	0.0	0	0.0
Sangeum	13	0.90	6.15	3	23.1	6	46.2	4	30.8	0	0.0	0	0.0
Salcete	13	1.35	6.40	4	30.8	7	53.8	2	15.4	0	0.0	0	0.0
Quepem	4	0.93	7.73	2	50.0	1	25.0	1	25.0	0	0.0	0	0.0
Ponda	4	2.20	4.85	0	0.0	4	100.0	0	0.0	0	0.0	0	0.0
Pernem	6	0.03	6.43	2	33.3	3	50.0	1	16.7	0	0.0	0	0.0
Canacona	10	0.54	14.90	6	60.0	1	10.0	1	10.0	2	20.0	0	0.0
Bicholim	4	0.93	16.15	2	50.0	1	25.0	0	0.0	1	25.0	0	0.0
Bardez	8	0.45	6.80	4	50.0	3	37.5	1	12.5	0	0.0	0	0.0
Total	76			32	42.1	31	40.8	10	13.2	3	3.9	0	0.0

Table 3.3

Talukwise Well Frequency for Different Ranges of Depth to Water Level

Month / Year : Nov-2013

Taluk	No of WL measured	D.T.W. (m bgl)		0 - 2 (m)		2 - 5 (m)		5 -10 (m)		10 - 20 (m)		> 20 (m)	
		Min.	Max.	No.	%	No.	%	No.	%	No.	%	No.	%
Tiswadi	3	0.89	7.48	2	66.7	0	0.0	1	33.3	0	0.0	0	0.0
Sattari	10	2.39	7.16	0	0.0	7	70.0	3	30.0	0	0.0	0	0.0
Sangeum	14	2.92	10.44	0	0.0	4	28.6	8	57.1	2	14.3	0	0.0
Salcete	12	0.72	6.29	3	25.0	7	58.3	2	16.7	0	0.0	0	0.0
Quepem	4	1.63	7.57	1	25.0	1	25.0	2	50.0	0	0.0	0	0.0
Ponda	4	1.33	6.51	1	25.0	1	25.0	2	50.0	0	0.0	0	0.0
Pernem	6	0.27	7.78	1	16.7	4	66.7	1	16.7	0	0.0	0	0.0
Canacona	10	0.55	15.24	3	30.0	3	30.0	1	10.0	3	30.0	0	0.0
Bicholim	4	2.70	14.98	0	0.0	3	75.0	0	0.0	1	25.0	0	0.0
Bardez	8	0.64	7.61	5	62.5	1	12.5	2	25.0	0	0.0	0	0.0
Total	75			16	21.3	31	41.3	22	29.3	6	8.0	0	0.0

Table 3.4

Talukwise Well Frequency for Different Ranges of Depth to Water Level

Month / Year : Jan-2014

Taluk	No of WL measured	D.T.W. (m bgl)		0 - 2 (m)		2 - 5 (m)		5 -10 (m)		10 - 20 (m)		> 20 (m)	
		Min.	Max.	No.	%	No.	%	No.	%	No.	%	No.	%
Tiswadi	4	1.28	8.40	1	25.0	1	25.0	2	50.0	0	0.0	0	0.0
Sattari	11	2.11	7.83	0	0.0	7	63.6	4	36.4	0	0.0	0	0.0
Sangeum	15	2.39	10.95	0	0.0	3	20.0	10	66.7	2	13.3	0	0.0
Salcete	13	1.32	9.07	2	15.4	8	61.5	3	23.1	0	0.0	0	0.0
Quepem	4	1.99	16.17	1	25.0	2	50.0	0	0.0	1	25.0	0	0.0
Ponda	5	3.05	6.59	0	0.0	4	80.0	1	20.0	0	0.0	0	0.0
Pernem	6	0.67	8.31	1	16.7	3	50.0	2	33.3	0	0.0	0	0.0
Canacona	10	1.73	15.48	1	10.0	6	60.0	1	10.0	2	20.0	0	0.0
Bicholim	6	1.91	18.45	1	16.7	2	33.3	1	16.7	2	33.3	0	0.0
Bardez	11	1.65	14.27	2	18.2	5	45.5	2	18.2	2	18.2	0	0.0
Total	85			9	10.6	41	48.2	26	30.6	9	10.6	0	0.0

Table 3.5

Talukwise Categorisation of Water Level Fluctuation

(May-2013 to August-2013)

Taluk	Number of Station Analysed	Fall (in m)						Rise (in m)					
		0 - 2	%	2-4	%	> 4	%	0 - 2	%	2 - 4	%	> 4	%
Bardez	8	0	0.0	0	0.0	0	0.0	2	25.0	4	50.0	2	25.0
Bicholim	4	0	0.0	0	0.0	0	0.0	1	25.0	3	75.0	0	0.0
Canacona	9	0	0.0	0	0.0	0	0.0	1	11.1	5	55.6	3	33.3
Pernem	6	0	0.0	0	0.0	0	0.0	4	66.7	2	33.3	0	0.0
Ponda	3	0	0.0	0	0.0	0	0.0	0	0.0	3	100.0	0	0.0
Quepem	3	0	0.0	0	0.0	0	0.0	2	66.7	0	0.0	1	33.3
Salcete	12	2	16.7	0	0.0	0	0.0	2	16.7	4	33.3	4	33.3
Sangeum	13	0	0.0	0	0.0	0	0.0	4	30.8	4	30.8	5	38.5
Sattari	10	0	0.0	0	0.0	0	0.0	1	10.0	3	30.0	6	60.0
Tiswadi	4	0	0.0	0	0.0	0	0.0	1	25.0	2	50.0	1	25.0
Total	72	2	2.8	0	0.0	0	0.0	18	25.0	30	41.7	22	30.6

Table 3.6

Talukwise Categorisation of Water Level Fluctuation

(May-2013 to November-2013)

Taluk	Number of Station Analysed	Fall in m						Rise in m					
		0 - 2	%	2 - 4	%	> 4	%	0 - 2	%	2 - 4	%	> 4	%
Bardez	8	0	0.0	0	0.0	0	0.0	2	25.0	4	50.0	2	25.0
Bicholim	4	1	25.0	0	0.0	0	0.0	1	25.0	2	50.0	0	0.0
Canacona	9	0	0.0	0	0.0	1	11.1	1	11.1	6	66.7	1	11.1
Pernem	6	1	16.7	0	0.0	0	0.0	3	50.0	2	33.3	0	0.0
Ponda	3	0	0.0	0	0.0	0	0.0	2	66.7	0	0.0	1	33.3
Quepem	3	1	33.3	0	0.0	0	0.0	1	33.3	1	33.3	0	0.0
Salcete	11	0	0.0	0	0.0	1	9.1	2	18.2	6	54.5	2	18.2
Sangeum	14	2	14.3	0	0.0	0	0.0	6	42.9	4	28.6	2	14.3
Sattari	10	3	30.0	0	0.0	0	0.0	2	20.0	3	30.0	2	20.0
Tiswadi	3	0	0.0	0	0.0	0	0.0	2	66.7	0	0.0	1	33.3
Total	71	8	11.3	0	0.0	2	2.8	22	31.0	28	39.4	11	15.5

Table 3.7

Talukwise Categorisation of Water Level Fluctuation

(May-2013 to January-2014)

Taluk	Number of Station Analysed	Fall in m						Rise in m					
		0- 2	%	2 - 4	%	> 4	%	0 - 2	%	2 - 4	%	> 4	%
Bardez	11	0	0.0	0	0.0	0	0.0	9	81.8	2	18.2	0	0.0
Bicholim	5	0	0.0	0	0.0	0	0.0	5	100.0	0	0.0	0	0.0
Canacona	9	0	0.0	0	0.0	0	0.0	4	44.4	5	55.6	0	0.0
Pernem	6	1	16.7	0	0.0	0	0.0	5	83.3	0	0.0	0	0.0
Ponda	4	0	0.0	0	0.0	0	0.0	4	100.0	0	0.0	0	0.0
Quepem	3	1	33.3	0	0.0	0	0.0	1	33.3	1	33.3	0	0.0
Salcete	12	2	16.7	1	8.3	0	0.0	7	58.3	1	8.3	1	8.3
Sangeum	15	1	6.7	0	0.0	0	0.0	11	73.3	3	20.0	0	0.0
Sattari	10	1	10.0	0	0.0	0	0.0	5	50.0	3	30.0	1	10.0
Tiswadi	4	0	0.0	0	0.0	0	0.0	4	100.0	0	0.0	0	0.0
Total	79	6	7.6	1	1.3	0	0.0	55	69.6	15	19.0	2	2.5

Table 3.8

Talukwise Categorisation of Water Level Fluctuation

(May-2012 to May-2013)

Taluk	Number of Station Analysed	Fall in m						Rise in m					
		0 - 2	%	2 - 4	%	> 4	%	0- 2	%	2 - 4	%	> 4	%
Bardez	4	1	25.0	0	0.0	0	0.0	3	75.0	0	0.0	0	0.0
Bicholim	3	2	66.7	0	0.0	0	0.0	1	33.3	0	0.0	0	0.0
Canacona	7	4	57.1	1	14.3	0	0.0	2	28.6	0	0.0	0	0.0
Pernem	5	0	0.0	1	20.0	0	0.0	4	80.0	0	0.0	0	0.0
Ponda	1	1	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Quepem	3	1	33.3	1	33.3	0	0.0	1	33.3	0	0.0	0	0.0
Salcete	4	2	50.0	0	0.0	0	0.0	1	25.0	1	25.0	0	0.0
Sangeum	5	0	0.0	0	0.0	0	0.0	5	100.0	0	0.0	0	0.0
Sattari	5	4	80.0	0	0.0	0	0.0	1	20.0	0	0.0	0	0.0
Tiswadi	4	2	50.0	0	0.0	0	0.0	2	50.0	0	0.0	0	0.0
Total	41	17	41.5	3	7.3	0	0.0	20	48.8	1	2.4	0	0.0

Table 3.9

Talukwise Categorisation of Water Level Fluctuation

(August-2012 to August-2013)

Taluk	Number of Station Analysed	Fall in m						Rise in m					
		0 - 2	%	2 - 4	%	> 4	%	0 - 2	%	2 - 4	%	> 4	%
Bardez	5	2	40.0	0	0.0	0	0.0	3	60.0	0	0.0	0	0.0
Bicholim	1	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0
Canacona	6	2	33.3	0	0.0	0	0.0	4	66.7	0	0.0	0	0.0
Pernem	5	4	80.0	0	0.0	0	0.0	1	20.0	0	0.0	0	0.0
Ponda	2	0	0.0	0	0.0	0	0.0	2	100.0	0	0.0	0	0.0
Quepem	3	0	0.0	0	0.0	0	0.0	3	100.0	0	0.0	0	0.0
Salcete	3	1	33.3	0	0.0	0	0.0	2	66.7	0	0.0	0	0.0
Sangeum	3	0	0.0	0	0.0	0	0.0	3	100.0	0	0.0	0	0.0
Sattari	5	1	20.0	0	0.0	0	0.0	4	80.0	0	0.0	0	0.0
Tiswadi	3	2	66.7	0	0.0	0	0.0	1	33.3	0	0.0	0	0.0
Total	36	12	33.3	0	0.0	0	0.0	24	66.7	0	0.0	0	0.0

Table 3.10

Talukwise Categorisation of Water Level Fluctuation

(November-2012 to November-2013)

Taluk	Number of Station Analysed	Fall in m						Rise in m					
		0 - 2	%	2 - 4	%	> 4	%	0 - 2	%	2 - 4	%	> 4	%
Bardez	5	2	40.0	0	0.0	0	0.0	3	60.0	0	0.0	0	0.0
Bicholim	3	1	33.3	0	0.0	0	0.0	2	66.7	0	0.0	0	0.0
Canacona	7	1	14.3	0	0.0	0	0.0	6	85.7	0	0.0	0	0.0
Pernem	5	5	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Ponda	2	2	100.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Quepem	4	1	25.0	0	0.0	0	0.0	3	75.0	0	0.0	0	0.0
Salcete	3	1	33.3	0	0.0	0	0.0	1	33.3	1	33.3	0	0.0
Sangeum	4	2	50.0	0	0.0	0	0.0	2	50.0	0	0.0	0	0.0
Sattari	5	2	40.0	0	0.0	0	0.0	3	60.0	0	0.0	0	0.0
Tiswadi	2	1	50.0	0	0.0	0	0.0	1	50.0	0	0.0	0	0.0
Total	40	18	45.0	0	0.0	0	0.0	21	52.5	1	2.5	0	0.0

Table 3.11

Talukwise Categorisation of Water Level Fluctuation

(January-2013 to January-2014)

Taluk	Number of Station Analysed	Fall in m						Rise in m					
		0 - 2	%	2 - 4	%	> 4	%	0 - 2	%	2 - 4	%	> 4	%
Bardez	8	3	37.5	1	12.5	0	0.0	4	50.0	0	0.0	0	0.0
Bicholim	5	1	20.0	0	0.0	0	0.0	3	60.0	1	20.0	0	0.0
Canacona	10	5	50.0	1	10.0	0	0.0	4	40.0	0	0.0	0	0.0
Pernem	6	1	16.7	1	16.7	0	0.0	4	66.7	0	0.0	0	0.0
Ponda	5	1	20.0	0	0.0	0	0.0	3	60.0	1	20.0	0	0.0
Quepem	4	2	50.0	0	0.0	0	0.0	2	50.0	0	0.0	0	0.0
Salcete	11	2	18.2	1	9.1	0	0.0	8	72.7	0	0.0	0	0.0
Sangeum	15	3	20.0	1	6.7	1	6.7	9	60.0	1	6.7	0	0.0
Sattari	10	4	40.0	0	0.0	0	0.0	5	50.0	1	10.0	0	0.0
Tiswadi	4	2	50.0	0	0.0	0	0.0	2	50.0	0	0.0	0	0.0
Total	78	24	30.8	5	6.4	1	1.3	44	56.4	4	5.1	0	0.0

Table 3.12

Talukwise Categorisation of Change in Water Level

10 Yrs Mean (May-2003 - May-2012) - May-2013

Taluk	Number of Station Analysed	Range in m				Rise in m						Fall in m					
		Rise		Fall		0 - 2		2 -4		> 4		0 -2		2 -4		> 4	
		Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%
Bardez	5	0.02	2.57	0.34	0.34	3	60.0	1	20.0	0	0.0	1	20.0	0	0.0	0	0.0
Bicholim	3	0.94	1.08	0.21	0.21	2	66.7	0	0.0	0	0.0	1	33.3	0	0.0	0	0.0
Canacona	7			0.16	2.21	0	0.0	0	0.0	0	0.0	6	85.7	1	14.3	0	0.0
Pernem	5	0.03	1.82	3.52	3.52	4	80.0	0	0.0	0	0.0	0	0.0	1	20.0	0	0.0
Ponda	2			0.21	0.47	0	0.0	0	0.0	0	0.0	2	100.	0	0.0	0	0.0
Quepem	3	0.31	0.37	2.71	2.71	2	66.7	0	0.0	0	0.0	0	0.0	1	33.3	0	0.0
Salcete	4	1.45	2.96	0.34	1.11	1	25.0	1	25.0	0	0.0	2	50.0	0	0.0	0	0.0
Sangeum	4	0.09	0.39	0.16	0.83	2	50.0	0	0.0	0	0.0	2	50.0	0	0.0	0	0.0
Sattari	5	0.49	0.56	0.17	0.76	2	40.0	0	0.0	0	0.0	3	60.0	0	0.0	0	0.0
Tiswadi	4	2.21	2.21	0.02	0.86	0	0.0	1	25.0	0	0.0	3	75.0	0	0.0	0	0.0
Total	42					16	38.1	3	7.1	0	0.0	20	47.6	3	7.1	0	0.0

Table 3.13

Talukwise Categorisation of Change in Water Level

10 Yrs Mean (August-2003 - August-2012) - August-2013

Taluk	Number of Station Analysed	Range in m				Rise in m						Fall in m					
		Rise		Fall		0 - 2		2 -4		> 4		0 -2		2 -4		> 4	
		Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%
Bardez	5	0.34	2.57			3	60.0	2	40.0	0	0.0	0	0.0	0	0.0	0	0.0
Bicholim	3	0.23	1.29			3	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Canacona	7	0.01	0.56			7	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Pernem	5	0.23	0.75	0.71	1.43	2	40.0	0	0.0	0	0.0	3	60.0	0	0.0	0	0.0
Ponda	2	0.29	2.05			1	50.0	1	50.0	0	0.0	0	0.0	0	0.0	0	0.0
Quepem	3	0.13	0.41			3	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Salcete	4	0.98	1.06	0.04	1.33	2	50.0	0	0.0	0	0.0	2	50.0	0	0.0	0	0.0
Sangeum	3	0.52	1.20	0.57	0.57	2	66.7	0	0.0	0	0.0	1	33.3	0	0.0	0	0.0
Sattari	5	0.36	2.53			4	80.0	1	20.0	0	0.0	0	0.0	0	0.0	0	0.0
Tiswadi	3	1.22	1.66	0.37	0.37	2	66.7	0	0.0	0	0.0	1	33.3	0	0.0	0	0.0
Total	40					29	72.5	4	10.0	0	0.0	7	17.5	0	0.0	0	0.0

Table 3.14

Talukwise Categorisation of Change in Water Level

10 Yrs Mean (November-2003 - November-2012) - November-2013

Taluk	Number of Station Analysed	Range in m				Rise in m						Fall in m					
		Rise		Fall		0 - 2		2 -4		> 4		0 -2		2 -4		> 4	
		Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%
Bardez	5	0.64	2.40			4	80.0	1	20.0	0	0.0	0	0.0	0	0.0	0	0.0
Bicholim	3	0.09	1.98	0.21	0.21	2	66.7	0	0.0	0	0.0	1	33.3	0	0.0	0	0.0
Canacona	7	0.05	0.50	0.35	0.98	5	71.4	0	0.0	0	0.0	2	28.6	0	0.0	0	0.0
Pernem	5	0.10	0.61	0.56	1.18	2	40.0	0	0.0	0	0.0	3	60.0	0	0.0	0	0.0
Ponda	2			0.11	0.32	0	0.0	0	0.0	0	0.0	2	100.	0	0.0	0	0.0
Quepem	4	0.08	5.41			3	75.0	0	0.0	1	25.0	0	0.0	0	0.0	0	0.0
Salcete	3	1.19	3.55	0.14	0.14	1	33.3	1	33.3	0	0.0	1	33.3	0	0.0	0	0.0
Sangeum	4	0.01	0.01	0.24	0.80	1	25.0	0	0.0	0	0.0	3	75.0	0	0.0	0	0.0
Sattari	5	0.01	0.14	0.52	1.51	2	40.0	0	0.0	0	0.0	3	60.0	0	0.0	0	0.0
Tiswadi	2	0.04	1.35			2	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	40					22	55.0	2	5.0	1	2.5	15	37.5	0	0.0	0	0.0

Table 3.15

Talukwise Categorisation of Change in Water Level

10 Yrs Mean (January-2004 - January-2013) - January-2014

Taluk	Number of Station Analysed	Range in m				Rise in m						Fall in m					
		Rise		Fall		0 - 2		2 -4		> 4		0 -2		2 -4		> 4	
		Min	Max	Min	Max	No	%	No	%	No	%	No	%	No	%	No	%
Bardez	5	0.24	2.44			3	60.0	2	40.0	0	0.0	0	0.0	0	0.0	0	0.0
Bicholim	4	0.21	1.76	0.55	0.55	3	75.0	0	0.0	0	0.0	1	25.0	0	0.0	0	0.0
Canacona	7	0.10	0.29	0.08	0.17	4	57.1	0	0.0	0	0.0	3	42.9	0	0.0	0	0.0
Pernem	5	0.15	0.19	0.16	3.58	2	40.0	0	0.0	0	0.0	2	40.0	1	20.0	0	0.0
Ponda	3	0.14	1.65			3	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Quepem	3	0.11	0.15	0.21	0.21	2	66.7	0	0.0	0	0.0	1	33.3	0	0.0	0	0.0
Salcete	4	1.01	1.01	1.02	2.20	1	25.0	0	0.0	0	0.0	2	50.0	1	25.0	0	0.0
Sangeum	5	0.12	0.80	0.04	0.53	2	40.0	0	0.0	0	0.0	3	60.0	0	0.0	0	0.0
Sattari	5	0.20	0.99	0.70	0.97	3	60.0	0	0.0	0	0.0	2	40.0	0	0.0	0	0.0
Tiswadi	3	0.14	1.22			3	100.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	44					26	59.1	2	4.5	0	0.0	14	31.8	2	4.5	0	0.0

ANNEXURE I

GENERAL DETAILS OF HYDROGRAPH NETWORK STATIONS

SOUTH WESTERN REGION

GOA STATE

Sl No.	Well No.	District	Talulk	Village	Latitude	Longitude	Total Depth (mbgl)
1	48E2D9	North Goa	Bicholim	Bicholim(pz)	15°35'00"	73°57'40"	46.7
2	48I3A4	North Goa	Ponda	Ponda(pz)	15°23'27"	74°00'01"	30
3	48E2D5	North Goa	Bardoz	Sirsaim	15°37'36"	73°52'35"	5.21
4	48E2D7	North Goa	Bardoz	Mapuca	15°36'34"	73°49'35"	8.55
5	48E2D10	North Goa	Bardoz	Baga	15°33'37"	73°45'03"	3.37
6	48E2D11	North Goa	Bardoz	Calangute	15°32'43"	73°45'29"	9.7
7	48E2D12	North Goa	Bardoz	Alto Betim Porvorim	15°31'25"	73°49'49"	17.6
8	48E2D4	North Goa	Bicholim	Sal	15°41'11"	73°55'38"	5.82
9	48E2D6	North Goa	Bicholim	Mulgaon Shivalkherwad	15°36'49"	73°55'35"	5.04
10	48E2D8	North Goa	Bicholim	Bicholim	15°35'05"	73°57'27"	6.81
11	48I2A6	North Goa	Bicholim	Surla(pz)	15°30'26"	74°02'47"	41.76
12	48E1D1	North Goa	Pernem	Uguem(ugawe)	15°45'08"	74°50'20"	6.2
13	48E2C1	North Goa	Pernem	Morji	15°38'15"	73°44'12"	3.71
14	48E2D1	North Goa	Pernem	Pernem	15°43'03"	73°47'56"	4.25
15	48E2D2	North Goa	Pernem	Nagjhar	15°42'31"	73°51'18"	7.95
16	48E2D3	North Goa	Pernem	Korgaon	15°42'29"	73°45'05"	6.9
17	48I3A7	North Goa	Ponda	Shiroda	15°19'12"	74°02'08"	10.91
18	48I3A8	North Goa	Ponda	Panchawadi(pz)	15°16'57"	74°05'45"	
19	48I2A1	North Goa	Sattari	Hivre Budruk	15°37'55"	74°08'47"	9.8
20	48I2A2	North Goa	Sattari	Bayalwadikeri(querim)	15°36'36"	74°04'00"	8.45
21	48I2A3	North Goa	Sattari	Morlem	15°35'35"	74°02'47"	6.51
22	48I2A4	North Goa	Sattari	Honda	15°32'48"	74°03'02"	6.16
23	48I2A5	North Goa	Sattari	Valpoi	15°31'55"	74°08'18"	9.13
24	48I3A1	North Goa	Sattari	Khadki(harijanwada)	15°29'04"	74°08'26"	14.47
25	48E3D1	North Goa	Tiswadi	Velha Goa	15°29'59"	73°55'00"	14.4
26	48E3D2	North Goa	Tiswadi	Karanjhalen	15°27'29"	73°48'15"	6.38
27	48E3D3	North Goa	Tiswadi	Goa Velha	15°26'29"	73°52'47"	2.4
28	48I4A10	South Goa	Canacona	Shrishtal Gaondongar	15°02'07"	74°07'08"	25
29	48I4A11	South Goa	Canacona	Gulem Velipwada	15°02'12"	74°01'52"	5.6
30	48I4A12	South Goa	Canacona	Canacona	15°00'23"	74°03'02"	8.8
31	48I4D3	South Goa	Canacona	Agonda Desaiwada	15°02'25"	73°59'32"	7.9
32	48J1A1	South Goa	Canacona	Hattipal Poinguinem	14°59'00"	74°06'33"	9.41
33	48J1A2	South Goa	Canacona	Daptamol Lolien	14°56'56"	74°03'22"	16.27
34	48J1A3	South Goa	Canacona	Polem(polen)	14°54'39"	74°05'11"	6.57
35	48E3D4	South Goa	Marmugoa	Marmagoa	15°24'22"	73°47'54"	7.1
36	48E3D5	South Goa	Salcete	Majorda Bpada Curilo	15°19'28"	73°55'04"	6.17
37	48E3D6	South Goa	Salcete	Ballynuvhen	15°18'56"	73°56'55"	10.77
38	48E4D1	South Goa	Salcete	Carmona	15°12'10"	73°57'09"	9.42
39	48I3D7	South Goa	Salcete	Fathorda Margao(pz)	15°17'17"	73°58'10"	
40	48I4A6	South Goa	Salcete	Cuncalim(pz)	15°10'28"	74°00'22"	20
41	48I3A2	South Goa	Sanguem	Bolkharnem	15°25'42"	74°11'36"	8.24
42	48I3A3	South Goa	Sanguem	Darbandahra(pz)	15°23'25"	74°07'28"	14.07

Sl No.	Well No.	District	Talulk	Village	Latitude	Longitude	Total Depth (mbgl)
43	48I3A5	South Goa	Sanguem	Molem	15°22'33"	74°13'49"	15.49
44	48I3A6	South Goa	Tiswadi	Collem(kolamba)	15°20'03"	74°14'39"	10.5
45	48I4A2	South Goa	Sanguem	Ugem(pz)	15°13'47"	74°10'55"	6.2
46	48I4A3	South Goa	Sanguem	Valkinim	15°13'12"	74°12'53"	26.3
47	48I4A7	South Goa	Sanguem	Deulwada Kolamba	15°08'56"	74°07'55"	4.52
48	48I4A8	South Goa	Sanguem	Waddem(pz)	15°07'27"	74°12'37"	24.45
49	48I4A9	South Goa	Sanguem	Netrolim	15°05'22"	74°13'00"	11.42
50	48E4D2	South Goa	Quepem	Kanagini(pz)	15°07'24	73°56'48"	42.12
51	48I4A1	South Goa	Quepem	Ghadiawada	15°14'17"	74°06'50"	7.78
52	48I4A4	South Goa	Quepem	Quepem	15°13'01"	74°04'53"	9.13
53	48I4A5	South Goa	Quepem	Akamol Ambavalli	15°11'25"	74°02'17"	8.21
54	GAMY1301	North Goa	Bardez	Britona	15°30'45"	73°50'34"	4.1
55	GAMY1302	North Goa	Bicholim	Olaulim	15°34'10"	73°51'48"	9.6
56	GAMY1303	North Goa	Bardez	Colval	15°38'38"	73°50'14"	30
57	GAMY1304	North Goa	Bardez	Pirna	15°40'06"	73°52'53"	6.8
58	GAMY1305	North Goa	Tiswadi	Gauli Mola	15°27'41"	73°53'53"	5.4
59	GAJY1301	North Goa	Bardez	Parra	15°34'22"	73°47'33"	7.85
60	GAJY1302	North Goa	Bardez	Anjuna Beach	15°35'03"	74°44'17"	13.12
61	GAJY1303	North Goa	Sattari	Cross)	15°35'16"	74°11'28"	7.26
62	GAJY1304	North Goa	Sattari	Nagargoan	15°33'41"	74°09'47"	8
63	GAJY1305	North Goa	Tiswadi	Chimbel(kirl)	15°29'22"	73°52'27"	8.3
64	GAJY1306	North Goa	Pernem	m)	15°40'53"	73°45'08"	6.27
65	GAJY1307	North Goa	Bicholim	Adavapal	15°38'23"	73°53'45"	9.48
66	GAJY1308	North Goa	Bardez	Shivoli (brahmanwada)	15°37'24"	73°46'03"	5.2
67	GAJY1309	North Goa	Ponda	Mankem	15°18'19"	74°02'54"	7.22
68	GAJY1310	North Goa	Ponda	Bori	15°21'10"	74°00'12"	7.92
69	GAJY1311	North Goa	Sattari	Bhujpal	15°32'21"	74°05'17"	8.35
70	GAJY1312	North Goa	Sattari	Charayode	15°37'40"	74°07'50"	7.32
71	GAJY1313	North Goa	Sattari	Khotodem	15°28'58"	74°08'13"	8.5
72	Jy1301	South Goa	Sangeum	Malkarnem	15°10'41"	74°09'06"	11.28
73	Jy1302	South Goa	Sangeum	Vichundrem	15°06'12"	74°12'11"	8.26
74	Jy1303	South Goa	Sangeum	Vadam	15°07'50"	74°12'27"	9.15
75	Jy1304	South Goa	Canacona	Yedda	14°59'52"	74°11'28"	16.12
76	Jy1305	South Goa	Salecete	Kaveslium	15°11'08"	73°56'50"	6.14
77	Jy1306	South Goa	Salcete	Chikalim	15°23'53"	73°50'12"	3.5
78	Jy1307	South Goa	Canacona	Sristal	15°01'12"	74°04'31"	7.9
79	Jy1308	South Goa	Canacona	Ponquini	14°58'31"	74°05'43"	18.1
80	Jy1309	South Goa	Salcete	Mashe	14°01'30"	74°08'49"	5.6
81	Jy1310	South Goa	Sanguem	Suktali (molem)	15°21'49"	74°10'31"	7.45
82	Jy1311	South Goa	Sanguem	Kalay	15°17'18"	74°10'48"	13.45
83	Jy1312	South Goa	Sanguem	Guddemal	15°17'08"	74°46'08"	13.5
84	Jy13113	South Goa	Sanguem	Themchewada	15°13'10"	74°09'27"	15.58
85	Jy13114	South Goa	Sanguem	Bhati	15°10'54"	74°13'35"	7.7
86	Jy13115	South Goa	Salcete	Navelim	15°15'16"	73°58'02"	7.41
87	Jy13116	South Goa	Salcete	Betalbatti	15°18'02"	73°55'12"	7.5
88	Jy13117	South Goa	Salcete	Barodi Velni (betul)	15°08'59"	73°57'39"	5.4
89	Jy13118	South Goa	Salcete	Cuncalim	15°10'48"	74°00'00"	4.3
90	Jy13119	South Goa	Salcete	Padi	15°05'34"	74°01'50"	14.2
91	Jy13120	South Goa	Sanguem	Jambavli	15°11'11"	74°05'43"	13.31
92	Jy13121	South Goa	Sanguem	Revona	15°09'51"	74°06'24"	10.62

Annexure-II

MONTHLY NORMAL RAINFALL OF GOA STATE

Station	JAN	FEB	Winter	MAR	APR	MAY	Pre Mon	JUN	JUL	AUG	SEP	SW Mon	OCT	NOV	DEC	NE mon	ANNUAL
PERNEM	1.0	0.3	1.3	0.8	13.6	69.5	83.9	923.8	1220.8	623.3	277.7	3045.6	146.4	34.0	2.9	183.3	3314.1
MAPUSA	1.1	0.2	1.3	0.2	15.8	89.8	105.8	870.0	1009.3	538.9	276.0	2694.2	127.5	33.8	2.6	163.9	2965.3
BICHOLIM	1.0	0.2	1.2	0.1	10.0	64.4	74.5	957.5	1264.9	659.6	312.1	3194.1	196.7	50.0	3.6	250.3	3520.1
PONDA	1.2	0.1	1.3	0.3	21.0	91.0	112.3	1072.6	1358.0	691.2	323.3	3445.1	177.4	46.4	2.7	226.5	3785.2
VALPOI	1.4	0.1	1.5	0.9	13.7	92.3	106.9	955.5	1486.3	849.0	378.4	3669.2	216.6	51.2	4.1	271.9	4049.5
COLEM	1.4	0.3	1.7	1.7	19.8	111.5	133.0	1075.2	1800.1	1091.7	516.7	4483.7	266.3	60.8	5.3	332.4	4950.8
MARGAO	1.3	0.4	1.7	0.1	16.4	86.8	103.3	913.1	1054.4	505.8	257.2	2730.5	117.8	40.1	3.9	161.8	2997.3
QUEPEM	0.2	0.3	0.5	0.0	12.2	93.1	105.3	960.9	1378.2	712.7	320.2	3372.0	165.0	56.4	0.3	221.7	3699.5
SANGUEM	0.6	0.0	0.6	1.6	11.5	78.9	92.0	1010.5	1537.2	774.7	391.6	3714.0	215.0	64.5	3.9	283.4	5090.0
CANACONA	0.6	0.0	0.6	0.4	16.2	96.2	112.8	902.0	1025.0	537.4	293.2	2757.6	130.1	41.2	7.2	178.5	3049.5
PANAJI	1.7	0.1	1.8	0.7	18.4	86.6	105.7	869.4	923.4	456.2	252.7	2501.7	118.9	35.8	3.0	157.7	2766.9
MORMUGOA	1.8	0.0	1.8	0.4	20.3	81.3	102.0	777.8	905.1	412.9	225.9	2321.7	138.7	42.6	4.9	186.2	2611.7
MEAN	1.1	0.2	1.3	0.6	15.7	86.2	102.5	940.7	1246.9	954.3	318.7	3460.6	168.0	46.4	3.7	218.1	3483.3

ANNEXURE III

WATER LEVEL DATA OF HYDROGRAPH NETWORK STATIONS FOR WATER YEAR 2013-2014
SOUTH WESTERN REGION, GOA

Sl No.	Well No	District	Location	Depth to waterlevel (mbgl)								Decadal mean water levels mbgl			
				May-12	Aug-12	Nov-12	Jan-13	May-13	Aug-13	Nov-13	Jan-14	May-13	Aug-13	Nov-13	Jan-14
1	48E2D9	North Goa	Bicholim(pz)	15.29	-	-	14.6	-	-	-	15.68	-	-	-	15.75
2	48I3A4	North Goa	Ponda(pz)		-	-	3.18	4.25	-	-	3.55	3.54	-	-	3.21
3	48E2D5	North Goa	Sirsaim	3.57	1.27	1.79	3.81	13	1.6	2.32	3.95	4.21	1.9	3.96	3.74
4	48E2D7	North Goa	Mapuca	4.29	1.39	1.5	3.87	5	1.2	2.16	2.84	4.27	3.02	3.81	4.53
5	48E2D10	North Goa	Baga	2.91	2.06	2.4	2.77	3	2.33	1.28	2.85	2.85	2.39	2.62	2.81
6	48E2D11	North Goa	Calangute	8.26	3.02	4.6	6.15	8	3.6	3.35	6.82	8.32	4.03	4.89	6.62
7	48E2D12	North Goa	Alto Betim Porvorim	-	1.26	4.26	5.23	6.5	3.3	6.72	6.6	8.5	4.44	6.49	8.12
8	48E2D4	North Goa	Sal	3.21	1.77	3.17	2.86	4	1.65	3.39	3.44	3.1	1.98	2.79	2.96
9	48E2D6	North Goa	Mulgaon Shivalkherwad	2.66	-	3.89	4.12	3.8	1.8	3.85	2.78	4.01	2.22	2.77	3.67
10	48I2A6	North Goa	Surla(pz)	18.87	-	14.53	18.55	19.56	16.85	15.68	19.15	19.8	16.38	16.96	17.9
11	48E1D1	North Goa	Uguem(ugawe)	3.9	1.89	1.61	3.15	4.6	-	4.15	3.92	3.87	3.25	3.96	3.27
12	48E2C1	North Goa	Morji	2	0.35	0.22	0.78	2.4	0.5	0.74	1.14	2.07	0.26	0.37	0.86
13	48E2D1	North Goa	Pernem	3.77	2.29	3.06	3.23	7	3.8	3.97	6.78	2.7	1.59	2.01	2.42
14	48E2D2	North Goa	Nagjhar	9.43	6.41	7.77	7.88	-	7.2	8.55	9.08	9.55	5.57	7	8.15
15	48E2D3	North Goa	Korgaon	4.95	3.09	2.54	4.13	5.7	4.1	4.73	4.93	4.88	2.54	3.32	3.65
16	48I3A7	North Goa	Shiroda	6.77	5.16	5.43	6.57	8.1	5.9	7.1	7.64	6.58	5.14	5.94	6.73
17	48I3A8	North Goa	Panchawadi(pz)	6.94	4.56	5.55	6.3	-	3.35	7.21	5.18	-	4.7	6.19	6.13
18	48I2A2	North Goa	Bayalwadikeri(querim)	2.44	1.42	4.87	2.01	4.47	2	5.95	4.34	8.86	1.92	4	2.93
19	48I2A3	North Goa	Morlem	3.32	2.96	3.68	3.27	4.6	2.8	4.8	4	3.58	2.95	3.58	3.6
20	48I2A4	North Goa	Honda	3.45	1.57	2.54	3.32	4.5	1.65	3.14	3.46	4.24	2.05	2.53	2.7
21	48I2A5	North Goa	Valpoi	5.63	1.52	4.89	5.14	6.05	1.7	5.48	6.2	5.81	3.43	4.69	5.6
22	48I3A1	North Goa	Khadki(harijanwada)	10.93	3.58	7.43	7.88	12	3.9	7.92	8.59	10.48	4.31	6.31	7.13
23	48E3D1	North Goa	Velha Goa	1.73	0.2	0.56	1.15	2	0.8	1.21	1.6	3.89	1.7	2.24	2.5
24	48E3D2	North Goa	Karanjhalen	3.28	0.76	1.69	2.83	4.2	-	-	3.18	3.09	-	-	2.76
25	48E3D3	North Goa	Goa Velha	1.64	1	2.17	1.09	3.62	1.6	-	-	2.3	0.77	-	-
26	48I4A10	South Goa	Shrishtal Gaondongar	7.15	3.42	4.15	4.38	7.5	4	4.62	4.9	6.63	3.57	3.77	4.3
27	48I4A11	South Goa	Gulem Velipwada	3.83	0.57	1.42	3.26	4.33	1.25	1.26	3.15	3.07	0.55	0.73	2.63
28	48I4A12	South Goa	Canacona	4.82	1.52	2.75	3.58	5.7	2.2	3.05	4.53	4.69	1.78	2.81	3.89

Sl No.	Well No	District	Location	Depth to waterlevel (mbgl)								Decadal mean water levels mbgl			
				May-12	Aug-12	Nov-12	Jan-13	May-13	Aug-13	Nov-13	Jan-14	May-13	Aug-13	Nov-13	Jan-14
29	48I4D3	South Goa	Agonda Desaiwada	3.73	1.6	1.9	3.85	6.7	2.45	3.56	4.28	3.77	2.12	2.94	3.71
30	48J1A1	South Goa	Hattipal Poinguinem	8.57	5.84	6.41	6.58	9.3	5.8	7.01	7.31	8.16	5.67	6.37	6.54
31	48J1A2	South Goa	Daptamol Lolien	14.82	14.72	14.66	14.76	16.1	15.5	15.74	16	14.84	14.51	13.66	14.73
32	48J1A3	South Goa	Polem(polen)	3.67	-	2.3	1.63	5.8	2	1.92	2.69	4.1	1.17	1.21	2.02
33	48E3D5	South Goa	Majorda Bpada Curilo	5.57	1.8	2.72	4.2	6.55	2.5	3	5.47	4.72	1.74	2.13	3.1
34	48E3D6	South Goa	Ballynuvhen	6.5	4.56	5.93	6.25	6.3	7.2	3.4	9.19	6.83	4.94	6.03	6.08
35	48E4D1	South Goa	Carmona	8.2	-	-	-	8.55	3.1		7.25	7.91	3.48		5.63
36	48I4A6	South Goa	Cuncalim(pz)	4.76	3.72	4.68	4.66	6.9	4.2	6.99	4.55	5.01	4.56	7.48	4.86
37	48I3A2	South Goa	Bolkharnem	7.01	4.11	5.23	5.78	7.85	4.9	6.21	6.62	7.02	4.5	5.05	5.82
38	48I3A3	South Goa	Darbandahra(pz)	10.09	-	-	9.4	10.5	-	-	10.02	-	-	-	8.71
39	48I3A5	South Goa	Molem	13.98	1.15	7.69	11.05	14.65	1.75	7.93	11.21	13.64	2.1	7.09	10.32
40	48I3A6	South Goa	Collem(kolamba)	8.95	4.17	8	8.15	9.7	3.1	8.23	9.15	8.93	4.01	7.52	8.54
41	48I4A7	South Goa	Deulwada Kolamba	3.24	2.18	2.67	2.34	4.1	2.8	3.81	3.28	2.38	1.34	2.12	1.98
42	48I4A9	South Goa	Netrolim	10.64	9.66	10.5	10.14	11	9.8	11.2	10.06	10.63	-	10.19	10.1
43	48E4D2	South Goa	Kanagini(pz)	16.16	-	7.64	16.37	-	8.35	8.19	16.79	-	-	12.98	-
44	48I4A1	South Goa	Ghadiawada	2.06	0.99	1.82	1.92	2.7	1.66	2.36	2.72	2.34	1.19	1.72	2.1
45	48I4A4	South Goa	Quepem	3.24	2.08	2.52	3.07	7.3	2.35	3.4	4.25	3.99	1.88	3.17	3.44
46	48I4A5	South Goa	Akamol Ambavalli	3.77	3.7	5.36	2.62	4.4	3.7	5.67	3.09	4.15	3.55	5.19	2.68
47	GAJY1301	North Goa	Parra	-	-	-	1.23	3.05	1.2	1.24	2.25	-	-	-	-
48	GAJY1302	North Goa	Anjuna Beach	-	-	-	8.82	12.1	6.8	8.48	12.09	-	-	-	-
49	GAJY1303	North Goa	Bhamber(Nanoda Cross)	-	-	-	5.28	6.4	3.5	4.97	5.52	-	-	-	-
50	GAJY1304	North Goa	Nagargoan	-	-	-	4.65	8.55	1.1	3.95	6.08	-	-	-	-
51	GAJY1305	North Goa	Gavalebhat	-	-	-	6.05	3.05	3.8	2.19	5.95	-	-	-	-
52	GAJY1306	North Goa	Sawanthwada(mandrem)	-	-	-	5.31	6	2	3.3	5.25	-	-	-	-
53	GAJY1307	North Goa	Adavapal	-	-	-	6.4	6.4	4.3	4.9	5.45	-	-	-	-
54	GAJY1308	North Goa	Shivoli (brahmanwada)	-	-	-	2.95	4	0.75	2.05	2.78	-	-	-	-
55	GAJY1309	North Goa	Mankem	-	-	-	4.21	5.05	2.2	4.18	4.2	-	-	-	-
56	GAJY1310	North Goa	Bori	-	-	-	5.86	5.8	3.7	2.43	4.95	-	-	-	-
57	GAJY1311	North Goa	Bhujpal	-	-	-	4.41	7	1.6	7.98	4.15	-	-	-	-
58	GAJY1312	North Goa	Charayode	-	-	-	4.7	6.7	1.8	3.72	2.83	-	-	-	-
59	GAJY1313	North Goa	Khotodem	-	-	-	6.8	7.1	1.8	5.62	7.13	-	-	-	-
60	Jy1301	South Goa	Malkarnem	-	-	-	9.11	6.7	5.3	5.98	6.74	-	-	-	-
61	Jy1302	South Goa	Vichundrem	-	-	-	1.86	8.6	1.05	6.25	7.82	-	-	-	-

Sl No.	Well No	District	Location	Depth to waterlevel (mbgl)								Decadal mean water levels mbgl			
				May-12	Aug-12	Nov-12	Jan-13	May-13	Aug-13	Nov-13	Jan-14	May-13	Aug-13	Nov-13	Jan-14
62	Jy1303	South Goa	Vadam	-	-	-	3.12	4.9	3.4	3.93	4.13	-	-	-	-
63	Jy1304	South Goa	Yedda	-	-	-	1.49	7.9	1.9	1.26	4.8	-	-	-	-
64	Jy1305	South Goa	Kaveslium	-	-	-	2.9	4.55	2.15	2.41	4.3	-	-	-	-
65	Jy1306	South Goa	Chikalim	-	-	-	2.62	2.75	1.35	1.14	1.74	-	-	-	-
66	Jy1307	South Goa	Sristal	-	-	-	4.15	5.8	1.4	11.31	4.01	-	-	-	-
67	Jy1308	South Goa	Ponquini	-	-	-	16.19		14.9	16	16.24	-	-	-	-
68	Jy1309	South Goa	Mashe	-	-	-	4.3	5.4	2.9	3.86	4.2	-	-	-	-
69	Jy1310	South Goa	Suktali (molem)	-	-	-	5.18	7.7	4.35	5	9.9	-	-	-	-
70	Jy1311	South Goa	Kalay	-	-	-	10.65	12.9	3.7	11.38	12	-	-	-	-
71	Jy1312	South Goa	Guddemal	-	-	-	10.68	13.1	4.65	8.74	10.05	-	-	-	-
72	Jy13113	South Goa	Themchewada	-	-	-	8.6	8.55	6.15	9.98	8.87	-	-	-	-
73	Jy13114	South Goa	Bhati	-	-	-	5	5.85	4.2	4	4.9	-	-	-	-
74	Jy13115	South Goa	Navelim	-	-	-	5.16	6.35	2.1	3.4	5.53	-	-	-	-
75	Jy13116	South Goa	Betalbatti	-	-	-	5.63	7.1	2.17	3.57	5.15	-	-	-	-
76	Jy13117	South Goa	Barodi Velni (betul)	-	-	-	3.1	3.9	2.4	2.78	3.14	-	-	-	-
77	Jy13118	South Goa	Cuncalim	-	-	-	2.45	2.75	1.6	2.28	2.58	-	-	-	-
78	Jy13119	South Goa	Padi	-	-	-	10.5	13.6	6.4	6.56	9.85	-	-	-	-
79	Jy13120	South Goa	Jambavli	-	-	-	9.68	9.4	5.27	9.57	9.5	-	-	-	-
80	Jy13121	South Goa	Revona	-	-	-	8	9.1	5.5	8.06	7.05	-	-	-	-

ANNEXURE IV

FLUCTUATION DATA OF HYDROGRAPH NETWORK STATIONS FOR WATER YEAR 2013-2014
SOUTH WESTERN REGION
GOA STATE

Sl No.	Well No	Location	District	Seasonal Water Level Fluctuation (mbgl)			Annual Water Level Fluctuation (mbgl)				Water Level Fluctuation with respect to decadal mean water level (mbgl)			
				May13-Aug13	May13-Nov13	May13-Jan14	May12-May13	Aug12-Aug13	Nov12-Nov13	Jan13-Jan14	Mean May(2003-2012) to May2013	Mean Aug(2003-2012) to Aug2013	Mean Nov(2003-2012) to Nov2013	Mean Jan(2004-2013) to Jan2014
1	48E2D9	Bicholim(pz)	North Goa	-	-	-	-	-	-	-0.58	-	-	-	0.569
2	48I3A4	Ponda(pz)	North Goa	-	-	0.7	-	-	-	0.13	-0.21	-	-	0.163
3	48E2D5	Sirsaim	North Goa	3.4	2.68	1.05	-0.98	0.12	-0.08	0.31	-0.343	0.754	1.089	0.244
4	48E2D7	Mapuca	North Goa	3.8	2.84	2.16	0.04	0.94	0.09	1.78	0.021	2.567	2.404	2.436
5	48E2D10	Baga	North Goa	0.67	1.72	0.15	0.19	0.01	1.4	0.2	0.133	0.338	1.62	0.239
6	48E2D11	Calangute	North Goa	4.4	4.45	1.18	0.76	-0.08	1.54	-0.17	0.824	0.935	1.842	0.302
7	48E2D12	Alto Betim Porvorim	North Goa	3.5	0.08	0.2	-	-1.17	-1.59	-0.5	2.571	2.01	0.638	2.395
8	48E2D4	Sal	North Goa	2.35	0.65	0.56	-0.1	0.81	0.47	0.11	-0.208	1.023	0.09	0.213
9	48E2D6	Mulgaon Shivalkherwad	North Goa	2	-0.05	1.02	-0.27	-	0.91	2.21	1.083	1.288	-0.208	1.759
10	48I2A6	Surla(pz)	North Goa	2.71	3.88	0.41	0.01	-	-0.45	0.1	0.936	0.234	1.979	-0.549
11	48E1D1	Uguem(ugawe)	North Goa	1.3	0.45	0.68	0.1	-0.61	-1.74	-	0.067	0.748	0.612	0.154
12	48E2C1	Morji	North Goa	1.9	1.66	1.26	0.07	0.32	-0.05	0.11	0.136	0.226	0.109	0.19
13	48E2D1	Pernem	North Goa	3.2	3.03	0.22	-2.45	-0.73	-0.13	-2.77	-3.52	-1.426	-1.182	-3.578
14	48E2D2	Nagjhar	North Goa	1.3	-0.05	-0.58	1.7	-0.02	-0.01	-0.43	1.825	-0.856	-0.784	-0.161
15	48E2D3	Korgaon	North Goa	1.6	0.97	0.77	0.1	-0.16	-1.34	0.05	0.029	-0.711	-0.56	-0.434
16	48I3A7	Shiroda	North Goa	2.2	1	0.46	-0.28	0.31	-0.62	-0.02	-0.47	0.291	-0.105	0.137
17	48I3A8	Panchawadi(pz)	North Goa	2.47	-	-	-	1.91	-0.96	1.82	-	2.051	-0.323	1.649
18	48I2A2	Bayalwadikeri(querim)	North Goa	-	-1.48	0.13	-1.59	-0.14	-0.64	-1.89	-0.167	0.355	-1.514	-0.97
19	48I2A3	Morlem	North Goa	1.8	-0.2	0.6	-0.58	0.86	-0.42	-0.02	-0.318	0.847	-0.518	0.298
20	48I2A4	Honda	North Goa	2.85	1.36	1.04	-0.3	0.67	0.15	0.61	0.492	1.155	0.143	0.993
21	48I2A5	Valpoi	North Goa	4.35	0.57	-0.15	0.38	0.62	0.21	-0.26	0.556	2.532	0.013	0.199
22	48I3A1	Khadki(harijanwada)	North Goa	8.1	4.08	3.41	-0.31	0.44	0.27	0.05	-0.757	1.172	-0.845	-0.699
23	48E3D1	Velha Goa	North Goa	1.2	0.79	0.4	0.05	-0.28	-0.33	-0.13	2.21	1.216	1.349	1.224

Sl No.	Well No	Location	District	Seasonal Water Level Fluctuation (mbgl)			Annual Water Level Fluctuation (mbgl)				Water Level Fluctuation with respect to decadal mean water level (mbgl)			
				May13-Aug13	May13-Nov13	May13-Jan14	May12-May13	Aug12-Aug13	Nov12-Nov13	Jan13-Jan14	Mean May(2003-2012) to May2013	Mean Aug(2003-2012) to Aug2013	Mean Nov(2003-2012) to Nov2013	Mean Jan(2004-2013) to Jan2014
24	48E3D2	Karanjhalen	North Goa	-	-	1.02	-0.02	-	-	0.55	-0.213	-	-	0.478
25	48E3D3	Goa Velha	North Goa	2.02	-	-	-1.52	-0.14	-	-	-0.86	-0.368	-	-
26	GAMY1303	Colval	North Goa	-	-	2.03	-	-	-	-	-	-	-	-
27	GAMY1304	Pirna	North Goa	-	-	1.9	-	-	-	-	-	-	-	-
28	GAMY1302	Olaulim	North Goa	-	-	1.64	-	-	-	-	-	-	-	-
29	48I4A10	Shrishtal Gaondongar	South Goa	3.5	2.88	2.67	0.15	-0.08	0.03	-0.02	-0.37	0.069	-0.354	-0.101
30	48I4A11	Gulem Velipwada	South Goa	3.08	3.07	1.18	0.21	0.03	0.87	0.82	-0.55	0.013	0.179	0.189
31	48I4A12	Canacona	South Goa	3.5	2.65	1.17	-0.14	0.06	0.44	-0.21	-0.268	0.315	0.501	0.095
32	48I4D3	Agonda Desaiwada	South Goa	4.25	3.14	2.42	-2.25	-0.13	-0.94	0.29	-2.213	0.394	0.095	0.148
33	48J1A1	Hattipal Poinguinem	South Goa	3.5	2.29	1.99	-0.04	0.73	0.09	-0.04	-0.451	0.557	0.048	-0.083
34	48J1A2	Daptamol Lolien	South Goa	0.52	0.36	0.1	-0.18	0.24	0.02	-0.15	-0.161	0.027	-0.98	-0.174
35	48J1A3	Polem(polen)	South Goa	3.8	3.88	3.11	-1.17	-	1.34	-0.17	-0.74	0.126	0.254	0.286
36	48E3D5	Majorda Bpada Curilo	South Goa	4.05	3.55	1.08	-0.26	0.02	0.44	-0.55	-1.107	-0.044	-0.145	-1.648
37	48E3D6	Ballynuvhen	South Goa	-0.9	2.9	-2.89	1.12	-1.72	3.45	-2.02	1.454	-1.332	3.547	-2.195
38	48E4D1	Carmona	South Goa	5.75	-	1.6	-0.05	0.22	-	-	-0.337	0.976	-	-1.017
39	48I4A6	Cuncalim(pz)	South Goa	-1.45	1.57	-1.8	2.71	-	-1.61	0.81	2.961	1.061	1.191	1.008
40	48I3A2	Bolkharnem	South Goa	2.95	1.64	1.23	0.08	0.13	-0.06	0.08	0.09	0.524	-0.236	0.122
41	48I3A3	Darbandahra(pz)	South Goa	-	-	0.48	0.37	-	-	0.16	-	-	-	-0.529
42	48I3A5	Molem	South Goa	12.9	6.72	3.44	0.18	0.25	-	0.69	-0.16	1.201	0.006	-0.043
43	48I3A6	Collem(kolamba)	South Goa	6.6	1.47	0.55	0	1.82	0.52	-0.25	-0.017	1.662	0.039	0.136
44	48I4A7	Deulwada Kolamba	South Goa	1.3	0.29	0.82	0.03	0.27	-	-0.05	-0.827	-0.57	-0.8	-0.412
45	48I4A9	Netrolim	South Goa	-	-0.2	0.94	0.4	-	0.06	0.84	0.389	-	-0.25	0.8
46	48E4D2	Kanagini(pz)	South Goa	-	-	-	-	-	0.07	0.2	-	-	5.412	-
47	48I4A1	Ghadiawada	South Goa	1.04	0.34	-0.02	0.09	0.06	0.19	-0.07	0.368	0.264	0.091	0.114
48	48I4A4	Quepem	South Goa	4.95	3.9	3.05	-3.46	0.33	-0.28	-0.58	-2.706	0.133	0.368	-0.206
49	48I4A5	Akamol Ambavalli	South Goa	0.7	-1.27	1.31	-0.07	0.56	0.25	0.09	0.308	0.413	0.08	0.154
50	GAJY1301	Parra	North Goa	1.85	2.41	1.4	-	-	-	-0.42	-	-	-	-
51	GAJY1302	Anjuna Beach	North Goa	5.3	4.49	0.88	-	-	-	-2.4	-	-	-	-
52	GAJY1303	Bhamber(Nanoda cross)	North Goa	2.9	2.43	1.88	-	-	-	0.76	-	-	-	-
53	GAJY1304	Nagargoan	North Goa	7.45	5.3	3.17	-	-	-	-0.73	-	-	-	-

Sl No.	Well No	Location	District	Seasonal Water Level Fluctuation (mbgl)			Annual Water Level Fluctuation (mbgl)				Water Level Fluctuation with respect to decadal mean water level (mbgl)			
				May13-Aug13	May13-Nov13	May13-Jan14	May12-May13	Aug12-Aug13	Nov12-Nov13	Jan13-Jan14	Mean May(2003-2012) to May2013	Mean Aug(2003-2012) to Aug2013	Mean Nov(2003-2012) to Nov2013	Mean Jan(2004-2013) to Jan2014
54	GAJY1305	Gavalebhat	North Goa	2.65	4.86	1.1	-	-	-	0.7	-	-	-	-
55	GAJY1306	Sawanthwada(mandrem)	North Goa	4	3.42	1.47	-	-	-	0.03	-	-	-	-
56	GAJY1307	Adavapal	North Goa	2.1	2.31	1.76	-	-	-	1.76	-	-	-	-
57	GAJY1308	Shivoli (brahmanwada)	North Goa	3.25	2.47	1.74	-	-	-	0.69	-	-	-	-
58	GAJY1309	Mankem	North Goa	2.85	1.52	1.5	-	-	-	0.66	-	-	-	-
59	GAJY1310	Bori	North Goa	2.1	4.47	1.95	-	-	-	2.01	-	-	-	-
60	GAJY1311	Bhujpal	North Goa	5.4	-0.14	3.69	-	-	-	1.1	-	-	-	-
61	GAJY1312	Charayode	North Goa	4.9	3.7	4.59	-	-	-	2.58	-	-	-	-
62	GAJY1313	Khotodem	North Goa	5.3	2.29	0.78	-	-	-	0.48	-	-	-	-
63	GAMY1301	Britona	North Goa	-	-	0.83	-	-	-	-	-	-	-	-
64	Jy1301	Malkarnem	South Goa	1.4	1.44	0.68	-	-	-	3.09	-	-	-	-
65	Jy1302	Vichundrem	South Goa	7.55	3.05	1.48	-	-	-	-5.26	-	-	-	-
66	Jy1303	Vadam	South Goa	1.5	1.49	1.29	-	-	-	-0.49	-	-	-	-
67	Jy1304	Yedda	South Goa	6	7.14	3.6	-	-	-	-2.81	-	-	-	-
68	Jy1305	Kaveslium	South Goa	2.4	2.64	0.75	-	-	-	-0.9	-	-	-	-
69	Jy1306	Chikalim	South Goa	1.4	2.03	1.43	-	-	-	1.3	-	-	-	-
70	Jy1307	Sristal	South Goa	4.4	-4.69	2.61	-	-	-	0.96	-	-	-	-
71	Jy1308	Ponquini	South Goa	-	-	-	-	-	-	0.71	-	-	-	-
72	Jy1309	Mashe	South Goa	2.5	2.02	1.68	-	-	-	0.58	-	-	-	-
73	Jy1310	Suktali (molem)	South Goa	3.35	3.74	-1.16	-	-	-	-3.68	-	-	-	-
74	Jy1311	Kalay	South Goa	9.2	2.57	1.95	-	-	-	-0.3	-	-	-	-
75	Jy1312	Guddemal	South Goa	8.45	5.16	3.85	-	-	-	1.43	-	-	-	-
76	Jy13113	Themchewada	South Goa	2.4	-0.76	0.35	-	-	-	0.4	-	-	-	-
77	Jy13114	Bhati	South Goa	1.65	2.63	1.73	-	-	-	0.88	-	-	-	-
78	Jy13115	Navelim	South Goa	2.95	2.33	0.2	-	-	-	0.31	-	-	-	-
79	Jy13116	Betalbatti	South Goa	4.93	4.11	2.53	-	-	-	1.06	-	-	-	-
80	Jy13117	Barodi Velni (betul)	South Goa	1.5	1.85	1.49	-	-	-	0.69	-	-	-	-
81	Jy13118	Cuncalim	South Goa	-	-4.24	-	-	-	-	0.47	-	-	-	-
82	Jy13119	Padi	South Goa	7.2	7.82	4.53	-	-	-	1.43	-	-	-	-
83	Jy13120	Jambavli	South Goa	4.13	0.78	0.85	-	-	-	1.13	-	-	-	-

Sl No.	Well No	Location	District	Seasonal Water Level Fluctuation (mbgl)			Annual Water Level Fluctuation (mbgl)				Water Level Fluctuation with respect to decadal mean water level (mbgl)			
				May13-Aug13	May13-Nov13	May13-Jan14	May12-May13	Aug12-Aug13	Nov12-Nov13	Jan13-Jan14	Mean May(2003-2012) to May2013	Mean Aug(2003-2012) to Aug2013	Mean Nov(2003-2012) to Nov2013	Mean Jan(2004-2013) to Jan2014
84	Jy13121	Revona	South Goa	3.6	1.65	2.66	-	-	-	1.56	-	-	-	-
85	48I3D7	Fathorda	South Goa	2.62	-	-0.16	-	-	-	-	-	-	-	-

Annexure V

Depth to Water Level of Piezometers in Goa State during 2013-14

Sl No.	District	Taluk	Location	Depth to Water Level			
				May-13	Aug-13	Nov-13	Jan-14
1	North Goa	Bardez	Aropora	2.76		1.12	1.17
2	North Goa	Bardez	Kirl Pirna	9.8	5.8	7.42	8.37
3	North Goa	Bardez	Adavapal	5.37	4.13	6.36	5.17
4	North Goa	Bardez	Aldona	16.84	10.07	-	15.65
5	North Goa	Bardez	Tivim	-	16.1	-	20.62
6	North Goa	Bicholim	Mayam	-	2	-	-
7	North Goa	Bicholim	Narve	12.95	-	-	-
8	North Goa	Bicholim	Sanqulim	21.6	15.35	26.12	25.55
9	North Goa	Bicholim	Kasar Pal	2.15	6.16	9.84	10.01
10	North Goa	Pernem	Parsekarwada	18.94	16.9	15.28	18.5
11	North Goa	Pernem	Varkhand	15.7	2.8	-	14.88
12	North Goa	Pernem	Hassapur	5.9	4.6	4.07	-
13	North Goa	Pernem	Tuem	14.65	1.91	9.22	10.34
14	North Goa	Pernem	Colvale	13.67	10	12.98	-
15	North Goa	Pernem	Silolium	5.66	4	-	5.17
16	North Goa	Pernem	Morjum	3.1	2.2	2.26	2.49
17	North Goa	Pernem	Sawanthwada	5.93	2.57	5.1	5.28
18	North Goa	Pernem	Korgoan	-	-	-	-
19	North Goa	Ponda	Betki	17.4	11.8	15.56	16.09
20	North Goa	Ponda	Madakai	22.9	6.2	-	19.78
21	North Goa	Satari	Morlem	-	-	-	-
22	North Goa	Satari	Thane	10.4	4.6	7.36	7.81
23	North Goa	Satari	Nanoda	-	17.4	17.27	20.46
24	North Goa	Satari	Sanvordam	15.15	11.2	13.92	14.76
25	North Goa	Tiswadi	Mola	1.24	1.19	-	-
26	North Goa	Tiswadi	Ajosi	-	2.24	3.38	4.84
27	North Goa	Tiswadi	Krilwada	2.1	1.8	1.76	2.03
28	South Goa	Canacona	Dabel	13.65	6.66	9.54	10.43
29	South Goa	Canacona	Yedda	8.8	6.8	7.9	8.88
30	South Goa	Canacona	Kuske	14.9	12	12.62	12.97
31	South Goa	Canacona	Aven	10.54	7.08	8.25	8.66
32	South Goa	Canacona	Ponquini	9.8	7.08	8.94	9.22
33	South Goa	Canacona	Patnem	8.5	1.79	3.51	5.37
34	South Goa	Mormugao	Bogmola	1.3	0.57	0.88	0.94
35	South Goa	Quepem	Quiescond	16.5	10.51	13.28	14.49
36	South Goa	Salcete	Chinchinim	13	1.93	-	-
37	South Goa	Salcete	Chandvar	3	2.02	-	2.66
38	South Goa	Salcete	Dovorlim	5.8	4.3	5.38	5.77
39	South Goa	Salcete	Manora Rai	5.8	3.61	-	-
40	South Goa	Salcete	Kavelosim	3.15	1.33	-	-
41	South Goa	Salcete	Carmona	7.2	3.84	-	6.05
42	South Goa	Salcete	Canabonulim	6.6	3.94	3.97	4.9
43	South Goa	Salcete	Verna	-	-	-	2.18
44	South Goa	Sanquem	Natravlim	-	-	-	-
45	South Goa	Sanquem	Collem	6.7	2.06	5.9	6.1
46	South Goa	Sanquem	Meidawada	11.95	4.8	10.5	11.24
47	South Goa	Sanquem	Dhat Farm	-	3.8	-	-
48	South Goa	Sanquem	Molem	9.9	1.4	4.74	7.03
49	South Goa	Sanquem	Kalay	5.5	2.57	3.61	4.26

Annexure VI

Hydrochemical Data of water level monitoring Stations, Goa State, May 2013

Sl No.	DISTRICT	LOCATION	pH	Specifc Conduct. in µS/cm at 25°C	Concentration in mg/l												
					CO_3^{--}	HCO_3^{-}	Cl^{-}	NO_3	SO_4	F^{-}	Ca^{++}	Mg^{++}	TH	Na^{+}	K^{+}	PO_4	B
1	NORTH GOA	BAYALWADIKERI(QUERIM)	7.0	110	0	24	14	0.3	12	0.10	4	7	40	5.6	0.2	0.10	0.002
2	NORTH GOA	MORLEM	7.1	100	0	18	21	0.4	4	0.06	8	2	30	9	0.2	0.11	0.001
3	NORTH GOA	HONDA	7.3	120	0	24	21	3.0	5	0.09	8	5	40	8	0.4	0.11	0.004
4	NORTH GOA	BHUIPAL	7.2	140	0	30	28	0.6	4	0.12	16	2	50	8.8	0.5	0.15	0.001
5	NORTH GOA	VALPOI	7.3	200	0	49	36	3.0	5	0.09	16	2	50	21	3.1	0.12	0.002
6	NORTH GOA	CHARAYOD	7.4	240	0	61	36	4.0	12	0.11	12	10	70	21	1.3	0.11	0.002
7	NORTH GOA	BAMBER	7.6	100	0	18	21	0.5	2	0.09	8	2	30	8	0.3	0.15	0.005
8	NORTH GOA	KHADKI(HARIJANWADA	7.4	110	0	24	21	0.8	4	0.08	12	2	40	6.5	0.4	0.16	0.021
9	NORTH GOA	KOTADEN	7.5	100	0	30	14	2.0	2	0.07	4	5	30	8	0.5	0.14	0.001
10	NORTH GOA	GAVALEBHAT	7.6	160	0	24	36	1.2	5	0.05	12	2	40	16	1.1	0.12	0.035
11	NORTH GOA	GOA VELHA	7.8	280	0	91	28	7.0	16	0.09	32	10	120	7	2.3	0.11	0.006
12	NORTH GOA	GAULIMOLA	7.7	160	0	30	35	1.0	3	0.07	12	5	50	12	1.3	0.07	0.007
13	NORTH GOA	MULGAON SHIVALKHER	7.5	130	0	24	28	0.7	4	0.04	8	5	40	11	0.5	0.11	0.003
14	NORTH GOA	ADAVAPAL	7.4	100	0	18	21	3.0	1	0.05	8	2	30	8.5	0.3	0.10	0.001
15	NORTH GOA	PIRNA	7.4	120	0	18	28	1.2	2	0.04	12	2	40	8	0.3	0.25	0.006
16	NORTH GOA	SAL	7.5	160	0	43	21	2.0	11	0.06	16	2	50	10	5.7	0.01	0.001
17	NORTH GOA	SIRSAIM	7.6	110	0	24	21	2.0	2	0.04	8	5	40	6	0.8	0.37	0.002
18	NORTH GOA	CALANGUTE	7.6	370	0	55	57	31.0	30	0.06	32	7	110	32	3.4	0.16	0.003
19	NORTH GOA	BAGA	7.7	570	0	140	78	30.0	32	0.08	48	17	190	40	6.3	0.11	0.002
20	NORTH GOA	PARRA	7.6	130	0	37	21	2.0	2	0.13	8	5	40	9	2.1	0.01	0.006
21	NORTH GOA	MAPUCA	7.5	320	0	24	78	21.0	10	0.05	20	5	70	39	2.4	0.16	0.001
22	NORTH GOA	COLVAL	7.6	350	0	79	36	29.0	30	0.80	28	14	130	18	3.4	0.15	0.027

23	NORTH GOA	NAGJHAR	7.7	120	0	18	21	11.0	4	0.40	12	2	40	8	1.6	0.06	0.001
24	NORTH GOA	UGUEM	7.4	130	0	18	28	2.0	6	0.50	8	5	40	10	1.3	0.09	0.002
25	NORTH GOA	PERNEM	7.0	160	0	49	21	5.0	4	0.50	12	7	60	8	1.0	0.11	0.001
26	NORTH GOA	KORGAON	7.1	140	0	30	28	1.0	4	0.05	12	2	40	12	2.5	0.11	0.021
27	NORTH GOA	SAWANTWADA	7.2	110	0	24	21	2.0	2	0.04	8	5	40	6	0.4	0.07	0.001
28	NORTH GOA	MORJI	7.3	190	0	30	28	9.0	16	0.06	16	2	50	19	0.7	0.06	0.002
29	NORTH GOA	SHIVOLI	7.8	340	0	146	28	4	6	0.09	44	5	130	15	4.9	0.10	0.003
30	NORTH GOA	OLAULIM	7.4	130	0	30	21	2	4	0.10	12	2	40	10	0.68	0.19	0.011
31	NORTH GOA	BRITONA	7.5	160	0	43	21	2	10	0.06	20	2	60	8	0.6	0.06	0.004
32	NORTH GOA	ANJUNA BEACH	7.3	150	0	18	35	5	2	0.07	4	5	30	19	0.3	0.17	0.001
33	NORTH GOA	BORI	7.4	160	0	37	28	3	4	0.10	8	10	60	7.6	0.38	0.11	0.014
34	NORTH GOA	SHIRODA	7.3	200	0	30	35	13	10	0.07	16	2	50	21	1.9	0.24	0.006
36	SOUTH GOA	GUDEMAL	7.5	190	0	55	28	2	6	0.04	16	5	60	15	0.8	0.08	0.002
37	SOUTH GOA	KALAY	7.3	120	0	18	28	2.5	2	0.04	4	5	30	13	0.02	0.20	0.001
38	SOUTH GOA	COLLEM	7.5	130	0	30	21	2	6	0.02	12	2	40	10	0.4	0.11	0.005
39	SOUTH GOA	MOLEM	7.8	280	0	122	21	1	8	0.20	28	12	120	8	0.18	0.07	0.002
40	SOUTH GOA	BOLKHARNEM	7.7	150	0	43	21	2	4	0.10	12	5	50	9	0.88	0.14	0.001
41	SOUTH GOA	KARANJHALEN	7.7	650	0	238	43	23	46	0.19	60	22	240	37	2.4	0.21	0.035
42	SOUTH GOA	VELHA GOA	7.6	300	0	116	28	5	10	0.21	28	12	120	13	0.42	0.13	0.004
43	SOUTH GOA	GHADIWADA	7.4	170	0	61	21	1	2	0.08	8	10	60	10	1	0.06	0.002
44	SOUTH GOA	MALKARNEM	7.3	120	0	30	14	1	12	0.07	12	5	50	3	0.94	0.09	0.012
45	SOUTH GOA	BHATI	7.5	100	0	30	14	2	1	0.05	4	7	450	4	0.26	0.03	0.004
46	SOUTH GOA	VADDEM	7.4	130	0	24	28	3	2	0.04	4	7	40	11	0.4	0.11	0.008
47	SOUTH GOA	NETROLIM	7.4	180	0	55	21	3	10	0.60	8	7	50	16	2.8	0.16	0.001
48	SOUTH GOA	VINCHURDEM	7.5	120	0	37	14	1	5	0.40	12	2	40	8	0.36	0.07	0.003
49	SOUTH GOA	DEULWADA KOLAMBA	7.6	170	0	55	21	4	3	0.10	8	10	60	8	3.5	0.03	0.024
50	SOUTH GOA	REVONA	7.6	140	0	30	21	9	4	0.40	12	2	40	12	1.0	0.11	0.004
51	SOUTH GOA	QUEPEM	7.7	120	0	43	14	3	2	0.07	16	2	50	4	0.9	0.08	0.001
52	SOUTH GOA	FATHORDA MARGOA	7.6	250	0	49	43	15	10	0.20	12	10	70	23	3	0.1	0.027
53	SOUTH GOA	MAJORDA B C	7.3	210	0	24	43	19	8	0.05	16	5	60	18	1.7	0.03	0.001
54	SOUTH GOA	BETALBATTI	7.5	220	0	43	35	23	6	0.10	16	2	50	26	2	0.16	0.007
55	SOUTH GOA	BALLYNUVHEN	7.4	110	0	18	21	5	3	0.05	8	2	30	9	1.9	0.09	0.021

56	SOUTH GOA	NAVELIM	7.2	170	0	24	35	10	4	0.10	8	5	40	19	1.6	0.07	0.001
57	SOUTH GOA	KAVASELIUM	7.6	520	0	195	50	17	12	0.15	44	14	170	38	4	0.22	0.031
58	SOUTH GOA	BARODIVELNI	7.7	110	0	24	21	3	2	0.05	4	2	20	14	2.9	0.15	0.006
59	SOUTH GOA	AGONDA DESAIWADA	7.6	230	0	55	43	3	5	0.20	12	10	70	19	0.5	0.18	0.004
60	SOUTH GOA	GULEM VELIPWADA	7.7	180	0	67	21	1	2	0.10	16	5	60	12	2.3	0.1	0.002
61	SOUTH GOA	CUNCULIUM	7.7	210	0	73	21	2	10	0.20	20	2	60	18	3.1	0.11	0.001
62	SOUTH GOA	AKAMOL AMBAVALLI	7.5	90	0	12	21	3	2	0.04	4	5	30	6	0.6	0.06	0.002
63	SOUTH GOA	PADI	7.4	170	0	49	28	1	2	0.05	12	2	40	19	1.1	0.12	0.008
64	SOUTH GOA	SRISTAL	7.7	220	0	98	14	2	6	0.30	24	5	80	11	1.6	0.16	0.022
65	SOUTH GOA	SHRISHTAL GAONDONGAR	7.6	180	0	55	28	1.5	2	0.06	12	2	40	22	1	0.11	0.001
66	SOUTH GOA	HATTIPAL P	7.5	90	0	24	14	1	2	0.03	4	5	30	5	1.3	0.03	0.011
67	SOUTH GOA	MASHE	7.6	130	0	30	21	2	4	0.04	12	2	40	10	0.8	0.07	0.002
68	SOUTH GOA	DAPTAMOL LOLIEN	7.7	130	0	24	28	1	3	0.02	8	2	30	15	0.6	0.12	0.004
69	SOUTH GOA	POLEM	7.8	420	0	152	43	4	15	0.30	20	19	130	34	3.2	0.25	0.011