
# केन्द्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण
विभाग, जल शक्ति मंत्रालय

भारत सरकार

# Central Ground Water Board

Department of Water Resources, River
Development and Ganga Rejuvenation,
Ministry of Jal Shakti
Government of India

# AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

## Malkangiri District
## Odisha

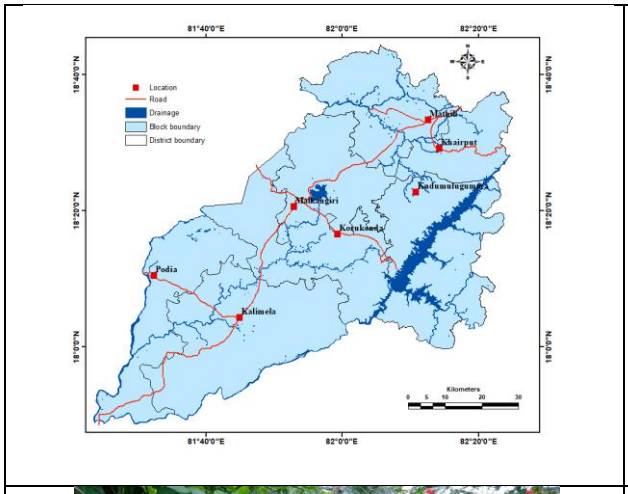
दक्षिण पूर्वी क्षेत्र, भुवनेश्वर
South Eastern Region, Bhubaneswar

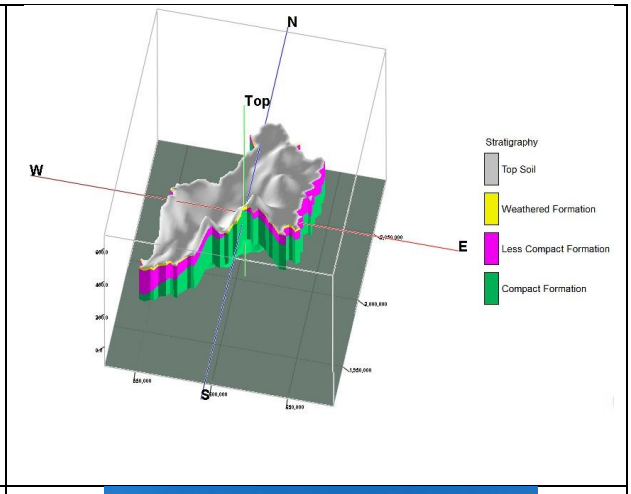
Government of India

MINISTRY OF JAL SHAKTI,

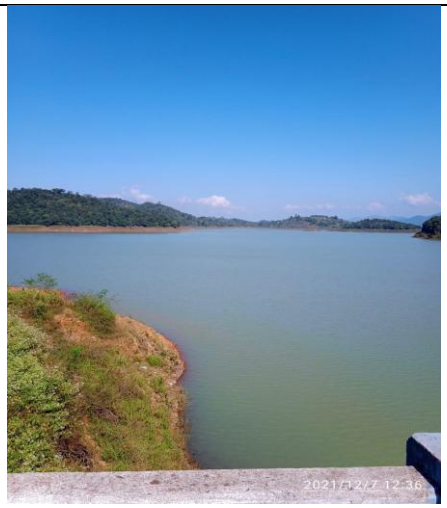
DEPARTMENT OF WATER RESOURCES, RIVER DEVELOPMENT & GANGA REJUVENATION

# REPORT ON
# AQUIFER MAPPING AND MANAGEMENT PLAN
# IN MALKANGIRI DISTRICT, ODISHA








**CENTRAL GROUND WATER BOARD**

**South Eastern Region, Bhubaneswar**

**August-2022**

**FOREWORD**

Malkangiri is the southernmost district of Odisha state, bears an agrarian economy. The agriculture in the district is inevitably exposed to the vagaries of rainfall. Erratic rainfall is quite frequent and also the irrigation facilities are inadequate in the district, affecting the agriculture production from year to year. The agrarian development of the district can be boosted by tapping the groundwater resources through dug wells and medium-deep bore wells.

Due to wide variation in hydrogeological set up in the district, the occurrence and distribution of aquifers are non-uniform and so also their yielding properties. The common modes of groundwater exploitation in the district are dug well, dug-cum-bore well, shallow tube well etc. The hard crystalline rocks of the district form two distinct aquifer systems. The shallow aquifers formed by the weathered mantle, stores groundwater under phreatic condition. The deeper aquifer is formed by fracture zones, joints, etc holds groundwater in semi-confined/confined conditions. Granitic hard-rock aquifers have water yielding fracture zones and have average success rate with 2-10 lps of discharge. The places where weathering thickness is more and condition is favourable, the phreatic aquifer attains good yield potential and large diameter dug wells are suitable structures to extract water from them.

Groundwater irrigation is currently an underutilized resource that could mitigate the effects of drought such as surface water scarcity and crop failure. Groundwater irrigation practices can insure increased agricultural production by enhancing the area irrigated and scope of irrigation. Apart from irrigation, drinking water scarcity can also be mitigated through judicious utilization of groundwater. The present stage of groundwater development is only 19.43%, leaving a vast scope for future groundwater development in the district. Groundwater irrigation practices can ensure increased agricultural production by enhancing the area irrigated and scope of irrigation.

Based on the available data and the earlier hydrogeological studies taken up in 07 blocks of the district viz. Kalimela, Khairput, Korukonda, Kudumulguma, Malkangiri, Mathili and Podia, covering 3510 Sq. Km. of mappable area, an attempt has been made in this report to compile all relevant information, such as hydrogeological, agriculture, irrigation, land use, rain fall, chemical quality of water and other collateral data. **Shri Rajeev kumar Tripathy, Scientist-'B'and Shri Sudhanshu kumar Mohanty, Scientist-'B'**has compiled and prepared the present report on **"Aquifer Mapping and Management Plan in Malkangiri District, Odisha".** Their sincere efforts in preparation of the report will no doubt be very useful and benefit the state. It is hoped that, it will be of immense help to different groundwater user agencies, administrators and planners in preparation of groundwater development plans and will be a handy tool in effective management of groundwater resources in the district.

Date: 29.08.2022

**(P. K. Mohapatra)**
**Regional Director**

# CONTRIBUTORS PAGE

| | | |
|---|---|---|
| **Data Acquisition** | **:** | Shri R. K. Tripathy, Scientist-'B'<br>Shri S. K. Mohanty, Scientist-'B' |
| **Data Processing** | **:** | Shri R. K. Tripathy, Scientist-'B'<br>Shri S. K. Mohanty, Scientist-'B' |
| **Data Compilation & Editing** | **:** | Shri R. K. Tripathy, Scientist-'B'<br>Shri S. K. Mohanty, Scientist-'B' |
| **Geophysics** | **:** | Shri Rajesh Babu , AGP<br>Smt. Bindu Singh,AGP |
| **Data Interpretation** | **:** | Shri R. K. Tripathy, Scientist-'B'<br>Shri S. K. Mohanty, Scientist-'B' |
| **GIS** | **:** | Dr. Satyabrata Sahoo, Young Professional |
| **Report Compilation** | **:** | Shri R. K. Tripathy, Scientist-'B'<br>Shri S. K. Mohanty, Scientist-'B' |
| **Technical Guidance** | **:** | Shri D. N. Mandal, Scientist-'D' |
| **Overall Supervision** | **:** | Shri P. K. Mohapatra, Regional Director |
| **Report Editing** | **:** | **Report Processing Section, SER** |

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## AQUIFER MAPPING AND MANAGEMENT PLAN IN MALKANGIRI DISTRICT (3510 Sq. Km)

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# 1 INTRODUCTION

## 1.1 Objective

Central Ground Water Board (CGWB) has taken up National Aquifer Mappingand Management (NAQUIM) programme during the XII$^{th}$ five year plan to carry out integration of micro level hydrogeological, geophysical, hydrochemical data and information on geology, geomorphology, soil, hydrometeorology, hydrology, landuse, cropping pattern etc on a GIS platform to formulate district, block or aquifer-wise Ground Water Management Plan. The formulation of a sustainable ground water management plan would help in achieving the demand for drinking, irrigation and industrial need for water with minimal stress on the aquifer.

The activities under NAQUIM are aimed at identifying the aquifer geometry, aquifer characteristics their yield potential along with the quality of water occurring at various depths, aquifer-wise assessment of ground water resources and development. Aquifer mapping itself is an improved form of groundwater management – recharge, conservation, harvesting and protocols of managing groundwater.With these aims, Aquifer Mapping was carried out in Malkangiri district in Odisha covering an area of about 3510sq. km.The district has been divided into 7 Blocks namely, Kalimela,Khairput, Korukonda, Chitrakonda, Malkangiri, Mathili and Podia.

Aquifer mapping is a multidisciplinary exercise wherein a combination of geological, geophysical, hydrological, hydrogeological, meteorological and hydro-chemical information is integrated to characterize the spatial and temporal variation of quantity and quality of the aquifer system and identification of local ground water related problems and issues.

To resolve such issues, the NAQUIM study was carried out with the following broad objectives: to define the aquifer geometry with precise lateral and vertical demarcation down to the depth of 200 mbgl, to define the behaviour of ground water regime in time and space, to study the hydraulic characteristics of both shallow and deeper aquifers,to study the hydrochemistry of aquifer systems,to prepare Aquifer Maps indicating disposition of aquifers along with their characterization and to formulate the Aquifer Management Plans for sustainable development and management of ground water resources.

## 1.2 Approach and Methodology

Multi-disciplinary approach involving geological, geophysical, hydrological, hydrogeological and hydro-geochemical survey would be carried out to meet the aim and objectives listed above. GIS would be used to prepare the maps.The entire Malkangiri district has been geologically mapped by the Geological Survey of India. The geological mapping of the area was carried out by Sri H. Crookshank (1938). Shri F. Ahmed, Geologist of G.S.I conducted investigations on the geo-hydrological conditions in parts of the area in 1959. Parts of the area were covered by S/Sri S. K. Guha & P. N. Nag of G.S.I through systematic hydrogeological surveys (Malkangiri Zone, Dandakaranya Project) during 1966-67. The district was covered through systematic hydrogeological surveys by Sh. M. V. Rao, STA (Hydrogeology) CGWB during 1975-76. Reappraisal hydrogeological surveys were also carried out by S/Sh. G. Y. Setty(1987-88) and S. Suresh (1990-91). So far 36 exploratory wells, 05 observation wells have been drilled under exploratory drilling programme of CGWB to delineate ground water potential of deeper aquifers. Ground water monitoring is being done through 35 numbers of permanent hydrograph network stations four times in a year and water samples are collected once in a year during pre-monsoon for complete chemical analysis.

## 1.3 Compilation of Existing Data,Identification of Data Gaps and Data Generation

Preliminary work consists of the collection and review of all existing data which relate to the area. This usually included the results of any previous hydrogeological studies and exploratory drilling carried out by CGWB and State agencies and compiled to identify the data gaps in the study area. After the data compilation all the data were integrated and analysed.

From the data analysis it is found that only 35 NHNS monitoring wells found in the District. So additional 68 key well established to fill the gap of water level monitoring. (Annexures V)

In case of exploratory 41 EWs driiled in the distrct before NAQUIM study. So additional 32 EWs drilled during NAQUIM study to fill the gap. (Annexures IIB)

Similarly for Geophysical analysis, data availability was zero.

Review of background information will lead the study teams to carry out further studies in the field, where they will employ various techniques to determine the three-dimensional extent and aquifer characteristics of the significant water-bearing formations. Key Observation wells representing the different aquifers have to be established and monitoring to be carried out. Well inventory and collection of relevant data is to be carried out to strengthen the data base. The analysis of the data has to be carried out for preparation of thematic maps.

**1.4 Study area Details**

During XII five year plan, the National Aquifer Mapping and Management (NAQUIM) programme were taken up under Annual Action Plan (AAP) 2021-22 for detailed hydrogeological investigation and Aquifer Mapping in Malkangiri district. Malkangiri is the southern most district of Orissa. It was awarded the status of the district in October 1992, when the erstwhile Koraput district was divided into four new districts. The district is bordered in the North and West by Bastar district of Chhatishgarh and in the south by Khammam and East Godavari districts of Andhra Pradesh, in the east by Koraput district, Orissa. The district lies between north latitudes 17°47'58" and 18°44'18" and East longitudes 81°23'23" and 82°27'05" falling in Survey of India Degree sheet Nos. 65 F,G,J. The district covers an area of 5791 Sq.Km and is divided into 7 Community Development Blocks – Kalimela, Khairput, Korukonda, Kudumulguma, Malkangiri, Mathili and Podia. The Malkangiri town, the district headquarter is approachable from adjacent districts through State Highways. The important towns of the district are well connected by road. It is one of the most economically backward tribal district of Orissa.The administrative map of the District is given in Fig.1.1

The Malkangiri town, the district headquarter is approachable from adjacent districts through State Highways. The important towns of the district are well connected by road.

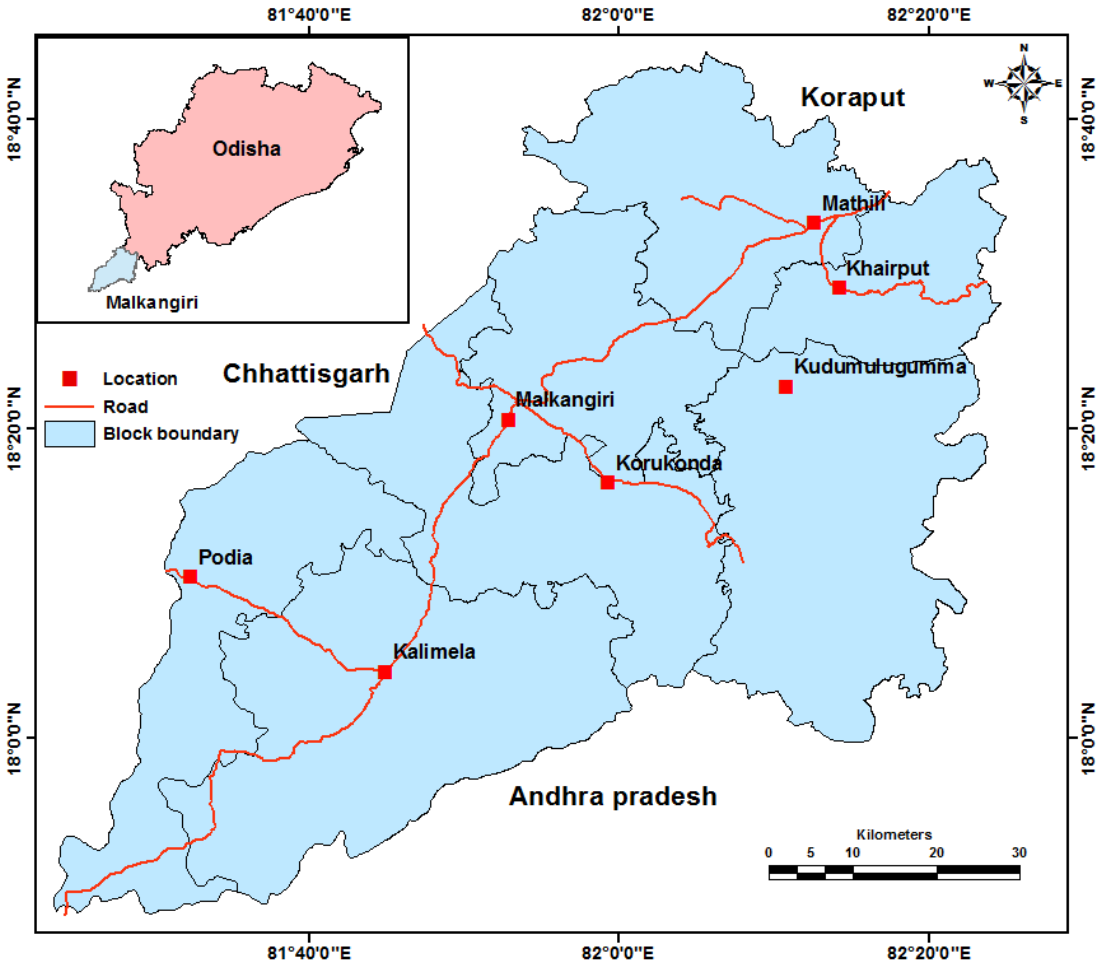


**Fig. 1.1: Administrative Map of Malkangiri District.**

The district is having a total population of 613192 with a rural population of 563664 (91.93 percent) and urban population of 49528 (8.07 percent) and 253624 males and 309568 females.The Schedule Caste (SC) and Schedule Tribe (ST) household of the district counts to 138295 (22.6 %) &354614 (57.8 %) respectively.So, the district is more rural in its character though the district is experiencing increasing rate of urbanisation in recent years.Number of households in the district is 137599.The population density of the district is 106. The district recorded a decadal change of 21.6 percent during the period 2001-2011 in its population. A positive change is observed in the sex composition of the district with increased sex ratio from 997 (census 2001) to 1020(census2011).

The district comprises 07 CD Blocks namely, Malkangiri, Kalimela, Podia, Korukonda, Chitrakunda, Khairput and Mathili.In the District there are two urban centres i.e Malkangiri Municipality and Balimela N.A.CThere are 111Gram Panchayats with 1055 villages.

Source: Census data (2011 )of Malkangiri district

### 1.5 Rainfall and Climate

The rainfall in the district is mainly derived from the south west monsoon. The average annual rainfall is of the order of 1818.056 mm, out of which 91% is received during monsoon (mid-June to mid-October). Based on the average annual rainfall for 10 yrs(2012 – 2021)it was observed that during the last 10 years, from 2012 to 2021, the highest rainfall amounting 3067.7 mm occurred in Korukonda block in 2019 and the lowest annual of 984.5 mm. in Podia block in 2014.

The climate of this district is characterized by a very hot dry summer and well distributed rains in the south-west monsoon season. The cold season commences from November and lasts till the end of March. The hot season follows thereafter and continues till about the second week of June. The south-west monsoon season is from mid-June to the mid of October.

During summer temperature varies from 35° to 45°C. May is the hottest month with the maximum mean daily temperature of 41°C. In winter temperature varies from 9 to 27°C. December is the coldest month of the year.

Humidity of the air is generally high during south west monsoon and decreases from the end of November due to cold wave. The relative humidity is varying from 14% to 92% during summer and monsoon. The average humidity during summer is 25% to 30% and in monsoon 75%.

Wind is generally light to moderate. During summer and south-west monsoon season, wind velocity increases. In the post-monsoon months and in winter, wind is mainly from the north and east. During summer wind direction is variable and in rainy season wind from south west direction is very common. Mean wind speed varies from 34 km/ hr. in January to 6.8 km./hr. in June - July. The rainfall map of the district is shown in fig.1.2 and the isohyte map of the district is shown in Fig.1.2a.

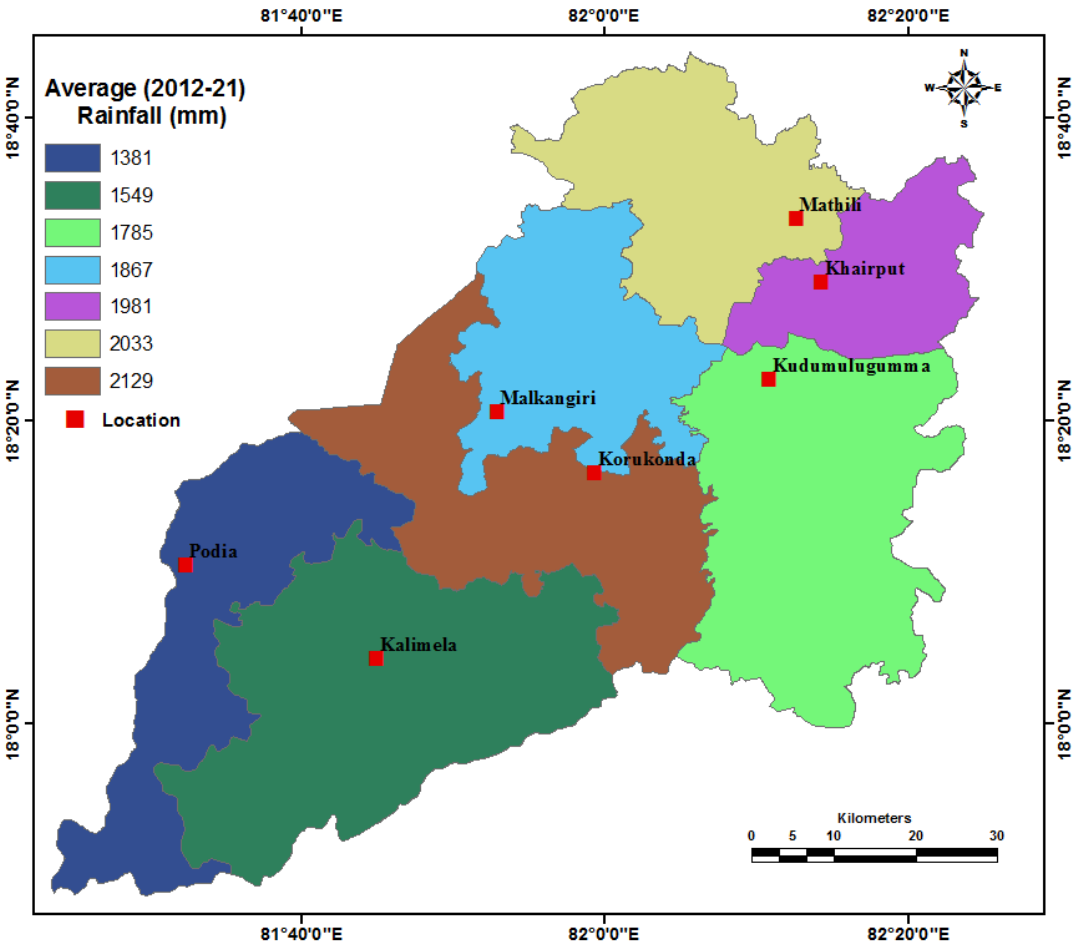


**Fig. 1.2: Rainfall Map of Malkangiri District.**

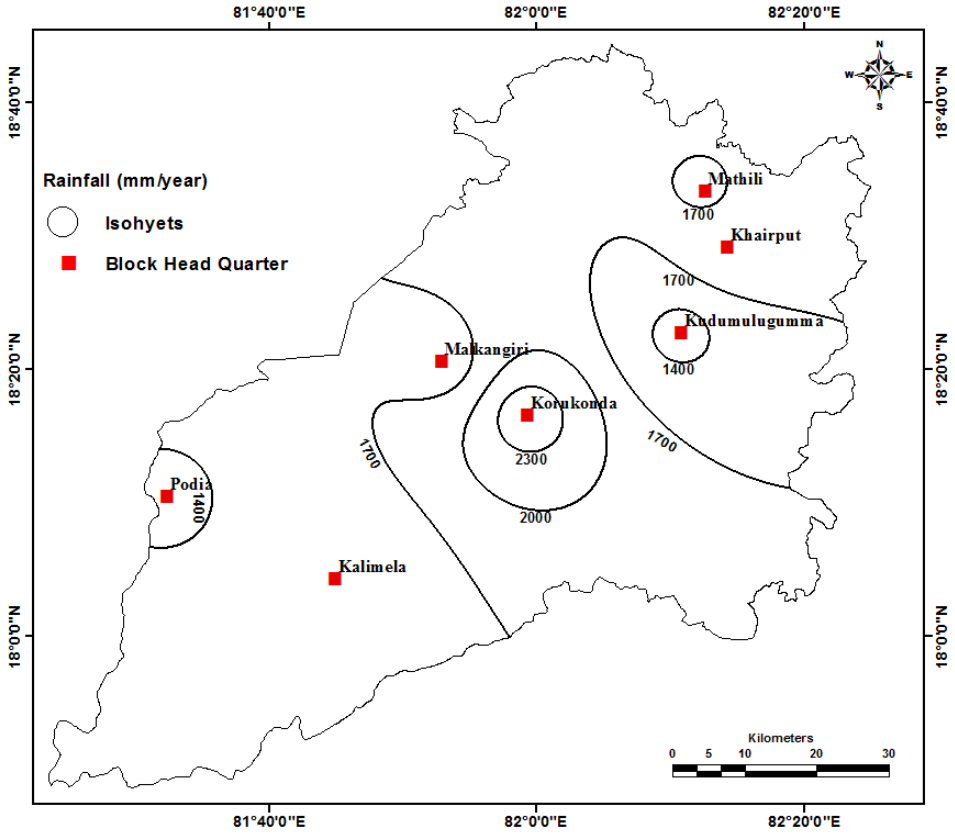


**Fig. 1.2a: Isohyet map of Malkangiri District.**

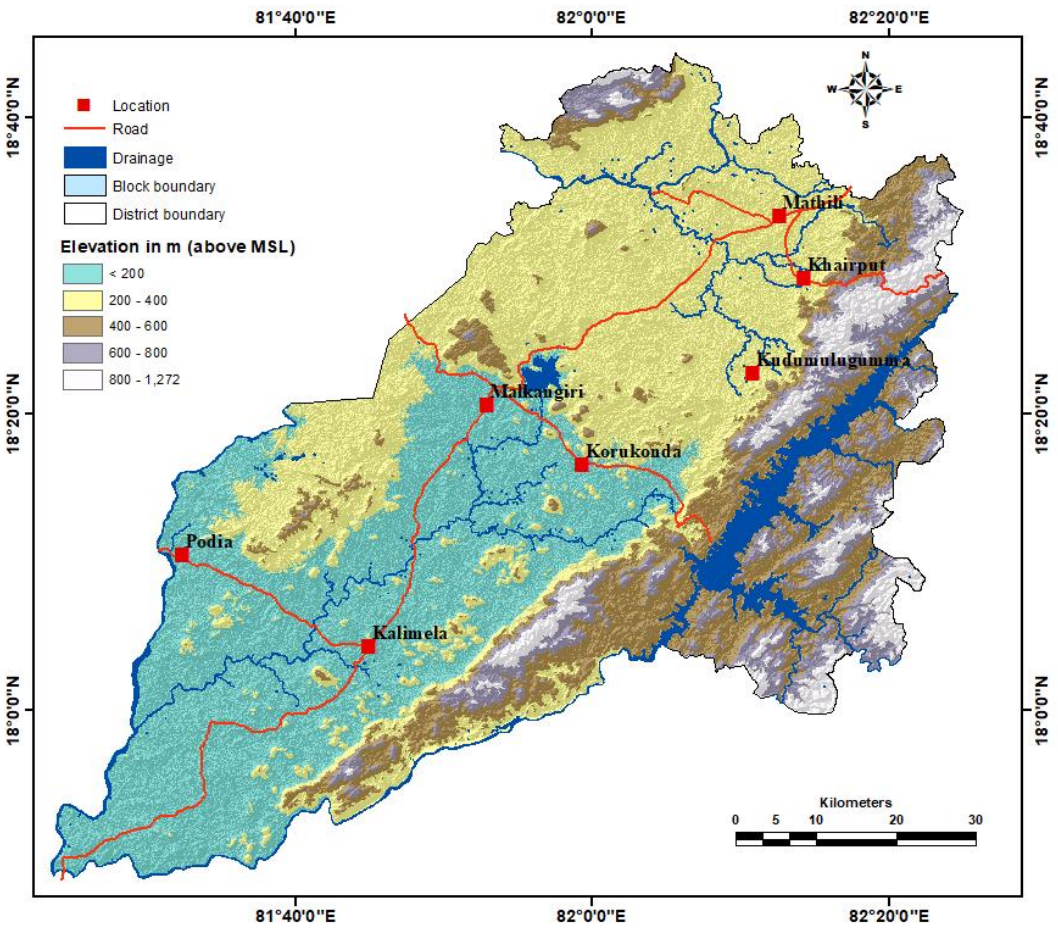


**Fig. 1.3: Land Elevation Map of Malkangiri District**

## 1.6 Geomorphology

The district is characterized by varied geomorphological features. Based on Landsat data interpretations and field studies, the geomorphic units of the district are broadly identified as - Structural Hills, Denundational Hills, Residual Hills, Shallow and Moderately weathered pediplain, Pediment – Inselberg complex, Inselberg, Flood plains, Structural Valley, Linear Ridge and Bazada are as follows.

**Structural Hills** – It is characterized by a group of linear/curvilinear/folded hill ranges of large areal exte nt, interspersed with narrow intermontane valleys showing definite structural control. It is the most important geomorphological unit in the district adjoining the entire southern border and occupying the northern corner of the district.

**Denudational Hills** – It occurs in the North Eastern corner of the district in a limited patch. It is represented by a group of massive hill ranges interspersed with narrow intermontane valleys having no structural control or structures obliterated by denudation.

**Residual Hills** – Hill ranges of moderate dimension surrounded by plains all around, occur as isolated features along the northern boundary of the district.

**Shallow and Moderately Weathered Pediplain** – Next to the structural hills this forms the major geomorphological unit in the district. It presents gently undulating terrain of vast areal extent, formed as a result of coalescence of different pediments along the foot hills of the Eastern Ghats and affected by shallow to moderate weathering. The northeastern part of the district is characterized by moderately weathered pediplane with weathering prevalent down to a depth of 5-20 m. The rest of the district is covered by shallow weathered pediplain with weathering restricted to 5 m depth.

**Pediment** – Inselberg Complex – It is a gently undulating bed rock surface with a number of small inselbergs. This unit is widely distributed throughout the district.

**Inselberg** – Inselbergs are scattered all over the district. These are isolated hills of limited areal extent surrounded by plains all around.

**Flood Plain** – A narrow stretch of alluvium occurs along river Kolab and its tributaries in the northern part of the district.

**Structural Valley** – A narrow linear valley within the structural hills and formed along the structurally weak planes occurs along the south eastern boundary of the district.

**Linear Ridge** – A narrow linear ridge of quartz reef with steep sloped covered by debris, is found in the northern part of the district.

**Bazada** – A gently sloping plain is formed in the foot hill zone and consist mainly of alluvial and partly alluvial material comprising fine silt to big boulders. It occurs in the Southern part of the district.

The geomorphological map of the district is shown in **Fig.1.4**.

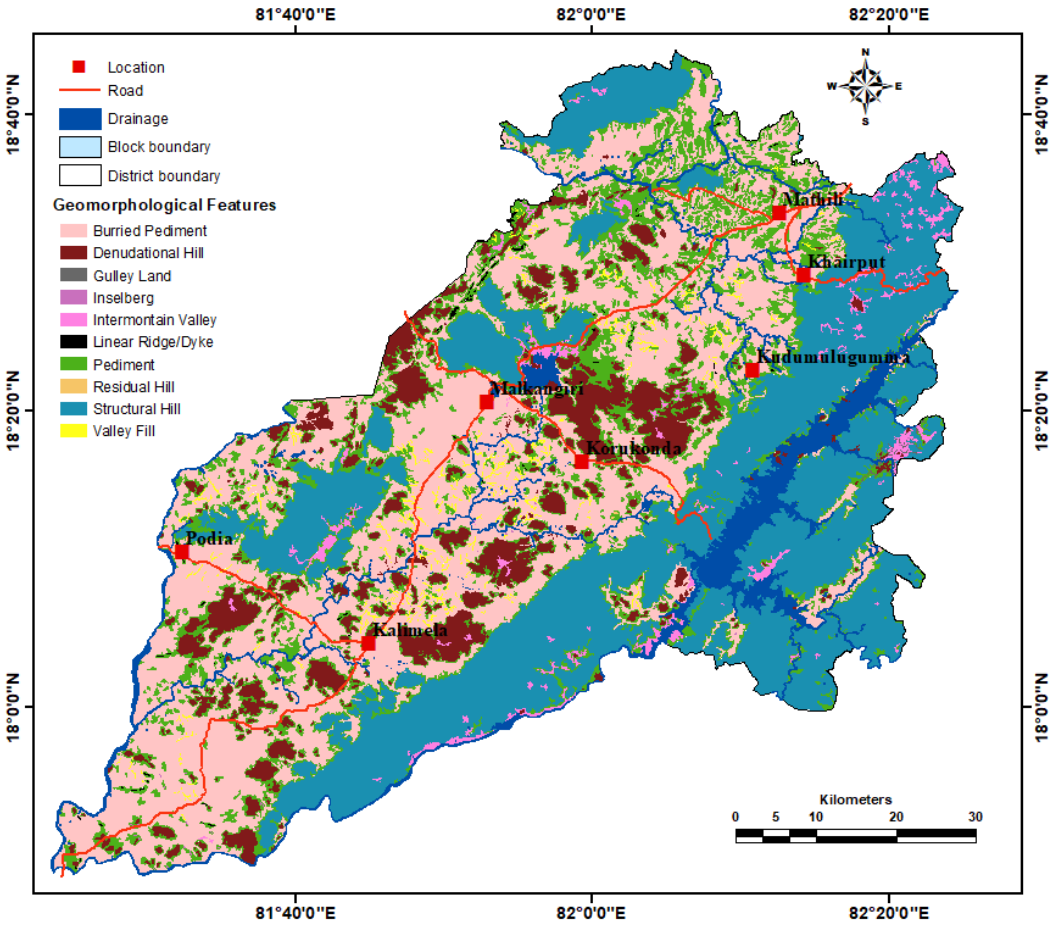


**Fig. 1.4: Geomorphological map of Malkangiri District.**

## 1.7 Soil characteristics

The distribution of different soil types in the district depends much on its physiographic and lithologic variations. Based on the physical and chemical characteristics, mode of origin and occurrence, soils of the district may be classified into two groups namely Alfisols (Red Soil) and Ultisols (Lateritic soil).

Alfisols - Alfisols or red soil are the most prominent soil types in the district. There are two different varieties – red sandy soil and red loamy soil. They are red in colour and clayey in nature especially the loamy soil, poor in organic matter. Its fertility is low.

Ultisols - Ultisols or lateritic soil occurs in a narrow diagonal strip across the district trending NE-SW. They are red to brown in colour and clayey in nature. Due to low organic matter content the

fertility of lateritic soil is low. The soil map of malkangiri district is shown in Fig.1.5.

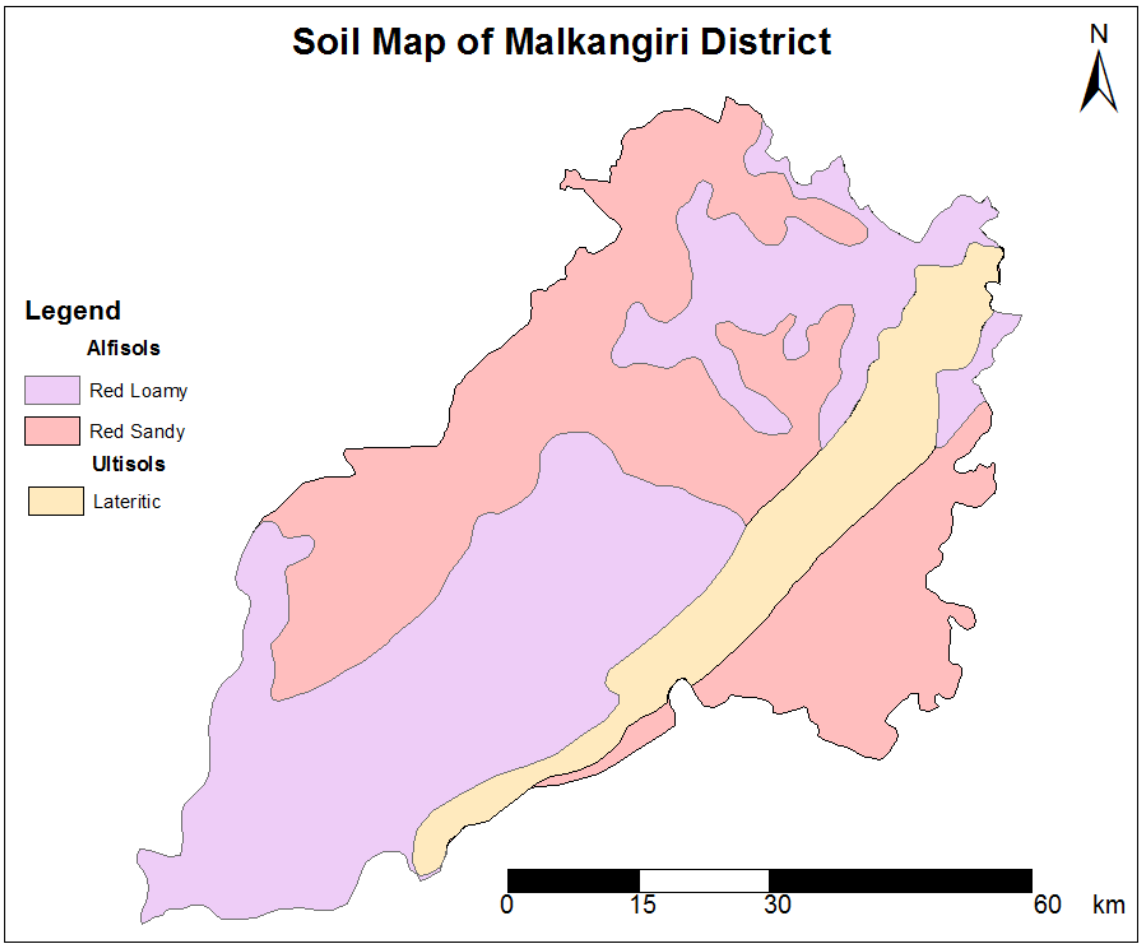


Fig. 1.5 : Soil Map of Malkangiri District.

### 1.8 Landuse,Cropping Pattern and Irrigation Potential

The study area shows wide variation in the pattern of land utilization. The forest area is 14.64% of total geographical area.The net sown area of the district is 106964 ha .Agriculture is the main stay for the rural population of the district. The block-wise landuse pattern is shown in Table 1.1 and the thematic map on land use is shown in **Fig. 1.6**.

The cultivation is mainly in the Kharif season. Rabi cultivation is restricted to areas with irrigation facilities. The different crops grown in the area are paddy, pulses (Arhar, Green and Black gram) and

vegetables (potato, onion, garlic, turmeric, ginger and seasonal vegetables), etc.The major crop of the district is paddy. The paddy area in the district covers 58000 ha.

**Land use, Cropping Pattern**

Large percentage of the land in the district is kharif crop land which indicates that the land is used predominantly for agriculture. Crop land in Kharif is 75024 hectares where as in rabi it is 31947 hectares. The agriculture land is the major land use pattern having 64.07% of the total geographical area followed by forest land with 14.64%, pastures 6.07%. Agriculture land use includes Net Sown, Cultivable Waste, Land under miscellaneous tree crops & groves and Fallows Land. The average cropping intensity is 156%. and Net sown area constitute 68.07 % of the total Agriculture area.

- Malkangiri district showed wide variation in land use pattern. The land utilization pattern indicates that out of total geographical area, the forest area constitute 156493 ha. (27.02 %) and the net sown area is 142550 ha.
- Cropping intensity of the district is lower than the state average. Average cropping intensity of the district is 122.4%. The blocks namely Kalimela, Korkunda, Malkangiri having more cropping intensity than district average.
- There is a scope to increase cropping intensity by increasing area under irrigation thus provides water source for growing second crops.

**Table 1.1: Block wise land use pattern in Malkangiri District (in Ha)**

| S No | Name of Blocks | Total GeographicalArea (ha) | Area Under Agriculture | | | | Area Under Forest(ha) | Area under Wstelan d (ha) | Area Under Other Uses (ha) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Gross Cropped Area (ha) | Net Sown Area (ha) | Area sown >once | Cropping Intensity (% ) | | | |
| 1 | Malkangiri | 87441 | 20470 | 16213 | 4257 | 126 | 14125 | 53 | 3326 |
| 2 | Korkunda | 98759 | 45241 | 35035 | 10206 | 129 | 24469 | 1588 | 7622 |
| 3 | Mathil | 72456 | 22842 | 21834 | 1008 | 105 | 26487 | 706 | 3519 |
| 4 | Kalimela | 89276 | 46874 | 26760 | 20114 | 175 | 30603 | 617 | 3285 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 5 | Podia | 90214 | 25825 | 21985 | 3840 | 117 | 18732 | 747 | 4054 |
| 6 | Khairput | 63900 | 10710 | 10140 | 570 | 102 | 17009 | 84 | 1638 |
| 7 | K.Gumma | 77054 | 10948 | 10583 | 365 | 103 | 25068 | 982 | 2039 |
| | **Total** | **579100** | **182910** | **142550** | **40360** | | **156493** | **4777** | **25483** |

**Source : District Irrigation plan of Malkangiri District,Govt.of Odisha**

- The total cropped area is about 1.99 lakh ha out of which 0.91 lakh ha (45.6% of TCA) is irrigated and 1.08 lakh ha (54.4% of TCA) is under rainfed area .
- Kalimela block is fully irrigated (98 % of TCA).
- The blocks like Korukonda, Malkangiri, and Podia, in which percent of irrigated areas are high as compared to other blocks, and Kudumulugum block is poorly irrigated (5.0% of TCA).
- Among the different crop groups, cereals accounts for 38.0% of the irrigated area followed by oil seed crops (22.4%), pulses (16.4%), other crops (15.2%), coarse cereals (5.6%), and horticulture and plantation (1.1%), and. This indicates that major source of water in agriculture is being used for cultivation of cereals like paddy and maize .

  - In the district as a whole, total cereal accounts for 20.5 % of the TCA is under irrigated and 32.1% of the total TCA is under rainfed. Among the blocks, Kalimela (35.6%), Podia (34.5%), Korukonda (22.4%) having higher percent of the TCA is under irrigated and followed by Malkangiri (21.5%). Other hand, Mathili (70.7%), Kudumulugum (65.8%), and Khairaput (63.6%) are the blocks, where higher percent of TCA is under rainfed cereals.
- Total pulses accounts only 7.5% of the TCA is under irrigated and 4.8% is under rainfed in the Malkangiri district. The blocks like Kalimela (29.4%), Podia (6.1%), Malkangiri (2.3%) and Korukonda (2.1%) are the blocks having higher percent of the total pulses under irrigated.
- In Malkangiri district, only 23.2% the TCA is under irrigated food crops and nearly 43.5% of the TCA is under rainfed food crops). The blocks like Kalimela

(65.0%), Podia (40.6%), Korukonda (24.6%) and Malkangiri (23.7%) are having higher per cent of TCA under irrigated food crops. This suggests that other blocks having greater potential to convert rainfed area into irrigated.

- Oil seeds account 10.2% of the TCA under irrigated and 14.4% of the TCA under rainfed, which shows majority of the oilseeds is under rainfed areas. In the district, Kalimela (25.9%), Podia (17.3%) and Korukonda (8.0%) blocks are having maximumpercentage of TCA, under irrigated oil seeds .
- Other crops including fibre crops accounts about 7.0% of the GCA is irrigated but percent area under rainfed is 1.4%, due to major crops are being the vegetable crops is under irrigated.
- In the district hardly 0.5% of the TCA is irrigated horticulture and plantation crops and, 1.5% of the TCA is under rainfed horticulture & plantation. Particularly Malkangiri block is having more horticulture and plantation cropped areathan other blocks in the district.

**1.9 Source-wise Irrigation potential of Malkangiri District**

**Status of Ground Water Availability**

Total ground water recharge in different blocks of Malkangiri district is 0.336 BCM out of which, the draft is only 0.03188 BCM (9.5 %) thereby generating a gap of 0.3041 BCM (90.5 %).

Ground water draft varies only in the range of 5.1-13.6 % and gap in the range of 86.4-94.9 % of the ground water recharge in different blocks of Malkangiri

Maximum (0.0684 BCM) and minimum (0.0222 BCM) ground water recharge were found in Korkunda and Khairaput block, respectively.

Maximum (0.0068 BCM) and minimum (0.0028 BCM) ground water draft were found in Korkunda and Podia block, respectively.

Maximum (0.0617 BCM) and minimum (0.0192 BCM) ground water gap in utilization were found in Korkunda and Khairaput block, respectively.

However, all the blocks were found in very much ground water gap in utilization in Malkangiri

district showing a enormous scope of ground water utilization.

Average ground water development in the Malkangiri district is 10% and it varied between 5.06 to 13.60% among the blocks. Highest in the block of Khairaput (13.6%) followed by Kalimela (12.42%) and Malkangiri (11.39%). The lowest ground water development in the block oh Podia (5.06%), followed by Mathili (7.76%).

Among the existing type of irrigation systems, six surface irrigation government canal existing Malkangiri district in four blocks namely Malkangiri, Korkunda, Kalimela and Podia covering an area of 57901 ha. Maximum area irrigated through govt. canal in Kalimela block (23190 ha) followed by Podia (15354 ha) block.

Three blocks viz., Mathili, Khairput, Guma are not having any govt. canal for irrigation where as there is no community based/private canal in the district.

Tank/ponds/reservoirs are an exceptional source of surface irrigation in Malkangiri district. A total of 77 community ponds and 23 Govt. reservoirs exist in district.

Maximum area irrigated through community ponds are in Korkunda block (625 ha) followed by remaining blocks only in the range of 90-130 ha each. Similarly maximum area irrigated through Govt. reservoirs in Korkunda block (1631 ha) and the remaining block in the range of only 111-597 ha with no area in Guma block.

There are only 1255 private open well and 1183 private Bore well as source of ground water for irrigating an area of 251 ha and 2045 ha, respectively. There is no tube wellseither Govt. or private and community or Govt. open well used for irrigation in any blocks of the district.

There are 394 Nos. of other source of irrigation including water harvesting structures irrigating an area of 7833 ha in the district with maximum area of 1826 ha in Kalimelablock followed by 1520 ha area in Korkunda block .

There are only 1535 electicity pump and 2255 diesel pump used for water extraction in irrigation in the district, showing a great scope of using more water extraction devices in the district.

More diesel pumps are used in comparison to electicity pump, may be due to non availablity of electicity near the source of water.

Highest number of water exctracting devices (1029) including both diesel and eclectric pump is in Korkunda block followed by Kalimela and Malkangiri blocks .

A maximum of 36 % area is irrigated in Kalimela block from all sources followed by Podia block (23%) and lowest in Guma block (1%) in the district.

**Table 1.2: Different sources of water availability in Malkangiri district (ha)**

| S. No | Source | Kharif | Rabi | Summer | Total |
|---|---|---|---|---|---|
| **1** | **Surface Irrigation** | | | | |
| i. | Canal (Major & Medium Irrigation) | 57901 | 31903 | 1625 | 91429 |
| ii. | Minor Irrigation tanks | 2251 | 393 | 15 | 2659 |
| iii. | Lift Irrigation / Diversion | 7108 | 3307 | 396 | 10811 |
| iv. | Various Water Bodies including Rain Water Harvesting | 1295 | 706 | 356 | 2357 |
| v. | Treated Effluent Received from STP | 0 | 0 | 0 | 0 |
| vi | Untreated Effluent | 0 | 0 | 0 | 0 |
| vii. | Perennial Source of Water | 725 | 444 | 155 | 1324 |
| **Sub-total** | | **69280** | **36753** | **2547** | **108580** |
| **2** | **Ground Water** | | | | |
| i. | Open Well | 251 | 251 | 0 | 502 |
| ii. | Deep Tube Well | 2045 | 1717 | 629 | 4391 |
| iii. | Medium Tube Well | 0 | 0 | 0 | 0 |
| iv. | Shallow Tube Wells | 0 | 0 | 0 | 0 |
| **Sub-total** | | **2296** | **1968** | **629** | **4893** |
| **Total** | | **71576** | **38721** | **3176** | **113473** |

**Source:District Irrigation plan of Malkangiri District,Govt.of Odisha**

**Table 1.3: Total water demand of the district for various sector in Malkangiri District**

| Block | Components for 2011 (In BCM) | | | | | Components for 2025 (In BCM) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Domestic | Crop | Livestock | Industrial | Total | Domestic | Crop | Livestock | Industrial | Total |
| Mathili | 0.00210 | 0.01850 | 0.00170 | 0.00032 | 0.02262 | 0.00424 | 0.06899 | 0.00005 | 0.00064 | 0.07393 |
| Khairaput | 0.00094 | 0.00759 | 0.00170 | 0.00014 | 0.01037 | 0.00190 | 0.02835 | 0.00005 | 0.00028 | 0.03058 |
| Kudumulguma | 0.00136 | 0.00541 | 0.00170 | 0.00020 | 0.00868 | 0.00275 | 0.02316 | 0.00005 | 0.00041 | 0.02637 |
| Malkangiri | 0.00147 | 0.08068 | 0.00170 | 0.00951 | 0.09335 | 0.00296 | 0.22096 | 0.00005 | 0.00973 | 0.23370 |
| Korkunda | 0.00282 | 0.19762 | 0.00170 | 0.00042 | 0.20256 | 0.00528 | 0.53675 | 0.00005 | 0.00079 | 0.54288 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Podia | 0.00126 | 0.15323 | 0.00170 | 0.00019 | 0.15639 | 0.00255 | 0.40584 | 0.00005 | 0.00038 | 0.40883 |
| Kalimela | 0.00259 | 0.31113 | 0.00170 | 0.00039 | 0.31581 | 0.00522 | 0.81710 | 0.00005 | 0.00078 | 0.82316 |
| **Total** | **0.01254** | **0.77417** | **0.01190** | **0.01117** | **0.80978** | **0.02489** | **2.10115** | **0.00037** | **0.01302** | **2.13944** |

**Source:District Irrigation plan of Malkangiri District,Govt.of Odisha**

**Table 1.4: Water budget of Malkangiri district**

| Blocks | Existing water availability (BCM) | | Total (BCM) | Water demand (BCM) | | Water gap (BCM)* | |
|---|---|---|---|---|---|---|---|
| | Surface water | Ground water | | 2011 | 2025 | 2011 | 2025 |
| Mathili | 0.23200 | 0.05810 | 0.29010 | 0.02262 | 0.07393 | -0.26748 | -0.21617 |
| Khairaput | 0.14700 | 0.02220 | 0.16920 | 0.01037 | 0.03058 | -0.15883 | -0.13862 |
| Kudumulguma | 0.32300 | 0.03510 | 0.35810 | 0.00868 | 0.02637 | -0.34942 | -0.33173 |
| Malkangiri | 0.17300 | 0.04360 | 0.21660 | 0.09335 | 0.23370 | -0.12325 | 0.01710 |
| Korkunda | 0.34700 | 0.06840 | 0.41540 | 0.20256 | 0.54288 | -0.21284 | 0.12748 |
| Podia | 0.24400 | 0.05600 | 0.30000 | 0.15639 | 0.40883 | -0.14361 | 0.10883 |
| Kalimela | 0.37400 | 0.05270 | 0.42670 | 0.31581 | 0.82316 | -0.11089 | 0.39646 |
| **Total** | **1.84000** | **0.33610** | **2.17610** | **0.80978** | **2.13944** | **-1.36632** | **-0.03666** |
| *If water gap negative indicates surpus water is available | | | | | | | |

**Source:District Irrigation plan of Malkangiri District,Govt.of Odisha**

Block wise water budget has been estimated based on existing water availability, water demand during 2011 and 2025 and water gap during 2011 and 2025.

Lowest groundwater is available in the Khairaput block (7% of total groundwater), whereas highest groundwater is available in Korkundar block (20%).

More than 50% of the groundwater resources are available in three blocks (Korkunda, Mathili and Podia).

Lowest surface water is available in the Khairaput block (8% of total surface water), whereas highest surface water is available in Kalimela block (20%).

More than 55% of the surface water resources are available in three blocks (Kalimela, Korkunda and Kudumulguma) .

In caseof total water resource is concerned, lowest water is available in the Khairaput block (8% of total water), whereas highest water is available again in Korkunda block (19%).

Available surface water resource (1.8400 BCM) is more than five times higher than total groundwater resource (0.3361 BCM).

More than 55% of the total water resources are available in three blocks (Kalimela, Korkunda and Kudumulguma).

At present there is surplus water of 1.3663 BCM in the district. During 2025 the surplus will be reduced to 0.0367 BCM. But the block wise picture is different.

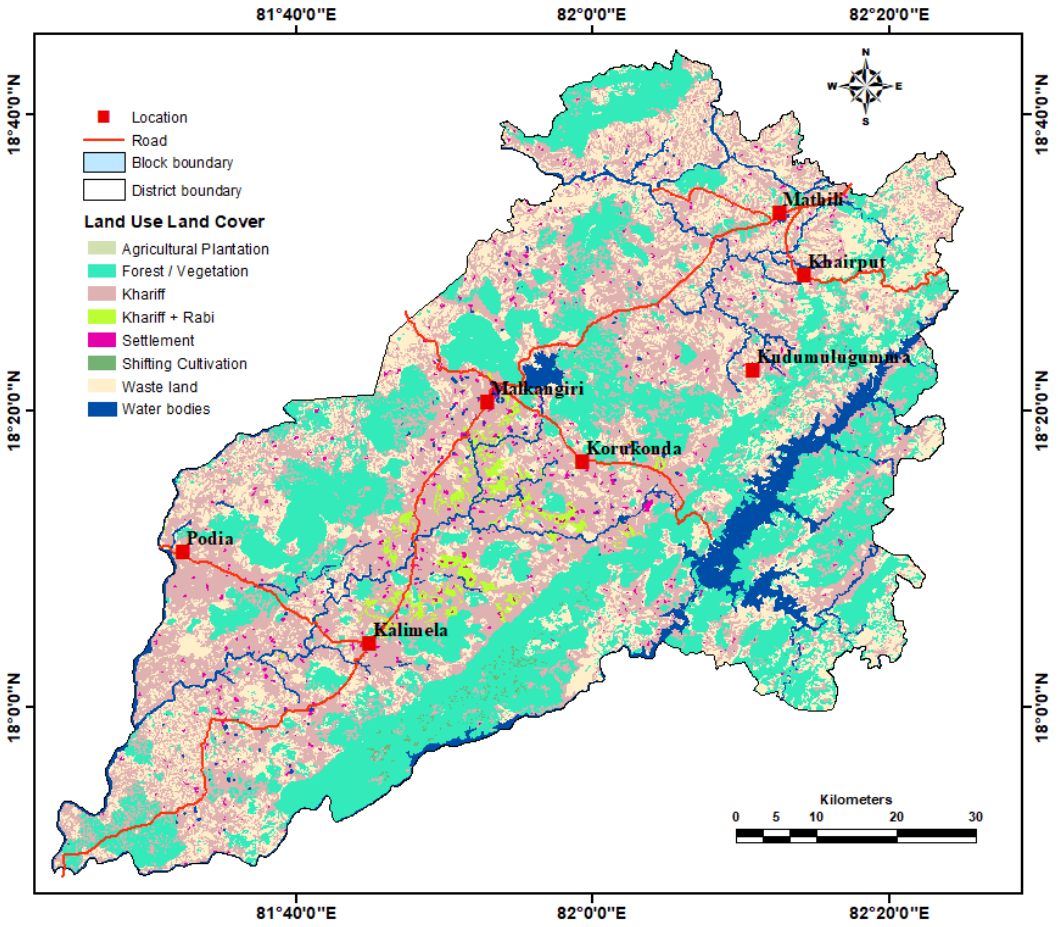


**Fig. 1.6: Landuse map of Malkangiri District.**

## 1.10 Drainage and Hydrology

The general drainage pattern in the district is dendritic to sub-parallel. The Kolab river alongwith its tributaries, the Potteru and Sileru rivers is the most prominent river of the region. The Kolab river issues from the Sinkaram hills and follows a south westerly course after passing over Malkangiri district. The river joins the Godavari river in Khammam district of Andhra Pradesh. The drainage map of Malkangiri district is shown in Fig.1.7.

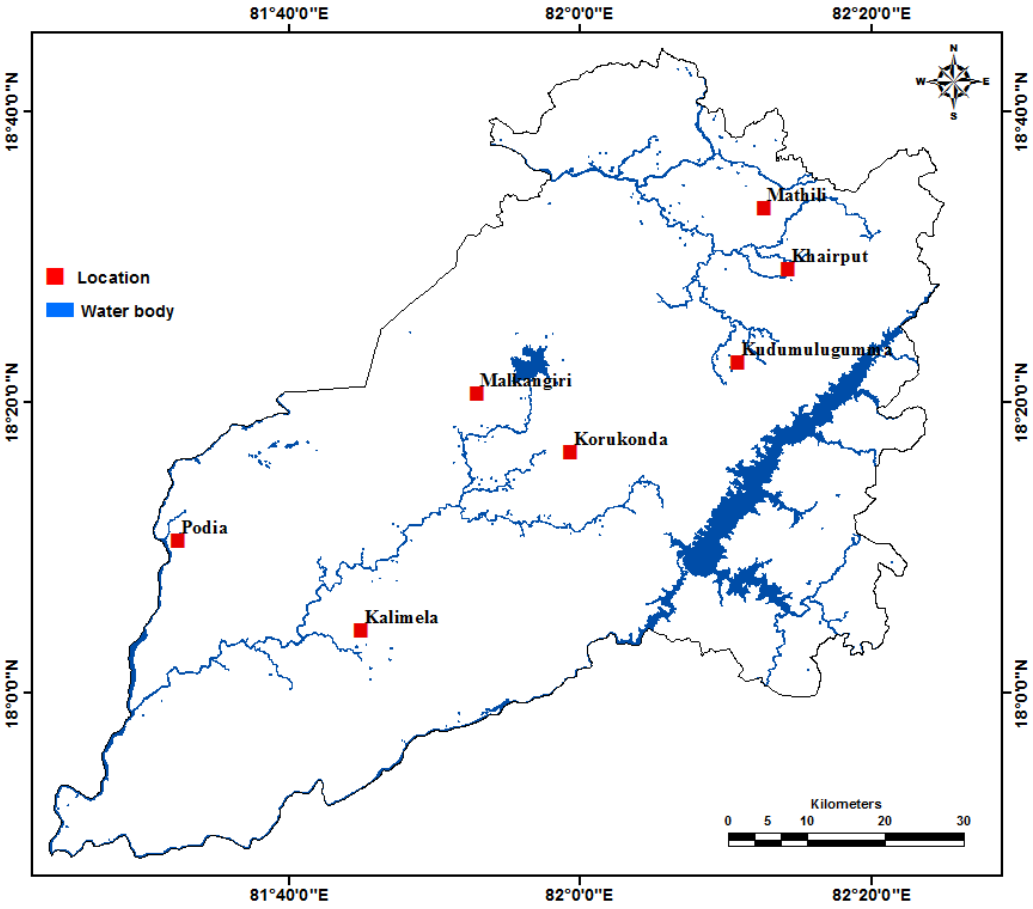


**Fig. 1.7: Drainage map of Malkangiri District.**

# 2 DATA COLLECTION AND GENERATION

## 2.1 Geology

The area is characterized by a complex geological set up with a variety of rock types belonging mainly to the Precambrians and Archeans, except a thin alluvial patch along river Kolab. The Geological successions of the district is as follows –

**Table2.1 : Generalised Stratigraphic sequence in Malkangiri District**

| | | |
|---|---|---|
| Recent | Alluvium | |
| Pre-Cambrian | Unconformity | |
| | Quartzites, Limestones, Conglomerates, Shales | |
| | Unconformity | |
| Archeans | Younger Intrusives | Dolerite Dykes, Pegmatites, Vein Quartz |
| | Unconformity | |
| | Andalusite Schists, Sericite Quartz Schists | |
| | Unconformity | |
| | Charnockites<br>Khondalites<br>Granite Gneiss and its variants | |
| | Basement not known | |

The area has suffered regional metamorphism up to the granulite facies and has experienced numerous phases of magmatic intrusions, accompanied by progressive and retrogressive metamorphism, repeated folding and shearing. As a result original structures, textures and mineral compositions have been completely obliterated by new structures and mineral assemblages.

Granite Gneiss and its variants – These are medium to fine grained rocks exposed in the undulating plains and scattered hillocks. The suite of rocks comprises Hornblende Gneiss, Biotite, Gneiss and Pink Granite. Megascopically the rocks are fine to medium grained, leucocratic with well-developed foliation planes in case of gneisses. The gneisses are usually

banded. The bands consist of thin layers rich in quartz and feldspar. Hornblende and mica are common occurrence while Garnet is found occasionally. The strike of the gneisses is variable, viz. N 750E – S750W with 200 dip to N 850W – S 850E with vertical dips. In the majority of the cases, the strike is similar to that of the Eastern Ghats. Granites occur in limited patches in the central and western parts of the district.

Khondalites – The khondalitic group of rocks consists of quartz – Garnet – Sillimanite Schist & Gneiss and Garnetiferous sillimanite quartzite. The khondalites are usually found in the South Eastern and Western parts of the district in the hilly terrains. These rocks exhibit multiple sets of joints having steep dips.

Charnockites – These generally occupy the hill ranges. The rock is coarse grained, dark green to grey in colour with feldspar and quartz crystals. The ferromagnesian minerals are hypersthene and pyroxene. Garnet is also present. The charnockitic rocks form massive out crops. The joints found in charnockites trend N 300E, N-S, & E-W with sub-vertical to vertical dips.

Schists - These include Andalusite – Schists and gneisses and quartz – sericite schists. These occupy the northern part of the district. They are essentially composed of feldspar, andalusite, sericite with inclusions of quartz.

Pegmatites and Dolerites– The pegmatites are commonly associated with the granite gneisses. These are rarely associated with the rocks of charnockites. The dolerites occur locally as dykes and small intrusions in the gneisses and charnockites. Garnet is found in the dolerite in some areas.

Quartz Reef – A prominent Quartz reef is observed in the northeastern boundary of the district. This is intrusive into the country rock and occurs as a narrow linear ridge with steep slopes covered by debris.

Conglomerate, Quartzite, Limestone, Shale – These rock types occurs near in North Eastern –

South Western boundary of the district. The Quartzites are generally ferruginous in nature and are overlain by the limestones, fine grained and white to blue in colour.

Alluvium - A narrow patch of alluvium occurs along the river Kolab and its tributaries in the northern part of the district. It has only limited thickness.

The granites and its variants are most predominant rock type and occupy major parts of the district. Geological set up of the district primarily controls the Hydrogeological condition of the area.

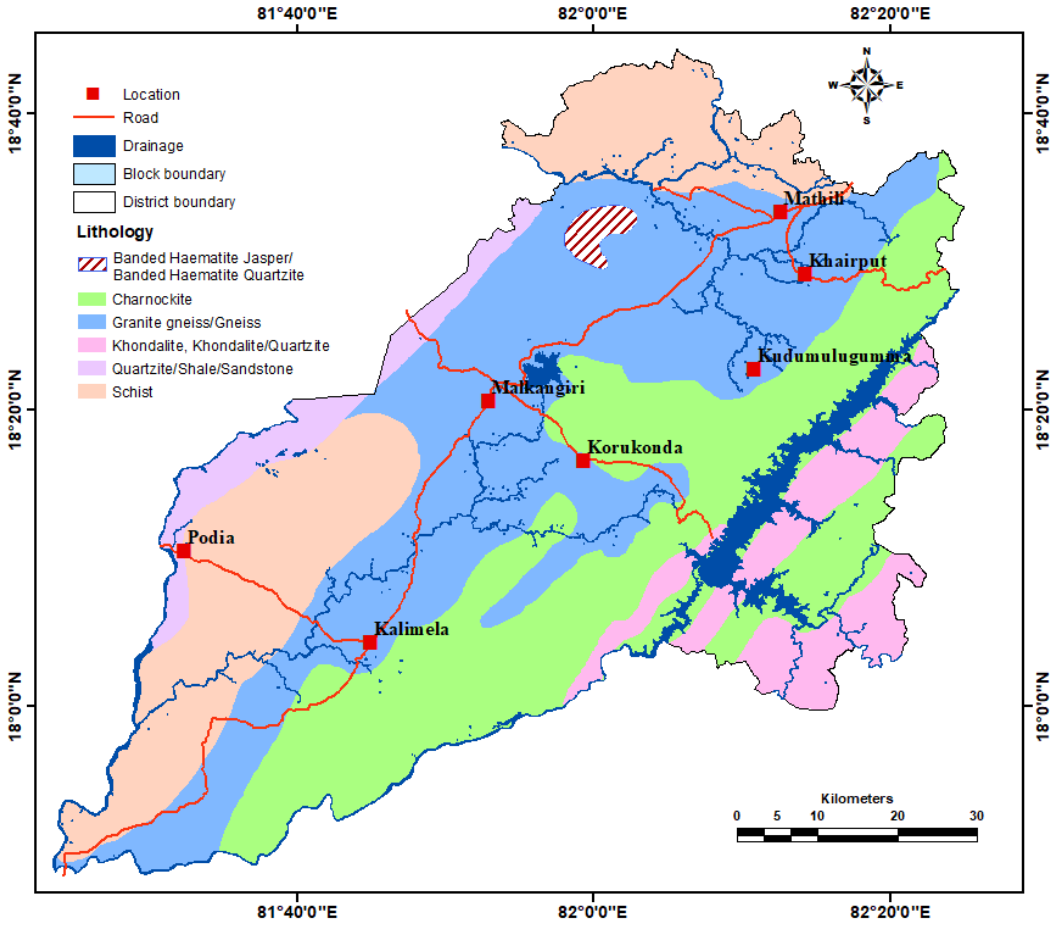


**Fig. 2.1: Geological Map of Malkangiri District.**

## 2.2 Hydrogeology

The hydrogeology of the district varies widely depending upon the geological and geomorphic set up and soil characteristics. The major hydrgeological units may be categorized as – Consolidated formations and Unconsolidated to Semi-consolidated formations.

**Consolidated formations** - Almost the entire district is underlain by the consolidated formations, comprising granites, granite gneiss and its variants, charnockites, Khondalites, Schists, Quartzites, Limestones etc. These formations lack primary porosity and are rendered porous and permeable only.

when weathered and fractured. The weathered residuum forms the main repositories of groundwater, which occurs under water table conditions and circulates through deeper fractures and fissures.

Granites and Granite Gneisses - These are the most prominent rock types in the district occupying the undulating terrains and low lying areas. On weathering these rocks are altered to loose kaolinised sandy clay. The thickness of the weathered zone ranges from 6 to 16 m depending on the topography and foliated and joined nature of the rocks. The sheet joints and vertical joints are interconnected. These facilitate free horizontal and vertical flow of groundwater. The depth to water table ranges from 0.57 to 10.97 m bgl in the months of May – June while 0.00 to 8.19 m bgl in the months of Dec – January. The seasonal water table fluctuation is in the range of –2.37 to 10.00 m. The specific capacity Index of open wells varies from 0.017 to 17 lpm/m/m2. The discharge of up to 6 lps has been recorded in the dugwells tapping unconfined aquifers. In exceptional cases discharge of 18 LPS has also been recorded. The borewells tapping deeper fracture zones, record discharge up to 10 Lps for moderate drawdowns. The transmissivity values of water bearing fractured zones tapped in borewells, 38 m to 200 m deep, vary from 1.3 m2/day to 27.5 m2/day.

Charnockites – Next to Granite Gneiss, the charnockite form the second most dominant aquifers in the area. These rocks are usually fine to medium grained, occasionally coarse grained. The weathering in these rocks is not very pronounced and restricted to 3 to 20 m depth. These rocks are jointed and fractured but the joints are not very prominent. These rocks occupy the hill ranges. The premonsoon and postmonsoon depth to water table values

range from 4.93 to 9.06 m and 3.99 to 7.69 m below ground level respectively. The seasonal water table fluctuation varies from 0.50 to 6.12 m. The specific capacity Index of aquifer as computed in a representative open well was 0.134 lpm/m/m2. Due to their hard and compact nature and occurrence in hill ranges, these rocks have poor yield prospects. The wells in this formation generally yield 1 to 2 lps.

Khondalites - The khondalites are restricted to the western parts of the district. These rocks exhibit multiple sets of joints. Most of the joints have nearly vertical to steep dips. The opening of joints range from 5-60 mm and the thickness of the weathered residuum ranges from 3.5 to 13.00 m. The weathered residuum and underlying fractured rocks constitute the aquifers. The premonsoon and post monsoon depth to water table values range from 2.2 to 14.25 m and 1.1 to 12.25 m bgl respectively. Fluctuations is in the range of 1.1 to 3.0 m.

Schists – These include Andalusite Schists, Quartz – Sericite – Schists. The highly Weathered and decomposed products consist generally of moderately sticky clay. The depth of weathering varies from 12 – 30 m.

Quartzites, Limestones – These rocks occur in small patches along the northern boundary of the district. They were not explored hydrogeologically. The depth of weathering is not known. The depth to water level in the premonsoon is 1.88 m bgl and in the postmonsoon period is 1.83 to 2.37 m bgl.

Quartz Reef - A narrow linear ridge with steep slopes covered by debris, acts as barrier to the movement of groundwater. The upstream side of the ridge is favourable for groundwater occurrence.

**Unconsolidated Formations**

Alluvium –Alluvium is not well developed in the area. Small and local patches occur along the Sabari river. It is generally 2-5 m in depth. Its width varies from Zero to less than a Km. Most part of the banks of Sabari, Sileru and Potteru rivers are rocky with no tendency to deposit alluvium on either side. As such these are not useful for groundwater development because of its limited areal extent and thickness.

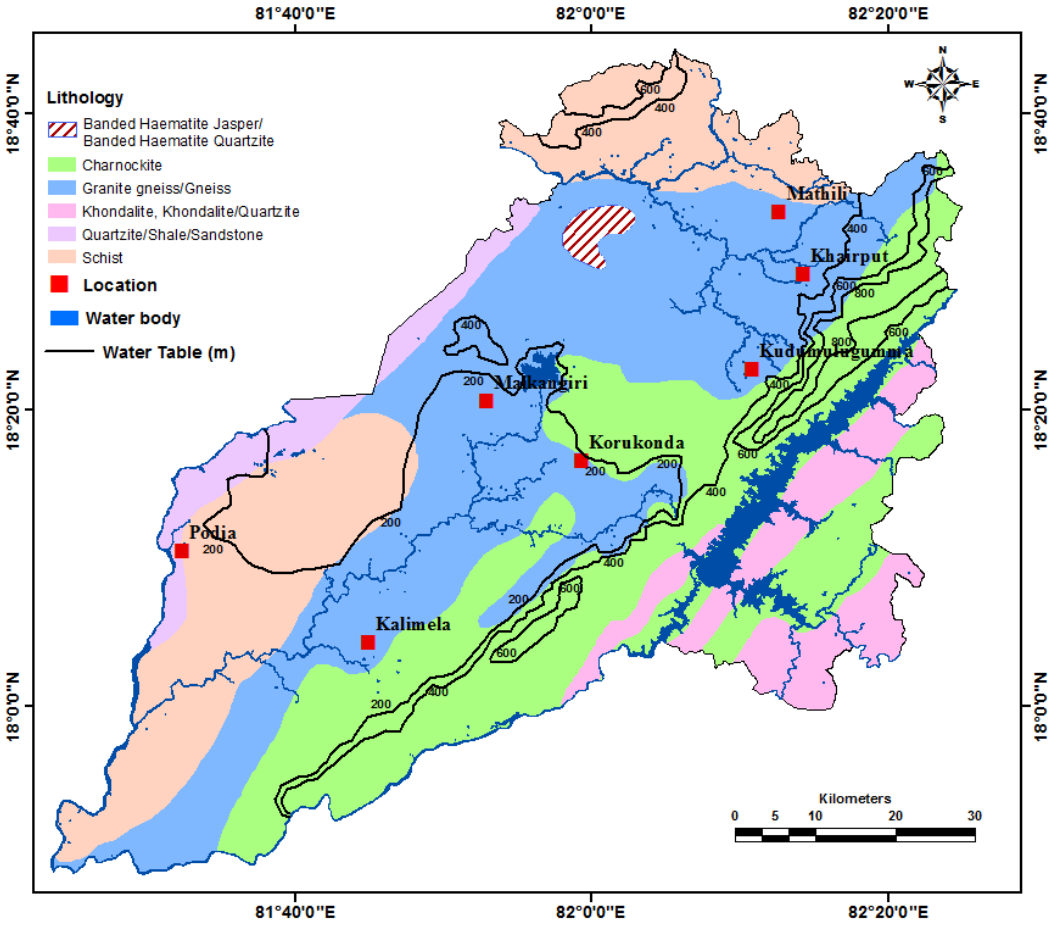


**Fig. 2.2: Hydrogeological Map of Malkangiri District.**

## 2.3 Ground Water Exploration

In order to decipher the aquifer system of the area, CGWB has constructed numerous exploratory wells and observation wells which are shown in **Fig. 2.3**. The details of data generated from this exploration are given in annexure-IIA.

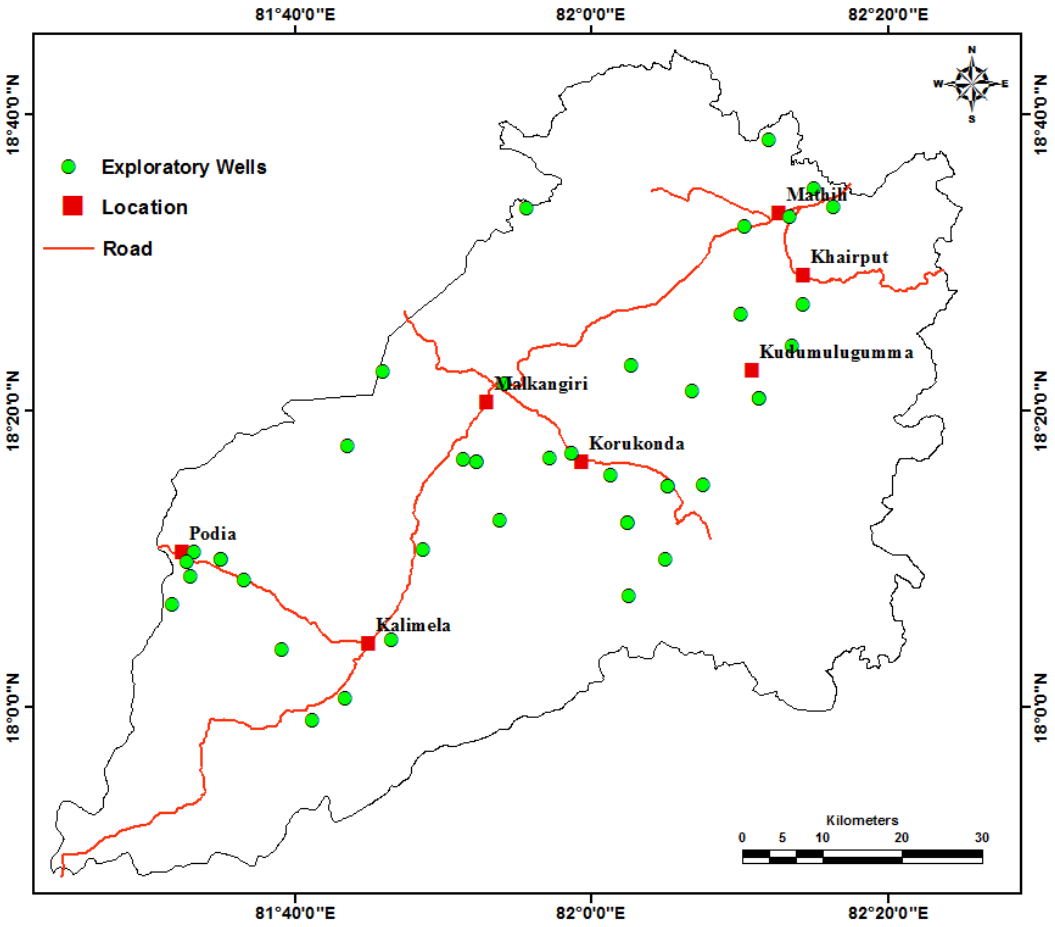


**Fig. 2.3: Locations of ExploratoryWells Drilled by CGWB in Malkangiri District.**

## 2.4 Monitoring of Ground Water Regime

Due to covid19 pandemic situation in the year 2020 and 2021 the pre monsoon monitoring (April 2021) of water level could not taken in the district. So the pre monsoon and post monsoon water level of NHS 2019 data is taken into account for preparation of maps.. There are 20 National Hydrograph Network Stations (NHNS) exist in the District. Under NAQUIM, 68 Key Observation wells (dug wells).were established during post monsoon period 2021 The details of the National Hydrograph Network Stations (NHNS) are shown in **Table 2.3** and the locations of the monitoring stations are shown in **Fig. 2.4**.The list of Keywells established in Malkangiri District is given in annexure-IV. The chemical quality of ground water in the district is monitored annually on a routine basis by CGWB through its National Hydrograph Network Stations. During the NAQUIM

programme, 68water samples were collected from the monitoring wells .The Ground water Quality data of Exploratory well in Malkangiri Dist is given in annexure-IIIA.

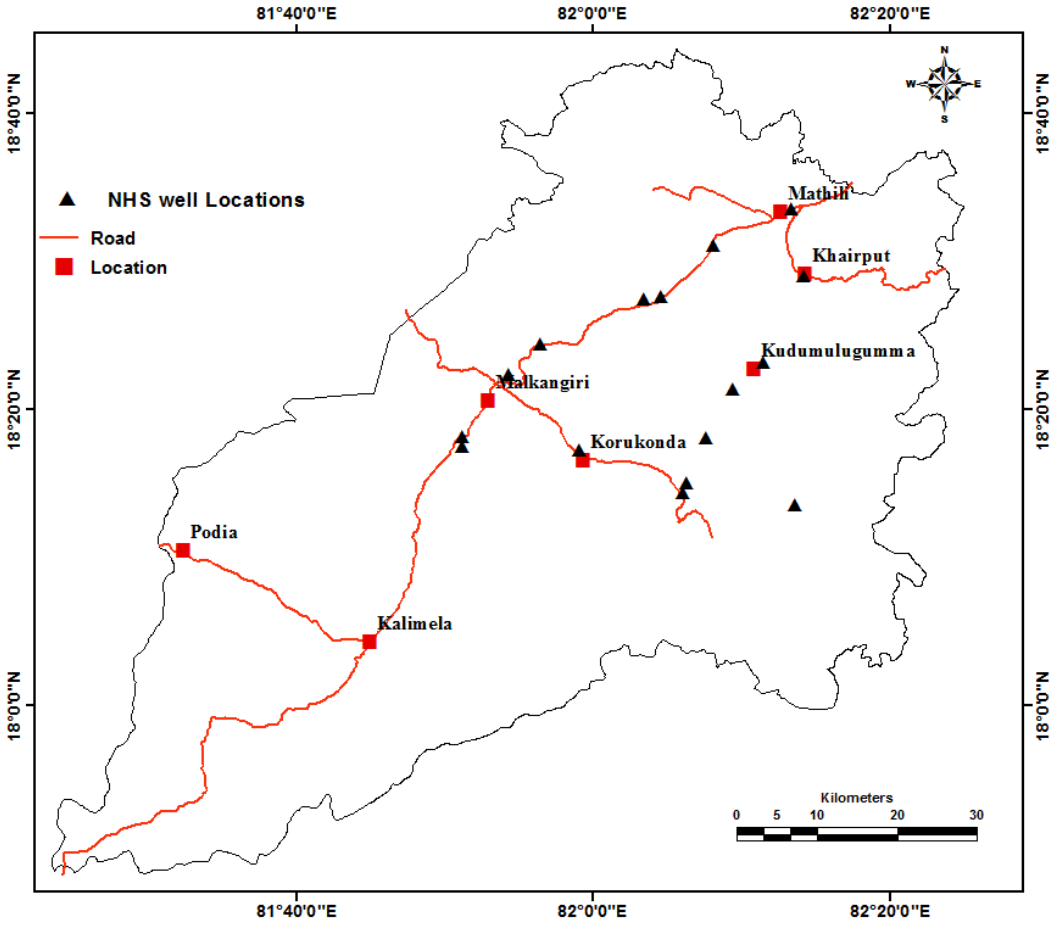


**Fig. 2.4: Locations of NHNS in Malkangiri District.**

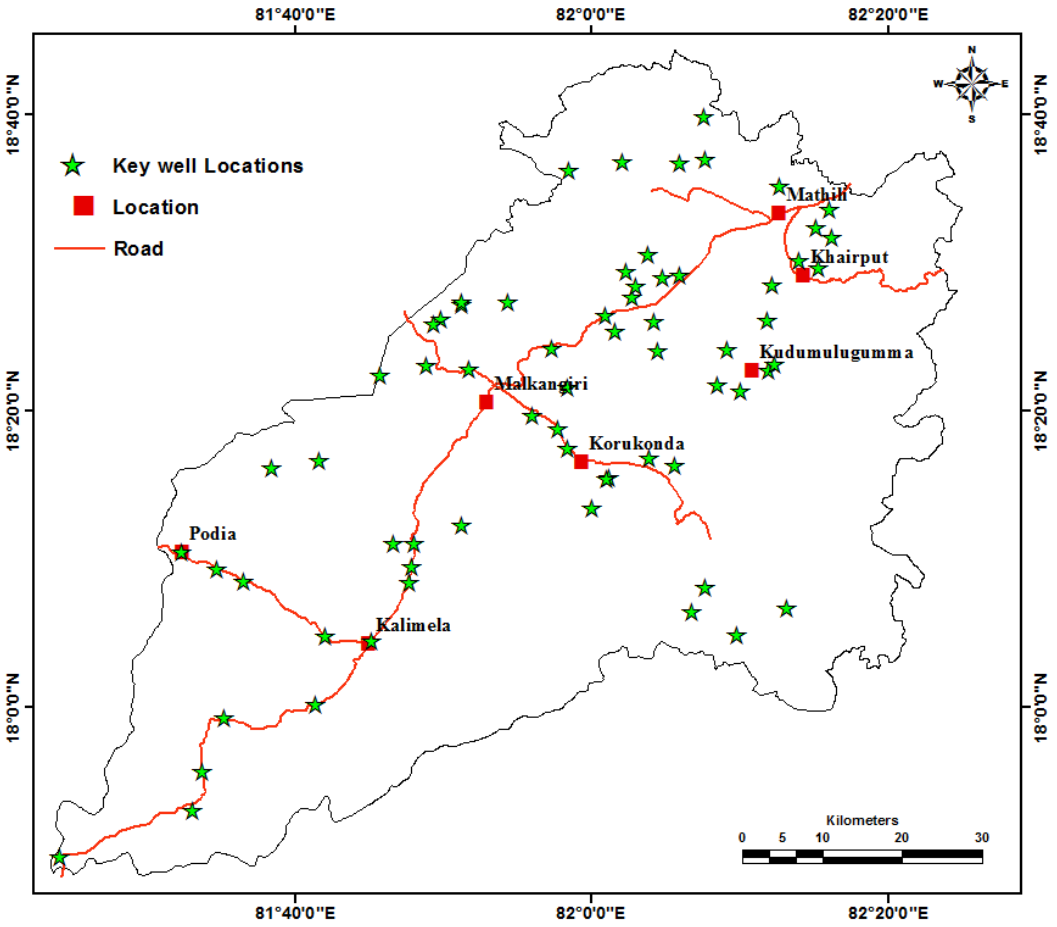


**Fig. 2.5: Locations of Key wells in Malkangiri District.**

**Table-2.2:Seasonal Water Level Fluctuation in NHS in Malkangiri district**

| Sl. No. | Location | Latitude | Longitude | Pre-Monsoon Water level(2019) | Post-Monsoon Water level(2019) | Fluctuation |
|---|---|---|---|---|---|---|
| 1 | Pongam | 18.51 | 82.14 | 6 | 1.95 | 4.05 |
| 2 | maithili1 | 18.56 | 82.2225 | 5.8 | 0.92 | 4.88 |
| 3 | Kudumulugumma | 18.38 | 82.197 | 3.95 | 1.39 | 2.56 |
| 4 | Somnathpur1 | 18.30138 | 82.127 | 4.6 | 2.21 | 2.39 |
| 5 | Khairput | 18.4838 | 82.237 | 5.65 | 4.09 | 1.56 |
| 6 | MV 37 | 19.304 | 82.720 | 3.2 | 2.21 | 0.99 |
| 7 | MV 9 | 18.3025 | 81.853 | 9 | 1.76 | 7.24 |
| 8 | Balimela Chowk | 18.2394 | 82.1013 | 4.45 | 1.63 | 2.82 |
| 9 | Korukonda 1 | 18.2886 | 81.985 | 4.2 | 2.17 | 2.03 |
| 10 | katameta | 18.46027 | 82.0758 | 3 | 1.07 | 1.93 |
| 11 | Chitapari | 18.25083 | 82.105 | 2.9 | 1.54 | 1.36 |
| 12 | Parkannala | 18.35666 | 82.156 | 6 | 2.02 | 3.98 |
| 13 | Sindhimal | 18.4069 | 81.94 | 5.7 | 1.49 | 4.21 |
| 14 | Malkangiri 1 | 18.3730 | 81.9044 | 5.75 | 1.41 | 4.34 |
| 15 | Kumbharguda | 18.4577 | 82.056 | 3.75 | 0.92 | 2.83 |
| 16 | Mundiguda | 18.2266 | 82.22 | 4.8 | 1.04 | 3.76 |

**Table-2.4: List of NHS in Malkangiri district**

## 2.5 Geophysical Survey

58 VES carried out in Malkangiri district during NAQUIM studty to fill the Gap . (Interpreted VES results is given in Annexure-I)

### VES Data Generation

A total of 58 VES were carried out in Malkangiri district. The VES locations are shown in figure 2.6.

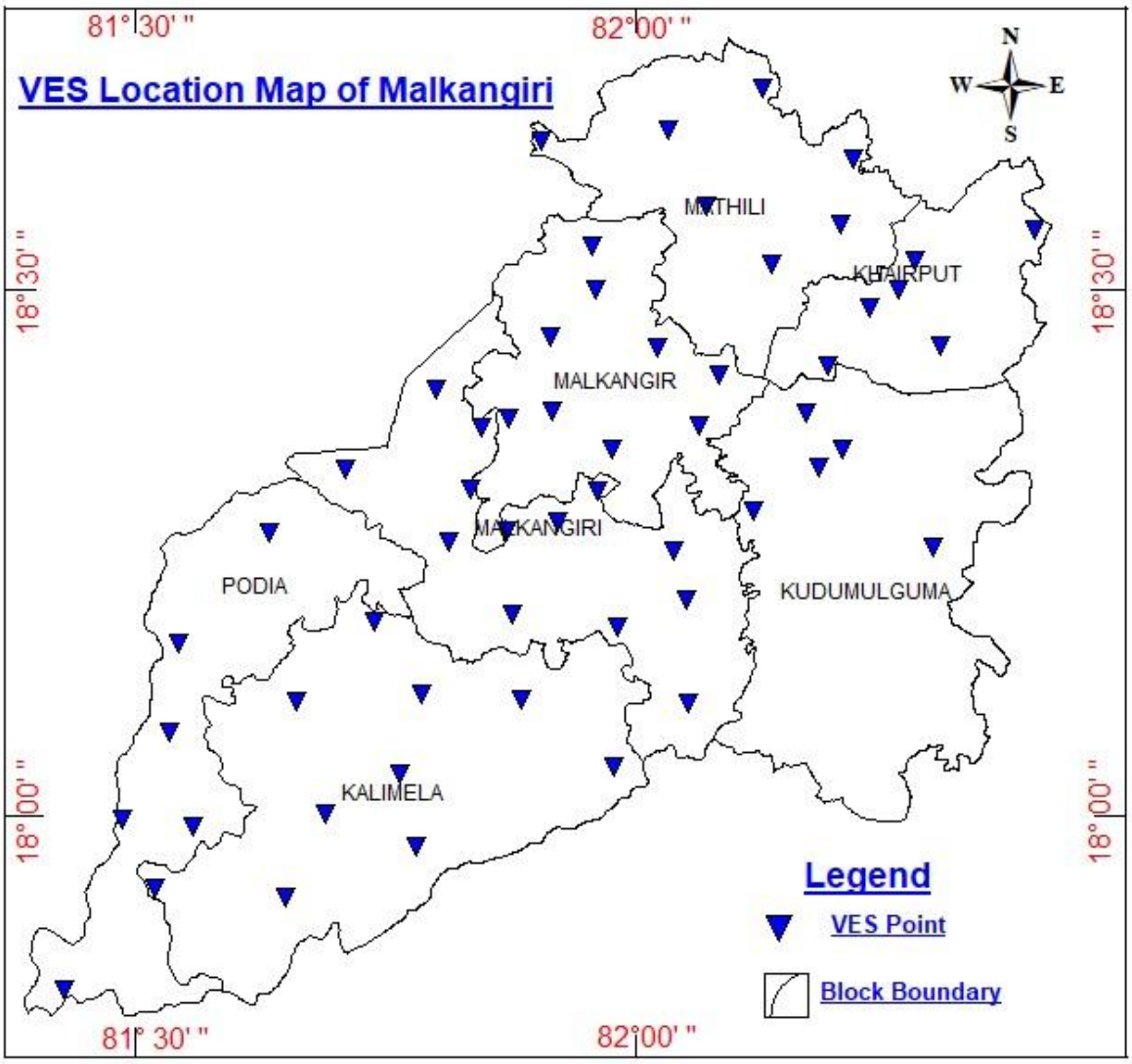


**Fig 2.6: VES location Map of Malkangiri District**

**Interpreted VES Results**

The Interpreted results of VES are given in Annexure I. All the existing CGWB Boreholes are more than 1 km from the nearby VES points. So comparison may not give good results. After comparing the VES results with the local geology and hydrogeology, the resistivity characteristics of the near surface weathered rock and the underlying massive / fractured formation were established.

The top geoelectric layer with resistivities varying between 3 and 575 Ohm m inferred as soil depending on its nature and saturation and the thickness varies between 0.3 and 3.5 m

Mostly the 2nd or 3rd geoelectric layer, occasionally the 1st one with resistivities ranging from 3.6 to 76 Ohm m has been inferred as weathered layer. The layer with more than 80 Ohm m has been considered as semi weathered layer. The wide range of resistivities may be due to its nature and saturation. In general, the weathered / semi weathered zone extends down to a depth of 19 m bgl., occasionally exceeds to 23m. To understand the possibility of encountering thin fractured zones, the VES curves were analysed for 'current increase', 'curve break' and 'factor flat'. The depth zones with combination of all these three attributes, viz., increase in current, associated with reduced gradient in apparent resistivity trend (curve break) and horizontal flattening of factor curve were identified as indicators of the presence of fractured zones. Mostly the 3rd or 4th geoelectric layer, occasionally, the 5th or 6th one with resistivities ranging from 16 to 516 Ohm m, occasionally exceeding to 1100 Ohm m has been inferred as Less compact formation / formation with fractures. The higher order of resistivities may be due to the suppression of thin low resistive geoelectric layer in between the two high resistive layers. Wide range of the resistivities may be due to the variations in the degree of fracturing, nature of the formation, etc. The thickness of the geoelectric layer inferred as less compact / formation with fractures, in general varies between 9.7 and 100 m, occasionally exceeds to more than 200m. The depth to bottom of this layer is, in general, varying from 17.8 to 200 m. occasionally exceeds to more than 300m. The layer with resistivities more than 600 Ohm m may be inferred as compact depending on the nature and type of the formation.

On the basis of geoelectrical layer parameters and the fractured zone analysis a few sites are recommended for borehole drilling or Shallow borehole or Dug well .

Conclusions and Recommendations:

In the surveyed area of Malkangiri district, in general, the weathered zone extends down to a depth of 19 m bgl. Thin fractured zones were identified by 'current increase', 'curve break' and 'factor flat'. Mostly the 3rd or 4th geoelectric layer, occasionally, the 5th or 6th one with resistivities ranging from 16 to 516 Ohm m, occasionally exceeding to 1100 Ohm m has been inferred as Less compact formation / formation with fractures. The higher order of resistivities may be due to the suppression of thin low resistive geoelectric layer in between the two high resistive layers. Wide range of the resistivities may be due to the variations in the degree of fracturing, nature of the formation, etc. The thickness of the geoelectric layer inferred as less compact / formation with

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On the basis of geoelectrical layer parameters and the fractured zone analysis a few sites are recommended for borehole drilling

## 2.6 Chemical Quality

The chemical quality of ground water in the district is monitored annually on a routine basis by CGWB through its national Hydrograph Network Stations. Quality of ground water from deeper aquifers was assessed during the exploration activities like drilling and pumping tests. The suitability of ground water for drinking/irrigation/industrial purposes is determined keeping in view the effects of various chemical constituents present in water.

The chemical quality of ground water in the district is monitored annually on a routine basis by CGWB through its national Hydrograph Network Stations. Quality of ground water from deeper aquifers was assessed during the exploration activities like drilling and pumping tests. The suitability of ground water for drinking/irrigation/industrial purposes is determined keeping in view the effects of various chemical constituents present in water.Based on the chemical analysis of water samples( Annex-III A &B**)** from different sources, it was observed that, almost all chemical parameters lie within permissible limit for drinking and irrigation purpose except few samples of some isolated pockets. The iso-conductivity map of phreatic aquifers of the district has been prepared and presented as **Fig. 2.8** . The quality of ground water is generally good with EC ranging from 70 to 3100µs/cm.

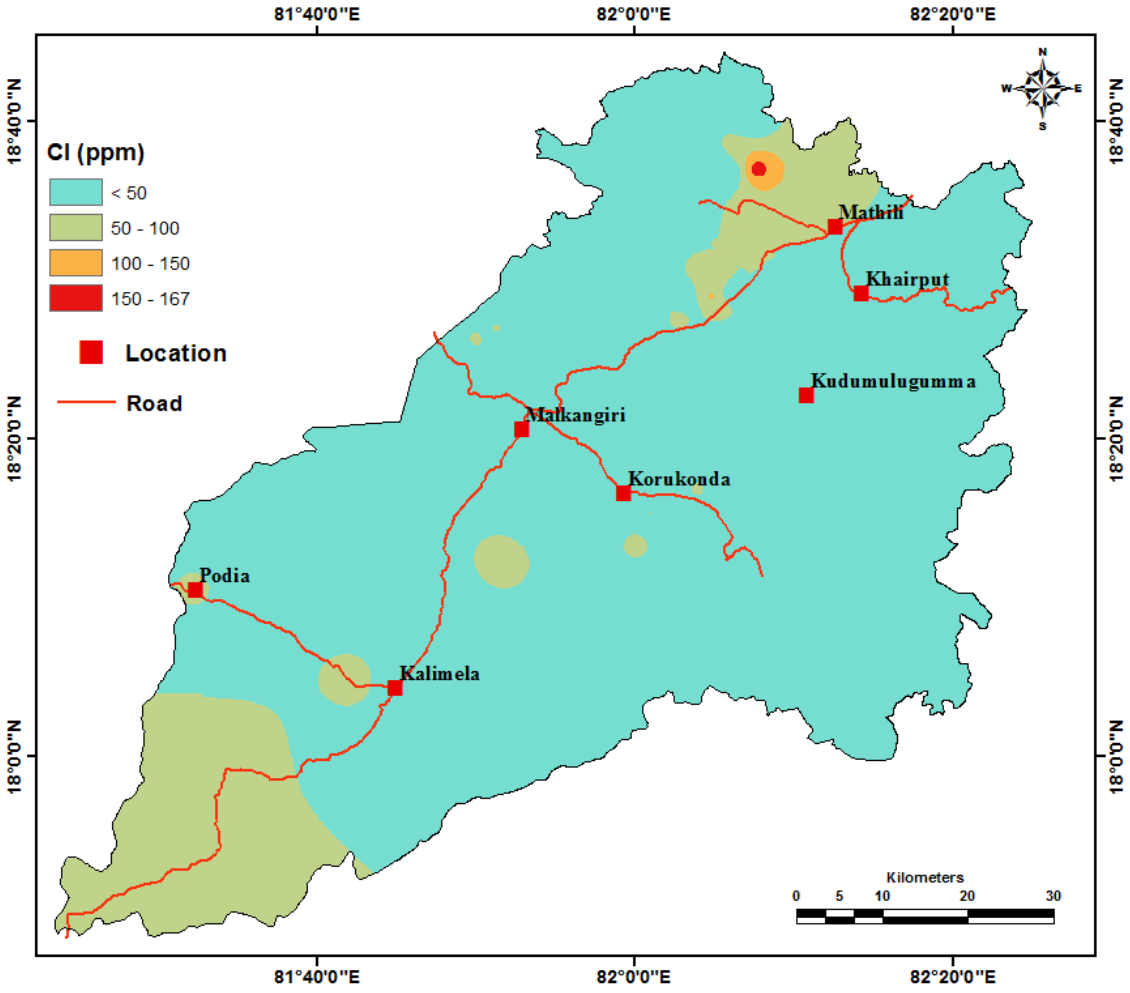



**Fig:2.7 Chloride map of phreatic aquifer of Malkangiri District.**

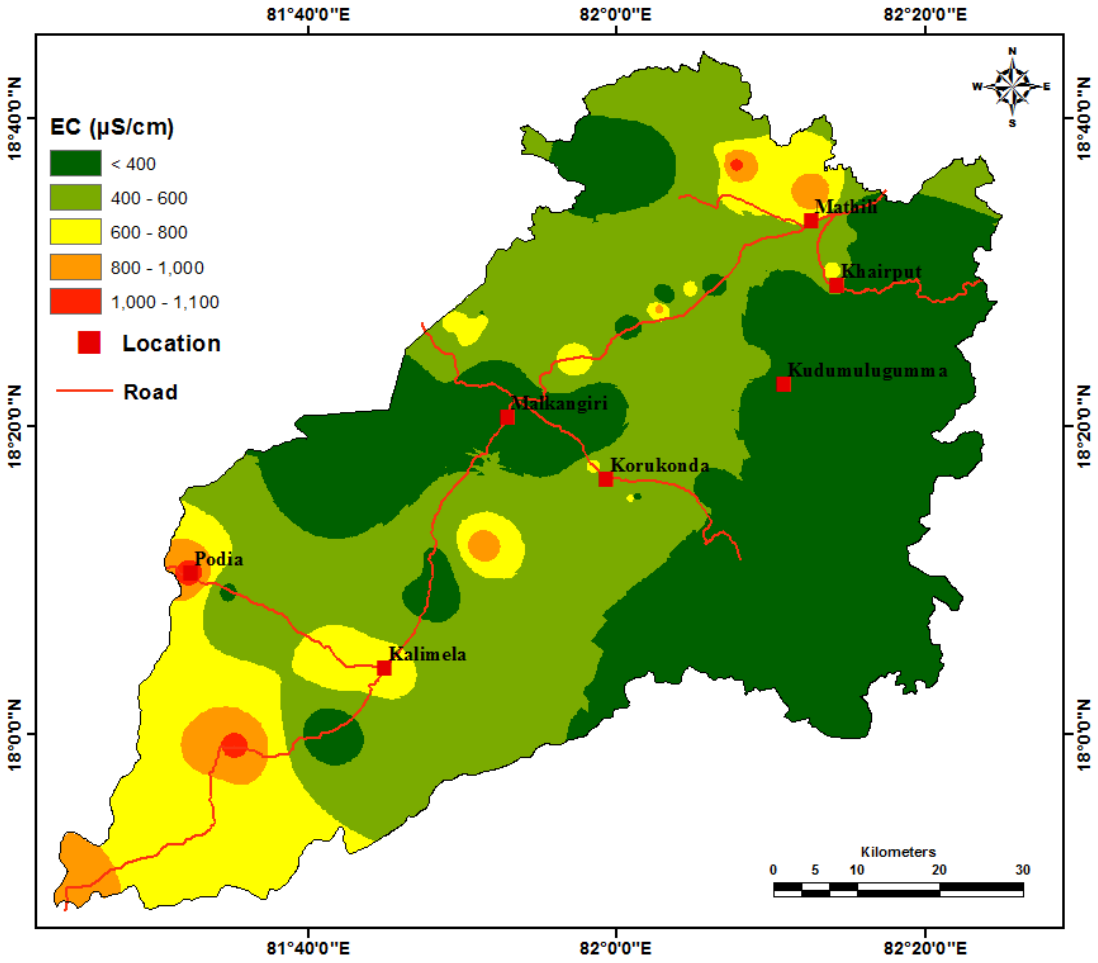



**Fig:2.8 Iso- Conductivity map of Phreatic aquifer of Malkangiri District.**

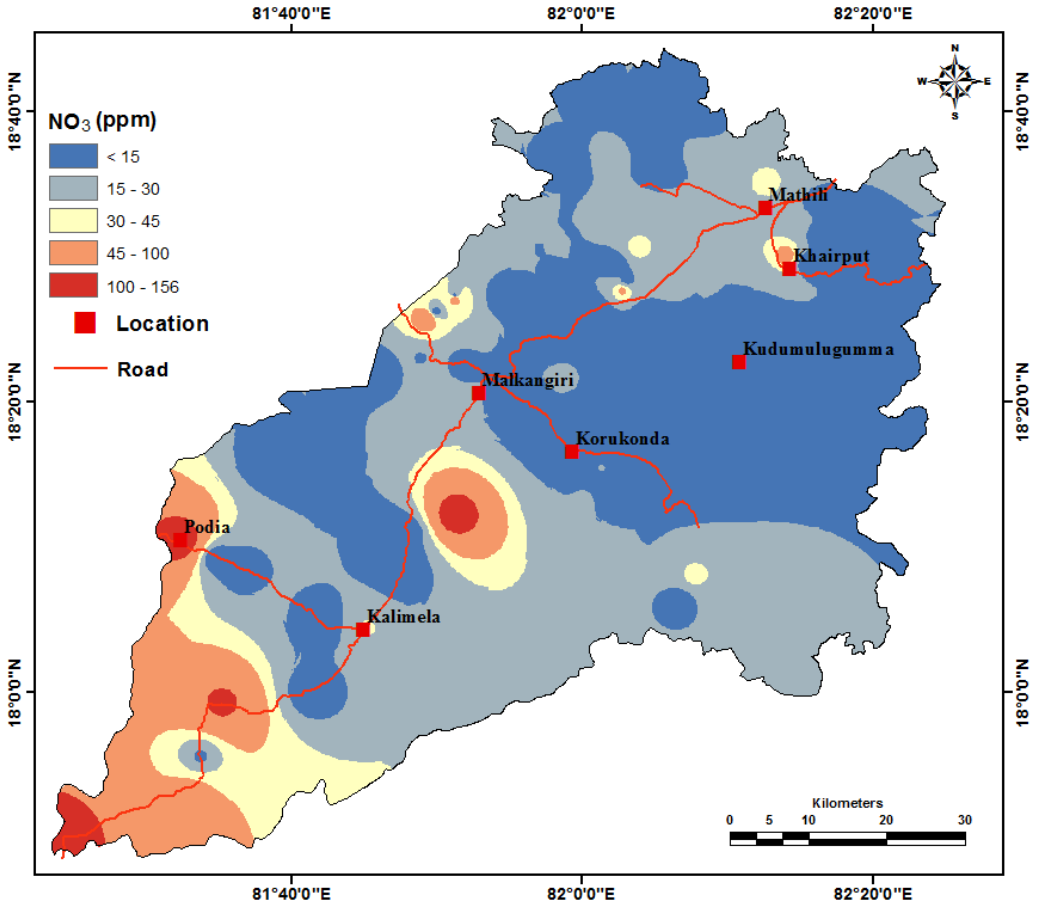



**Fig:2.9 Nitrate map of Phreatic aquifer of Malkangiri District.**

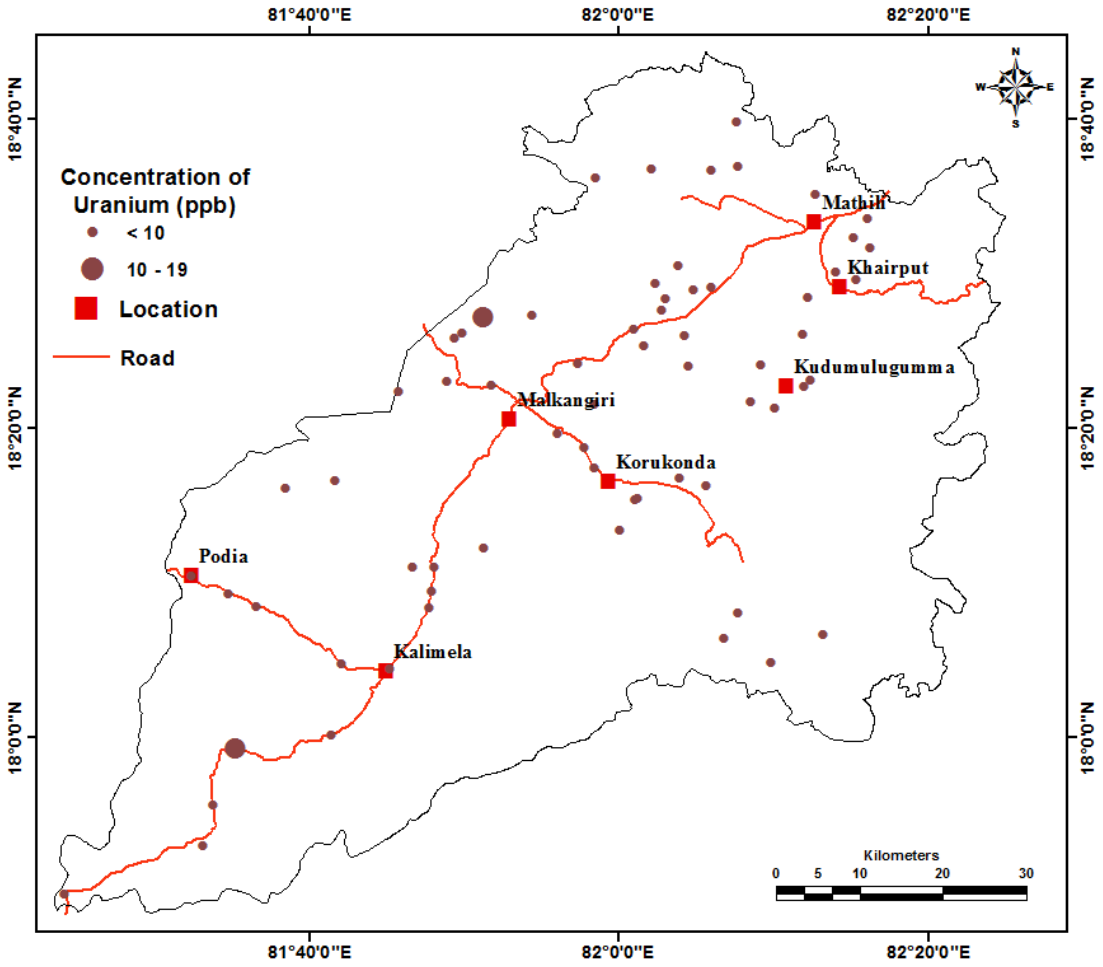



**Fig:2.10 Uranium map of Phreatic aquifer of Malkangiri District.**

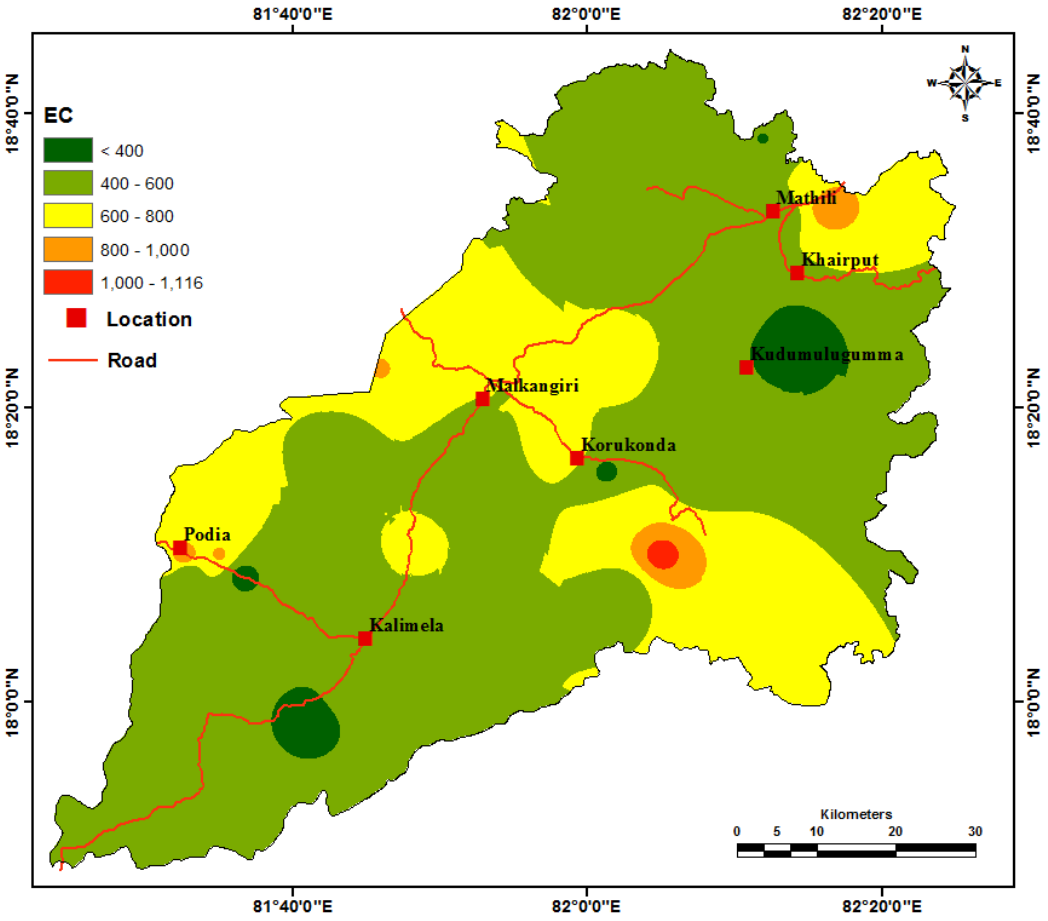



**Fig: 2.11 Iso conductivity map of deeper aquifer in Malkangiri District.**

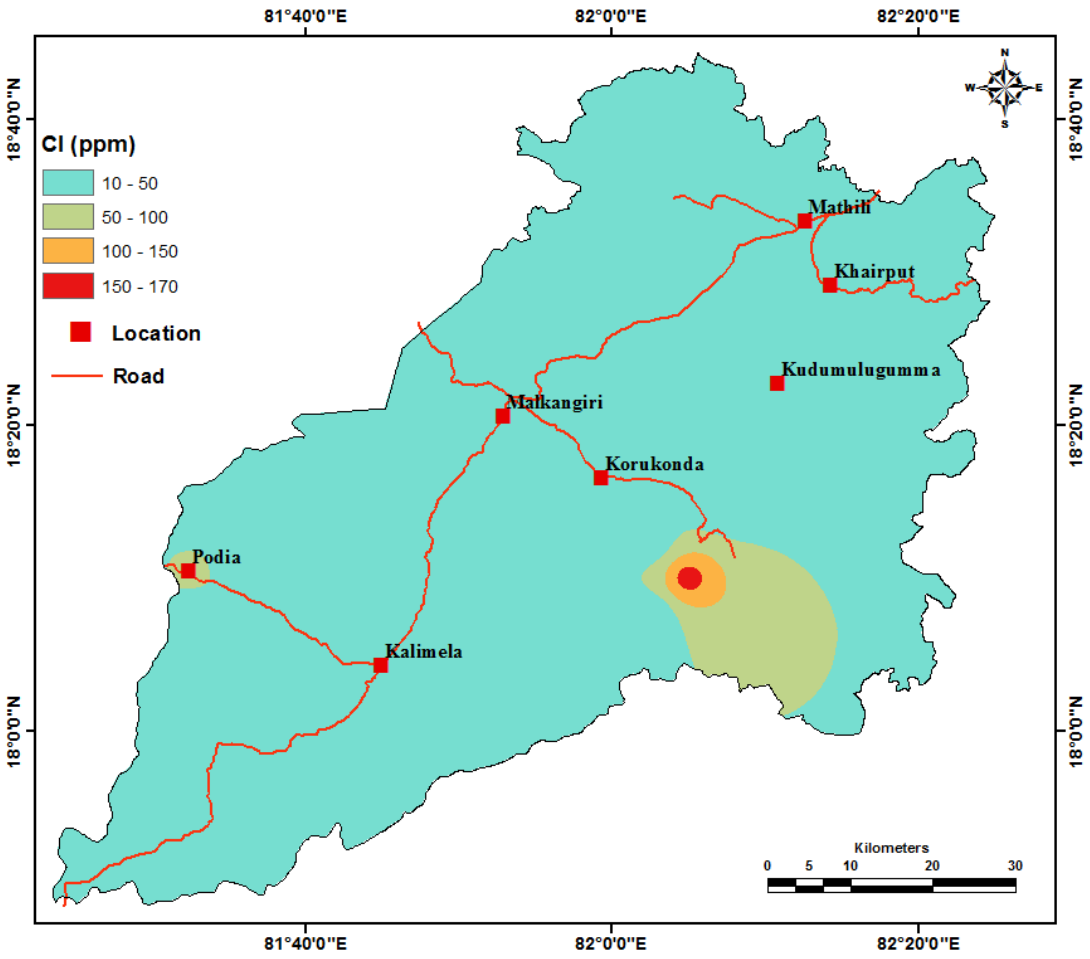



**Fig: 2.12 Chloride map of deeper aquifer in Malkangiri District.**

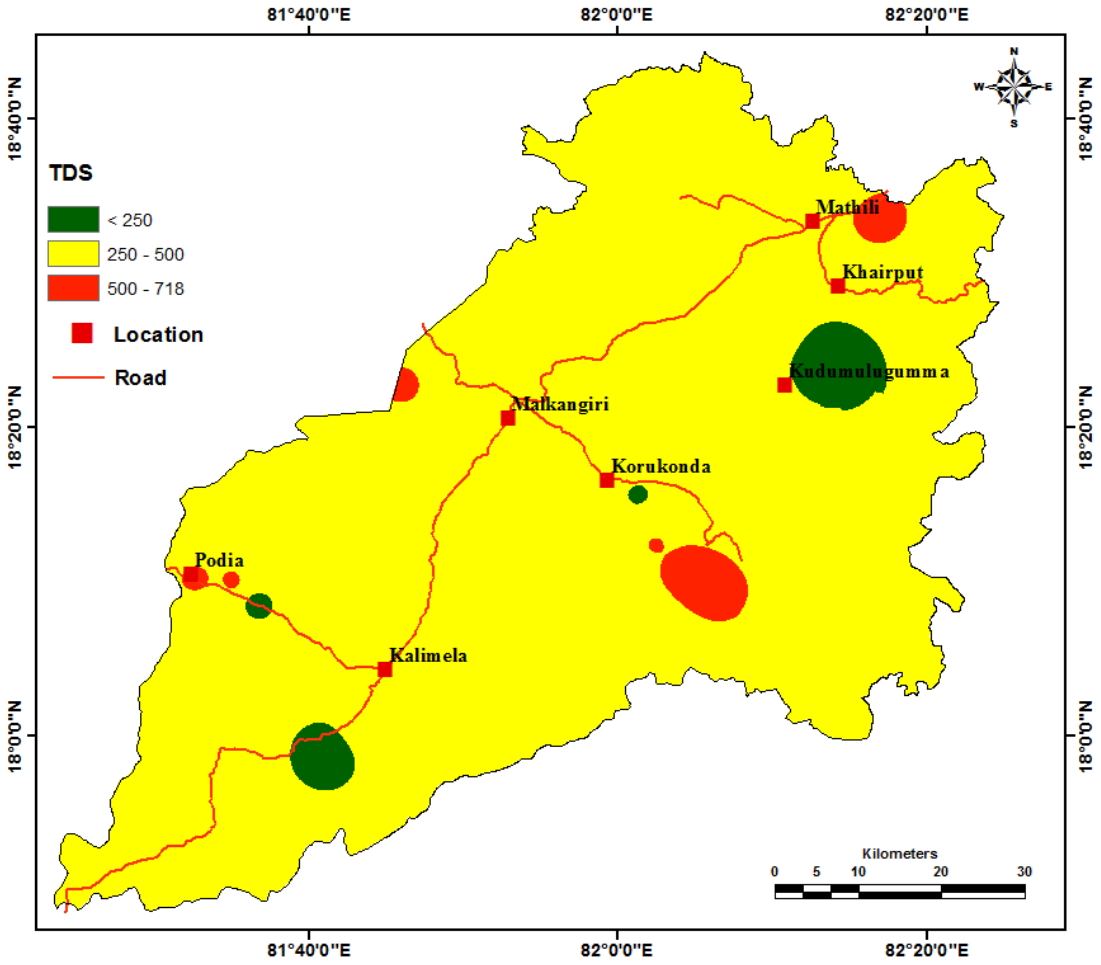



**Fig: 2.13 TDS map of deeper aquifer in Malkangiri District.**

# 3 DATA INTERPRETATION, INTEGRATION AND AQUIFER MAPPING

## 3.1 Shallow Aquifer

Ground water occurs in phreatic condition in shallow aquifers and is utilized by means of dug wells or shallow tube wells. The depth of the dug wells used as observation points vary from 5.3 to 14.1 mbgl and their diameter ranges from 1.0 m to 8.1 m. The wells are generally lined to the total depth.

### 3.1.1 Pre-monsoon Depth to Water Level

The Depth to water level in pre-monsoon period varies from 2.9 mbgl (Chitapari) to 9.75 mbgl (MV-7) the average being 5.20mbgl. In general, the study area has the depth to water level in between 4to6 mbgl during the pre-monsoon. The pre-monsoon depth to water level map is shown in Fig. 3.1.

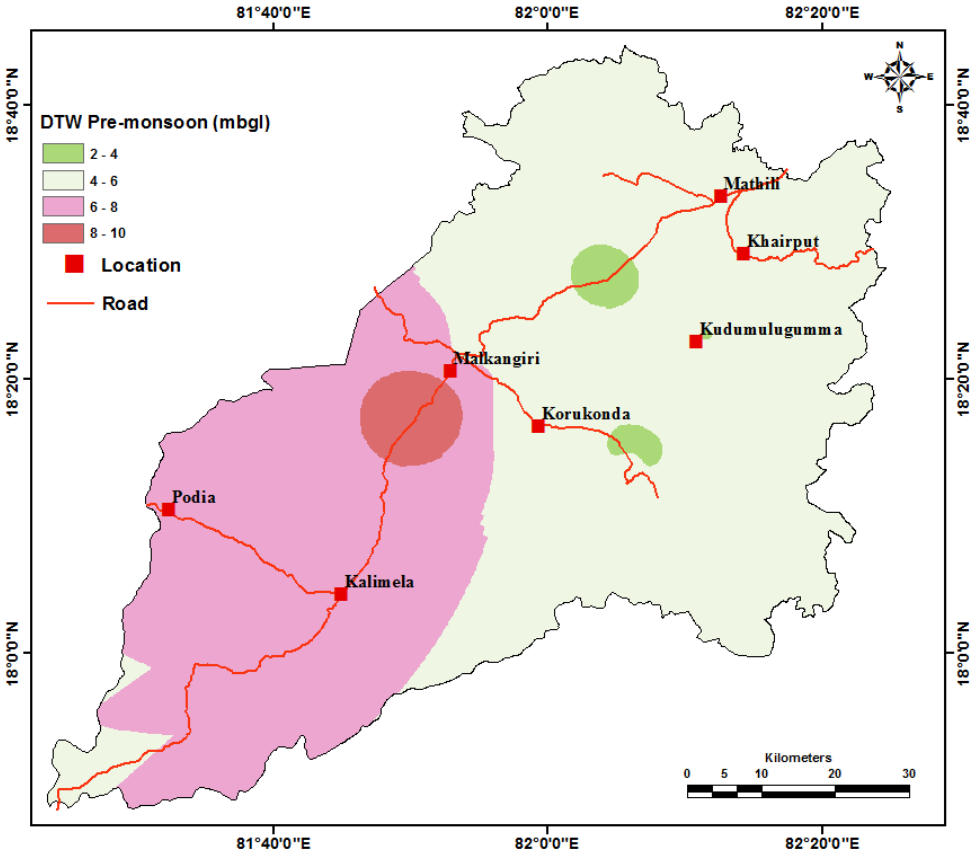



**Fig. 3.1: Depth to Water Level in Phreatic Aquifer During Pre-monsoon.**

### 3.1.2 Post-monsoon Depth to Water Level

Depth to water level in post-monsoon period varies from 0.92 mbgl (Mathili) to 5.75 mbgl (Bhejaguda) the average being 1.97 mbgl. The depth to water level of the study area during post-monsoon is in general within 0-2 mbgl. The post-monsoon depth to water level map is shown below in **Fig. 3.2**.

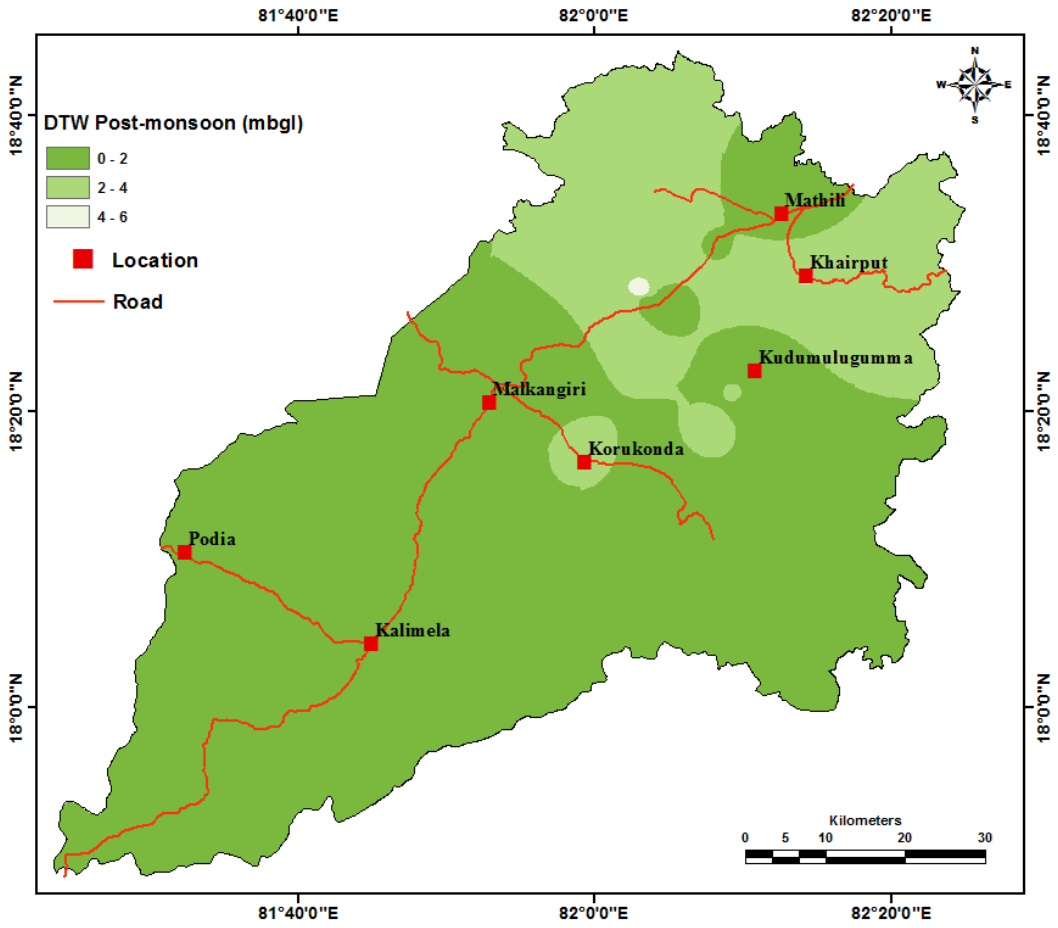



**Fig. 3.2: Depth to Water Level in Phreatic Aquifer During Post-monsoon.**

### 3.1.3 Seasonal Fluctuation of Water Level

The water level fluctuation varies from 0.99 mbgl (MV-37) to 4.88mbgl (Mathili) the average being 2.99mbgl. The general range of fluctuation in water level in the study area is between 2-4m. The

shallow post-monsoon water level along with fluctuation pattern indicates that the annual replenishment of phreatic aquifer due to monsoon rainfall is adequate in the district but deeper summer level is due to rapid dewatering of the phreatic aquifer .The seasonal fluctuation of water level of Aquifer-I is shown in **Fig. 3.3**.

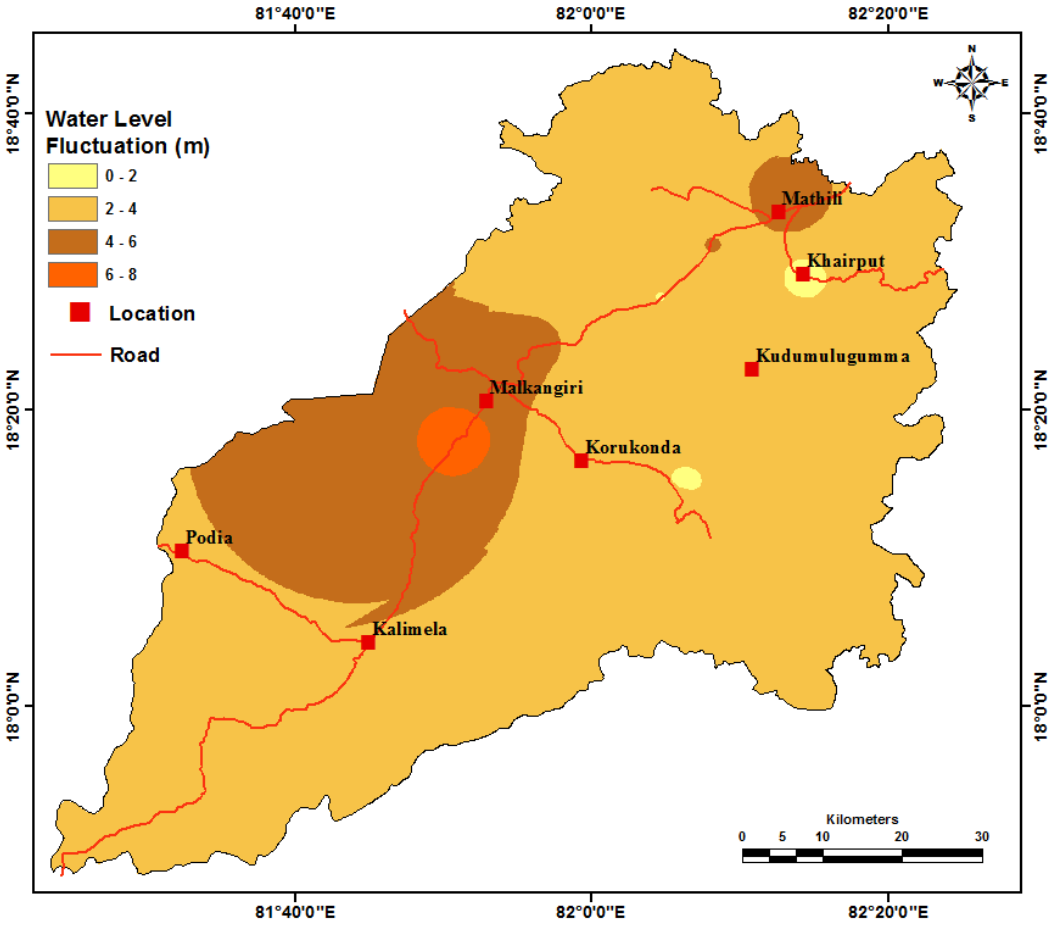



**Fig. 3.3: Seasonal Fluctuation in Water Level in Phreatic Aquifer.**

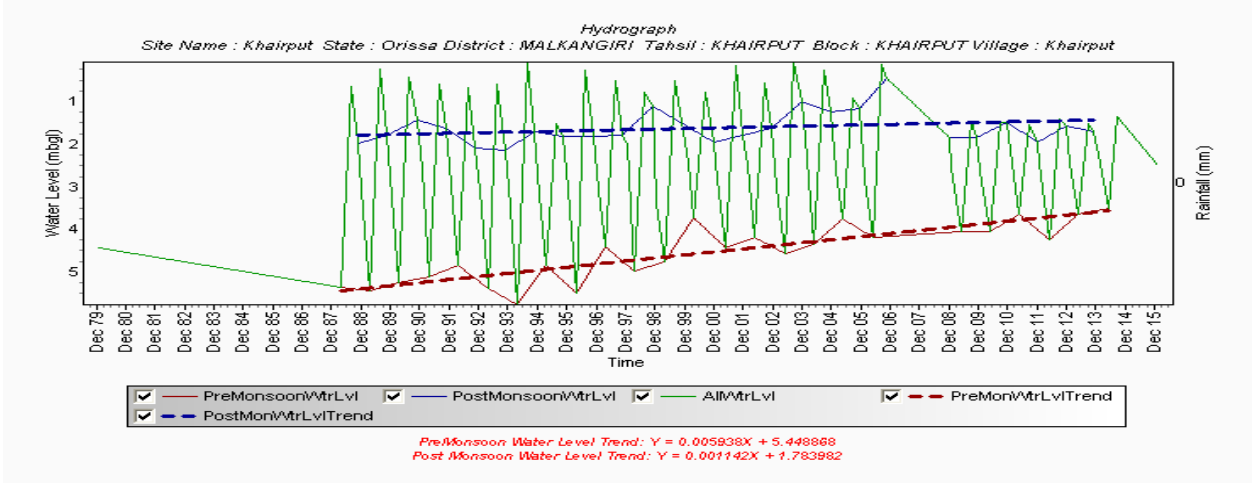
### 3.1.4 Decadal Water Level Trend

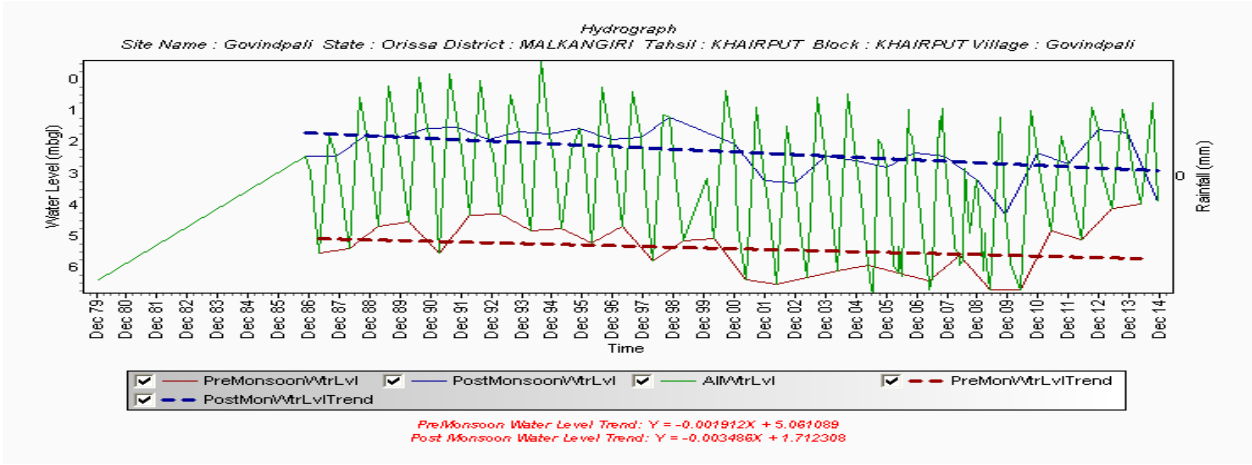
The National Hydrograph Network Stations (NHNS) data are considered for analysis of long-term trend for the period 2011-20. The trend of water level for both pre-monsoon and post-monsoon periods (2011-21)were analyzed. The results of trend analysis have been shown in **Table-3.1**. The long term trend analysis indicates that out of 11 stations, 8(72.72%) show falling trend and 3 stations (27.28%) show rising trend in pre-monsoon. In the post-monsoon out of 11 stations 05(45.45%) show rising trend and 6(54.55%) show falling trend.

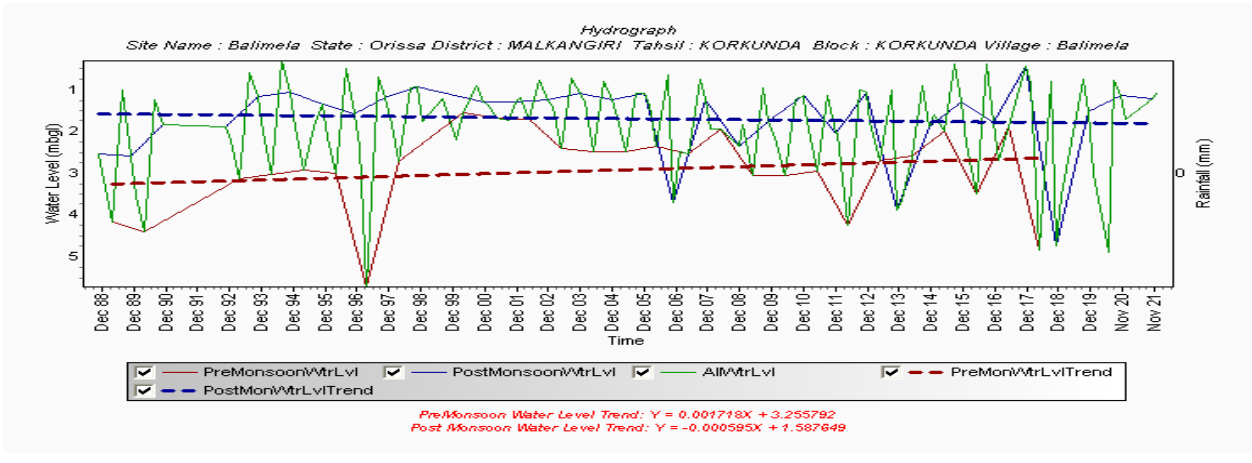
**Table-3.1: Decadal Water Level Trend Analysis of CGWB NHS (period 2011-2021) in Malkangiri District**

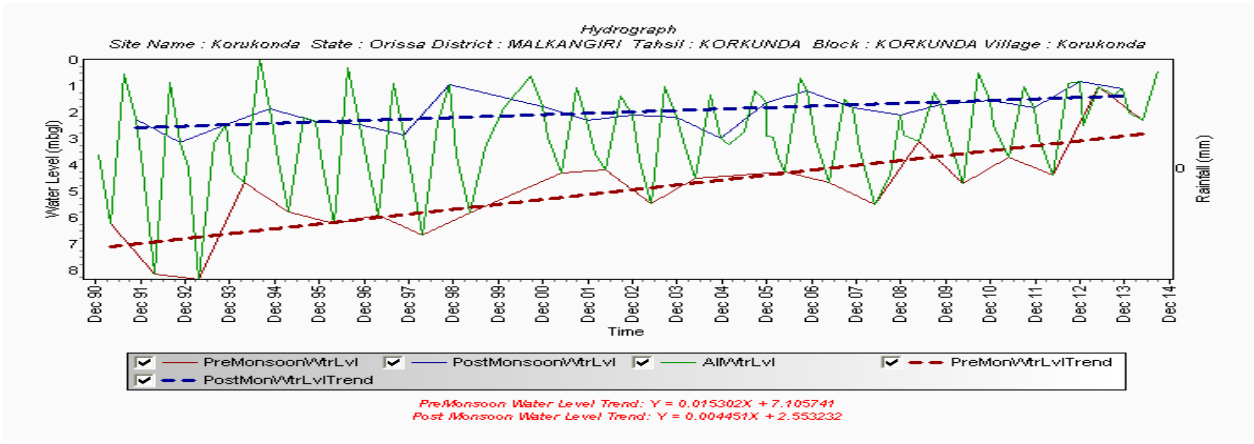
| Sl No. | Location | Block | Premonsoon | | Postmonsoon | |
|---|---|---|---|---|---|---|
| | | | Trend (m/year) | Remark | Trend (m/year) | Remark |
| 1 | Balimela | Korukunda | 0.0393 | Fall | 0.054 | Rise |
| 2 | Bejaguda | Mathili | 0.0334 | Rise | 0.0756 | Rise |
| 3 | Chitapari | Korukunda | 0.0507 | Rise | 0.0398 | Fall |
| 4 | Katameta | Mathili | 0.0063 | Fall | 0.0028 | Fall |
| 5 | Kumbharguda | Malkangiri | 0.2133 | Fall | 0.0663 | Rise |
| 6 | M.V.9 | Malkangiri | 0.0454 | Fall | 0.006 | Rise |
| 7 | Malkangiri 1 | Malkangiri | 0.0187 | Fall | 0.0708 | Fall |
| 8 | Mundiguda | Khairaput | 0.0598 | Fall | 0.0821 | Rise |
| 9 | Parkannala | Kodumulguma | 0.1070 | Fall | 0.0314 | Fall |
| 10 | Pongam | Mathili | 0.0683 | Rise | 0.0297 | Rise |
| 11 | Sindhimal | Malkangiri | 0.1258 | Fall | 0.0288 | Fall |

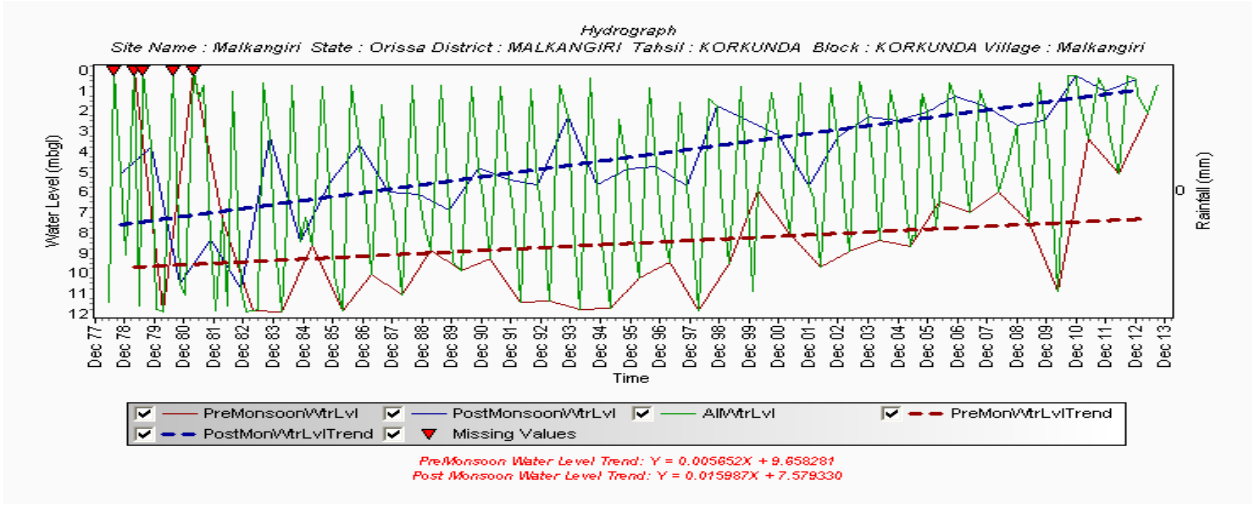
**Fig. 3.4: Hydrographs (NHNS) in different blocks of Malkangiri District**

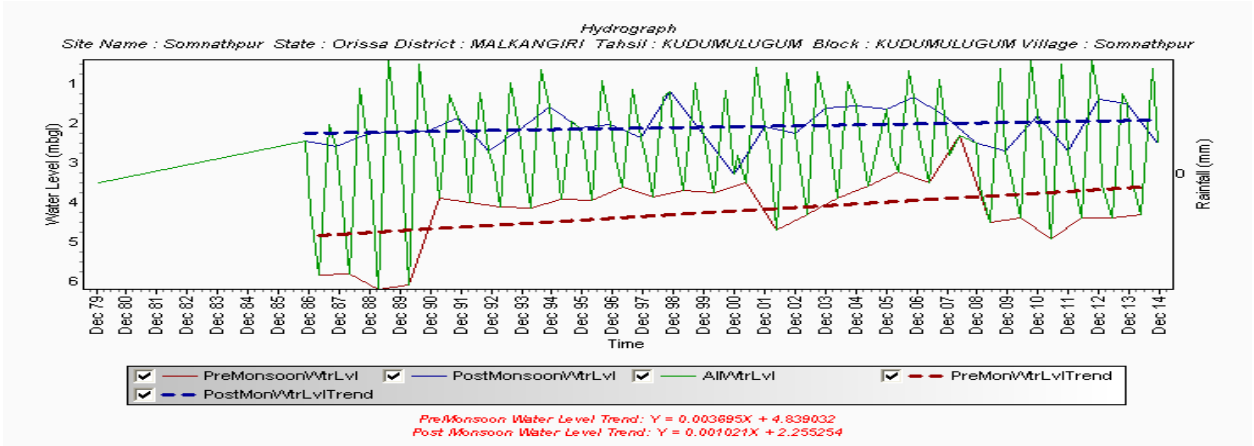


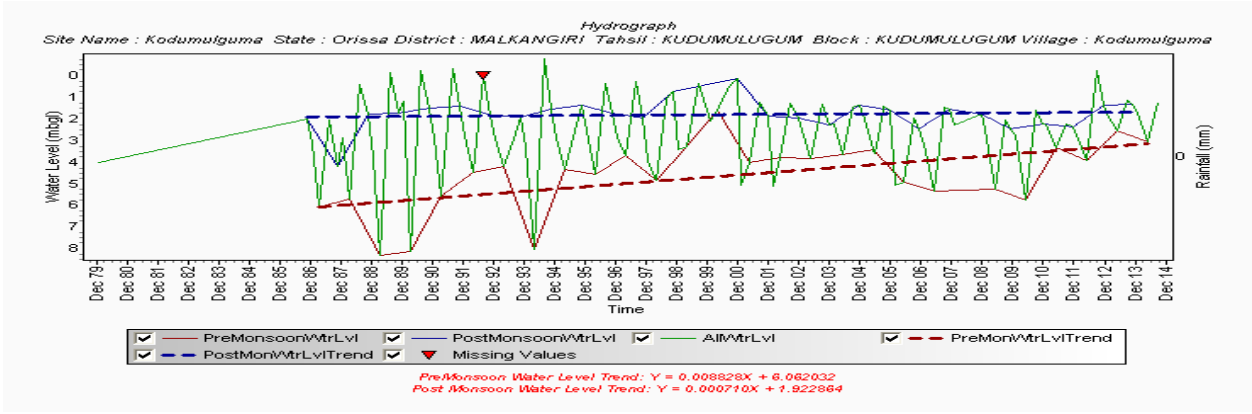



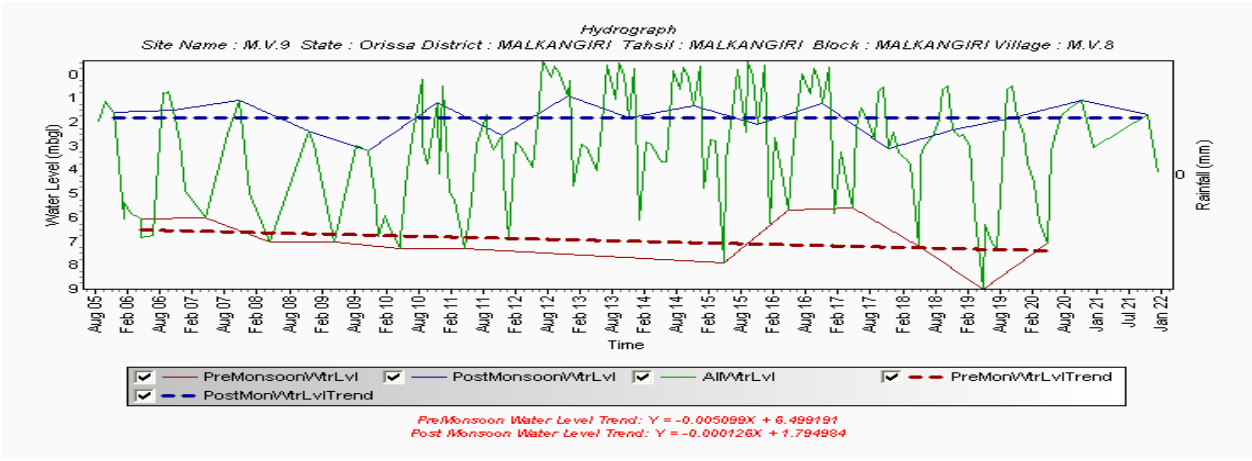



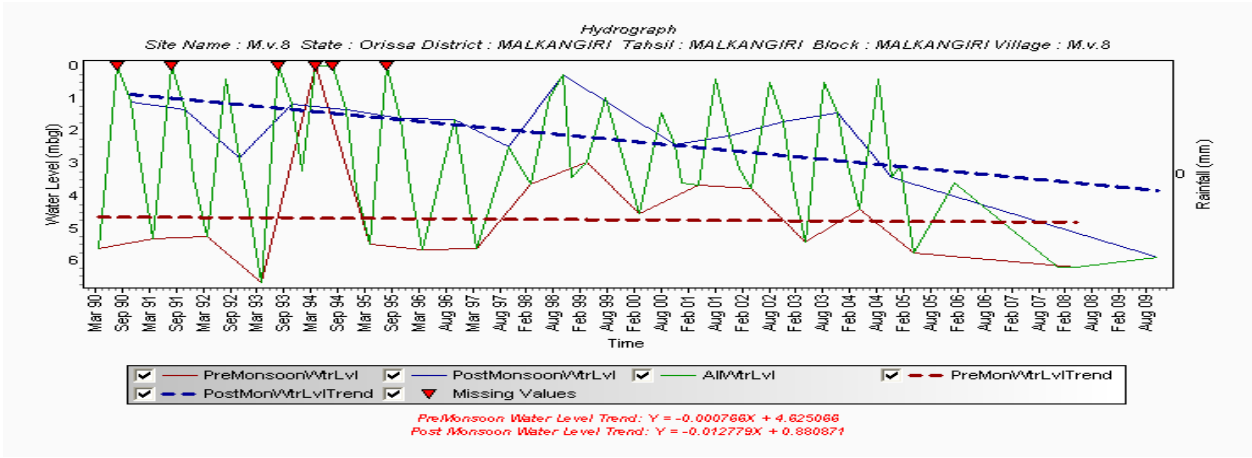

Hydrograph
Site Name : Korukonda State : Orissa District : MALKANGIRI Tahsil : KORKUNDA Block : KORKUNDA Village : Korukonda
Water Level (mbgl)
Rainfall (mm)
Time
PreMonsoonWtrLvl
PostMonsoonWtrLvl
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.015302X + 7.105741
Post Monsoon Water Level Trend: Y = 0.004451X + 2.553232

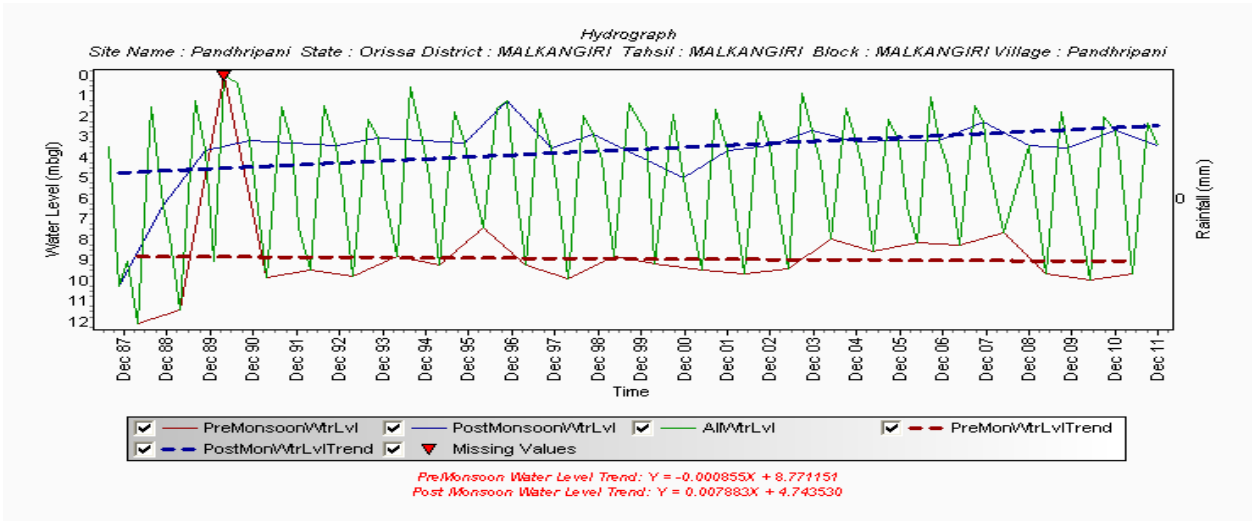

Hydrograph
Site Name : Malkangiri State : Orissa District : MALKANGIRI Tahsil : KORKUNDA Block : KORKUNDA Village : Malkangiri
Water Level (mbgl)
Rainfall (mm)
Time
PreMonsoonWtrLvl
PostMonsoonWtrLvl
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
Missing Values
PreMonsoon Water Level Trend: Y = 0.005652X + 9.658281
Post Monsoon Water Level Trend: Y = 0.015987X + 7.579330

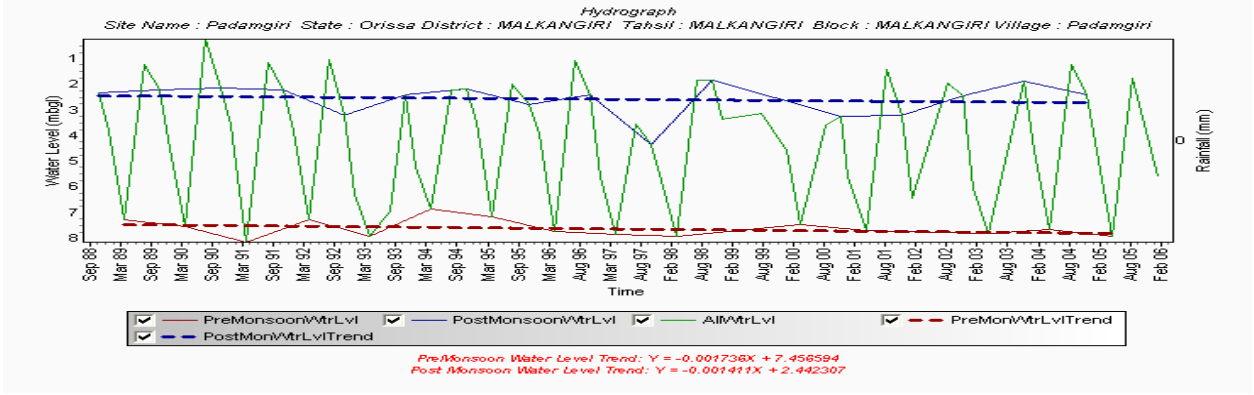

Hydrograph
Site Name : Somnathpur State : Orissa District : MALKANGIRI Tahsil : KUDUMULUGUM Block : KUDUMULUGUM Village : Somnathpur
Water Level (mbgl)
Rainfall (mm)
Time
PreMonsoonWtrLvl
PostMonsoonWtrLvl
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.003895X + 4.839032
Post Monsoon Water Level Trend: Y = 0.001021X + 2.255254

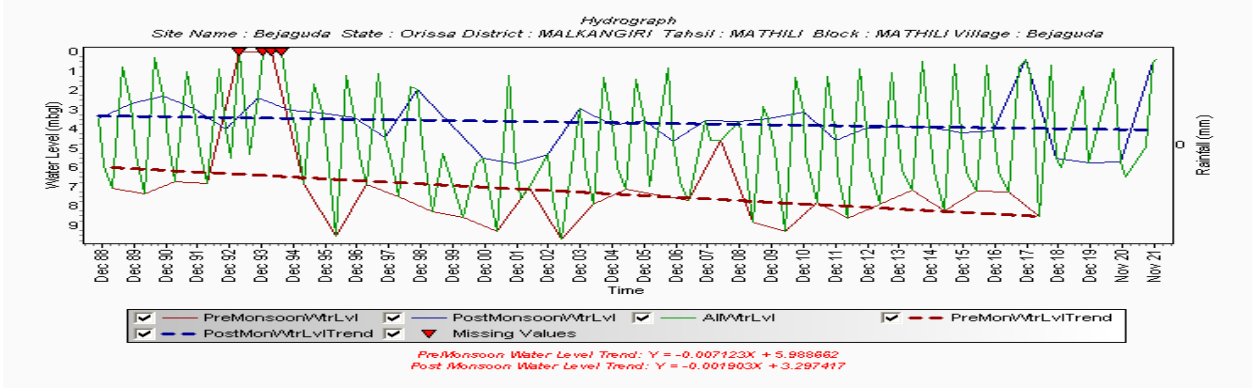

Hydrograph
Site Name : Kodumulguma State : Orissa District : MALKANGIRI Tahsil : KUDUMULUGUM Block : KUDUMULUGUM Village : Kodumulguma
Water Level (mbgl)
Rainfall (mm)
Time
PreMonsoonWtrLvl
PostMonsoonWtrLvl
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
Missing Values
PreMonsoon Water Level Trend: Y = 0.008828X + 6.062032
Post Monsoon Water Level Trend: Y = 0.000710X + 1.922864

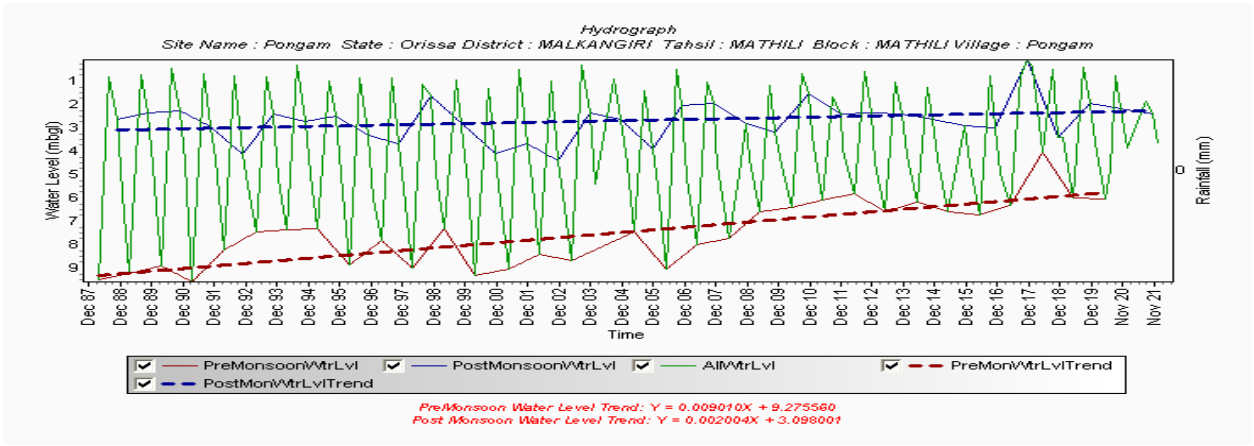

Hydrograph
Site Name : M.V.9 State : Orissa District : MALKANGIRI Tahsil : MALKANGIRI Block : MALKANGIRI Village : M.V.8
Water Level (mbgl)
Rainfall (mm)
Time
PreMonsoonWtrLvl
PostMonsoonWtrLvl
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
PreMonsoon Water Level Trend: Y = -0.005099X + 6.499191
Post Monsoon Water Level Trend: Y = -0.000126X + 1.794984

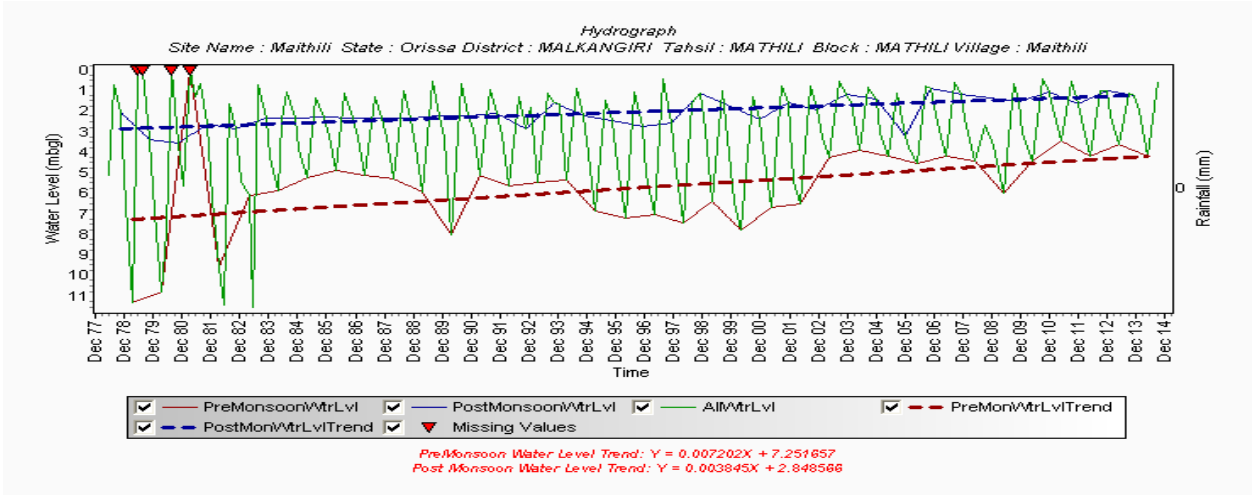

Hydrograph
Site Name : M.v.8 State : Orissa District : MALKANGIRI Tahsil : MALKANGIRI Block : MALKANGIRI Village : M.v.8
Water Level (mbgl)
Rainfall (mm)
Time
PreMonsoonWtrLvl
PostMonsoonWtrLvl
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
Missing Values
PreMonsoon Water Level Trend: Y = -0.000786X + 4.625066
Post Monsoon Water Level Trend: Y = -0.012779X + 0.880871

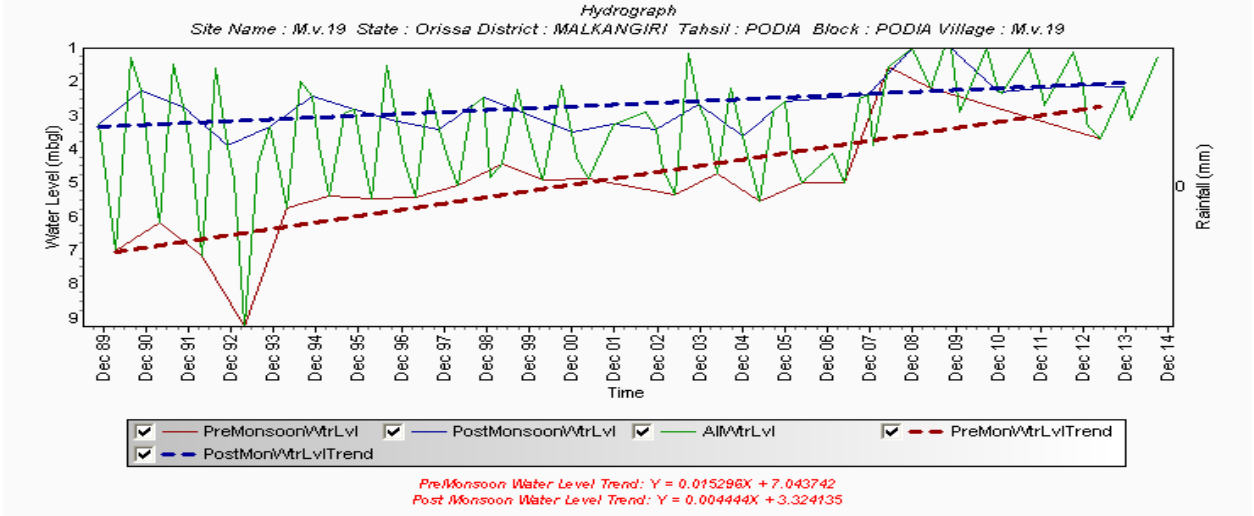

Hydrograph
Site Name : Pandhripani State : Orissa District : MALKANGIRI Tahsil : MALKANGIRI Block : MALKANGIRI Village : Pandhripani
Water Level (mbgl)
Rainfall (mm)
Time
PreMonsoonWtrLvl
PostMonsoonWtrLvl
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
Missing Values
PreMonsoon Water Level Trend: Y = -0.000855X + 8.771151
Post Monsoon Water Level Trend: Y = 0.007883X + 4.743530


Hydrograph
Site Name : Padamgiri State : Orissa District : MALKANGIRI Tahsil : MALKANGIRI Block : MALKANGIRI Village : Padamgiri
Water Level (mbgl)
Rainfall (mm)
Time
PreMonsoonWtrLvl
PostMonsoonWtrLvl
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
PreMonsoon Water Level Trend: Y = -0.001736X + 7.456594
Post Monsoon Water Level Trend: Y = -0.001411X + 2.442307


Hydrograph
Site Name : Bejaguda State : Orissa District : MALKANGIRI Tahsil : MATHILI Block : MATHILI Village : Bejaguda
Water Level (mbgl)
Rainfall (mm)
Time
PreMonsoonWtrLvl
PostMonsoonWtrLvl
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
Missing Values
PreMonsoon Water Level Trend: Y = -0.007123X + 5.988662
Post Monsoon Water Level Trend: Y = -0.001903X + 3.297417


Hydrograph
Site Name : Pongam State : Orissa District : MALKANGIRI Tahsil : MATHILI Block : MATHILI Village : Pongam
Water Level (mbgl)
Rainfall (mm)
Time
PreMonsoonWtrLvl
PostMonsoonWtrLvl
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.009010X + 9.275560
Post Monsoon Water Level Trend: Y = 0.002004X + 3.098001


Hydrograph
Site Name : Maithili State : Orissa District : MALKANGIRI Tahsil : MATHILI Block : MATHILI Village : Maithili
Water Level (mbgl)
Rainfall (mm)
Time
PreMonsoonWtrLvl
PostMonsoonWtrLvl
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
Missing Values
PreMonsoon Water Level Trend: Y = 0.007202X + 7.251657
Post Monsoon Water Level Trend: Y = 0.003845X + 2.848566


Hydrograph
Site Name : M.v.19 State : Orissa District : MALKANGIRI Tahsil : PODIA Block : PODIA Village : M.v.19
Water Level (mbgl)
Rainfall (mm)
Time
PreMonsoonWtrLvl
PostMonsoonWtrLvl
AllWtrLvl
PreMonWtrLvlTrend
PostMonWtrLvlTrend
PreMonsoon Water Level Trend: Y = 0.015296X + 7.043742
Post Monsoon Water Level Trend: Y = 0.004444X + 3.324135

### 3.2 Deeper Aquifer

Unlike phreatic aquifer, ground water occurs under confined to semi-confined condition in the deeper aquifer. The deeper aquifer comprises of the jointed, fractured and consolidated or crystalline formations. In general, it is confined on top by weathered formations and bottom by massive rocks.

### 3.3 Ground Water Quality

The suitability of the ground water for the purpose of irrigation analysed in the US-Salinity diagram as shown in **Fig. 3.6**.in which EC is taken as salinity hazard and SAR as alkalinity hazard. The predominant USSL classes of the water samples fall within C2S1and C3S1 classes. C3S1 class indicating high salinity and low alkali water which cannot be used on soil with restricted drainage and requires special arrangement for salinity control.The soil must be permeable and the drainage must be adequate,irriagation water must be added in excess to provide considerable leaching and tolerant crops and plants should be selected for such regions.The water samples represent Ca-$HCO_3$ type to mixed facies of Ca-Mg-Na-$HCO_3$-$SO_4$ types as shown in the Piper diagram in **Fig. 3.5**. This indicates a transitional or mixing environment between the younger water and resident water.

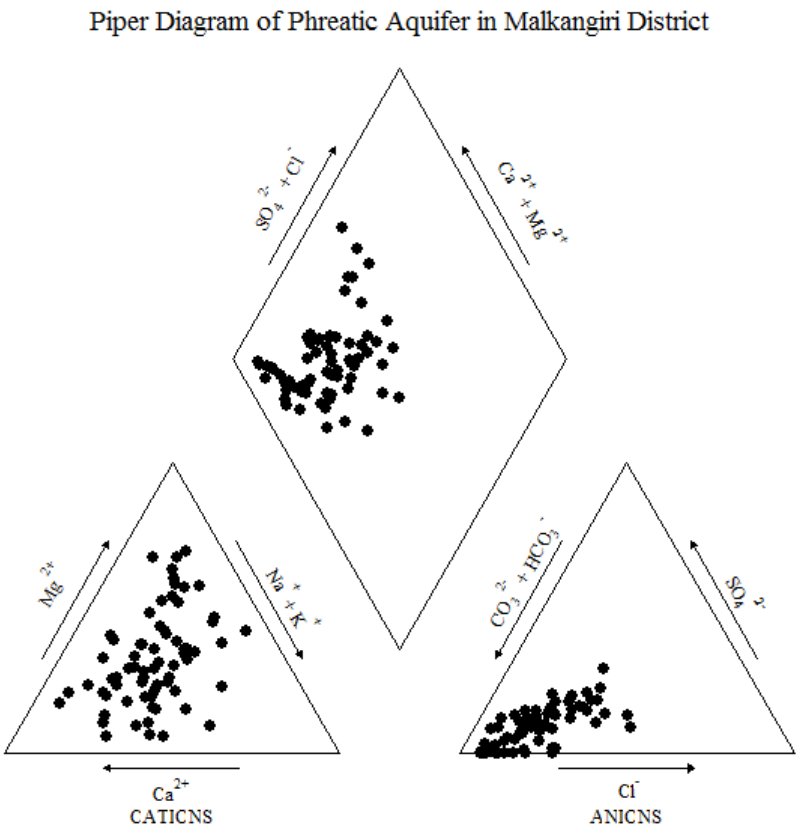
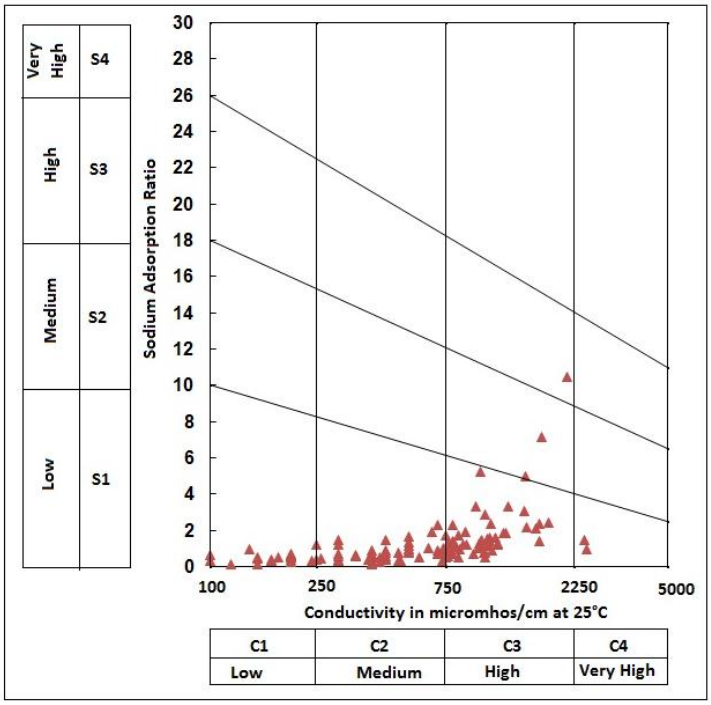



**Fig. 3.5 : Piper-Diagram of Water Samples, Malkangiri District.**




**Fig;3.6 US-Salinity Diagram, Phreatic Aquifer in Malkangiri District.**

### 3.4 Aquifer Groups and Their Demarcation

Based on extensive analysis of historical data, micro level hydrogeological survey data generated and ground water exploration carried out in the area, the following two types of aquifers can be demarcated and the details are given below:

**Aquifer- I (Unconfined Aquifer):**Unconfined aquifer, occurs in entire area except rocky outcrops, formed by the weathered mantle atop all crystalline formations and discontinuous alluvial tracts along major river channels. This aquifer generally occurs down to maximum depth of 30m bgl. Based on field observations, isopach map of Aquifer–I is generated..

**Aquifer-II(Semi-Confined to Confined Aquifer)**: Semi-confined to confined aquifer occurs as fracture zone aquifers in the entire area irrespective of rock types. However the aquifer properties, the yield of bore wells constructed in them depends on the rock type. As per the

ground water exploration, carried out by CGWB. Aquifer-II in Granitic rocks has better yield in comparison to Charnockites and Khondalites. In general, most of the fracture zones are encountered within 30 to 180 mbgl and seldom beyond that. Thus the maximum dep for the Aquifer-II has been taken as 200 mbgl.

### 3.5 Aquifer Disposition

The ground water exploration data has been used to generate the 3D disposition of the aquifer system. It comprises of all existing litho-units and the zones tapped during the ground water exploration, forming an aquifer. Three 2D schematic sections were drawn along lines A-A', B-B' and C-C', which are shown in plan view in Fig.3.7 and the corresponding 2D schematic sections are shown in **Fig. 3.8 ,3.9 and 3.10** The fence diagram and 3D disposition of the aquifer system of Malkangiri District are shown in **Fig.3.12and 3.13**

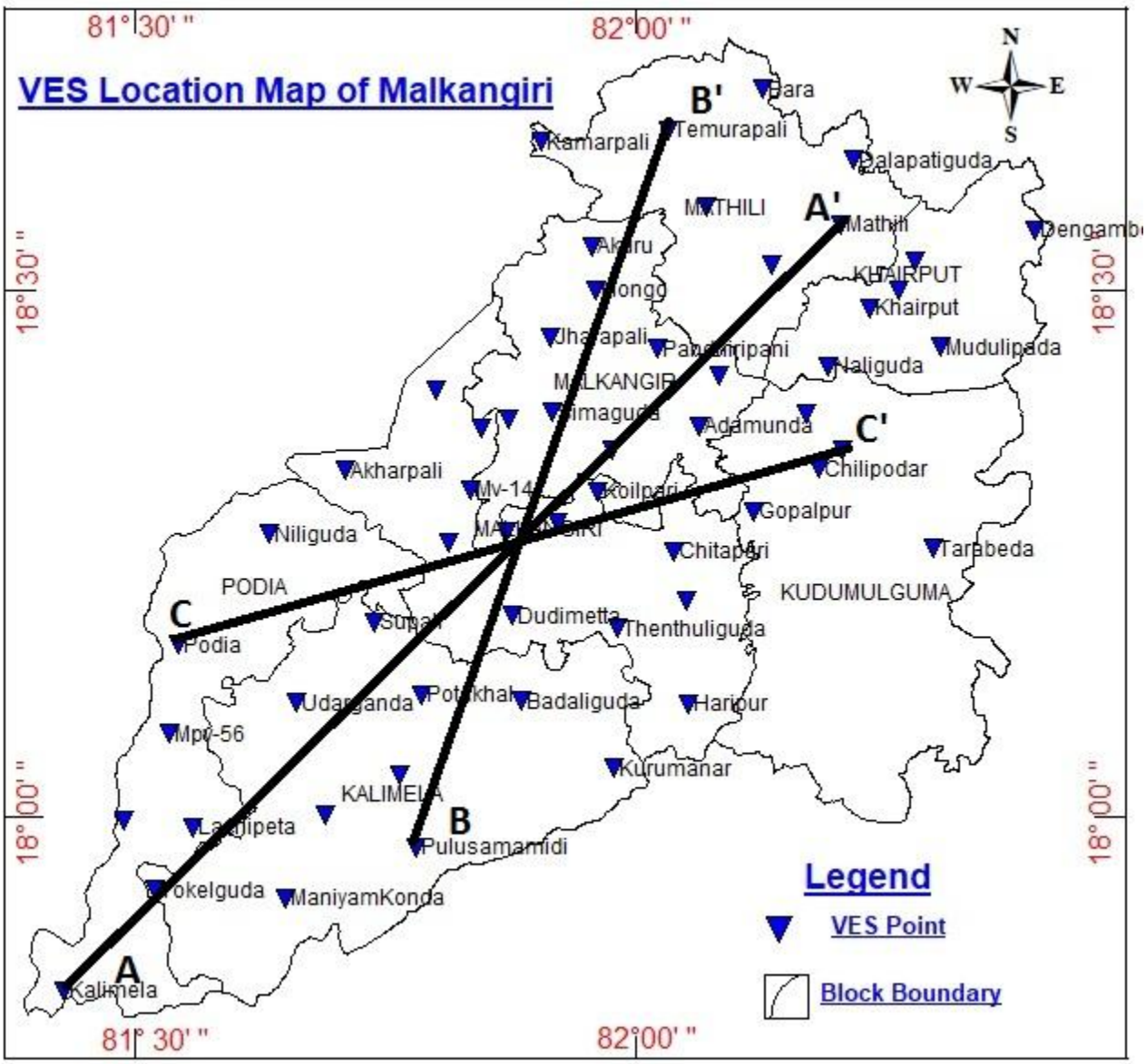



**Fig. 3.7: Location and plan view of schematic hydrogeological cross-sections in Malkangiri District**

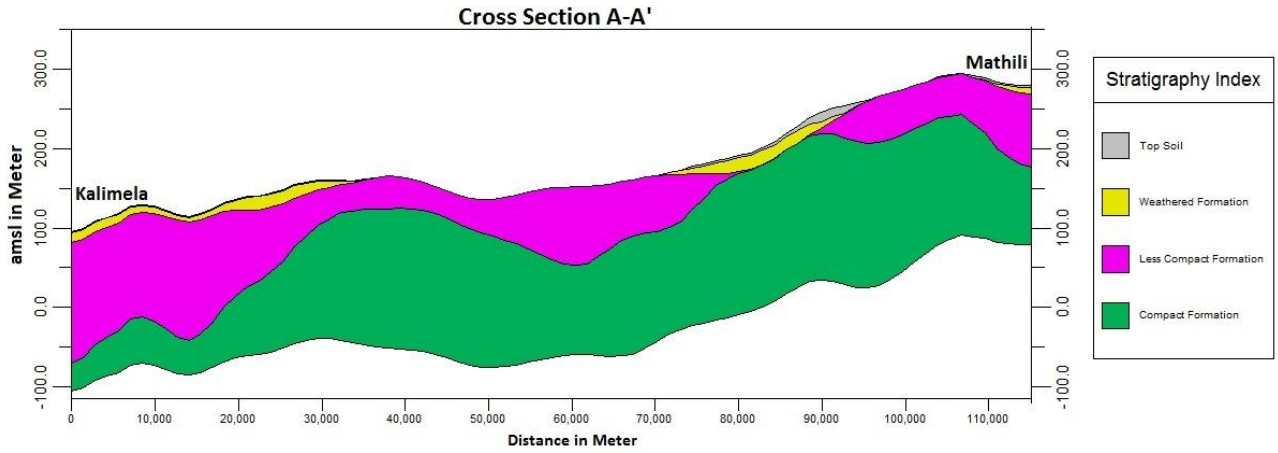



**Fig:3.8 Schematic aquifer cross-section A-A' in Malkangiri district**

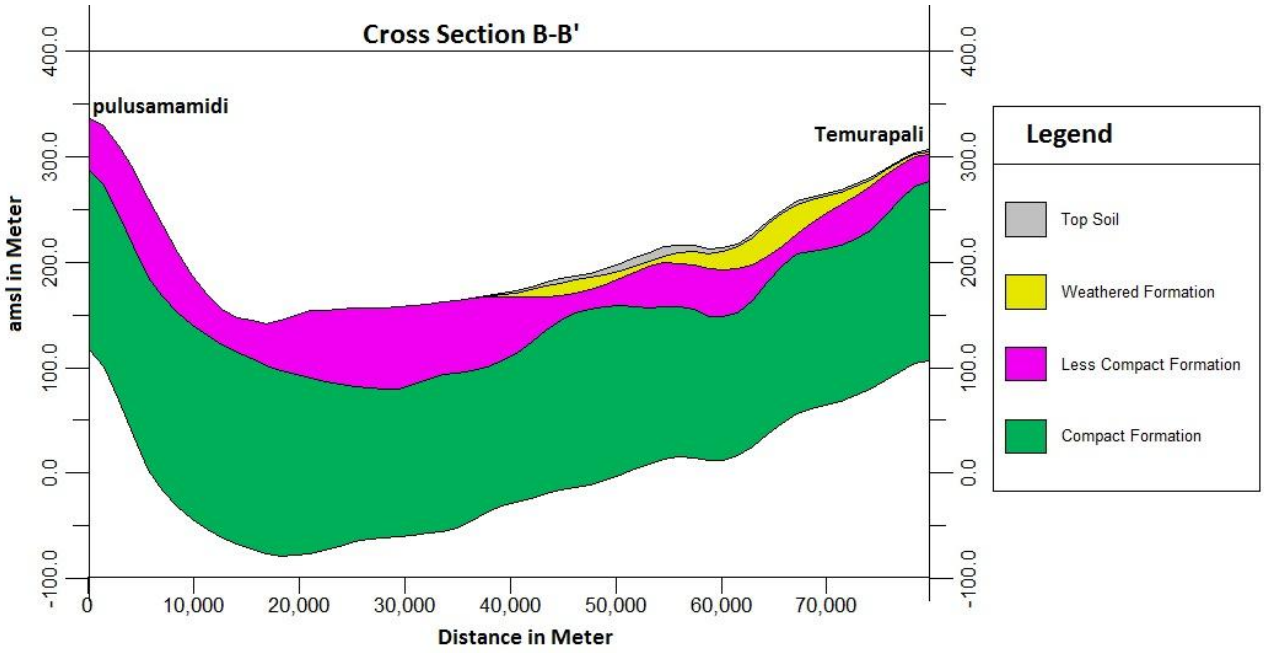



**Fig:3.9 Schematic aquifer cross-section B-B' in Malkangiri district**

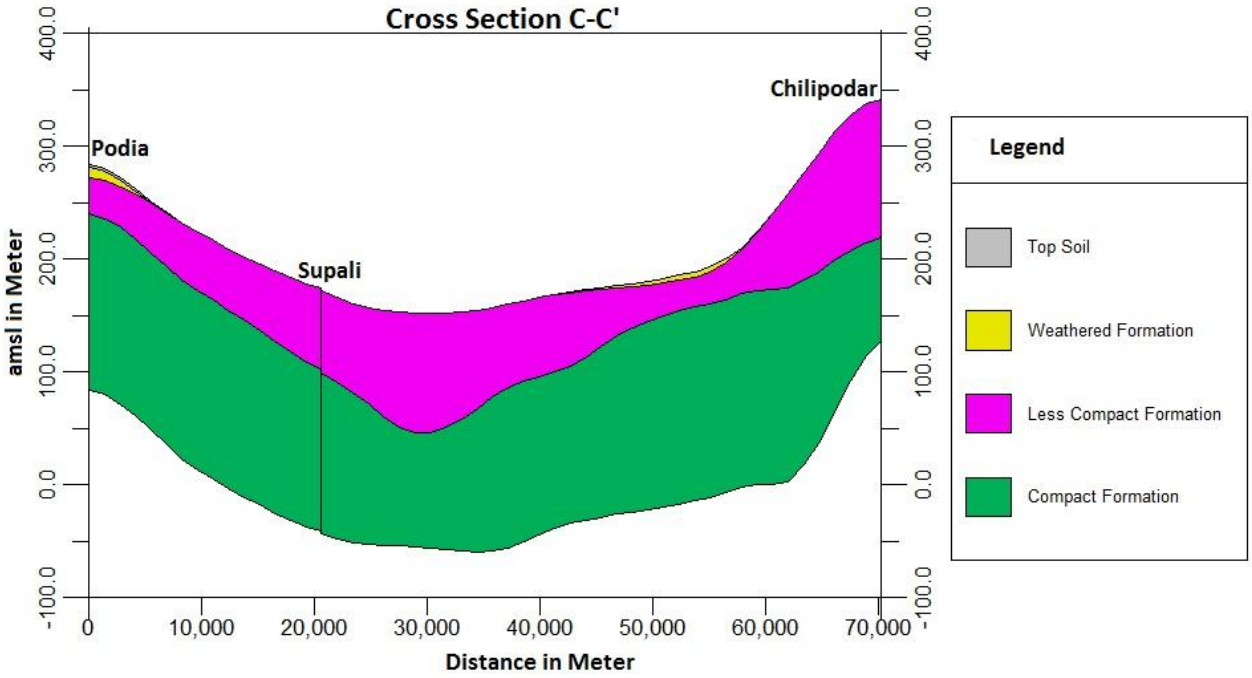



**Fig:3.10 Schematic aquifer cross-section C-C' in Malkangiri district**

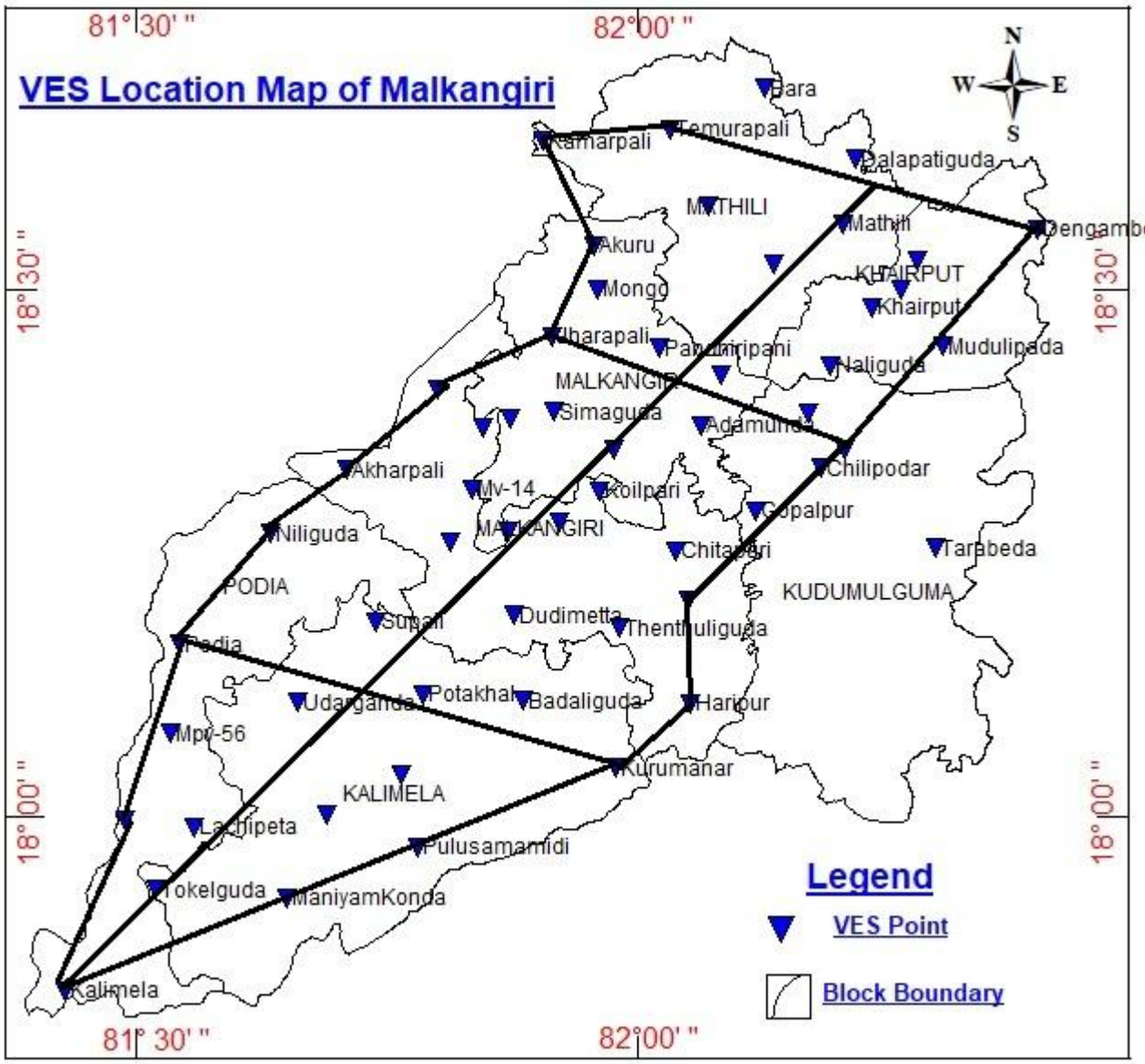



**Fig:3.11 Location and plan view of Fence diagram in Malkangiri district.**

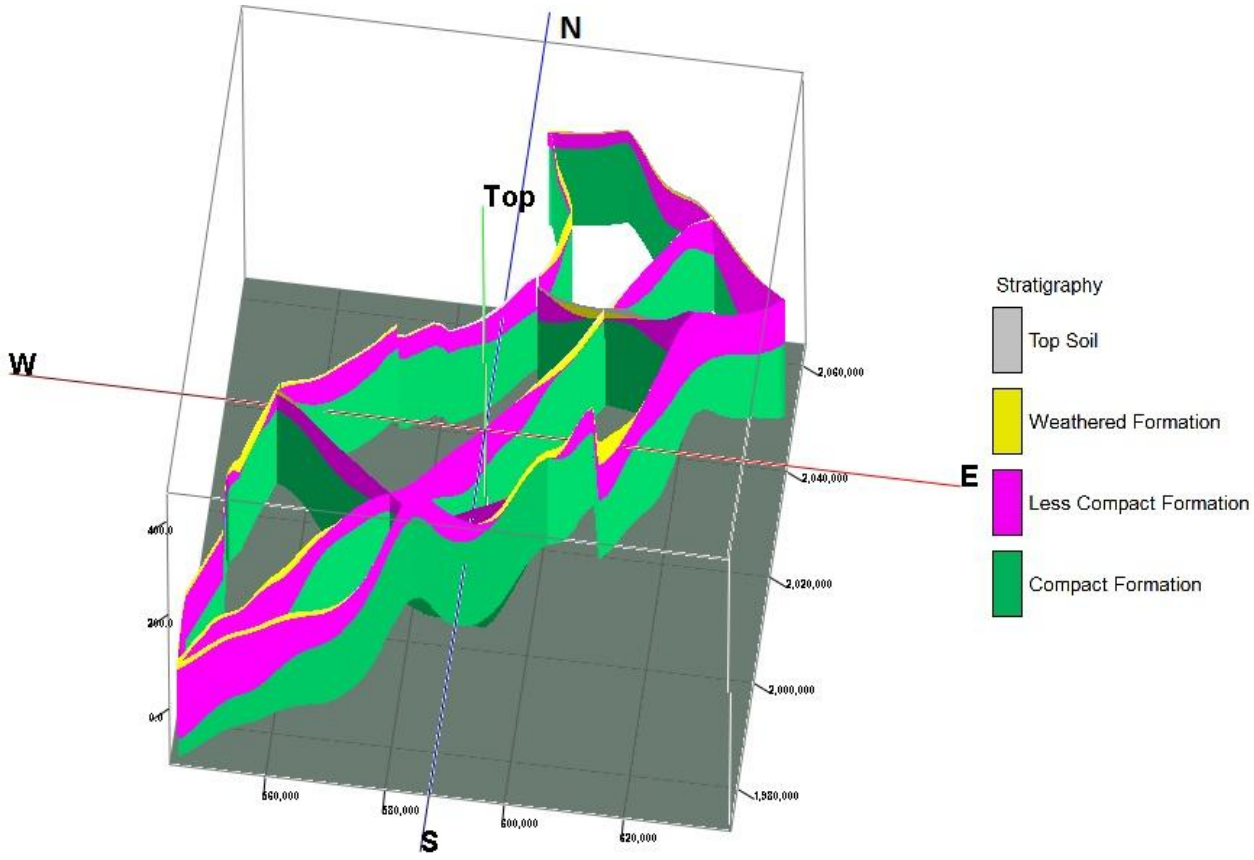



**Fig:3.12 : Fence diagram depicting the aquifer disposition in Malkangiri District**

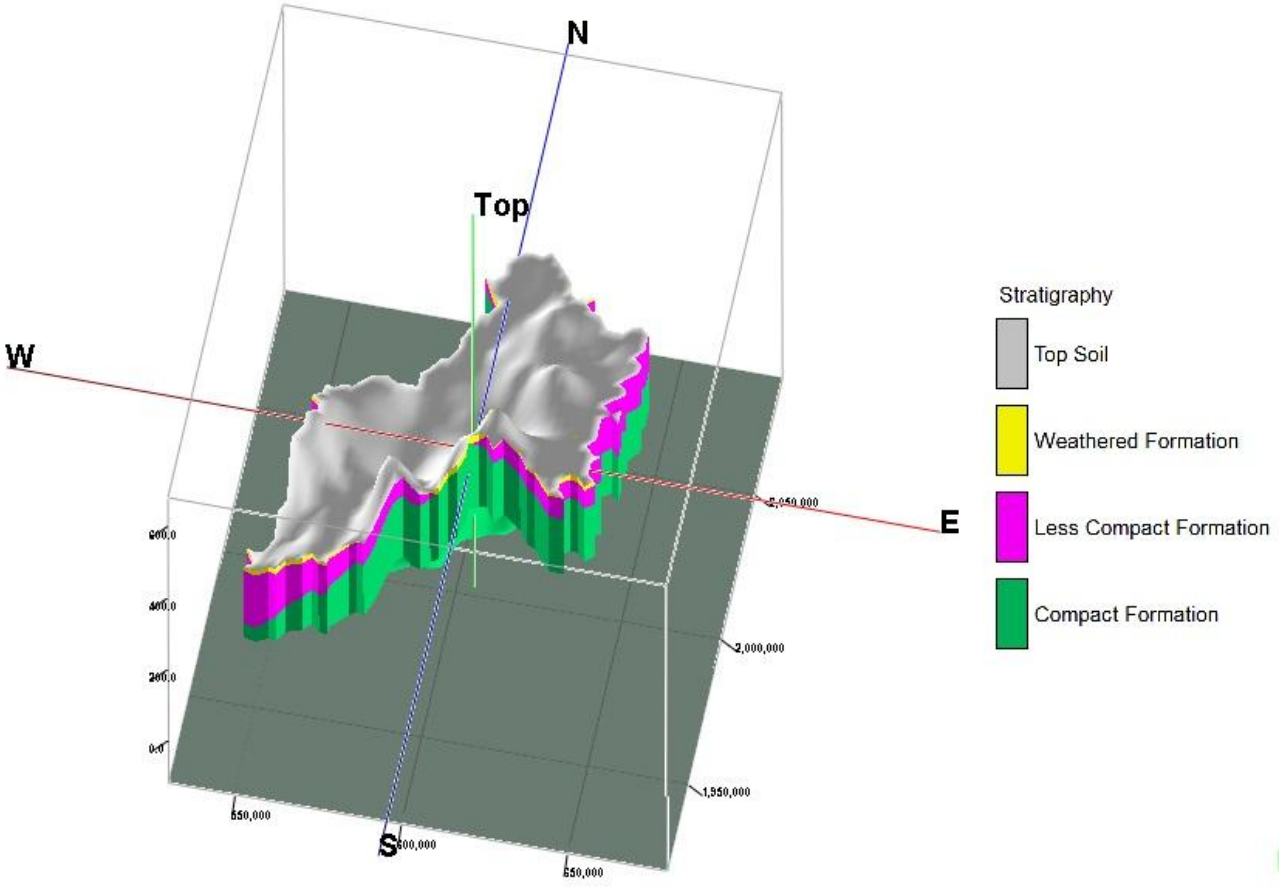



**Fig. 3.13 : 3D aquifer disposition in Malkangiri District**

# 4 GROUND WATER RESOURCES

The dynamic ground water resource of the district was jointly carried out in 2020 by Central Ground Water Board (CGWB) and Ground Water Survey and Investigation (GWS&I) adopting the methodology recommended by GEC 2015. The ground water resource can be aquifer wise divided into Dynamic and Static resource. The dynamic resource is the part of resource within the water level fluctuation zone which is also the annual replenishable resource. The resource below the water level fluctuation zone is termed as the In-storage (Static) resource. Mainly the water level fluctuation method was adopted for calculation of recharge. The block-wise resource of the aquifer mapping blocks as on 2020 is given below in **Table 4.1.**

**Table 4.1:Dynamic Ground Water Resources of Aquifer-I in Malkangiri District. (2020)**

| Sl No | Block | Net Annual Ground Water Availability | Existing Gross Ground Water Draft for Irrigation | Existing Gross Ground Water Draft for domestic & Industrial Supply | Existing Gross Ground Water Draft for all uses | Annual ground water allocation for domestic water supply as on 2025 | Net Ground Water Availability for future irrigation development | Stage of Ground Water Development |
|---|---|---|---|---|---|---|---|---|
| | | (Ham) | (Ham) | (Ham) | (Ham) | (Ham) | (Ham) | ( % ) |
| 1 | Kalimela | 6859.4 | 762.12 | 347.206 | 1109.33 | 382.36 | 5714.92 | 16.17 |
| 2 | Khairaput | 1469.68 | 242.38 | 134.114 | 376.49 | 155.09 | 1072.21 | 25.61 |
| 3 | Korukunda | 6870.38 | 687.08 | 404.620 | 1091.7 | 435.37 | 5747.93 | 15.88 |
| 4 | Kudumulugu | 2666.56 | 177.58 | 226.934 | 404.52 | 257.1 | 2231.87 | 15.17 |
| 5 | Malkangiri | 4590.73 | 484.3 | 408.093 | 892.4 | 485.79 | 3620.63 | 19.43 |
| 6 | Mathili | 3526.77 | 379.62 | 290.411 | 670.03 | 326.94 | 2820.21 | 18.99 |
| 7 | Podia | 4484.11 | 315.56 | 182.909 | 498.48 | 214.13 | 3954.41 | 11.11 |
| | **Total** | 30467.63 | 3048.64 | 1994.29 | 5042.95 | 2256.78 | 25162.18 | |

The combined net ground water available is 30467.6 Ham and gross annual draft is 5042.95 Ham. The stage of ground water development is minimum for Podia block which is 11.11 %. The highest ground water development is in Khairaput block that is 25.61 % .All the Blocks of the District comes under safe category.The In-storage resources are calculated for Aquifer-I and II separately. However the semi-confined to confined deeper aquifers have linkage to the unconfined aquifer through the fractures and receive continuous recharge. The In-storage ground water resources of Aquifer-I are given in **Table 4.2** and the total resources of Aquifer-I in **Table 4.3** below.

**Table 4.2: In-Storage Ground Water Resources of Aquifer-I in Malkangiri District.**

| Sl No | Block | Assessment Area | Bottom Depth of Aquifer | Average Pre-monsoon Water Level | Total Effective Saturated Thickness 5% of (2-3) | Average Specific Yield | In Storage Ground Water Resources [(1)*(4)*(5)] |
|---|---|---|---|---|---|---|---|
| | | (Ha) (1) | (mbgl) (2) | (mbgl) (3) | (m) (4) | (5) | (Ham) (6) |
| 1 | Kalimela | 124817 | 30.00 | 6.5 | 1.175 | 0.03 | 4399.799 |
| 2 | Khairaput | 42182 | 30.00 | 5.4 | 1.23 | 0.03 | 1556.516 |
| 3 | Korukunda | 88640 | 30.00 | 4.8 | 1.26 | 0.03 | 3350.592 |
| 4 | Kudumulugu | 109564 | 30.00 | 5.5 | 1.225 | 0.03 | 4026.477 |
| 5 | Malkangiri | 66309 | 30.00 | 6.8 | 1.16 | 0.03 | 2307.553 |
| **6** | Mathili | 46717 | 30.00 | **5.2** | 1.24 | 0.03 | 1737.872 |
| **7** | Podia | 46717 | 30.00 | **6.4** | 1.18 | 0.03 | 1653.782 |
| | **Total** | 524946 | | | | | 19032.59 |

**Table 4.3: Total Ground Water Resources of Aquifer-I in Malkangiri District. (2020)**

| Sl No | Block | Dynamic | In Storage | Total Ground |
|---|---|---|---|---|
| 1 | Kalimela | 6859.4 | 4399.799 | 11259.2 |
| 2 | Khairaput | 1469.68 | 1556.516 | 3026.196 |
| 3 | Korukunda | 6870.38 | 3350.592 | 10220.97 |
| 4 | Kudumulugumal | 2666.56 | 4026.477 | 6693.037 |

| | | | | |
|---|---|---|---|---|
| 5 | Malkangiri | 4590.73 | 2307.553 | 6898.283 |
| 6 | Mathili | 3526.77 | 1737.872 | 5264.642 |
| 7 | Podia | 4484.11 | 1653.782 | 6137.892 |
| | **Total** | 30467.63 | 19032.59 | 49500.22 |

The in-storage ground water resource in Aquifer- II i.e. the semi-confined to confined aquifer is shown in **Table 4.4**.

**Table 4.4: In-Storage Ground Water Resources of Aquifer-II in Malkangiri District. (2020)**

| Sl No | Block | Assessment Area | Bottom Depth of Aquifer | Average Pre-monsoon Water Level | Total Effective Saturated Thickness 5% of (2-3) | Average Specific Yield | In Storage Ground Water Resources [(1)*(4)*(5)] |
|---|---|---|---|---|---|---|---|
| | | (Ha) -1 | (mbgl) -2 | (mbgl) -3 | (m) -4 | -5 | (Ham) -6 |
| 1 | Kalimela | 124817 | 163 | 6.5 | 7.825 | 0.004 | 3906.7721 |
| 2 | Khairaput | 42182 | 146 | 5.4 | 7.03 | 0.004 | 1186.15784 |
| 3 | Korukunda | 88640 | 137 | 4.8 | 6.61 | 0.004 | 2343.6416 |
| 4 | Kudumulugumal | 109564 | 160 | 5.5 | 7.725 | 0.004 | 3385.5276 |
| 5 | Malkangiri | 66309 | 174 | 6.8 | 8.36 | 0.004 | 2217.37296 |
| 6 | Mathili | 46717 | 137 | **5.2** | 6.59 | 0.004 | 1231.46012 |
| 7 | Podia | 46717 | 149 | **6.4** | 7.13 | 0.004 | 1332.36884 |
| | **Total** | 524946 | | | | | 15603.30106 |

# 5 GROUND WATER RELATED ISSUES

The highly diversified occurrence and considerable variations in the availability and utilization of groundwater makes its management a challenging task. Scientific development and management strategy for groundwater has become imperative to avert the looming water crisis. In this context, various issues such as, prioritization of areas for development of groundwater resources vis-a-vis its availability, augmentation of groundwater through rainwater harvesting and artificial recharge, pricing and sectoral allocation of resources and participation of the stakeholders must be considered.

## 5.1 Under Utilisation of Ground Water Resources

As per the ground water resource estimated jointly by CGWB and State Govt. in 2020, all Blocks of Malkangiri District comes under safe category.Thus there is ample scope exists for further ground water development in all Blocks. The Stages of ground water development in these Blocks varies from 11.12% to 25.62% . There is scope for extraction of water available from the phreatic aquifer keeping the percentage of ground water development within 60%.

## 5.2 Ground Water Problem in Hilly Areas

Malkangiri district receives adequate rainfall and the normal annual rainfall is 1818mm. The eastern parts of the district are mainly of of hilly terrain and thus high run off zone. They act as recharge zones as well as good reservoir of ground water. Once they get saturated, during monsoon the excess water flows as run off and base flow. During the post-monsoon period, the thin weathered zones soon loose the entire storage water due to base flow. So there is scarcity of water in these areas in lean and summer season.

## 5.3 Depleted Water Level in Phreatic Aquifer

The Depth to water level in pre-monsoon period varies from 2.9 mbgl (Chitapari) to 9.75 mbgl (MV-7) the average being 5.20mbgl. In general, the study area has the depth to water level in between 4to6 mbgl during the pre-monsoon. Depth to water level in post-monsoon period varies from 0.92 mbgl (Mathili) to 5.75 mbgl (Bhejaguda) the average being 1.97 mbgl. The depth to water level of the study area during post-monsoon is in general within 0-2 mbgl. The water level fluctuation varies from 0.99 mbgl (MV-37) to 4.88mbgl (Mathili) the average being 2.99mbgl. The general range of fluctuation in water level in the study area is between 2-4m. The shallow post-

monsoon water level along with fluctuation pattern indicates that the annual replenishment of phreatic aquifer due to monsoon rainfall is adequate in the district but deeper summer level is due to rapid dewatering of the phreatic aquifer . The deeper level during the pre-monsoon indicates ground water scarcity in the areas during the summer months.

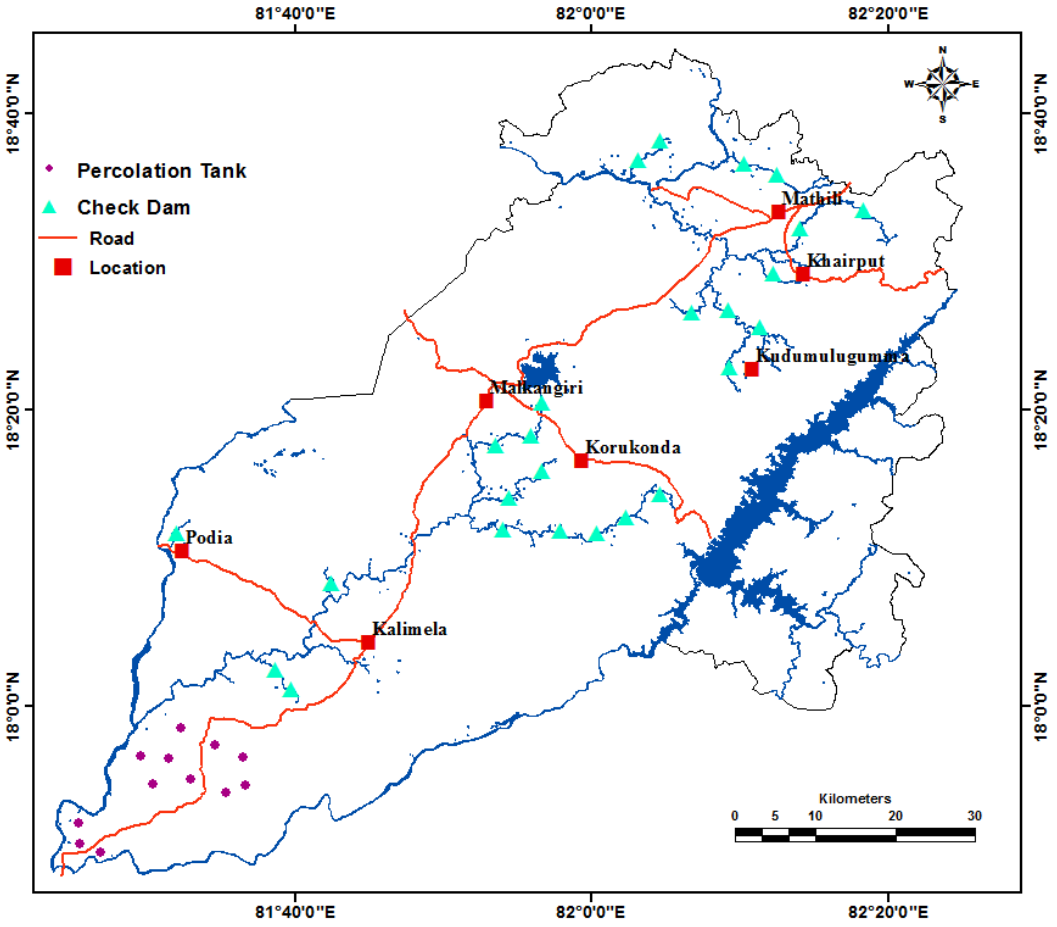



**Fig: 5.1 Proposed sites for Artificial Recharge structures in Malkangiri District.**

# 6 MANAGEMENT STRATEGIES

## 6.1 Management Plan for Under-Utilisation of Ground Water

**Proposed Interventions:** There is very little scope for the demand side interventions as the district experiences acute shortage of water during the lean seasons. However to meet the irrigation requirement in relatively water deficient areas, efficient irrigation techniques such as drip and sprinkler should be practised. No other demand side intervention is feasible.

For the supply side intervention, further development of ground water resource is possible as there is sufficient scope for this is available in the district as the present ground water development ranges from 11.12% to 25.62% in the district. The quantum of water available for extraction from the phreatic aquifer is thus calculated, keeping the percentage of ground water development within 60%. The same is shown in the **Table 5.1**.

**Table 5.1: Ground Water Development Potential of Malkangiri District.**

| Block | Net Ground Water Availability (Ham) | Stage of Ground Water Development (% in 2020) | Present Ground Water Draft (Ham) | Ground Water draft at 60% Stage of development (Ham) | Surplus Ground Water at Present Stage of development (Ham) | Number of BW/ STW Recommended in Each block (assuming unit draft as 2.21 ham per structure per year) 50% | Number of DW Recommended in Each block( assuming unit draft as 0.26 ham per structure per year) 50% |
|---|---|---|---|---|---|---|---|
| | | | | (1)*0.6 | (4)-(3) | | |
| | -1 | -2 | -3 | -4 | -5 | -6 | -7 |
| Kalimela | 6859.4 | 16.17241 | 1109.33 | 4115.64 | 3006.31 | 680 | 5781 |
| Khairaput | 1469.68 | 25.61714 | 376.49 | 881.808 | 505.318 | 114 | 972 |
| Korukunda | 6870.38 | 15.88995 | 1091.7 | 4122.228 | 3030.528 | 686 | 5828 |
| Kudumulugumal | 2666.56 | 15.17011 | 404.52 | 1599.936 | 1195.416 | 270 | 2299 |
| Malkangiri | 4590.73 | 19.43917 | 892.4 | 2754.438 | 1862.038 | 421 | 3581 |
| Mathili | 3526.77 | 18.9984 | 670.03 | 2116.062 | 1446.032 | 327 | 2781 |
| Podia | 4484.11 | 11.11659 | 498.48 | 2690.466 | 2191.986 | 496 | 4215 |
| Total | 30467.6 | | 5042.95 | 18280.58 | 13237.63 | 2995 | 25457 |

**Structures Feasible:**The feasible ground water structures and probable yield in different geological units in Nuapada district is given below:

*Granite and Granite Gneiss*: Ground water occurs in weathered horizon in unconfined condition, yield of dug well upto 50 m3/day; Deeper fracture zones - yield of bore wells within 2.0 lps, occasionally upto 5 lps.

*Charnockites*: Ground water in weathered zone in unconfined condition, yield of dug wells upto 30 $m^3$/day; Deeper fracture zones- yield of bore wells less than 1 lps

*Khondalites:* Ground water in weathered zone in unconfined condition, yield of dug wells upto 50 $m^3$/day; Deeper fracture zones- yield of bore wells less than 1 lps

### 6.2 Management Plan for Scarcity of Water in Hilly Areas

Due to uneven and hilly terrain and lower ground water recharge and storage capacity, there are many areas where the phreatic aquifer quickly desaturates causing water scarcity during non-monsoon periods. To enhance the ground water availability, suitable measures for augmentation of monsoon recharge, should be taken up. In the foot hill regions, contour trenching alongwith gabion structures should be constructed to arrest the surface runoff and improve rainfall recharge.

### 6.3 Management Plan for Depleted Water Level in Phreatic Aquifer

The problem of water level depletion in the phreatic aquifers can be addressed through artificial recharge through various water conservation structures. However, as already discussed, water level between 3- 5 mbgl during post-monsoon period in most of the district shows adequate natural recharge and replenishment of phreatic aquifer.But there is still a lot of scope for artificial recharge to address the sustenance of phreatic aquifer to address the summer period water crisis due to deepening of water level. All the existing $1^{st}$ order streams are suitable for construction of nala bunds.Similarly $2^{nd}$ and $3^{rd}$ order drainages are suitable for the construction of check dams.For the mitigation of deeper water level areas in thedistrict, the following measures can be taken up:

1.Contour trenching, staggered trenching and gabion structures to arrest the surface runoff in foot-hill areas.

2.Construction of farm ponds and renovation of existing water bodies.

The proposed sites for artificial recharge structures are shown in **Fig. 5.1**

**6.4 Organising Public interaction programmes(PIPs)**

To create awareness among local public, farmers and various stake holders of Ground water CGWB has organized various PIPs and mass awareness programmes in the state of Odisha .In this context one public interaction programmes has been organized at Malkangiri in Malkangiri District to discuss about local issues,sustainable Ground water development and management, water conservation,Rain water Harvesting and Artificial Recharge techniques.

# 7 SUMMARY AND RECOMMENDATIONS

## 7.1 Summary

National Aquifer Mapping Programme (NAQUIM) was taken up for detailed hydrogeological investigation, data-gap analysis and Aquifer Mapping and Management in the district of Malkangiri, covering seven blocks namely Kalimela, Khairput, Korukonda, Kudumulguma, Malkangiri, Mathili and Podia. during the period 2021-22 The following are the summarised details.

1 The district lies between north latitudes 17°47'58" and 18°44'18" and East longitudes 81°23'23" and 82°27'05" falling in Survey of India Degree sheet Nos. 65 F,G,J. The district covers an area of 5791 Sq.Km.The district is bordered in the North and West by Bastar district of Chhatishgarh and in the south by Khammam and East Godavari districts of Andhra Pradesh, in the east by Koraput district, Orissa The Malkangiri town, the district headquarter is approachable from adjacent districts through State Highways. The mappable area under NAQUIM is 3510 sq. Km,.

2 The average annual rainfall of the district is 1818 mm,Based on the average annual rainfall for 10 yrs(2012 – 2021)it was observed that during the last 10 years, from 2012 to 2021, the highest rainfall amounting 3067.7 mm occurred in Korukonda block in 2019 and the lowest annual of 984.5 mm. in Podia block in 2014.

3 The forest area is 14.64% of total geographical area.The net sown area of the district is 106964 ha and constitute 68.07 % of the total Agriculture area, with cropping intensity of 156.0 %.

4 Two types of soil are found in the district viz. Ultiisols and Alfisols.

5 The total cropped area is about 1.99 lakh ha out of which 0.91 lakh ha (45.6% of TCA) is irrigated and 1.08 lakh ha (54.4% of TCA) is under rainfed area .

6 There are two major sources of water available in Malkangiri district,namely surface irrigation and ground water irrigation. The surface irrigations include Canal (Major & Medium Irrigation), minor irrigation, lift irrigation, Various Water Bodies including Rain Water Harvesting, Untreated Effluent and Perennial sources of

water. For the ground water includes Open well (Dug well), Deep Tube Well, Medium Tube Well (Bore well), Shallow Tube Wells respectively. All the area is divided as per seasons like Kharif and Rabi. Based on the season, the area under canal water in Kharif is 57901 ha, for Rabi season is 31903 ha,for summer season 1625ha and the total area under canal water is 91429 Ha. The total area available through minor irrigation is 2659 Ha, and the area under lift irrigation is 10811 Ha. The area under the perennial sources of water extents is 1324Ha. Similarly, the area under open well is 502 Ha, Bore well is 4391 Ha.Total area under surface water irrigation is 108580ha and area under ground water irrigation is4893ha

7 The district is underlain by Granite-gneiss and its variants,of Easern-ghat group and Chhattisgarh Group a small patch of alluvium and laterites.

8 The district is occupied by the consolidated formations comprising Granites, Granite gneiss, Quartzites, Khondalites and Charnockites, . These rocks are very hard and compact, and lack primary porosity. Ground water is stored mainly in the secondary porosity resulting from weathering and fracturing of the rocks. The aquifer materials are highly heterogeneous in character showing both vertical and lateral variations. The weathered residum form the main repositories of ground water, which occurs under water table conditions and circulates through deeper fractures and fissures. Ground water occurs under confined to semi-confined condition in the deeper fractured zones. The water yielding capacity of fractured rocks largely depends on the extent of fracturing, openness and size of fractures and extent of their interconnections into the near surface weathered zone.The Unconsolidated Formation includes alluvial deposits of recent origin occur as thin discontinuous patches along the prominent drainage channels. These mainly consist of silt, sand with gravel & pebble, which form potential shallow aquifers tapped through dug wells.

9 CGWB has constructed 36 EWs and 05 OWs during the ground water exploration programme. For the monitoring of ground water level and quality CGWB has established 35 National Hydrograph Network Stations in the district.

10 The Depth to water level in pre-monsoon period varies from 2.9 mbgl (Chitapari) to 9.75

mbgl (MV-7) the average being 5.20mbgl. In general, the study area has the depth to water level in between 4to6 mbgl during the pre-monsoon. Depth to water level in post-monsoon period varies from 0.92 mbgl (Mathili) to 5.75 mbgl (Bhejaguda) the average being 1.97 mbgl. The depth to water level of the study area during post-monsoon is in general within 0-2 mbgl. The water level fluctuation varies from 0.99 mbgl (MV-37) to 4.88mbgl (Mathili) the average being 2.99mbgl. The general range of fluctuation in water level in the study area is between 2-4m. The long term trend analysis indicates that out of 11 stations, 8(72.72%) show falling trend and 3 stations (27.28%) show rising trend in pre-monsoon. In the post-monsoon out of 11 stations 05(45.45%) show rising trend and 6(54.55%) show falling trend.

11 Based on the chemical analysis of water samplesfrom different sources, it was observed that, almost all chemical parameters lie within permissible limit for drinking and irrigation purposes.

12 The estimated dynamic ground water resource is 30467.6 Ham and the stages of development of ground water range from 11.1 to 25.6 %.All the blocks of the Malkangiri district comes under safe category.

## 7.2 Recommendations

For a sustainable ground water development in the area, a systematic, economically sound and politically feasible framework for groundwater management is required. Considering the local physiographical and hydrogeological set up the following ground water management strategy is suggested.

1 As there is large scope for development of ground water, suitable schemes may be launched for development to boost agricultural production in the district. The financial institutions should generously finance such schemes.

2 Diversification of crops from paddy to non paddy crops like oil seed, pulses and vegetables during rabi season at least in the high land and part of medium land areas is essential.

3 Priority should be given to the phreatic aquifer for extraction of ground water through large diameter dugwells and dug cum borewells at hydrogeologically suitable locations. Selection of proper site for drilling of bore wells, based on the favourable hydrogeological conditions has to be done.

4 For the irrigation requirement in relatively water deficient areas, efficient irrigation techniques such as drip and sprinkler should be practiced.

5 Conjunctive use of surface and ground water is must in the command areas.

6 In the foot hill regions, contour trenching, staggered trenching along with gabion structures should be constructed to arrest the surface runoff and improve rainfall recharge

7 Artificial recharge projects may be taken up in the district especially in hard rock areas for augmentation of ground water resources through construction of percolation tanks, check dams, farm ponds.

8 Rain water harvesting should be adopted in all Govennment and public buildings.

9 The farmers should be educated through agricultural extension services for adopting suitable cropping patterns for optimal utilization of available ground water and surface water resources.

10 Industrial waste waters and effluents should be treated and disposed off properly under an effective monitoring mechanism.

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**Annexure-1 :INTERPRETED VES RESULTS IN PARTS OF MALKANGIRI DISTRICT**

| **Malkangiri District_HR** | | | **WAPCOS Ltd.** | | **PROJECT: VERTICAL ELECTRICAL SOUNDING(VES) IN ODISHA STATE DATA GENERATION** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **S.No.** | **LOCATION** | **Block** | **VES NO.** | **EASTING/** | **NORTHING** | **Direct interpretion of VES layer parameters by software** | | | | **Inferred lithology** | **Aquifer Charectristics** | | |
| | | | | | | **Layer** | **Resisitivity (ohm.m)** | **Thickness (m)** | **Depth (m)** | | **Aquifer** | **Depth Range(m)** | **Inferred aquifer water quality** |
| | | | | **Longitude** | **Latitude** | | | | | | | | |
| 1 | Naliguda | Khairput | 408 | 44Q0626003 | 2037947 | 1 | 167 | 2.0 | 2.0 | Top Soil | | | |
| | | | | | | 2 | 31 | 2.7 | 4.7 | Weathered Formation | Aquifer | 2-4.7 | Potable |
| | | | | | | 3 | 894 | 74.7 | 79.4 | Compact formation | | | |
| | | | | | | 4 | VH | | | Compact formation | | | |
| 2 | Khairput | Khairput | 409 | 44Q0630320 | 2044141 | 1 | 18 | 1.1 | 1.1 | Top Soil | | | |
| | | | | | | 2 | 39 | 9.2 | 10.3 | Weathered Formation | Aquifer | 1.1-10.3 | Potable |
| | | | | | | 3 | VH | 40.8 | 51.1 | Compact formation | | | |
| | | | | | | 4 | 279 | 143.2 | 194.3 | Less Compact formation | Aquifer | 51.1-194.3 | Potable |
| | | | | | | 5 | VH | | | Compact formation | | | |
| 3 | Dengambo | Khairput | 410 | 44Q0647591 | 2052460 | 1 | 70 | 2.0 | 2.0 | Top Soil | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2 | 28 | 12.8 | 14.8 | Weathered Format5ion | Aquifer | 2-14.8 | Potable |
| | | | | | | 3 | VH | | | Compact formation | | | |
| | | | | | | 4 | | | | | | | |
| 4 | Kuriguda | Khairput | 411 | 44Q0633370 | 2046027 | 1 | 171 | 0.4 | 0.4 | Top Soil | | | |
| | | | | | | 2 | 40 | 5.6 | 6.0 | Weathered Formation | | | |
| | | | | | | 3 | 14 | 8.3 | 14.3 | Weathered Formation | Aquifer | 0.4-14.3 | Potable |
| | | | | | | 4 | VH | 8.0 | 22.3 | Compact formation | | | |
| | | | | | | 5 | 20 | | | Less Compact formation | Aquifer | 22.3- ? | Potable |
| 5 | Dabuguda | Khairput | 412 | 44Q0635098 | 2048985 | 1 | 134 | 1.3 | 1.3 | Top Soil | | | |
| | | | | | | 2 | 70 | 4.6 | 5.9 | Weathered Formation | Aquifer | 1.3-5.9 | Potable |
| | | | | | | 3 | 115 | 17.9 | 23.8 | Less Compact formation | Aquifer | 5.9-23.8 | Potable |
| | | | | | | 4 | VH | | | Compact formation | | | |
| 6 | Mudulipada | Khairput | 413 | 44Q0637869 | 2040052 | 1 | 131 | 2.3 | 2.3 | Top Soil | | | |
| | | | | | | 2 | 67 | 7.4 | 9.7 | Weathered Formation | Aquifer | 2.3-9.7 | Potable |
| | | | | | | 3 | 184 | 19.7 | 29.4 | Less Compact formation | Aquifer | 9.7-29.4 | Potable |
| | | | | | | 4 | 692 | 283.4 | 312.8 | Less Compact formation | Aquifer | 29.4-312.8 | Potable |
| | | | | | | 5 | VH | | | Compact formation | | | |
| 7 | Dalapatigud a | Mathili | 414 | 44Q0628565 | 2059670 | 1 | 93 | 1.5 | 1.5 | Top Soil | | | |
| | | | | | | 2 | 64 | 11.5 | 13.0 | Weathered Formation | Aquifer | 1.5-13 | Potable |
| | | | | | | 3 | 16 | 13.0 | 26.0 | Less Compact | Aquif | 13-26 | Potabl |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | formation | er | | e |
| | | | | | | 4 | VH | | | Compact formation | | | |
| 8 | Kaliaguda | Mathili | 415 | 44Q0613117 | 2054647 | 1 | 40 | 0.48 | 0.5 | Top Soil | | | |
| | | | | | | 2 | 10 | 9.96 | 10.4 | Weathered Formation | Aquif er | 0.5-10.4 | Potabl e |
| | | | | | | 3 | 320 | | | Less Compact formation | | | |
| 9 | Pangam | Mathili | 416 | 44Q0619928 | 2048578 | 1 | 55 | 0.9 | 0.9 | Top Soil | | | |
| | | | | | | 2 | 23 | 2.4 | 3.2 | Weathered Formation | Aquif er | 0.9-3.2 | Potabl e |
| | | | | | | 3 | 102 | 19.9 | 23.1 | Less Compact formation | Aquif er | 3.2-23.1 | Potabl e |
| | | | | | | 4 | 866 | | | Compact formation | | | |
| 10 | Mathili | Mathili | 417 | 44Q0627296 | 2052809 | 1 | 48 | 0.5 | 0.5 | Top Soil | | | |
| | | | | | | 2 | 8 | 5.5 | 6.0 | Weathered Formation | Aquif er | 0.5-6 | Potabl e |
| | | | | | | 3 | 5 | 9.5 | 15.4 | Weathered Formation | | | |
| | | | | | | 4 | 215 | | | Less Compact formation | Aquif er | 15.4- ? | Potabl e |
| | | | | | | | | | | | | | |
| 11 | Kamarpali | Mathili | 418 | 44Q0595602 | 2061336 | 1 | 242 | 0.6 | 0.6 | Top Soil | | | |
| | | | | | | 2 | 113 | 3.4 | 4.0 | Semi Weathered Formation | | | |
| | | | | | | 3 | 140 | 20.3 | 24.3 | Less Compact formation | Aquif er | 4-24.3 | Potabl e |
| | | | | | | 4 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 12 | Temurapali | Mathili | 419 | 44Q0608956 | 2062646 | 1 | 22 | 0.9 | 0.9 | Top Soil | | | |
| | | | | | | 2 | 9 | 1.0 | 1.9 | Top Soil | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 3 | 61 | 2.1 | 4.1 | Weathered Formation | Aquifer | 1.9-4.1 | Potable |
| | | | | | | 4 | 27 | 15.5 | 19.6 | Less Compact formation | Aquifer | 4.1-19.6 | Potable |
| | | | | | | 5 | 827 | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 13 | Bara | Mathili | 420 | 44Q0618951 | 2066946 | 1 | 35 | 1.0 | 1.0 | Top Soil | | | |
| | | | | | | 2 | 20 | 9.1 | 10.1 | Weathered Formation | Aquifer | 1.0-10.1 | Potable |
| | | | | | | 3 | 317 | 38.4 | 48.5 | Less Compact formation | Aquifer | 10.1-48.5 | Potable |
| | | | | | | 4 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 14 | Jharapali | Malkangiri | 422 | 44Q0596586 | 2040887 | 1 | 9 | 1.1 | 1.1 | Top Soil | | | |
| | | | | | | 2 | 3 | 1.0 | 2.2 | Top Soil | | | |
| | | | | | | 3 | VH | 15.4 | 17.6 | Compact formation | | | |
| | | | | | | 4 | 454 | | | Less Compact formation | Aquifer | 17.6- ? | Potable |
| | | | | | | | | | | | | | |
| 15 | Pandhiripani | Malkangiri | 423 | 44q0608067 | 2039724 | 1 | 99 | 0.5 | 0.5 | Top Soil | | | |
| | | | | | | 2 | 21 | 13.1 | 13.6 | Weathered Formation | Aquifer | 0.5-13.6 | Potable |
| | | | | | | 3 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 16 | Baraja | Malkangiri | 424 | 44Q0614513 | 2036886 | 1 | 76 | 10 | 10.4 | Weathered Formation | Aquifer | 0-10.4 | Potable |
| | | | | | | 2 | VH | 253 | 263.4 | Compact formation | | | |
| | | | | | | 3 | VH | | | Compact formation | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | Simaguda | Malkangiri | 425 | 44Q0596906 | 2032938 | 1 | 67 | 1.4 | 1.4 | Top Soil | | | |
| | | | | | | 2 | 14 | 6.9 | 8.2 | Weathered Formation | Aquifer | 1.4-8.2 | Potable |
| | | | | | | 3 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 18 | Malkangiri | Malkangiri | 426 | 44Q0592344 | 2032200 | 1 | 58 | 0.7 | 0.7 | Top Soil | | | |
| | | | | | | 2 | 106 | 15.9 | 16.6 | Weathered Formation | Aquifer | 0.7-16.6 | Potable |
| | | | | | | 3 | VH | 18.2 | 34.8 | Compact formation | | | |
| | | | | | | 4 | 662 | 86.0 | 120.8 | Less Compact formation | Aquifer | 34.8-120.8 | Potable |
| | | | | | | 5 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 19 | Akuru | Malkangiri | 427 | 44Q0601054 | 2050385 | 1 | 70 | 0.8 | 0.8 | Top Soil | | | |
| | | | | | | 2 | 25 | 2.9 | 3.7 | Top Soil | | | |
| | | | | | | 3 | 48 | 19.3 | 23.0 | Weathered Formation | Aquifer | 3.7-23 | Potable |
| | | | | | | 4 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 20 | Adamunda | Malkangiri | 428 | 44Q0612435 | 2031579 | 1 | 27 | 3.2 | 3.2 | Top Soil | | | |
| | | | | | | 2 | 13 | 4.3 | 7.5 | Weathered Formation | Aquifer | 3.2-7.5 | Potable |
| | | | | | | 3 | 899 | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 21 | Koilpari | Malkamgiri | 429 | 44Q0601804 | 2024699 | 1 | 91 | 1.0 | 1.0 | Top Soil | | | |
| | | | | | | 2 | 13 | 4.5 | 5.4 | Weathered Formation | Aquifer | 1.0-5.4 | Potable |
| | | | | | | 3 | VH | | | Compact formation | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22 | MunusKonda R.F | Malkangiri | 430 | 44Q0603162 | 2028976 | 1 | 24 | 0.7 | 0.7 | Top Soil | | | |
| | | | | | | 2 | 13 | 2.1 | 2.8 | Top Soil | | | |
| | | | | | | 3 | 239 | 16.3 | 19.1 | Semi Weathered Formation | Aquifer | 2.8-19.1 | Potable |
| | | | | | | 4 | 767 | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 23 | Mongo | Malkangiri | 431 | 44Q0601435 | 2045821 | 1 | 56 | 1.2 | 1.2 | Top Soil | | | |
| | | | | | | 2 | 76 | 6.8 | 8.0 | Weathered Formation | Aquifer | 1.2-8 | Potable |
| | | | | | | 3 | 268 | 80.5 | 88.5 | Less Compact formation | Aquifer | 8-88.5 | Potable |
| | | | | | | 4 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 24 | Balimela | Korkunda | 432 | 44Q0611279 | 2013382 | 1 | 27 | 1.3 | 1.3 | Top Soil | | | |
| | | | | | | 2 | 3 | 2.0 | 3.2 | Top Soil | | | |
| | | | | | | 3 | VH | 8.2 | 11.5 | Compact formation | | | |
| | | | | | | 4 | 468 | | | Less Compact formation | Aquifer | 11.5- ? | Potable |
| | | | | | | | | | | | | | |
| 25 | Haripur | Korkunda | 433 | 44Q0611537 | 2002474 | 1 | 55 | 2.3 | 2.3 | Top Soil | | | |
| | | | | | | 2 | 99 | 10.9 | 13.2 | Weathered Formation | Aquifer | 2.3-13.2 | Potable |
| | | | | | | 3 | 65 | 30.9 | 44.1 | Less Compact formation | Aquifer | 13.2-44.1 | Potable |
| | | | | | | 4 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 26 | Bandukiguda | Korkunda | 434 | 44Q0584684 | 2035267 | 1 | 53 | 0.5 | 0.5 | Top Soil | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 2 | 180 | 0.9 | 1.3 | Top Soil | | | |
| | | | | | | 3 | 16 | 2.2 | 3.5 | Weathered Formation | Aquifer | 1.3-3.5 | Potable |
| | | | | | | 4 | 220 | 14.3 | 17.8 | Less Compact formation | Aquifer | 3.5-17.8 | Potable |
| | | | | | | 5 | 608 | 219 | 236.8 | Compact formation | | | |
| | | | | | | 6 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 27 | Bankiguda | Korkunda | 435 | 44Q0589396 | 2031351 | 1 | 126 | 1.8 | 1.8 | Top Soil | | | |
| | | | | | | 2 | 26 | 3.8 | 5.6 | Weathered Formation | Aquifer | 1.8-5.6 | Potable |
| | | | | | | 3 | VH | 6.5 | 12.1 | Compact formation | | | |
| | | | | | | 4 | 428 | | | Less Compact formation | Aquifer | 12.1- ? | Potable |
| | | | | | | | | | | | | | |
| 28 | Chitapari | Korkunda | 436 | 44Q0609786 | 2018475 | 1 | 191 | 0.9 | 0.9 | Top Soil | | | |
| | | | | | | 2 | 52 | 5.8 | 6.8 | Weathered Formation | Aquifer | 0.9-6.8 | Potable |
| | | | | | | 3 | 158 | 12.2 | 19.0 | Less Compact formation | Aquifer | 6.8-19 | Potable |
| | | | | | | 4 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 29 | Thenthuliguda | Korkunda | 437 | 44Q0603853 | 2010385 | 1 | 66 | 0.3 | 0.3 | Top Soil | | | |
| | | | | | | 2 | 9 | 4.7 | 4.9 | Weathered Formation | Aquifer | 0.3-4.9 | Potable |
| | | | | | | 3 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 30 | Sukraguda | Korkunda | 438 | 44Q0585995 | 2019298 | 1 | 32 | 0.9 | 0.9 | Top Soil | | | |

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| | | | | | | 2 | 10 | 1.0 | 1.9 | Top Soil | | | |
| | | | | | | 3 | 36 | 6.8 | 8.7 | Weathered Formation | Aquifer | 1.9-8.7 | Potable |
| | | | | | | 4 | 111 | 9.7 | 18.4 | Less Compact formation | Aquifer | 8.7-18.4 | Potable |
| | | | | | | 5 | 471 | 166.0 | 184.4 | Less Compact formation | Aquifer | 18.4-184.4 | Potable |
| | | | | | | 6 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 31 | Titango | Korkunda | 439 | 44Q0589396 | 2031350 | 1 | 1237 | 1.0 | 1.0 | Top Soil | | | |
| | | | | | | 2 | 2653 | 0.8 | 1.8 | Top Soil | | | |
| | | | | | | 3 | 556 | 1.6 | 3.4 | Top Soil | | | |
| | | | | | | 4 | VH | 2.7 | 6.1 | Compact formation | | | |
| | | | | | | 5 | 747 | 37.2 | 43.3 | Compact formation | | | |
| | | | | | | 6 | 184 | 27.6 | 70.9 | Less Compact formation | Aquifer | 43.3-70.9 | Potable |
| | | | | | | 7 | 855 | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 32 | Dudimetta | Korkunda | 440 | 44Q0592738 | 2011589 | 1 | 18 | 2.2 | 2.2 | Top Soil | | | |
| | | | | | | 2 | 41 | 8.4 | 10.6 | Weathered Formation | Aquifer | 2.2-10.6 | Potable |
| | | | | | | 3 | 437 | 279.1 | 289.7 | Less Compact formation | Aquifer | 10.6-290 | Potable |
| | | | | | | 4 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 33 | Tumusapali | Korkunda | 441 | 44Q0597527 | 2021490 | 1 | 575 | 0.3 | 0.3 | Top Soil | | | |
| | | | | | | 2 | 277 | 4.6 | 4.9 | Semi Weathered Formation | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 3 | 121 | 2.5 | 7.4 | Semi Weathered Formation | | | |
| | | | | | | 4 | 383 | 91.3 | 98.7 | Less Compact formation | Aquifer | 7.4-99 | Potable |
| | | | | | | 5 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| 34 | Chedipali | Korkunda | 442 | 44Q0592178 | 2020353 | 1 | 28 | 0.9 | 0.9 | Top Soil | | | |
| | | | | | | 2 | 13 | 3.2 | 4.1 | Weathered Formation | Aquifer | 0.9-4.1 | Potable |
| | | | | | | 3 | 76 | 14.2 | 18.3 | Weathered / Less Compact Formation | Aquifer | 4.1-18.3 | Potable |
| | | | | | | 4 | VH | | | Compact Formation | | | |
| | | | | | | | | | | | | | |
| 35 | Akharpali | Korkunda | 443 | 44Q0575034 | 2026769 | 1 | 418 | 2 | 1.6 | Top Soil | | | |
| | | | | | | 2 | 90 | 9 | 10.6 | Semi Weathered Formation | Aquifer | 1.6-10.6 | Potable |
| | | | | | | 3 | 334 | 33 | 43.8 | Less Compact Formation | Aquifer | 10.6-43.8 | Potable |
| | | | | | | 4 | VH | | | Compact Formation | | | |
| | | | | | | | | | | | | | |
| 36 | Mv-14 | Korkunda | 444 | 44Q0588370 | 2024805 | 1 | 85 | 2 | 2.4 | Top Soil | | | |
| | | | | | | 2 | 47 | 3 | 5.7 | Weathered Formation | Aquifer | 2.4-5.7 | Potable |
| | | | | | | 3 | 137 | 23 | 28.4 | Less Compact Formation | Aquifer | 5.7-28.4 | Potable |
| | | | | | | 4 | 516 | 295 | 323.4 | Less Compact Formation | Aquifer | 28.4-323 | Potable |

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| | | | | | | 5 | VH | | | Compact Formation | | | |
| | | | | | | | | | | | | | |
| 37 | Niliguda | Podia | 445 | 44Q0567011 | 2020098 | 1 | 184 | 1.6 | 1.6 | Top Soil | | | |
| | | | | | | 2 | 362 | 1.0 | 2.7 | Top Soil | | | |
| | | | | | | 3 | 30 | 4.2 | 6.9 | Weathered Formation | Aquifer | 2.7-6.9 | Potable |
| | | | | | | 4 | VH | 5.0 | 11.9 | Compact Formation | | | |
| | | | | | | 5 | 272 | 63.0 | 74.9 | Less Compact Formation | Aquifer | 11.9-75 | Potable |
| | | | | | | 6 | VH | | | Compact Formation | | | |
| | | | | | | | | | | | | | |
| 38 | Mpv-56 | Podia | 446 | 44Q0556586 | 1999071 | 1 | 22 | 1.5 | 1.5 | Top Soil | | | |
| | | | | | | 2 | 344 | 2.6 | 4.1 | Top Soil | | | |
| | | | | | | 3 | 36 | 5.7 | 9.8 | Weathered Formation | Aquifer | 4.1-9.8 | Potable |
| | | | | | | 4 | VH | | | Compact Formation | | | |
| | | | | | | | | | | | | | |
| 39 | Podia | Podia | 447 | 44Q0557583 | 2008484 | 1 | 10 | 1.6 | 1.6 | Top Soil | | | |
| | | | | | | 2 | 24 | 9.2 | 10.8 | Weathered Formation | Aquifer | 1.6-10.8 | Potable |
| | | | | | | 3 | VH | 10.4 | 21.2 | Compact Formation | | | |
| | | | | | | 4 | 118 | 23.6 | 44.8 | Less Compact Formation | Aquifer | 21.2-44.8 | Potable |
| | | | | | | 5 | VH | | | Compact Formation | | | |
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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | Kalimela | Kalimela | 448 | 44Q0545523 | 1972152 | 1 | 29 | 0.9 | 0.9 | Top Soil | | | |
| | | | | | | 2 | 10 | 3.6 | 4.6 | Weathered Formation | | | |
| | | | | | | 3 | 20 | 8.6 | 13.2 | Weathered Formation | Aquifer | 0.9-13.2 | Potable |
| | | | | | | 4 | 116 | 156.3 | 169.5 | Less Compact Formation | Aquifer | 13.2-170 | Potable |
| | | | | | | 5 | VH | | | Compact Formation | | | |
| | | | | | | | | | | | | | |
| 41 | Tokelguda | Podia | 449 | 44Q0555160 | 1982761 | 1 | 411 | 0.4 | 0.4 | Top Soil | | | |
| | | | | | | 2 | 152 | 2.3 | 2.7 | Semi Weathered Formation | | | |
| | | | | | | 3 | 317 | 32.6 | 35.3 | Less Compact Formation | Aquifer | 2.7-35.3 | Potable |
| | | | | | | 4 | 704 | 146.6 | 181.9 | Less Compact Formation | Aquifer | 35.3-182 | Potable |
| | | | | | | 5 | VH | | | Compact Formation | | | |
| | | | | | | | | | | | | | |
| 42 | Lachipeta | Podia | 450 | 44Q0559199 | 1989346 | 1 | 120 | 0.8 | 0.8 | Top Soil | | | |
| | | | | | | 2 | 53 | 16.9 | 17.7 | Weathered Formation | Aquifer | 0.8-17.7 | Potable |
| | | | | | | 3 | 611 | | | Less Compact Formation | Aquifer | 17.7- ? | Potable |
| | | | | | | | | | | | | | |
| 43 | Gorekhapali | Podia | 451 | 44Q0551759 | 1989930 | 1 | 336 | 0.6 | 0.6 | Top Soil | | | |
| | | | | | | 2 | 42 | 6.7 | 7.3 | Weathered Formation | Aquifer | 0.6-7.3 | Potable |
| | | | | | | 3 | 77 | 13.9 | 21.2 | Less Compact Formation | Aquifer | 7.3-21.2 | Potable |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 4 | 1088 | | | Less Compact Formation | Aquifer | 21.2- ? | Potable |
| | | | | | | | | | | | | | |
| 44 | Potakhal | Kalimela | 452 | 44Q0583239 | 2003328 | 1 | 31 | 0.9 | 0.9 | Top Soil | | | |
| | | | | | | 2 | 23 | 3.2 | 4.1 | Weathered Formation | Aquifer | 0.9-4.1 | Potable |
| | | | | | | 3 | 133 | 14.4 | 18.5 | Less Compact Formation | Aquifer | 4.1-18.5 | Potable |
| | | | | | | 4 | 801 | | | Less Compact Formation | Aquifer | 18.5- ? | Potable |
| | | | | | | | | | | | | | |
| 45 | Engulikunda | Kalimela | 453 | 44Q0581005 | 1994861 | 1 | 11 | 0.4 | 0.4 | Top Soil | --- | | |
| | | | | | | 2 | 4 | 4.3 | 4.7 | Weathered Formation | | | |
| | | | | | | 3 | VH | | | Compact Formation | | | |
| | | | | | | | | | | | | | |
| 46 | Doganda | Kalimela | 454 | 44Q0573162 | 1990647 | 1 | 45 | 1.5 | 1.5 | Top Soil | | | |
| | | | | | | 2 | 27 | 6.3 | 7.8 | Weathered Formation | Aquifer | 1.5-7.8 | Potable |
| | | | | | | 3 | 84 | 14.8 | 22.6 | Less Compact Formation | Aquifer | 7.8-22.6 | Potable |
| | | | | | | 4 | 1053 | | | Less Compact Formation | Aquifer | 22.6- ? | Potable |
| | | | | | | | | | | | | | |
| 47 | Birenpali | Kalimela | 455 | 44Q0637869 | 2040052 | 1 | 157 | 0.8 | 0.8 | Top Soil | | | |
| | | | | | | 2 | 15 | 8.3 | 9.1 | Weathered Formation | Aquifer | 0.8-9.1 | Potable |
| | | | | | | 3 | VH | | | Compact Formation | | | |
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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 48 | ManiyamKonda | Kalimela | 456 | 44Q0569015 | 1981890 | 1 | 177 | 0.8 | 0.8 | Top Soil | | | |
| | | | | | | 2 | 30 | 6.2 | 7.1 | Weathered Formation | Aquifer | 0.8-7.1 | Potable |
| | | | | | | 3 | 187 | 68.1 | 75.2 | Less Compact Formation | Aquifer | 7.1-75.2 | Potable |
| | | | | | | 4 | 688 | | | Less Compact Formation | Aquifer | 75.2- ? | Potable |
| | | | | | | | | | | | | | |
| 49 | Pulusamamidi | Kalimela | 457 | 44Q0582712 | 1987322 | 1 | 315 | 0.6 | 0.6 | Top Soil | | | |
| | | | | | | 2 | 66 | 3.1 | 3.7 | Weathered Formation | Aquifer | 0.6-3.7 | Potable |
| | | | | | | 3 | 174 | 28.1 | 31.8 | Less Compact Formation | Aquifer | 3.7-31.8 | Potable |
| | | | | | | 4 | 3255 | 000f | | Compact Formation | | | |
| | | | | | | | | | | | | | |
| 50 | Kurumanar | Kalimela | 458 | 44Q0603684 | 1995711 | 1 | 29 | 2.6 | 2.6 | Top Soil | | | |
| | | | | | | 2 | 40 | 8.6 | 11.2 | Weathered Formation | Aquifer | 2.6-11.2 | Potable |
| | | | | | | 3 | VH | 2.8 | 14.0 | Compact Formation | | | |
| | | | | | | 4 | 815 | | | Compact Formation | | | |
| | | | | | | | | | | | | | |
| 51 | Badaliguda | Kalimela | 459 | 44Q0593800 | 2002699 | 1 | 4 | 0.7 | 0.7 | Top Soil | | | |
| | | | | | | 2 | 9 | 5.7 | 6.3 | Weathered Formation | Aquifer | 0.7-6.3 | Potable |
| | | | | | | 3 | VH | | | Compact Formation | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52 | Udarganda | Kalimela | 460 | 44Q0569963 | 2002343 | 1 | 68 | 1.9 | 1.9 | Top Soil | | | |
| | | | | | | 2 | 17 | 2.2 | 4.1 | Weathered Formation | | | |
| | | | | | | 3 | 51 | 14.2 | 18.3 | Weathered Formation | Aquifer | 1.9-18.3 | Potable |
| | | | | | | 4 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 53 | Supali | Kalimela | 461 | 44Q0578220 | 2010898 | 1 | 94 | 6.2 | 6.2 | Weathered Formation | Aquifer | 0-6.2 | Potable |
| | | | | | | 2 | 209 | 12.5 | 18.6 | Semi Weathered Formation | | | |
| | | | | | | 3 | 817 | 189.6 | 208.2 | Less Compact Formation | | | |
| | | | | | | 4 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 54 | Kudumula Gumma | K.Gumma | 462 | 44Q0623688 | 2032944 | 1 | 148 | 1.89 | 1.9 | Top Soil | | | |
| | | | | | | 2 | 40 | 2.5 | 4.4 | Weathered Formation | Aquifer | 1.9-4.4 | Potable |
| | | | | | | 3 | 135 | 17.1 | 21.5 | Less Compact Formation | Aquifer | 4.4-21.5 | Potable |
| | | | | | | 4 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 55 | Gopalpur | Korkunda | 463 | 44Q0618234 | 2022697 | 1 | 119 | 0.4 | 0.4 | Top Soil | | | |
| | | | | | | 2 | 470 | 0.9 | 1.2 | Top Soil | | | |
| | | | | | | 3 | 17 | 11.1 | 12.3 | Weathered Formation | Aquifer | 1.2-12.3 | Potable |
| | | | | | | 4 | 1401 | | | Compact formation | | | |
| | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 56 | Tarabeda | Kudumulaguma | 464 | 44Q0637214 | 2018946 | 1 | 25 | 0.6 | 0.6 | Top Soil | | | |
| | | | | | | 2 | 33 | 3.5 | 4.1 | Top Soil | | | |
| | | | | | | 3 | 55 | 14.3 | 18.4 | Weathered Formation | Aquifer | 4.1-18.4 | Potable |
| | | | | | | 4 | 190 | 20.5 | 38.9 | Less Compact formation | Aquifer | 18.4-38.9 | Potable |
| | | | | | | 5 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 57 | Chilipodar | Kudumula Gumma | 465 | 44Q0625033 | 2027271 | 1 | 32 | 1.2 | 1.2 | Top Soil | | | |
| | | | | | | 2 | 21 | 5.8 | 7.0 | Weathered Formation | Aquifer | 1.2-7 | Potable |
| | | | | | | 3 | 220 | 145.6 | 152.6 | Less Compact formation | Aquifer | 7-153 | Potable |
| | | | | | | 4 | VH | | | Compact formation | | | |
| | | | | | | | | | | | | | |
| 58 | Tikrapadar | Kudumula Gumma | 466 | 44Q0627598 | 2029214 | 1 | 43 | 0.8 | 0.8 | Top Soil | | | |
| | | | | | | 2 | 27 | 2.8 | 3.7 | Top Soil | | | |
| | | | | | | 3 | 12 | 9.6 | 13.3 | Weathered Formation | Aquifer | 3.7-13.3 | Potable |
| | | | | | | 4 | 294 | | | Less Compact formation | Aquifer | 13.3- ? | Potable |
| | | | | | | | | | | | | | |

## Annexure-IIA:Basic Data of Exploratory Wells Drilled by CGWB in Malkangiri District.

| Sr.No | Block | Location | Latitude in decimal | Longitude in decimal | Depth drilled (mbgl) | Lithology | Depth to Bed rock (mbgl) Casing Pipe Lowered | Granular zones/ deciphered (mbgl) | SWL (mbgl) / Date | Discharge (lps) | Drawdown (m) | T (m² / day) | S |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Khairput | Khairput | 18.4526 | 82.2383 | 186.6 | Biotite Gr. Gneiss | 15.96 | 24,32 | 2.55 | 2.8 | 23.43 | | |
| 2 | Kudmulguma | Kudmulguma | 18.3473 | 82.189 | 38.5 | -do- | 19.75 | 11,38 | 3.56 | 10.60 | 10.14 | | |
| 3 | Kudmulguma | Kudmulguma | 18.3473 | 82.189 | 130.10 | -do- | 16.55 | 25,29,31,32 | 3.80 | 7.33 | 10.19 | | |
| 4 | Kudmulguma | Balimela | 18.2479 | 82.0853 | 166.75 | -do- | 10.20 | 28,75,84,85,131, 160 | 4.35 | 5.16 | 22.75 | | |
| 5 | Kudmulguma | Balimela | 18.2479 | 82.0853 | 141.25 | -do- | 12.40 | 20,24,52,60,76 | 4.93 | 4.40 | 18.15 | | |
| 6 | Korkunda | Korkunda | 18.2802 | 81.9529 | 200.00 | -do- | 14.20 | | | Nil | | | |
| 7 | Malkangiri | Malkangiri | 18.3628 | 81.9020 | 200.00 | -do- | 12.15 | 16,81,126,144 | 2.60 | 0.88 | | | |
| 8 | Kalimela | Kalimela | 18.0760 | 81.7741 | 195.30 | -do- | 8.30 | 20,57,70,76, 103, 158 | 5.67 | 2.54 | 23.58 | | |
| 9 | Kalimela | Podia | 18.1743 | 81.5523 | 135.95 | Gr. Gneiss | 13.29 | 9,15,94,118 | 8.03 | 4.23 | 17.39 | | |
| 10 | Mathili | Mathili | 18.5405 | 82.1718 | 159.60 | -do | 13.20 | 99,137 | 3.25 | 2.00 | 29.40 | | |
| 11 | Korukonda | MV-53 | 18.2931 | 81.7253 | 92 | Granite | 21 | 29,32,75,76 | 7.23 | 6.5 | 2.07 | 251.16 | |
| 12 | Korukonda | Potrel | 18.2600 | 82.0214 | 203 | Granite | 13.15 | 103,133 | 1.3 | 1.5 | 14.82 | 6.91 | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | Korukonda | Neelakhamberu | 18.2067 | 82.0406 | 195 | Granite | 16 | 77,79,89,95 | 3.87 | 7.5 | 15.15 | 98.19 | |
| 14 | Korukonda | Neelakhamberu | 18.2067 | 82.0406 | 147 | Granite | 12.8 | | 3.67 | | 5.34 | 51.43 | $8.95x10^{-4}$ |
| 15 | Korukonda | MV-47 | 18.2756 | 81.8708 | 200 | Granite | 13.5 | 135,137 | 4.13 | 4.6 | 16.65 | 33.8 | |
| 16 | Korukonda | MV-47 | 18.2756 | 81.8708 | 200 | Granite | 14.63 | | 4.07 | | 8.63 | 22.53 | $3.01x10^{-4}$ |
| 17 | Korukonda | MV-26 | 18.2097 | 81.8961 | 129 | Granite | 18.5 | 126,128 | 2.93 | 6.5 | 17.77 | 12.74 | |
| 18 | Malkangiri | Titiberi | 18.3767 | 81.7656 | 201 | Granite | 62.5 | | 6.75 | | | 0.33 | |
| 19 | Malkangiri | Tangapalli | 18.5606 | 81.9261 | 204 | Granite | 56 | 84,85,104,115,173,174 | 7.28 | 0.15 | | | |
| 20 | Mathili | Kutunipalli | 18.6375 | 82.1992 | 201 | Granite | 16.5 | | | | | | |
| 21 | Mathili | Champajharna | 18.5619 | 82.2719 | 198 | Granite | 19.5 | | | | | | |
| 22 | Mathili | Pujariguda | 18.5833 | 82.2500 | 198 | Granite | 18.5 | 95,96 | 2.24 | | | 1.89 | |
| 23 | Khairput | Palkaguda | 18.4061 | 82.2258 | 200 | Granite | 35.7 | 52,52.5 | 3.73 | 2.1 | 10.63 | 11.67 | |
| 24 | Khairput | Gotiguda | 18.4419 | 82.1681 | 198 | Granite | 12.5 | | | | | | |
| 25 | Khairput | Dongakunda | 18.3550 | 82.1125 | 199 | Granite | 12.5 | 145,146 | 13 | | | 0.33 | |
| 26 | Podia | Girkanpalli | 18.0650 | 81.6506 | 200 | Granite | 19 | | | | | | |
| 27 | Podia | MPV-67 | 18.1667 | 81.5833 | 144 | Granite | 18.5 | 123,124 | 1.18 | 7.01 | 14.25 | 80.55 | |
| 28 | Podia | MPV-67 | 18.1667 | 81.5833 | 72 | Granite | 24.39 | | 1.68 | | 4.38 | 98.37 | $8.02x10^{-4}$ |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | Kalimela | Jakalgondi | 18.0103 | 81.7225 | 201 | Granite | 19 | 22,23,45,46,53,54 | 1.95 | 1.75 | 15.55 | 12.6 | |
| 30 | Malkangiri | Doriguda | 18.2778 | 81.8558 | 201 | Granite | 12.19 | | | | | | |
| 31 | Malkangiri | Thapaguda | 18.3833 | 82.0447 | 120 | Granite | 16.46 | 33,33.5 | 5.46 | 4.6 | 9.92 | 23.06 | |
| 32 | Podia | M.V- 58 / Gothanpalli | 18.1425 | 81.6092 | 152.43 | Granite | 12.19 | 148,149 | 1.64 | 2.3 | 14.85 | 3.84 | |
| 33 | Podia | Kunchanpalli | 18.1467 | 81.5478 | 200 | Granite | 12.19 | 14,15 | | | | | |
| 34 | Kalimela | Balliguda | 17.9850 | 81.6856 | 200 | Granite | 16.46 | 119,120 | | | | | |
| 35 | Korukonda | Korukonda | 18.2853 | 81.9781 | 96.5 | Granite | 10.67 | | 1.05 | 4.56 | 17.06 | 14.45 | |
| 36 | Korukonda | Nakamamudi | 18.2500 | 82.1250 | 111 | Granite | 15.24 | 108,108.50 | 2.16 | 5 | 15.34 | 35.52 | |
| 37 | Chitrakonda | Maliguda | 18.1667 | 82.0833 | 200 | Granite | 12.19 | | | | | | |
| 38 | Chitrakonda | Kankiripada | 18.1250 | 82.0417 | 164 | Granite | 18.29 | 120,121 | 5.01 | 3.28 | 14.21 | 12.99 | |
| 39 | Mathili | Mathili | 18.6250 | 82.2500 | 200 | Granite | 12.19 | 14,14.70 | | 3 | | | |
| 40 | Kalimela | MV-63 | 18.1775 | 81.8097 | 200 | Granite | 18.29 | 161,163 | 4.45 | 3.5 | 21.45 | 4.86 | |
| 41 | Podia | Kaldapalli | 18.1250 | 81.5000 | 200 | Granite | 12.8 | 78,79 | 2.34 | | | 0.71 | |

**ANNEXURE-IIB:Basic Data of Exploratory Wells Drilled by contractual Drilling in Malkangiri District**

| Sr.No | Block | Location | Lattitude | Longitude | Discharge in lps | Draw-down (m) | T (m2/d) | Storativity |
|---|---|---|---|---|---|---|---|---|
| 1 | Korukonda | MV-53 | 18.2931 | 81.7253 | 6.5 | 2.07 | 251.16 | |
| 2 | Korukonda | Potrel | 18.26 | 82.0214 | 90 | 14.82 | 6.91 | |
| 3 | Korukonda | Neelakhamberu | 18.2067 | 82.0406 | 450 lpm | 15.15 | 98.19 | |
| 4 | Korukonda | Neelakhamberu | 18.2067 | 82.0406 | | 5.34 | 51.43 | $8.95x10^{-4}$ |
| 5 | Korukonda | MV-47 | 18.2756 | 81.8708 | 274 lpm | 16.65 | 33.8 | |
| 6 | Korukonda | MV-47 | 18.2756 | 81.8708 | | 8.63 | 22.53 | $3.01x10^{-4}$ |
| 7 | Korukonda | MV-26 | 18.2097 | 81.8961 | 6.5 | 17.77 | 12.74 | |
| 8 | Malkangiri | Titiberi | 18.3767 | 81.7656 | | | 0.33 | |
| 9 | Malkangiri | Tangapalli | 18.5606 | 81.9261 | 0.15 | | | |
| 10 | Mathili | Kutunipalli | 18.6375 | 82.1992 | | | | |
| 11 | Mathili | Champajharna | 18.5619 | 82.2719 | | | | |
| 12 | Mathili | Pujariguda | 18.5833 | 82.25 | | | 1.89 | |
| 13 | Khairput | Palkaguda | 18.4061 | 82.2258 | 126 | 10.63 | 11.67 | |
| 14 | Khairput | Gotiguda | 18.4419 | 82.1681 | | | | |
| 15 | Khairput | Dongakunda | 18.355 | 82.1125 | | | 0.33 | |
| 16 | Podia | Girkanpalli | 18.065 | 81.6506 | | | | |
| 17 | Podia | MPV-67 | 18.1667 | 81.5833 | 421 lpm | 14.25 | 80.55 | |
| 18 | Podia | MPV-67 | 18.1667 | 81.5833 | | 4.38 | 98.37 | $8.02x10^{-4}$ |
| 19 | Kalimela | Jakalgondi | 18.0103 | 81.7225 | 105 | 15.55 | 12.6 | |
| 20 | Malkangiri | Doriguda | 18.2778 | 81.8558 | | | | |
| 21 | Malkangiri | Thapaguda | 18.3833 | 82.0447 | 4.6 | 9.92 | 23.06 | |
| 22 | Podia | M.V- 58 / Gothanpalli | 18.1425 | 81.6092 | 2.3 | 14.85 | 3.84 | |
| 23 | Podia | Kunchanpalli | 18.1467 | 81.5478 | | | | |
| 24 | Kalimela | Balliguda | 17.985 | 81.6856 | | | | |
| 25 | Korukonda | Korukonda | 18.2853 | 81.9781 | 4.56 | 17.06 | 14.45 | |
| 26 | Korukonda | Nakamamudi | 18.25 | 82.125 | 5 | 15.34 | 35.52 | |
| 27 | Chitrakonda | Maliguda | 18.1667 | 82.0833 | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 28 | Chitrakonda | Kankiripada | 18.125 | 82.0417 | 3.28 | 14.21 | 12.99 | |
| 29 | Mathili | Mathili | 18.625 | 82.25 | 182 | | | |
| 30 | Kalimela | MV-63 | 18.1775 | 81.8097 | 210 | 21.45 | 4.86 | |
| 31 | Podia | Kaldapalli | 18.125 | 81.5 | | | 0.71 | |
| 32 | Podia | Podia | 18.2083 | 81.5 | | | | |

**ANNEXURE-III A:Ground Water Quality Data of Exploratory Wells in Malkangiri District.**

| Sr.No | Block | Location | Latitude in decimal | Longitude in decimal | EC | Cl | TH | TDS | Ca | Na | K | $HCO_3$ | $SO_4$ | $NO_3$ | Cl | F | Fe |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Micro siemens/cm | concentration in mg/l | | | | | | | | | | | |
| 1 | Korukonda | MV-53 | 18.2931 | 81.7253 | 540 | 25 | 150 | 352 | 36 | 51.5 | 2.3 | 160 | 60.3 | 6.9 | 25 | 0.48 | 0.15 |
| 2 | Korukonda | Potrel | 18.2600 | 82.0214 | 352 | 10 | 100 | 225 | 24 | 32.2 | 1.5 | 130 | 24 | 3.8 | 10 | 0.32 | 0.14 |
| 3 | Korukonda | Neelakhamberu | 18.2067 | 82.0406 | 848 | 20 | 350 | 542 | 72 | 29.6 | 2.9 | 330 | 48.8 | 8.8 | 20 | 0.74 | 0.16 |
| 4 | Korukonda | Neelakhamberu | 18.2067 | 82.0406 | 736 | 20 | 300 | 470 | 64 | 37.2 | 2.3 | 320 | 26.2 | 7.8 | 20 | 0.64 | 0.16 |
| 5 | Korukonda | MV-47 | 18.2756 | 81.8708 | 538 | 20 | 170 | 344 | 36 | 42 | 2.1 | 200 | 29.1 | 6 | 20 | 0.5 | 0.15 |
| 6 | Korukonda | MV-47 | 18.2756 | 81.8708 | 536 | 20 | 160 | 342 | 36 | 46 | 2.3 | 200 | 128 | 6.3 | 20 | 0.54 | 0.14 |
| 7 | Korukonda | MV-26 | 18.2097 | 81.8961 | 506 | 20 | 180 | 320 | 40 | 30.1 | 2.1 | | 23.8 | 5.6 | 20 | 0.52 | |
| 8 | Malkangiri | Titiberi | 18.3767 | 81.7656 | 808 | 25 | 100 | 514 | 24 | 135.7 | 2.7 | 280 | 71.3 | 8.5 | 25 | 0.6 | |
| 9 | Malkangiri | Tangapalli | 18.5606 | 81.9261 | | | | | | | | | | | | | |
| 10 | Mathili | Kutunipalli | 18.6375 | 82.1992 | 396 | 25 | 60 | 260 | 16 | 60 | 1.9 | 120 | 32.9 | 4.7 | 25 | 0.45 | |
| 11 | Mathili | Champajharna | 18.5619 | 82.2719 | 998 | 25 | 100 | 636 | 24 | 179.4 | 2.9 | 350 | 93.4 | 9.7 | 25 | 0.72 | |
| 12 | Mathili | Pujariguda | 18.5833 | 82.2500 | 606 | 40 | 190 | 388 | 40 | 48 | 2.5 | 200 | 32.3 | 7.5 | 40 | 0.56 | |
| 13 | Khairput | Palkaguda | 18.4061 | 82.2258 | 194 | 10 | 60 | 126 | 16 | 14.9 | 0.9 | 60 | 17.2 | 2.5 | 10 | 0.21 | |
| 14 | Khairput | Gotiguda | 18.4419 | 82.1681 | 548 | 25 | 180 | 347 | 40 | 40 | 2.3 | 200 | 26.7 | 6.3 | 25 | 0.44 | |
| 15 | Khairput | Dongakunda | 18.3550 | 82.1125 | 402 | 15 | 30 | 256 | 8 | 78.6 | 1.6 | 160 | 17 | 4.7 | 15 | 0.48 | |
| 16 | Podia | Girkanpalli | 18.0650 | 81.6506 | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | Podia | MPV-67 | 18.1667 | 81.5833 | 824 | 35 | 350 | 528 | 76 | 24.1 | 2.9 | 310 | 36.2 | 8.8 | 35 | 0.74 | 0.15 |
| 18 | Podia | MPV-67 | 18.1667 | 81.5833 | 834 | 40 | 310 | 530 | 72 | 45 | 2.9 | 320 | 25.1 | 8.5 | 40 | 0.69 | 0.16 |
| 19 | Kalimela | Jakalgondi | 18.0103 | 81.7225 | 444 | 25 | 130 | 282 | 28 | 38.8 | 2.1 | 150 | 26.2 | 5.3 | 25 | 0.45 | 0.13 |
| 20 | Malkangiri | Doriguda | 18.2778 | 81.8558 | | | | | | | | | | | | | |
| 21 | Malkangiri | Thapaguda | 18.3833 | 82.0447 | 738 | 45 | 130 | 470 | 32 | 106 | 2.7 | 250 | 39 | 8.8 | 45 | 0.68 | 0.16 |
| 22 | Podia | M.V- 58 / Gothanpalli | 18.1425 | 81.6092 | 306 | 10 | 100 | 194 | 24 | 21.1 | 1.9 | | 29.7 | | 10 | 0.4 | |
| 23 | Podia | Kunchanpalli | 18.1467 | 81.5478 | 412 | 10 | 160 | 266 | 36 | 18 | 2.1 | 160 | 21 | 5.6 | 10 | 0.43 | |
| 24 | Kalimela | Balliguda | 17.9850 | 81.6856 | 334 | 20 | 90 | 212 | 20 | 32.2 | 1.9 | 110 | 2.3 | 4.4 | 20 | 0.36 | |
| 25 | Korukonda | Korukonda | 18.2853 | 81.9781 | 692 | 45 | 200 | 448 | 44 | 63.2 | 2.5 | 240 | 28.4 | 7.5 | 45 | 0.48 | 0.12 |
| 26 | Korukonda | Nakamamudi | 18.2500 | 82.1250 | 496 | 20 | 180 | 324 | 40 | 27.8 | 2.1 | 60 | 142.9 | 6.3 | 20 | 0.5 | 0.14 |
| 27 | Chitrakonda | Maliguda | 18.1667 | 82.0833 | 1116 | 170 | 230 | 718 | 48 | 146.2 | 3.1 | 210 | 86.4 | 11 | 170 | 0.78 | |
| 28 | Chitrakonda | Kankiripada | 18.1250 | 82.0417 | 426 | 10 | 140 | 270 | 32 | 30.5 | 1.7 | 170 | 20.1 | 4.4 | 10 | 0.48 | 0.12 |
| 29 | Mathili | Mathili | 18.6250 | 82.2500 | 478 | 10 | 170 | 306 | 36 | 28.1 | 2.3 | 180 | 33.5 | 5.6 | 10 | 0.5 | |
| 30 | Kalimela | MV-63 | 18.1775 | 81.8097 | 634 | 30 | 150 | 406 | 32 | 72.9 | 2.5 | 240 | 21.3 | 7.2 | 30 | 0.48 | 0.16 |
| 31 | Podia | Kaldapalli | 18.1250 | 81.5000 | 538 | 20 | 200 | 342 | 44 | 28.2 | 2.1 | 200 | 29.1 | 6 | 20 | 0.49 | |
| 32 | Podia | Podia | 18.2083 | 81.5000 | 940 | 85 | 240 | 596 | 52 | 101.4 | 2.9 | 270 | 60.7 | 10.1 | 85 | 0.72 | |

## ANNEXURE-IIIB:Ground Water Quality Data of monitoring wells in Malkangiri District.

| | VILLAGE | Block | Lattitude | Longitude | pH | EC | TDS | Hardness | Alkalinity | Ca++ | Mg++ | Na+ | K+ | CO3- | HCO3- | Cl- | SO4= | NO3 | F - | Uranium |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | mg/L | | | | | | | | | | | | | |
| 1 | Jharapali | MALKANGIRI | 18.45 | 81.91 | 7.8 | 550 | 326 | 61 | 250 | 25 | 36 | 28 | 2 | 0 | 305 | 14 | 5 | 1.82 | 0.65 | 0.007 |
| 2 | Damaguda | MALKANGIRI | 18.45 | 81.85 | 7.5 | 800 | 320 | 56 | 185 | 22 | 57 | 54 | 1.5 | 0 | 226 | 70 | 72 | 75.84 | 0.71 | 0.019 |
| 3 | Damaguda | MALKANGIRI | 18.46 | 81.85 | 8 | 300 | 161 | 82 | 150 | 33 | 17 | 9 | 1 | 0 | 183 | 7 | 5 | 0.87 | 0.76 | BDL |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Narayangu | MALKANGIRI | 18.44 | 81.83 | 7.8 | 800 | 439 | 138 | 345 | 55 | 44 | 28 | 47.5 | 0 | 421 | 58 | 4 | 3.91 | 0.28 | BDL |
| 5 | Pandripani | MALKANGIRI | 18.44 | 82.02 | 7.7 | 300 | 188 | 87 | 140 | 35 | 9 | 10 | 10.5 | 0 | 171 | 12 | 0 | 3.09 | 0.25 | BDL |
| 6 | Kenduguda | MALKANGIRI | 18.42 | 82.03 | 8 | 450 | 265 | 92 | 160 | 37 | 16 | 13 | 31.11 | 0 | 195 | 26 | 28 | 2 | 0.16 | BDL |
| 7 | Dugali | MALKANGIRI | 18.40 | 82.07 | 8.12 | 600 | 336 | 128 | 200 | 51 | 21 | 18 | 65 | 0 | 244 | 42 | 46 | 12.32 | 0.45 | 0.005 |
| 8 | Gangala | MATHILI | 18.43 | 82.07 | 8 | 450 | 300 | 66 | 160 | 27 | 18 | 40 | 2.67 | 0 | 195 | 39 | 19 | 0.74 | 0.34 | BDL |
| 9 | Bhaluguda | MALKANGIRI | 18.46 | 82.05 | 7.8 | 900 | 519 | 148 | 235 | 59 | 10 | 39 | 128 | 0 | 287 | 70 | 78 | 51.2 | 0.19 | BDL |
| 10 | Sursmal | MALKANGIRI | 18.40 | 81.96 | 7.7 | 750 | 392 | 112 | 230 | 45 | 36 | 18 | 68 | 0 | 281 | 46 | 72 | 1.97 | 0.31 | 0.004 |
| 11 | Saunliguda | MATHILI | 18.48 | 82.08 | 7.9 | 700 | 312 | 66 | 145 | 27 | 57 | 29 | 5 | 0 | 177 | 104 | 41 | 29.58 | 0.39 | BDL |
| 12 | Bhijaguda | MATHILI | 18.47 | 82.05 | 8 | 150 | 89 | 51 | 55 | 20 | 1 | 7 | 4 | 0 | 67 | 7 | 3 | 6.4 | 0.18 | BDL |
| 13 | Pulapali-1 | MATHILI | 18.49 | 82.04 | 7.6 | 400 | 235 | 41 | 145 | 16 | 30 | 12 | 13 | 0 | 177 | 23 | 17 | 0 | 0.14 | BDL |
| 14 | Bhandar P | MATHILI | 18.51 | 82.06 | 8.1 | 550 | 252 | 71 | 120 | 29 | 24 | 50 | 3.5 | 0 | 146 | 56 | 54 | 39.81 | 0.44 | 0.007 |
| 15 | Naikguda | MATHILI | 18.49 | 82.10 | 7.8 | 300 | 202 | 61 | 70 | 25 | 6 | 32 | 5 | 0 | 85 | 37 | 18 | 18.87 | 0.34 | BDL |
| 16 | Mentukuli | MATHILI | 18.59 | 82.21 | 7.9 | 1000 | 543 | 36 | 290 | 14 | 52 | 47 | 122.5 | 0 | 354 | 91 | 55 | 34.96 | 0.36 | BDL |
| 17 | Kiang | MATHILI | 18.62 | 82.13 | 7.7 | 1050 | 477 | 117 | 225 | 47 | 86 | 25 | 1.4 | 0 | 275 | 167 | 43 | 23.64 | 0.18 | 0.004 |
| 18 | Udaygiri | MATHILI | 18.66 | 82.13 | 7.8 | 400 | 203 | 71 | 155 | 29 | 26 | 17 | 4.6 | 0 | 189 | 30 | 16 | 2.65 | 0.19 | BDL |
| 19 | Talapadar HP | MATHILI | 18.61 | 82.10 | 8 | 450 | 215 | 107 | 205 | 43 | 21 | 13 | 1.3 | 0 | 250 | 14 | 4 | 0.84 | 0.2 | BDL |
| 20 | Kansariput HP | MATHILI | 18.61 | 82.03 | 7.3 | 200 | 90 | 46 | 80 | 18 | 7 | 10 | 1.7 | 0 | 98 | 5 | 0 | 16.78 | 0.15 | BDL |
| 21 | Permarasi | MATHILI | 18.60 | 81.97 | 7.4 | 300 | 161 | 82 | 140 | 33 | 12 | 8 | 2.5 | 0 | 171 | 7 | 0 | 12.25 | 0.16 | BDL |
| 22 | MV-11 | MALKANGIRI | 18.33 | 81.93 | 7.6 | 200 | 109 | 51 | 75 | 20 | 7 | 12 | 4.4 | 0 | 92 | 12 | 15 | 0.06 | 0.11 | BDL |
| 23 | Koilipari | KORUKONDA | 18.31 | 81.96 | 7.7 | 140 | 76 | 36 | 55 | 14 | 1 | 14 | 1 | 0 | 67 | 5 | 9 | 0.77 | 0.15 | BDL |
| 24 | MV-34 HP | KORUKONDA | 18.26 | 82.02 | 7.7 | 200 | 131 | 61 | 80 | 25 | 5 | 12 | 5 | 0 | 98 | 5 | 8 | 20.45 | 0.22 | BDL |
| 2 | MV-33 | KORUKONDA | 18.26 | 82.02 | 7.7 | 800 | 440 | 92 | 290 | 37 | 22 | 72 | 41.8 | 0 | 354 | 58 | 31 | 4.71 | 0.21 | BDL |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | | | | | | | | | | | | | | | | | | |
| 26 | MV-30 | KORUKONDA | 18.22 | 82.00 | 7.5 | 500 | 276 | 107 | 140 | 43 | 24 | 25 | 3.7 | 0 | 171 | 56 | 36 | 15.83 | 0.22 | BDL |
| 27 | Tarlakota | KORUKONDA | 18.28 | 82.07 | 7.7 | 550 | 287 | 82 | 170 | 33 | 26 | 42 | 13.6 | 0 | 207 | 53 | 41 | 0.06 | 0.14 | BDL |
| 28 | MV-46 | MALKANGIRI | 18.29 | 82.81 | 7.8 | 450 | 278 | 66 | 195 | 27 | 21 | 26 | 24.11 | 0 | 238 | 26 | 18 | 0.57 | 0.39 | BDL |
| 29 | MV-54 | KALIMELA | 18.18 | 81.78 | 7.6 | 550 | 379 | 102 | 190 | 41 | 22 | 36 | 22.6 | 0 | 232 | 46 | 37 | 0.62 | 0.23 | BDL |
| 30 | Kachalwada | KALIMELA | 18.20 | 81.85 | 7.6 | 950 | 354 | 143 | 150 | 57 | 47 | 29 | 37.4 | 0 | 183 | 72 | 98 | 156.32 | 0.35 | BDL |
| 31 | MPV-6 | KALIMELA | 18.18 | 81.80 | 7.6 | 300 | 168 | 71 | 105 | 29 | 11 | 18 | 4.5 | 0 | 128 | 23 | 22 | 0.08 | 0.17 | BDL |
| 32 | Kangorkon | KALIMELA | 18.14 | 81.80 | 7.9 | 400 | 230 | 66 | 145 | 27 | 22 | 25 | 2.5 | 0 | 177 | 30 | 20 | 0.13 | 0.24 | BDL |
| 33 | Kalimela | KALIMELA | 18.07 | 81.75 | 7.9 | 700 | 376 | 117 | 275 | 47 | 33 | 33 | 57.8 | 0 | 336 | 33 | 37 | 31.51 | 0.34 | BDL |
| 34 | MV-64 | KALIMELA | 18.16 | 81.80 | 7.5 | 200 | 109 | 56 | 85 | 22 | 10 | 11 | 3.5 | 0 | 104 | 12 | 8 | 11.14 | 0.21 | BDL |
| 35 | Champanag | MALKANGIRI | 18.38 | 81.86 | 6.8 | 120 | 100 | 46 | 60 | 18 | 4 | 2 | 4.3 | 0 | 73 | 5 | 0 | 9.6 | 0.17 | BDL |
| 36 | Chalanguda | MALKANGIRI | 18.38 | 81.74 | 7.6 | 400 | 243 | 102 | 160 | 41 | 10 | 18 | 23.71 | 0 | 195 | 19 | 31 | 13.91 | 0.17 | BDL |
| 37 | Tandki | MALKANGIRI | 18.43 | 81.82 | 7.9 | 550 | 233 | 128 | 130 | 51 | 10 | 23 | 40.85 | 0 | 159 | 30 | 36 | 81.36 | 0.2 | BDL |
| 38 | Titiberi HP | MALKANGIRI | 18.37 | 81.76 | 7.3 | 150 | 101 | 71 | 90 | 29 | 4 | 3 | 1.21 | 0 | 110 | 5 | 0.2 | 0.6 | 0.22 | BDL |
| 39 | Tralgundi | PODIA | 18.28 | 81.69 | 7.3 | 60 | 46 | 20 | 35 | 8 | 2 | 6 | 1.4 | 0 | 43 | 2 | 5 | 0 | 0.14 | BDL |
| 40 | Niliguda | PODIA | 18.27 | 81.64 | 7.7 | 400 | 281 | 36 | 210 | 14 | 38 | 7 | 20.37 | 0 | 256 | 16 | 6 | 2.53 | 0.21 | BDL |
| 41 | Podia HP | PODIA | 18.17 | 81.54 | 8 | 1100 | 497 | 87 | 340 | 35 | 63 | 68 | 64 | 0 | 415 | 56 | 60 | 148.7 | 0.49 | BDL |
| 42 | MPV-67 | PODIA | 18.15 | 81.58 | 7.7 | 350 | 227 | 71 | 170 | 29 | 17 | 18 | 10.1 | 0 | 207 | 16 | 8 | 0.5 | 0.27 | BDL |
| 43 | MV-58 | PODIA | 18.14 | 81.61 | 7.9 | 550 | 304 | 51 | 180 | 20 | 39 | 31 | 3 | 0 | 220 | 37 | 35 | 3.38 | 0.44 | 0.003 |
| 4 | MV-67 | KALIMELA | 18.08 | 81.70 | 7.9 | 750 | 378 | 56 | 225 | 22 | 45 | 35 | 63.8 | 0 | 275 | 65 | 66 | 0.28 | 0.27 | BDL |

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| 4 | | | | | | | | | | | | | | | | | | | |
| 45 | MPV-74 | KALIMELA | 18.00 | 81.69 | 7.6 | 200 | 181 | 46 | 85 | 18 | 9 | 15 | 3 | 0 | 104 | 12 | 12 | 0.85 | 0.28 | BDL |
| 46 | MV-79 | KALIMELA | 17.99 | 81.59 | 7.6 | 1050 | 519 | 87 | 270 | 35 | 50 | 112 | 5.1 | 0 | 329 | 95 | 73 | 114.3 | 0.52 | 0.011 |
| 47 | Motu | KALIMELA | 17.83 | 81.40 | 7.9 | 850 | 389 | 87 | 175 | 35 | 62 | 42 | 4.7 | 0 | 214 | 81 | 61 | 127.4 | 0.27 | BDL |
| 48 | MV-88 | KALIMELA | 17.88 | 81.55 | 7.9 | 750 | 362 | 102 | 175 | 41 | 49 | 36 | 1.7 | 0 | 214 | 74 | 59 | 56 | 0.28 | BDL |
| 49 | MPV-81 | KALIMELA | 17.93 | 81.56 | 7.9 | 750 | 365 | 148 | 205 | 59 | 22 | 62 | 1.8 | 0 | 250 | 77 | 55 | 12.8 | 0.26 | BDL |
| 50 | Kukudaguda | MALKANGIRI | 18.36 | 81.97 | 7.7 | 250 | 154 | 82 | 90 | 33 | 4 | 27 | 1.3 | 0 | 110 | 19 | 21 | 24 | 0.45 | BDL |
| 51 | Suliacolony | KORUKONDA | 18.29 | 81.97 | 7.9 | 650 | 330 | 77 | 280 | 31 | 44 | 37 | 7.6 | 0 | 342 | 28 | 16 | 1.8 | 1.16 | BDL |
| 52 | MV-36 | KORUKONDA | 18.27 | 82.09 | 8 | 350 | 179 | 102 | 165 | 41 | 12 | 17 | 2.7 | 0 | 201 | 7 | 15 | 0.7 | 0.48 | BDL |
| 53 | Temporary | CHITRAKONDA | 18.13 | 82.13 | 6.6 | 150 | 79 | 51 | 45 | 20 | 2 | 9 | 8.7 | 0 | 55 | 12 | 1 | 35.12 | 0.13 | 0.007 |
| 54 | Sariapali | CHITRAKONDA | 18.08 | 82.16 | 7 | 100 | 58 | 41 | 45 | 16 | 2 | 5 | 3 | 0 | 55 | 5 | 0 | 15.12 | 0.15 | BDL |
| 55 | Janbai | CHITRAKONDA | 18.11 | 82.22 | 7 | 170 | 93 | 61 | 60 | 25 | 5 | 8 | 3.6 | 0 | 73 | 16 | 0 | 27.8 | 0.14 | BDL |
| 56 | Chitrakunda | CHITRAKONDA | 18.11 | 82.11 | 7 | 100 | 69 | 36 | 50 | 14 | 1 | 9 | 5.4 | 0 | 61 | 7 | 0 | 7.7 | 0.1 | BDL |
| 57 | Parkanmala | KHOIRAPUT | 18.36 | 82.14 | 7.9 | 400 | 235 | 102 | 150 | 41 | 15 | 21 | 2.2 | 0 | 183 | 42 | 3 | 1 | 0.2 | BDL |
| 58 | Sindhiguda | KHOIRAPUT | 18.40 | 82.15 | 8.2 | 450 | 240 | 158 | 180 | 63 | 6 | 18 | 15.7 | 0 | 220 | 28 | 24 | 4.1 | 0.28 | BDL |
| 59 | Doraguda | KHOIRAPUT | 18.36 | 82.17 | 7.9 | 400 | 206 | 153 | 190 | 61 | 11 | 5 | 6.8 | 0 | 232 | 9 | 1 | 5.7 | 0.24 | BDL |
| 60 | Puruna G | KHOIRAPUT | 18.38 | 82.20 | 7.9 | 200 | 115 | 56 | 100 | 22 | 7 | 14 | 2.8 | 0 | 122 | 9 | 0 | 4.5 | 0.11 | BDL |
| 61 | Muduliguda | KHOIRAPUT | 18.39 | 82.21 | 7.6 | 200 | 112 | 61 | 100 | 25 | 7 | 9 | 2.5 | 0 | 122 | 9 | 0 | 1.9 | 0.14 | BDL |
| 62 | Kutiguda | KHOIRAPUT | 18.43 | 82.20 | 7.5 | 80 | 57 | 26 | 40 | 10 | 2 | 8 | 1.4 | 0 | 49 | 7 | 0 | 5.3 | 0.12 | BDL |
| 63 | Podaghat | KHOIRAPUT | 18.47 | 82.20 | 8.1 | 250 | 137 | 82 | 90 | 33 | 7 | 10 | 3.5 | 0 | 110 | 19 | 5 | 15.9 | 0.13 | BDL |

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| 64 | Kakabahal | KHOIRAPUT | 18.49 | 82.26 | 7.9 | 300 | 217 | 77 | 135 | 31 | 9 | 14 | 22.8 | 0 | 165 | 19 | 11 | 2.9 | 0.2 | BDL |
| 65 | Kodaguda | KHOIRAPUT | 18.50 | 82.23 | 7.9 | 700 | 334 | 46 | 265 | 18 | 69 | 30 | 12.7 | 0 | 323 | 37 | 40 | 61.6 | 0.24 | BDL |
| 66 | Amliput | KHOIRAPUT | 18.53 | 82.27 | 7.8 | 180 | 131 | 46 | 75 | 18 | 6 | 10 | 11 | 0 | 92 | 16 | 9 | 1 | 0.16 | BDL |
| 67 | Badliguda | MATHILI | 18.54 | 82.25 | 8.1 | 430 | 250 | 107 | 170 | 43 | 24 | 17 | 18 | 0 | 207 | 30 | 25 | 21 | 0.18 | BDL |
| 68 | Bhoiguda | MATHILI | 18.56 | 82.27 | 7.8 | 300 | 189 | 66 | 90 | 27 | 9 | 28.4 | 7.5 | 0 | 110 | 42 | 17 | 10.5 | 0.15 | BDL |

## ANNEXURE-IV: List of Key wells established in Malkangiri district

| SL NO. | VILLAGE | LOCATION | BLOCK | MP(MAGL) | DIA(M) | SWL(MBMP) | DEPTH(MBMP) | LATITUDE | LONGITUDE |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Jharapali | DW in the H/o Chandra Padhiani along Tetemeta road near field | MALKANGIRI | 0.7 | 3.1 | 1.4 | 7.4 | 18.45465 | 81.90604 |
| 2 | Damaguda | Infront of Upper Primary school. | MALKANGIRI | 0.45 | 2.45 | 2.2 | 9.3 | 18.45217 | 81.85353 |
| 3 | Damaguda | In the field of Mukka Darua on RHS of road. | MALKANGIRI | 0.65 | 6.45 | 1.2 | 4.36 | 18.45516 | 81.85353 |
| 4 | Narayanguda | In the H/o Balaram Samaratha 100 m from Primary school | MALKANGIRI | GL | 4.1 | 3.3 | 6.4 | 18.43676 | 81.83143 |
| 5 | Pandripani | Near Pandripani Chowk in front of Agriculture office. | MALKANGIRI | 0.5 | 2.2 | 2.8 | 6.5 | 18.4406 | 82.01543 |
| 6 | Kenduguda | Infront of Anganwadi Kendra | MALKANGIRI | 0.7 | 2.5 | 3.5 | 7.7 | 18.42307 | 82.02692 |
| 7 | Dugali | in the house of Guru Dora | MALKANGIRI | GL | 2.1 | 1.1 | 4.8 | 18.40051 | 82.07476 |
| 8 | Gangala | In the house of prahallad chaunara | MATHILI | 0.82 | 1.95 | 2.57 | 8.52 | 18.43363 | 82.07128 |
| 9 | Bhaluguda Colony-2 | near meeting hall | MALKANGIRI | 0.83 | 1.5 | 5.1 | 9.55 | 18.46108 | 82.04554 |
| 10 | Sursmal | near the house of Ramachandra | MALKANGIRI | 0.3 | 4.1 | 2.15 | 6.2 | 18.40363 | 81.9553 |

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|---|---|---|---|---|---|---|---|---|---|
| | | Kabasti | | | | | | | |
| 11 | Saunliguda | in the house of Puria Dora | MATHILI | 0.87 | 1.9 | 1.57 | 10.2 | 18.48228 | 82.07978 |
| 12 | Bhijaguda | in front of panchayat office | MATHILI | 0.67 | 2.75 | 1.62 | 3.75 | 18.47338 | 82.05078 |
| 13 | Pulapali-1 | in front of Kothaghara | MATHILI | 0.55 | 2.35 | 3.62 | 7.12 | 18.49018 | 82.03857 |
| 14 | Bhandari Pangam | in front of jatri Visram gruha | MATHILI | 0.7 | 2.1 | 1.61 | 7.9 | 18.5092 | 82.06389 |
| 15 | Naikguda | opposite to Kasturba Gandhi Girls' Hostel | MATHILI | 0.85 | 2.05 | 3.72 | 9.1 | 18.48553 | 82.09909 |
| 16 | Mentukuli | in the house of sh. Bala Naik | MATHILI | 0.75 | 1.8 | 2.2 | 5.9 | 18.58504 | 82.21141 |
| 17 | Kiang | in the house of Sh. Sandeep Biswal | MATHILI | GL | 2.4 | 3.75 | 9.65 | 18.61633 | 82.12834 |
| 18 | Udaygiri | in the house of Sh. Budu Bhumiya | MATHILI | 0.5 | 1.8 | 3 | 6.45 | 18.66357 | 82.1272 |
| 19 | Talapadar | at entry of the village | MATHILI | 0.55 | 2.9 | 1.7 | 7.9 | 18.61133 | 82.09992 |
| 20 | Kansariput | in front of Govt. primary school | MATHILI | 0.9 | 1.4 | 3.9 | 7.85 | 18.6125 | 82.03498 |
| 21 | Permarasi | near Adarsha Anganwadi center | MATHILI | 0.6 | 2.05 | 3.45 | 6.9 | 18.6038 | 81.97423 |
| 22 | MV-11 | in the house of Sh. Bharat Sarkar | MALKANGIRI | GL | 2.1 | 2.2 | 3.95 | 18.32834 | 81.93385 |
| 23 | Koilipari | in the house of Sh. Deepak Mistri | KORUKONDA | 0.42 | 3.85 | 1.45 | 4.4 | 18.31325 | 81.96198 |
| 24 | MV-34 | in the house of Sh. Krishna prasad Mondol | KORUKONDA | 0.65 | 2.15 | 3.58 | 7.85 | 18.2575 | 82.01951 |
| 25 | MV-33 | in the house of Sh. Madhav Mandol | KORUKONDA | 1.12 | 0.85 | 2.36 | 6.01 | 18.25662 | 82.01673 |
| 26 | MV-30 | in the house of Smt. Kumuda Mandal | KORUKONDA | 0.8 | 3.5 | 3.38 | 10.35 | 18.22329 | 82.0007 |
| 27 | Tarlakota | in the house of Sh. Padmanabha Madkani | KORUKONDA | 0.75 | 2.75 | 3.3 | 6.95 | 18.28028 | 82.06586 |
| 28 | MV-46 | Near transformer adjacent to Primary School | MALKANGIRI | 0.75 | 3.55 | 1.52 | 7.95 | 18.29097 | 82.80541 |
| 29 | MV-54 | in the house of Sh. Nikhil Das | KALIMELA | 0.72 | 3.1 | 1.9 | 7.65 | 18.18325 | 81.77728 |
| 30 | Kachalwada RO colony | near Mission Shakti House | KALIMELA | 1 | 2.4 | 3.1 | 6.95 | 18.20377 | 81.85406 |
| 31 | MPV-6 | inside High school | KALIMELA | 0.52 | 3.25 | 2.92 | 6.05 | 18.18391 | 81.8003 |
| 32 | Kangorkonda | in front of post office | KALIMELA | 0.7 | 2 | 1.91 | 3.98 | 18.13999 | 81.79533 |
| 33 | Kalimela | in front of post office | KALIMELA | 0.3 | 2.3 | 2.1 | 6.95 | 18.07481 | 81.75209 |
| 34 | MV-64 | inside Irrigation Colony | KALIMELA | 0.82 | 2.55 | 4.52 | 8.9 | 18.15715 | 81.79754 |
| 35 | Champanagar | near brick factory | MALKANGIRI | GL | 1.3 | 1.12 | 7.55 | 18.37967 | 81.86166 |
| 36 | Chalanguda | back side of Jatri pratikshyalaya | MALKANGIRI | 0.65 | 1.85 | 2.08 | 6.35 | 18.38318 | 81.74029 |
| 37 | Tandki | in front of Ashram School | MALKANGIRI | 0.7 | 1.95 | 5.41 | 10.5 | 18.42998 | 81.82268 |

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|---|---|---|---|---|---|---|---|---|---|
| 38 | Titiberi | at the end of the village | MALKANGIRI | GL | 2.3 | 1.41 | 6.95 | 18.37332 | 81.76218 |
| 39 | Tralgundi | in the house Sh. Budura Padiami | PODIA | 0.4 | 1.95 | 3.05 | 6.9 | 18.2772 | 81.69413 |
| 40 | Niliguda | in front of the Anganwadi kendra near over head tank. | PODIA | 0.85 | 1.9 | 4.24 | 7.25 | 18.26872 | 81.63992 |
| 41 | Podia | in front of post office in H/O Saphiq Ahmed | PODIA | 0.7 | 2.3 | 3.35 | 8.1 | 18.17454 | 81.5394 |
| 42 | MPV- 67 | in the house of Sh. Milan Biswas | PODIA | 0.55 | 1.5 | 3.01 | 4.31 | 18.15442 | 81.5791 |
| 43 | MV-58 | near telephone tower | PODIA | 0.68 | 3.75 | 1.71 | 8.2 | 18.14184 | 81.60825 |
| 44 | MV-67 | in the paddy field of Sh. Bihari Tetta | KALIMELA | 0.65 | 2.5 | 1.82 | 6.85 | 18.08025 | 81.70043 |
| 45 | MPV-74 | in the house of Sh. Sudhanshu Mallick | KALIMELA | GL | 4.8 | 1.55 | 6.3 | 18.00264 | 81.68929 |
| 46 | MV-79 | in the house of Sh. Kanchan Mandal | KALIMELA | 0.52 | 3.8 | 4.4 | 7.9 | 17.98838 | 81.58654 |
| 47 | Motu | back side of Geeta Pathasala | KALIMELA | 0.75 | 2.1 | 5.01 | 9.55 | 17.83191 | 81.40111 |
| 48 | MV-88 | in front of anganwadi kendra | KALIMELA | 0.8 | 3.5 | 3.4 | 6.85 | 17.88429 | 81.55049 |
| 49 | MPV-81 | in the house of Sh. Amrit Mirdha | KALIMELA | 0.3 | 1.15 | 7.45 | 12.3 | 17.92735 | 81.56153 |
| 50 | Kukudaguda | in the house of Sh. Manju Khila | MALKANGIRI | 0.83 | 3.55 | 1.75 | 6.1 | 18.35992 | 81.97384 |
| 51 | Sulia colony | in front of primary school | KORUKONDA | 1.15 | 2.2 | 2.25 | 7.8 | 18.29134 | 81.97354 |
| 52 | MV-36 | At the entry of the village | KORUKONDA | 0.75 | 2.3 | 2.81 | 5.07 | 18.27128 | 82.09391 |
| 53 | Temporary Colony | near adarsh Anganwadi kendra | CHITRAKONDA | 0.75 | 2.15 | 7.52 | 8.9 | 18.13408 | 82.12855 |
| 54 | Sariapali | at the end of the village | CHITRAKONDA | 0.65 | 2.55 | 5.35 | 8.15 | 18.08124 | 82.16414 |
| 55 | Janbai | near primary health center | CHITRAKONDA | 0.55 | 2 | 9.1 | 12.9 | 18.11143 | 82.22074 |
| 56 | Chitrokonda | near electric sub-station | CHITRAKONDA | 0.96 | 1.7 | 10.02 | 15.4 | 18.10674 | 82.11253 |
| 57 | Parkanmala Colony | in the soil conservation office premises | KHOIRAPUT | 0.42 | 4.35 | 2.9 | 7.77 | 18.36213 | 82.14224 |
| 58 | Sindhiguda | in the house of Sh. Mukunda Kuasi | KHOIRAPUT | 0.7 | 1.8 | 2.45 | 6.15 | 18.40207 | 82.15358 |
| 59 | Doraguda | in front of Anganwadi Kendra | KHOIRAPUT | 0.55 | 2.8 | 5 | 6.35 | 18.3555 | 82.16825 |
| 60 | Puruna Guma | in the house of Smt. Gena Majhi | KHOIRAPUT | 0.75 | 3.45 | 4.25 | 7.9 | 18.37812 | 82.19902 |
| 61 | Mudliguda | in the house of Sh. Sanya Golpeda | KHOIRAPUT | 0.6 | 3.65 | 4.5 | 10.2 | 18.38551 | 82.20674 |
| 62 | Kutiguda | in the house of Sh. Hari Jani | KHOIRAPUT | 0.65 | 3.1 | 2.61 | 8.65 | 18.43444 | 82.1979 |
| 63 | Podaghat Colony | at the end of the village | KHOIRAPUT | 0.75 | 1.6 | 4.12 | 7.1 | 18.47449 | 82.20352 |
| 64 | Kakabahal | in the house of Sh. Hari Khila | KHOIRAPUT | 0.5 | 3.1 | 2.25 | 4.1 | 18.49315 | 82.25618 |
| 65 | Kodaguda | in the house of Sh. Padmanabha | KHOIRAPUT | 0.75 | 1.2 | 4.15 | 9.45 | 18.50131 | 82.23365 |

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|---|---|---|---|---|---|---|---|---|---|
| | | Naik | | | | | | | |
| 66 | Amliput | in the house of Sh. Ramachandra Gouda | KHOIRAPUT | 0.9 | 2 | 2.28 | 6 | 18.52828 | 82.27144 |
| 67 | Badliguda | in the house of Sh. Dorru Pujari | MATHILI | 0.65 | 2.25 | 1 | 3.05 | 18.539 | 82.25335 |
| 68 | Bhoiguda | in the house of Sh. Podia Pujari | MATHILI | 0.82 | 3.7 | 3.35 | 6.85 | 18.55904 | 82.26794 |

**Annexure-V: List of NHS in the district**

| Sl. No. | Village | Location |
|---|---|---|
| 1 | Badili | In front of School. |
| 2 | Balimela | Bus Stand Area |
| 3 | Balimela Chowk | Near road junction to Balimela and Korukonda. In front of H/O Mahendra Pattanaik |
| 4 | Bejaguda | Infront of P.S.M.E School. |
| 5 | Bhejangawara | Near Post office. |
| 6 | Chitapari | Entracle of village, 100m left of Somanathpur-balimela road. 6 km from Somanathpur. |
| 7 | Chitrakonda | Near Station, infront of Panchayat office. |
| 8 | Govindpali 1 | Compound of kartik Purna Chandra Mishra house. 1/2 km from Govindpali bazar towards balimela chhak,opposite to relience mobile tower. |
| 9 | Kalimela | Block Office compound. |
| 10 | Kalimela1 | Opp to Post office |
| 11 | Kanyashram | In the compound of Kanyashram (High School). 10 KM from Kalinath. |
| 12 | Katameta | Near Mobile Tower left side of Malkangiri-Jeypore road. 7 km from Pandrpani towards Jeypore. |
| 13 | Khairput1 | Centre of Lineman Sahi, Near electric Transformer,end of the Khairput Market area 12 km from Govindpali |
| 14 | Korukonda 1 | End of village, divergence road to Khilaguda sahi and market near Trinath temple |
| 15 | Kudumuluguma1 | Infront of Didayi Development Agency office. 14km from Khairput |
| 16 | Kumbharguda | Vill Kumbharguda, 2km From Pandiripani Towards Pongam, Beside |

| | | |
|---|---|---|
| | | Main road & Opp. to Village Entrance Road to Kumbarguda. |
| 17 | M.V 37 | Back side of house and shop of Amal das. Right side of Balimela-malkangiri road. 5 km from Balimela chowk towards Korukonda. |
| 18 | M.v.58 | Infront of Shiva Mandir. Inbetween Kanyashram and Podia. |
| 19 | M.v.64 | Potteru Irrigation Project Colony. Left side of the road to Kalimele. |
| 20 | M.v.7 | In the house of Shri. Ramakrishna Talukdar |
| 21 | M.v.79 | Left side of main Road, near Market. |
| 22 | M.v.88 | Infront of Medical Qrts & Panchabati Gramya Bank. |
| 23 | M.V.9 | Inside the compound of Shri B. C. Sardar's House. Approachable via Malkangiri (approx 9 Km) by Road. |
| 24 | M.V1- 19 | 11km from M.V 7, 400 mtrs from main road towards irrigation colony, near rogi kalyan samiti, left side of road |
| 25 | Maithili1 | In the compound of T.Nilakantha's house. Near Panchayat Office |
| 26 | Malkangiri 1 | Opposite to Sivam Filling Stations & Catholic Church, Dipti Convent School, In Front of Bhairavi Bar, Malkangiri |
| 27 | Motu | In the premises of Jaganath Temple. |
| 28 | Mundiguda | 3kms from Khairaput Towards Kudumuluguma, Entrance of the Village, Right side of the Road |
| 29 | Parkannala | Centre of village, 100 m right of Kudumulugumma-Balimela road. 5 km from Kudumulugumma. |
| 30 | Pongam | Inside village on the Rt side of the Rd Malkangiri-Mathili |
| 31 | Porhia | Infront of Post Office |
| 32 | Raddaguda | Opp.to U.P.School, at the end of village. |
| 33 | Sindhimal | At Bhimasahi near pond at the end of village right side of Malkangiri-Mathili road. 10km from Malkangiri. |
| 34 | Somnathpur 1 | In front of house of Shayama Majhi inside nuasahi. Opposite side of overhead water tank. About 100 m away from main road. |
| 35 | Venkatapalam | Inside the village & adj. to Praful Mandal's house. |