भारत सरकार
Government of India
जल शक्ति मंत्रालय,
Ministry of Jal Shakti,
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग,
Department of Water Resources,
River Development and
Ganga Rejuvenation

केंद्रीय भूमि जल बोर्ड
Central Ground Water Board

NAQUIM 2.0

जलभृत प्रबंधन योजना

Aquifer Management Plan

सावनेर, नागपुर जिला, महाराष्ट्र

Saoner, Nagpur District, Maharashtra

Central Region
Nagpur
2024

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जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
Department of Water Resources, River Development & Ganga Rejuvenation
केन्द्रीय भूमि जल बोर्ड
CENTRAL GROUND WATER BOARD

जलभृत प्रबंधन योजना
Aquifer Management Plan
सावनेर, नागपुर जिला, महाराष्ट्र
Saoner, Nagpur District, Maharashtra

प्राथमिकता प्रकार: जल संकटग्रस्त क्षेत्र
Priority Type: Water Stressed Area

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Central Region, Nagpur
2024

डॉ. सुनील कुमार अम्बष्ट
अध्यक्ष
Dr. Sunil Kumar Ambast
Chairman

सत्यमेव जयते

भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन,
नदी विकास और गंगा संरक्षण विभाग
केन्द्रीय भूमि जल बोर्ड
Government of India
Ministry of Jal Shakti
Department of Water Resources,
River Development & Ganga Rejuvention
Central Ground Water Board

Message

National Aquifer Mapping and Management Programme (NAQUIM) was initiated by Central Ground Water Board (CGWB) in 2012 with the goal of mapping and managing aquifers across India to promote sustainable groundwater use. So far the entire mappable area of 25 lakh km^2 has been covered under the NAQUIM programme. While these initial efforts have been highly impactful, they faced certain limitations especially in terms of spatial resolution.

Taking it forward, CGWB has now initiated **NAQUIM 2.0,** the next phase of aquifer mapping designed to provide a deeper, more detailed understanding of India's groundwater systems. During 2023-24, CGWB had completed NAQUIM 2.0 studies in 68 study areas. The study areas were selected in consultation with the State/UT government agencies.

I am confident that this report of NAQUIM 2.0 study will serve as a critical resource for government agencies, research institutions, NGOs, and the general public. By fostering a collaborative approach to groundwater management, this report will play a key role in safeguarding and sustaining India's precious ground water resources.

(Dr. Sunil Kumar Ambast)
Chairman, CGWB

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Smt. T. S. Anitha Shyam
Member (South)

Government of India
Central Ground Water Board
Ministry of Jal Shakti
Department of Water Resources, RD & GR
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Message

I am glad to present the report on *National Aquifer Mapping and Ground Water Management Plan* for Saoner block, Nagpur district Maharashtra.

This report attempts to understand the groundwater-related issues in Saoner block, Nagpur district, and suggests a groundwater management plan to address them. The plan incorporates a multidisciplinary approach, including geological, geophysical, hydrogeological, hydrological, and water quality analyses, leveraging issue-based high-density dynamic data.

I am hopeful that management plan suggested in this report will help in proper management of ground water resources in the targeted area.

I would like to appreciate the work done by the team of NAQUIM 2.0, Central Ground Water Board, Central Region, Nagpur.

(Smt. T. S. Anitha Shyam)

Central Ground Water Board
Central Region, Nagpur
September-2024

Foreword

It is with great pleasure that I present the report on the aquifer mapping of Saoner Block, a crucial initiative undertaken by the Central Ground Water Board (CGWB). This comprehensive study reflects our commitment to understanding and managing the groundwater resources in one of Maharashtra's vital regions.

Aquifer mapping is an essential step in ensuring sustainable water management. In Saoner Block, this study aims to delineate the aquifer systems, assess their capacities, and evaluate their quality and sustainability. With the growing demands on groundwater resources due to agricultural and industrial activities, accurate and detailed aquifer mapping is imperative for effective water resource planning and management.

The work presented in this report highlights the geological and hydrogeological characteristics of the Saoner Block's aquifers. It provides a thorough analysis of groundwater availability, quality, and potential threats, offering invaluable insights for policymakers, planners, and stakeholders. The findings will serve as a foundational resource for developing strategies to address water scarcity and contamination issues, ensuring that future generations benefit from well-managed and sustainable groundwater resources.

I commend the dedicated efforts of Smt. Nelofar, Sc. D, Smt. Bhagyashree Sahoo, Sc. B, Sh. Prakash Chandra Maharana, AHg., Sh. V. Venktesham, STA, Dr. P. Kiran Kumar, Sc. C and Sh. Modi Durgaprasad, Sc. C, Hydrologist for their outstanding work on the NAQUIM 2.0 Aquifer Mapping of Saoner Block, Nagpur district. Their contributions provide crucial data for stakeholders, including planners, researchers, and end-users, enhancing our ability to manage and safeguard groundwater resources effectively.

(Dr. Pandith Madhnure)
Head of Office

कार्यकारी सारांश

महाराष्ट्र के नागपुर जिले के जल-संकटग्रस्त सावनेर तहसील में वार्षिक-कार्य-योजना 2023-24 की अवधि में 'राष्ट्रीय जलभृत मानचित्रण-2.0' (रा.ज.मा.-2.0) अध्ययन, किया गया और **"महाराष्ट्र के नागपुर जिले के सावनेर ब्लॉक की जलभृत प्रबंधन योजना"** शीर्षक से रिपोर्ट तैयार की गई।

अध्ययन क्षेत्र 675.43 वर्ग किमी में फैला हुआ है, जो अक्षांश 21°14'56.08"N और 21°37'06.10"N तथा देशांतर 78°42'29.36"E और 79°09'27.78"E के बीच स्थित है। इसकी आबादी लगभग 2.29 लाख है और प्रशासनिक रूप से 79 ग्राम पंचायतें इसे संचालित करती हैं। कन्हान और कोलार नदियाँ, अपनी सहायक नदियों के साथ, क्षेत्र के उत्तर पश्चिमी से पूर्वी भागों की ओर बहती हैं, और यहाँ का मुख्य जल-निकासी स्वरूप 'सब-डेन्ड्रिटिक' से लेकर 'डेन्ड्रिटिक' (वृक्ष के समान) है।

इस क्षेत्र में सामान्य वार्षिक वर्षा 1009 मिमी होती है और यह मुख्य रूप से विविध भूवैज्ञानिक संरचनाओं से घिरा हुआ है, जिसमें संयुक्त और खंडित आर्कियन गनीस/शिस्ट, गोंडवाना बलुआ पत्थर, खंडित और संयुक्त बेसाल्ट चट्टानें और जलोढ़ जमा शामिल हैं। भू-आकृतियाँ मुख्य रूप से अनाच्छादन और संरचनात्मक मूल की हैं, जिनकी विशेषताएँ पेडिमेंट, विच्छेदित पठार और अलग-अलग पहाड़ी चट्टानें हैं।

वर्ष 2022-23 के दौरान, कुल सिंचित क्षेत्र 64.92 वर्ग किमी है। खेती योग्य क्षेत्र 452.85 वर्ग किमी (कुल भौगोलिक क्षेत्र का 68.88%) है, जबकि शुद्ध बोया गया क्षेत्र 514.96 वर्ग किमी (76.24%) है। इसके अतिरिक्त, दोहरी फसल वाला क्षेत्र 51.65 वर्ग किमी है, जो भौगोलिक क्षेत्र का 7.64% है।

भूजल 20 मीटर तक की गहराई पर उथले जलभृतों में अप्रतिबंधित परिस्थितियों में और 50 मीटर तक की गहराई पर गहरे जलभृतों में सीमित परिस्थितियों में पाया गया है। इसे मुख्य रूप से 15 से 30 मीटर की गहराई वाले खोदे गए कुओं और 60 से 100 मीटर की गहराई वाले बोरवेल के माध्यम से निकाला जाता है। इन बोरवेल से निर्वहन 0.14 से 5 लीटर प्रति सेकंड (ली.प्र. से.) के बीच होता है।

अध्ययन के अंतर्गत 111 से 200 मीटर की गहराई वाले कुल 16 बोरवेल का निर्माण किया गया। ये बोरवेल गहरे जलभृतों तक बनाए गए हैं, जिससे 14.88 लीटर प्रति सेकंड (ली। प्र. से.) तक का निर्वहन हुआ है। गणना की गई संचारण क्षमता 0.16 से 88.19 वर्ग मीटर/दिन है, और भंडारण क्षमता 0.000041 और 0.00309 है। इसके अतिरिक्त, उपसतह जलभृत व्यवस्था की जाँच करने के लिए 66 ऊर्ध्वधर विध्युतीय साउंडिंग (संकेत) की गईं। ऊर्ध्वधर विध्युतीय साउंडिंग द्वारा अनुमानित भूवैज्ञानिक परतें भू-स्तर (भू.से नी.) से पाया गया की ऊपरी मिट्टी और जलोढ़ मिट्टी जो ज़मीन के स्तर से 17 मीटर भू.से नी. (भू-स्तर से नीचे) तक फैली हुई है, उसके बाद 0.7 और 61 मीटर भू.से नी. के बीच अपक्षयी बेसाल्ट, 4.46 से 69.18 मीटर भू.से नी. की गहराई पर खंडित/वेसिकुलर बेसाल्ट द्वारा रेखांकित। इन परतों के नीचे विशाल बेसाल्ट है, जिसमें गोंडवाना सैंडस्टोन 4.46 और 96 मीटर भू.से नी. के बीच पाया जाता है और फ्रैक्चर्ड/हार्ड ग्रेनाइट गनीस 5.36 से 96 मीटर भू.से नी. की गहराई पर मौजूद है। ये निष्कर्ष क्षेत्र की जलभृत प्रणालियों और भूवैज्ञानिक ढांचे की व्यापक समझ प्रदान करते हैं।

त्रि-विमीय भूजलीय नमूना, दो-विमीय भूजलीय नमूना और बाड़ आरेख तथा क्षेत्र के ऊर्ध्वाधर-भू-काटों की संकल्पना, प्रतिनिधि अन्वेषणात्मक बोरवेल और भूभौतिकीय सर्वेक्षणों से प्राप्त आंकड़ों को एकीकृत करके तैयार की गई है। परिणाम से पता चलता है, कि सामान्य तौर पर, ऊपरी अपक्षयित भाग उथले जलभृत का प्रतिनिधित्व करता है। तैयार किए गए ऊर्ध्वाधर-काटों और मानचित्र इंगित करते हैं कि अपक्षयित क्षेत्र की मोटाई बेसाल्टिक संरचनाओं में 18 से 19 मीटर और गनीसिक संरचनाओं में 28 से 30 मीटर तक होती है। इस क्षेत्र के नीचे, गहरा जलभृत वातामकी, केशिकीय और खंडित बेसाल्ट के साथ-साथ खंडित गनीस द्वारा निर्माण करती हैं। ब्लॉक के कुछ क्षेत्रों में, गोंडवाना संरचनाओं की उपस्थिति जलभृत प्रणाली में और योगदान देती है।

अन्वेषणात्मक भू-वेधन के आकड़ों से पता चलता है कि अधिकांश चट्टानी-दरारें 16 से 100 मीटर की गहराई पर केंद्रित हैं। सबसे गहरी चट्टानी-दरारें क्षेत्र के उत्तर-पूर्वी हिस्से में 117 से 120 मीटर की गहराई पर पाई गई हैं।

उथले जलभृत (अपक्षयित क्षेत्र) का प्रतिनिधित्व करने वाले कुल 115 कुओं की सूची बनाई गई, जबकि गहरे जलभृत में स्थित 97 बोरवेलों की भी सूची बनाई गई तथा 2023 में जल स्तर द्वारा भूजल की निगरानी और भूजल-गुणवत्ता की जांच की गई।

प्रथम जलभृत (उथले) में, मानसून पूर्व जल स्तर 1.20 से 20.30 मीटर भू.से नी. के बीच था। 5 से 10 मीटर भू.से नी. के वर्गीकृत खंड ने 57% क्षेत्र में पाया गया, जबकि 10 से 20 मीटर भू.से नी. के जल स्तर ने 38% क्षेत्र में पाया गया। मानसून के बाद की अवधि के दौरान, जल स्तर 1.00 से 19.9 मीटर भू.से नी. के बीच था। ब्लॉक के अधिकांश क्षेत्र में जल स्तर 5 से 10 मीटर भू.से नी. (क्षेत्र का 46%) दिखाई दे रहा है, इसके बाद 10 से 20 मीटर भू.से नी. (क्षेत्र का 34%) है। उथले भूजल स्तर (2 से 5 मीटर भू.से नी.) के बहुत केंद्रित हिस्से ब्लॉक के पश्चिमी भाग और उत्तरी भाग में और पूर्वी भाग में कुछ हिस्से में देखे गए हैं। जल स्तर में उतार-चढ़ाव 9.1 मीटर की वृद्धि से लेकर 14.7 मीटर की गिरावट के बीच 115 कुओं में से 94 कुओं (81%) में जल स्तर में 0 से 9.1 मीटर तक की वृद्धि देखी गई, जो ब्लॉक के अधिकांश हिस्सों में देखी गई। हालांकि, अलग-अलग क्षेत्रों में 19 कुओं में जल स्तर में गिरावट देखी गई, जो -14.7 से -0.2 मीटर तक थी, जबकि केवल 2 कुओं में जल स्तर में कोई महत्वपूर्ण परिवर्तन नहीं देखा गया।

दूसरे जलभृत (गहरा) में मानसून-पूर्व जल स्तर 2 मीटर भू.से नी. से लेकर 30 मीटर भू.से नी. तक था। 5 से 10 मीटर भू.से नी. के जल स्तर ने 45% क्षेत्र में पाया गया, 10 से 20 मीटर भू.से नी. ने 46% क्षेत्र में पाया गया जबकि 30 मीटर भू.से नी. की सबसे गहरी श्रेणी ने अध्ययन क्षेत्र के 1.2% हिस्सों में पाया गया। मानसून के बाद की अवधि के दौरान, जल स्तर 5 मीटर भू.से नी. से कम से लेकर 20 मीटर भू.से नी. के बीच की सीमा तक बढ़ गया। सबसे गहरे जल स्तर वाले क्षेत्र घटकर केवल 0.4% रह गए। 5 से 10 मीटर भू.से नी. के बीच जल स्तर दिखाने वाले कुओं की संख्या में उल्लेखनीय कमी आई है जो 42.2% से घटकर 40.2% हो गई है जल स्तर में उतार-चढ़ाव -15.13 से 26.2 मीटर तक है, जिसमें औसतन 1.96 मीटर की गिरावट है। 97 कुओं में से, 69 कुओं (71%) ने अधिकांश ब्लॉक में जल

स्तर (0.08 से 26.2 मीटर) में वृद्धि दिखाई, जबकि अलग-अलग क्षेत्रों में 28 कुओं में -15.3 से -0.22 मीटर तक के स्तर में गिरावट देखी गई।

भूजल संसाधन आकलन का एक प्राथमिक घटक मृदा-अंतःस्यंदन के मान को, दोहरे-वलय वाले अंत:स्यंदनमापी का क्षेत्रीय प्रयोगों के आधार पर परिशुद्ध करने की कोशिश की गई थी। छह विभिन्न स्थानों पर किए गए मृदा-अंतःस्यंदन परीक्षणों से प्राप्त औसत मान (8.8%), औसत वर्षा गुणांक 8.7% के विचारित मूल्य के बहुत करीब है, इसलिए इसे और परिशुद्ध करने का सुझाव नहीं दिया गया।

सावनेर तालुका में भूजल की रासायनिक गुणवत्ता का मूल्यांकन करने के लिए, 2023 के प्री-मानसून सीजन (मई) और 2023 के पोस्ट-मानसून सीजन (नवंबर) के दौरान चिन्हित अवलोकन कुओं से कुल 287 और 117 जल-नमूने एकत्र किए गए। इन नमूनों का विश्लेषण प्रमुख धनायनों और प्रमुख ऋणायनों के लिए किया गया।

विद्युत चालकता (वि.चा.) पानी की गुणवत्ता का एक प्रमुख संकेतक है। सामान्य तौर पर, इसका मान वर्षा जल और समुद्री जल के लिए क्रमशः 25°C पर 10 से 50,000 मिली सीमेन प्रति सेंटीमीटर (मि.सी./सें.मी.) तक होता है। उथले जलभृत के 17 नमूनों और गहरे जलभृत के 26 नमूनों में वि.चा. का मान 1500 से 3000 के बीच पाया गया, जो स्थानीयकृत क्षेत्र जैसे पूर्वी भाग, दक्षिण-पूर्वी भाग और सावनेर तालुका का मध्य भाग है।

सावनेर तालुका के पश्चिमी और उत्तर-पश्चिमी भाग में स्थानीय क्षेत्रों में फ्लोराइड की मात्रा 1.5 मिलीग्राम/लीटर (मि.ग्रा./ली.) की अनुमेय सीमा से अधिक पाई गई है। सावनेर तालुका के हर स्थान पर नाइट्रेट की मात्रा अनुमेय सीमा (>45 मि.ग्रा./ली.) से अधिक पाया गया है। नाइट्रेट अमूमन उर्वरक से निकलकर पानी में घुलता है।

मानसून-पूर्व की अवधि के दौरान कुल 131 भूजल-नमूने एकत्र किए गए और लेशतत्वों का विश्लेषण किया गया। परिणामों के अनुसार, 3 नमूनों में एल्युमीनियम, 3 नमूनों में मैंगनीज और 3 नमूनों में आयरन की सांद्रता 'भारतीय मानक ब्यूरो' की अनुमेय सीमा से अधिक पाया गया है।

पीने और सिंचाई के उद्देश्य के लिए भूजल की योग्यता के लिए रासायनिक गुणवत्ता डेटा का विश्लेषण किया गया है। विश्लेषण से पता चलता है कि दोनों मौसमों (मानसून-पूर्व और मानसून-पश्चात) में गहरे जलभृतों की तुलना में उथले जलभृतों में फ्लोराइड की सांद्रता अधिक है। यह भी देखा गया है कि उथले जलभृतों में 33.5% नमूने और गहरे जलभृतों में 45.34% नमूने नाइट्रेट सांद्रता को अनुमेय सीमा (>45 मि.ग्रा./ली.) से अधिक दर्शाते हैं। जहाँ तक सिंचाई के लिए उपयुक्तता की बात है, तो मानसून-पूर्व और मानसून-पश्चात सीज़न के दौरान उथले जलभृतों से लिए गए ज़्यादातर नमूने (100% और 87.10%) और गहरे जलभृतों से लिए गए 100% और 76.36% नमूने क्रमशः कम लवणता वाले क्षेत्र में आते हैं।

केन्द्रीय भूजल बोर्ड द्वारा इस क्षेत्र में निर्मित अन्वेषण कुओं से प्राप्त भूजल की गुणवत्ता सामान्यतः पीने योग्य है।

"भूजल स्रोतों की स्थिरता" के लिए "मानक संचालन प्रक्रिया" (एसओपी) के तहत किए गए विश्लेषण में वर्षा, भू-भाग की स्थिति, जलभृत क्षमता, भूजल स्थिरता/उपलब्धता, जल स्तर की गहराई और जल गुणवत्ता जैसे प्रमुख मापदंडों पर विचार किया गया। 134 गांवों में से पांच को "जोखिमग्रस्त" के रूप में

वर्गीकृत किया गया था क्योंकि उनके भौगोलिक क्षेत्र के 50% से अधिक हिस्से में 20% से अधिक ढलान है। इन गांवों में, समोच्च खाइयों, बांधों और कंपित समोच्च खाइयों जैसी पुनर्भरण संरचनाओं की दक्षता में सुधार करने की सिफारिश की गई है। मांग-आपूर्ति अंतराल, जलभृत क्षमता और जल स्तर की गहराई के आधार पर "जोखिमग्रस्त" के रूप में पहचाने गए छह गांवों को उत्पादक जलभृतों का दोहन करने और भविष्य की पेयजल मांगों को पूरा करने के लिए भूभौतिकीय सर्वेक्षणों के माध्यम से नई निकासी संरचनाओं के निर्माण की आवश्यकता है। इसके अतिरिक्त, 1.5 मिलीग्राम/लीटर से अधिक फ्लोराइड सांद्रता वाले चार गांवों को "जोखिमग्रस्त" के रूप में वर्गीकृत किया गया है, जहां पानी को डीफ्लोराइडेशन तकनीक, रिवर्स ऑस्मोसिस (आरओ) निस्पंदन, और पुनर्भरण संरचनाओं के माध्यम से पतला करके उपयोग के लिए उपयुक्त बनाया जा सकता है।

अध्ययन से प्रमुख मुद्दों की पहचान गहरे जल स्तर (> 20 मीटर), जल स्तर में दीर्घकालिक गिरावट की प्रवृत्ति, मौजूदा संरचनाओं की स्रोत स्थिरता, भूजल गुणवत्ता के मुद्दे (भूगर्भीय और मानवजनित), कम जल धारण क्षमता और खनन क्षेत्र के पास सिंचाई कुओं का सूखना, सावनेर तालुका में खनन क्षेत्र के पास के गांवों में भूमि धंसने की रिपोर्ट के रूप में की गई है। इन समस्याओं पर काबू पाने के लिए प्रचलित उपायों की अनुशंसा की गई है।

भूजल गुणवत्ता संबंधी समस्याओं से जूझ रहे गांवों में सतही जल की आपूर्ति की दिशा में प्रयास किए जाने चाहिए।

फ्लोराइड युक्त भूजल का उपयोग अन्य घरेलू उद्देश्यों के लिए किया जा सकता है या इसे फ्लोराइड मुक्त पानी के साथ मिलाकर लिया जा सकता है।

सक्रिय एल्युमिना, कम लागत वाले अधिशोषक और आयन एक्सचेंज जैसे डीफ्लोराइडेशन तरीकों की सिफारिश की जाती है। इन प्रणालियों के संचालन और रखरखाव में समुदाय की भागीदारी आवश्यक है, साथ ही एकीकृत फ्लोरोसिस शमन उपायों को लागू करना भी आवश्यक है।

उच्च लवणता वाले क्षेत्रों में, ज्वार, गेहूं, चना, तिल, सोयाबीन, सूरजमुखी, जौ और डेलिली (एक लोकप्रिय और आसानी से उगने वाला फूल वाला पौधा) आदि जैसी लवण सहनशील फसलों को उगाने की सिफारिश की जाती है।

भूजल में नाइट्रेट संदूषण के प्रभावी उपचार में आयन एक्सचेंज, रिवर्स ऑस्मोसिस और जैविक विनाइट्रीफिकेशन जैसी तकनीकें शामिल हैं। उर्वरक के उपयोग को अनुकूलित करके और अपशिष्ट जल उपचार प्रथाओं को बढ़ाकर नाइट्रेट के रिसाव को रोकें। भूजल की गुणवत्ता की नियमित निगरानी और भूमि उपयोग में सर्वोत्तम प्रबंधन प्रथाओं को अपनाना दीर्घकालिक उपचार और जल संसाधनों की सुरक्षा के लिए महत्वपूर्ण है।

खनन क्षेत्रों के पास कम जल प्रतिधारण और कुओं के सूखने की समस्या को दूर करने के लिए, भूजल पुनःपूर्ति को बढ़ावा देने के लिए चेक डैम और रिचार्ज पिट बनाने सहित प्रभावी जल संरक्षण तकनीकों को लागू करें। भूजल की कमी को कम करने के लिए नियंत्रित खनन प्रथाओं को अपनाएँ और जल स्तर को बहाल करने के लिए कृत्रिम पुनर्भरण विधियों का उपयोग करें। प्रभावित क्षेत्रों में जल संसाधनों की वसूली और सतत उपयोग का समर्थन करने के लिए नियमित रूप से कुओं की निगरानी और रखरखाव करें, और स्थानीय किसानों के बीच स्थायी जल प्रबंधन प्रथाओं को बढ़ावा दें।

खनन क्षेत्रों के निकट निवारक उपायों में टिकाऊ खनन प्रथाओं और भूजल पुनर्भरण तकनीकों को लागू करना शामिल होना चाहिए, साथ ही संरचनात्मक सुदृढ़ीकरण जैसे कि ग्राउटिंग और मिट्टी स्थिरीकरण

भी शामिल होना चाहिए। पुनर्स्थापना प्रयासों को भूमि सुधार और भूजल गुणवत्ता सुधार पर ध्यान केंद्रित करना चाहिए, जिसे सामुदायिक शिक्षा और हितधारक सहयोग द्वारा पूरक बनाया जाना चाहिए।

उपलब्ध भूजल संसाधनों को टिकाऊ तरीके से प्रबंधित करने के लिए, रणनीति ने चार श्रेणियों के तहत सिफारिश की: आपूर्ति पक्ष, मांग पक्ष, संस्थागत और नियामक उपाय।

आपूर्ति पक्षीय प्रबंधन के अंतर्गत मौजूदा संरचनाओं की मरम्मत, नवीनीकरण और जीर्णोद्धार (म.न.जी.): 03 मध्यम सिंचाई परियोजनाएं, 12 लघु स्थानीय स्तर की सिंचाई परियोजनाएं, 10 कोल्हापुरी प्रकार के बंधारा, 19 मिट्टी के नाला बांध, 127 सीमेंट नाला बांध, 20 निरंतर समोच्च खाइयां 'म.न.जी.' के लिए पहचाने गए हैं।

कृत्रिम पुनर्भरण संरचनाओं का निर्माण: अध्ययन के आधार पर, 136 गांवों में से 123 गांवों में 406 कृत्रिम पुनर्भरण संरचनाओं (पु. सं) (चेक डैम: 200, परकोलेशन टैंक: 6, और पुनर्भरण शाफ्ट: 206) के निर्माण का सुझाव दिया गया है।

जल संरक्षण उपाय: उपरोक्त कृत्रिम पुनर्भरण हेतु अनुपयुक्त गांवों के उपयुक्त स्थानों पर खेत-में-तालाब और समोच्च खाइयां बनाए जाने का सुझाव है।

मांग पक्षीय प्रबंधन के तहत, पारंपरिक बाढ़ सिंचाई विधियों के बजाय टपक तथा छिड़काव सिंचाई और अंतरफसल का सुझाव दिया गया है।

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Executive Summary

The NAQUIM-2.0 studies were conducted as part of the Annual Action Plan (AAP) 2023–24 in the water-stressed Saoner block of Nagpur District, Maharashtra. A comprehensive report, titled **Aquifer Management Plan of Saoner Block, Nagpur District, Maharashtra**, has been prepared as a result of these studies.

The study area spans a geographical extent of 675.43 km², located between latitudes 21°14'56.08"N and 21°37'06.10"N, and longitudes 78°42'29.36"E and 79°09'27.78"E. It has a population of approximately 2.29 lakh and is administratively governed by 79-gram panchayats. The Kanhan and Kolar Rivers, along with their tributaries, flow from the north western to eastern parts of the region, exhibiting a predominant sub-dendritic to dendritic drainage pattern.

The region receives an average annual rainfall of 1009 mm and is predominantly underlain by diverse geological formations, including jointed and fractured Archaean gneiss/schist, Gondwana sandstone, fractured and jointed basaltic rocks, and alluvium deposits. The landforms are primarily of denudational and structural origin, characterized by features such as pediments, dissected plateaus, and isolated hilly outcrops.

During 2022-23, the net irrigated area was 64.92 sq. km. The cultivable area accounted for 452.85 sq. km (68.88% of the total geographical area), while the net sown area covered 514.96 sq. km (76.24%). Additionally, the double-cropped area was 51.65 sq. km, representing 7.64% of the geographical area.

Groundwater is found under unconfined conditions in shallow aquifers at depths of up to 20 meters and under confined conditions in deeper aquifers at depths of up to 50 meters. It is primarily extracted through dug wells with depths ranging from 15 to 30 meters and bore wells with depths of 60 to 100 meters. The yield from these bore wells varies between 0.14 and 5 liters per second (lps).

A total of 16 borewells were constructed to depths ranging from 111 to 200 meters, tapping into deeper aquifers with discharges of up to 14.88 liters per second (lps). The transmissivity values range from 0.16 to 88.19 m²/day, while storativity values vary between 0.000041 and 0.00309. Additionally, 66 Vertical Electrical Soundings (VES) were conducted to investigate the subsurface aquifer disposition. The VES data revealed multiple geological layers: topsoil and alluvium extending down to 17 meters below ground level (bgl), followed by weathered basalt between 0.7 and 61 meters bgl, underlain by fractured/vesicular basalt at depths of 4.46 to 69.18 meters bgl. Below these layers lies massive basalt, with Gondwana sandstone occurring between 4.46 and 96 meters bgl and fractured/hard granite gneiss present at depths of 5.36 to 96 meters bgl. These findings provide a comprehensive understanding of the region's aquifer systems and geological framework.

A 3D hydrogeological model, along with fence diagrams and 2D sections, has been developed by interpreting and integrating data from representative exploratory borewells and geophysical surveys. The findings indicate that the overlying weathered zone generally constitutes the shallow aquifer. Cross-sections and maps reveal that the thickness of the weathered zone ranges from 18 to 19 meters in basaltic formations and from 28 to 30 meters in gneissic formations. Beneath this zone, the deeper aquifer is formed by amygdaloidal, vesicular, and fractured basalt, as well as fractured gneiss. In certain areas of the block, the occurrence of Gondwana formations further contributes to the aquifer system.

Exploratory drilling data indicates that most fractures are concentrated at depths ranging from 16 to 100 meters. The deepest fracture was identified at a depth of 117 to 120 meters in the north-eastern part of the area.

A total of 115 dug wells, representing the shallow aquifer (weathered zone), were inventoried, while 97 bore wells tapping into the deeper aquifer were also inventoried and monitored for water levels and groundwater quality in 2023.

In 1st aquifer, pre-monsoon water level ranged from 1.20 to 20.30 m bgl. The classified segment of 5 to 10 m bgl covered 57% of the area, while water levels of 10 to 20 m bgl covered 38% of the area. During the post-monsoon period, water level ranged from 1.00 to 19.9 m bgl. Majority area of the block is showing water level 5 to 10 m bgl (46% of the area) followed by 10 to 20 m gbl (34% of the area). Very concentrated patches of shallow ground water level (2 to 5 m bgl) is observed over western part and northern part of the block and in some patches in eastern part. Water level fluctuations range from a rise of 9.1 meters to a drop of 14.7 meters, with an average decline of 3.04 meters. Among the 115 wells, 94 wells (81%) showed a rise in water levels, ranging from 0 to 9.1 meters, observed across most parts of the block. However, 19 wells in isolated areas experienced a decline in water levels, ranging from -14.7 to -0.2 meters, while only 2 wells exhibited no significant change in water levels.

In 2nd aquifer (deeper) the pre-monsoon water level ranged between 2 m bgl and >30 meter below ground level (m bgl). The water level range of 5 to 10 m bgl covered 45% of the area, 10 to 20 m bgl covered 46% of the area whereas the deepest category of >30 m bgl covered 1.2% of the study area. During the post-monsoon period, the water level rose by between the ranges of less than 5 m bgl to 20 m bgl. The area with the deepest water levels reduced to only 0.4%. Significant decrease in the number of wells showing water level between 5 to 10 m bgl from 42.2 % to 40.2% with decreasing the area falling from 45% to 43.52% during post monsoon. Water level fluctuations range from -15.13 to 26.2 meters, with an average decline of 1.96 meters. Out of the 97 wells, 69 wells (71%) showed a rise in water levels (0.08 to 26.2 meters) across most of the block, while 28 wells in isolated areas experienced a drop-in level ranging from -15.3 to -0.22 meters.

Soil infiltration, a primary component of groundwater resource estimation, was tried to be refined based on field experiments using a double ring infiltrometer. The average rainfall coefficient from infiltration tests (8.8%) conducted at six various locations is very close to the considered value of 8.7%, therefore no further refinement was suggested.

To evaluate chemical quality of the groundwater in Saoner Taluka, total 287 samples and 117 samples were collected from established key observation wells during pre-monsoon season (May) of 2023, and post-monsoon season (November) of 2023 respectively. The samples were analysed for major cations and major anions.

Electrical conductivity (EC) is a key indicator of water quality. In general, its value ranges from 10 to 50,000 µs/cm at 25°C for rainwater and seawater, respectively. The EC value between 1500 to 3000 found in 17 samples of shallow aquifer and 26 samples of deeper aquifer localised area viz eastern part, south-eastern part and central of Saoner taluka.

The fluoride concentration exceeding permissible limit of 1.5 mg/l in localised areas in western and north-western part of Saoner taluka. The higher value of Nitrate, more than permissible limit (>45 mg/l) has been found at every location of Saoner taluka. It is released from fertiliser.

Total 131 samples were collected during pre-monsoon period and analysed for trace elements. As per the results, 3 samples have Aluminium, 3 samples have Manganese and 3 samples have Iron more than their permissible of BIS.

The chemical quality data has been analysed for its suitability for drinking and irrigation purpose. The analysis indicates that during fluoride concentration is more in shallow aquifers as compared to deeper aquifers in both seasons. It is also observed that 33.5% samples in shallow aquifer and 45.34% samples in deeper aquifer showing nitrate concentration more than permissible limit (>45 mg/l). As for suitability for irrigation is considered, majority of samples (100 % & 87.10 %) from shallow aquifer and 100% & 76.36% from deeper aquifer during pre- and post-monsoon season respectively falls under low salinity zone.

The ground water quality as observed from the exploratory-wells constructed by Central Ground Water Board is generally suitable for drinking purpose.

An analysis conducted under the “Standard Operating Procedure” (SOP) for the “Sustainability of Groundwater Sources” considered key parameters such as rainfall, terrain conditions, aquifer potential, groundwater sustainability/availability, depth to water level, and water quality. Among 134 villages, five were classified as "At Risk" due to over 50% of their geographical area having slopes greater than 20%. In these villages, improving the efficiency of recharge structures like contour trenches, bunds, and staggered contour trenches is recommended. Six villages, identified as "At Risk" based on demand-supply gaps, aquifer potential, and water table depths, require the creation of new abstraction structures through GP surveys to tap productive aquifers and meet future drinking water demands. Additionally, four villages with fluoride concentrations exceeding 1.5 mg/l were categorized as "At Risk," where water can be treated using defluoridation techniques, reverse osmosis (RO) filtration, and dilution through recharge structures to make it suitable for use.

The major issues from the study are identified as deeper water levels (> 20 m), long term declining trend in water levels, source sustainability of existing structures, ground water quality issues (Geogenic and Anthropogenic), reduced water retention capacity and drying out of irrigation dug wells near Mining area, reported land subsidence in Villages nearby Mining Area in Saoner Block. The prevailing interventions have been recommended to overcome these issues.

Efforts should be directed towards supplying surface water to villages experiencing groundwater quality issues.

The fluoride rich ground water may be used for other domestic purposes or it can be taken after blending with fluoride free water.

Defluoridation methods such as activated alumina, low-cost adsorbents, and ion exchange are recommended. Community involvement in the operation and maintenance of these systems is essential, along with implementing integrated fluorosis mitigation measures.

In high salinity areas, it is recommended to go for salt tolerant crops like sorghum, wheat, chickpea, sesame, Soybean, sunflower, barley and daylilies a popular and easy to grow flowering plant etc are recommended.

Effective remediation of nitrate contamination in groundwater involves techniques like ion exchange, reverse osmosis, and biological denitrification. Prevent further nitrate leaching by optimizing fertilizer use and enhancing wastewater treatment practices. Regular groundwater quality monitoring and the adoption of best management practices in land use are crucial for long-term remediation and protection of water resources.

To address reduced water retention and well drying near mining areas, implement effective water conservation techniques, including constructing check dams and recharge pits to

boost groundwater replenishment. Adopt controlled mining practices to reduce groundwater depletion and use artificial recharge methods to restore water levels. Regularly monitor and maintain wells, and promote sustainable water management practices among local farmers to support the recovery and sustainable use of water resources in affected regions.

Near mining areas preventive measures should include implementing sustainable mining practices and groundwater recharge techniques, in conjunction with structural reinforcements such as grouting and soil stabilization. Restoration efforts should focus on land reclamation and groundwater quality improvement, complemented by community education and stakeholder collaboration. In order to manage the available ground water resources in sustainable manner, the strategy recommended under the four categories: Supply side, Demand side, Institutional and Regulatory measures.

Repair, Renovation & Restoration (RRR) of existing structures (Existing): there are 03 medium irrigation projects, 12 small local level irrigation projects, 10 Kolhapur Type bandharas, 19 earthen nalla bunds, 127 cement nalla bunds, 20 continuous contour trenches are identified for RRR.

Construction of artificial recharge structures: Based on the study, construction of 406 artificial recharge structures (ARS) (Check Dam:200, Percolation tank:6, and Recharge Shafts:206) are suggested in 123 villages out of 136 villages.

Water conservation Measures: The villages, not suitable for artificial recharge, farm pond and contour trenches at suitable locations.

Under the Demand Side management, drip and sprinkler irrigation instead of traditional flooding irrigation methods and intercropping are suggested.

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NAQUIM 2.0: WATER STRESSED AREA

AQUIFER MANAGEMENT PLAN OF SAONER BLOCK, NAGPUR DISTRICT, MAHARASHTRA

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SAONER BLOCK AT A GLANCE

1. GENERAL INFORMATION				
	Geographical Area	:	675.43 sq.km	
	Villages	:	134	
	Gram Panchayat	:	79	
	Population (2011)	:	229450	
2.	**CLIMATE AND RAINFALL**			
	Normal Rainfall	:	1008 mm	
	Actual Rainfall (2023)	:	831 mm	
3. GEOMORPHOLOGY AND DRAINAGE				
	Geomorphology	:	Pediments, plateaus dissected and isolated hilly	
	River Basin/Sub Basin	:	Wardha - Wainganga sub basin	
	Major Drainage	:	Kanhan River and its tributaries	
4.	**SOIL**			
	SOIL TYPE	:	Deep moderate loamy to Moderately Deep Loamy to Moderately Loamy to slightly Deep Loamy to very shallow loamy to extremely shallow clayey soil	
5. LAND USE (2023) (source: mahades.maharashtra.gov.in/district Report)				
	Forest Area	:	76.6 sq. km.	
	Agriculture	:	470.13 sq km.	
	Net Area Sown	:	514.96 sq. km.	
	Cultivable Area	:	452.85 sq. km.	
6. PRINCIPAL CROPS (2023)				
	Cereals	:	83.19 sq. km.	
	Wheat	:	20.85 sq. km.	
	Cotton	:	294.29 sq. km.	
	Vegetable	:	13.02 sq. km.	
	Citrus crop (Orange, sweet lemon etc)	:	15.14 sq. km.	
7. IRRIGATION BY DIFFERENT SOURCES (2022-23) Nos. / Potential Created (sq. km.**)**				
	Irrigation wells	:	5681 nos.	64.92 sq. km.
	Minor Irrigation	:	12 nos.	17.06 sq. km.
	Medium Irrigation	:	3	97.40 sq. km.
	Major Irrigation	:	Nil	Nil
	Net Irrigated Area	:	64.92 sq. km.	
8. GROUND WATER MONITORING WELLS (2024)				
	Dug wells	:	6	
9. GEOLOGY				
	Recent	:	Alluvium	

	Upper Cretaceous-Lower Eocene	:	Deccan Trap Basalt	
	Upper Carboniferous to Lower Cretaceous	:	Lameta	
	Permo-carboniferous	:	Gondwana	
	Archean	:	Saucer and Sakoli formations (Granite gneiss, schists, Phyllite)	
10. HYDROGEOLOGY				
	Water Bearing Formation	:	Alluvium- Sand and Gravel under phreatic condition. Basalt- weathered/fractured/ jointed vesicular/massive, under phreatic and semi-confined to confined conditions. Gondwana Sandstone- under semi-confined to confined conditions. Archaean Gneiss/Schist- Jointed/fractured	
11. GROUND WATER EXPLORATION (Upto March 2024)				
	Wells Drilled	:	41 (EW-14 OW-19, Pz-8)	
	Depth Range	:	43 to 307 m bgl	
	Discharge	:	0.14 - 14.88 lps	
	Storativity	:	$3.0x10^{-3}$ to $4.9x10^{-4}$	
	Transmissivity (m2/day)	:	0.16 to 250	
12.	**GP SURVEY**	**:**	66 VES	
13.	**nd WATER SCENARIO**			
		:	Pre-monsoon	Post-monsoon
	Shallow Aquifer: Depth to Water Level (mbgl)	:	1.2 (Bhagi mari)- 20.30 (Karjhat)	1 (Bhondetal)- 19.9 (Katodi)
	Shallow Aquifer Water Level Trend (2014-2023) (m/year)	:	Rise: upto 0.2 in majority area of the block	Rise: 0.8 (Sillori)
			Fall: 0.4 to 0.6 (Nandpur)	Fall: 0 to 0.2 (Kelwad)
	Deeper Aquifer: Depth to Water Level (mbgl)	:	1.6 (Bhagi mari) - 30 (Nimtalai)	1.1 (Bhagi mari) - 49.54 (Sawali)
14. GROUND WATER QUALITY				
	Quality of both the aquifers (shallow and Deeper Aquifers) Good and suitable for drinking and irrigation purpose, however localized nitrate/ fluoride contamination is observed.			
15. DYNAMIC GROUND WATER RESOURCES-2023 (MCM)				
	Net Annual Ground Water Availability	:	49.1348	
	Total Extraction (Irrigation + Domestic+ Industrial)	:	34.2421	
	Projected Demand (Domestic + Industrial)	:	6.5414	
	Stage of Ground Water	:	69.32	

	Development		
	Overall Category	:	**Safe**
16. MAJOR GROUND WATER PROBLEMS AND ISSUES			
	• Deeper water levels (> 20 m) • Long term declining trend in water levels • Source sustainability of existing structures • Ground water Quality Issues (Geogenic and Anthropogenic) • Reduced water retention capacity and drying out of irrigation dug wells near Mining area • Reported Land Subsidence in Villages nearby Mining Area in Saoner Block.		
17.	**Proposed Management Plan**	:	**Supply side Intervention:** Percolation tank with Recharge Shaft-6 Check dam/Cement nala bund with Recharge Shaft -200 **Demand Side Intervention:** 757 ha area of orange and sweet lime is proposed for micro-Irrigation.

AQUIFER MANAGEMENT PLAN OF

SAONER BLOCK, NAGPUR DISTRICT, MAHARASHTRA

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AQUIFER MANAGEMENT PLAN OF SAONER BLOCK, NAGPUR DISTRICT, MAHARASHTRA

1. INTRODUCTION

1.1 Background

National Aquifer Mapping (NAQUIM) was initiated in 2012 as a part of the 'Ground Water Management and Regulation' scheme with the objective to delineate and characterize the aquifers and develop plans for sustainable ground water management in the country. The NAQUIM has been prioritized to study Over-exploited, Critical and Semi-Critical blocks as well as the other stress areas recommended by the State Govt.

Aquifer mapping is a process wherein a combination of geologic, geophysical, hydrologic and chemical analyses is applied to characterize the quantity, quality and sustainability of ground water in aquifers. National level mapping of Aquifers on 1:50,000 scale was considered sufficient for planning requirements up to block level. Mapping of entire targeted area has been completed in the year 2023. The studies completed so far have provided several newer insights into ground water scenarios and management alternatives. Evidence based management interventions including supply and demand-side measures are recommended for containing over-exploitation in stressed aquifers. Alternative contaminant-safe aquifers have been delineated in many areas, where ground water contamination have been reported. The studies show that large aquifer systems can be recharged in an integrated manner improving ground water availability for irrigation over extensive areas. The findings of NAQUIM studies are being utilized by many agencies including State Ground water Departments or agencies working in Ground Water Development and Management works.

In Maharashtra State, findings of NAQUIM report are being used in

1. Source Water Sustainability (NRDWP)
2. Atal Bhujal Yojna -Participatory Ground Water Management
3. Sites for Artificial Recharge (AR works in Aspirational District of Osmanabad works**)**
4. Implementation of water Conservation under MGNREGA in Over-Exploited Warud block of Amravati district
5. Drinking water source Findings and source Sustainability (Drought Mitigation in Latur district)
6. Other State Govt. Projects i.e., **Tapi Mega Recharge Scheme.**
7. The NAQUIM outputs are very useful for pinpointing the sites for water supply and Artificial Recharge investigation undertaken by CGWB for various Defence establishments located in Maharashtra.

1.2 NAQUIM 2.0

Though the NAQUIM output has been useful for sustainable ground water management in numerous ways as enumerated above, large scale implementation of its recommendations at ground level by the user agencies is lacking. As per the feedback received from the agencies using the NAQUIM outputs, major limitations of the on-going studies include i) non-availability of printed maps at usable scales and ii) lack of site-specific recommendations for implementation at Panchayat or village level.

Keeping the above limitations in mind and considering the future requirements, broad objectives of NAQUIM 2.0 studies will be i) providing information in higher granularity with a focus on increasing density of dynamic data like ground water level, ground water quality etc. ii) providing issue based scientific inputs for ground water management up to Panchayat level iii) providing printed maps to the users iv) putting in place a strategy to ensure implementation of the recommended strategies and involving v) State agencies in the studies for a sense of ownership.

The NAQUIM 2.0 studies are envisaged to be multidisciplinary. The study is designed to provide detailed information to support groundwater management decisions at ground level. Since the issues are different in different areas, the studies under NAQUIM 2.0 are proposed as issue specific and will be undertaken in prioritized focus areas. Broadly 11 Priority areas are identified based on ground water related issues one of the main identified issues is Water Stressed Areas.

1.3. About the Study Area

Saoner block is one of the fourteen blocks of Nagpur district and is located in Northeastern region of the district. Saoner block is extended from **21°14'56.08"**N to **21°37'06.10"**N and **78°42'29.36" E** to **79°09'27.78"E**. Towards the northern border of the taluka the state Madhya Pradesh is located. Towards eastern border of the taluka Parsioni taluka is located and western boarder Umerkhed taluka is located. Towards southern border Kalmeshwar, Nagpur taluka and towards southeast region Kamptee taluka is located. This block has been taken up in NAQUIM 2.0 in AAP 2023-24 covering an area of 675.43 Sq. km **(Fig. 1.1)**. The area has been mapped on 1:10,000 scales. Considering the Water Stressed Areas, facing ground water scarcity due to various reasons i.e., Over Exploitation of ground Water for Cash Crop (Orange/Lime Cultivation), Low yield Potential of the Aquifers, poor saturation of aquifers due to low rainfall etc., Saoner block has been taken up in “Water stressed area” out of 11 Priority areas as per Central Ground Water Board National mandate.

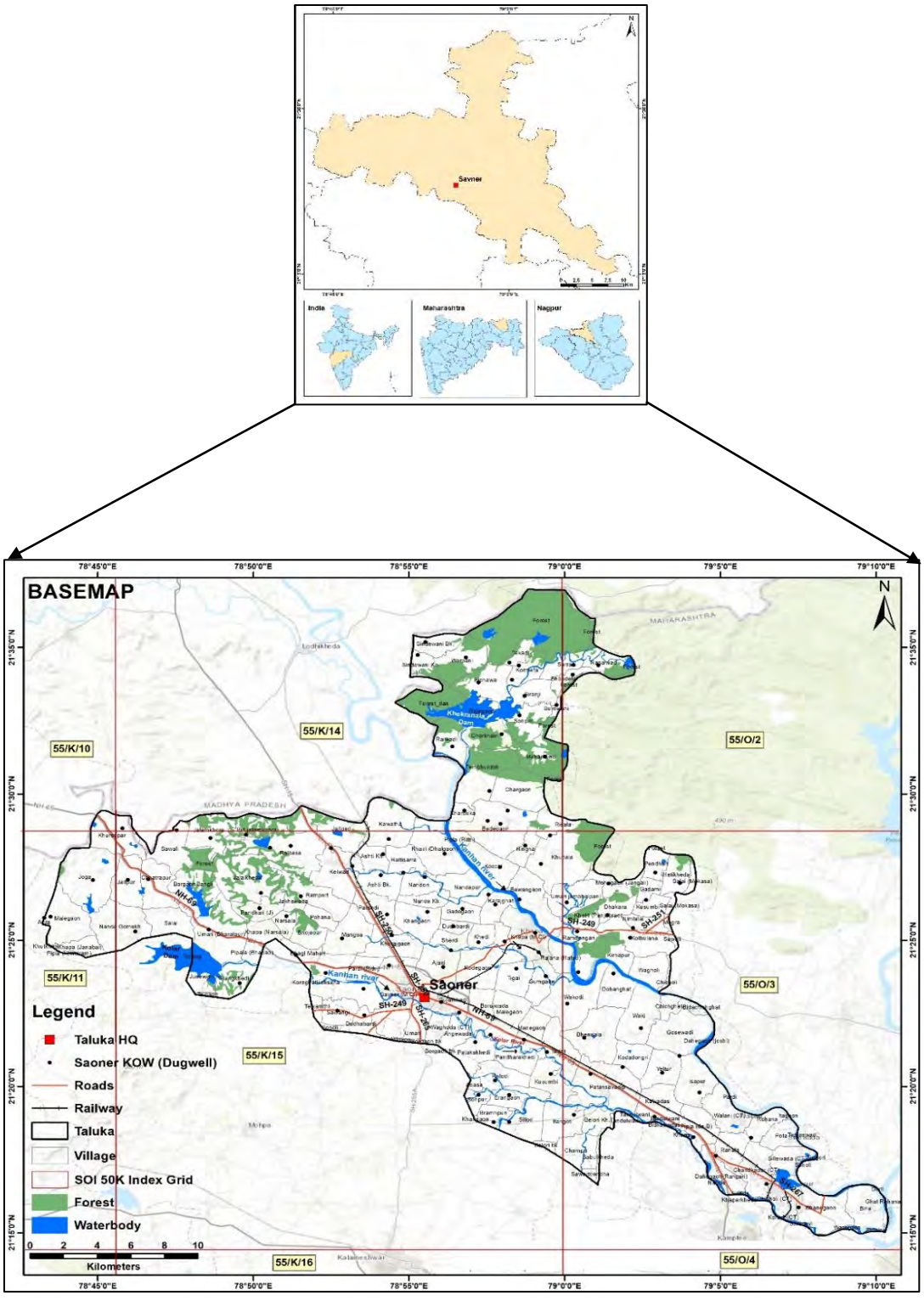


Fig 1.1: Index map, Saoner block, Nagpur District under NAQUIM 2.0.

The objectives of the present study are to delineate

1. Detailed Aquifer Dispositions.
2. Aquifer-wise ground Water Levels.
3. Delineation of Recharge Areas.
4. Watershed-based Aquifer Mapping
5. Estimation/Refinement of parameters used for resource assessment by field work/Farmer feedback.
6. Assessment of ground water resources.
7. Ground Water Quality.
8. Areas showing signs of subsidence.
9. Ground Water Quality Management Interventions, including demarcation of safer aquifers.
10. Artificial Recharge Plan.
11. Identification of potential aquifers for drinking water supply using GP survey (Profiling)
12. A plan for drinking water source sustainability.
13. Other Measures for Sustainable Ground Water Development and Management of GW resources.
14. Impact of Mining activities and vulnerability of the aquifers.

Table 1.1 Salient features of the Saoner block, Nagpur district		
A.	**General Information**	
	State	Maharashtra
	District	Nagpur
	Block	Saoner
	BLOCK/TALUK HQ	Saoner
	Geographical area (sq km)	675.43
	Mappable Area (sq km)	562.37
	Hilly Area (sq. Km)	113.06
	Toposheet Nos.	55K/11, 55K/14, 55K/15, 55O/2, 55O/3, 55O/4
	No. of Gram Panchayats	79
	No. of Towns	7
	No. of Villages	134
	Total population	2,29,450
	Male	1,18,645
	Female	1,10,805
	Rural Population	1,27,436
	Urban Population	1,02,014
	Climate	Tropical
	Normal Rainfall	1,012.70

	River Basin	Wardha-Wainganga Basin			
	Drainage	Kanhan river and its tributaries			
	Drainage Pattern	Sub Dendritic to Dendritic drainage			
	Soil type	Deep moderate loamy to Moderately Deep Loamy to Moderately Loamy to slightly Deep Loamy to very shallow loamy to extremely shallow clayey soil			
B	**Land Use (Source: DSA 2022)**				
	Forest area (sq.km.)	76.6			
	Cultivable area (sq.km.)	452.85			
	Net sown area (sq.km.)	514.96			
	Double cropped area (sq.km.)	51.65			
C	**Cropping Pattern (DSA 2022)**				
	Major crops	Kharif	Rabi	Summer	Perennial
		Jowar	Wheat	Vegetables	Citrus
		Soyabean	Channa	Chilli	Cotton
			Tuar		Sugarcane
D	**Irrigation Facilities**				
	Net Irrigated Area (sq.km.)	64.92			
E	**Geology & Hydrogeology**				
	Predominant Aquifer Type	Hard Rock			
	Major Geological Formation	Deccan Trap Basalt Gondwanas (Sandstone with Shale) Archean Granite Gneiss			
	Principal Aquifer	Basalt (BS01) Sandstone with Shale (ST03) Gneiss (GN02)			

1.4 Priority Area:

Saoner block of Nagpur district has been taken up under NAQUIM 2.0 under "**Water Stressed Area" Category.** The groundwater resource assessment is taken up by the CGWB in collaboration with GSDA, where it has been decided to assess the ground water resources on yearly basis. As per GWRA-2022 the stage of groundwater extraction is 70.06% and is categorized as "*Semi Critical*". The annual extractable groundwater resource is 47.98 MCM, whereas the total draft is 33.61 MCM. The stage of GW extraction of the block is **70.06%**. Due to over exploitation of ground water with less development activities the Saoner taluka has been categorized as the Semi-Critical area which leads to water stressed area. The dynamic ground water resources are presented in **Fig.1.2**

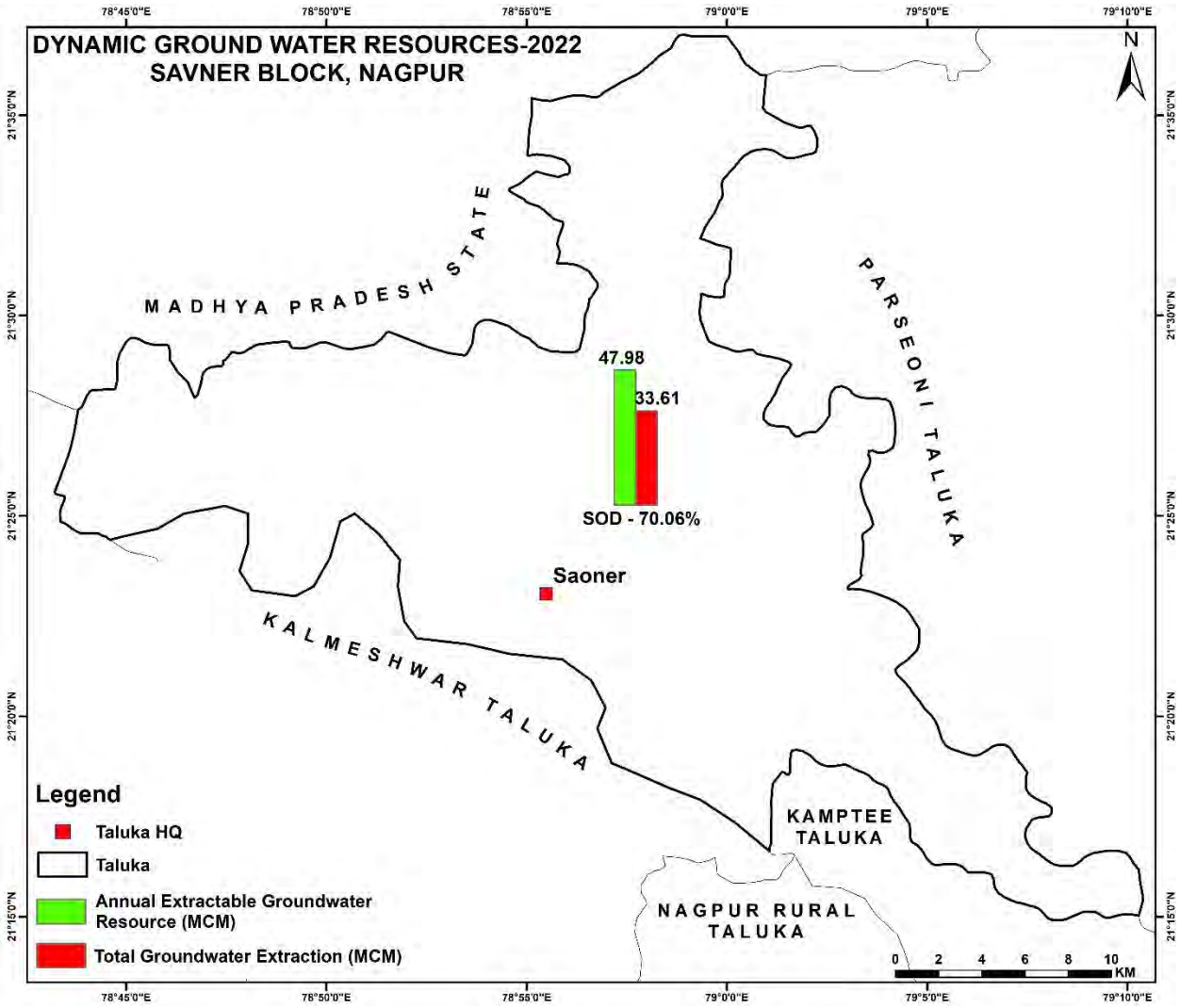


Fig 1.2: The Dynamic Groundwater Resources of GWRA-2022 of Saoner block, Nagpur district.

Saoner block has total 7 watersheds WGK-1, WGK-2, WGK-5, WGKK-1, WGKK-2, WGKK-3 and WGKKC-1. The watershed wise resource assessment shows out of 7 watersheds, one falls under semi-critical category remaining all are in safe category **(Table-1.2)**.

Table-1.2: Watershed wise Ground Water Resource assessment GWRA 2022.

GWRA 2022							
Watersheds	**WGK-1**	**WGK-2**	**WGK-5**	**WGKK-1**	**WGKK-2**	**WGKK-3**	**WGKKC-1**
Recharge worthy area (ha)	18161	16117	16982	18057	14561	13791	13914
Annual recharge from Rainfall (ham)	1001.93	1107.8	1280.2	1162.62	984.92	1133.49	1531.72
Recharge from other sources (ham)	265.92	661.7	477.912	586.868	247.954	341.47	388.72
Gross Ground Water extraction (ham)	772.58	978.45	1066.01	1379.9	803.19	943.74	1169.46
Annual extractable groundwater (ham)	1204.45	1681.03	1644.53	1610.86	1164.33	1356.11	1737.65
Stage of Extraction (%)	64.14	58.20	64.82	85.66	68.98	69.59	67.30
Category	**Safe**	**Safe**	**Safe**	**Semi critical**	**Safe**	**Safe**	**Safe**

1.5 Previous Studies

Central Ground Water Board (CGWB), Nagpur has carried out several Regional and specific studies in Saoner taluka of Nagpur district **(Table 1.3)**.

Table 1.3: Regional and Specific Studies carried out in Saoner taluka of Nagpur district

A.	**Systematic/ Reappraisal Hydrogeological Surveys**		
S.No.	**Type of Survey/Study**	**Officers Name**	**Year of Study**
1.	Systematic Hydrogeological Surveys	Shri Atram, N. S.	(1970-71, 1971-72, 1976-77 & 1981-82)
2.	Systematic Hydrogeological Surveys	Shri Gajbhiye N. G.	1975-76
3.	Systematic Hydrogeological Surveys	Shri Motghare	1976-77 & 1977-78
4.	Systematic Hydrogeological Surveys	S/Shri Sudarshan G, Jain, S.K. and Binoy Ranjan and by Talukdar, T	1990-91
5.	Systematic Hydrogeological Surveys	Sh. Binoy Ranjan	1995
6	Reappraisal Hydrogeological Surveys	S/Shri Bhattacharya, S. Joshi. D. and Binoy Ranjan	1991-92
	Reappraisal Hydrogeological Surveys in parts of Godavari Basin, Nagpur District, M.S.	Shri K.B. Sahoo	1999-2000
B.	**GW Resource Assessment Report**		
1	Ground Water Resources and Development Potential of Nagpur District, M.S.	Shri K. N. Murthy and K. B. Sahoo	1999-2000
C.	**District Brochure/Report**		
1	District Brochure of Nagpur District, Maharashtra State.	Sh. S.K. Bhatnagar	2018
2	Hydrogeology of Nagpur District	Sh. A. B. Deshmukh	1981
D.	**NAQUIM report**		
1	NAQUIM report of Saoner block, Nagpur District 2019-20	Dr. Bhusan Lamsoge, Sh. Abhay Nivasarkar Ms. Pournima Barahate Sh. Sandip Bhowal	2019-20
E	**Other Report/Study**		
	Ground water exploration in the Gondwanas (1979-80, 1994-95, 2003-04 and 2004-05), Trap-covered-Gondwanas (1980-90, 1992-93), Deccan volcanics (1989-92) and Archeans (1989-95) was carried out by Central Ground Water Board (CGWB, 1998; present compilation) Hydrogeological Investigation in Silewara Coalfield of Nagpur District, M.S., studies on ground water flows into coalmines.		

	Report on the impact of Dewatering of Coal mines on GW levels in the Kamptee -Inder-Gondegaon coal Mines, Nagpur district, 1999.
E.	**Paper Published/News Paper Article**
	• Identifying potential sites for artificial groundwater recharge in sub-watershed of River Kanhan, India. Aabha P. Sargaonkar, Barkha Rathi, Archana Baile, Environ Earth Sci (2011) 62:1099–1108 DOI 10.1007/s12665-010-0598-z. • Using resistivity to delineate surface areas at risk of subsidence over Kamptee colliery, Maharashtra, India. K. K. K. SINGH, Central Mining Research Institute, Dhanbad, India. • Identification of Water Conservation Sites in Kolar Watershed of Nagpur District, Maharashtra using Geographical Information System (GIS) Technique. P. Kundal, S.V. Muley, and Y.B. Katpatal, Watershed Management for Sustainable Development, ISBN - 978-93-83083-82-4.

1.6 Climate and Rainfall

Rainfall is an important parameter which plays a crucial role in controlling groundwater dynamics. Rainfall Variability is one of the key factors that affect agricultural production in the region. Hence the appropriate study of rainfall variability and its trends will support water resources development and to make decisions for the developmental activities over the study area. For the present study the seasons can be defined as the pre-monsoon (March, April and May), summer/southwest monsoon (June, July, August and September), post-monsoon (October and November) and winter/northeast monsoon (December, January and February). The Groundwater level dynamics depends on the amount of rainfall over the region and the residence time of rainwater water over the recharge worthy area and ground water draft for various purposes. In addition, the soil properties and regional geology influence the rainfall recharge to the groundwater. Also, the groundwater extraction for domestic, industrial and irrigation purposes have significant influence on available extractable groundwater. The groundwater resources in the State of Maharashtra have various limitations, mainly attributed to typical physiographical, geological and hydro-geological conditions coupled with dynamics of monsoon.

Geologically, most of the State ~ 80 % of the area is covered by hard rock formation (Deccan trap basalt) and 33 % of geographical area is occupied by thin alluvium. The study area experiences a tropical climate. Saoner taluka of Nagpur district predominantly receives the rainfall from the summer monsoon. Almost 85-90% of the annual rainfall is received during the monsoon months i.e., from June to September. The rainfall variability in Saoner taluka highly dynamic at annual and seasonal times scales.

1.6.1 Annual Rainfall Variability:

The normal annual rainfall of Saoner taluka is 1008 mm. The annual rainfall observed with significant variability ranges from 792.5 mm to 1699.5 mm with minimum annual rainfall was

observed during 2014 and maximum annual rainfall during 1999 **(Fig. 1.3a)**. The rainfall trend analysis shows annual rainfall decreased with -10.10 mm/year during 1998 to 2023.

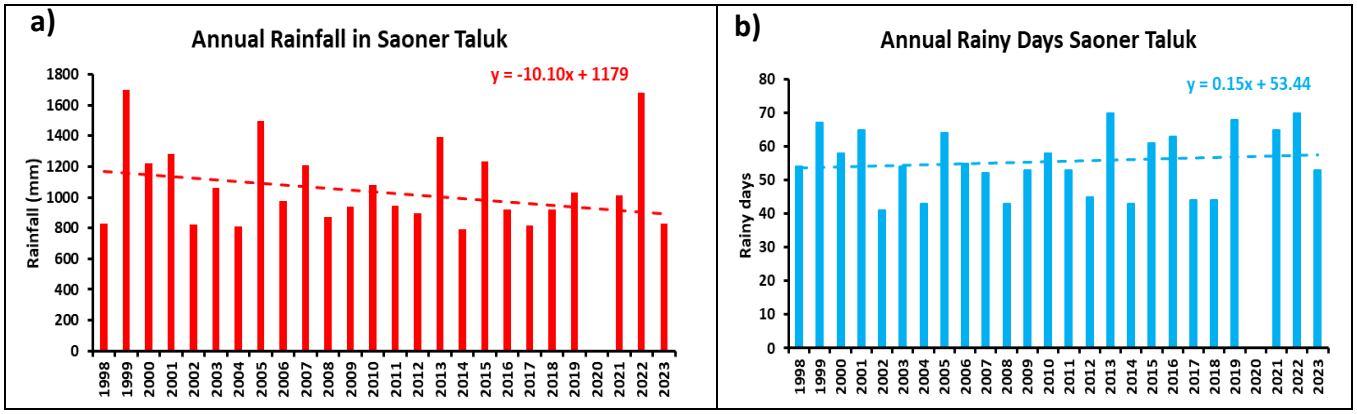
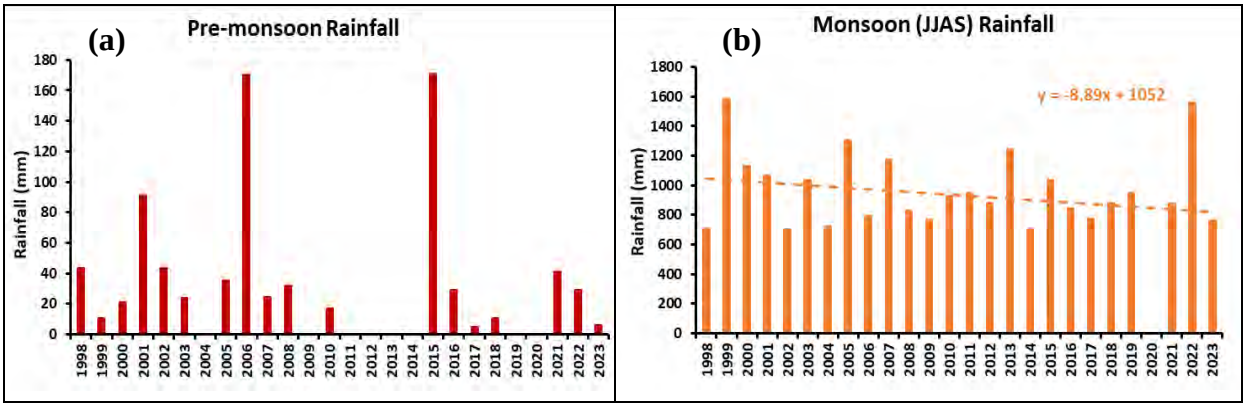


Fig 1.3: a) Annual rainfall variation b) annual rainy days during 1998-2023

The annual rainy days showing variability with minimum rainy days 41 and maximum rainy days 70 **(Fig. 1.3b)**. The annual rainfall shows a coefficient of variation of 50% which shows the rainfall during the 1998 to 2023 has ±50% variation around the mean rainfall of 437.5 mm to 1312.5 mm. The assured rainfall is 437.5 mm.

1.6.2 Seasonal Rainfall Variability of Saoner Taluka

The seasonal rainfall analysis shows significant changes in the rainfall amount during 1998-2023 **(Fig. 1.4)**. An insignificant increasing rainfall amount with trend value 0.34 mm/year is observed for summer monsoon **(JJAS; Fig. 1.4 b)**. Remaining seasons such as pre-monsoon (MAM), post monsoon (ON) and Winter monsoon (DJF) did not show any significant changes **(Fig. 1.4a, 1.4c, 1.4d)**.



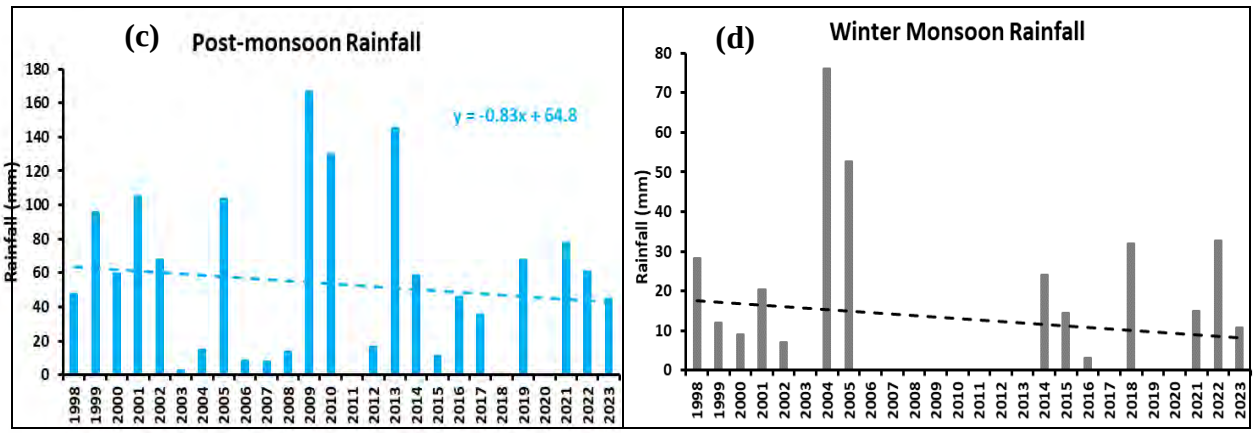
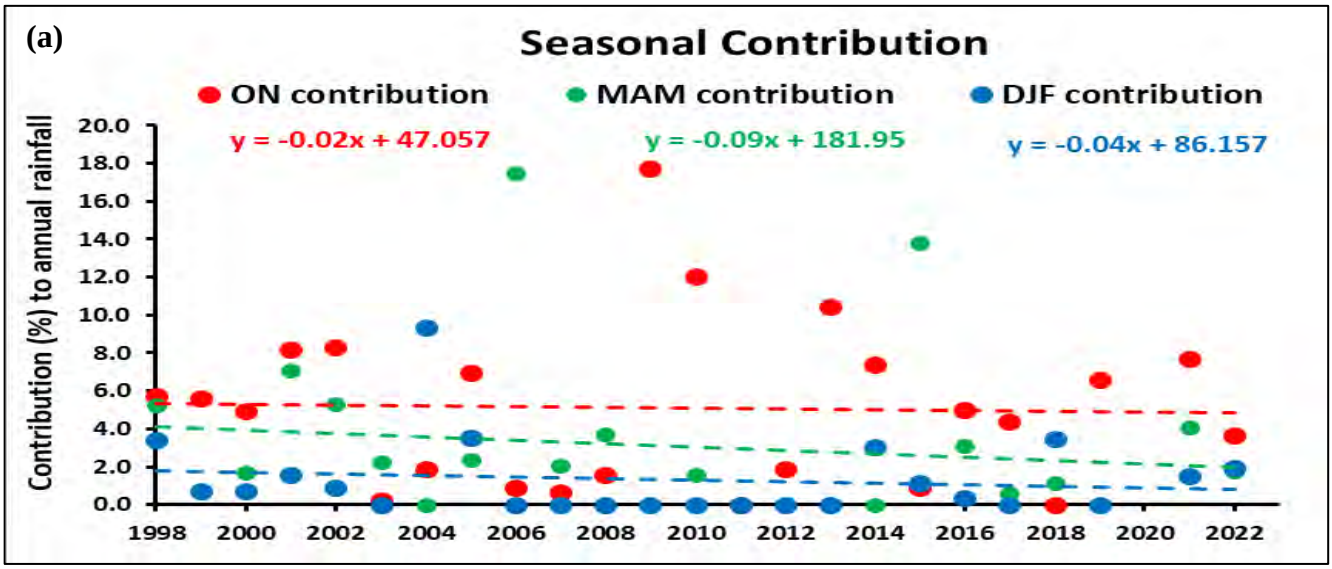


Fig 1.4: a) Pre-monsoon, b) Summer monsoon, c) post monsoon and d) winter monsoon rainfall variability.

In the total annual rainfall major contribution is from summer monsoon (JJAS) and insignificant contribution from remaining seasons was observed **(Fig. 1.5)**. During the period 1998-2023 the seasonal contribution to the annual rainfall is observed to be varying. The trend analysis shows significantly increasing trend in the summer monsoon trend to the total annual rainfall. The pre-, post- and winter monsoon seasons show decreasing trends for the study period which shows the seasonal contribution to annual rainfall except for summer monsoon has significantly decreased.



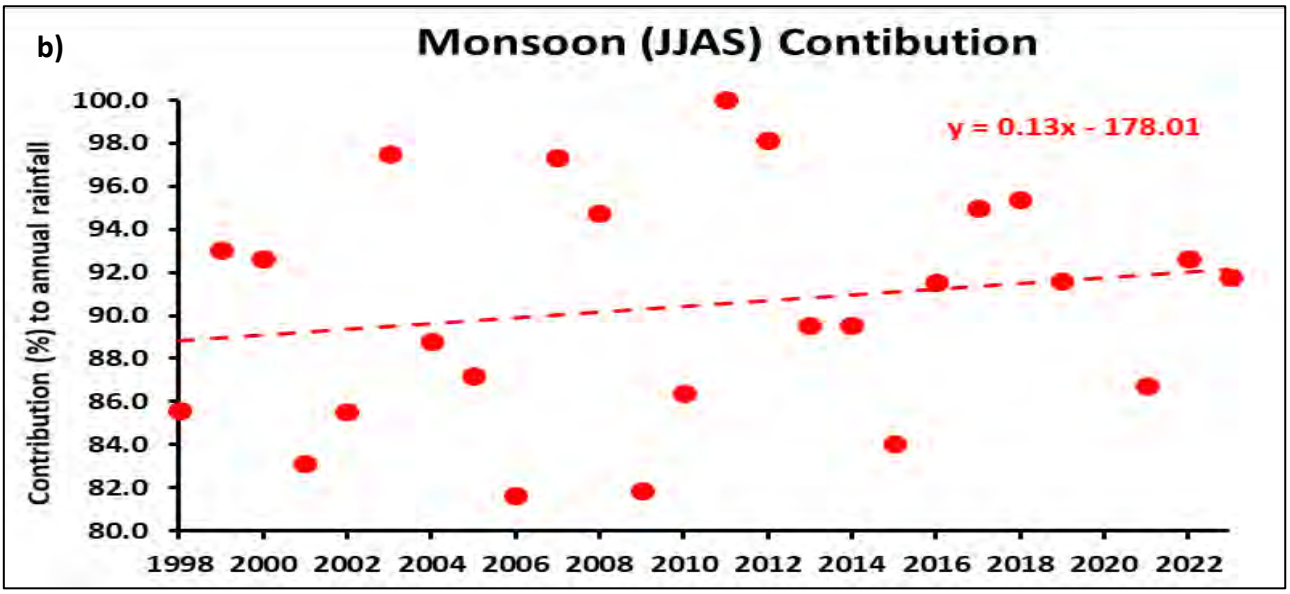


Fig. 1.5: a) Monsoon (JJAS) contribution (%) b) other seasonal (pre-, post- and winter) monsoon contribution (%) to annual rainfall variation during 1998-2023

1.6.3 Atmospheric parameters variability over Saoner Taluka

The atmospheric parameters play an important role in controlling local/regional climate (Table 1). The low atmospheric pressure systems will help in convergence of winds and associated moisture which will lead to formation of clouds by achieving dew point temperature and finally results in rain. The stronger the low-pressure system strengthens local surface convergence of air and increase rainy time. How in addition to the atmospheric pressure system the atmospheric humidity condition, i.e., relative humidity also plays an important role. The relative humidity is defined as the ratio of amount actual moisture present in the air to the amount of air that can hold at given temperature. Relative humidity is a unite less quantity expressed in percentage. Higher the relative humidity greater the chance of rain as it saturates the air. The climatic variation of atmospheric surface pressure and relative humidity of Saoner Taluka is presented in the **Fig.1.6**. The atmospheric pressure is observed with lower values during summer monsoon period (JJAS) and relative humidity show higher values during summer monsoon.

Table 1.4: Saoner taluka climate monthly mean rainfall, rainy days, atmospheric pressure, relative humidity and temperature variation.

Month	Mean monthly rainfall (mm)	Number of rainy days	Atmospheric pressure (mb)	Relative humidity (%)	Mean Monthly Temperature	
					Max (°C)	Min (°C)
Jan	9.3	1	1014.7	51	28	16
Feb	12.8	1	1012.9	46	32	19
Mar	21.5	2	1010.1	30	37	24
Apr	10.6	2	1006.6	21	41	28
May	11.7	3	1003.1	18	43	32
Jun	155.9	14	1001.3	55	37	29
Jul	354.7	22	1001.5	78	30	25
Aug	269.5	21	1003.1	82	30	24
Sept	191	16	1005.5	75	31	24
Oct	42.4	6	1010.1	57	32	22
Nov	11.8	2	1013.3	52	30	19
Dec	1.5	1	1014.6	49	28	16

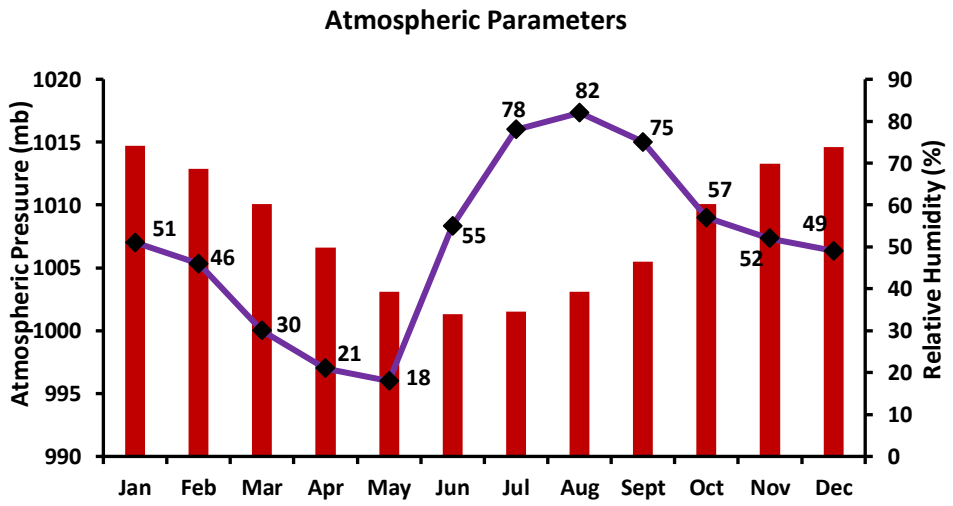


Fig 1.6: Atmospheric parameters (atmospheric pressure and relative humidity) variation.

The monthly mean actual rainfall variation along with rainy days for the study period is presented in **Fig.1.7**. The monthly mean (for period 1998 to 2023) rainfall shows maximum rainfall is received during summer monsoon followed by post monsoon (October and November).

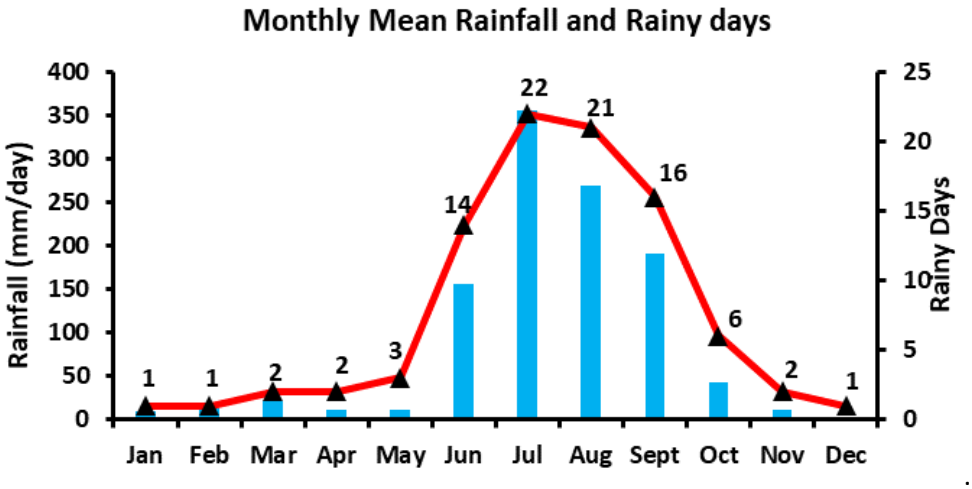


Fig 1.7: Monthly mean actual rainfall and rainy days variability

1.6.4 Drought Analysis

The normal rainfall of the district is 1009 mm. Annual rainfall data of 1998-2023 is analysed and presented in **Fig. 1.3a**. This indicates that Minimum rainfall occurred in 2014 (792.5 mm) and maximum rainfall in 1999 (1699.5 mm). The rainfall analysis shows that the departure of annual rainfall from the normal rainfall, expressed in terms of percentage, varied from -21.7 to 70.1 percent. The area experienced 4 time (19%) excess rainfall, 17 times (81%) normal rainfall conditions as given in **Table 1.5.** The coefficient of variation of the annual rainfall from the mean rainfall has been observed to be 50%.

Table 1.5: Saoner taluka annual rainfall drought analysis

Period = 1998 to 2023								
YEAR	**AVERAGE**	**NORMAL**	**DEPARTURE**	**No. of Rainy Days**	**CATEGORY**	Normal Rainfall	1009	
1998	830.5	1012.7	-18.0	54	NORMAL	Standard Deviation	267	
1999	1699.5	1012.7	67.8	67	EXCESS	Coefficient of Variation	25	
2000	1221.8	1012.7	20.6	58	NORMAL	Mean	1072	
2001	1282.4	1012.7	26.6	65	NORMAL	Median	974	
2002	823.6	1012.7	-18.7	41	NORMAL	Slope	-2.41	
2003	1063.6	1012.7	5.0	54	NORMAL	Intercept	939	
2004	812.6	1012.7	-19.8	43	NORMAL	Equation of Trend Line	y = -10.10x + 1179	
2005	1497.2	1012.7	47.8	64	EXCESS	**CATEGORY**	**NUMBER OF YEARS**	**%OF TOTAL YEARS**
2006	974.1	1012.7	-3.8	55	NORMAL	DEPARTURES		
2007	1209	1012.7	19.4	52	NORMAL	POSITIVE	12	48.0
2008	873.6	1012.7	-13.7	43	NORMAL	NEGATIVE	13	52.0
2009	941.6	1012.7	-7.0	53	NORMAL	**DROUGHTS**		
2010	1078.4	1012.7	6.5	58	NORMAL	MODERATE	0	0.0
2011	945.8	1012.7	-6.6	53	NORMAL	SEVERE	0	0.0
2012	897.5	1012.7	-11.4	45	NORMAL	ACUTE	0	0.0
2013	1391.1	1012.7	37.4	70	EXCESS	**NORMAL & EXCESS R/F**		
2014	792.5	1012.7	-21.7	43	NORMAL	NORMAL	21	84.0
2015	1234.8	1012.7	21.9	61	NORMAL	EXCESS	4	16.0
2016	923.3	1012.7	-8.8	63	NORMAL			
2017	818.3	1012.7	-19.2	44	NORMAL			
2018	923.8	1012.7	-8.8	44	NORMAL			
2019	1032.5	989	4.4	68	NORMAL			
2020	-	-	-		-			
2021	1012	989	2.3	65	NORMAL			
2022	1683	989	70.1	70	EXCESS			
2023	831	989	-15.9	53	NORMAL			

Rainfall departure:
EXCESS: > +25;
NORMAL: +25 TO -25;
MODERATE: -25 TO -50;
SEVERE: -50 TO -75;
ACUTE: < -75

1.6.5 Decadal Groundwater level analysis

The decadal groundwater level analysis with respect to rainfall variability for recent 10 years (2013 to 2022) show significant relation **(Fig.1.8)**. The Groundwater level shows rising and falling trends in observation wells with majority of them are showing falling trends during the period 2013 to 2022. During the same period the rainfall show similar rising decreasing trend. Based on the decadal rainfall analysis it observed that rainfall has significant influence in controlling groundwater level dynamics.

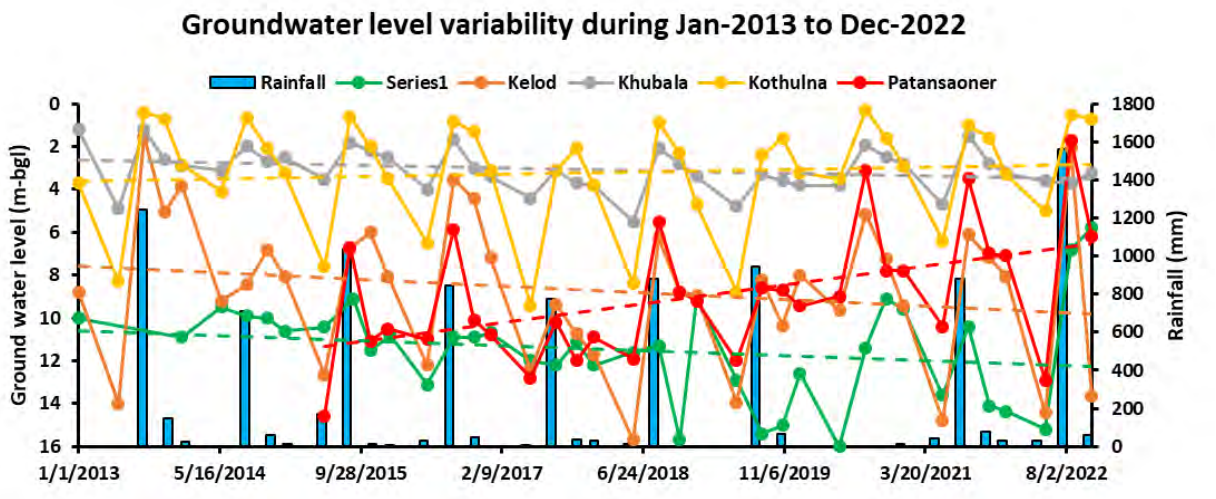


Fig 1.8: Decadal Groundwater analysis and rainfall variability over Saoner Taluka in four observation wells.

1.7 Physiography

The area can be broadly divided into two physiographic units i.e., the Satpuda Hill range, and plateaus. The elevation in the area ranges between 262.5 to 558.1 m amsl. In the western and northern, the upland ranges are an extension of the Satpuda ranges; these are narrow in the east but widen towards the west. The Pilkapar hill runs northwards through the Saoner taluka from Kondhali to Kelod, separating the Wardha and Wainganga valleys and are a smaller counterpart of Satpuda hill range. They present a characteristic appearance of flat or slightly rounded tops, covered with thin forests or brush woodland in some cases completely bare and stony. The hills are generally clear of trees, while upland plateaus covered with stones and with soil of varying depth (**Fig. 1.9**).

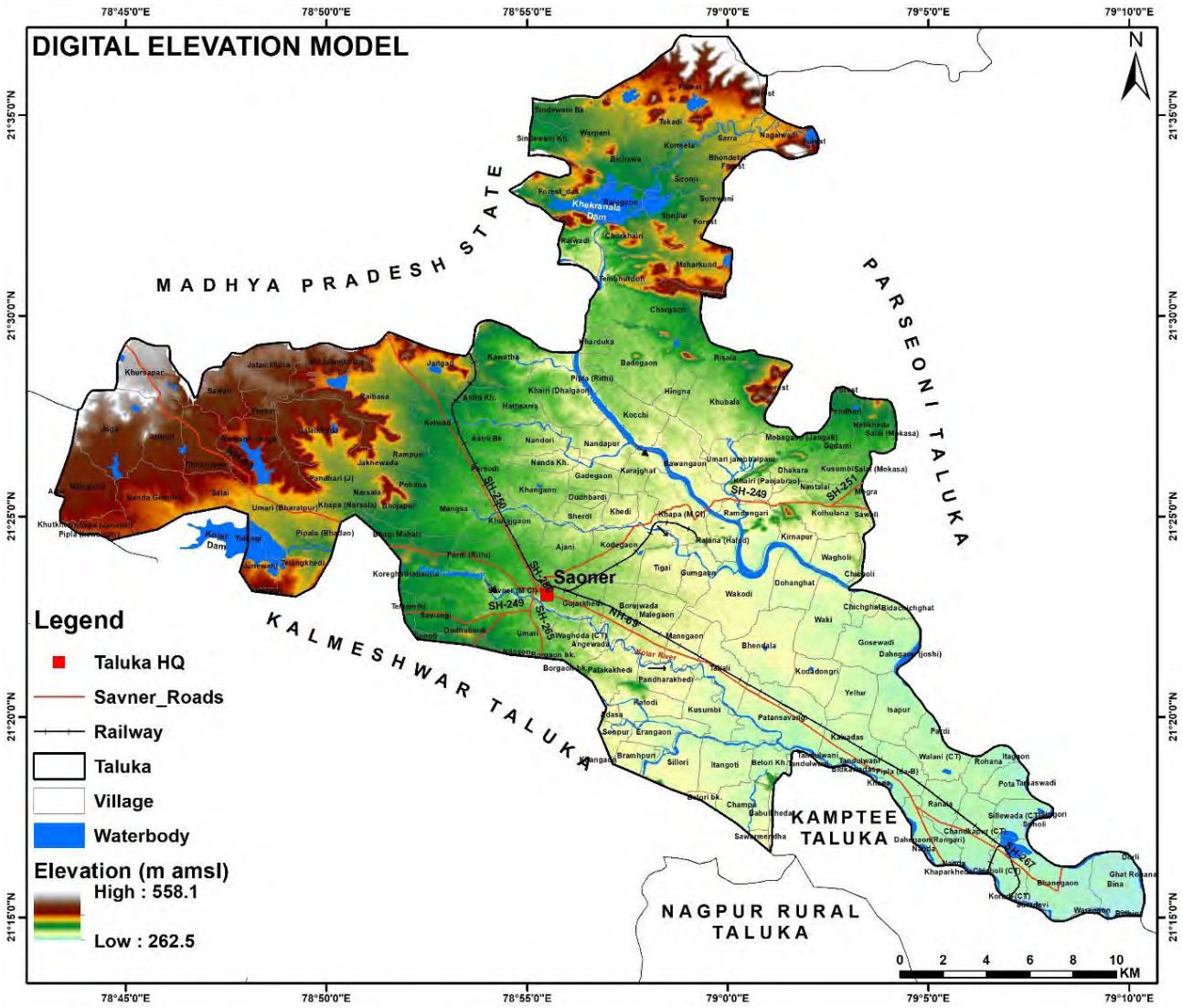


Fig 1.9: DEM of the study area, Saoner block

1.8 Drainage

Kanhan river and its tributaries and Kolar River and its tributaries constitute the principal drainage system in the area. Saoner block is in Wardha -Wainganga Sub basin. The drainage pattern is sub dendritic to Dendritic. The Drainage with watershed map is shown in **Fig 1.10**.

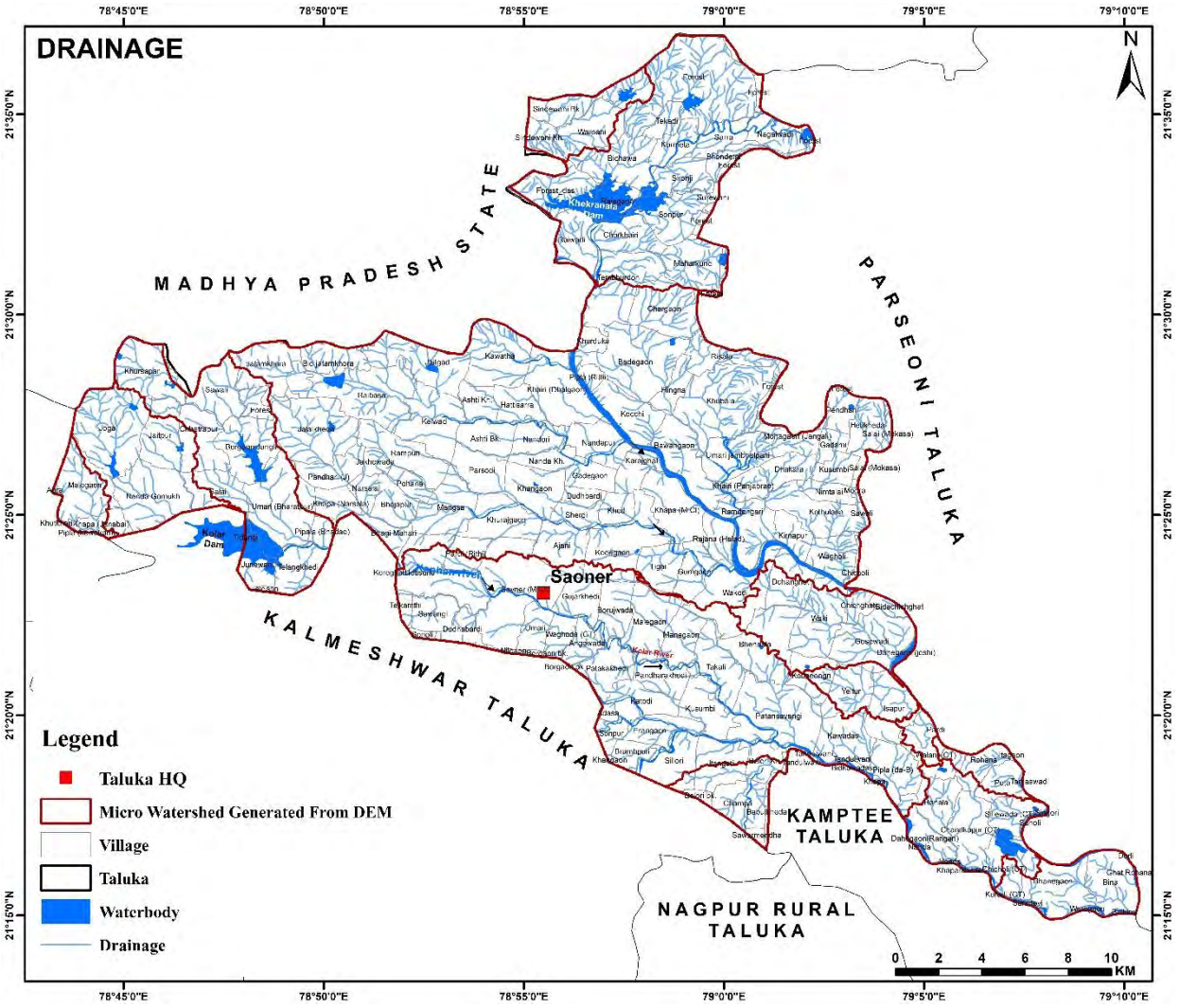


Fig 1.10: Drainage and Watershed map, Saoner block, Nagpur district

1.9 Geomorphology

The geomorphological map for this study area indicates that a significant portion of the taluka is composed of a high plateau. This plateau, with its gentle slopes and thick layer of weathered material, acts as a natural storage zone. The map also reveals other geomorphological features, including alluvium, denudational hills, plateau tops, and dissected hills and valleys. These varied landforms across the study area create ideal conditions for groundwater occurrence and storage.

Geomorphologically, the Saoner block contains features shaped by the ongoing erosion of Deccan volcanic basalts. Since most of the block is composed of Deccan basaltic formations, it predominantly displays characteristics such as pediments, dissected plateaus, and isolate ed hilly outcrops. These landforms are primarily of denudational and structural origin. The Saoner

block in the Nagpur district is largely characterized by a pediment-pediplain complex resulting from denudational processes.

Western part of the taluka is mainly covered by Pediplain and northern and some of the eastern part of the taluka is covered by Pediment Zone. The blank of the Kanhan river is mainly covered with valley fills.

In this taluka, sligjtly dissected plateau with weathering 0 to 1 m is widely spread followed by Moderately Dissected Plateau (MDP). The Geomorphological map of Saoner taluka is shown in **Fig. 1.11.**

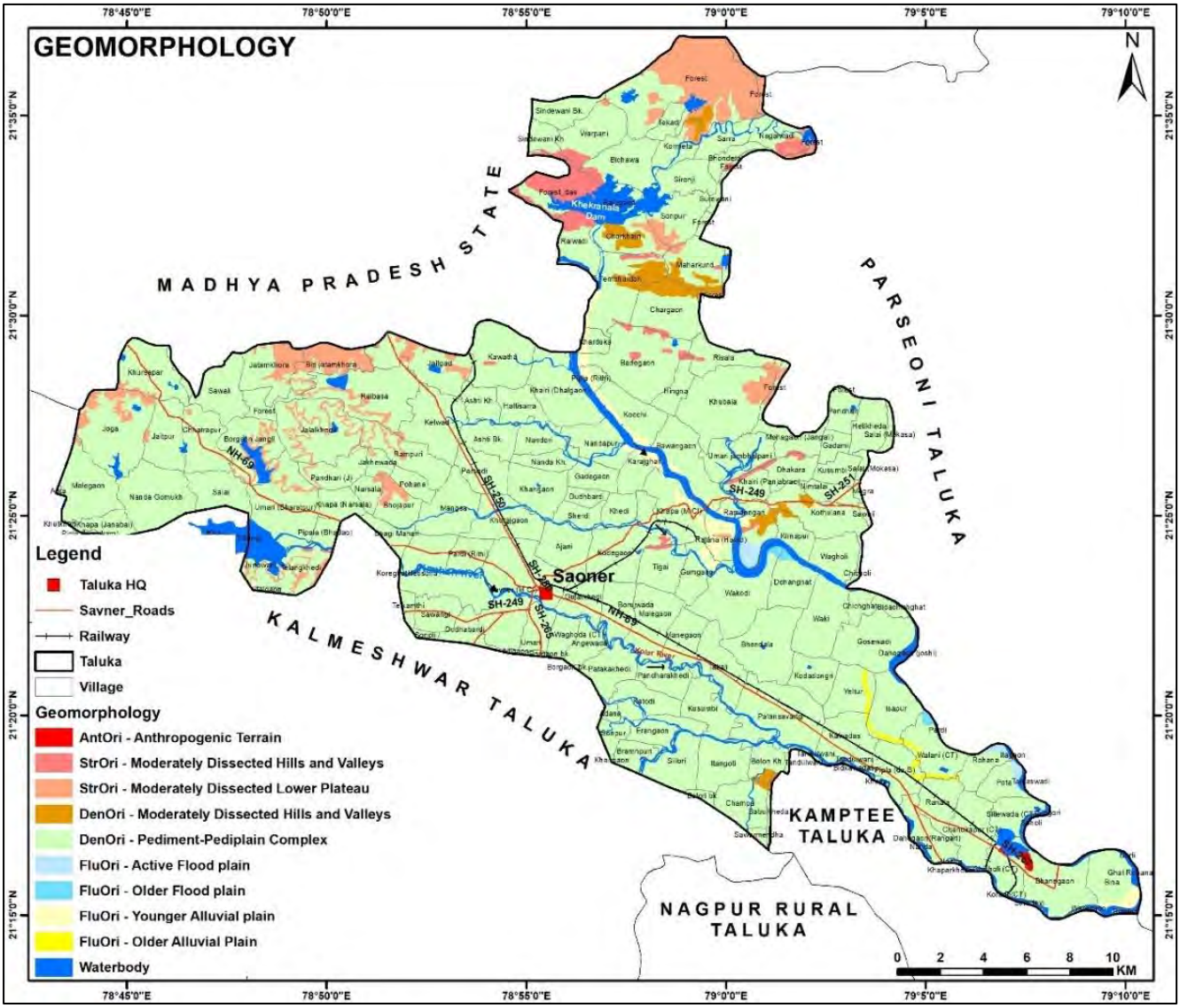


Fig 1.11: Geomorphological map of Saoner taluka

1.10 Land Use and Cropping Pattern

It has been observed that major parts of block are covered by agricultural land. The major area covers 'Kharif' while the orange orchards are categorized under 'Horticulture' category. Forest covers major area in the western, northwestern, northern part of Saoner taluka. The built-up area is reflected wherever settlements have come up. The major crops grown in Saoner are, Wheat, Soybean, Pulses, Groundnut, Gram, Jowar, Bajra, Linseed, Cotton, Sunflower, Tur and others. Soybean is considered to be the most important cash crop of Saoner. The agricultural distribution of crops does follows traditional pattern as oil seeds is the most dominant single crop in the Saoner taluka followed by pulses, cotton and oranges. The ground water-based irrigation caters to the major area i.e., 151 sq.km. (16.4% of net sown area), while surface water irrigated areas is about 126.38 sq.km (13.38 % of net sown area).

It has been observed that a major part of the area is occupied by clayey soil followed by gravelly clay to Silty loam. The southern part of the Saoner taluka gravelly sandy loam to Sandy clay loam soil is observed.

The socio-cultural and economic factors have significantly influenced over land use both in rural and urban areas in the taluka. Landforms, slope, soils and natural resources are some of the important which controls the land use pattern of the taluka. The land use pattern of district is based on the statistical outline of the district 2020, published by Government of Maharashtra and is presented in **Table 1.6.** Detailed land use pattern is shown in land use map in **Fig 1.12.**

Table 1.6 Land Use Pattern of Saoner taluka

S.No.	Land Use	Area in sq.km	%
1	Total geographical area	675.43	
2	Forest	76.6	11.34
3	Agriculture	470.13	69.60
4	Built up villages (Rural)	10.5	1.55
5	Wastelands	96	14.21
6	Waterbody	22.2	3.29

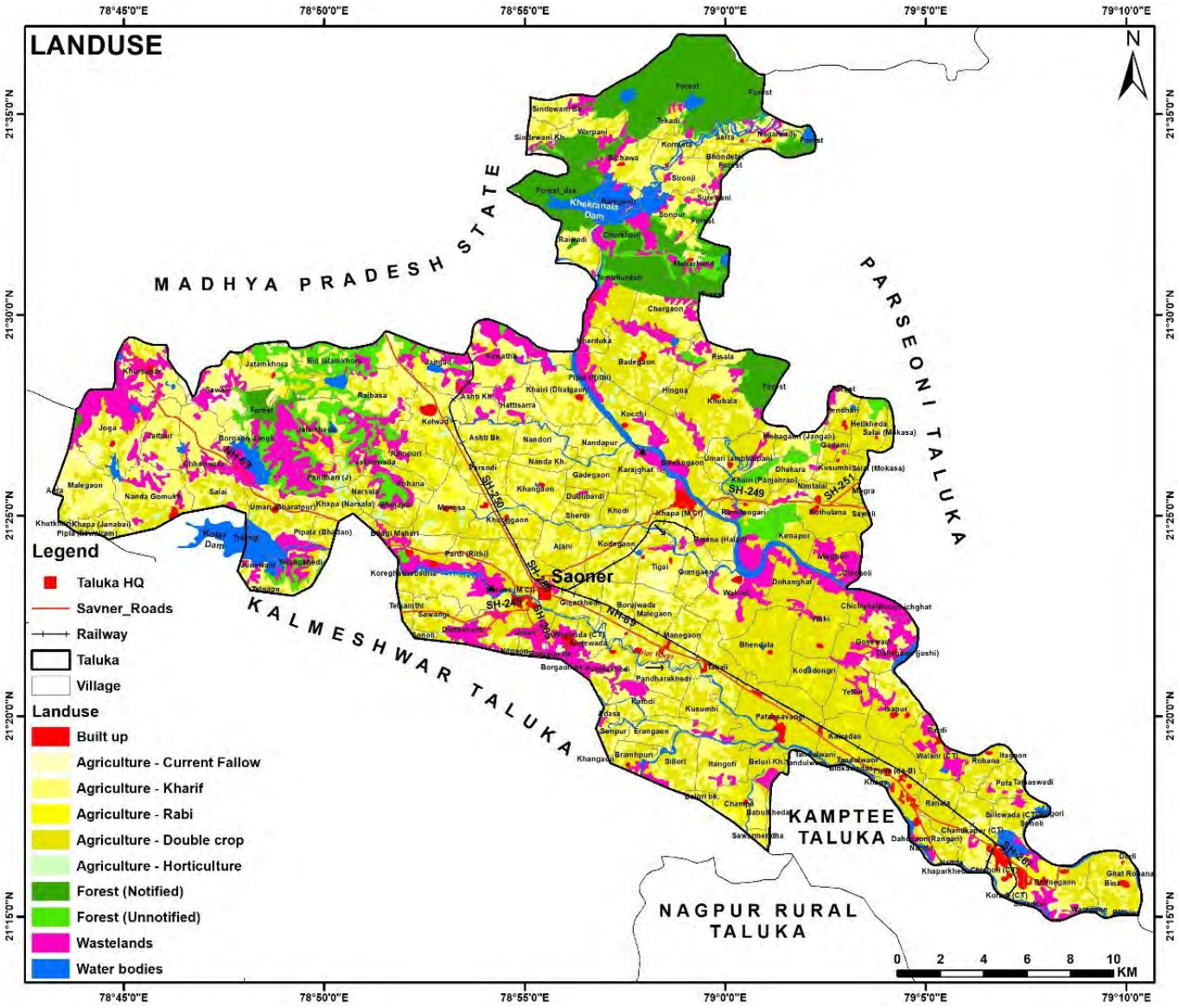


Fig 1.12: Land use, Saoner taluka, Nagpur District

1.11 Agriculture

Agriculture activity in the Saoner taluka is, by and large, confined to traditional kharif cultivation depending on monsoon rainfall and rabi cultivation is prevailing in areas where irrigation facilities are available. The major crops grown in the area are given in Table no. 1.9. Cotton is the most important crop under the rain fed. Soybean, pigeon pea, green pea, black gram also grown in this rain fed. Although some crops like gram, wheat and sunflower were grown in rabbi season. The Saoner taluka is famous for Oranges and Sweet lemons.

Table 1.7 Major crops of Saoner taluka, Nagpur District

Food Grain	Wheat, Jowar, Barley, Maize,
Cereals	Gram, other kharif cereals, Tur, Channa, other rabbi cereals
Oil seeds	Soyabean and Ground Nut
Non-food grains	Sugarcane, Cotton, Onion, Red chilli, Mango, Banana, Potato, Tomato, Brinjal
Horticulture Crop	Oranges and Sweet lemon

1.12 Irrigation

Ground water plays an important role for irrigation contribute almost 100% and is utilized through dug wells, dug cum bore wells and bore wells run almost by electricity in the area. There are 1 percolation tank, 56 Kolhapuri bandhara, and 5681 irrigation wells in the Saoner taluka. Details of Area irrigated with sources in Saoner taluka, Nagpur District is given in **Table 1.8.**

Table 1.8 Details of Area irrigated with sources in Saoner taluka

Taluka	Percolation tank	Kolhapuri bandhara	Irrigation wells
Saoner	1	56	5681

Source: District Outline, Nagpur, 2023

1.13 Soils

Soil has a major influence on the amount of water that can seep through and reach the water table from the surface. As the study area is largely covered by Deccan trap formations, it predominantly consists of black cotton soil, with textures ranging from clay loam and clay to sandy loam. The presence of clay soil indicates a gentle slope with a thick weathered layer, which creates favourable conditions for groundwater recharge. Given these characteristics, this area is highly suitable for water infiltration and percolation, making it an ideal location for enhancing groundwater resources. The distribution of major types of soils in the block is shown in **Fig-1.13.**

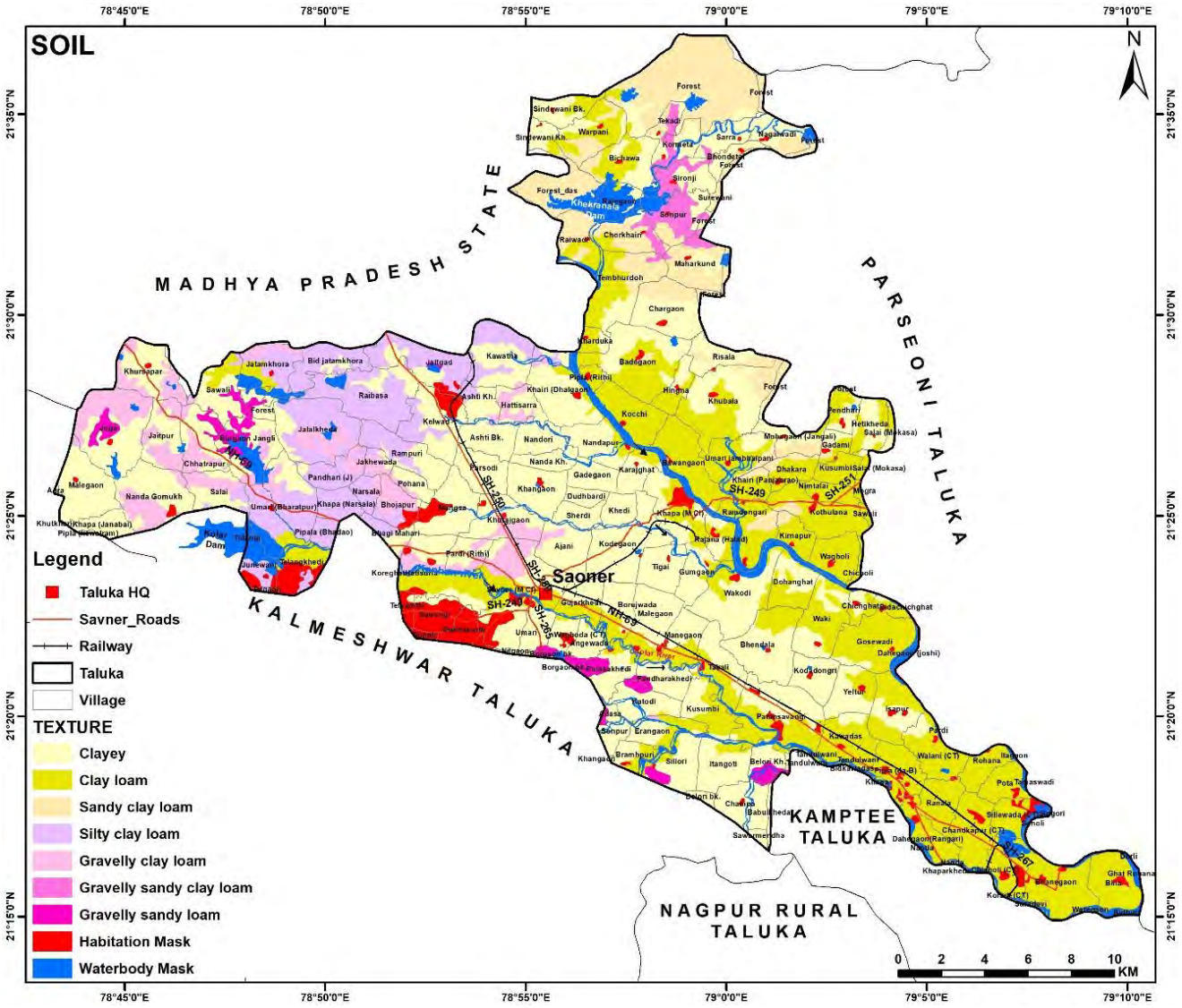


Fig 1.13: Soil map, Saoner taluka, Nagpur District

1.14 Geology

Saoner Block has varied Geology. The Block has all the rock types like igneous, sedimentary, and metamorphic. Geologically, the area is divided into following three parts i.e., deccan trap basalt, trap covered Gondwana sandstone and Granite Gneisses and Schists. The geological map is shown in **Fig 1.14**. The generalized geological sequence occurring in the area is given in **Table 1.9**.

Table 1.9 Generalized Geological Sequence Occurring In Saoner

SL NO.	AGE	FORMATION	LITHOLOGY
1	Recent to sub recent	Alluvial	Sand, silt & clay
2	Upper Cretaceous to lower Eocene	Deccan trap(basalt)	basaltic lava flows with associated intertappean sediments
3	Upper Carboniferous to Lower Cretaceous	Lameta	calcareous sandstone with intercalations of chert and clay

4	Lower Permian to Upper Permian	Gondwana	Kamthi, Barakar and Talchir stages (sandstone, grit,clay, carboniferous shales and basal conglomerates
5	Archean	saucer and sakoli formations	streaky Granite gneiss, schists, metasediments of Sausar and Sakoli

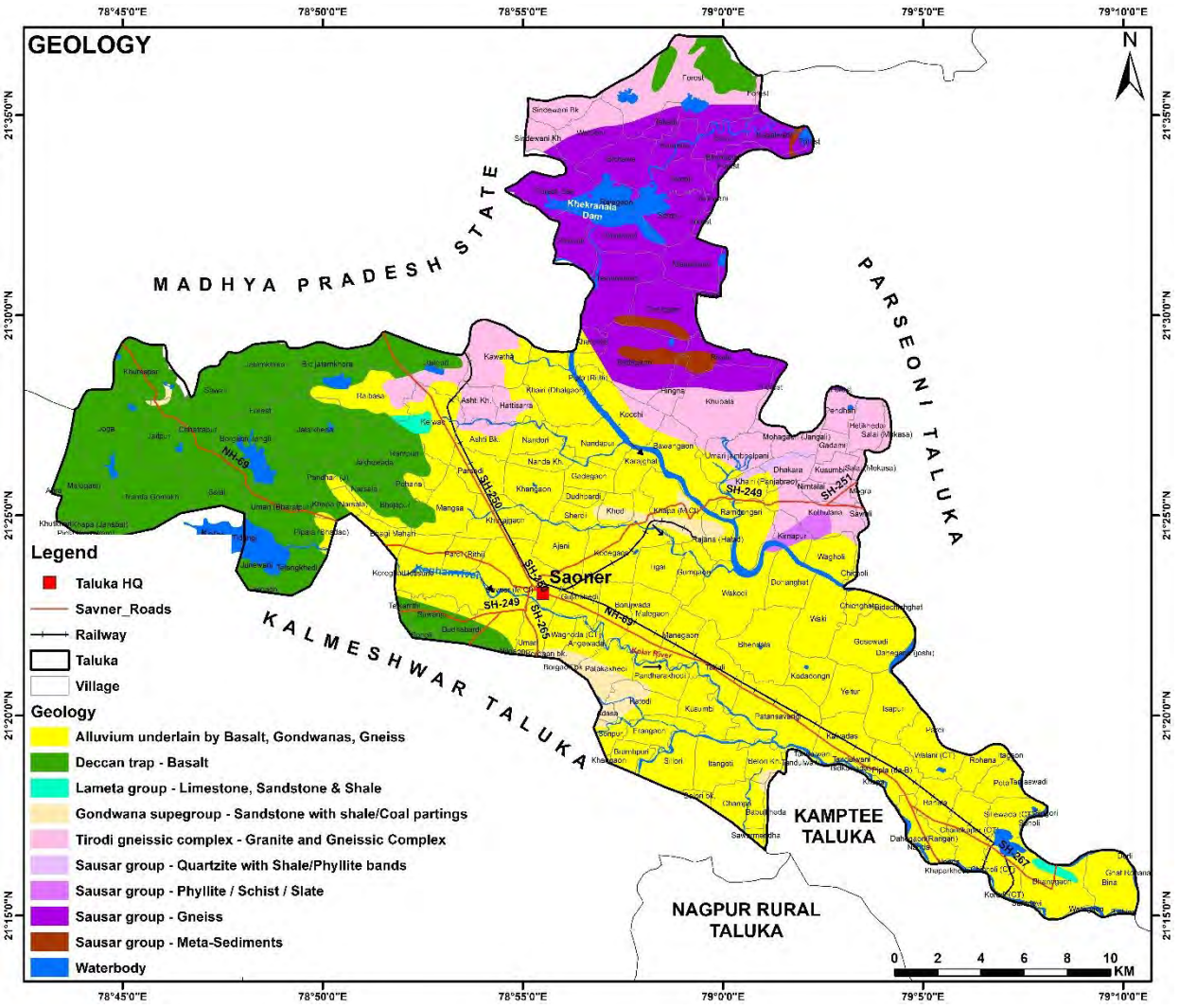


Figure 1.14 Geological Map of Saoner taluka, Nagpur District

Archaean Formation

The northern region contains the Meso Proterozoic-aged Sausar and Sakoli Groups. The Sitasawangi Formation is composed of quartz-muscovite schist, feldspar-muscovite schist, and quartzite. The Lohangi Formation includes calc-gneiss and manganiferous marble with manganese ore pockets. The Mansar Formation has muscovite-biotite schist with manganese ore, while the Chorbaoli Formation consists of quartzite and quartzite-muscovite schist. The Junewani Formation contains muscovite-biotite schist and quartzite-biotite granite. The Bichua

Formation features crystalline limestone and dolomite. These formations are generally tightly folded. The Sausar Group is known for its manganese ore deposits, while the Sakoli Group is considered an extension of the Sausar Group. Tirodi Gneissic Complex of Archaean to paleo Proterozoic age comprising Migmatite, ortho gneiss, and Granite occupies the eastern and north eastern part.

Gondwana Group

The rocks consisting of the Talchir, Barakar, and Kamthi stages of the Gondwana formation originate from fluvial and lacustrine environments. These sediments were deposited in geological troughs and synclines, where they were later consolidated, uplifted, and are now preserved within fault-generated troughs.

Lametas

Lametas, also known as infratrappeans, are freshwater deposits that lie horizontally over the older Gondwana and Archean rocks. They are relatively limited in size and rarely exceed 15 to 20 meters in thickness. These formations are generally composed of calcareous sandstones or sandy limestones, with some layers containing chert and clay.

Deccan Trap

Geologically, the majority of the Saoner block is covered by Deccan Trap basalt, which originated from the Réunion plume eruption during the formation of the Deccan Volcanic Traps in peninsular India. The basaltic lava flows are typically categorized into vesicular, amygdaloidal, and dense, compact types. These Deccan Trap basalts were formed by the solidification of lava that spread widely laterally, with a lesser focus on vertical thickness. Groundwater in this region is mainly found in secondary permeable structures, such as fractured and weathered layers, as well as in the upper unconsolidated materials.

Alluvium

Alluvium deposits of recent age have been laid down by the tributaries of the Kanhan and Kolar rivers. These alluvial deposits consist of sand, gravel, clay, and kankar, and their thickness rarely exceeds 30 meters. They rest on older formations like the Archean, Gondwana, and Basalt and typically measure over 25 meters in depth.

2.0 HYDROGEOLOGY

Hydrogeologically, the area occupied is mainly comprised of archaean crystalline rocks, basaltic deccan traps with inter-trappean beds of Chikhli formation, Gondwana formation and alluvium. (Fig.2.1).

The yields of wells are functions of the permeability and transmissivity of aquifer encountered and vary with location, diameter and depth etc. There are three types of ground water structures in the area i.e. dug wells, borewells and dug cum borewells (dcb), their yield characteristics are described below. Dug wells are generally used for both domestic water supply and irrigation purposes in this area. It is observed that the dug wells varying from 6.00 m to around 23.20 m in depth in basaltic lava flows can sustain assured water supply for domestic needs of about 500 people throughout the year. The yield of dug wells in basalt for irrigation purposes varies from 12 to 186 m^3/day. Ground water is predominantly used for irrigation, as it is the major ground water utilizing sector in these intense orange growing talukas. State government has drilled large number of borewells fitted with hand pumps and electric motors for rural drinking water purposes in the area. The ground water development in these talukas is mostly through dug wells.

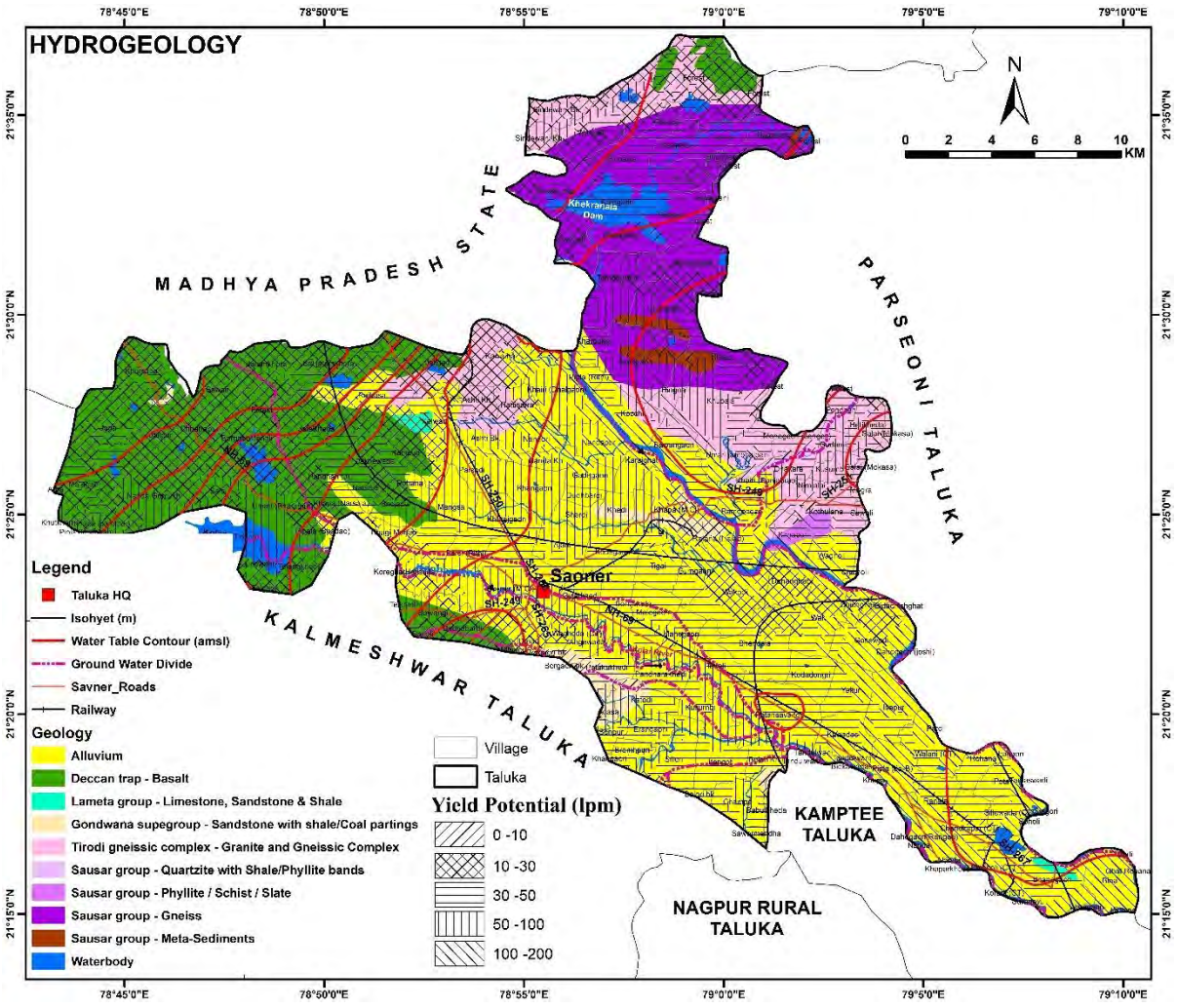


Fig 2. 1: Hydrogeology, Saoner block, Nagpur district

Consolidated Formations:

Archaean and the Deccan trap basalts are the two consolidated formations, which form the hard rock aquifers occurring in the district.

Archaean- The crystalline rocks comprising of gneiss, schist, phyllite and quartzite are the main formations occurring in northern and north-eastern parts of the block. In these rocks, weathered parts, in general, observed down to a depth of 25 mbgl, forms the important shallow aquifers being exploited through dug wells. In crystalline rocks, besides weathered parts of the rock, the occurrence and movement of ground water is controlled mainly by joints and fractures. The yields are generally controlled by the density, intensity and interconnection of joints/fractures in the rock formations.

Deccan Traps- Basalt is the main rock formation of the Saoner taluka of Nagpur district. Basalts are hydrogeologically inhomogeneous rocks. The weathered and jointed /fractured parts of the rock constitute the zone of ground water flow. Each individual lava flow consists of lower massive part becoming vesicular/amygdaloidal towards top, range in their individual thickness from a few centimeters to tens of meters.

With inherently low permeability and lack of primary porosity, ground water accumulation and movement within a sequence of lava flow are controlled by the nature and the extent of weathering, degree of openness of the joints vertically as well as laterally and contacts between individual units of each flow, and the cavities developed within various parts of the lava flow.

Semi-Consolidated Formations

Two types of semi consolidated formations i.e. Lameta and Gondwanas occur in the Saoner taluka of Nagpur district. They along with the unconsolidated Alluvial formation form the soft rock aquifers occurring in the district.

Lameta beds- Lameta beds, found to the northwest and southeast parts of the block in a small patch are compact, clayey and poor in permeability. Hence it is not a good water bearing formation.

Gondwana Sediments- Gondwana formation occurs in the central, southern and south-eastern parts of the Saoner block. Among the Gondwanas, the Barakars and Kamthis generally consist of medium to coarse-grained friable sandstone. These constitute the important water bearing formations in the block. Barakars are usually associated with coal seams of economic importance. The depth of this aquifer is about 45 to 50 m bgl.

Unconsolidated Alluvial Formations

Alluvium consisting of sand, silt, clay and kankar forms the water bearing formations and occurs in central and southeastern part of Saoner taluka of Nagpur district. The alluvium of recent to sub-recent age and are found to have been deposited along the Kanhan River. They overlie the older formations such as Gondwana and Basalt and have thickness 5 to 6 m.

Deccan basalts are hydro geologically in-homogeneous rocks. The weathered and jointed /fractured parts of the rock constitute the zone of ground water storage and flow. The existence of multiple aquifers is characteristic of basalt and is indicative of wide variation in the joint/fracture pattern and intensity. The yield of wells is function of the permeability and transmissivity of aquifer and it depends upon the degree of weathering, intensity of joints\fractures and topographic setting of the aquifer. Due to wide variation in secondary openings, the potential areas for ground water are generally localized. In general Ground water occurs under phreatic/unconfined to semi-confined conditions in basalts.

Based on Ground Water Exploration, aquifer wise characteristics are given in **Table 2.1**. Maps depicting aquifer wise depth of occurrence and fractured/granular zone's thickness and yield potential are shown in **Fig 2.2, 2.3** and **2.4**.

Table 2.1: Aquifer Characteristic of Major aquifers of Saoner Taluka, Nagpur District.

Major Aquifers	**Alluvium (Al01)**	**Basalt (Deccan Trap)** (BS 01)		**Gondwana Sandstone (ST05)**		**Gneiss (GN 02)/Schist**	
Type of Aquifer (Phreatic/Semiconfined/Confined)	**Aquifer-I (Phreatic)**	**Aquifer-I (Phreatic)**	**Aquifer-II (Semiconfined/ confined)**	**Aquifer-I (Phreatic)**	**Aquifer-II (Semiconfined/ confined)**	**Aquifer-I (Phreatic)**	**Aquifer-II (Semiconfined/ confined)**
Depth to Bottom of Aquifer (mbgl)	7-30	5-32	25-153.8	5-35	12-297	18-30	77-184
Granular/Weathered/Fractured rocks thickness (m)	12-30	5-13	1-9	5-13	3-30	5-12	0.5-6
Yield Potential	10-50 m^3/day	10 to 25 m^3/day	0.14 to 3.17 lps	<10-25 m^3/day		<10-50 m^3/day	0.14-14.88 lps
Specific Yield (Sy)/ Storativity (S)	0.07	0.02	$4.9x10^{-4}$	0.03	$3.0x10^{-3}$ to $5.8x10^{-3}$	0.015	$4.1 x10^{-4}$
Transmissivity (T) (m^2/day)	-	-	Upto 10.26	-	Upto 250	-	0.16 to 94.49

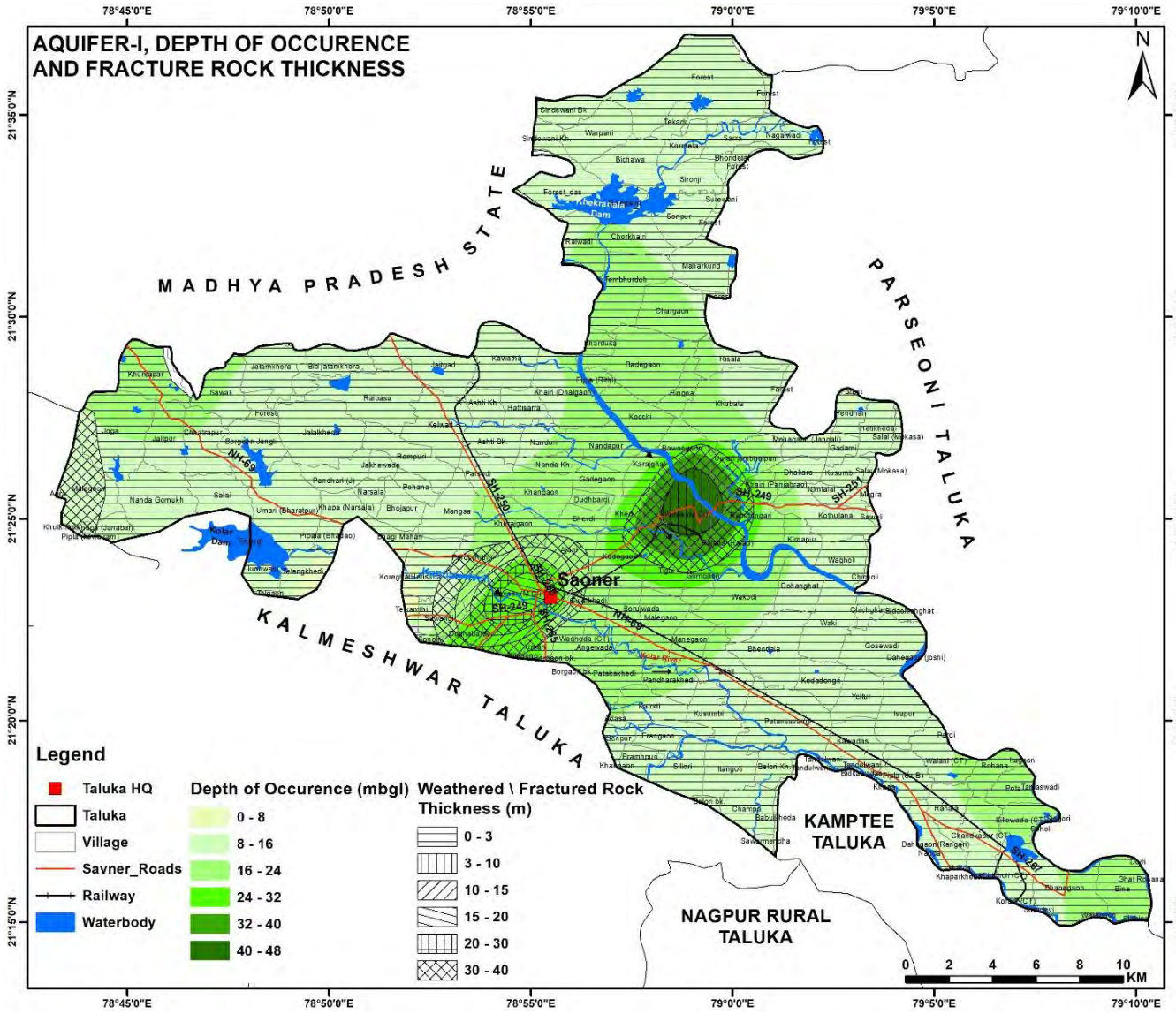


Figure 2.2: Aquifer -I Depth of occurrence and fractured rock thickness

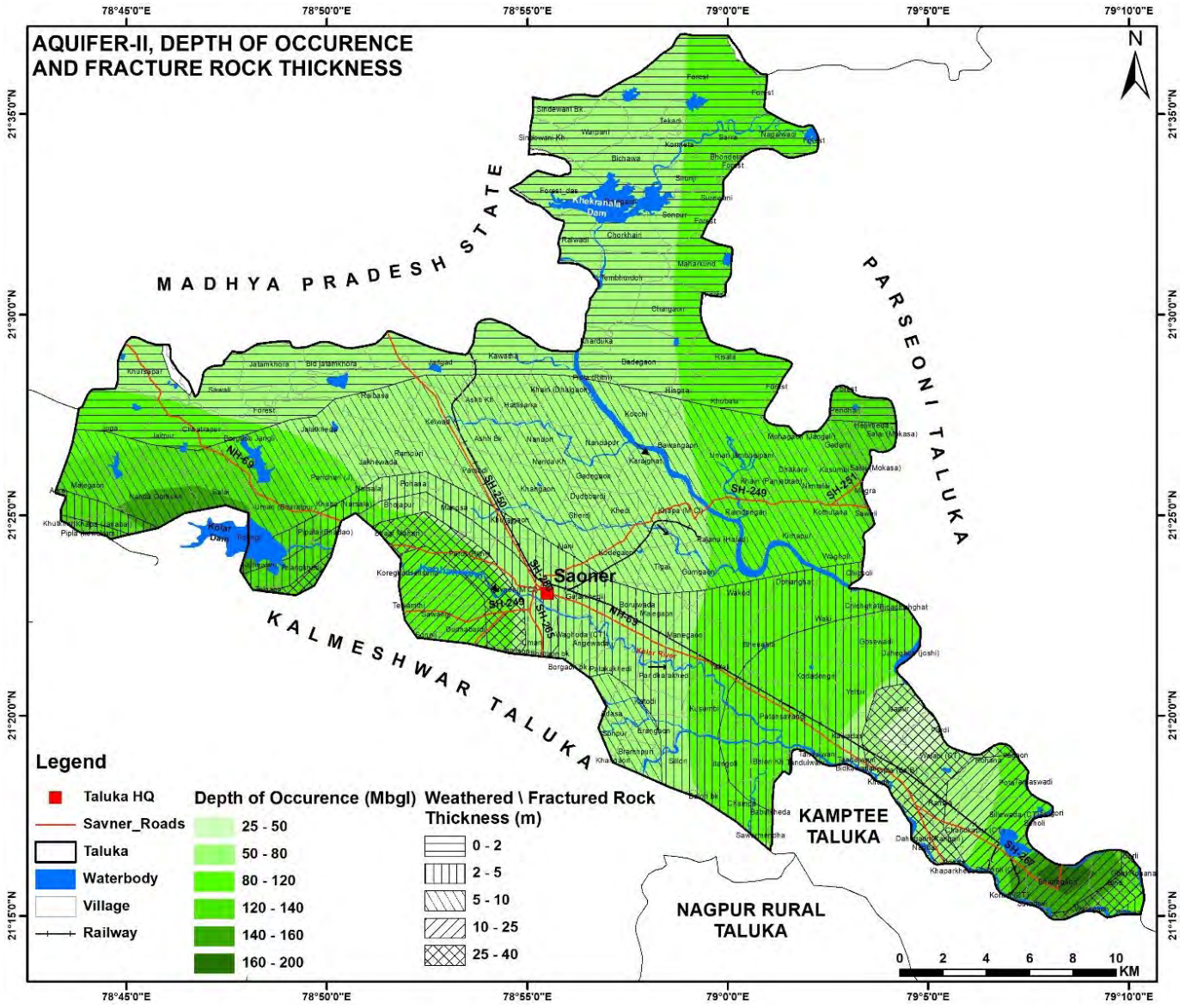
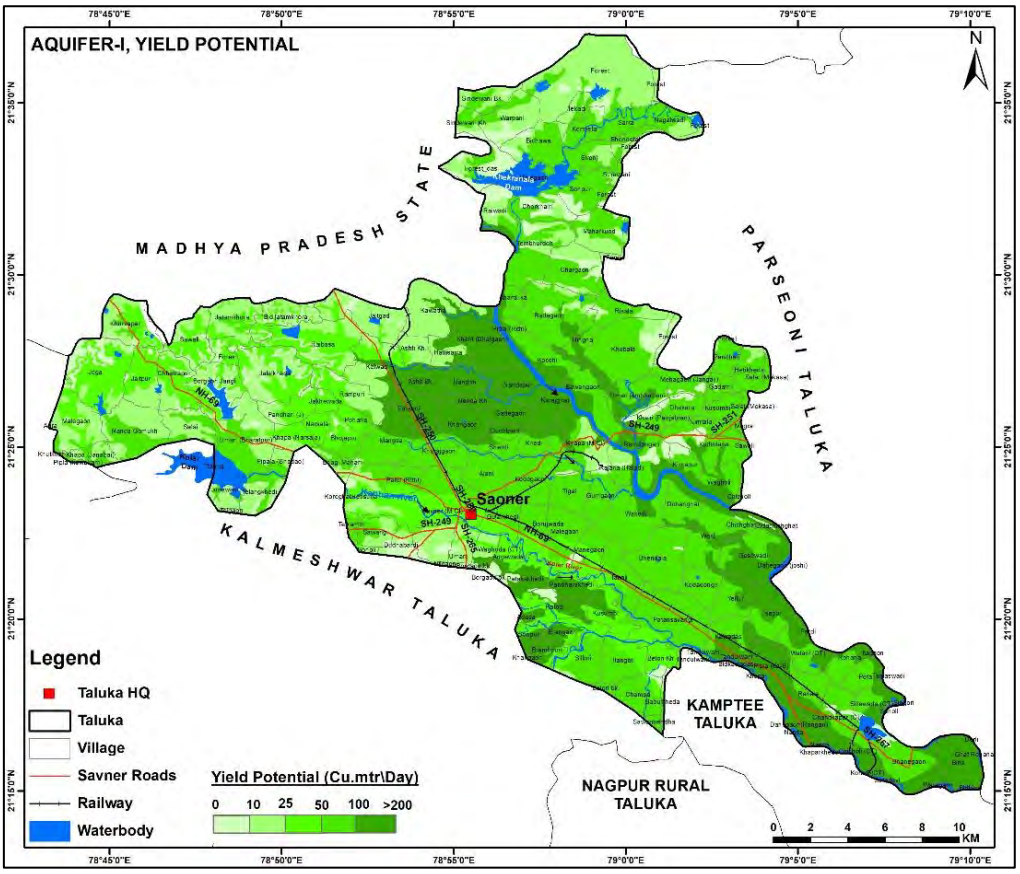


Figure 2.3: Aquifer-II Depth of occurrence and fractured rock thickness



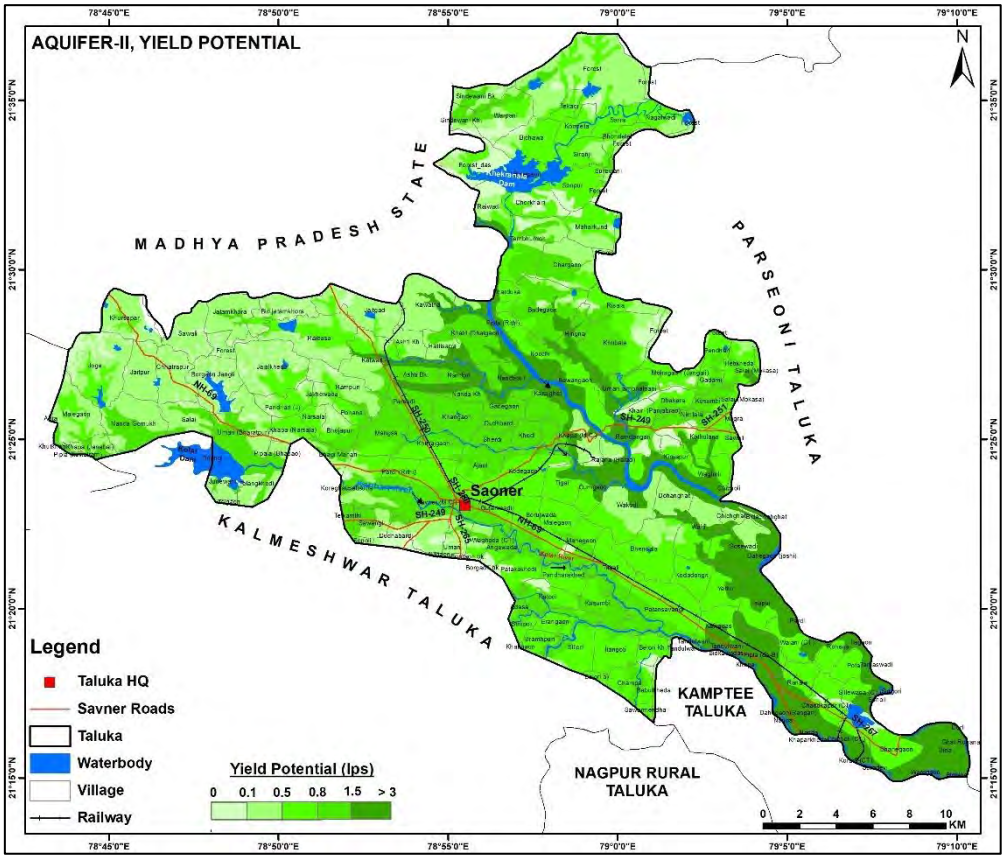


Figure 2.4: Aquifer wise yield Potential

2.1 Water Table Contour

Based on the data, a Pre-monsoon water table contour map (2023) has been prepared and presented in **Fig. 2.5** & **Fig.2.6**. The map depicts occurrence and movement of ground water in the study areas. The ground water flow lines are marked to show the direction of ground water flow. The elevation of water table ranges from less than 280 to 450 m amsl and generally follows the topography. In general, the overall ground water movement is towards the Kanhan River and Kolar River in NW to SE direction in Wardha-Wainganga River basin. It almost follows the surface water divide. It has been observed that the ground water flow directions follow the major drainage of Kanhan river, Kolar River and topography of the area. This indicates the topographic control for the ground water movement. However, in western part of the study area, the ground water movement is controlled by Kolar River and structural discontinuity. The ground water movement is generally sluggish in the alluvial areas with high permeable zones and in the areas of convergent ground water flow. Such areas have been demarcated as ground water potential zones. In area of low permeability, the water table contours are closely spaced indicating steep gradient.

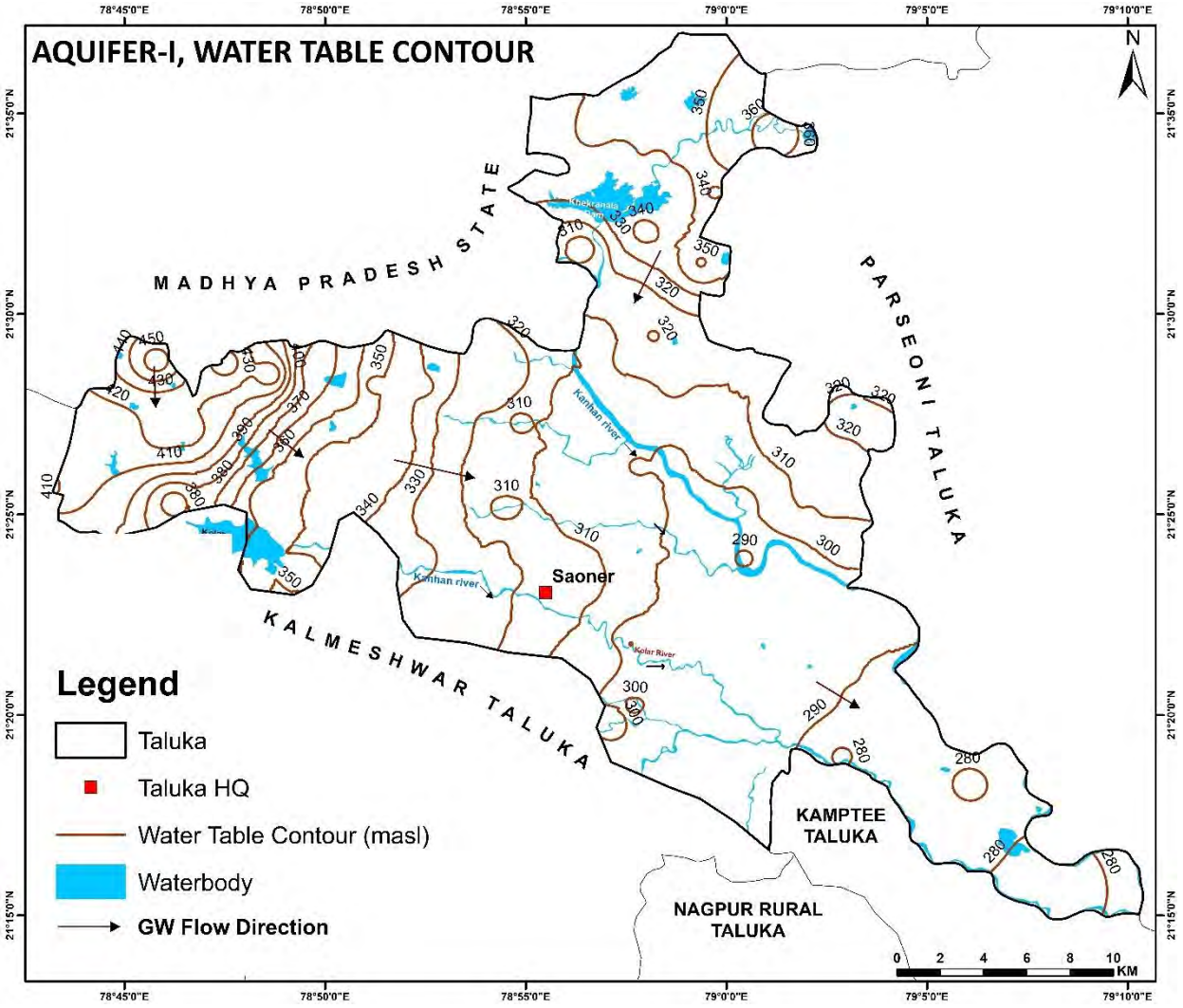


Fig.2.5 Aquifer-I Water Table Contour Saoner Block

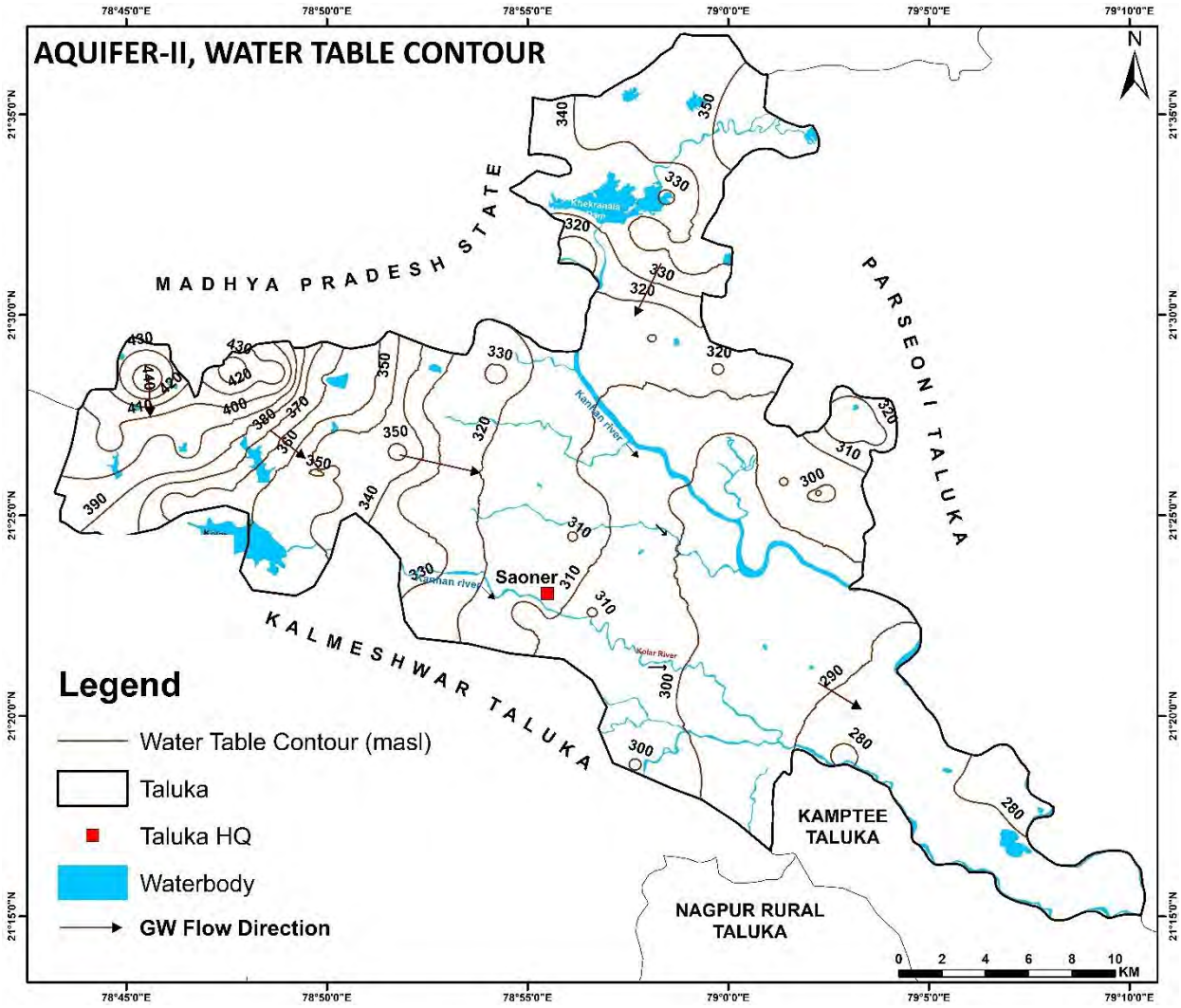


Fig.2.6 Aquifer-II Water Table Contour Saoner Block

2.2 Aquifer Parameters

Aquifer parameters have been obtained from ground water exploratory drillings carried out in the district. During the course of ground water exploration, pumping tests were conducted at Gondwana formation. It was observed that the from transmissivity varied from59.64 to 250.0 m^2/day and Storativity from $3.0x10^{-3}$ to $5.8x10^{-4}$, Basaltic formation transmissivity varied from traces to 10.26 m2/day and Storativity up to $4.9x10^{-4.}$

In the Granite gneisses formation observed that the transmissivity varied from 0.16 to 94.49 m^2/day and Storativity upto $4.1 x10^{-4}$.

The yield of wells is functions of the permeability and transmissivity of aquifer encountered and varies with location, diameter and depth etc. There are three type of ground water structures i.e., dugwells, borewells and tubewells in the area. However, dug wells are the main abstraction structures in the district for ground water development. The yield of such structures varies from 15 to 50 m^3/day. High yielding dugwells are generally located in fractured granites and Gondwana occurring in physiographic depressions. The yields of dugwells in basalt are less and the recovery percentage is also very less, whereas yield of dugwells in Archean Metamorphics up to 30 m^3/day are observed.

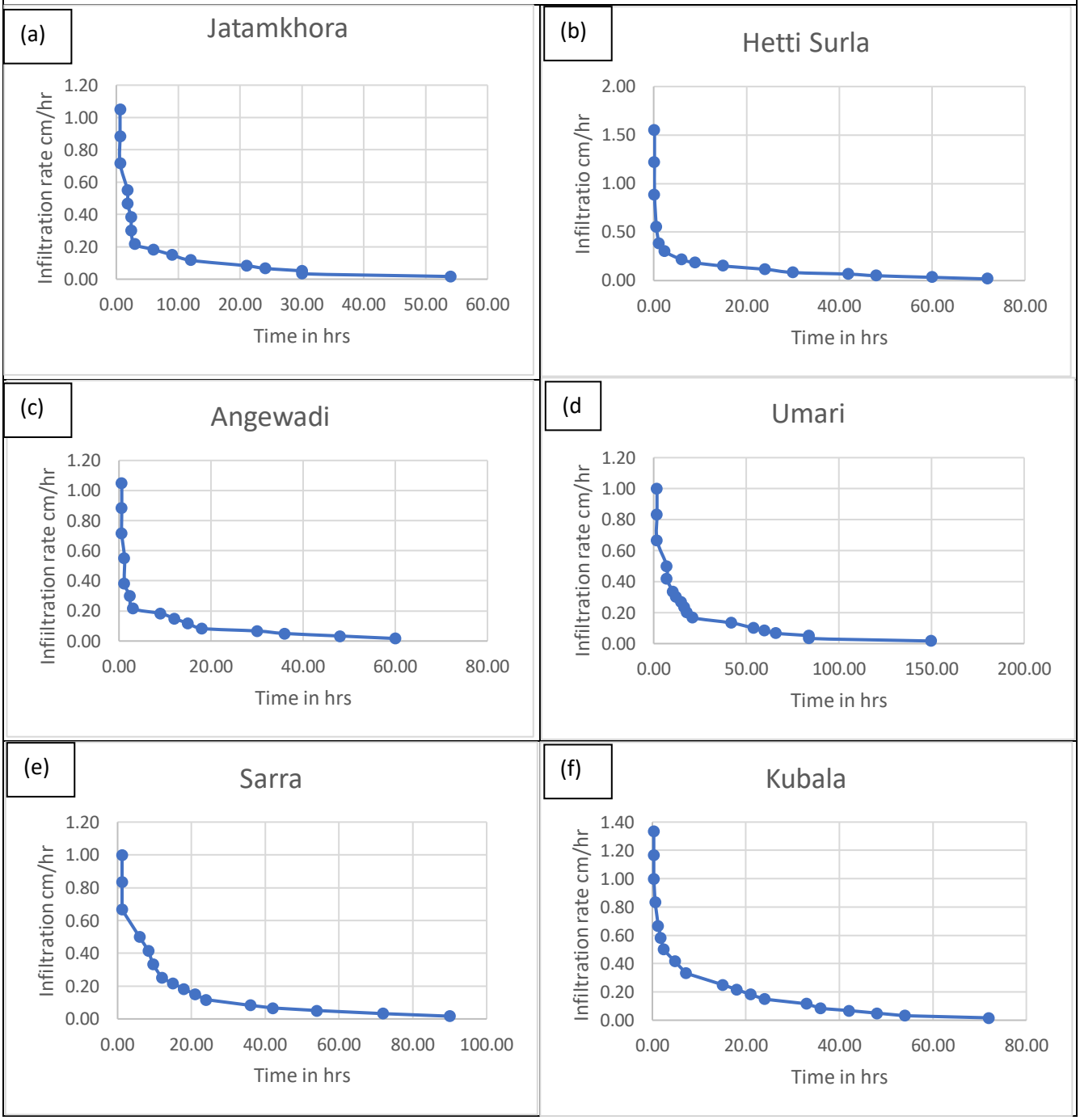
2.3 Soil Infiltration Tests

To estimate the actual rate of infiltration of various soil cover and their impact on recharge to ground water, 6 infiltration tests have been conducted at Umari, Khubala, Sarra, Jatamkhora, Hetti surla and Angewadain various soil types. The data has been analyzed and the salient features of the infiltration tests are presented in **Table 2.2** and the plots of soil infiltration tests are presented in **Figure 2.7 (a, b, c, d, e & f)**. The duration of the test ranged from 53 to 90 minutes, the depth of water infiltrated varied from 0.03 cm to 0.40 cm and the final infiltration rate in the area ranged from 0.18 cm/hr at Hetti Surla to 1.80 cm/hr at Umari.

Table 2.2: Salient Features of Infiltration Tests

S. No.	Village	Date	Duration (min)	Water Level (cm agl)	Final Infiltrated Water Depth (cm)	Final Infiltration Rate (cm/hr)
1	Jatamkora	02.01.2024	53	27.5	0.10	1.20
2	Hetti surla	03.01.2024	93	23.0	0.03	0.18
3	Angewada	09.01.2024	73	27.5	0.10	0.60
4	Umari	01.02.2024	60	26.5	0.40	1.80
5	Sarra	05.03.2024	60	26.0	0.20	1.20
6	Khubala	06.03.2024	80	29.0	0.05	0.30

Fig.2.7 Plots of soil infiltration tests are presented in Saoner Block



2.4 3-D and 2-D Aquifer Disposition

Based on the existing data, aquifer disposition in 3D, Fence diagram, 3D Bar diagram and few hydrogeological sections have been prepared along section lines shown in **Figure 2.8(a & b), 2.9, 2.10 and 2.11(a to c)** to understand the subsurface disposition of aquifer system.

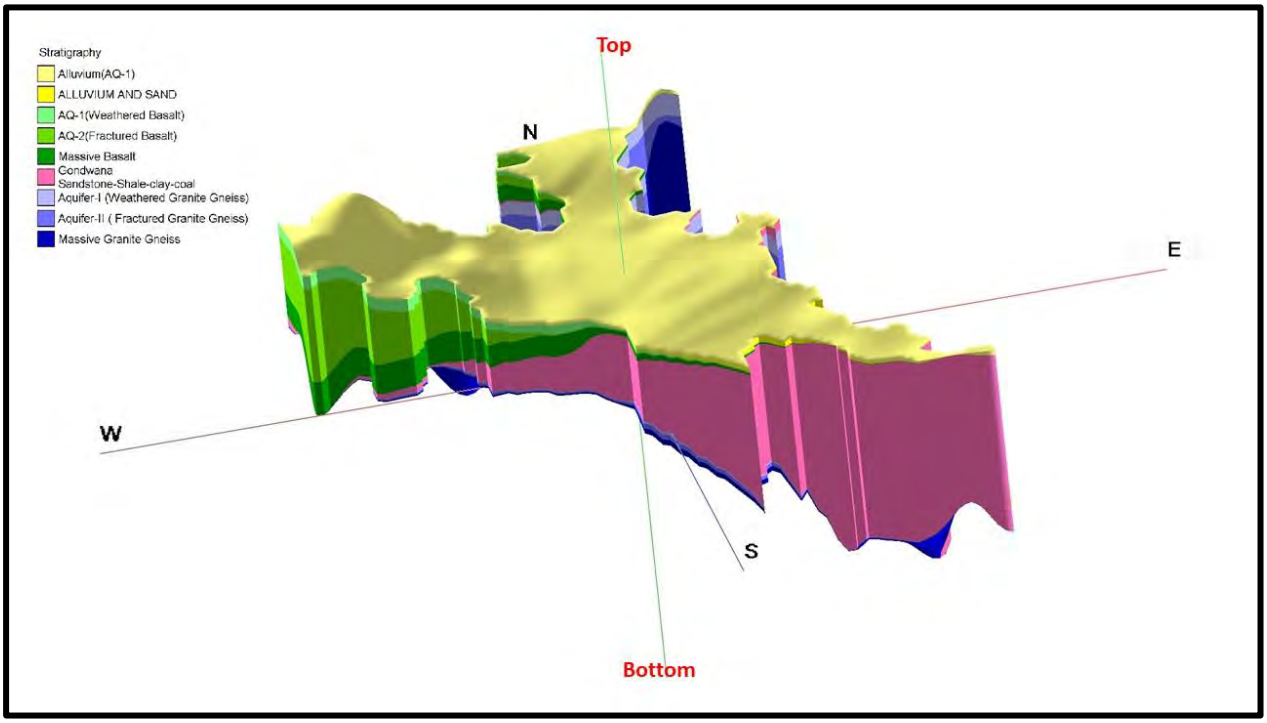


Fig 2.8(a): 3D Aquifer Disposition

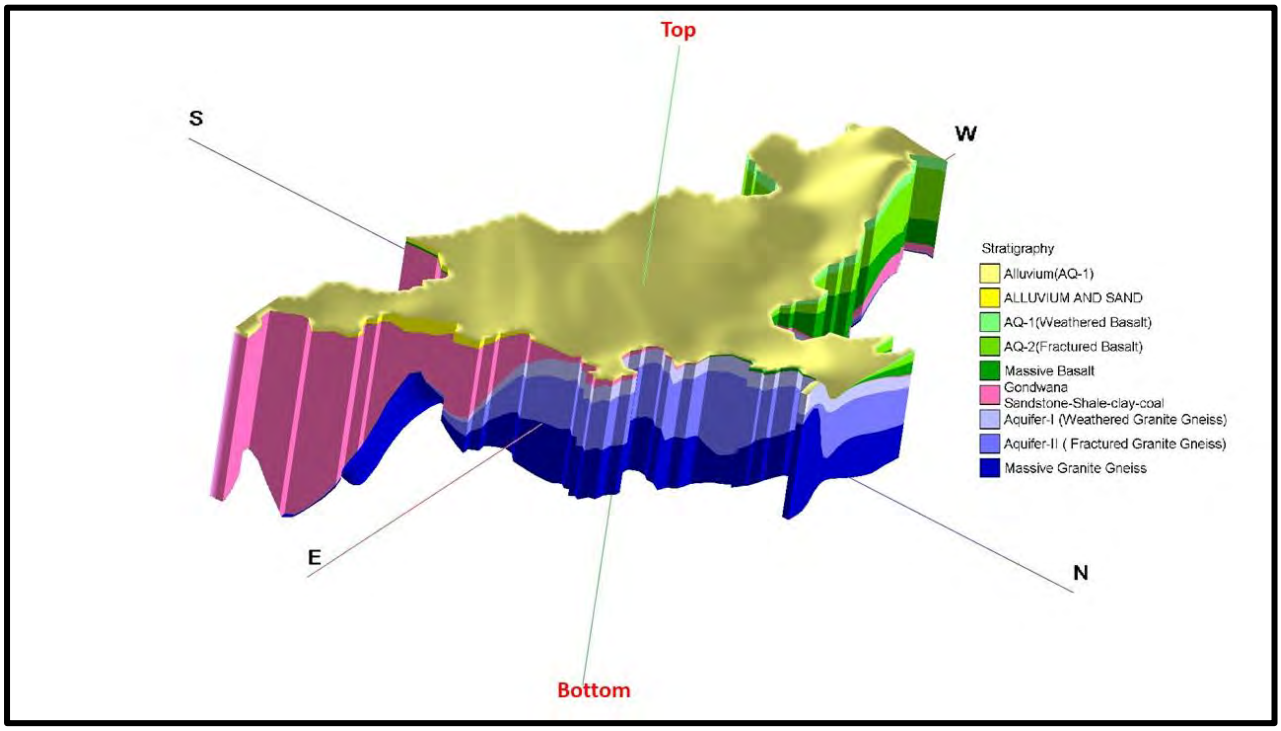


Fig 2.8(b): 3D Aquifer Disposition

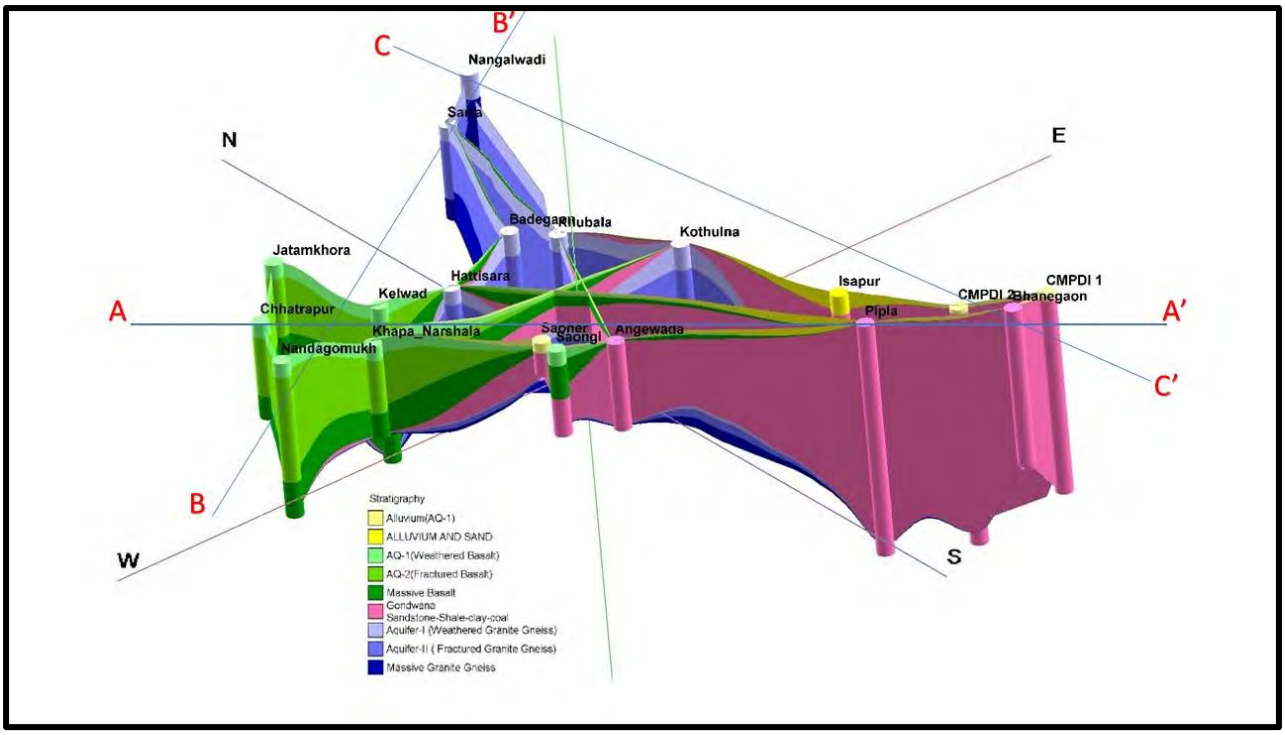


Fig 2.9: 3D Fence Diagram

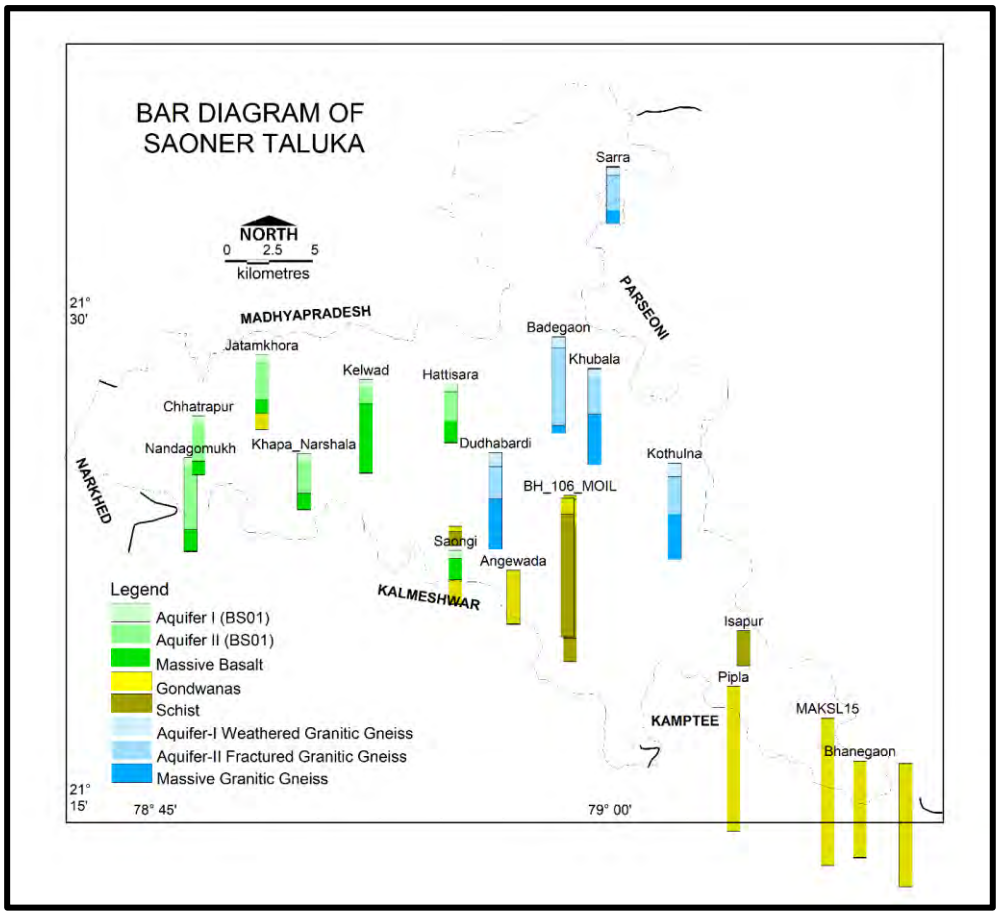


Fig 2.10: Bar Diagram

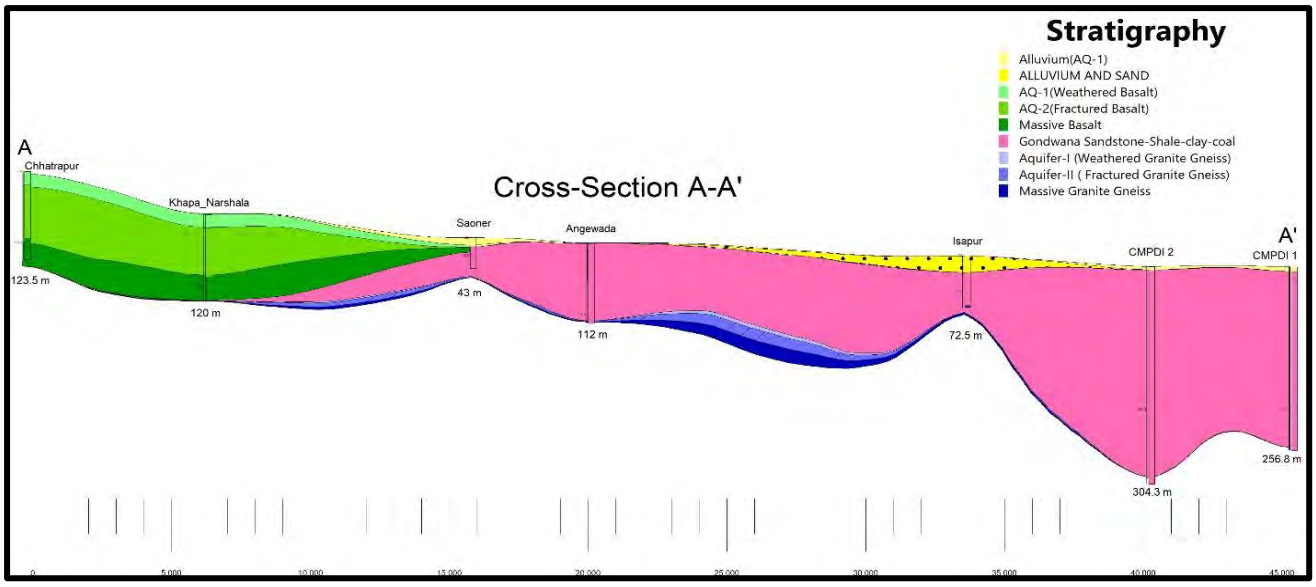


Fig 2.11 (a): Lithological section along A – A'

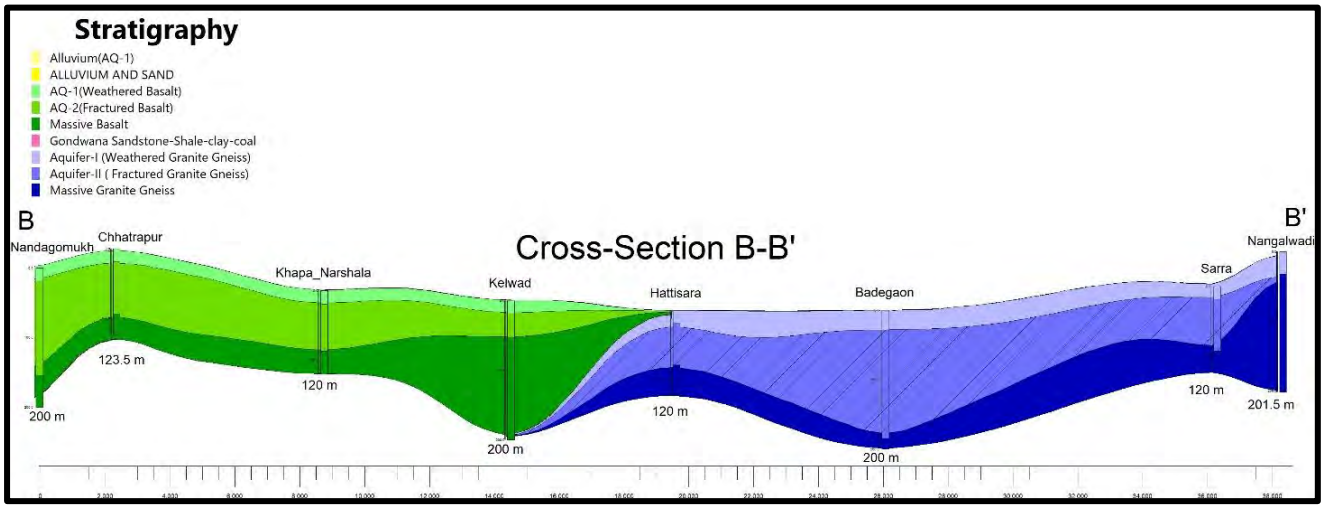


Fig 2.11 (b): Lithological section along B – B'

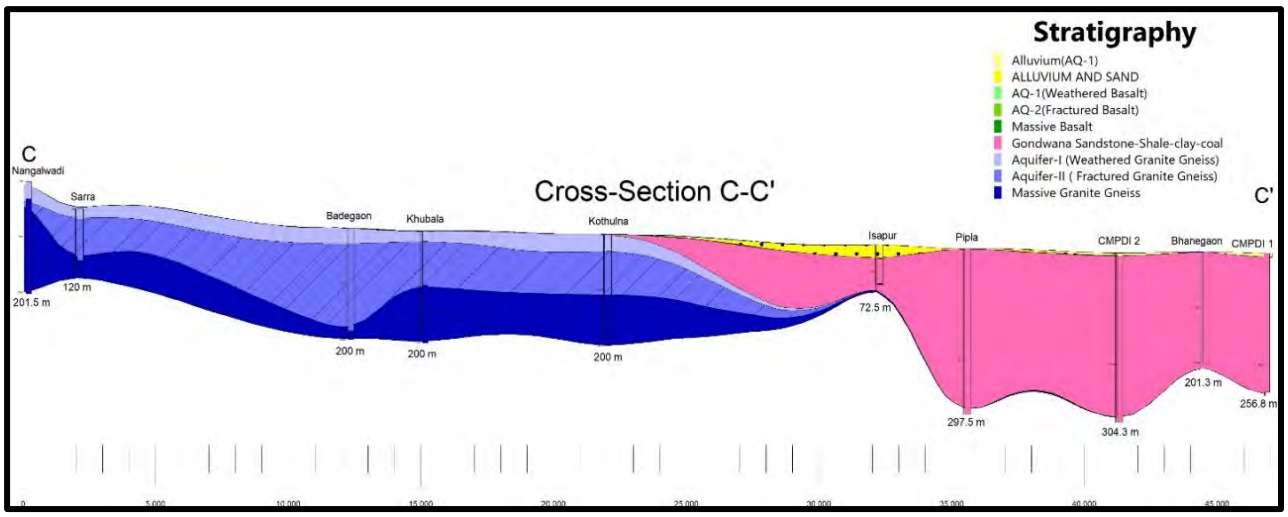


Figure 2.11 (c): Lithological section along C – C'

3.0 GEOPHYSICAL SURVEY IN SAONER BLOCK

3.1 Electrical Resistivity Survey:

In response to the comprehensive geological surveys to support various developmental endeavors in NAQUIM 2.0, a Geophysical Vertical Electrical Sounding (VES) study was conducted in the Saoner Block, located in the vicinity of Nagpur, Maharashtra. Vertical Electrical Sounding (VES) was carried out at 66 locations at Saoner Block, Nagpur to understand the subsurface characteristics of the region. The utilization of geophysical methods, particularly Vertical Electrical Sounding, offers a non-invasive and cost-effective approach to delineate subsurface structures, lithological variations, and groundwater potential. Location of existing EW/OW/VES/NHS data are shown in **Fig 3.1**.

The primary objectives of this study were:

1. **Characterization of Subsurface Lithology**: By analysing the resistivity distribution at various depths, we aimed to identify and delineate geological formations, providing insights into the lithological composition of the subsurface layers.
2. **Evaluation of Groundwater Potential:** Through interpretation of resistivity data, we sought to assess the presence of potential aquifers and delineate their spatial distribution, aiding in effective groundwater resource management and exploration.
3. **Mapping of Subsurface Structures:** The study aimed to identify structural features such as faults, fractures, and stratigraphic variations, which are crucial for geological and geotechnical assessments.

   The geophysical survey encompassed the acquisition of resistivity data through Vertical Electrical Sounding at selected locations within the Saoner Block. Data acquisition was conducted using SSR-MP-ATS, IGIS, India geophysical equipment and adhered to established protocols to ensure accuracy and reliability. Vertical Electrical Soundings were performed at predetermined locations in a symmetric Schlumberger array configuration to facilitate accurate measurement of subsurface resistivity variations. Interpretation was carried out by analysing the apparent resistivity curves obtained from the VES measurements. The curves were interpreted manually and using automated inversion algorithms available in the IPI2Win software. Lithological boundaries, aquifer zones, and structural features were delineated based on resistivity variations. By adhering to this methodology, the Geophysical Vertical Electrical Sounding survey using IPI2Win software provided valuable insights into the subsurface characteristics of the Saoner Block, contributing to informed decision-making in various geological and hydro geological applications.

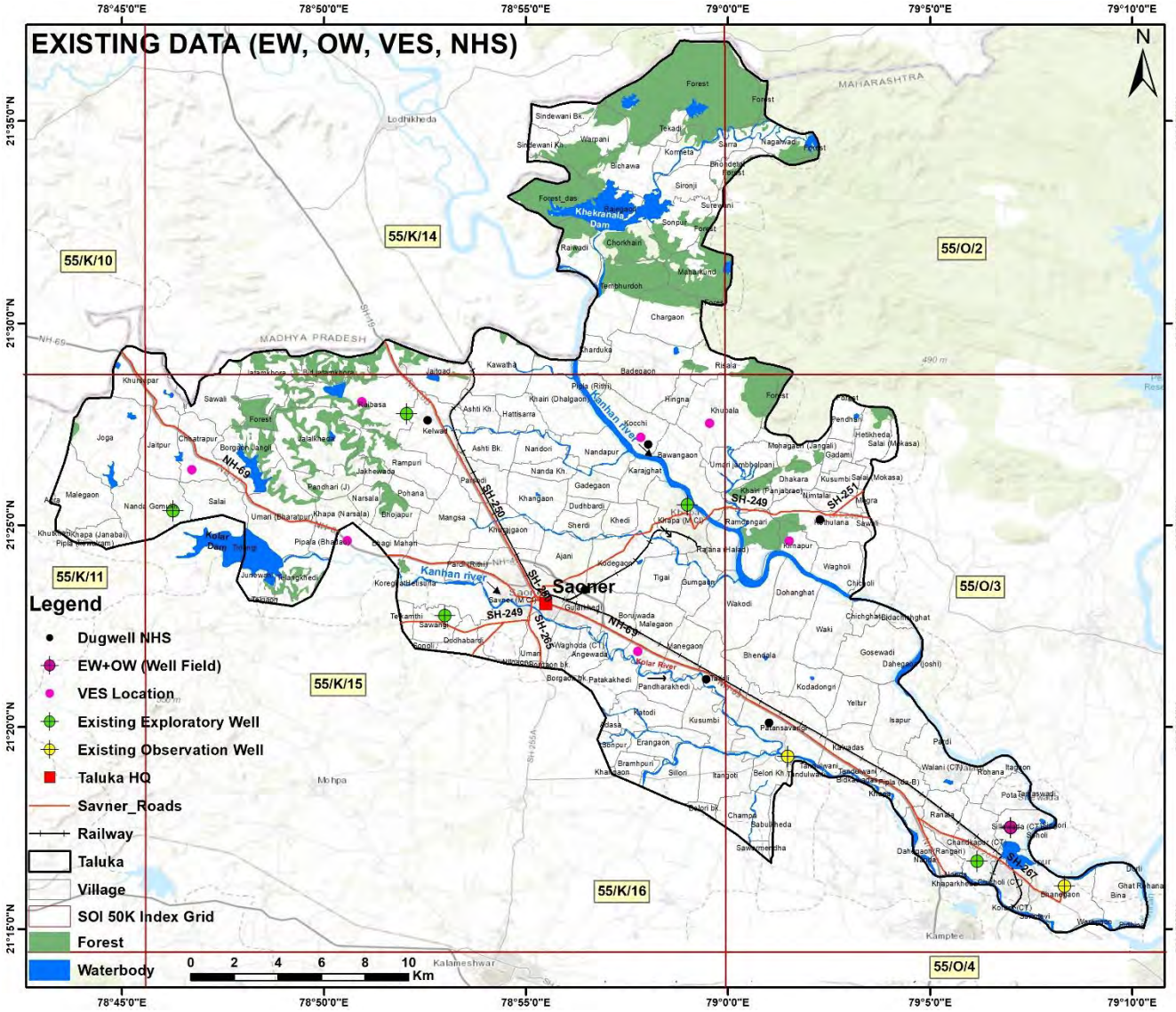


Figure 3. 1: location of Existing data (Exploration, GWM well and VES)

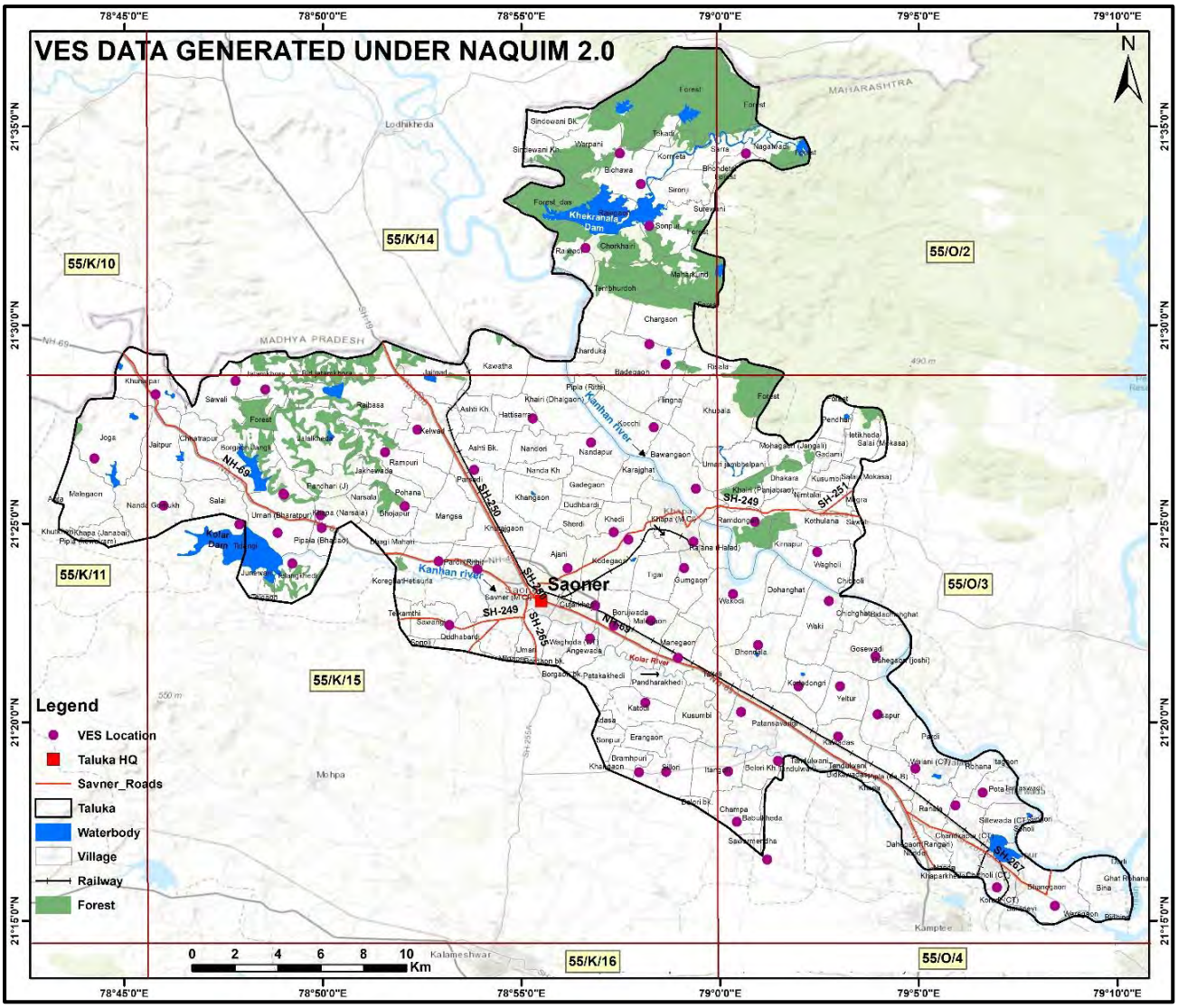


Fig 3.2: VES locations – Data Generation under NAQUIM 2.0 of Saoner Block, Nagpur

3.2 Result and Discussion:

In all 66 VES (**Fig 3.2**) have been carried out in Saoner taluka of Nagpur district covering an area of 562.37 Sq. km. Interpreted VES results infer that resistivity of the Top Geo-electric layer varying between 4.13 and 708 Ohm m corresponds to the Alluvium / Topsoil depending on its nature & saturation and the thickness between 1 and 17 m. The geo-electric layer with resistivity ranging between 1.12 and 7.94 Ohm m and thickness between 0.5 m and 32 m corresponds to Clay layer depending on its degree of saturation majorly around the area of where sandstone presents. The geo-electric layer with resistivity varying between 44.63 and 89 Ohm m may correspond to the basalt with weathered nature depending on its degree of weathering and the thickness between 0.7 and 61 m in Western part of the study area. The geo-electric layer with resistivity varying between 5.77 to 150 Ohm m may correspond to the weathered sandstone depending on its degree of weathering and the thickness between 2 and 50 m in the Southern and Southeastern part of the study area. The geo-electric layer with resistivity varying from 5.6 Ohm m to 3484 Ohm m may correspond to the Weathered Granite gneiss to Hard Granite gneiss

depending on its nature of weathering or hardness in the Northern and Northeastern part of the study area. The geo-electric layer with resistivity varying from 11.6 Ohm m to 4953 Ohm m may correspond to the Fractured granite gneiss to Hard granite gneiss and the thickness of 5.36 to 96 m in the Northern and Northeastern part of the study area. The geo-electric layer with resistivity varying from 6.72 Ohm m to 1237 Ohm m may correspond to the Fractured basalt to Massive Basalt and the thickness of 4.46 to 69.18 m in western part of the study area. The geo-electric layer with resistivity varying from 5.33 Ohm m to 1876 Ohm m may correspond to the Gondwana sandstone and saturated sandstone in isolated patches in Southern and southeastern parts of the study area and the thickness of 4.464 to 96 m. The geo-electric layer with resistivity varying from 249 Ohm m to 3432 Ohm m may correspond to the High resistive sandstone in the isolated patches of southeastern end of the study area. Summary of the results of Vertical Electrical Soundings is furnished in **Table 3.1.**

Table 3.1: Resistivity Ranges and inferred litho Units in Parts of Saoner Block, Nagpur district

Resistivity Ranges (Ohm m)		Inferred litho Units	Thickness Ranges (m)	
From	To		From	To
4.13	708	Alluvium / Topsoil	1	17
1.12	7.94	Clay	0.2	32
44.63	89	basalt with weathered nature	0.7	61
5.77	150	weathered sandstone	2	50
5.6	3484	Weathered/Hard Granite gneiss		
11.6	4953	Fractured/Hard granite gneiss	5.36	96
6.72	1237	Fractured/Massive basalt	4.46	69.18
5.33	1876	Gondwana sandstone	4.464	96
249	3432	High resistive sandstone		

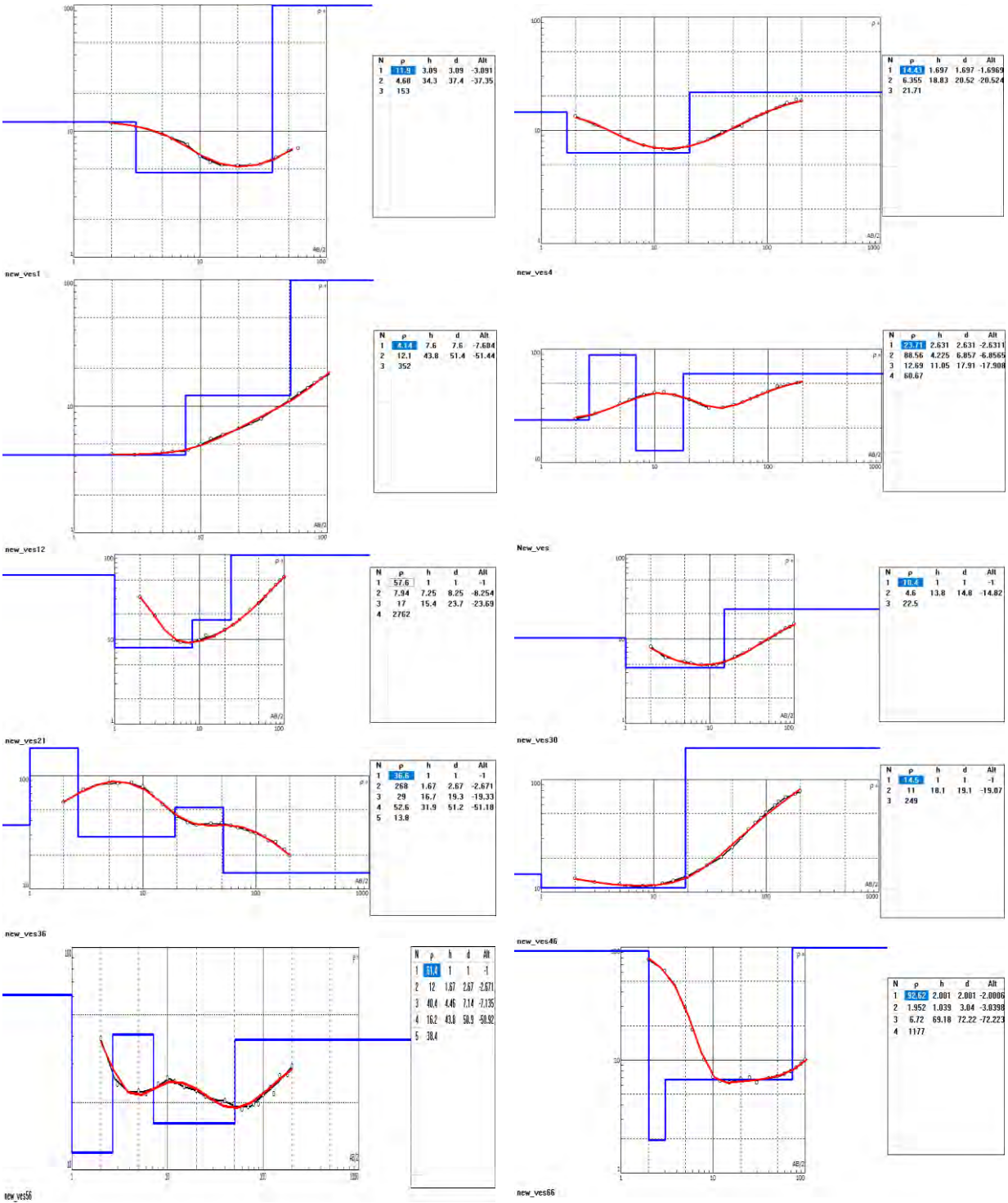


Fig 3.3: VES Curves

4.0 WATER LEVEL SCENARIO

OCCURRENCE OF GROUND WATER IN BASALT (SHALLOW AQUIFER-I & DEEPER AQUIFER-II)

Ground water occurs under phreatic/ unconfined to semi-confined conditions in basalts. Ground water occurs in unconfined state in shallow Aquifer-I tapped by dug wells of 5 to 25 m depth**,** 115 water levels are ranging from 1.2 to 20.3 m bgl and yield varies from 1 to 3 lps. The deeper Aquifer-II is present which is being tapped by borewells and it ranges from 8 to 55 m bgl, whereas the water level ranges from 1.1 to 49.54 m bgl.

OCCURRENCE OF GROUND WATER IN SANDSTONE

The peculiar formation i.e., trap covered Gondwana sandstone is forming the deeper Aquifer-II in central and western part of Saoner. The local people rarely tap it, as it is difficult to pierce sandstone through basalt by rotary drilling rig. The ground water occurs mostly in semi-confined to confined condition, tapped by the bore wells. The ground water exploration reveals that it has huge ground water potential. It is one of the high yielding Aquifer of the area and yields are mainly observed in the range of 5 to more than 10 lps with continues pumping. On the other hand, in the eastern and southeastern area, Gondwana sandstone occurs as unconfined aquifer.

GROUND WATER DYNAMICS

The existing depth to water level data available in CGWB, data available with State Ground Water Department, Maharashtra were collected, and new data generated for the current study were compiled with the existing data. For the phreatic aquifer, village wise key wells (KOWs) (115 dug wells) were monitored in pre-monsoon (May) and post monsoon (Nov.) 2023 periods. For deeper aquifer, 97 KOWs (Bore Wells and Tube Wells) and 6 exploratory wells, 4 observation wells and 6 piezometers were used for monitoring purposes and monitored these wells in pre and post-monsoon 2023 periods. Details of KOWs are given in Annexure-I, II and III. The historical dataset is derived from CGWB Data set and hydrograph are used for assessing the long-term changes in water level. The maps were prepared in ARC-GIS software using natural neighbour interpolation techniques.

4.1 Depth to water level (Shallow Aquifer-I)

To understand the depth to water level scenario in Saoner taluka, water level measurement from all the key observation wells (KOW) were carried out in the month of May and November. The pre and post monsoon data collected from these KOWs along with data collected by CGWB and GSDA, Ground Water Monitoring from there network monitoring stations have been used to ascertain the water level scenario and preparation of depth to water level maps of the area.

4.1.1 Depth to Water Level-Pre-monsoon (May 2023):

The depth to water levels in Saoner taluka during May 2023 ranges between 1.20 and 20.30 m bgl. Depth to water levels during pre-monsoon shows water levels within 5 to 10 m bgl in almost entire Saoner taluka. However, water levels 2 to 5 mbgl is mostly observed along the

northern part of the block. The deeper water level i.e., 10 to 20 m bgl is restricted mostly areas following nortwestern-southeastern trend. The pre-monsoon depth to water level map is given in **Fig. 4.1** and the water level data is presented as **Annexure II.**

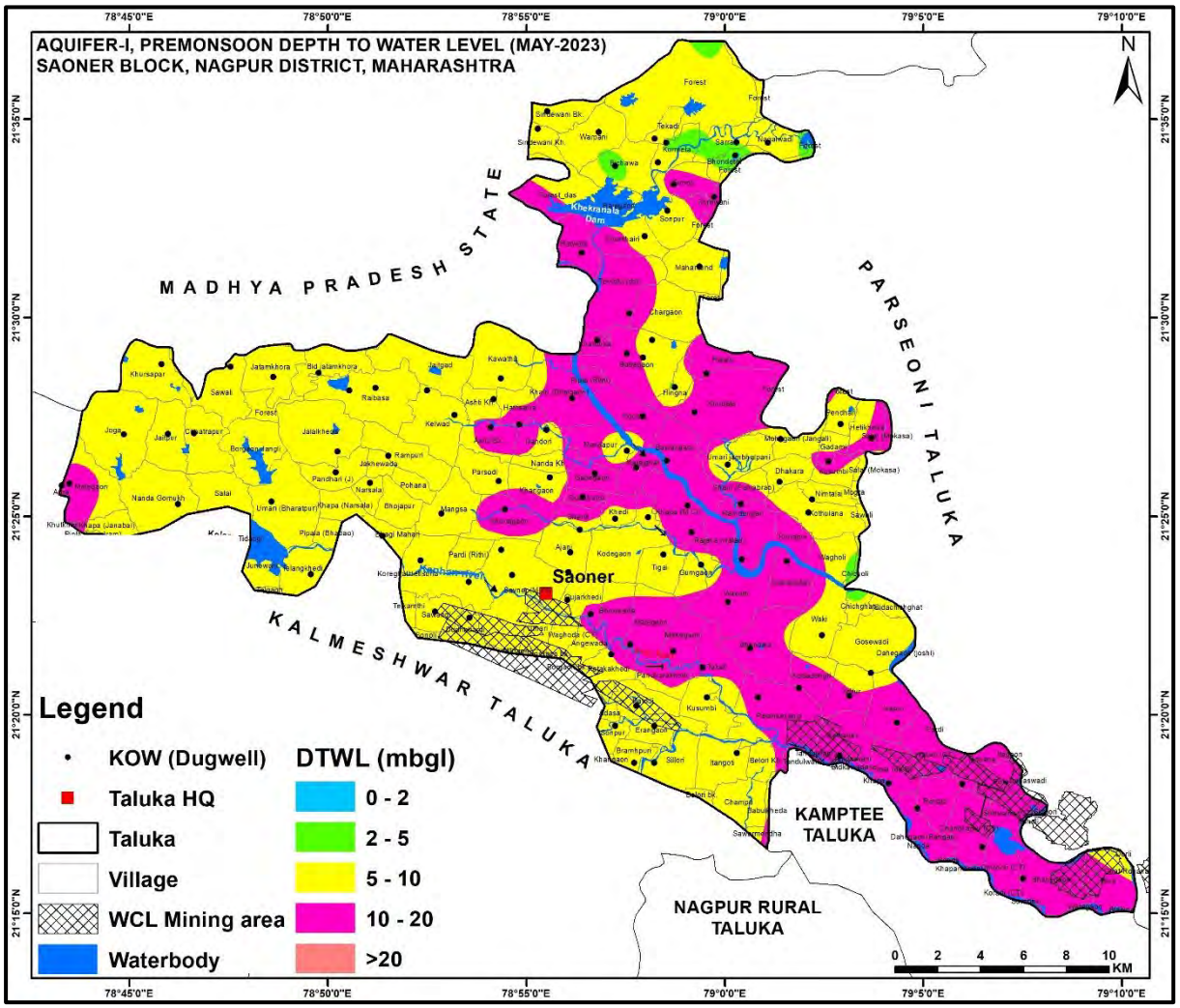


Fig 4.1: DTWL Aquifer-I Shallow aquifer (May 2023)

4.1.2 Depth to Water Level-Post-monsoon (Nov 2023):

The post monsoon water level is distributed over ranges of less than 1 m bgl to 19.9 m bgl. Majority area of Saoner block is showing water level 5 to 10 m bgl followed by 10 to 20 m gbl. Very concentrated patches of shallow ground water level (2 to 5 m bgl) is observed over western part and northern part of the block and in some patches in eastern part. In addition, deeper ground water levels (10-20 m bgl) were observed mainly areas following nortwestern-southeastern trend of the block and a patch in eastern region of the block. Significant rise in the groundwater levels are observed in the unconfined aquifer during post monsoon. Total 115 unconfined dug wells water level data have been utilized for understanding the post-monsoon water level distribution in Saoner block. The deepest water level is observed in Katodi village (19.9 mbgl). The post-monsoon depth to water level map is depicted in **Fig 4.2**.

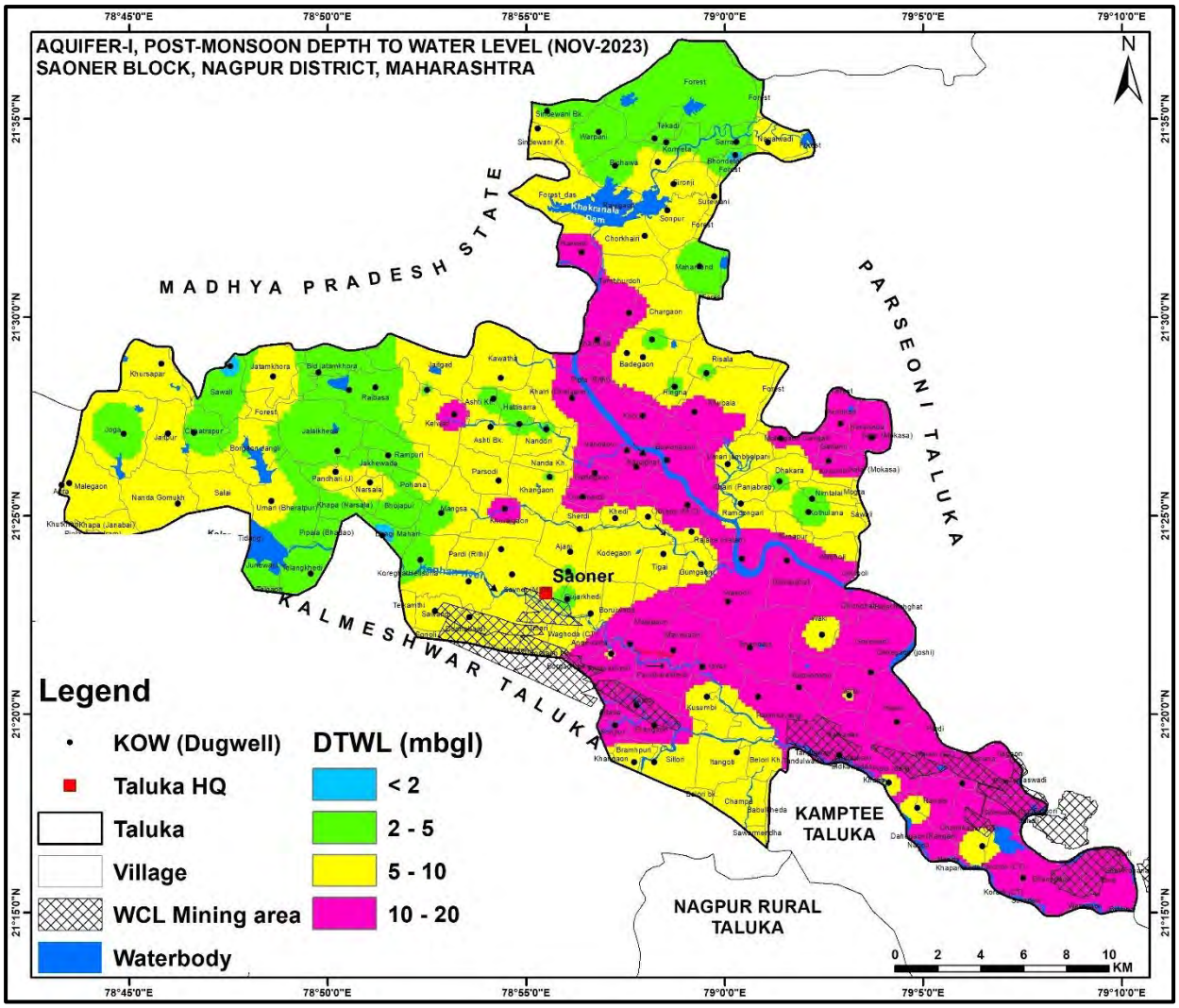


Figure 4.2: DTWL Aquifer-I Shallow aquifer (November 2023)

The distribution of groundwater levels and contribution from the number wells from shallow aquifers and area covering under water level depth ranges during pre- and post-monsoon period is shown in **Table-4.1**. During pre-monsoon shows, 49.5 % of wells showing water level ranging from 5 to 10 m bgl followed by the 39.1 % between 10-20 mbgl during pre-monsoon. Similar, the area under water level depth range between 5 to 10 m bgl is 57% followed by 38.4 % under 10 to 20 m bgl. Whereas during post monsoon, data indicates 40.8% of wells showing water levels between 5 to 10 m bgl followed by 29.5 % between 10 to 20 m bgl. Noteworthy reduction in the area covering under water level depth 5 to 10 m bgl and 10 to 20 m bgl from 57% to 46.4% and 38.4% to 34.2%, respectively. Significant increase in the number of wells showing water level between 2 to 5 m bgl (from 7.8% to 26.9 %) is observed during post monsoon. Drastic increase in the area falling under shallow water level 2 to 5 m bgl is observed from 4.4% to 19.2%. Significant increase in the number of wells showing water level less than 2 m bgl (from 1.7% to 2.6 %) is observed during post monsoon. The table shows that during post monsoon rising in water level is observed in almost all wells. This improvement in the ground water level showing rainfall playing a dominant role in controlling the seasonal water level dynamics.

Table-4.1: Ground Water level and % contribution from no. of wells from shallow aquifer and % of area covering during pre- and post-monsoon 2023.

WL (mbgl)	% of Shallow wells (pre-monsoon) and % of Area	% of Shallow wells (post-monsoon) and % of Area
<2	1.7% and 0.08%	2.6% and 0.2%
2-5	7.8 % and 4.4%	26.9% and 19.2%
5-10	50.5% and 57%	40.8% and 46.4%
10-20	40% and 38.4%	29.5% and 34.2%

4.1.3 Seasonal Water Level Fluctuation Aquifer-I (May-Nov 2023)

The water level fluctuations vary from -14.7 to 9.1 m with average fall of 3.04 m (**Fig.4.3**). Out of 115 wells, in 94 wells (81%) rise in water levels (0 to 9.1 m) is observed in almost entire area of the block. Falling water levels in the range of -14.7 to -0.2 m is observed in 19 wells in isolated parts of the block and only 2 wells show neither rise nor fall in water levels.

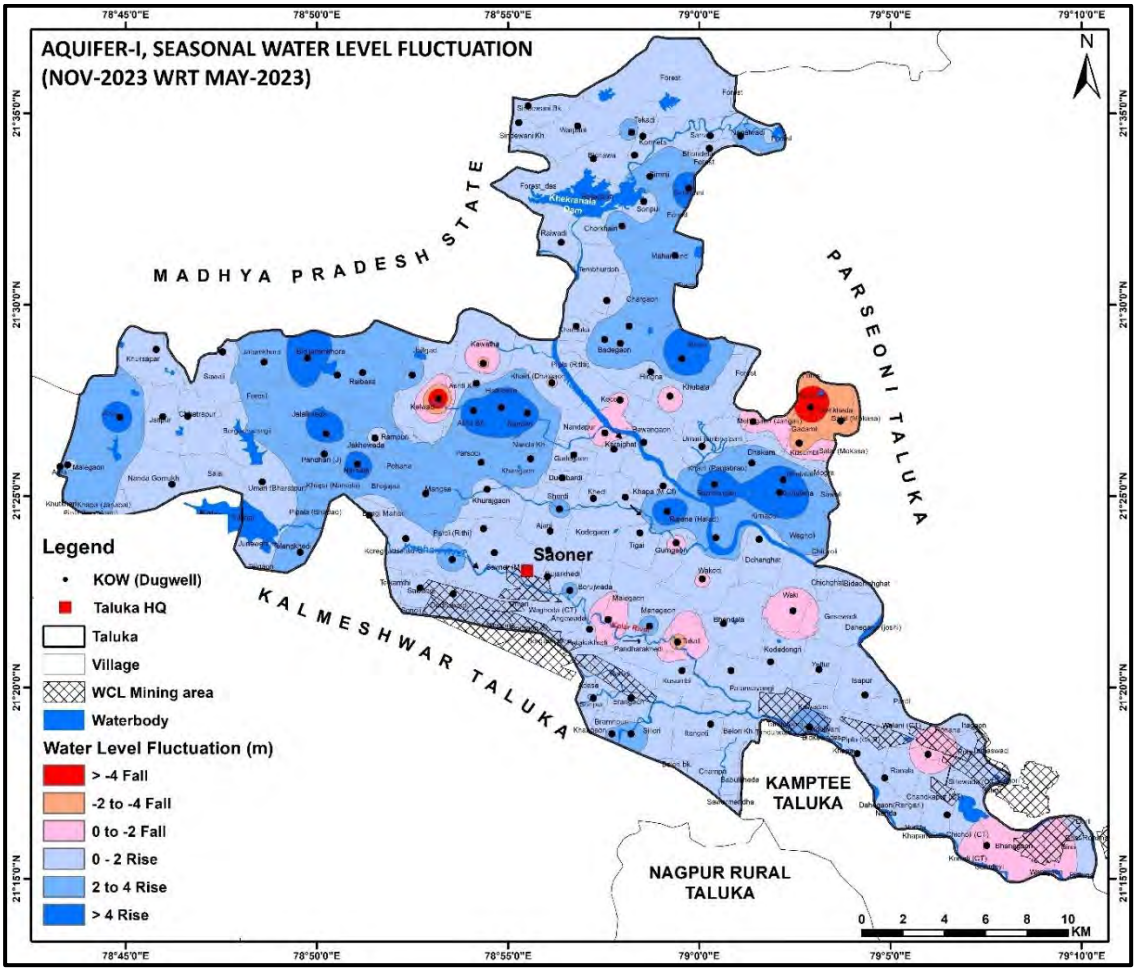


Fig 4. 3: Seasonal Fluctuation, Aquifer-I (May-November 2023)

4.2 Depth to water level (Aquifer-II / Deeper Aquifer)

In Aquifer-II, the pre-monsoon depth to water levels in Saoner taluka during pre-monsoon May 2023 ranges between 2 m bgl and >30 m bgl. The deeper dtwl (>30 m bgl) has been observed in southern and southwestern part of the Saoner taluka. In rest of the area water level ranges between 10 to 30 m bgl. The pre-monsoon depth to water level for Aquifer-II is given in fig. 3.6 and the details are presented in **Annexure III**. The post-monsoon dtwl ranges from 2 m bgl and 55 m bgl in Aquifer-II and presented in fig. 3.7. the area representing post monsoon dtwl in aquifer is more or less same except shallow water level (< 10 m bgl) is observed in entire Saoner taluka.

4.2.1 Pre-monsoon Depth to Water Level (May-2023)

The ground water level is distributed in wide ranges from 2 to 30 mbgl. Majority of the area showed water level between 10 to 20 mbgl followed by water level 5 to 10 mbgl covering western central part, northern part and some patches in southern part. There are some concentrated patches of shallow water level (2 to 5 mbgl) in southern region and northern region. Except Nimtalai all villages are showing water level less than 30 mbgl. The Pre-monsoon depth to water level map is depicted in **Fig 4.3**.

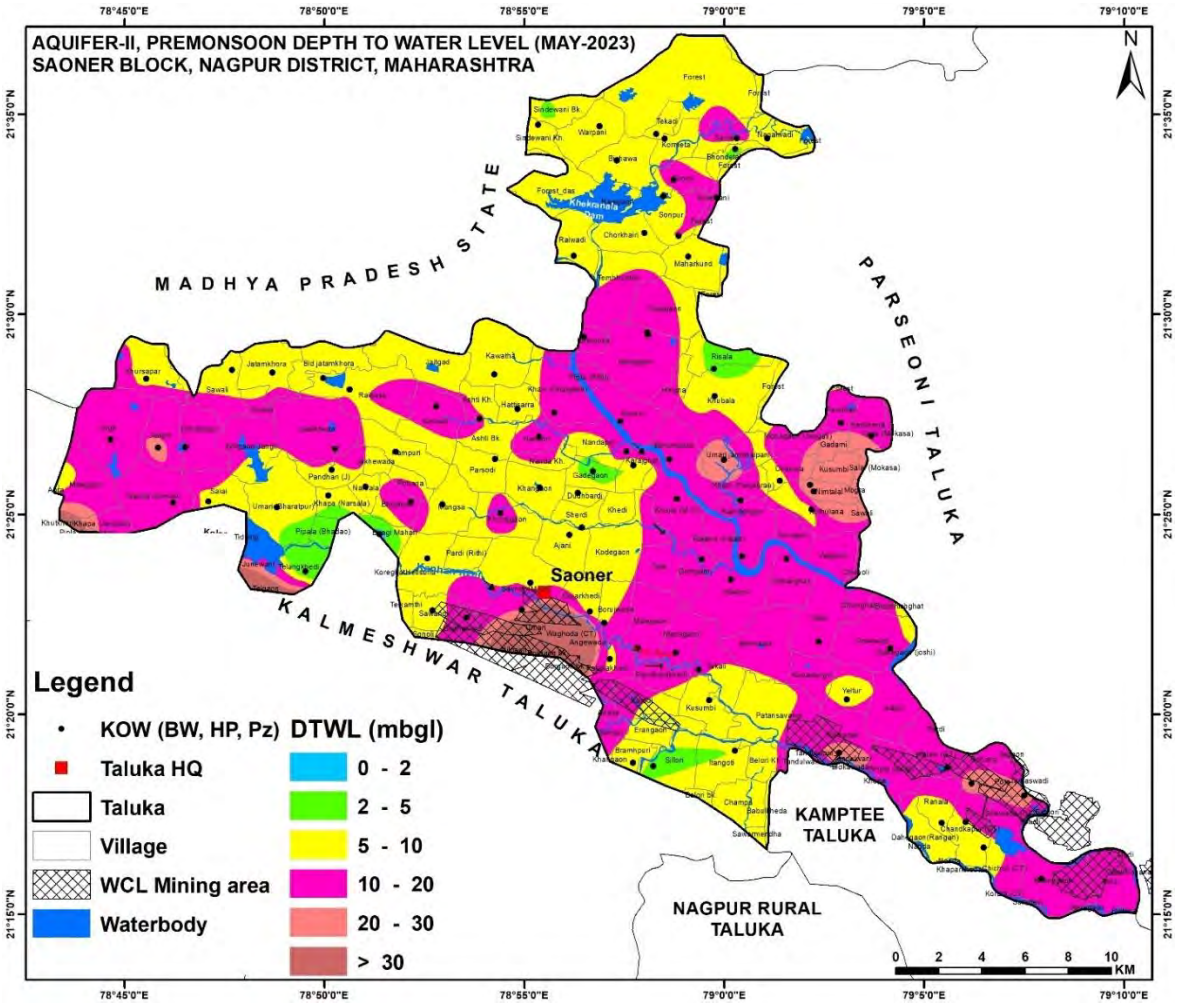


Fig 4.4: DTWL Aquifer-II Deeper aquifer (May 2023)

4.2.2 Post-monsoon Depth to Water Level (November 2023):

The post monsoon water level is distributed over ranges of less than 5 m bgl to 20 m bgl. Majority of Saoner taluka area is showing water level 10 to 20 m bgl followed by 5 to 10 m gbl. Very concentrated patches of shallow ground water level (2 to 5 m bgl) is observed in small patches in eastern and northwestern part of the block and western part of the block. In addition, deeper ground water levels were observed over villages in western, central and south-eastern part of Saoner. Significant rise in the groundwater levels are observed in the unconfined aquifer during post monsoon. Total 97 bore wells/hand pumps water level data have been utilized for understanding the post-monsoon water level distribution in Saoner taluka. The deepest water level is observed in Sawali village (49.54 m bgl). The post-monsoon depth to water level map is depicted in **Fig 4.5**

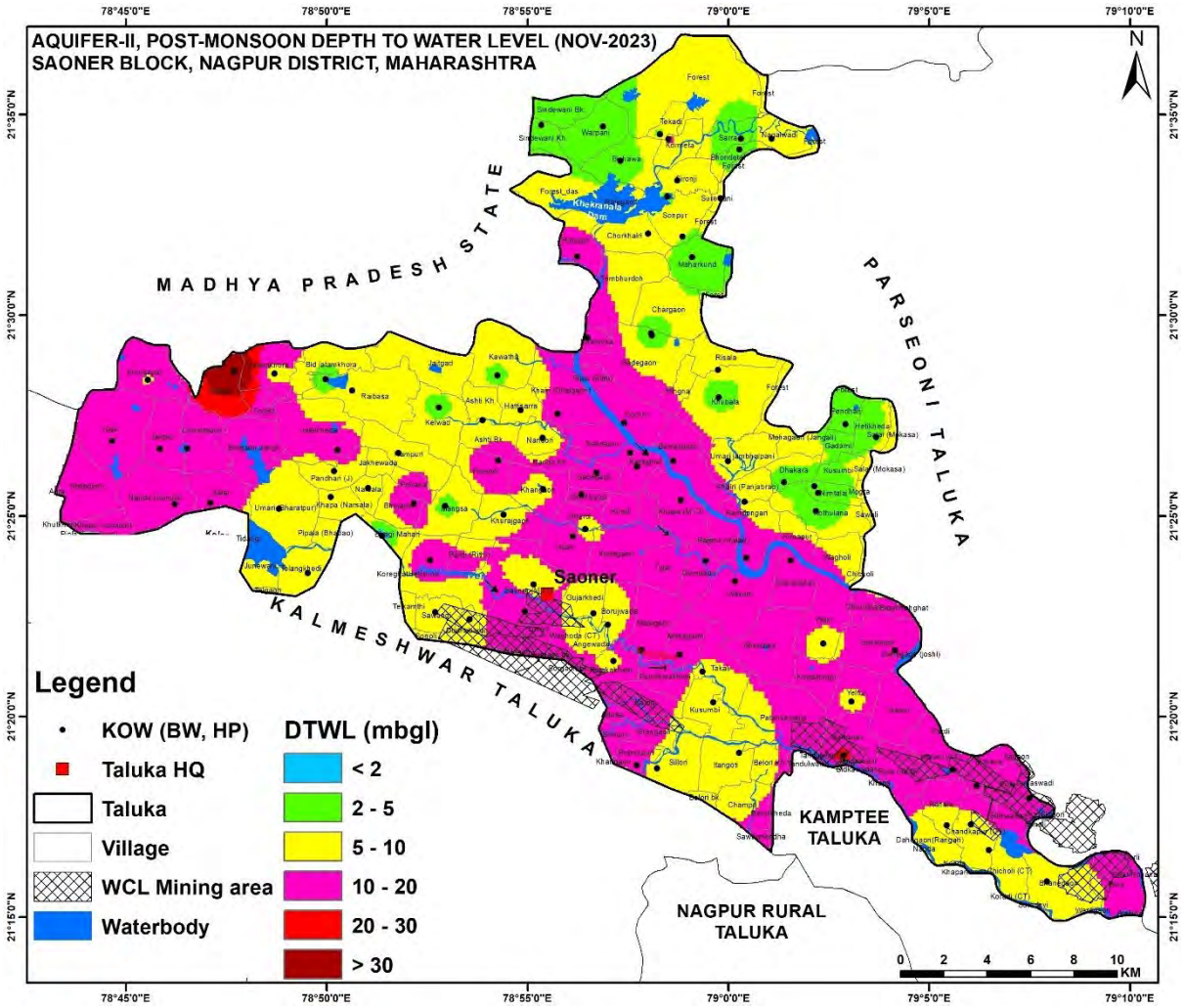


Fig 4.5: DTWL Aquifer-II Deeper aquifer (November 2023)

The distribution of groundwater levels and contribution from the number wells from deeper aquifer during pre- and post-monsoon period and % of study area falls under water level ranges is shown in **Table-4.2**. 42.2 % of wells showing water level ranging from 5 to 10 mbgl covering an 45 % of the Saoner block. During post monsoon rising in water level is observed in almost all wells by increasing the number of wells contribution from 12.3 % to 19.5 % with water level between

2 to 5 mbgl and area covering from 2.7 % to 8.1 %. Significant decrease in the number of wells showing water level between 5 to 10 m bgl from 42.2 % to 40.2% with decreasing the area falling from 45% to 43.52% during post monsoon. This improvement in the ground water level showing rainfall playing a dominant role in controlling the seasonal water level dynamics.

Table-4.2: Ground Water level and % contribution from no. of wells from deeper aquifer during pre- and post-monsoon 2023.

WL (mbgl)	% of shallow well (pre-monsoon) and % of Area	% of shallow wells (post-monsoon) and % of Area
0-2	2.06 % 0.02 %	1.0 and 0.02
2-5	12.3 % and 2.7 %	19.5 % and 8.1%
5-10	42.2 % and 45 %	40.2 % and 43.52%
10-20	35 % and 46.7%	36 % and 47.24 %
20-30	7.2 % and 3.6%	2.06 % and 0.6 %
>30	1.0 % and 1.7 %	1.03 % and 0.4 %

4.2.3 Seasonal Water Level Fluctuation Aquifer-II (May-Nov 2023):

The water level fluctuations vary from -15.13 to 26.2 m with average fall of 1.96 m (**Fig.4.6**). Out of 97 wells, in 69 wells (71%) rise in water levels (0.08 to 26.2 m) is observed in almost entire area of the block. Falling water levels in the range of -15.3 to -0.22 m is observed in 28 wells in isolated parts of the block.

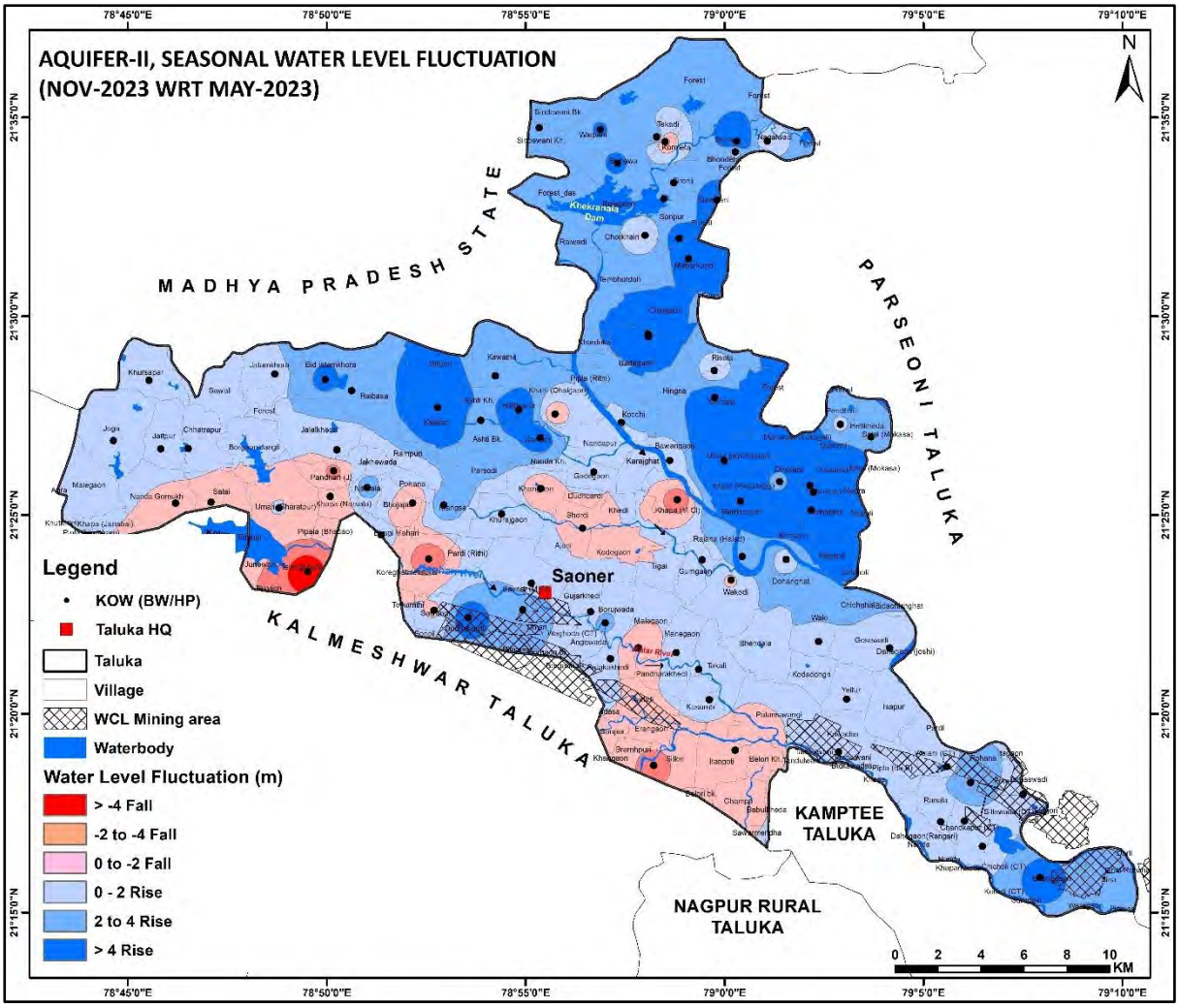


Fig 4. 6: Seasonal Fluctuation, Aquifer-I (May-November 2023)

4.3 Water Level Trend (2014-2023)

Based on the CGWB's GWMW, Nagpur, the long-term trend of water levels for pre-monsoon and post-monsoon periods for the last ten years (2014-23) have been computed. The long-term water level data of 9 GWMW of CGWB. The maps depicting the special variation in long-term water level trend is presented as (**Fig 4.7 and 4.8**).

4.3.1. Pre-monsoon decadal ground water level trend analysis (2014 to 2023):

The groundwater level decadal (2014 to 2023) trend analysis has been carried out and the distribution of water level trend over Saoner block is shown in **Fig.4.7** The decadal pre-monsoon water level trend map shows that the majority of the area showing a weak rising trend between upto 0.2 m/year. Adjacent to the central portion and some regions in the southeastern parts of the block are showing a weak falling trend (upto 0.2 m/year) during pre-monsoon. Whereas, the central parts, like villages Asthi Bk., Nandori, Parsodi, Khangaon, Nandpur, Hatisarra, Kelwad showing significant falling trends (0.2 to 0.4 m/year).

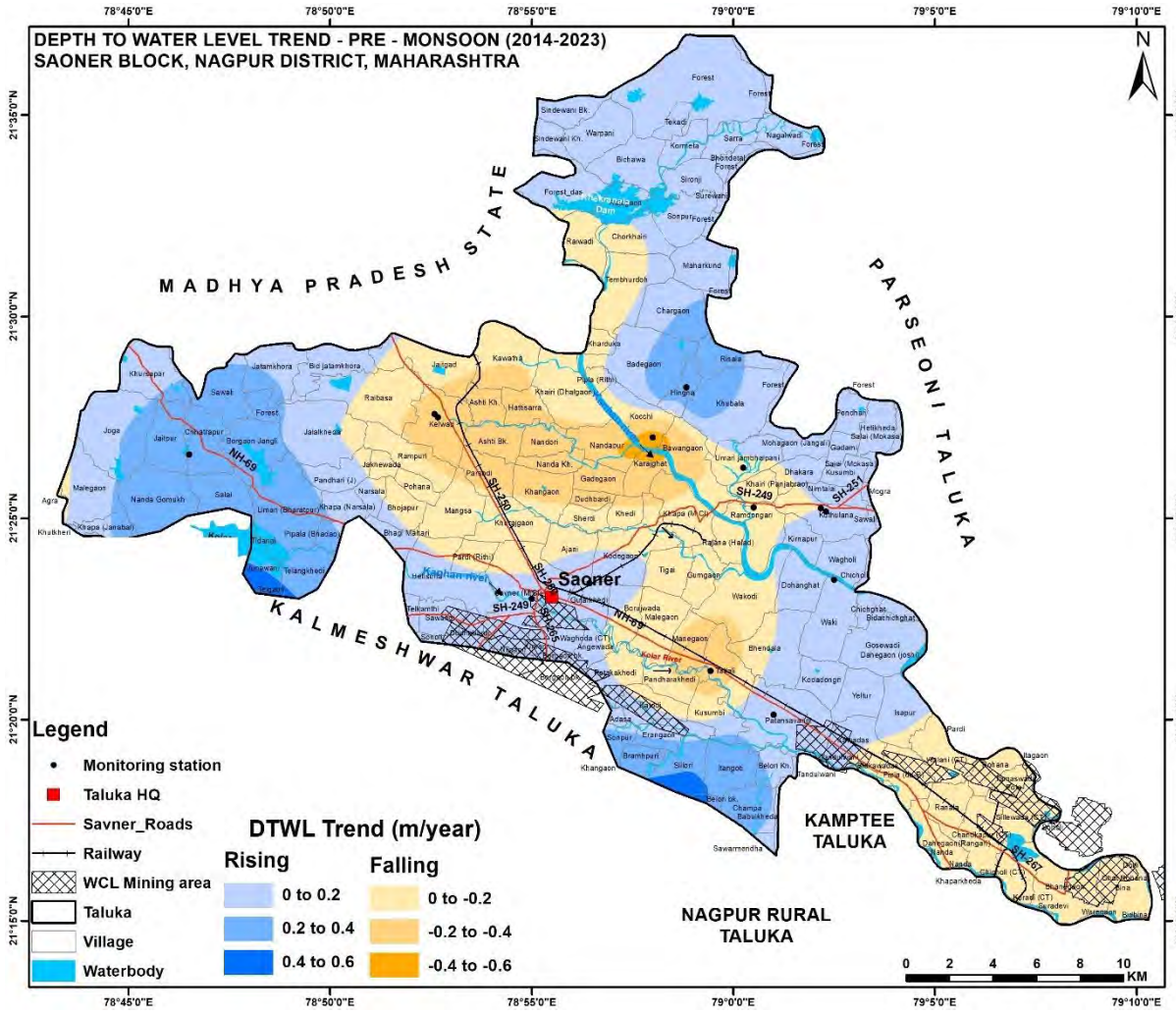


Fig 4.7: Pre-monsoon decadal ground water level trend

4.3.2. Post-monsoon decadal ground water level trend analysis (2014 to 2023):

The decadal trend analysis shows that majority of the area is associated with rising trend (upto 0.2 m/year) followed by 0.2 to 0.4 m/year. The central and western part shows falling trends (upto 0.2 m/year). The Northwestern and southeastern and some parts in southwestern show rising trend by 0.4 to 0.6 m/year. The northeastern and southern parts of Saoner block have been observed with significant rising in ground water level trends (0.6 to 0.8 m/year). The Pre-monsoon decadal ground water level trend map is depicted in **Fig 4.8.**

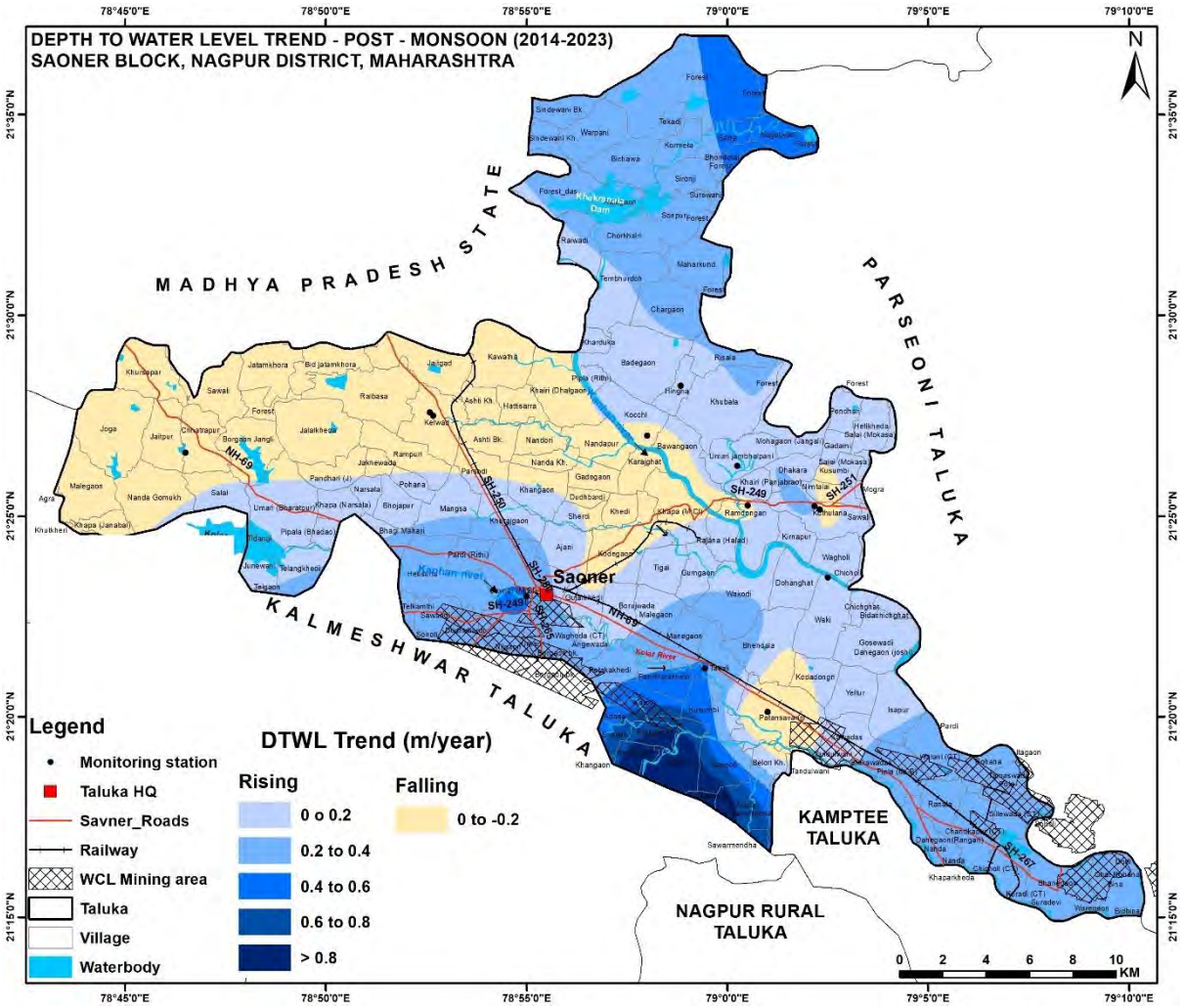


Fig 4.8: Post-monsoon decadal ground water level trend

4.4 Representative hydrographs:

The variation in short term and long-term water level trends may be due to variation in natural recharge due to rainfall and withdrawal of groundwater for various agricultural activities, domestic requirements, and industrial needs. The analysis of hydrographs (**Fig 2.9a to 2.9f**) shows that the annual rising limbs in hydrographs indicate the natural recharge of groundwater regime due to monsoon rainfall, as the monsoon rainfall is the sole source of natural recharge to the ground water regime. However, continuous increase in the groundwater draft is indicated by the recessionary limb.

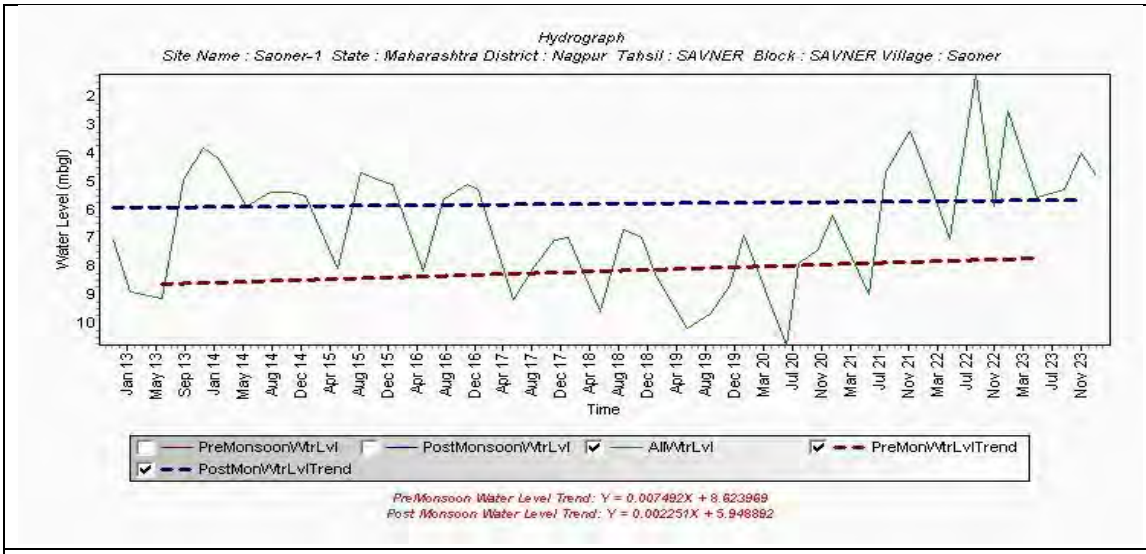


Figure 4.9 a: Hydrograph (2013-23), Saoner, Saoner Block, Nagpur District

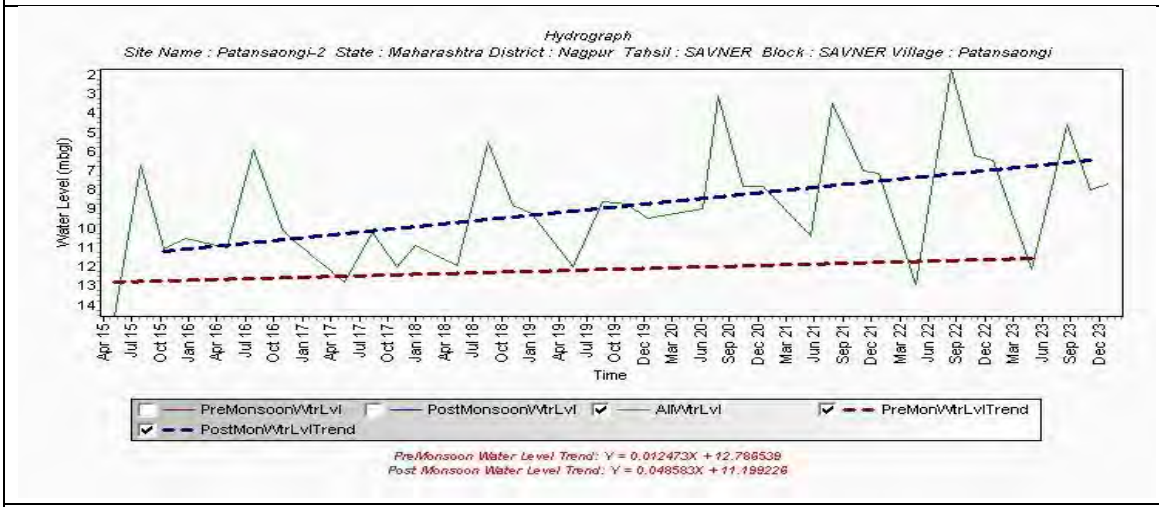


Figure 4.9 b: Hydrograph (2015-23), Patansaongi, Saoner Block, Nagpur District

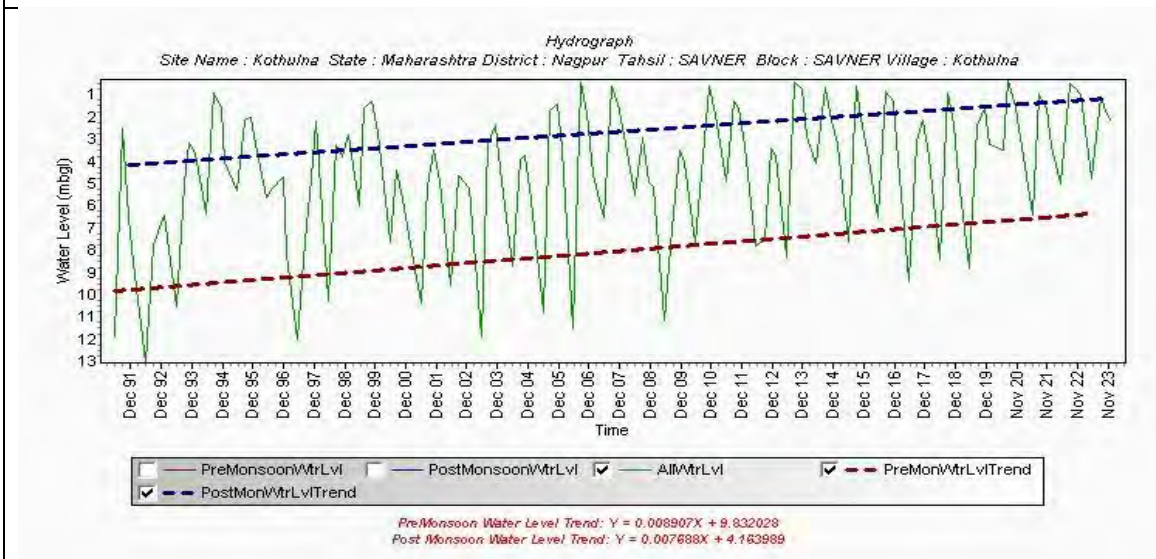


Figure 4.9 c: Hydrograph (1991-2023), Kothulna, Saoner Block, Nagpur District

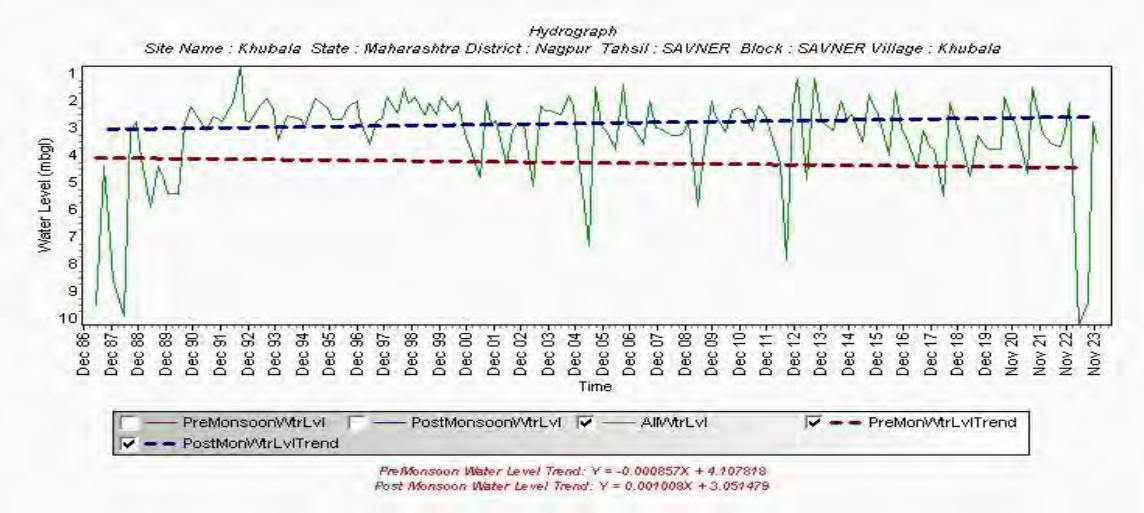


Figure 4.9 d: Hydrograph (1986-2023), Khubala, Saoner Block, Nagpur District

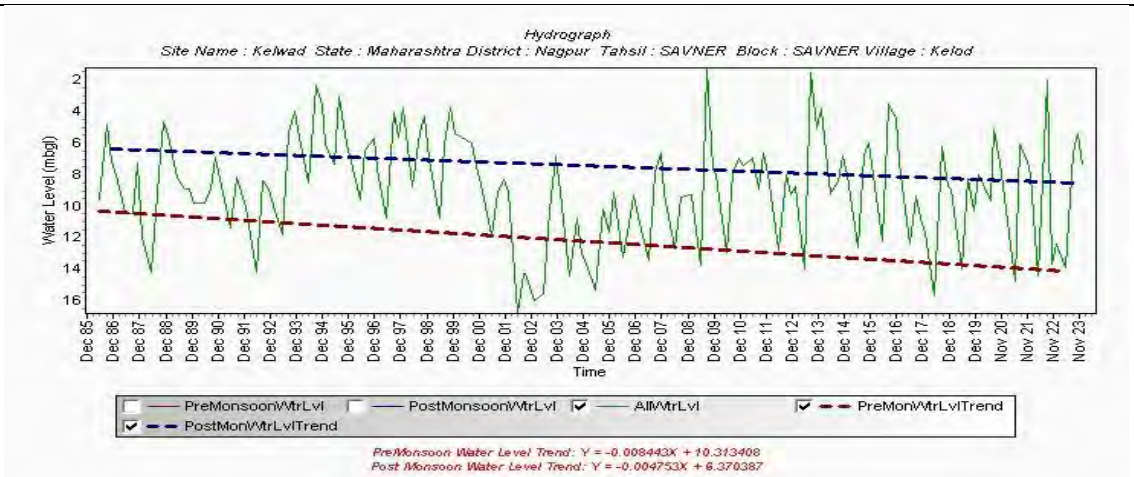


Figure 4.9 e: Hydrograph (1885-23), Kelwad, Saoner Block, Nagpur District

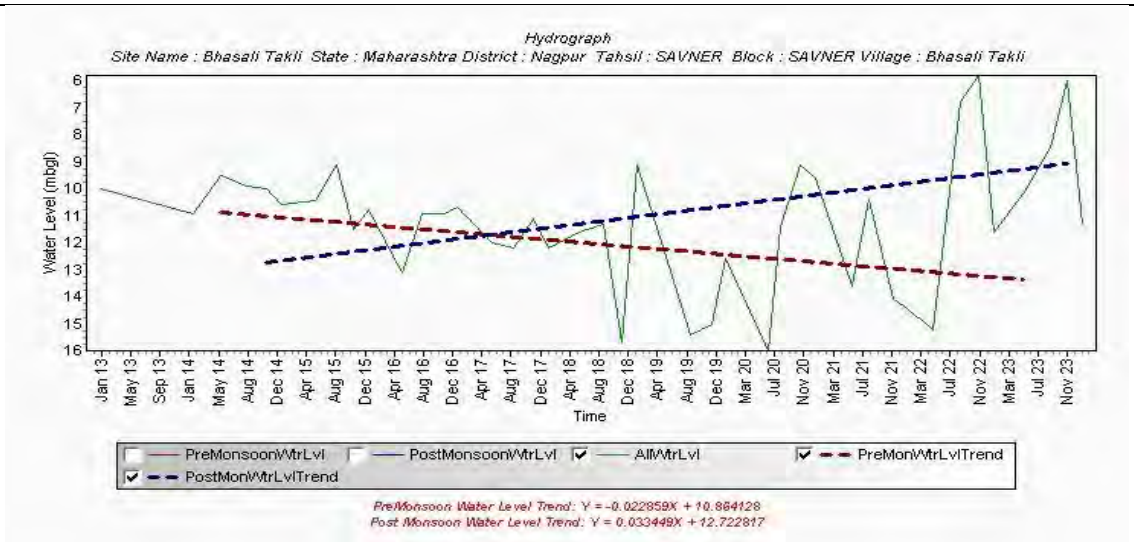


Figure 4.9 f: Hydrograph (2013-23), Bhasali, Saoner Block, Nagpur District

5.0 GROUND WATER QUALITY

OBJECTIVE

Water quality assessment is crucial for ensuring the safety and sustainability of water sources across various sectors, including drinking water, irrigation, and industrial processes. In the context of drinking water, assessing water quality is essential to safeguard public health. Contaminants such as bacteria, viruses, heavy metals, and chemicals can pose serious health risks if present in drinking water. Regular monitoring and assessment help identify and address potential hazards, ensuring that water treatment facilities can effectively remove or mitigate these contaminants, thus providing safe and clean drinking water to communities.

In agriculture, water quality assessment is pivotal for irrigation purposes. Poor water quality can have detrimental effects on soil health and crop productivity. High levels of salts, sediments, or toxic substances in water can lead to soil degradation, affecting the fertility and structure of the land. By monitoring water quality, farmers can make informed decisions about irrigation practices, selecting appropriate water sources, and optimizing resource utilization to enhance agricultural productivity while minimizing environmental impacts.

In industrial settings, water quality assessment is crucial for ensuring the efficiency and sustainability of manufacturing processes. Many industries rely on water for various purposes, including cooling, cleaning, and as a component in the production of goods. Poor water quality can lead to equipment corrosion, scaling, and fouling, impacting the overall efficiency of industrial operations. Regular water quality assessments enable industries to implement appropriate treatment measures, reduce environmental impact, and comply with regulations, ultimately contributing to sustainable and responsible industrial practices. Overall, water quality assessment plays a pivotal role in safeguarding human health, promoting agricultural productivity, and supporting sustainable industrial development.

The objective of the water quality analysis is to categorize areas with poor water quality for drinking, irrigation, and industrial purposes and find out the mechanism controlling the dissemination of the toxic elements.

MATERIAL AND METHODS

The methodology for assessing drinking water quality typically involves a comprehensive approach that considers a range of physical and chemical quality. Water quality testing is conducted at the laboraroty of Central Ground Water Board, located at Nagpur. Parameters assessed include pH levels, total dissolved solids, major anion and cation, Fluoride, heavy metals etc. Samples are collected from the shallow as well as deeper aquifer. The analysed data are then compared to established water quality standards determine suitability.

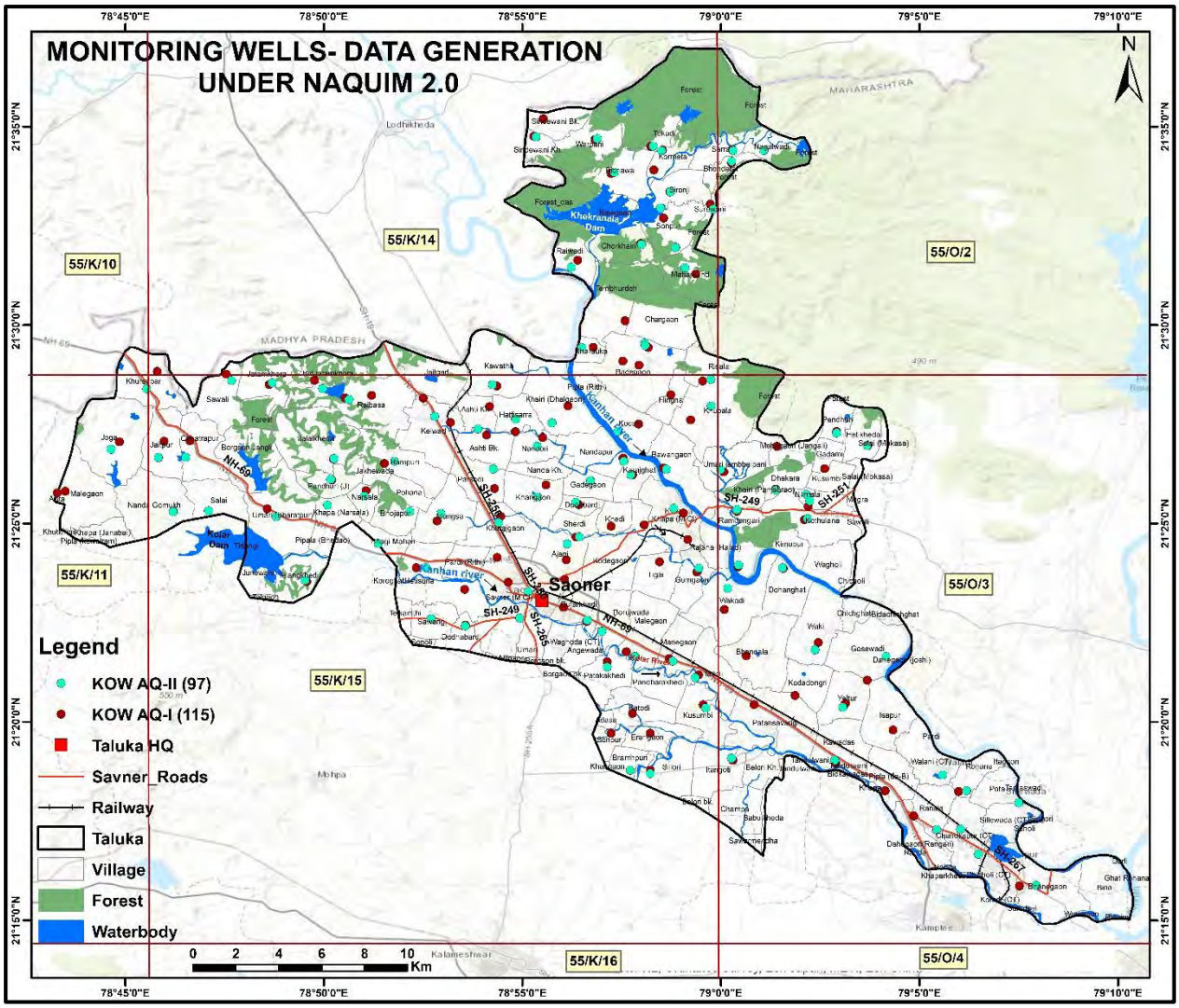


Figure 5. 1: Location of KOWs (shallow and deeper aquifer) in Saoner block, Nagpur district.

Ground water sampling was done from 308 established KOW wells during pre-monsoon period (May 2023) and 117 established KOWs during post-monsoon period (November 2023) under NAQUIM 2.0 study in Sanoer block, Nagpur district. During pre-monsoon period 152 samples were collected from shallow aquifer and 135 samples were collected from deeper aquifer for ground water quality. Ground water exploration was also carried out in the block and 26 water samples were collected from 8 wells representing deeper aquifer. During post-monsoon period 62 samples were collected from shallow aquifer and 55 samples were collected from deeper aquifer. The ground water quality of all samples of shallow aquifer and deeper aquifer collected during pre- and post-monsoon season is described below in detail. The location map of the area showing the newly established key observation wells for Aquifer I & Aquifer II is shown in figure 5.1.

RESULTS AND DISCUSSION

The concentrations of various gases and ions dissolved in water, from the atmosphere, soil, minerals and rocks with which it comes into the contact through its itinerary, are the characteristics of water. This ultimately determines the quality of ground water. The

concentration of CO32-, HCO3-, OH- and H+ ions and dissolved CO2 gases in water decides the acidic or basic nature of water while the salts of ions like Ca2+ and Mg2+ in water makes it soft or hard. Water with high Na+ and Cl- concentration can make the water saline. Nitrate ions percolated from anthropogenic sources can become predominant major anion in ground water. The excess fluoride concentration in ground water from fluoride bearing minerals may be related to the concentration of Ca2+, Na+ and HCO3- ions present in ground water.

Pre-Monsoon:

- **Water quality in Shallow aquifer**

The minimum, maximum and the average values of the chemical parameters analysed in the 152 ground water samples of shallow aquifer of Sanoer block, Nagpur district are summarized in **Table-5.1** and water quality data is presented in **Annexure-IV**.

- **Water quality in Deeper aquifer**

The minimum, maximum and the average values of the chemical parameters analysed in the 161 samples of deeper aquifer collected from Sanoer block, Nagpur district are summarized in **Table-5.1** and water quality data is presented in **Annexure-V**.

Table-5.1: Minimum, Maximum and Average Values of Parameters in Ground Water of Shallow Aquifer and Deeper Aquifer of Sanoer block, Nagpur district (Pre-Monsoon)

S.No.	Parameters	Shallow Aquifer			Deeper Aquifer		
		Minimum	Maximum	Average	Minimum	Maximum	Average
1	pH	6.92	8.85	7.62	6.78	8.39	7.55
2	Electrical Conductivity (EC) µS/cm @ 25°C	313	2694	1002	231	2683	1069
3	Total Dissolved Solid (TDS) mg/L	201	1724	642	148	1717	684
4	Total Hardness (TH) mg/L	65	790	325	65	910	326
5	Calcium (Ca^{++}) mg/L	12	144	50	8	174	52
6	Magnesium (Mg^{++}) mg/L	4	153	49	2	177	48
7	Sodium (Na^{+}) mg/L	10	344	71	9	289	80
8	Potassium (K^{+}) mg/L	0	113	5	0	170	8
9	Carbonate (CO_3^{--}) mg/L	0	72	0	0	36	0
10	Bi-Carbonate (HCO_3^{-}) mg/L	128	915	421	122	714	395

S.No.	Parameters	Shallow Aquifer			Deeper Aquifer		
		Minimum	Maximum	Average	Minimum	Maximum	Average
11	Chloride (Cl^-) mg/L	11	305	65	11	588	87
12	Sulphate (SO_4^{--})mg/L	1	669	41	0	251	48
13	Nitrate (NO_3^-) mg/L	0	224	44	0	291	54
14	Fluoride (F^-) mg/L	0.26	3.57	0.78	0.16	2.44	0.73
15	Uranium (U) µg/L	0.00	27.06	3.04	0.00	14.09	2.84

(BDL- Below Detection Limit)

Post-Monsoon:

- **Water quality in Shallow aquifer**

The minimum, maximum and the average values of the chemical parameters analysed in the 62 ground water samples of shallow aquifer are summarized in **Table-5.2** and water quality data is presented in **Annexure-VI**.

- **Water quality in Deeper aquifer**

The minimum, maximum and the average values of the chemical parameters analysed in the 55 ground water samples of deeper aquifer are summarized in **Table-5.2** and water quality data is presented in **Annexure-VII**.

Table-5.2: Minimum, Maximum and Average Values of Parameters in Ground Water of Shallow Aquifer and Deeper Aquifer of Saoner block, Nagpur district (Post-Monsoon)

S.No.	Parameters	Shallow Aquifer			Deeper Aquifer		
		Minimum	Maximum	Average	Minimum	Maximum	Average
1	pH	7.15	8.04	7.67	7.27	8.04	7.66
2	Electrical Conductivity (EC) µS/cm @ 25°C	512	3718	1168	527	2395	1219
3	Total Dissolved Solid (TDS) mg/L	327	2380	747	337	1533	780
4	Total Hardness (TH) mg/L	195	1190	417	95	885	403
5	Calcium (Ca^{++}) mg/L	30	152	71	18	206	75
6	Magnesium (Mg^{++}) mg/L	17	204	58	12	157	53
7	Sodium (Na^+) mg/L	10	286	71	18	251	79

S.No.	Parameters	Shallow Aquifer			Deeper Aquifer		
		Minimum	Maximum	Average	Minimum	Maximum	Average
8	Potassium (K^+) mg/L	0.2	81	4	0.5	125	11
9	Carbonate (CO_3^{--}) mg/L	0	0	0	0	0	0
10	Bi-Carbonate (HCO_3^-) mg/L	214	732	439	238	714	443
11	Chloride (Cl^-) mg/L	14	539	88	14	319	92
12	Sulphate (SO_4^{--}) mg/L	8	241	55	4	427	73
13	Nitrate (NO_3^-) mg/L	5	348	82	0.02	258	72
14	Fluoride (F^-) mg/L	0.18	1.85	0.56	0.09	2.53	0.50
15	Uranium (U) µg/L	0.10	8.71	2.79	0.00	18.92	3.88

(BDL- Below Detection Limit)

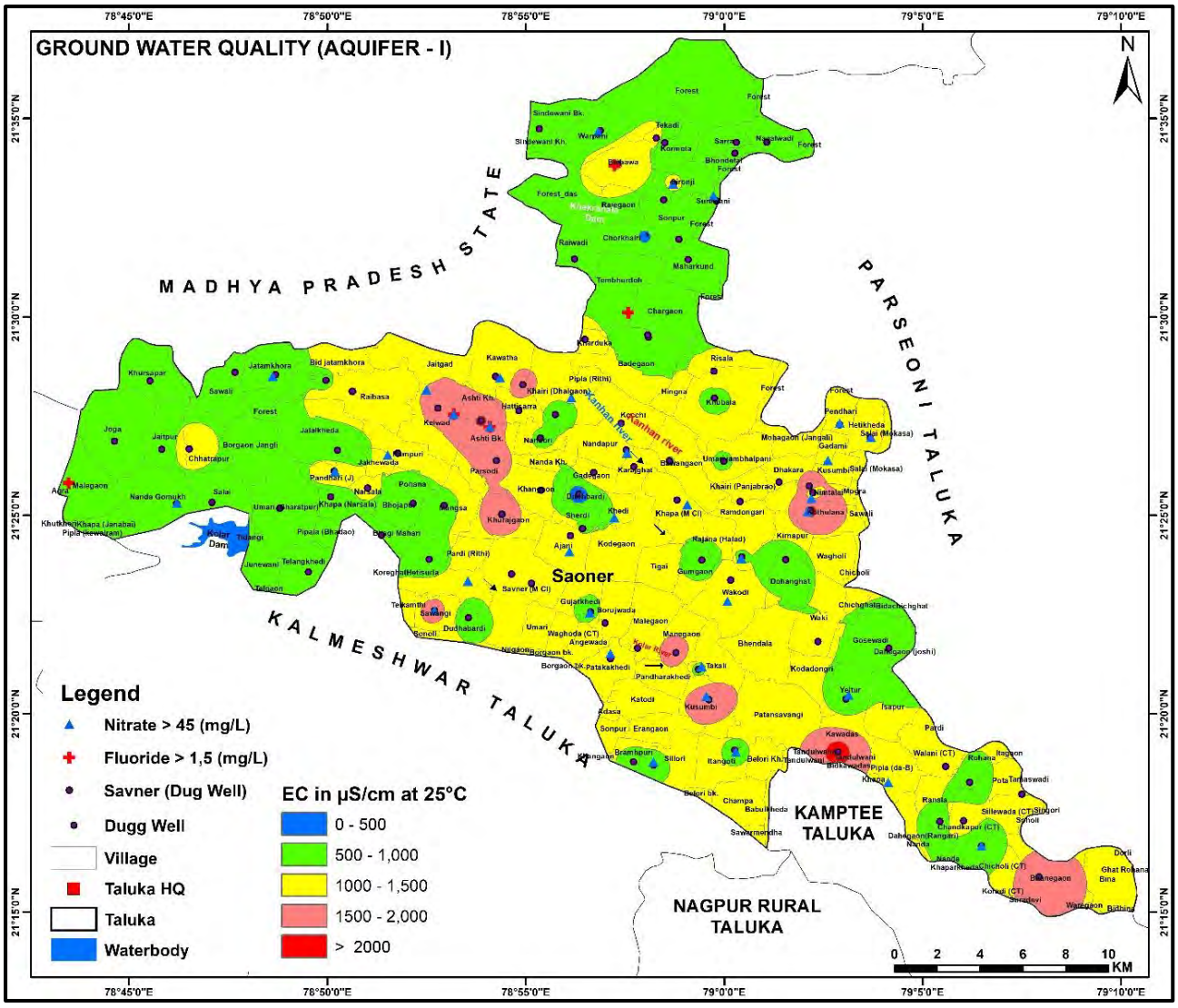


Fig 5. 2: Pre-monsoon Ground Water Quality of Shallow Aquifer

- During pre-monsoon 152 samples are analysed, the concentration of EC in shallow aquifer varies between 313.4 (Khapa village) and 2694 µS/cm (Parsioni Village). About 38% area of the block showing EC less than 1000 µS/cm and 62% area showing EC greater than 1000 µS/cm. The ground water is potable. The pre-monsoon water quality of shallow aquifers is shown in Fig. 4.1. The concentration of fluoride is found in the range of 0.26-3.57 mg/L with the average being 0.79 mg/L. Five samples showing Fluoride>1.5 mg/L at Asthi Bk. (1.62 mg/L), Kelwad(1.92 mg/L), Temburdoh(1.65 mg/L), Bichwa(1.55 mg/L), Malegaon (3.53 mg/L). The nitrate concentration is found in the range of BDL -224 mg/L with the average being 43.32 mg/L. Nitrate content is observed to be less than permissible limit of 45 mg/L in 95 wells and more than MPL in 46 wells (33% of samples). Maximum Nitrate concentration i.e., 224 mg/L has been observed at Sillori village. The Pre-monsoon depth to water level map of shallow aquifer is depicted in **Fig. 5.2**.
- During post-monsoon 62 samples are collected based on pre-monsoon hot spot area and analysed for shallow aquifer, the concentration of EC in shallow aquifer varies between 512

(Heti Nandaji village) and 3718 µS/cm (Kelwad Village). The concentration of fluoride in Saoner block is found in the range of 0.18-1.85 mg/L with the average being 0.56 mg/L. and only 1 samples haves fluoride concentration more than MPL of 1.5 mg/L at Kautha (1.87 mg/L). The nitrate concentration is found in the range of 5 – 348 mg/L with the average being 82 mg/L. Nitrate content is observed to be less than permissible limit of 45 mg/L in 19 wells and more than MPL in 43 locations. Maximum Nitrate concentration i.e., 348 mg/L has been observed at Kelwad village. The Post-monsoon depth to water level map of shallow aquifer is depicted in **Fig. 5.3**.

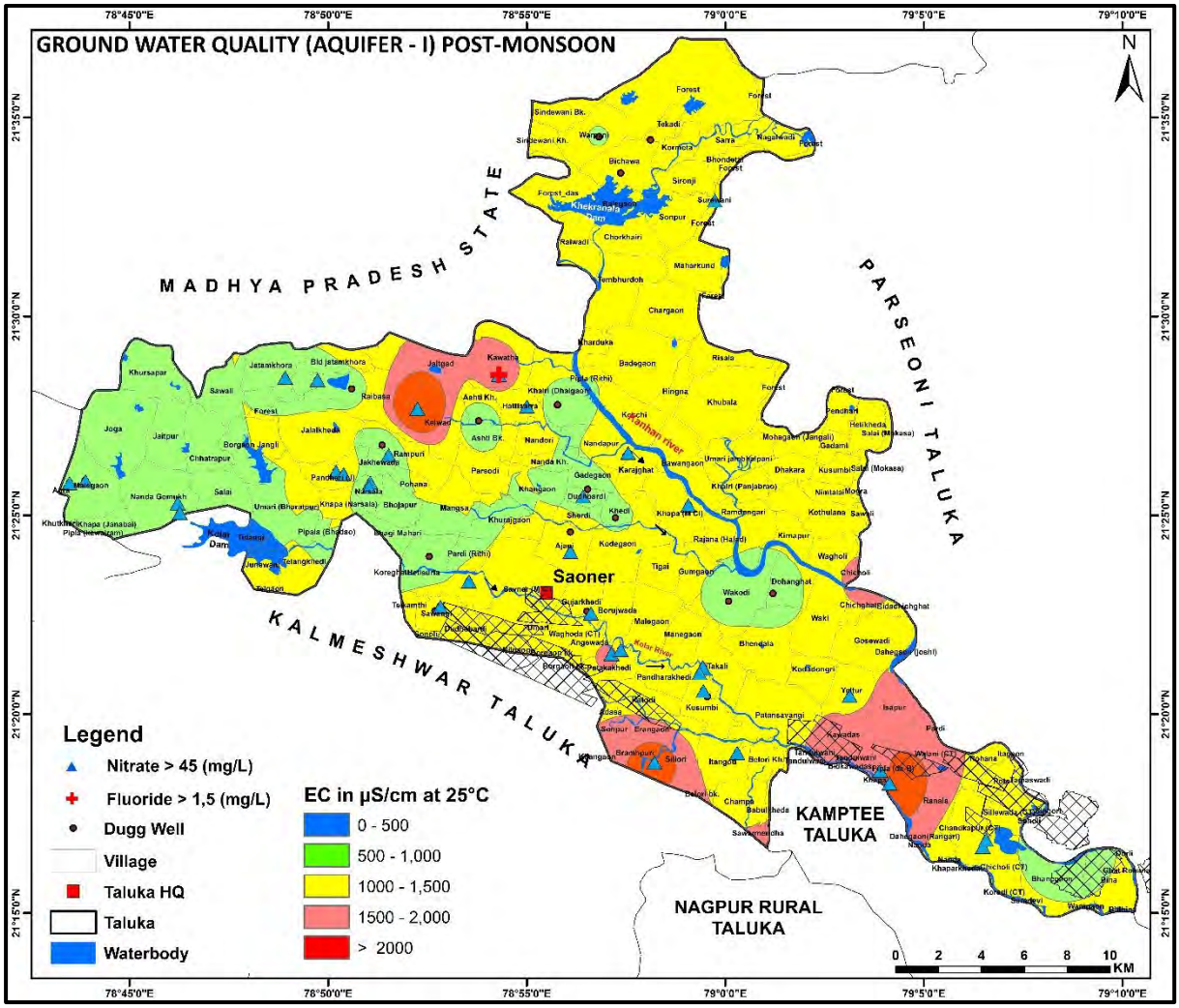


Fig 5. 3: Post-monsoon Ground Water Quality of Shallow Aquifer

- During pre-monsoon total 125 samples are analysed, the concentration of EC in Deeper aquifer varies between 230.6 (Dudhabardi village) and 2683 µS/cm (Digalwadi Village). About 58% area of the block showing EC less than 1000 µS/cm and 42% area showing EC greater than 1000 µS/cm. The ground water is potable. The water quality map of deeper aquifers is shown in Fig. 4.3. The Fluoride content in deeper aquifer is in the range of 0.27 to 2.22 mg/L with average being 0.75 mg/L. Fluoride content is observed to be less than desirable limit of 1 mg/L in 104 locations, between desirable and permissible limit for 19 locations and 2 locations have fluoride concentration more than MPL of 1.5 mg/L. Maximum Flouride concentration i.e., 2.22

mg/L has been observed at Malegaon village. The nitrate content in the ground water samples of Saoner block is found in the range of 0 -291 mg/L with the average being 51 mg/L. Nitrate content is observed to be less than permissible limit of 45 mg/L in 72 location and more than MPL in 53 locations (42% of samples). Maximum Nitrate concentration i.e., 291 mg/L has been observed at Anganwadi village. The Pre-monsoon depth to water level map of deeper aquifer is depicted in **Fig. 5.4**.

- During post-monsoon total 55 samples are collected based on pre-monsoon hot spot area (EC, F and Nitrate) and analysed, the concentration of EC in Deeper aquifer varies between 527 (Pipla (Bhada) village) and 2395 µS/cm (Khurajgaon Village). The ground water is potable. The Fluoride concentration in deeper aquifer is in the range of 0.09 to 2.53 mg/L with average being 0.50 mg/L. Fluoride content is observed to be less than desirable limit of 1 mg/L in 48 locations and 1 location have fluoride concentration more than MPL of 1.5 mg/L. Maximum Fluoride concentration i.e., 2.53 mg/L has been observed at Tishti Kh village. The nitrate content in the ground water samples of Saoner block is found in the range of 0 – 258 mg/L with the average being 72 mg/L. Nitrate content is observed to be less than permissible limit of 45 mg/L in 17 locations and more than MPL in 38 locations. Maximum Nitrate concentration i.e., 258 mg/L has been observed at Kawadas village. The Post-monsoon depth to water level map of deeper aquifer is depicted in **Fig. 5.5**.

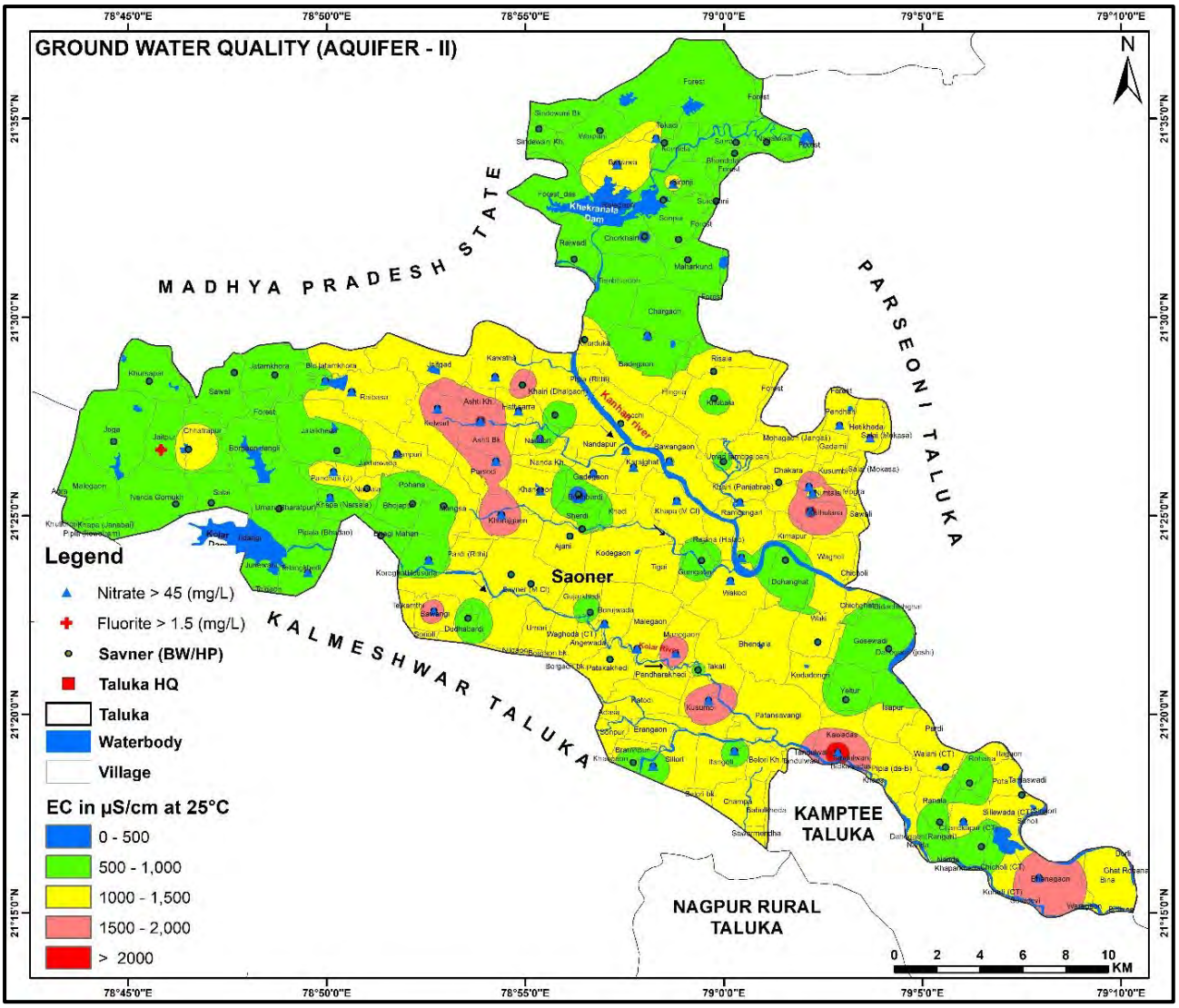


Fig 5. 4: Pre-monsoon Ground Water Quality of Deeper Aquifer

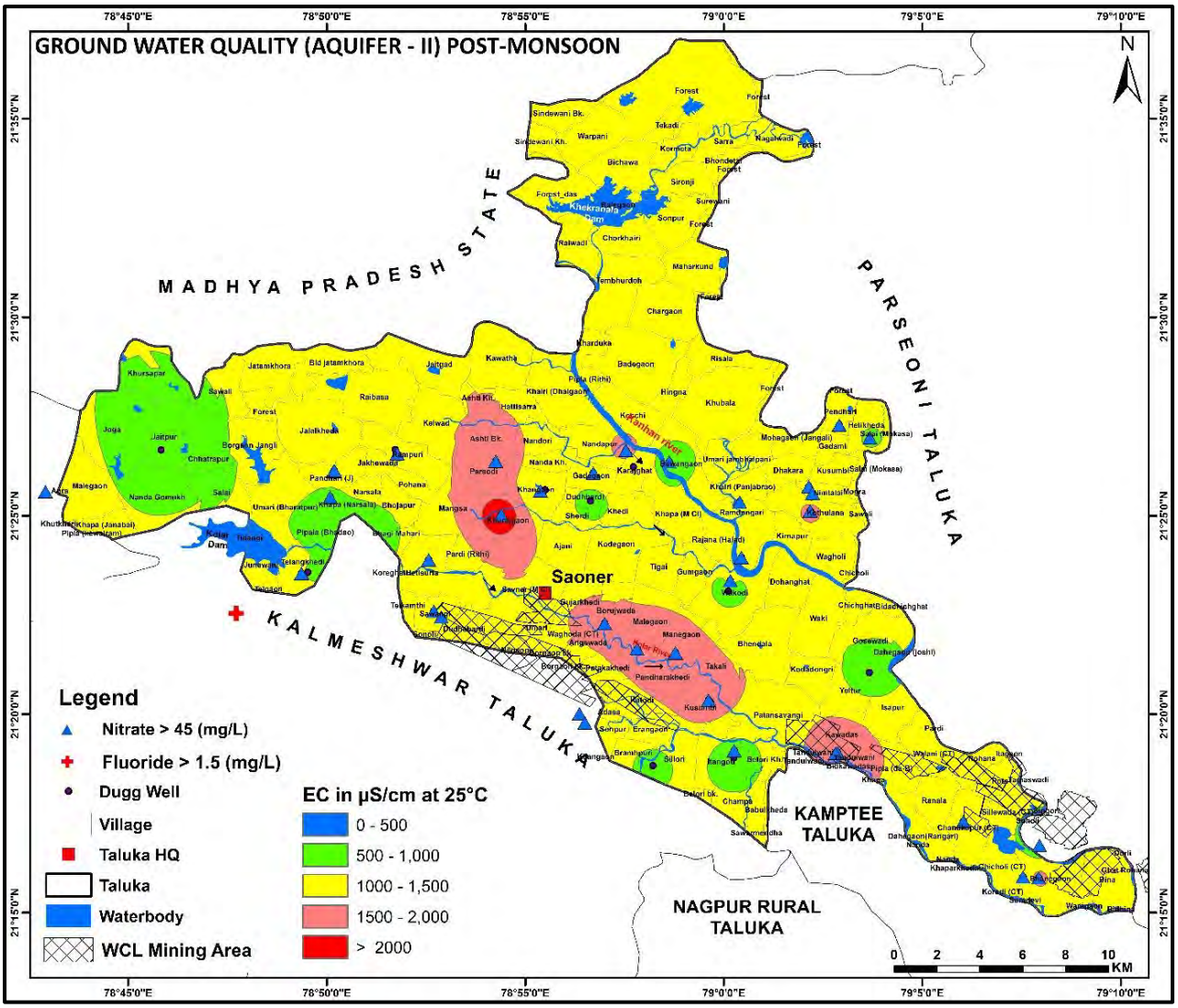


Figure 5. 4: Post-monsoon Ground Water Quality of Deeper Aquifer

5.1 Distribution of pH

Pre-Monsoon:

Shallow aquifer:

The range and average value of pH of the ground water samples of shallow aquifer indicates that the ground water in Sanoer block, Nagpur district is alkaline in nature. The pH values also indicate that the CO_2 dissolved in water exists mainly in the form of HCO_3^-. This is also clear from the concentration of HCO_3^- and CO_3^{2-} ions in the ground water. Under the natural condition, the pH of ground water is usually found in the range of 6.5 to 8.5. However, low pH (<6.5) found in the ground water may be due to the availability of CO_2 in environment in which the water is existing. Sometimes, it may also be due to the percolation of strongly acidic wastewater from anthropogenic sources to groundwater. In Sanoer block, Nagpur district, pH range was found to be between 6.92 and 8.85 with average pH being 7.62, with only 1 location Pardi DW with pH 8.85 which is more than the desirable limit.

Deeper aquifer:

The range and average value of pH of the ground water samples of deeper aquifer indicates that the ground water in the State is predominantly alkaline in nature. In the deeper aquifer the pH was found to be in the range of 6.78 to 8.39 with average pH being 7.55 which is in the desirable limit.

Post-Monsoon:

Shallow aquifer:

The range and average value of pH of the ground water samples of shallow aquifer indicates that the ground water in Saoner block is alkaline in nature. The pH range was found to be between 7.15 and 8.04 with average pH being 7.67.

Deeper aquifer:

In the deeper aquifer the pH was found to be in the range of 7.27 to 8.04 with average pH being 7.66 which is in the desirable limit.

5.2 Distribution of Electrical Conductivity (EC) and Total Dissolved Solids (TDS)

Pre-Monsoon:

Shallow aquifer:

The measurement of EC of water gives an idea about the ion's concentration in the water. As the concentration of dissolved ions increases, the water becomes more conductive and also shows rise in TDS values. EC and TDS are interrelated as mostly inorganic substances are dissolved in ground water. The TDS is computed as sum of ions concentration in ground water. It is also an important parameter to assess the quality of water.

The average values of EC and TDS of the samples suggest that the groundwater in 107 wells is fresh and potable in nature. The EC is in the range of 313 – 2694 µS/cm with the average EC being 1002µS/cm and TDS is in the range of 201 – 1724 mg/L with the average TDS being 642 mg/L.

Deeper aquifer:

The EC of deeper aquifer is found to be in the range of 231–2683 µS/cm with average being 1069 µS/cm. TDS is in the range of 148 - 1717 mg/L with average being 684 mg/L.

Post-Monsoon:

Shallow aquifer:

The average values of EC and TDS of the samples suggest that the groundwater in the shallow aquifer is fresh and potable in nature. The EC is in the range of 512 – 3718 µS/cm with the average EC being 1168 µS/cm and TDS is in the range of 327– 2380 mg/L with the average TDS being 747 mg/L. Only 1 location, Kelwad, has EC more than 3000 µS/cm and TDS more than 2000 mg/L.

Deeper aquifer:

The EC of deeper aquifer is found to be in the range of 527–2395 µS/cm with average being 1219µS/cm. The TDS is in the range of 337 - 1533 mg/L with average being 780 mg/L.

5.3 Distribution of Total Alkalinity

Pre-Monsoon:

Shallow aquifer:

The total alkalinity of water is its acid neutralizing capacity and primarily a function of carbonate, bicarbonate and hydroxide content of water. It is expressed in terms of CaCO3. The range and average concentration values of carbonate and bicarbonate ions indicate that the alkalinity of ground water is mainly due to the bicarbonate ion. The total alkalinity in Sanoer block, Nagpur district found in the range of 128 – 915 mg/L with the average being 421 mg/L. Total alkalinity is observed to be less than desirable limit of 200 mg/L in 3 wells, between desirable and permissible limit for 137 wells and 12 wells have total alkalinity more than maximum permissible limit of 200 mg/L.

Deeper aquifer:

The total alkalinity in Sanoer block, Nagpur district deeper aquifer is found in the range of 122 –714 mg/L with the average being 395 mg/L. The alkalinity of ground water in deeper aquifer is mainly due to the bicarbonate ion. Total alkalinity is observed to be less than desirable limit of 200 mg/L in 9 locations, between desirable and permissible limit for 144 wells and 8 locations have total alkalinity more than maximum permissible limit of 600 mg/L.

Post-Monsoon:

Shallow aquifer:

The total alkalinity in Saoner block, Nagpur district found in the range of 214 – 732 mg/L with the average being 439 mg/L. Total alkalinity is observed to be less than desirable limit of 200 mg/L in 0 wells, between desirable and permissible limit for 56 wells and 6 wells have total alkalinity more than maximum permissible limit of 600 mg/L.

Deeper aquifer:

The total alkalinity in Saoner block, Nagpur district deeper aquifer is found in the range of 238 – 714 mg/L with the average being 443 mg/L. The alkalinity of ground water in deeper aquifer is due to the bicarbonate ion. Total alkalinity is observed to be less than desirable limit of 200 mg/L in 0 locations, between desirable and permissible limit for 48 wells while 7 locations have total alkalinity more than maximum permissible limit of 600 mg/L.

5.4 Distribution of Total Hardness (TH)

Pre-Monsoon:

Shallow aquifer:

The total hardness (TH) is the sum of calcium (Ca) and magnesium (Mg) concentration expressed in terms of $CaCO_3$ in mg/L. The carbonate and bicarbonate salts of Ca and Mg give temporary hardness to ground water while a chloride and sulphate salt gives permanent hardness.The total Hardness in Sanoer block, Nagpur district found in the range of 65 – 790 mg/L with the average being 325 mg/L. Total hardness is observed to be less than desirable limit of 200 mg/L in 17 wells, between desirable and permissible limit for 131 wells and 4 wells have total hardness more than maximum permissible limit of 600 mg/L.

Deeper aquifer:

The total hardness in Sanoer block, Nagpur district deeper aquifer is found in the range of 65 – 910 mg/L with the average being 328 mg/L. The total hardness of ground water in deeper aquifer is mainly due to the bicarbonate ion. Total hardness is observed to be less than desirable limit of 200 mg/L in 29 lcoations, between desirable and permissible limit for 123 locations and 9 locations have total hardness more than maximum permissible limit of 600 mg/L.

Post-Monsoon:

Shallow aquifer:

The total Hardness in Saoner block, Nagpur district found in the range of 195 – 1190 mg/L with the average being 417 mg/L. Total hardness is observed to be less than desirable limit of 200 mg/L in 1 wells, between desirable and permissible limit for 56 wells and 5 wells have total hardness more than maximum permissible limit of 600 mg/L.

Deeper aquifer:

The total hardness in Saoner block, Nagpur district deeper aquifer is found in the range of 95 – 885 mg/L with the average being 403 mg/L. Total hardness is observed to be less than desirable limit of 200 mg/L in 3 locations, between desirable and permissible limit for 46 locations and 6 locations have total hardness more than maximum permissible limit of 600 mg/L.

5.5 Distribution of Chloride (Cl) and Sulphate (SO4)

Pre-Monsoon:

Shallow aquifer:

As Saoner block is covered mainly by Basalt, the possibility of Cl and SO_4 in ground water from aquifer material is low. It is observed that the chloride content in the ground water samples of Sanoer block, Nagpur district found in the range of 11 – 305 mg/L with the average being 65 mg/L. Chloride content is observed to be less than desirable limit of 250 mg/L in 149wells, between desirable and permissible limit for 3 wells while 0 wells have chloride concentration more than MPL of 1000 mg/L. The range of sulphate concentration was found to be 1 – 669 mg/L with the average being 41mg/L. Sulphate content is observed to be less than desirable limit of 200 mg/L in 150 wells, between desirable and permissible limit for 1 well and 1 well has sulphate concentration more than MPL of 400 mg/L.

Deeper aquifer:

The chloride content in the deeper aquifer ground water samples is found in the range of 11- 588 mg/L with the average being 87 mg/L. Chloride content is observed to be less than desirable limit of 250 mg/L in 152 locations and between desirable and permissible limit for 9 locations. The range of sulphate concentration was found to be 0 – 251 mg/L with the average being 48 mg/L. Sulphate content is observed to be less than desirable limit of 200 mg/L in 156 locations and between desirable and permissible limit for 5 locations.

Post-Monsoon:

Shallow aquifer:

It is observed that the chloride content in the ground water samples of Saoner block is in the range of 14 – 539 mg/L with the average being 88 mg/L. Chloride content is observed to be less than desirable limit of 250 mg/L in 59 wells and between desirable and permissible limit for 3 wells. The range of sulphate concentration was found to be 8 – 241 mg/L with the average being 55 mg/L. Sulphate content is observed to be less than desirable limit of 200 mg/L in 61 wells and between desirable and permissible limit for 1 well.

Deeper aquifer:

The chloride content in the deeper aquifer ground water samples is found in the range of 14- 319 mg/L with the average being 92 mg/L. Chloride content is observed to be less than desirable limit of 250 mg/L in 53 locations and between desirable and permissible limit for 2 locations. The range of sulphate concentration was found to be 4 – 427 mg/L with the average being 73 mg/L. Sulphate content is observed to be less than desirable limit of 200 mg/L in 54 locations and more than MPL of 400 mg/L for 1 location.

5.6 Distribution of Nitrate (NO_3)

Pre-Monsoon:

Shallow aquifer:

Under natural geochemical condition, nitrate rarely becomes a major ion in the ground water. Nitrogen in the form of dissolved nitrate, is a nutrient for vegetation and an essential element to all life. The major contribution in ground water is from sewage, waste disposal, nitrate fertilizer and decaying of organic matter. The nitrate content in the ground water samples of Saoner block, Nagpur district found in the range of BDL – 224 mg/L with the average being 44 mg/L. Nitrate content is observed to be less than permissible limit of 45 mg/L in 101 locations and more than maximum permissible limit in 51 locations.

Deeper aquifer:

The nitrate content in the ground water samples of Saoner block, Nagpur district is found in the range of BDL – 291 mg/L with the average being 54 mg/L. Nitrate content is observed to be less than permissible limit of 45 mg/L in 88 locations and more than maximum permissible limit in 73 locations.

Post-Monsoon:

Shallow aquifer:

The nitrate content in the ground water samples is found in the range of 5 – 348 mg/L with the average being 82 mg/L. Nitrate content is observed to be less than permissible limit of 45 mg/L in 19 wells and more than MPL in 43 locations.

Deeper aquifer:

The nitrate content in the ground water samples of Saoner block is found in the range of 0.02 – 258 mg/L with the average being 72 mg/L. Nitrate content is observed to be less than permissible limit of 43 mg/L in 17 locations and more than MPL in 38 locations.

5.7 Distribution of Fluoride (F)

Pre-Monsoon:

Shallow aquifer:

The concentration of fluoride in Sanoer block, Nagpur district is found in the range of 0.26 – 3.57 mg/L with the average being 0.78 mg/L. The concentrationof fluoride in shallow aquifer is low.Fluoride content is observed to be less than desirable limit of 1 mg/L in 123wells, between desirable and permissible limit for 24 wells and 5 wells havefluoride concentration more than maximum permissible limit of 1.5 mg/L. The source of fluoride in ground water is inherent fluoride bearing minerals present in the geological formation existing in the area.

Deeper aquifer:

The Fluoride content in deeper aquifer is in the range of 0.16 to 2.44 mg/L with average being 0.73 mg/L. Fluoride content is observed to be less than desirable limit of 1 mg/L in 136 locations, between desirable and permissible limit for 22 locations and 3 locations have fluoride concentration more than maximum permissible limit of 1.5 mg/L.

Post-Monsoon:

Shallow aquifer:

The concentration of fluoride in Saoner block is found in the range of 0.18 – 1.85 mg/L with the average being 0.56 mg/L. The concentration of fluoride in shallow aquifer is low. Fluoride content is observed to be less than desirable limit of 1 mg/L in 55 wells, between desirable and permissible limit for 6 wells and 1 well has fluoride concentration more than MPL of 1.5 mg/L.

Deeper aquifer:

The Fluoride content in deeper aquifer is in the range of 0.09 to 2.53 mg/L with average being 0.50 mg/L. Fluoride content is observed to be less than desirable limit of 1 mg/L in 48 locations, between desirable and permissible limit for 6 wells and 1 location has fluoride concentration more than MPL of 1.5 mg/L.

5.8 Distribution of Uranium (U)

Pre-Monsoon:

Shallow aquifer:

CGWB had decided to conduct ground water quality monitoring for Uranium through its Ground Water Monitoring Stations (GWMS) established throughout the country to generate background ground water quality data for U throughout India after an article titled "Large-Scale Uranium Contamination of Ground Water Resources in India" was published in 'Environmental Science and Technology letter' in May 2018. Based on the report, uranium concentration above

the permissible/guideline value of WHO, 2011 (30 ppb) had been observed in ground water in some pockets of 16 States in India. As a part of this activity, the CGWB, Central Region (CR), Nagpur, had also carried out the ground water quality monitoring during AAP 2019-20. Since 2021 all the collected ground water samples have been analysed for Uranium contamination. In the water quality of Sanoer block, Nagpur district, the Uranium concentration was found to be in the range of BDL – 27.06 ppb which indicated no Uranium contamination in Sanoer block, Nagpur district of Maharashtra.The groundwater in Sanoer block, Nagpur districtis safe for drinking as far as U concentration in groundwater is concerned.

Deeper aquifer:

The Uranium concentration was found to be in the range of BDL –14.09 ppb in the deeper aquifer of Sanoer block, Nagpur district, which indicated no Uranium contamination.

Post-Monsoon:

Shallow aquifer:

The Uranium concentration was found to be in the range of 0.10 – 8.71 ppb.

Deeper aquifer:

The Uranium concentration was found to be in the range of BDL –18.92 ppb in the deeper aquifer of Saoner block which indicated no Uranium contamination.

5.9. SUITABILITY OF GROUND WATER FOR DRINKING PURPOSE

The suitability of ground water for drinking purpose is determined keeping in view the effects of various chemical constituents in water on the biological system of human being. The standards proposed by the Bureau of Indian Standards (BIS) for drinking water (IS-10500-2012) were used to determine the suitability of ground water for drinking purpose. The ground water samples are classified on the basis of constituents falling below desirable limit (<DL), in the range of desirable and maximum permissible limit (DL-MPL) and above maximum permissible limit (MPL) for drinking water purpose.

Pre-Monsoon:

The classification of ground water samples of shallow aquifer for drinking water purpose is shown in **Table-5.3(a)** and graphical representation is shown in **Figure-5.5(a).** The classification of ground water samples of deeper aquifer for drinking water purpose is shown in **Table-5.3(b)** and graphical representation is shown in **Figure-5.5(b)**.

Table-5.3(a): Classification of Ground Water Samples of Shallow Aquifer as per BIS Drinking Water Standards

Parameter	Drinking water Standards (IS-10500-2012)		Total Samples	Samples < DL		Samples between DL and MPL		Samples > MPL	
	DL	MPL		Samples	%	Samples	%	Samples	%
pH	6.5-8.5	-	152	0	0.00	151	99.34	1	0.66
TDS (mg/L)	500	2000	152	45	29.61	5	3.29	0	0.00
TH (mg/L)	200	600	152	17	11.18	131	86.18	4	2.63
Ca (mg/L)	75	200	152	134	88.16	18	11.84	0	0.00
Mg (mg/L)	30	100	152	30	19.74	115	75.66	7	4.61
Cl (mg/L)	250	1000	152	149	98.03	3	1.97	0	0.00
SO_4 (mg/L)	200	400	152	150	98.68	1	0.66	1	0.66
NO_3 (mg/L)	45	No relax	152	101	66.45	0	0.00	51	33.55
F (mg/L)	1	1.5	152	123	80.92	24	15.79	5	3.29

(DL= Desirable Limit; MPL= Maximum Permissible Limit)

Table-5.3(b): Classification of Ground Water Samples of Deeper Aquifer as per BIS Drinking Water Standards

Parameter	Drinking water Standards (IS-10500-2012)		Total Samples	Samples < DL		Samples between DL and MPL		Samples > MPL	
	DL	MPL		Samples	%	Samples	%	Samples	%
pH	6.5-8.5	-	161	0	0.00	161	100.00	0	0.00
TDS (mg/L)	500	2000	161	37	22.98	124	77.02	0	0.00
TH (mg/L)	200	600	161	29	18.01	123	76.40	9	5.59
Ca (mg/L)	75	200	161	131	81.37	30	18.63	0	0.00
Mg (mg/L)	30	100	161	48	29.81	103	63.98	10	6.21
Cl (mg/L)	250	1000	161	152	94.41	9	5.59	0	0.00
SO_4 (mg/L)	200	400	161	156	96.89	5	3.11	0	0.00
NO_3 (mg/L)	45	No relax	161	88	54.66	0	0.00	73	45.34
F (mg/L)	1	1.5	161	136	84.47	22	13.66	3	1.86

(DL= Desirable Limit; MPL= Maximum Permissible Limit)

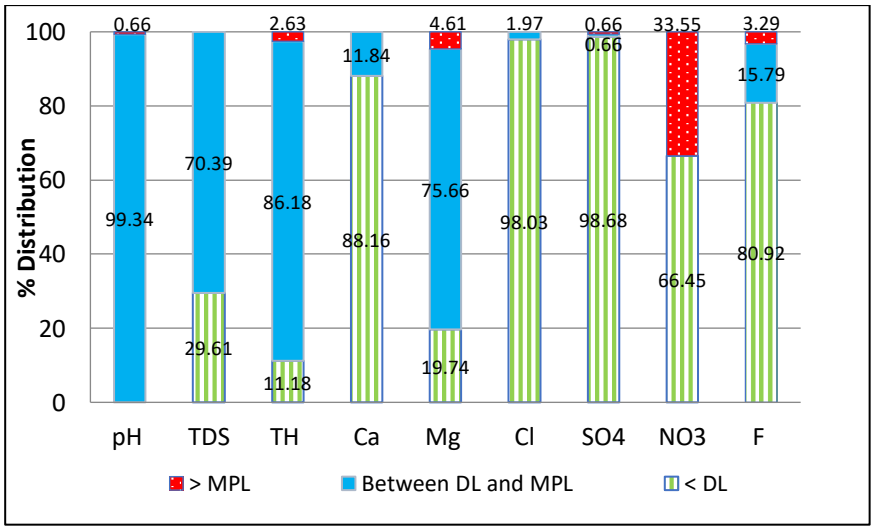


Figure-5.5(a): Percentage Distribution of Ground Water Samples of shallow aquifer as per BIS Drinking Water Standards (Pre-Monsoon)

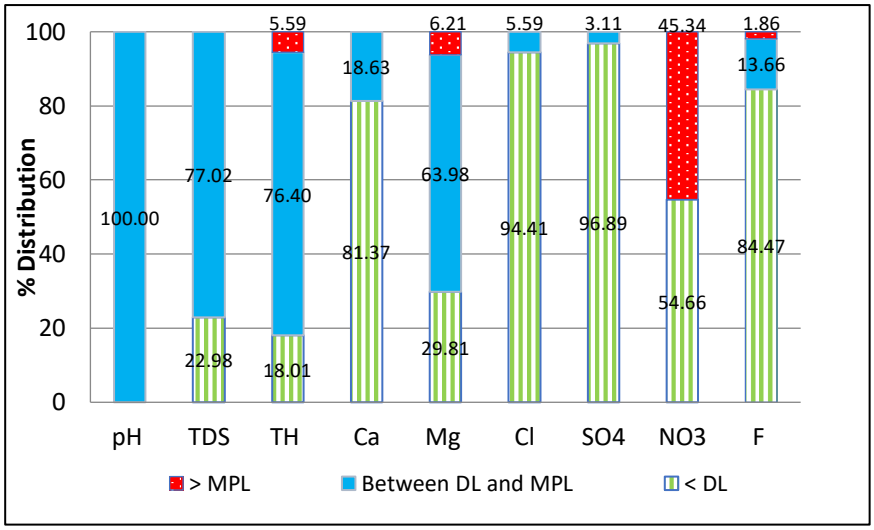


Figure-5.5(b): Percentage Distribution of Ground Water Samples of shallow aquifer as per BIS Drinking Water Standards (Pre-Monsoon)

As seen in **Table-5.3(a)** and **Table-5.3(b)**, the Ground water quality of Sanoer block, Nagpur district in shallow and deeper aquifer is affected mostly by nitrate followed by total hardness and fluoride in few locations, but the gound water is good and potable in general except nitrate contamination.

Post-Monsoon:

The ground water samples collected during post monsoon are also classified on the basis of constituents falling below desirable limit (<DL), in the range of desirable and maximum permissible limit (DL-MPL) and above maximum permissible limit (MPL) for drinking water purpose.

The classification of ground water samples of shallow aquifer for drinking water purpose is shown in **Table-5.4(a)** and graphical representation is shown in **Figure-5.6(a).** The classification of ground water samples of deeper aquifer for drinking water purpose is shown in **Table-5.4(b)** and graphical representation is shown in **Figure-5.6(b)**.

Table-5.4(a): Classification of Ground Water Samples of Shallow Aquifer as per BIS Drinking Water Standards (Post-Monsoon)

Parameter	Drinking water Standards (IS-10500-2012)		Total Samples	Samples < DL		Samples between DL and MPL		Samples > MPL	
	DL	MPL		Samples	%	Samples	%	Samples	%
pH	6.5-8.5	-	62	0	0.00	62	100.00	0	0.00
TDS (mg/L)	500	2000	62	8	12.90	53	85.48	1	1.61
TH (mg/L)	200	600	62	1	1.61	56	90.32	5	8.06
Ca (mg/L)	75	200	62	41	66.13	21	33.87	0	0.00

Parameter	Drinking water Standards (IS-10500-2012)		Total Samples	Samples < DL		Samples between DL and MPL		Samples > MPL	
	DL	MPL		Samples	%	Samples	%	Samples	%
Mg (mg/L)	30	100	62	11	17.74	46	74.19	5	8.06
Cl (mg/L)	250	1000	62	59	95.16	3	4.84	0	0.00
SO_4 (mg/L)	200	400	62	61	98.39	1	1.61	0	0.00
NO_3 (mg/L)	45	No relax	62	19	30.65	0	0.00	43	69.35
F (mg/L)	1	1.5	62	55	88.71	6	9.68	1	1.61

(DL= Desirable Limit; MPL= Maximum Permissible Limit)

Table-5.4(b): Classification of Ground Water Samples of Deeper Aquifer as per BIS Drinking Water Standards (Post-Monsoon)

Parameter	Drinking water Standards (IS-10500-2012)		Total Samples	Samples < DL		Samples between DL and MPL		Samples > MPL	
	DL	MPL		Samples	%	Samples	%	Samples	%
pH	6.5-8.5	-	55	0	0.00	55	100.00	0	0.00
TDS (mg/L)	500	2000	55	8	14.55	47	85.45	0	0.00
TH (mg/L)	200	600	55	3	5.45	46	83.64	6	10.91
Ca (mg/L)	75	200	55	32	58.18	22	40.00	1	1.82
Mg (mg/L)	30	100	55	9	16.36	43	78.18	3	5.45
Cl (mg/L)	250	1000	55	53	96.36	2	3.64	0	0.00
SO_4 (mg/L)	200	400	55	54	98.18	0	0.00	1	1.82
NO_3 (mg/L)	45	No relax	55	17	30.91	0	0.00	38	69.09
F (mg/L)	1	1.5	55	48	87.27	6	10.91	1	1.82

(DL= Desirable Limit; MPL= Maximum Permissible Limit)

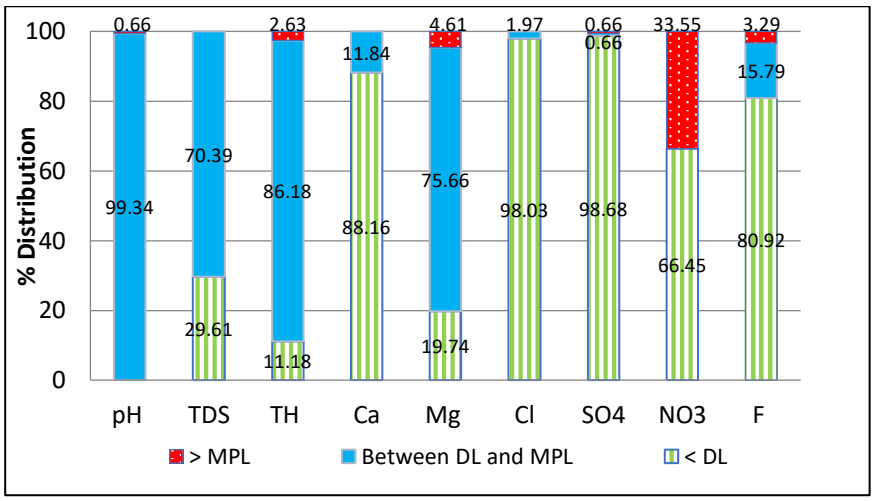


Figure-5.6(a): Percentage Distribution of Ground Water Samples of Shallow aquifer as per BIS Drinking Water Standards (Post-Monsoon)

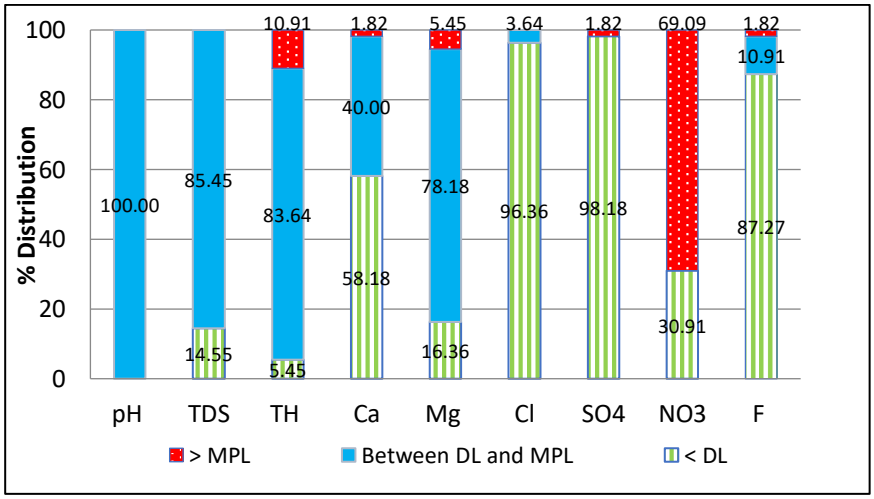


Figure-5.6(b): Percentage Distribution of Ground Water Samples of Deeper aquifer as per BIS Drinking Water Standards (Post-Monsoon)

As seen in **Table-5.4(a)** and **Table-5.4(b)**, the Ground water quality of Saoner block, Nagpur district in shallow and deeper aquifer is good and potable in general except nitrate contamination followed by total hardness and fluoride in few locations.

5.10. SUITABILITY OF GROUND WATER FOR IRRIGATION PURPOSE

The quality of water used for irrigation is an important factor in crop productivity, its yield and quality. The irrigation water quality depends primarily on the presence of dissolved salts and their concentrations. The Electrical Conductivity (EC), Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the most important quality criteria as per Bureau of Indian Standards (BIS) for quality of irrigation water (IS-11624-1986, Reaffirmed 2009), which influence the water quality and its suitability for irrigation.

1. **Electrical Conductivity (EC)**

The concentration of dissolved ions in the water is best represented by the parameter electrical conductivity. In relation to hazardous effects of the total salt concentration (EC), the irrigation water can be classified into four major groups-

Low Salinity Water (EC: Below 1500 µS/cm): Suitable for sensitive crops.
Medium Salinity Water (EC: 1500 – 3000 µS/cm): Suitable for semi-tolerant crops.
High Salinity Water (EC: 3000 – 6000 µS/cm): Suitable for tolerant crops.
Very High Salinity Water (EC: >6000 µS/cm): Not suitable for irrigation.

Pre-Monsoon:

It is clear from **Table-5.5(a)** that 100 % samples fall under low and medium salinity in shallow and deeper aquifer which are suitable for irrigation.

Table-5.5(a): Classification of Ground water of Shallow Aquifer and Deeper Aquifer for Irrigation based on EC values (Pre-Monsoon)

Sr.	Class	Range of EC in µS/cm	Shallow Aquifer		Deeper Aquifer	
			No. of samples	% of samples	No. of samples	% of samples
1	Low Salinity Water	< 1500	135	88.82	135	83.85
2	Medium Salinity Water	1500 – 3000	17	11.18	26	16.15
3	High Salinity Water	3000 – 6000	0	0.00	0	0.00
4	Very High Salinity Water	> 6000	0	0.00	0	0.00
Total			152	100.00	161	100.00

Post-Monsoon:

It is clear from **Table-5.5(b)** that 87.10 % samples collected in post-monsoon season, fall under low salinity in shallow aquifer and 11.29 % samples fall under medium salinity zone. 1 sample falls under high salinity zone which is not suitable for irrigation. Similarly, 76.36 % samples

fall under low salinity in deeper aquifer and 23.64 % samples fall under medium salinity zone which are suitable for irrigation. Thus, the ground water of Saoner Block is suitable for irrigation.

Table-5.5(b): Classification of Ground water of Shallow Aquifer and Deeper Aquifer for Irrigation based on EC values (Post-Monsoon)

Sr.	Class	Range of EC in µS/cm	Shallow Aquifer		Deeper Aquifer	
			No. of samples	% of samples	No. of samples	% of samples
1	Low Salinity Water	< 1500	54	87.10	42	76.36
2	Medium Salinity Water	1500 – 3000	7	11.29	13	23.64
3	High Salinity Water	3000 – 6000	1	1.61	0	0.00
4	Very High Salinity Water	> 6000	0	0.00	0	0.00
Total			62	100.00	55	100.00

2. <u>Sodium Adsorption Ratio (SAR)</u>

Since Calcium and Magnesium replace Sodium more readily than vice versa, the ratio reflects the Sodium hazard. The SAR indicates the relative activity of the Sodium ions in exchange reactions with the soil. Irrigation water with a high SAR will cause the soil to tighten up. The Sodium Adsorption Ratio (SAR) can be calculated from following formula-

(Here, the concentrations of cations are expressed in meq/L).

<u>Pre-Monsoon:</u>

In relation to hazardous effects of SAR, the irrigation water quality during pre- monsoon for shallow and deeper aquifer is given in **Table-5.6(a)**.

Table-5.6(a): Classification of Ground water of Shallow Aquifer and Deeper Aquifer for Irrigation based on SAR values (Pre-Monsoon)

Sr.	Class	SAR Value	Shallow Aquifer		Deeper Aquifer	
			No. of samples	% of samples	No. of samples	% of samples
1	Low	0-10	151	99.34	161	100
2	Medium	10-18	1	0.66	0	0
3	High	18-26	0	0	0	0
4	Very high	>26	0	0	0	0
Total			152	100	161	100

99.34% and 100 % water samples of shallow aquifer and deeper aquifer respectively have SAR values less than 10 and are considered good for irrigation.

Post-Monsoon:

In relation to hazardous effects of SAR, the irrigation water quality during post-monsoon for shallow and deeper aquifer is given in **Table-5.6(b)**.

Table-5.6(b): Classification of Ground water of Shallow Aquifer and Deeper Aquifer for Irrigation based on SAR values (Post-Monsoon)

Sr.	Class	SAR Value	Shallow Aquifer		Deeper Aquifer	
			No. of samples	% of samples	No. of samples	% of samples
1	Low	0-10	62	100.00	55	100
2	Medium	10-18	0	0.00	0	0
3	High	18-26	0	0	0	0
4	Very high	>26	0	0	0	0
Total			62	100	55	100

100 % ground water samples of shallow and deeper aquifer collected during post-monsoon have SAR values less than 10 and are considered good for irrigation.

3. **Residual Sodium Carbonate (RSC):**

The RSC index of irrigation water and soil water is used to indicate the alkalinity hazards for soil. RSC is considered to be superior to SAR as a measure of sodicity particularly at low salinity levels. Calcium reacts with bi-carbonate and precipitates as $CaCO_3$. Magnesium salt is more soluble and so there is less tendency for it to precipitate. When Calcium and Magnesium are lost from the water, the proportion of Sodium is increased resulting in the increase in sodium hazard. This hazard is evaluated in terms of RSC.

(All the ionic concentrations in the above equation are expressed in meq/L).

Pre-Monsoon:

In relation to hazardous effects of RSC, the irrigation water quality during pre-monsoon for shallow and deeper aquifer is given in **Table-5.7(a)**.

Table-5.7(a): Classification of Ground water of Shallow Aquifer and Deeper Aquifer for Irrigation based on RSC values (Pre-Monsoon)

Sr.	Class	RSC Value	Shallow Aquifer		Deeper Aquifer	
			No. of samples	% of samples	No. of samples	% of samples
1	Low	< 1.5	113	74.34	112	69.57
2	Medium	1.5 – 3.0	26	17.11	29	18.01
3	High	3.0 – 6.0	9	5.92	19	11.80
4	Very high	>6.0	4	2.63	1	0.62
Total			152	100.00	161	100.00

From **Table-5.7(a)** it is observed that 91.45 % of the samples of shallow aquifer and 87.58 % samples of deeper aquifer show RSC values less than 3.0meq/L. Overall, the ground water of Sanoer block, Nagpur district barring few locatons can be used for irrigation purpose.

Post-Monsoon:

In relation to hazardous effects of RSC, the irrigation water quality during post-monsoon for shallow and deeper aquifer is given in **Table-5.7(b)**.

Table-5.7(b): Classification of Ground water of Shallow Aquifer and Deeper Aquifer for Irrigation based on RSC values (Post-Monsoon)

Sr.	Class	RSC Value	Shallow Aquifer		Deeper Aquifer	
			No. of samples	% of samples	No. of samples	% of samples
1	Low	< 1.5	53	85.48	45	81.82
2	Medium	1.5 – 3.0	8	12.90	5	9.09
3	High	3.0 – 6.0	1	1.61	5	9.09
4	Very high	>6.0	0	0.00	0	0.00
Total			62	100.00	55	100.00

From **Table-5.7(b)** it is observed that 98.39 % of the samples of shallow aquifer and 90.91 % samples of deeper aquifer show RSC values less than 3.0 meq/L. Overall, the ground water of Saoner block, Nagpur district barring few locatons can be used for irrigation purpose based on above study with proper management.

5.11 DISCUSSION ON TRACE ELEMENTS CONTENT

From the area under investigation, 131 water samples collected during pre-monsoon were analyzed for 18 trace elements viz. B, Al, Cr, Mn, Fe, Ni, Cu, Zn, As, Se, Sr, Mo, Ag, Cd, Ba, Hg, Pb and U content. All the ground water samples contain Boron, Chromium, Copper, Nickel, Zinc, Arsenic, Selenium, Molybdenum, Silver, Cadmium, Barium, Mercury, Lead and Uranium below the desirable limit of BIS for the drinking water. The **Table 5.8** gives the range of all trace elements analysed and also the number of samples which are below acceptable limit and more than permissible limit as per BIS drinking water standards. As can be seen from the table, 3 samples have Aluminium, 3 samples have Manganese and 3 samples have Iron more than their permissible limits. Thus, it can be concluded that the ground water quality in major part of the study area is less affected by trace elements. The data for trace elements is presented in **Annexure-VIII.**

Table-5.8: Descriptive statistics of trace elements in groundwater of Sanoer block, Nagpur district (Pre-monsoon)

Trace element	Acceptable Limit (mg/L)	Permissible Limit (mg/L)	Min	Max	Average	No. of samples	BDL	<AL	Al- PL	>PL
B (mg/L)	0.5	1.0	0.0136	0.7282	0.1415	131	9	122	0	0
Al (mg/L)	0.03	0.2	0.0000	0.0550	0.0021	131	53	67	8	3
Cr (mg/L)	0.05	No relaxation	0.0000	0.0079	0.0009	131	78	53	-	0
Mn (mg/L)	0.1	0.3	0.0000	0.2161	0.0167	131	39	84	5	3
Fe (mg/L)	0.3	No relaxation	0.0001	0.0377	0.0039	131	66	62	-	3
Ni (mg/L)	0.02	No relaxation	0.0000	0.0056	0.0008	131	89	42	-	0
Cu (mg/L)	0.05	1.5	0.0001	0.0382	0.0021	131	34	97	0	0
Zn (mg/L)	5	15	0.0003	1.8138	0.1470	131	10	121	0	0
As (mg/L)	0.01	0.05	0.0000	0.0078	0.0004	131	2	129	0	0
Se (mg/L)	0.01	No relaxation	0.0000	0.0180	0.0013	131	9	122	-	0

Trace element	Acceptable Limit (mg/L)	Permissible Limit (mg/L)	Min	Max	Average	No. of samples	BDL	<AL	Al- PL	>PL
Sr (mg/L)	-	-	0.0003	1.0506	0.2580	131				
Mo (mg/L)	0.07	No relaxation	0.0001	0.0173	0.0017	131	35	96	-	0
Ag (mg/L)	0.1	No relaxation	0.0000	0.0043	0.0001	131	77	54	-	0
Cd (mg/L)	0.003	No relaxation	0.0000	0.0052	0.0002	131	29	102	-	0
Ba (mg/L)	0.7	No relaxation	0.0002	0.0255	0.0029	131	1	130	-	0
Hg (mg/L)	0.001	No relaxation	0.0001	0.0042	0.0014	131	124	7	-	0
Pb (mg/L)	0.01	No relaxation	0.0000	0.0056	0.0003	131	99	32	-	0
U (µg/L)	30	No relaxation	0.0260	15.5140	1.1682	131	0	131	-	0

6.0 DELINEATION OF RECHARGE AREA

To delineate suitable areas for artificial recharge in the study area, several key datasets were utilized, including SRTM Digital Elevation Model (DEM) data, water table contour data, topographic contour data and post-monsoon water level data. The process of delineation involved analyzing both surface and subsurface features to identify areas where artificial recharge can be most effective, particularly where surface runoff has the potential to infiltrate and replenish groundwater supplies.

6.1 Digital Elevation Model (DEM) and Drainage Analysis

Using SRTM DEM data, it was done by extracting drainage lines and demarcating watersheds with the aid of Geographic Information Systems (GIS) software. DEM data is supplementary for mapping surface elevations and determining the flow patterns of surface water.

Watershed demarcation is essential to understanding how water flows across the area. Watersheds define the area where surface water runoff collects and channels into rivers, streams, or low-lying areas and drain out in general in single outlet. It's boundary in general is surface water and ground water divide. This information helps to pinpoint areas where water accumulation can lead to higher infiltration rates, especially in regions with permeable soils or geologies conducive to groundwater recharge.

6.2 Water Table Contour Mapping

The pre-monsoon water level data was used to prepare a water table contour map. Water table contours represent the elevation of the groundwater surface, which typically mimics the shape of the overlying terrain but with more subdued variations. These contours were generated by analysing water level data from key observation well data with respect to mean sea level which spread across the study area, allowing for an accurate representation of the groundwater flow system.

This map provides crucial insights into the groundwater dynamics, illustrating flow directions and identifying areas where groundwater is most likely to move. In recharge area delineation, areas with diverging flow directions often indicate zones where water can enter the aquifer and spread. These areas are typically high-priority zones for artificial recharge, as they facilitate wide distribution of infiltrated water.

6.3 Post-Monsoon Water Level Data and Recharge Zone Identification

The next step involved analysing post-monsoon water level data. This dataset is important because it reflects how the groundwater system responds to seasonal rainfall, indicating areas where recharge naturally occurs after monsoon rains. A key finding was that regions where post-monsoon water levels are more than 5 meters below the ground surface were identified as the suitable for artificial recharge to avoid the chance of water logging situation.

6.4 Topographic Contour Mapping

A topographic contour map was created using Reduced Level (RL) values of key well locations and DEM data. These contours help to identify elevations and slopes within the study area, which in turn influence the movement of surface water. DEM-derived topographic data is essential for understanding the surface water dynamics and its interaction with the groundwater system.

6.5 Identification of Upstream Recharge Zones

One of the most important aspects of recharge area delineation is the identification of upstream areas in relation to the natural groundwater flow system. Recharge zones are often located upstream of the natural groundwater flow, where surface water has the highest potential to percolate into the ground and move downward into the aquifer. In these areas, water moves from higher hydraulic head (elevated water levels) toward regions of lower head, following the natural gradient of groundwater flow.

Upstream recharge zones are also significant because they act as entry points for water to infiltrate and replenish the aquifer, sustaining groundwater levels for downstream regions. These areas are particularly favourable when there is sufficient storage capacity in the subsurface and when the flow directions in the groundwater system indicate diverging patterns, which suggest that infiltrated water will spread laterally across a broad area of the aquifer.

6.6 Final Delineation of Recharge Area

After combining the insights from DEM, water table contours, post-monsoon water levels, and topographic contours, suitable area for artificial recharge were delineated. These zones are characterized by:

- Diverging groundwater flow directions, indicating the areas recharging the ground water.
- Considerable post-monsoon depth to water level (greater than 5 meters), ensuring there is available space for additional recharge.

The integration of these factors ensures that the identified zones have both surface and subsurface conditions conducive to artificial recharge. These zones are not only naturally suited for infiltration but also possess the hydraulic characteristics necessary to sustain long-term groundwater recharge, benefiting both the aquifer and the surrounding communities reliant on groundwater resources.

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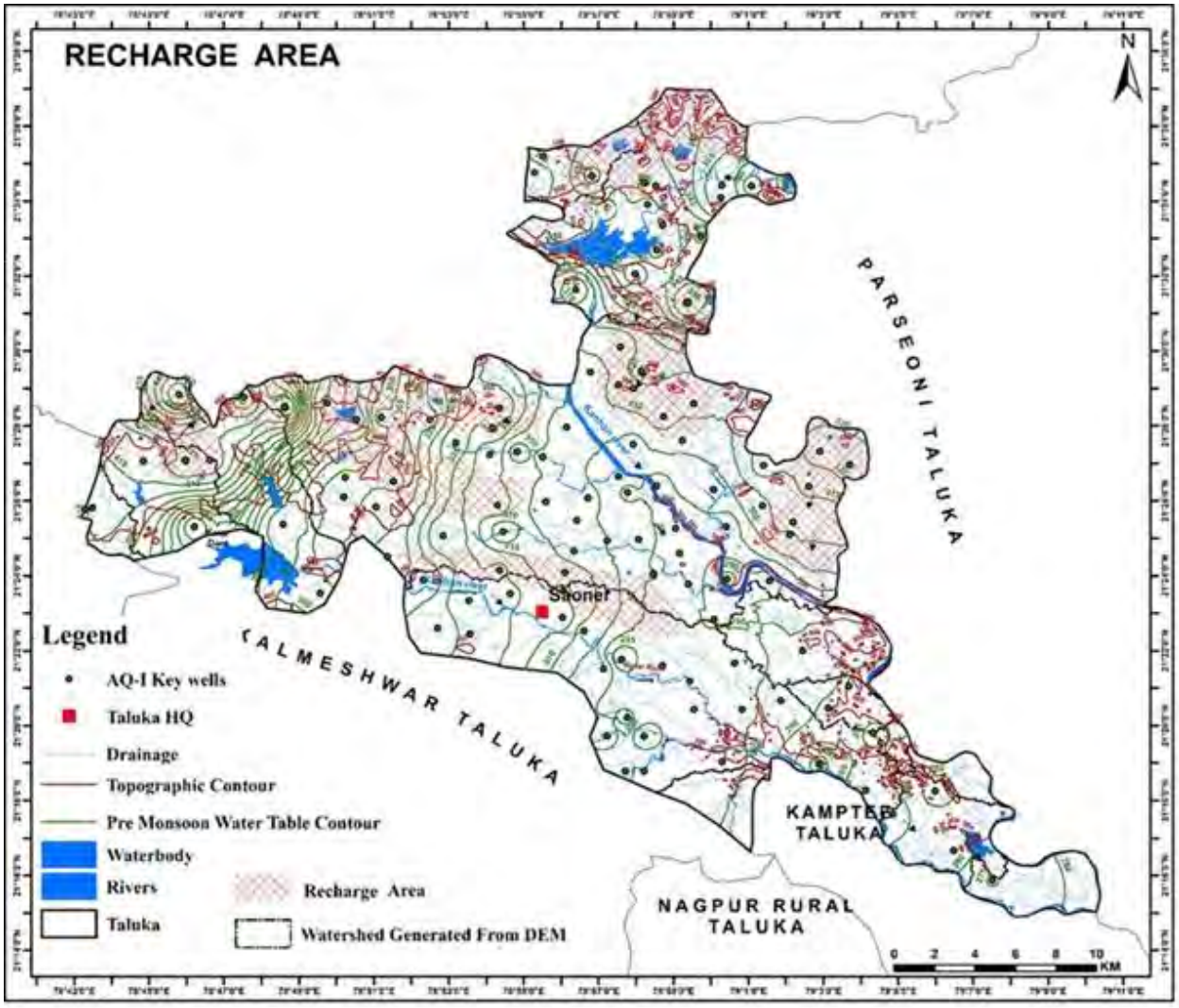

Fig. 6.1 Demarcated Recharge Area.

7.0 GROUND WATER RESOURCES AND REFINEMENT OF AQUIFER PARAMETERS

Groundwater resource assessment is the determination of the source, extent, dependability and quality of groundwater, on which the evaluation of the possibilities of the utilisation and control depends. Groundwater resource estimation is mainly dependent on the quality of the data. In Deccan Trap Basalt, there is no well-defined, uniformly distributed, homogeneous aquifer system. Even during the process of recharge, the surface water in the given area does not uniformly replenish the subsurface. For assessing the groundwater resources on a regular basis, it is necessary to determine certain hydrogeological factors, which define the groundwater regime. This includes precipitation, storativity of the bedrock, aquifer characteristics, water quality and the overall environment. As per GWRA-2022 the stage of groundwater extraction of Saoner is 70.06% and is categorized as "*Semi Critical*". The annual extractable groundwater resource is 49.13 MCM, whereas the total draft is 34.05 MCM. The groundwater resources have been reassessed for the year 2023 for Saoner block.

7.1 Dynamic Ground Water Resources Estimation 2023:

The ground water resource assessment as on March 2023 has been carried out and the salient features of the resources are given in Table 7.1. Total recharge worthy area is 56237 ha.

Table-7.1: The general information of Saoner block for resource estimation

Taluk	Total Geographical area (ha)	Hilly area (ha)	Recharge worthy area (ha)		
			Command Area (ha)	Non-Command Area (ha)	Total Area (ha)
Saoner	56237	0	20540	35697	56237

During monsoon season, the rainfall recharge is the main source for recharge parameter, which is estimated as the sum total of the change in storage and gross draft. The ground water resources estimation is based on the principle of water balance equation as given below:

$$\boldsymbol{Inflow - Outflow = Change\ in\ Storage\ (of\ an\ aquifer)}$$

$$\Delta S = R_{RF}+R_{STR}+R_C+R_{SWI}+R_{GWI}+R_{TP}+R_{WCS} \pm VF \pm LF - GE - T - E - B$$

Where

ΔS – Change is storage

R_{RF} – Rainfall recharge

R_{STR}- Recharge from stream channels

R_C – Recharge from canals

R_{SWI} – Recharge from surface water irrigation

R_{GWI}- Recharge from ground water irrigation

R_{TP}- Recharge from Tanks & Ponds

R_{WCS} – Recharge from water conservation structures

VF – Vertical inter aquifer flow

LF- Lateral flow along the aquifer system (through flow)
GE-Ground Water Extraction
T- Transpiration
E- Evaporation
B-Base flow

All the components of water balance equation should be estimated for an assessment unit for accurate measurement of resource estimations.

7.2 Rainfall recharge:

The recharge from rainfall component can be calculated from two methods i.e., Rainfall infiltration method and water table fluctuation method. However, the ground water recharge should be estimated on ground water table level fluctuation method and rainfall infiltration factor method during monsoon season. In Water table fluctuation method, the change in storage is computed by multiplying groundwater level fluctuation between pre and post monsoon periods with the area of assessment and specific yield and expressed as: -

$$R = h \times S_y \times A$$

where, h = rise in water level in the monsoon season,

S_y = specific yield A = area for computation of recharge,

The specific yield values field studies were taken, wherever available. In absence of field values of specific yield values as per GEC-2015 norms has been taken. The specific yield value for Deccan Traps - 0.002 to 0.03. Here, the value for Specific yield is taken as 0.02.

The monsoon ground water recharge has two components- rainfall recharge and recharge from other sources. The other sources of groundwater recharge during monsoon season include recharge from rainfall, seepage from canals, surface water irrigation, tanks and ponds, ground water irrigation, and water conservation structures. During the non-monsoon season, rainfall recharge is computed by using Rainfall Infiltration Factor method. Recharge from other sources is then added to get total non-monsoon recharge. As the area is occupied by Deccan traps, the factor is taken as 0.07 to 0.14 depending on the formation, which is weathered basalt and vesicular jointed basalt. The details of Recharge parameters are given in Table 7.2. It is estimated that the recharge from rainfall during monsoon season is 3559.48 while it is 167.59 during non-monsoon. Considering the natural discharges of 351.58 ham, net ground water availability estimated as 4913.48 ham.

Table-7.2: The resources recharge components calculated for Saoner block.

Taluk	Recharge from RF during monsoon (ham)	Recharge from other sources monsoon (ham)	Recharge from rainfall during non-monsoon season (ham)	Recharge from other sources during non-monsoon season (ham)	Total Annual Ground Water Recharge (ham)	Natural Discharges (ham)	Net Annual Ground Water Availability (ham)
Saoner	3559.48	486.71	167.59	1051.27	5265.06	351.58	4913.48

7.3. Ground Water Draft and other parameters:

The outflow parameters include natural discharge in the form of springs and base flow and discharge for ground water irrigation, domestic and industrial draft. The net annual ground water availability comes to be 4913.48 ham. The annual gross draft for all uses is estimated at 3424.21 ham with irrigation sector being the major consumer having a draft of 2338.30 ham. The annual draft for domestic and industrial uses was 697.97 ham. The allocation for domestic & industrial requirement supplies up to next 25 years is about 654.14 ham (Table 7.3). The stage of ground water development of Saoner taluka is 69.32 % and categorized as “Safe”.

Table-7.3: The extraction components & stage of ground water extraction for Saoner block

Taluka	Net Annual Ground Water Availability (ham)	Existing Gross Ground Water Draft for irrigation (ham)	Existing Gross Ground Water Draft for domestic and industrial water supply (ham)	Existing Gross Ground Water Draft for All uses (ham)	Provision for domestic and industrial requirement supply to 2025 (ham)	Net Ground Water Availability for future irrigation development (ham)	Stage of Ground Water Development (%)/Category
Saoner	4913.48	2338.30	697.97	3424.21	654.14	1507.69	69.32

7.4. Watershed wise dynamic ground water resource estimation:

The Saoner block has 7 watersheds where resources have been calculated watershed wise and presented in the table 7.4. Out of 7 watersheds one watershed WGKK-1 falls under semi-critical category, remaining all falls under safe category.

Table-7.4: Watershed wise resources components of Saoner block-2023							
Watersheds	**WGK-1**	**WGK-2**	**WGK-5**	**WGKK-1**	**WGKK-2**	**WGKK-3**	**WGKKC-1**
Recharge worthy area (ha)	18161	16117	16982	18057	14561	13779	13914
Annual recharge from Rainfall (ham)	1001.93	1107.8	1280.2	1173.17	841.41	1132.91	1516.61
Recharge from other sources (ham)	269.92	334.33	493.91	653.90	496.33	391.48	654.28
Gross Ground Water extraction (ham)	772.58	981.02	1109.19	1380.7	803.19	945.42	1169.46
Annual extractable groundwater (ham)	1208.25	1681.03	1658.93	1681.02	1264	1400.71	1966.72
Stage of Extraction (%)	63.94	58.36	66.86	82.13	63.54	67.49	59.46
Category	**Safe**	**Safe**	**Safe**	**Semi Critical**	**Safe**	**Safe**	**Safe**

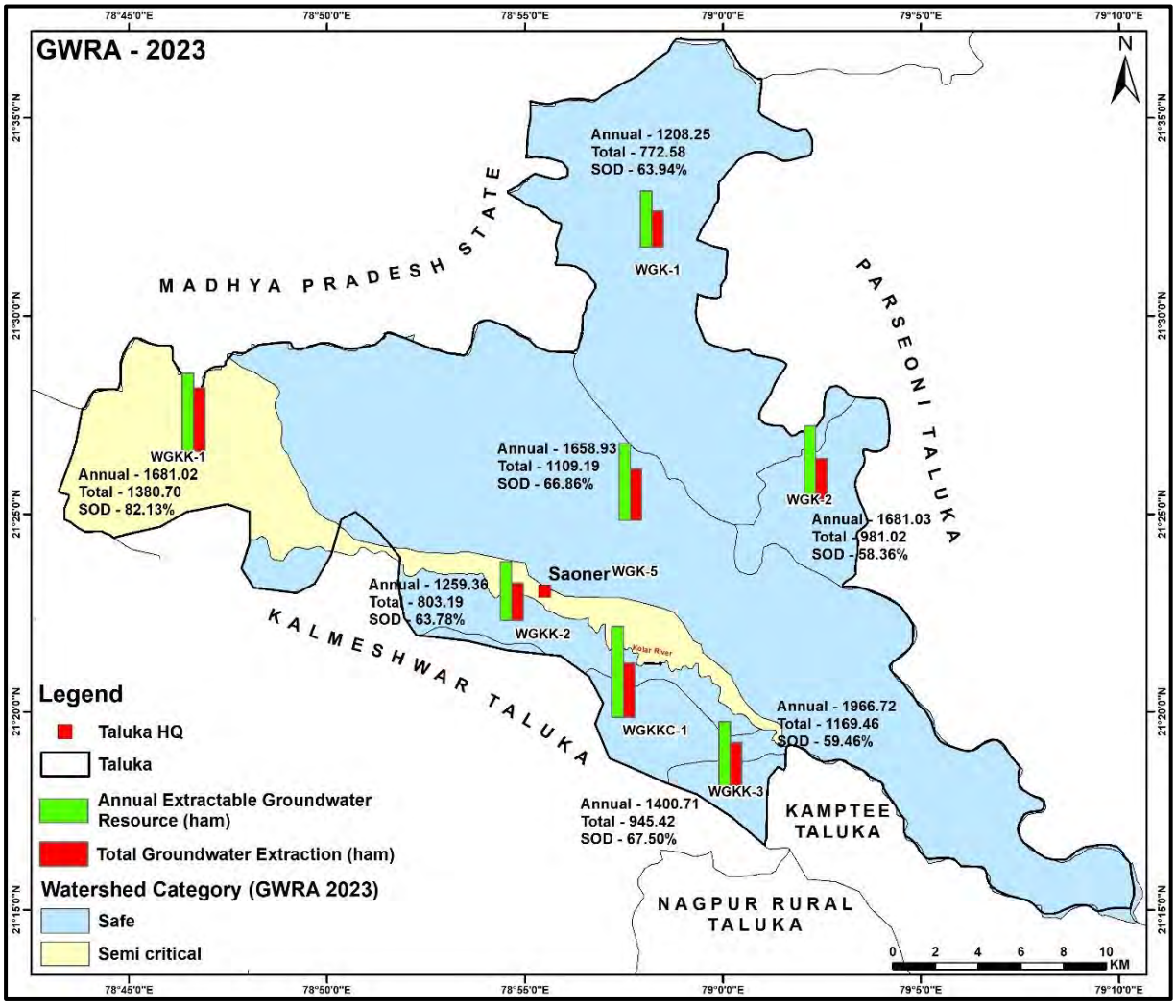

Figure 7.1: Watershed wise Ground Water resources assessment of Saoner block

7.5. Comparison of GWRA-2023 with previous years estimation:

The ground water resource estimation has been started to calculate every year from 2022. The resource estimations of Saoner block for 2023 is compared with previous years estimations that is 2022 and 2020 and presented in Fig. 7.2 and Table 7.5. The estimation table shows that the significant changes in the total ground water recharge, extractable water and draft has been observed. The stage of ground water extraction has been reduced drastically from 76.07% to 69.31% about 6.76% reduction in the stage of extraction is observed. The reduction in the stage of extraction shows improvement in the resources and ground water availability in Saoner block. However, the category of the Saoner block is Safe as stage of extraction falls SoGE ≤ 70%.

Table-7.5: Saoner block ground water resources comparison from 2020 to 2023

Resources Components	GWRA 2020	GWRA 2022	GWRA 2023
Total Recharge Worthy Area (Ha)	56237	56237	56237
Total Annual Ground Water Recharge (Ham)	5115.50	5138.72	5265.05
Total Natural Discharges (Ham)	333.38	340.66	351.58
Annual Extractable Ground Water Resource (Ham)	4782.12	4798.06	4913.47
Total Extraction (Ham)	3638.18	3361.59	3405.78
Stage of Extraction	76.07%	70.06%	69.31%
Category	Semi-critical	Semi-critical	Safe

The stage of ground water extraction has reduced drastically from 2020 to 2023 which is can be possible by reducing ground water draft (domestic, industrial and irrigation), increasing the recharge component such as recharge from other sources and increase in the rainfall. The changes in these components influence and control the stage of ground water extraction value. The individual component influence is presented below:

Change in Rainfall amount:

Rainfall is the major source for ground water dynamics. The changes in the rainfall amount causes changes in the direct recharge and recharge from others sources component contribution. The variability in the annual rainfall from 2020 to 2023 is presented in **Figure 7.2.** The annual rainfall analysis indicates the amount of rainfall received has been decreased from 2020 to 2023. Whereas the rainfall amount has significantly decreased from 2020 to 2023 which caused the drastic reduction in stage of extraction component.

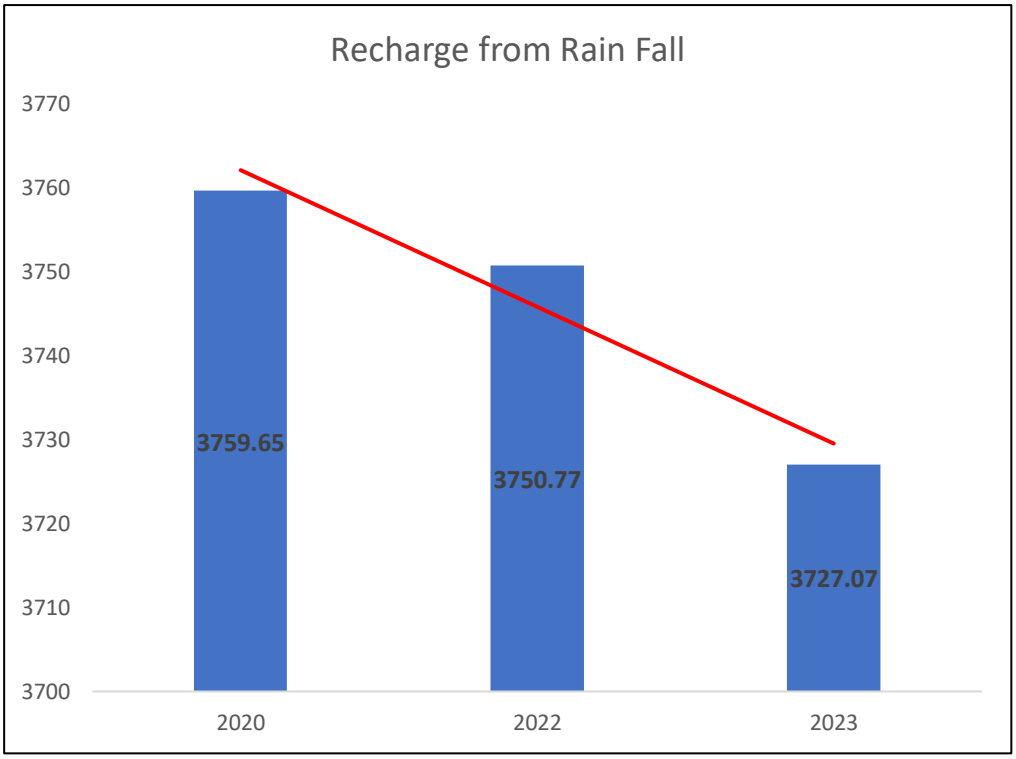

Figure 7.2: Annual rainfall in Saoner block

Change in draft:

The ground water extraction is the major component which has immediate effect on the ground water availability and changes in ground water extraction component. The ground water draft has three components, draft for domestic purpose, draft for industrial purpose and draft for irrigation activities. Out the three draft components, irrigation draft is major contribution. 70% to 80% of the ground water is being used for irrigation activities. The ground water extraction for irrigation activities has been compared from 2020 to 2023 for understanding its variability and control on Stage of ground water extraction. The draft for irrigation activity has significantly reduced from 2984.2 ham to 2707.81 ham. The reduction in the irrigation draft favoured the overall reduction in the draft component which indirectly impacted on reduction in improvement of stage of ground water extraction. The reduction in the ground water extraction for irrigation is possible by implementing the new advanced techniques in irrigation sector, i.e., is drip irrigation and sprinkler irrigation which has reduced the ground water draft. Change in Irrigation Draft in Saoner block is shown in **Figure 7.3.**

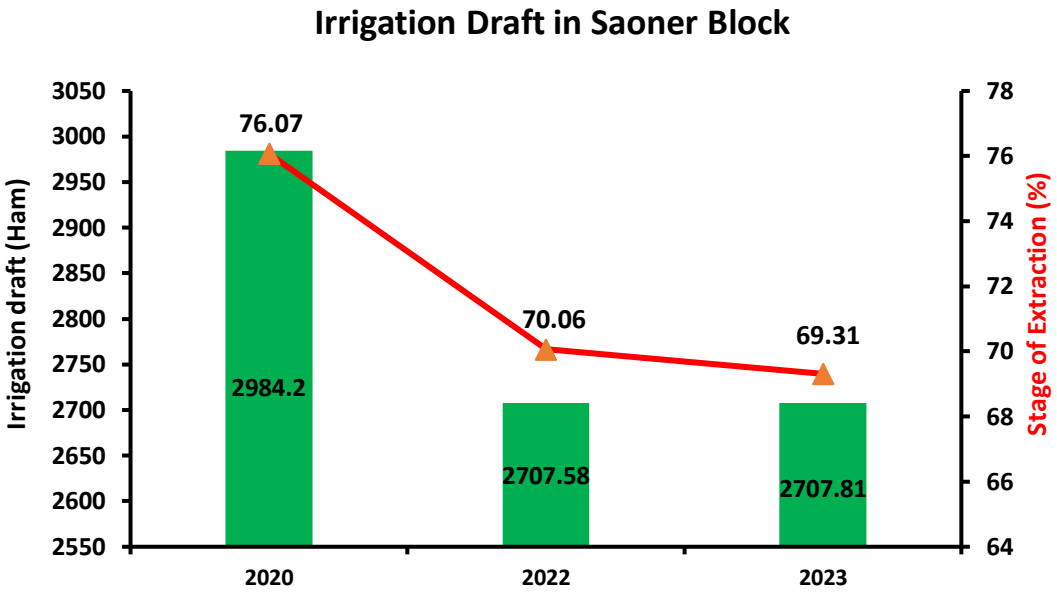

Figure 7.3: Irrigation Draft in Saoner Block

Change in recharge from other sources

The recharge from other sources which includes recharge from canals, surface wate irrigation, ground water irrigation, streams, tanks & ponds and water conservative structures. All these has noteworthy contribution in recharging the ground water. Out of all the component recharge from water conservative structure has major contribution. The govt of India has initiated various schemes and panchayat level to village level to state level where various recharge structure are being constructed and renovation of old structures. Jal Shakti Abhiya-catch the rain, Jalyukt shivar, Atal Bhujal Yoyana, Jalswarajya yojna are some of the major schemes implemented by the central government. Recharge from other Sources in Saoner Block is shown in **Figure 7.4.**

The recharge component from other sources has been compared from 2020 to 2023, where it has been observed that the recharge increased from 1355.83 ham to 1537.98 ham. The drastic increase in ground water recharge from other sources is due to the increase in number of water conservative structures contracted under various schemes in Saoner block.

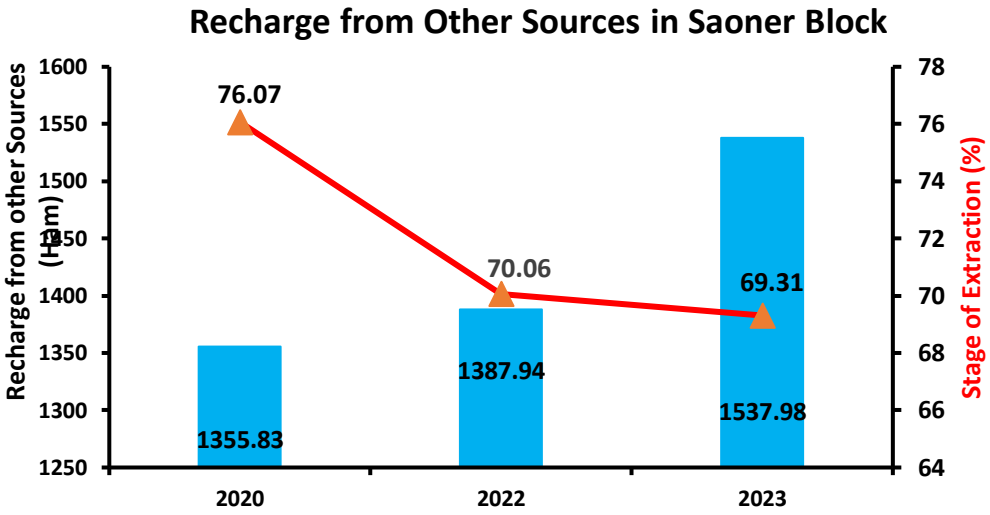

Figure 7.4: Recharge from other Sources in Saoner Block

7.6 ESTIMATION/REFINEMENT OF PARAMETER USE FOR RESOURCE ESTIMATION

OBJECTIVE

The quantitative estimation of various inputs to ground water resources and their temporal variation in space and time is imperative for a planned management and development of ground water resources. The resources in the surveyed area are computed on the basis of methodology recommended by the Ground Water Estimation Committee of Ministry of Water Resources, Govt. of India, 2015. The entire aquifer mapping area, falls under command area and has been covered under ground water resource assessment. The estimation of ground water resource in the surveyed area is taken as on March 2024. The prime objective of groundwater resource estimation is Refinement of Parameters and lithology wise groundwater resource estimation.

MATERIAL AND METHODS

The primary source of recharge of groundwater in Saoner taluka is rainfall. Therefore, water table balance method has been used for estimating the resources. Rainfall recharge factor or Infiltration factor is a recharge parameter that indicates a quantum of water recharged to the groundwater system in relation to the rainfall. It is a function of rate of infiltration and ability of the system to accept the infiltrated water. The infiltration factor can be expressed as follows

IF = (Qi/Qa) X SY,

Where,

IF = Infiltration Factor

Qi = Quantum of water infiltrated over the test period in m

Qa = Quantum of water applied in m

SY = Specific Yield

Recharge of ground water involves several components and rainfall being the major one. The other components are return irrigation flow from surface water and ground water.

Soil Infiltration Test:

In order to refine the rainfall infiltration factor considered for estimating ground water resources, 6 (six) number of soil infiltration test were carried during January, February & March months of 2023 at 6 different locations (Figure-7.5). These tests were conducted at different locations covering different soils by using standard double ring infiltrometer with constant head method (Table-7.6). Attempt has been made to spatially cover the entire area covering all types of soils and land use.

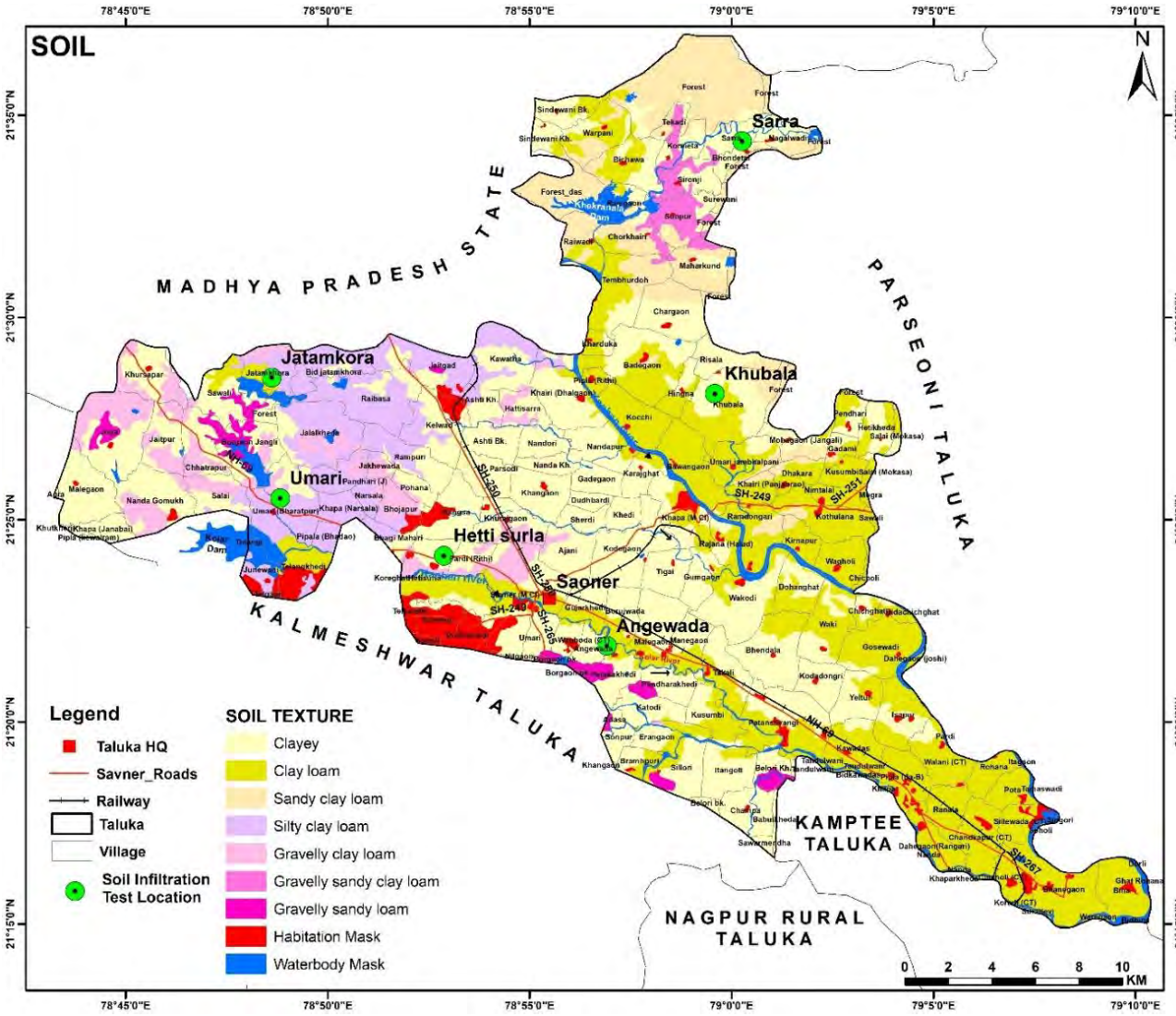

Figure 7. 5: Locations of soil infiltration test

The data of soil infiltration test is given in Annexure and result of the infiltration test is summarized in the table below.

Table 7. 6: Location of infiltration test.

S. No.	Village	Date	Latitude	Longitude	Soil Type	Final Infiltration rate (cm/hr)	Rainfall coefficient	Rainfall coefficient (%)
1	Jatamkora	02.01.2024	21.475258	78.810258	Silty clay loam	1.20	0.13	13
2	Hetti surla	03.01.2024	21.401789	78.881254	Clayey	0.18	0.03	3
3	Angewada	09.01.2024	21.364626	78.948525	Gravelly sandy loam	0.60	0.10	10
4	Umari	01.02.2024	21.425518	78.813688	Gravelly clay loam	1.80	0.11	11
5	Sarra	05.03.2024	21.572559	79.004356	Sandy clay loam	3.60	0.11	11
6	Khubala	06.03.2024	21.468547	78.9931	Clay loam	0.3	0.03	3
						Average 0.088		8.5

The rainfall coefficient has been calculated by using the Horton's infiltration equation as under

$$fp = fc + (fo-fc)e^{-kt}$$

Where:

fp = Infiltration capacity at any time t

fc=Final steady state infiltration capacity

fo = Initial infiltration capacity

k = Horton decay constant

Since the Infiltration coefficient is inversely related to the Horton decay constant, the rainfall coefficient has been calculated after getting the value of Horton decay constant from the above equation with the help of time Vs ln(fp-fc) graph.

The above method is very simplified and may not capture fully the other factor like soil property, antecedent soil moisture, rainfall intensity and duration, slope, vegetation cover etc.

However, based on the above exercise it can be inferred that in different type of soil in the study area the Infiltration coefficient (K) varies from 0.03 to 0.13. Its average value is calculated to be 0.088 (8.8%).

In Maharashtra State, the ground water resources have been estimated by taking the watershed as an assessment unit. The calculated ground water resources are finally allocated to

the blocks falling in the concerned watershed. Collectively for the Saoner block, infiltration factor is 0.87 (8.7%) has been taken for the GW Resources Estimation 2023 for both command and non-command area.

If avoiding the 'land use' in estimating ground water resources, the average value of infiltration coefficient (0.088) obtained from soil infiltration test which is very close to the infiltration factor taken/used (0.087). Therefore, no comparison has been attempted for the already calculated and corrected GW resources. Therefore, from the above exercise no refinement in infiltration factor has been suggested. However, if the assessment unit is further divided to calculate rainfall recharge based on the soil type and/or land use, the above data may be used for further refinement.

8.0 A PLAN FOR DRINKING WATER SOURCE SUSTAINABILITY

8.1 Introduction:

The Jal Jeevan Mission (JJM) in partnership with State is providing functional household tap connection (FFTC) to every rural household with mandate to supply safe drinking water in adequate quantity (55 lpcd) to tis people on long-term and regular basis. Therefore, in order to ensure sustainability of drinking water sources (based on ground water as a source) adaptation of water conservation measures and recharge is required. Hence, an exercise is made following "Standard Operating Procedure" (SOP) of "Sustainability of Ground Water Sources" as per flow chart **(Fig.8.1)**.

8.2 Objective:

The main objective of drinking water source sustainability is

i. To assess Sustainability of sources in the villages in each gram panchayat of Saoner taluka.
ii. To propose various supply side interventions (artificial recharge structures).

8.3 Methodology:

At present, ground water sources under JJM in all villages from study area are sustainable throughout the year. However, in order to predict demand and supply balance, the following exercise is carried out as per the SOP.

a) Collection of Basic Information:

Basic information like location, population, aquifer type, type of ground water abstraction structure (BW/TW/DW), sustainability of wells, average pumping hours, ground water related problems etc were collected during field surveys and feed backs obtained from Jaldoots and farmers.

b) Assessment of Demand and Supply:

Demand Assessment:

Population is major factor to calculate the demand of water in the village and as per BIS 10500 standards, the minimum per capita water demand of safe drinking water in rural areas is 55 litres per capita per day (LPCD). The annual demand is calculated as below.

Annual Demand (Cubic m/year) = Population*Per capita water supply (55 lpcd) * No. of days

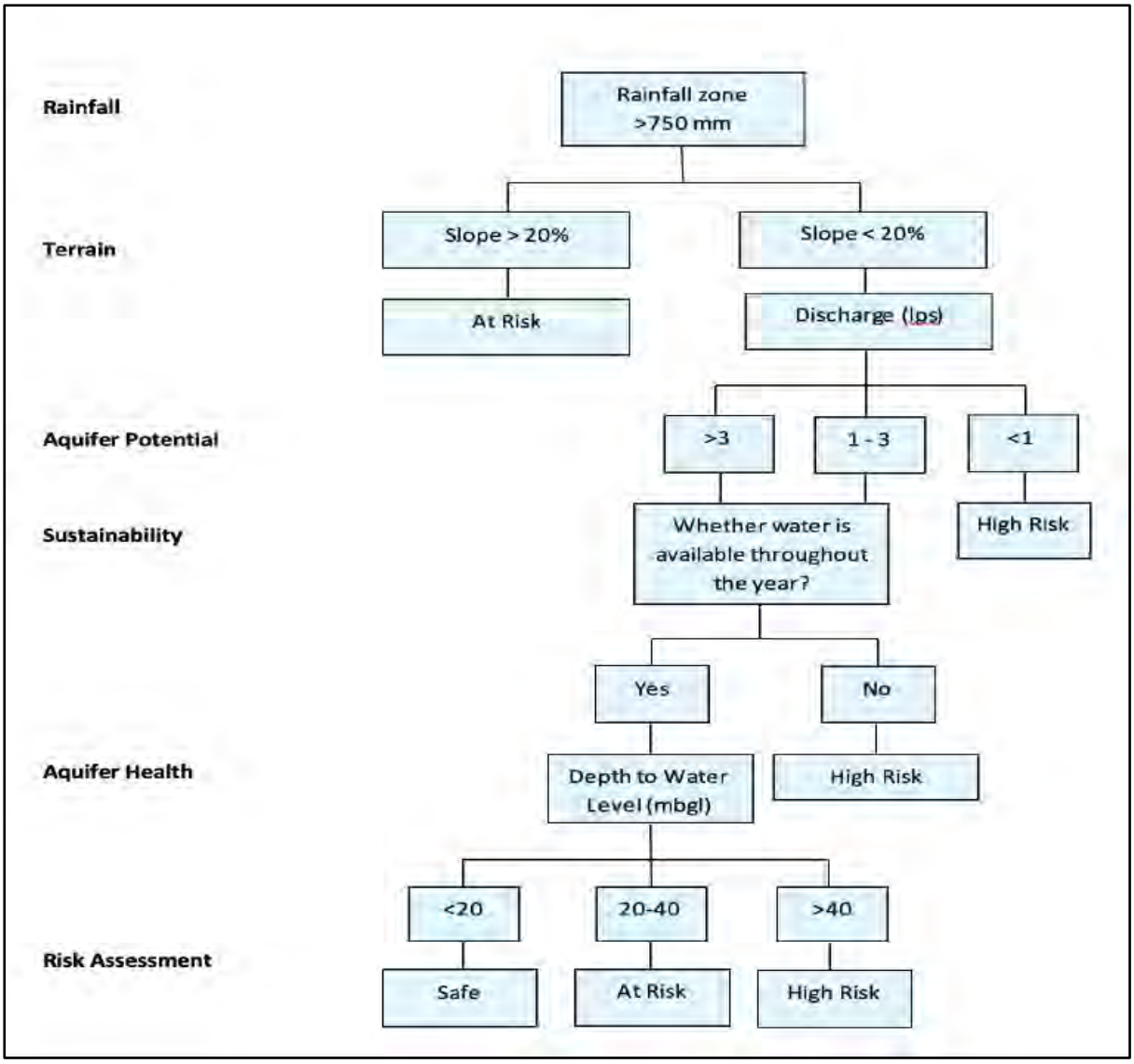

Fig. 8.1: - Step -wise process of Risk Assessment of Villages.

Supply Assessment:

Yield of structures and their pumping hours are the major supply side factors to calculate supply of ground water. In this exercise the pumping hour has been taken based on the field surveys electricity supply from Electricity Board, discussion with pump operator of source supply wells, members of gram panchayats, farmers. During the discussion it has been found that there is no decrease in yields throughout the year. In spite of ground water sustainable throughout the year, the pumping hours can be fluctuate based on the demand and electricity power supply. The number of ground water abstraction structures (DW/TW/BW) has been taken from JJM portal. The pumping hours ranged from 4 hrs to 12 hrs as per the information collected from gram panchayats, discussion with farmers and also on electricity power supply. Depending on the capacity of the storage water tank, horse power of the pump and based on the yield potential of the area, yields ranged from 3 to 6 liters/secod (lps)

Annual Extraction (cubic m/year) = Total discharge of wells being used for water supply (in Cubic m/hr) * No of running hours/day* 365

In this process gap between demand and supply has been calculated. Based on the demand-supply gap the villages are categorised as per sustainability of sources.

C) Assessment of Monsoon Runoff:

The area receives annual normal rainfall of 1008 mm and thus falls under the category of >750 mm annual rainfall. Based on the land use pattern, run off coefficient has been assigned. For agriculture, run off coefficient fraction taken as 0.20, for habitation 0.50 and for others 0.15. Total run off is calculated by multiplying run off coefficient fraction, area of village (m^2) and annual rainfall. The run off of the block (Gram Panchayat wise) ranges between 0.2619125 MCM to 56.31 MCM. The demand for all uses should not be more than the volume of water recharged in the gram panchayat concerned.

D) Risk Assessment of Villages:

For risk assessment of villages various parameters has been taken into consideration like

1. Rainfall
2. Terrain Condition
3. Aquifer potential
4. Sustainability/availability of groundwater
5. Depth to water level
6. Water quality.

Based on the above parameters the villages can be categorised as Safe, At Risk and High-Risk categories (**Fig.8.2**).

Safe: Safe villages are those that can sustain existing ground water-based schemes in the long term without needing any external intervention.

At Risk: At Risk villages are those where gap between demand and supply is positive. These villages can only be sustained by undertaking recharge/conservation interventions.

High Risk: High-risk villages are those where water sources cannot be sustained, even with interventions, due to factors such as low aquifer potential, insufficient rainfall, or groundwater levels exceeding 40 meters below the surface.

As per our assessment no Gram panchayat from study area comes under High Risk category.

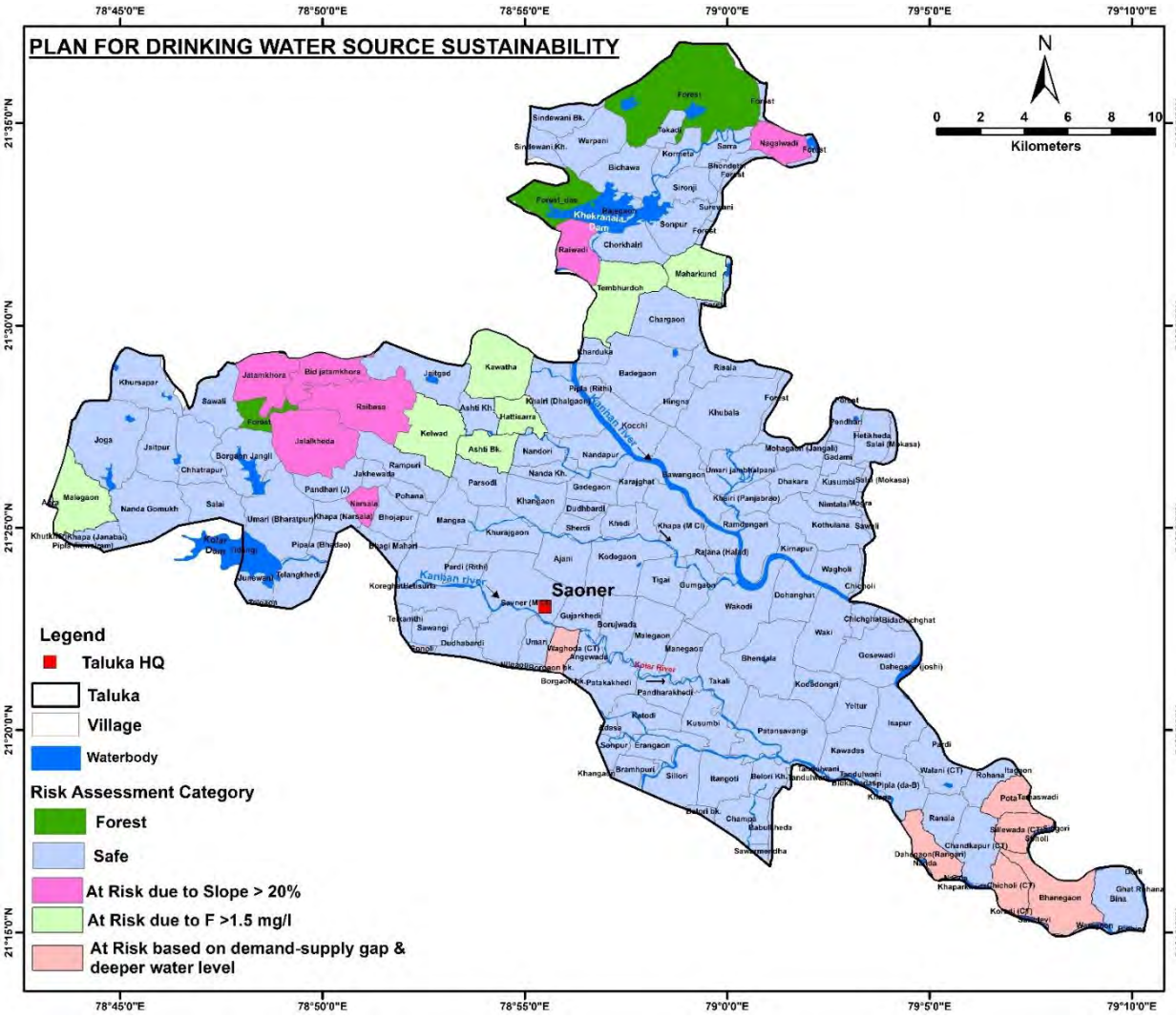

Fig.8.2: Categorization of Panchayat for Source Sustainability

8.4 Results and Discussion:

Based on terrain condition, slope has been calculated which varies from 5 to >20 %. From the results, it is observed that out of 134 villages, 5 villages namely Jalalkheda, Nagalwadi, Narsala, Raiwadi & Jatamkhora (**Table 8.1**), where 50% geographical area of villages falls under greater than 20% slope and thus falls under "at Risk" category. Therefore, in these villages more attention should be given on the efficiency of recharge structures like contour trenches/bunds and staggered contour trenches are suggested.

Table- 8.1: List of villages categorised as At Risk due to slope.

Sr No.	Location Dist./ Block/ GP	Latitude	Longitude	Population	Aquifer Type Soft Rock/ Hard Rock	Dug Well/TW/BW	No. of Structures (DW/BW/TW)	Sustainable throughout the year? Yes/ No	Terrain Slope > 20%)	Risk Assessment
1	Jalalkheda	21.451849	78.829664	987	Hard Rock	DW	2	Yes	> 20%	At Risk
2	Nagalwadi	21.574912	79.021584	543	Hard Rock	DW	2	Yes	> 20%	At Risk
3	Narsala	21.425996	78.850121	999	Hard Rock	DW	2	Yes	> 20%	At Risk
4	Raiwadi	21.530705	78.936934	1074	Hard Rock	DW	2	Yes	> 20%	At Risk
5	Jatamkhora	21.477593	78.811107	2105	Hard Rock	DW	3	Yes	> 20%	At Risk

Based on demand supply gap, aquifer potential and depth to water levels, 6 villages (Bhanegaon, Chicholi (CT), Dahegaon Rangari, Pota, Sillewada, Waghoda (CT)) falls under at risk category **(Annexure-X (a, b)**. These village have the positive gap of demand and supply. In these gram panchayats number of ground water abstraction structure is comparatively less. The field observation is summarised below.

During post-monsoon field work, the above identified area (Gram Panchayat) has been surveyed in detail. The field observations are as follows:

- All these 6-gram panchayats are located at lowest elevation around the existing mine area.
- The ground water abstraction structure is less (1 or 2) in comparison to other gram panchayats in the block where as in other Gram Panchayats the no. of ground water abstraction structures is 3 to 5.
- In Pota and Sillewada village, depth to water level is >20 mbgl. The field observations reveal that remarkably in this area no. of dug wells even in post monsoon period are found dry down to 30 m depth (Fig.8.3 (a, b)). It indicates that areal extent of aquifer is limited and aquifer system are discontinued in the area.
- New abstraction structure should be created with the help of GP survey tapping productive aquifer to fulfil future demand of ground water for drinking purpose.

Although, at present condition all the ground water abstraction wells for drinking purpose are sustainable, but in coming future due to mismanagement of available drinking water sources may bring the villages into High-Risk condition as the gap between demand-supply is very high. Therefore, responsible groundwater utilization is to be encouraged.

For risk assessment of villages based on water quality, 3 parameters taken into consideration like Iron, Fluoride and Arsenic concentration. From the above exercise, 4 villages i.e., Hattisarra, Kelwad, Malegaon (Jo) and Tembhurdoh are having fluoride concentration > 1.5mg/l and are categorised as At Risk. In these villages using defluoridation techniques, reverse osmosis (RO) filtration and by diluting ground water by constructing recharge structures, the water can be used.

Fig.8.3 (a-b): - Field photograph of Dry dug wells (depth30 m), Pota village, Saoner Block.

8.5 Recommendations

- In areas where slope > 20%, water conservation structures like contour bund, contour trenches are recommended.
- The areas where demand- supply gap is very high and having deeper water level (>20mbgl); new abstraction structure should be created with the help of GP survey tapping productive aquifer to fulfil future demand of ground water for drinking purpose. Sustainable use of ground water recommended in these areas. Various Artificial Recharge Structures such as Check Dams, Percolation Ponds may be recommended.
- The villages having fluoride contamination (>1.5 mg/l), the ground water can be treated by defluoridation techniques, reverse osmosis (RO) filtration and by diluting ground water by constructing recharge structures.

9.0 GROUND WATER RELATED ISSUES, MANIFESTATIONS & INTERVENTIONS

9.1 Objectives: The primary goal of this chapter is to identify key groundwater issues related to both quantity and quality, based on the findings. This will allow for the development and implementation of appropriate remedial measures to address and mitigate these issues.

9.2 Methodology: To pinpoint groundwater-related issues in the area, a comprehensive analysis is conducted, including the examination of rainfall patterns, water level depths, trends in water levels, aquifer characteristics, groundwater resource availability, and water quality. Additionally, feedback from farmers and observations from field visits are thoroughly considered before drawing conclusions and making recommendations.

9.3 Results and Discussion: In study area, following major issues are identified and are discussed below.

a) Deeper water levels (> 20 m)
b) Long term declining trend in water levels
c) Source sustainability of existing structures
d) Ground water Quality Issues (Geogenic and Anthropogenic)
e) Reduced water retention capacity and drying out of irrigation dug wells near Mining area
f) Reported Land Subsidence in Villages nearby Mining Area in Saoner Block.

a) Deeper water levels (> 20 m): In shallow aquifers (< 30 m), deep water levels in the range of 10-20 m are observed in ~256 km^2 (38.4%) and ~230 Km^2 (34.2%) area during per and post-monsoon seasons respectively. In deeper aquifers, very deep-water levels in the range of 20-30 m are observed in ~24 km^2 (3.6 %) and ~4 Km^2 (0.6 %) area and very deep-water levels of > 30 m are observed in ~11 km^2 (1.7 %) and ~3 Km^2 (0.4 %) area is observed during pre-monsoon and post-monsoon seasons respectively.

b) Declining trend in water levels over a decade: Trend analysis for last 10 years shows that, out of 45 wells, in 31 wells falling trends @ 0 to -0.2 m/year are observed during pre-monsoon. The central parts of Saoner block with wells in villages Asthi Bk., Nandori, Parsodi, Khangaon, Nandpur, Hatisarra, Kelwad showing significant falling trends (-0.2 to -0.4 m/year) during pre-monsoon. During post-monsoon falling trend is mostly observed in central and western parts of the block.

c) Source Sustainability of Existing Ground Water Structures:

The hydrogeology of the Saoner Block is characterized by a diverse geological composition, including Archaean crystalline rocks, basaltic Deccan traps with inter-trappean Chikhli formation beds, Gondwana formations, and recent alluvium.

In the Archaean crystalline rocks, groundwater occurrence and movement are primarily governed by the joints and fractures within the rock. The yield from wells in these formations is influenced by the density, intensity, and connectivity of these fractures. Basaltic formations, on the other hand, exhibit significant hydrogeological variability. The yields from wells in basaltic

areas are affected by factors such as the drainage network, the presence and connectivity of vesicles, and secondary porosity resulting from weathering and fracturing.

The Gondwana formations, which are predominantly found in the central, southern, and southeastern parts of the Saoner Block, include the Barakars and Kamthis. These formations are composed of medium to coarse-grained friable sandstone, which serves as a key water-bearing layer in the region.

Recent alluvium, deposited along the Kanhan River, constitutes highly productive aquifers. These aquifers are capable of sustaining prolonged pumping with minimal drawdown and quick recovery.

Given the presence of these productive aquifers in the Gondwana and recent alluvium formations, coupled with the high-water demand for orange cultivation, the Saoner Block has a large number of irrigations dug wells. An analysis using Google Earth maps has identified approximately **4,497** dug wells in the area, with well densities reaching up to 40 wells per square kilometer in majority parts of the block. This high density of irrigation wells contributes to a significant increase in irrigation drafts, which may impact the overall stage of groundwater extraction in the Saoner Block. The irrigation well density map shown in **fig 9.1**.

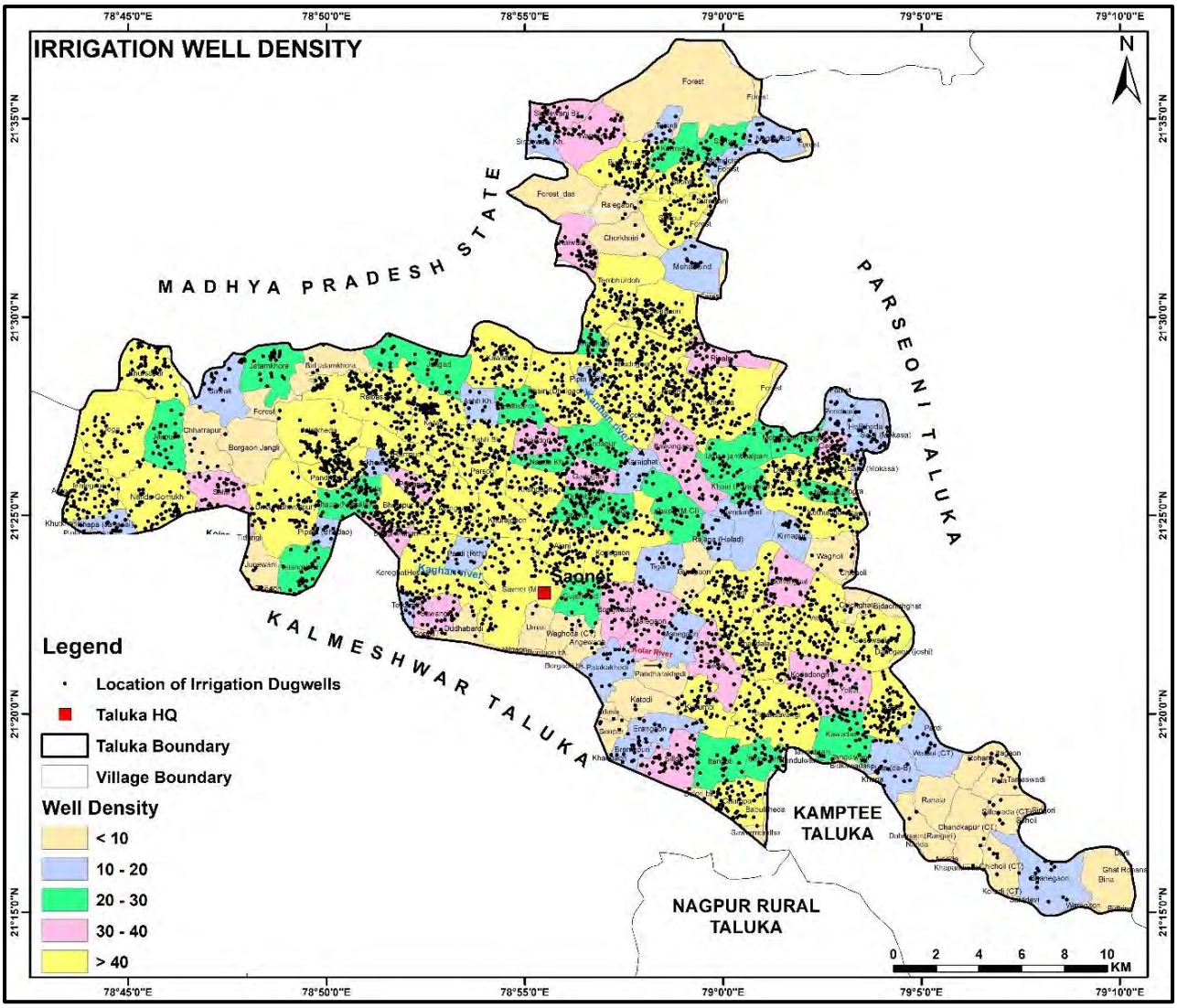

Figure-9.1: Irrigation well density, Saoner Taluka.

d) **<u>Ground Water Quality Issues (Anthropogenic and Geogenic):</u>** In the area, high electrical conductivity is detected in shallow as well deeper aquifers in both seasons. During pre-monsoon season 62% area showing EC greater than 1000 µS/cm in shallow aquifer and 42% area showing EC greater than 1000 µS/cm in deeper aquifer. During pre-monsoon shallow aquifer of Parsioni Village showing very high EC of 2694 µS/cm. During pre-monsoon deeper aquifer of Digalwadi Village showing very high EC of 2683 µS/cm.

During post-monsoon shallow aquifer of Kelwad Village showing very high EC of 3718 µS/cm. During post-monsoon deeper aquifer of Khurajgaon Village showing very high EC of 2395 µS/cm.

Nitrate is other major anthropogenic contaminant in ground water as it is found in both aquifers and in both seasons. Nitrate concentration more than MPL in 46 wells (33% of samples) during Pre-monsoon in shallow aquifer. Nitrate concentration more than MPL in 53 locations (42% of samples) during Pre-monsoon in deeper aquifer. During Post-monsoon season nitrate concentration more than MPL in 43 wells in shallow aquifer and nitrate concentration more than

MPL in 38 wells in deeper aquifer. The major cause of higher concentration of nitrate in ground water due to excess utilization of NPK fertilizers and nitrogen fixation by leguminous plants.

Fluoride is main geogenic contaminant in ground water in an area. Results reveals that during pre-& post-monsoon season, in shallow aquifer almost 3% & 1.6% samples are unfit for human consumptions and from deeper aquifers about 2.4% and 2% samples are unfit for human consumptions. The main reasons for occurrence of high fluoride in ground water is presence of zeolite as secondary filling minerals (in vesicular part of basalt), rock water interaction, longer residence time, high alkalinity and arid conditions.

e) <u>Reduced water retention capacity and drying out of irrigation dug wells near Mining area:</u>

The Saoner block in the Nagpur district is a significant area for coal mining. While coal mining supports economic development and energy needs, it also poses environmental and social challenges. The villages in close proximity to the mining areas in the Saoner block include Bhanegaon, Pota, Pipla, Gondegaon, Saoner, Silewada, Singhori, Waghoda etc. Mining often involves stripping away vegetation and topsoil to access coal deposits. The removal of this natural cover and subsequent excavation can lead to soil compaction and alteration. Compacted soil has reduced porosity, which diminishes its ability to absorb and retain water. This results in increased runoff and reduced infiltration, making it harder for water to penetrate and be stored in the soil. Mining activities can increase soil erosion by removing vegetation and disturbing soil layers. Erosion leads to the loss of fertile topsoil and further degradation of soil structure. Eroded soil can lead to reduced water retention capacity and increased sedimentation in water bodies, impacting both soil and water resources. During the field visit (Fig. No. 9.2) to the villages of Bhanegaon, Pipla, Gondegaon, Saoner, Silewada, Singhori etc., it is reported that mining activities have significantly diminished the water retention capacity of the soil. This reduction in soil moisture has had a detrimental impact on agricultural productivity in these areas.

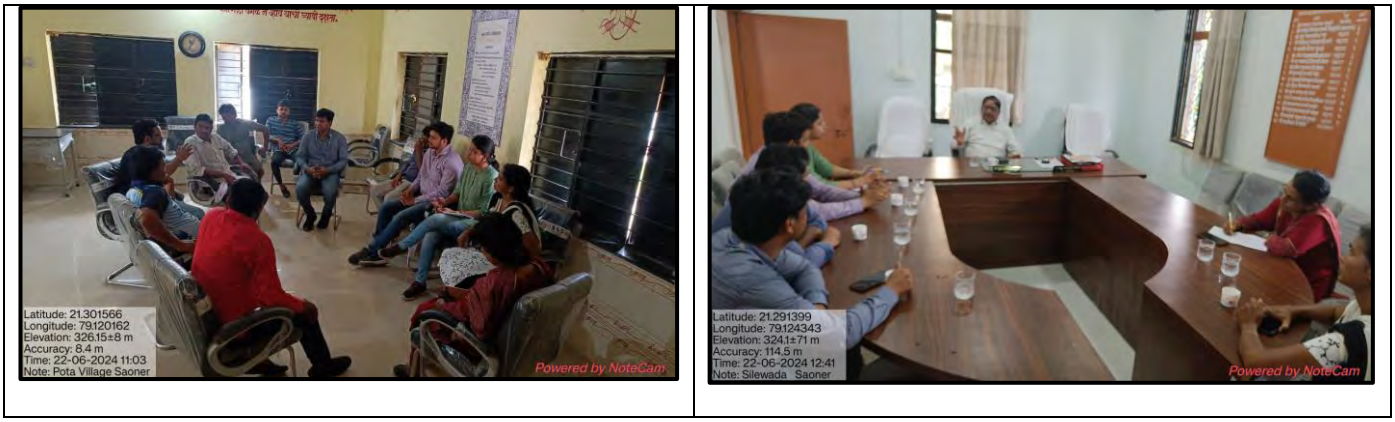

Fig. 9.2 Field visit to villages near Mining area in Saoner Block.

Mining operations, particularly those involving large-scale excavation or coal washing, require substantial quantities of water. This extraction can significantly lower the local groundwater table. Dug wells, which rely on natural groundwater recharge, may experience a decrease in water levels or even dry up as the groundwater table falls due to mining-induced depletion. Mining activities often disturb the land surface, altering natural drainage patterns and

reducing the amount of water that infiltrates the ground to replenish aquifers. With decreased infiltration, the natural recharge of aquifers is impeded, further contributing to lower groundwater levels and exacerbating well drying issues. During the field visit to villages near the mining area, it was observed that dug wells with depths of up to 30 meters are running dry. Additionally, there has been a noticeable decline in water levels across both shallow and deeper aquifers.

Fig. 9.3 Dug wells with depth upto 30m running dry in Pota village near mining area.

Fig. 9.4 Measurement of Bore well showing declining water level in Silewara village near mining area.

f) Reported Land Subsidence in Villages nearby Mining Area in Saoner Block:

Land subsidence refers to the gradual or sudden sinking of the Earth's surface, caused by factors such as earthquakes, rapid drops in the water table, or other factors including the extraction of underground resources. This phenomenon is commonly observed in regions with loose soils, tectonically active areas featuring numerous faults and folds, and locations with predominantly clayey or sandy soil layers.

In the context of mining, it typically results from the removal of minerals or coal, creating voids or cavities that cause the overlying land to settle or collapse. Mining operations, particularly

underground mining, involve the extraction of coal or other minerals from beneath the surface. This removal of material creates voids or cavities in the earth. When these underground voids become large or unstable, the support structures holding up the surface may fail, leading to subsidence. The ground above these voids can sink or collapse, resulting in surface deformation. Land subsidence near mining areas can significantly impact groundwater resources, altering flow patterns, reducing recharge rates, increasing contamination risks, and lowering water levels.

To identify areas exhibiting signs of land subsidence in Saoner taluka, comprehensive field surveys were conducted across the region. During these surveys, discussions were held with farmers and local residents to understand and address the issues they were experiencing. According to feedback from local villagers, land subsidence has been reported in the villages adjacent to the coal mines. The field investigation revealed significant damage, including cracks in walls, foundations, and pavements.

Fig. 9.5 Cracks in foundation and pavements due to land subsidence in Pota village, Saoner Block

9.4 Interventions Recommended to Overcome above Issues:

To address the issues identified in the area, the following recommendations are proposed.

- To maintain groundwater sources for drinking water under the Jal Jeevan Mission (JJM), it is recommended to construct check dams with recharge shafts upstream of water sources. Additionally, implementing subsurface dykes at appropriate downstream locations will further support groundwater replenishment.
- Efforts should be directed towards supplying surface water to villages experiencing groundwater quality issues.
- The fluoride rich ground water may be used for other domestic purposes or it can be taken after blending with fluoride free water.
- Defluoridation methods such as activated alumina, low-cost adsorbents, and ion exchange are recommended. Community involvement in the operation and maintenance of these systems is essential, along with implementing integrated fluorosis mitigation measures.
- Artificial recharge techniques are to be adopted as various studies have demonstrated that it reduces the F^- in ground water. It is also confirmed from results that during post-monsoon period, F concentration reduces.

- More emphasis may be given to intake of calcium and phosphorous rich food as it helps in reducing the absorption of fluoride by intestine and also reduces the rate of accumulations.
- In high salinity areas, it is recommended to go for salt tolerant crops like sorghum, wheat, chickpea, sesame, Soybean, sunflower, barley and daylilies a popular and easy to grow flowering plant etc are recommended.
- Effective remediation of nitrate contamination in groundwater involves techniques like ion exchange, reverse osmosis, and biological denitrification. Prevent further nitrate leaching by optimizing fertilizer use and enhancing wastewater treatment practices. Regular groundwater quality monitoring and the adoption of best management practices in land use are crucial for long-term remediation and protection of water resources.
- To address reduced water retention and well drying near mining areas, implement effective water conservation techniques, including constructing check dams and recharge pits to boost groundwater replenishment. Adopt controlled mining practices to reduce groundwater depletion and use artificial recharge methods to restore water levels. Regularly monitor and maintain wells, and promote sustainable water management practices among local farmers to support the recovery and sustainable use of water resources in affected regions.
- Near mining areas preventive measures should include implementing sustainable mining practices and groundwater recharge techniques, in conjunction with structural reinforcements such as grouting and soil stabilization. Restoration efforts should focus on land reclamation and groundwater quality improvement, complemented by community education and stakeholder collaboration.

10.0 PROPOSED GROUND WATER MANAGEMENT PLAN

Effective management of groundwater encompasses both its quantity and quality. Understanding and quantifying groundwater resources are fundamental prerequisites for ensuring sustainable use. With freshwater sources diminishing rapidly, it is crucial to grasp hydrogeological processes comprehensively. Moreover, deteriorating groundwater quality compounds these challenges. Addressing these issues is essential for safeguarding the availability of safe drinking water, emphasizing the critical importance of managing groundwater quality alongside quantity.

OBJECTIVE:

The main objectives are given below:

- To evolve a block-level management plan considering quantity as well quality aspects implementable at Village/GP level.
- By using supply side interventions, to increase the contact area and residence time of surface water over the soil to enhance the infiltration and to augment the ground water storage in phreatic aquifers and also dilute the areas affected by F and No_3 contaminants.
- By using supply side interventions, increase the sustainability of drinking water sources and tackle the water scarcity problem in lean period.
- To recharge the deeper aquifer by using direct injection methods as deeper aquifer is also found exploitable for irrigation purposes.
- For effective utilization of GW resources in Irrigation purposes also proposed the micro-Irrigation techniques.

METHODOLOGY:

The proposed management plan comprises two components namely supply-side management and demand side management. The supply side management for augmenting the GW resources and demand side management is proposed by use of micro irrigation techniques and change in cropping pattern for effective utilization of ground water resources.

10.1 Supply side intervention

The supply side management of ground water resources can be done through the artificial recharge of surplus runoff available within river sub basins and micro watersheds. Also, it is necessary to unsaturated aquifer volume available for recharge. The unsaturated volume of aquifer was computed based on the area feasible for recharge, unsaturated depth below 3 m bgl and the specific yield of the aquifer.

In Saoner block, prevailing AR structures found are Check Dam, Cement Nala Bund, Recharge Shaft, Loose boulder bed, Percolation tanks, KT weirs, RTRWH, CCT and Deep CCT structures etc. the data of existing recharge structures are collected from various state agencies and AR & WCS structured are also geotagged from Google earth satellite image. The location of existing structures is shown in figure 10.1. For preparation of implementable recharge Plan, area

specific GW issues-based and prevailing AR structures, are suggested in Saoner block. Apart from this during the field observation some existing AR structures were found damaged/not maintained and this will affect the efficacy of recharge structures. So desiltation and maintenance of existing and proposed structures are proposed to be made mandatory in every two years.

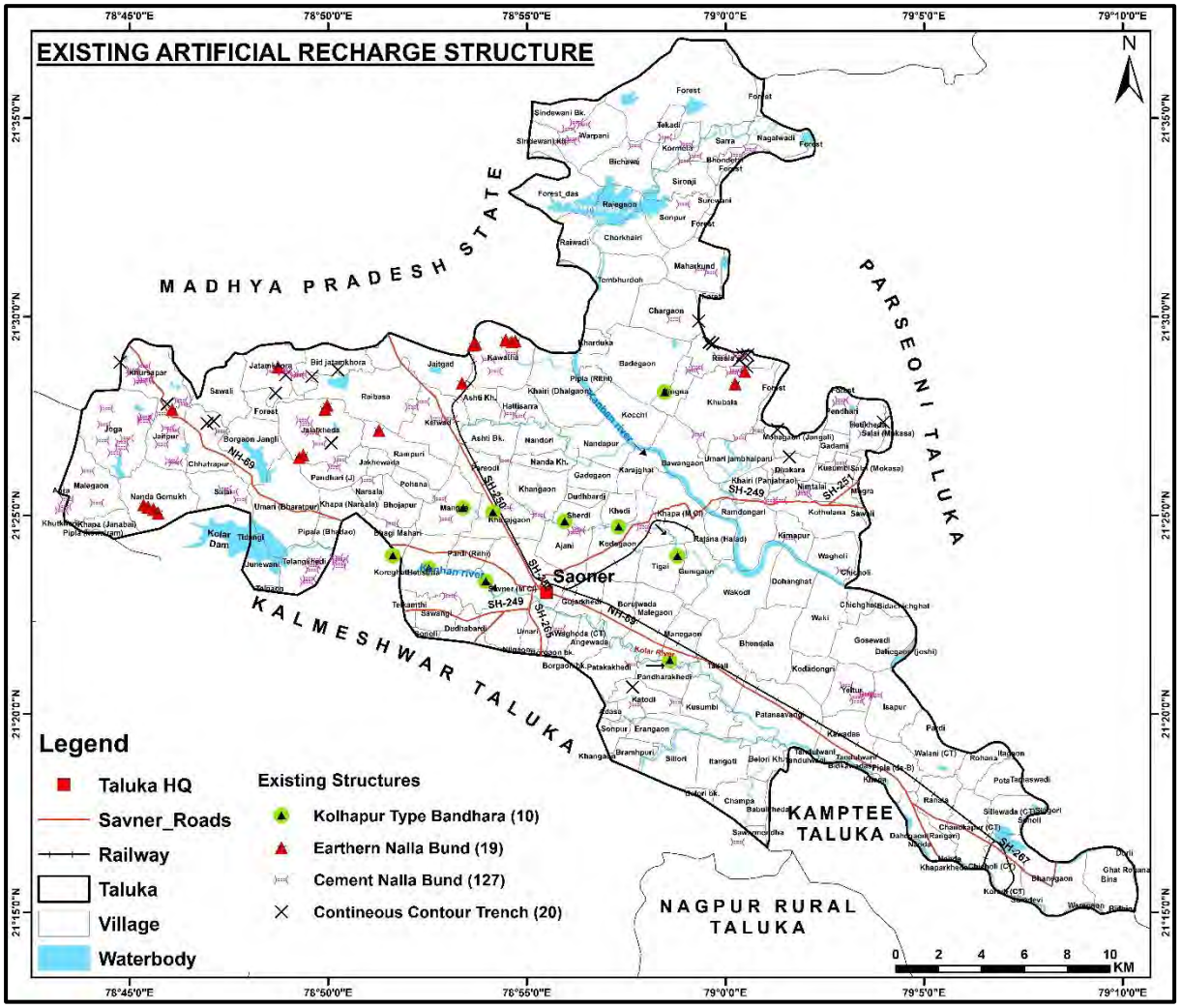

Figure 10. 1: Existing Artificial Recharge Structures in Saoner block.

FARM PONDS:

In Saoner block, farm ponds serve as crucial water conservation structures, strategically built in low-lying areas of farms. An optimal size for these ponds, such as 10 x 10 x 3 meters, is recommended. Figure 10.2 illustrates the current locations of existing farm ponds. To meet domestic and irrigation needs effectively, it is essential to periodically desilt farm ponds. This maintenance practice not only enhances storage capacity but also improves their recharge capabilities. Currently, some farmers use plastic sheets or concrete bases at the pond bottom to prevent groundwater percolation and recharge. To promote sustainable groundwater management, subsidized farm ponds should discontinue the use of plastic sheets or concrete bases. This measure will enable both improved storage capacity and enhanced groundwater recharge, aligning with long-term water conservation goals.

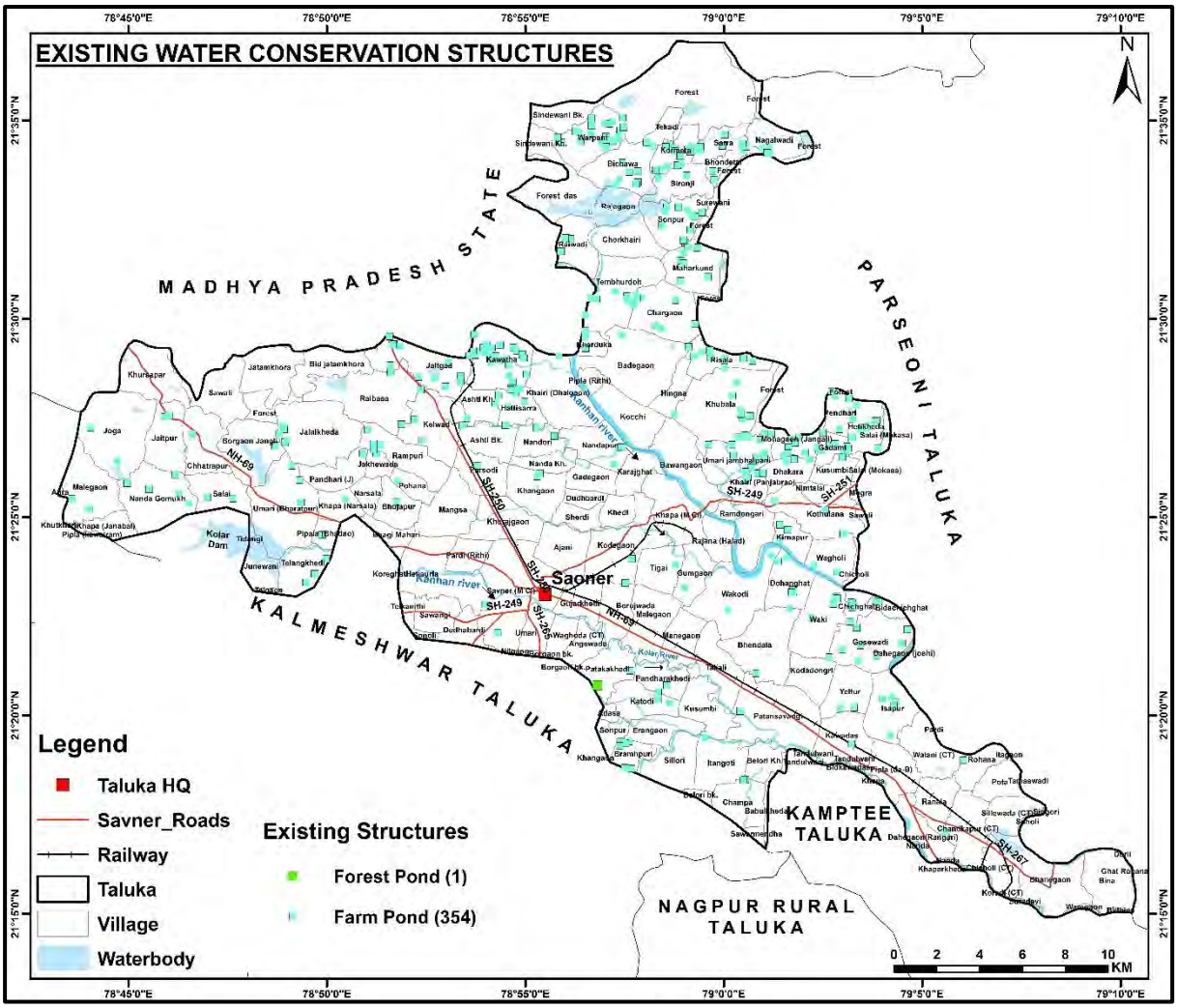

Figure 10. 2: Location of Existing Farm Ponds & Forest Pond

The total unsaturated volume available for artificial recharge is 3301.66 MCM. The available surplus runoff can be utilized for artificial recharge through construction of percolation tanks, Check dams and Recharge shafts at suitable sites. A total of 17.42 MCM of surplus water can be utilised for recharge. This surplus water can be utilized for constructing 6 percolation tanks, 200 check dams and 200 recharge shafts at suitable sites. The location of proposed AR structures shown in fig 10.3. This intervention should lead to recharge about 13.06 MCM/year.

Proposed artificial recharge structures can target:

- Areas affected by contaminants (F and NO3) to mitigate pollution.
- Areas in non-command OCS Category with moderate/high yield potential and deep weathering depth.
- Areas in command OCS Category with moderate/high yield potential and substantial weathering depth.

Water conservation structures are recommended for:

- Areas in non-command OCS Category with low yield potential and shallow weathering depth.
- Areas in command OCS Category with low yield potential and limited weathering depth.

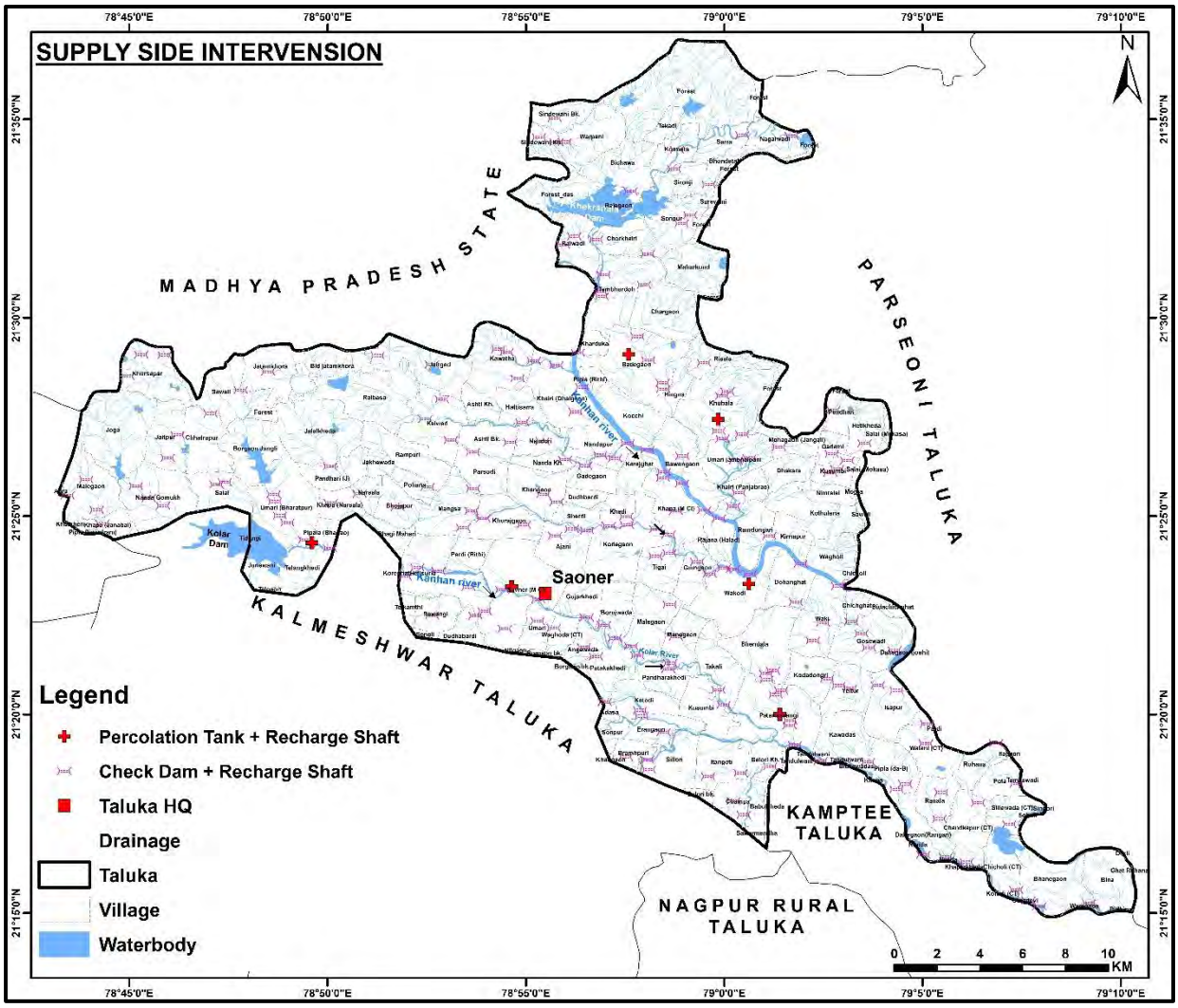

Figure 10 3: Location of Proposed AR structures

The Village wise Supply side interventions for Groundwater Management is given in **Annexure IX**. As per field observations and data acquired from Taluka authorities of Saoner taluka following villages are not feasible for artificial recharge structures but demand side interventions can be proposed. The 13 of 136 villages in Saoner taluka viz., Ashti Kh., Bhagi Mahari, Bhondetal, Bid jatamkhora, Chargaon, Jalalkheda, Joga, Kothulana, Maharkund, Rampuri, Sawali, Sawarmendha and Telangkhedi are not feasible for artificial recharge as the post monsoon water level is shallower than 3m.

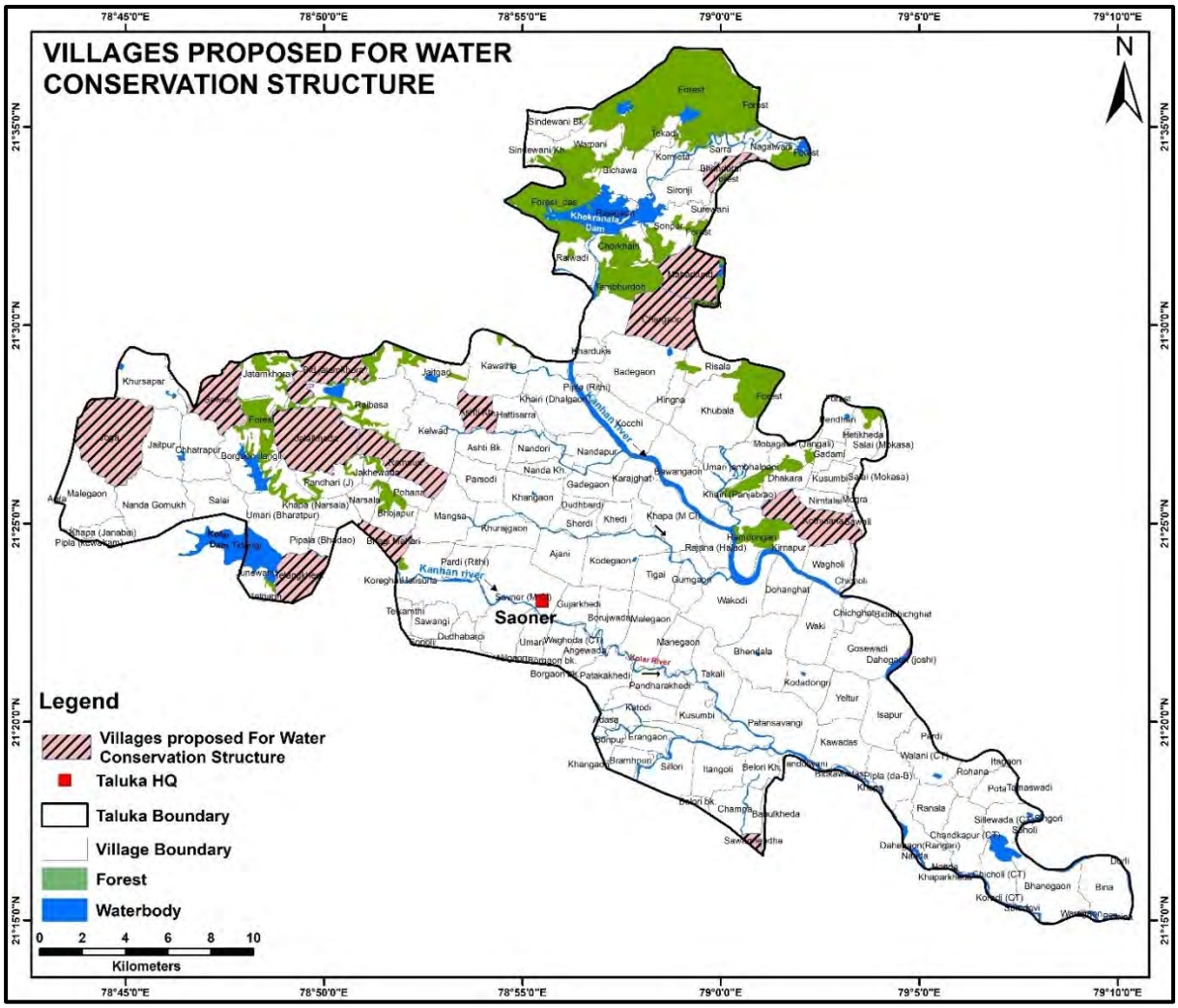

Figure 10.4. Map showing villages proposed for water conservation structure.

- In above villages to overcome water stress/scarcity, water conservation structures are proposed. Water conservation measures are typically multipurpose, synergistic, and beneficial for afforestation, and enhancing agricultural productivity. Various techniques are applicable to different zones such as runoff, recharge, and discharge zones. Commonly used structures include farm ponds, bench terracing, contour bunds, gully plugs, nala bunds, check dams, and percolation ponds.
- In Runoff zone area of watersheds, forest and barren land areas are proposed for soil and water conservation works with afforestation work; CCT, deep CCT, trenches are more effective soil and water conservation structures. The trenches break the slope at intervals and reduce the velocity of surface runoff. The water retained in the trench will help in conserving the soil moisture and ground water recharge
- Tree plantation is also important. Farmers should start planting trees at least on their bunds and fallow lands.

10.2 Demand side intervention

Demand-side interventions aim to conserve groundwater through the adoption of highly efficient irrigation methods, such as micro irrigation systems like drip and sprinkler irrigation, in place of conventional flooding techniques. Micro irrigation methods minimize water wastage by directly delivering water to the plant roots, reducing evaporation and runoff. This targeted approach ensures each plant receives the precise amount of water needed, promoting uniform growth and minimizing moisture on the land, which in turn reduces weed growth. These systems operate at low pressure (2–4 bar) and require less energy for pumping compared to other irrigation systems, contributing to energy conservation. Additionally, micro irrigation systems help crops withstand saline water or soil conditions by maintaining high moisture levels in the root zone and keeping soil salt concentration low. This makes crops under micro irrigation more resilient to saline water and enhances overall crop productivity.

Table 10.1: Water saving and productivity gains under drip method of irrigation in India

Crop's Name	Water consumption (mm/ha)		Yield (t/ha)		Water Saving over FIM (%)	Yield Increase over FIM (%)	Water Use Efficiency (yield/ha)/(mm/ha)	
Vegetables:	FIM	DIM	FIM	DIM			FIM	DIM
Ash gourd	840	740	10.84	12.03	12	12	0.013	0.016
Bottle gourd	840	740	38.01	55.79	12	47	0.045	0.075
Brinjal	900	420	28.0	32.00	53	14	0.031	0.076
Beet root	857	177	4.57	4.89	79	7	0.005	0.028
Sweet Potato	631	252	4.24	5.89	61	40	0.007	0.023
Potato	200	200	23.57	34.42	NIL	46	0.118	0.172
Lady's finger	535	86	10.0	11.31	84	13	0.019	0.132
Onion	602	451	9.30	12.20	25	31	0.015	0.0277
Radish	464	108	1.05	1.19	77	13	0.002	0.011
Tomato	498	107	6.18	8.87	79	43	0.012	0.083
Chillies	1097	417	4.23	6.09	62	44	0.004	0.015
Ridge gourd	420	172	17.13	20.00	60	2	0.030	0.075
Cauliflower	389	255	8.33	11.59	34	39	0.021	0.045
Fruit Crops:								
Papaya	2285	734	13.0	23.00	68	77	0.006	0.031
Banana	1760	970	57.5	87.50	45	52	0.033	0.090

Crop's Name	Water consumption (mm/ha)		Yield (t/ha)		Water Saving over FIM (%)	Yield Increase over FIM (%)	Water Use Efficiency (yield/ha)/(mm/ha)	
Vegetables:	**FIM**	**DIM**	**FIM**	**DIM**			**FIM**	**DIM**
Grapes	532	278	26.4	32.50	48	23	0.050	0.117
Lemon	42	8	1.88	2.52	81	35	0.045	0.315
Watermelon	800	800	29.47	88.23	Nil	179	0.037	0.110
Mosambi*	166	640	100.	150.00	61	50	0.060	0.234
Pomegranate*	144	785	55.0	109.0	45	98	0.038	0.139
Other Crops:								
Sugarcane	215	940	128.0	170.0	65	33	0.060	0.181
Cotton	856	302	2.60	3.26	60	25	0.003	0.011
Coconut	---	---	---	--	60	12	---	---
Groundnut	500	300	1.71	2.84	40	66	0.003	0.009

- **<u>Proposed Micro irrigation techniques in Saoner Taluka:</u>**

Following table depicts the proposed demand side interventions in the area. The micro-irrigation techniques are proposed to be adopted in 7.57 Sq. Km area in entire block by saving a total of 1.89 MCM of Ground Water as given Table 10.2.

Table 10.2: Proposed Micro irrigation Techniques

Block	Proposed to be covered under Drip (sq.km.)		Volume of Water expected to be saved (MCM)	
	Citrus	Total	Citrus	Total
Saoner	7.57	7.57	1.89	1.89

10.3 Benefits of Management Plan for saoner Taluka

The impact of groundwater management plans on the groundwater system in the taluka after its implementation is evaluated and the outcome shows significant improvement in groundwater scenario in the block as given in the table 10.3.

Table 10.3: Management Plan for Saoner Taluka

Block	Annual Available Resource	Current Ground Water Extractions	Stage Of GW Development	Total volume of water expected to be recharged/ conserved by AR	Total GW resource available After Supply side Interventions	Stage of GWD after supply side interventions (%)	Ground water available TO ENHANCE STAGE OF GWD UPTO 70%	Volume of Water expected to be saved (MCM). After Demand Side Intervention	Total GW Extraction after Demand side intervention (MCM)	Stage of GWD after Supply side and demand side interventions	Balance GWR available for GW Development so that STAGE OF GWD is ENHANCED to 70% (MCM)	Additional area that can be brought under assured GW irrigation with av. CWR of 0.65 m
	(MCM)	(MCM)	(%)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(%)	(MCM)	(Sq.Km)
Saoner	**49.13**	**34.06**	**69.32**	**13.06**	**62.19**	**54.76**	**9.48**	**1.89**	**32.17**	**51.72**	**11.37**	**17.49**

11.0 CONCLUSION AND RECOMMENDATION

Under NAQUIM 2.0, study Saoner block of district Nagpur has been taken up, covering an area of 675.43 sq.km. The total population of the block is 2,29,450. Saoner block has been taken up as "Water stressed area" priority type in NAQUIM 2.0. The salient features and highlights of NAQUIM studies from the area are given below:

1. The Saoner block, predominantly composed of Archaean crystalline rocks, basaltic formations, exhibits various landforms including pediments, dissected plateaus, and isolated hilly patches. The normal annual rainfall of Saoner block is 1009 mm. Groundwater Extraction (SOGE) for the block stands at 70.06%, categorized as semi-critical according to the Groundwater Resource Assessment (GWRA-2022). However, in 2023, the groundwater resource underwent reassessment, revealing a SOGE to be 69.32%, also classified as "Safe".
2. The block is agriculturally dominated covering 67% area of the block. The agricultural distribution of crops does follow traditional pattern as cotton is the most important crop under the rain fed in the Saoner block, followed by Soybean, pigeon pea, green pea, black gram. Although some crops like gram, wheat and sunflower were grown in rabbi season. The Saoner taluka is famous for Oranges and Sweet lemons. The ground water-based irrigation caters to the major area i.e., 64.92 sq.km.
3. Major issues of groundwater identified in the Saoner block are Deeper water levels (> 20 m), long term declining trend in water levels, source sustainability of existing structures, reduced water retention capacity and drying out of irrigation dug wells near Mining area, reported land subsidence in Villages nearby Mining Area in Saoner Block and Groundwater Quality issues (Fluoride, Nitrate) in some isolated parts of the block.
4. To address the issues identified in the study, a total of 212 key observation wells (115 dug wells and 97 bore wells/handpumps) were established in May 2023. Apart from this CGWB Exploratory wells and Piezometer drilled data also used. To decipher aquifer geometry and hydraulic properties, 16 wells were drilled upto a depth range of 111.3 to 200 mbgl. The groundwater yield varies from Traces to 14.88 liters/second (l/s).
5. The GW quality data reveals that the entire area of the block shows EC values in the of 231 to 3718 µS/cm in both the aquifers in both the seasons (pre and post monsoon seasons).
6. In shallow aquifers, 46 and 43 samples are affected by Nitrate contamination in pre and post-monsoon seasons, whereas in Deeper Aquifer, 53 and 38 samples have been affected by Nitrate contamination in pre and post-monsoon seasons.
7. In shallow aquifers, 5 sample are affected in pre-monsoon and 1 sample is affected in post-monsoon by Fluoride contamination, whereas in Deeper Aquifer, 2 sample are affected in pre-monsoon and 1 sample is affected in post-monsoon by Fluoride contamination.
8. Besides this, 3 samples have Aluminium, 3 samples have Manganese and 3 samples have Iron more than their permissible limits. Thus, it can be concluded that the ground water quality in major part of the study area is less affected by trace elements.

9. Vertical Electrical Sounding (VES) was done at 66 locations of Saoner Block, to identify the aquifer disposition of the block and demarcation of potential sites.
10. Combining the insights from DEM, water table contours, post-monsoon water levels, and topographic contours, suitable area for artificial recharge were delineated. These zones are characterized by diverging groundwater flow directions, indicating the areas recharging the ground water and considerable post-monsoon depth to water level (greater than 5 meters), ensuring there is available space for additional recharge. Apart from this, a plan for drinking water source sustainability has also been prepared.
11. The proposed management plan aims to effectively manage groundwater resources and curb the ongoing decline in water levels. the management comprises of supply-side and demand-side management addressing the multifaceted challenges of curbing groundwater depletion. Supply-side measures propose construction of 6 percolation tanks, 200 check dams with recharge shafts, collectively projected to augment groundwater resources by 13.06 million cubic meters (MCM). On the other hand, demand-side management focuses on implementing micro-irrigation techniques across a total area of 757 ha within the entire block. This initiative is projected to save substantial 1.89 MCM of water, contributing significantly to sustainable water usage practices.

Recommendation:

- In the runoff zone, it is proposed to implement soil and water conservation measures in forested and barren lands through afforestation and the construction of effective structures such as Continuous Contour Trenches (CCT), deep CCTs, and trenches. These measures will significantly enhance soil retention and water conservation in these areas.
- In all cultivable areas, implement soil and water conservation techniques such as farm ponds, contour trenches, contour bunds, and graded bunds. These methods will ensure maximum rainwater harvesting and percolation, thereby enhancing groundwater recharge.
- Intercropping cultivation excess available water can be used effectively to produce greater yield per unit area of the land.
- Periodical maintenance of artificial recharge structures /Farm ponds should made mandatorily so that effective GW recharge can be done.
- For the KT weir, it is recommended to install a concrete slab with a minimum height of 1 meter. On top of this slab, place iron slabs or gates to create prolonged dead storage. Additionally, use rubber beading between the iron slabs to prevent leaks.

ANNEXURES

Annexure I: Details of CGWB Exploration wells in Saoner Block, Nagpur district

S.No.	Taluka	Village	Longitude	Latitude	Altitude (m)	Year	Type	Aquifer	Geology	Drilling depth	Casing (m)	Aquifer Zones (m)	Drilling SWL (m bgl)	Drawdown (m)	Discharge (lps)	T (m2/day)	S
1	Savner	Saoner	78.9167	21.3875	326.1	1999-00	PZ	Sandstone	Gondwana	43	30	25 -30	11.9		0.78		
2	Savner	Khapa	78.9833	21.425	301.3	1989-90	EW			183	35.5	35 -48	6.27		3.77		
3	Savner	Sawangi	78.8833	21.3792	338	1989-90	EW	Sandstone	Gondwana	109.8	44.6	44 -61, 82 -104	17.42		5.15		
4	Savner	Kannyadoh	78.86667	20.33333		1989-90	EW	Sandstone	Gondwana	100.6		42-46,48-54, 59-60, 61-64, 71-73, 80-81.5, 93-94, 96-98	15.95	17.14	0.4	0.67	
5	Savner	Nangalwadi	79.07333	21.54028		1994-95	EW	Gneiss	Archean Gneisses	201.55	26.5		3.64		1.37		
6	Savner	Pipla	79.06944	21.30556		1993-94	EW	Sandstone	Gondwana	297.5		106-132, 148-160, 192-206	8.1	21.11	4	14.1	$5.6*10^{-4}$
7	Savner	Pota	79.1028	21.2778	293.9	2002-03	EW	Sandstone	Gondwana	135.15	130	80 -86, 100 -128	5.94		8.85		
8	Savner	Bhanegaon	79.1389	21.2675	288.6	2004-05	EW	Sandstone	Gondwana	200.34	196	98 -116, 121 -126, 138 -143, 131.5 -133.5, 152 -164, 170 -173, 179 -185, 191.5 -194.5	12.95	18.27	6.21		
9	Savner	Bhanegaon	79.1389	21.2675	288.6	2004-05	OW	Sandstone	Gondwana	201.64	196	104 -110, 122 -125, 182 -185, 155 -161, 191 -194	-		-	59.64	
10	Savner	Patansawangi	79.0247	21.3211	295.1	2004-05	EW	Sandstone	Gondwana	100.15	90	47 -50, 56 -71	6.98		3.25		
11	Savner	Patansawangi	79.0247	21.3211	295.1	2004-05	OW	Sandstone	Gondwana	196.38	170	109 -115,125 -128, 144150,136 -139, 164 -168	-		-		
12	Savner	Patansawangi	79.0247	21.3211	295.1	2004-05	OW	Sandstone	Gondwana	90.15	90	47 -50,58 -70	6		1.5		
13	Savner	Isapur	79.075	21.3342	300.9	2005-06	Pz	Sandstone	Gondwana	72.5	35	12.00-33.00		0.2	4.25		
14	Savner	Silewara (B1OW3)	79.1167	21.2917	285	1980-81	OW	Sandstone	Gondwana	117.5	65	5.5 -21.32, 28.35 -54.2	15.95		-		
15	Savner	Silewara (B1M)	79.1167	21.2917	285	1980-81	OW	Sandstone	Gondwana	123	58	32.92 -50.6, 54.86 -88.09	17.56		8	85	0.0003
16	Savner	Silewara (B1OW1)	79.1167	21.2917	285	1980-81	OW	Sandstone	Gondwana	133	75	20.23 -26.56, 34.14 -38.4, 47.24 -68.58, 41.45 -42.67, 72.85 -109.73, 114.6 -131.98	16.94		-		

S.No.	Taluka	Village	Longitude	Latitude	Altitude (m)	Year	Type	Aquifer	Geology	Drilling depth	Casing (m)	Aquifer Zones (m)	Drilling SWL (m bgl)	Drawdown (m)	Discharge (lps)	T (m2/day)	S
17	Savner	Silewara (B1OW2)	79.1167	21.2917	285	1980-81	OW	Sandstone	Gondwana	157	70	32 -35.97, 52.73 -57.91, 67.06 -89.3, 61.26 -62.79, 93.27 -134.42, 137.16 -155.45	16.04		-		
18	Savner	Silewara (B1OW4)	79.1167	21.2917	285	1980-81	OW	Sandstone	Gondwana	119.1	68	11.05 -34.36, 47.72 -58, 64.93 -118.9, 64.93 -118.9	18.54		-		
19	Savner	Silewara (B2MW)	79.1167	21.2917	285		OW	Sandstone	Gondwana	148.21	117	5.25 -7.35, 10.5 -44.75, 112.1 -132.27, 47.75 -109.76, 135.27 -176.21	19.55		2.5		
20	Savner	Silewara (B2OW)	79.1167	21.2917	285		OW	Sandstone	Gondwana	152.55	125	7.9 -11.05, 14.05 -29.05, 53.05 -113.05, 32.05 -53.05, 119.05 -152.05	19.06		-		
21	Savner	Silewara (BHE I)	79.1167	21.2917	285		OW	Sandstone	Gondwana	307	-	21.85 -31, 34.14 -39.62, 62.79 -64.01, 53.34 -60.05, 68.88 -90.22, 93.88 -137.16, 139.6 -162.76, 165.11 -187.15, 188.87 -199.34, 220.37 -250.55, 275.84 -286.27, 287.73 -296.57	-		-		
22	Savner	Silewara (BHE II)	79.1167	21.2917	285		OW	Sandstone	Gondwana	303	-	30.78 -35.66, 40 -64, 114 -132.89, 69.49 -110.94, 138.38 -157.28, 160.63 -170.99, 187.45 -224.33, 232.87 -238.44	-		-		
23	Savner	Silewara (BHE III)	79.1167	21.2917	285		OW	Sandstone	Gondwana	302	-	21.64 -24.08, 32.94 -49.68, 67.06 -85.66, 52.73 -64.31, 90.53 -110.03, 115.52 -135.03, 137.16 -140.22, 167.34 -235, 243.84 -255.12, 256.34 -260.43, 273.13 -142.93	-		-		
24	Savner	Silewara (WTM)	79.1167	21.2917	285	1980-81	EW	Sandstone	Gondwana	67.11	38	19.21 -21.95, 35.66 -56.08	15.4		6	250	0.000058
25	Savner	Silewara (WTOW 2)	79.1167	21.2917	285	1980-81	OW	Sandstone	Gondwana	50.2	34	7.01 -49.38	16.81		-		
26	Savner	Silewara (WTOW)	79.1167	21.2917	285	1980-81	OW	Sandstone	Gondwana	53.32	37	14.8 -52.73	15.81		-		
27	Savner	Nandagomukh	78.77111	21.4225		2019-20	EW	FMB	Deccan Basalt	200	24	150.70-153.80	48.5		0.14		
28	Savner	Kelwad	78.8675	21.4625		2019-20	EW	FMB	Deccan Basalt	200	18	50-53	18		0.78		

S.No.	Taluka	Village	Longitude	Latitude	Altitude (m)	Year	Type	Aquifer	Geology	Drilling depth	Casing (m)	Aquifer Zones (m)	Drilling SWL (m bgl)	Drawdown (m)	Discharge (lps)	T (m2/day)	S
29	Saoner	Hattisarra	21.46028	78.91406		2023-24	Pz	Gneisses	Archean Gneisses	120	18	13.70-16.70 &74.70-77.70	1.1	41.8	0.38	0.16	
30	Saoner	khapa Narsala	21.42463	78.83341		2023-24	pz	Basalt	Deccan Basalt	120	19	10.60-13.70 &83.80-86.90	6.7		3.17	2.24	
31	Savner	Chhatrapur	21.4439	78.77546		2023-24	Pz	Basalt	Deccan Basalt	123.5	18	13.70-16.70, 41.10-44.20, 89.90-93.00	14.40	29.8	2.16	88.19	
32	Savner	Jatamkhora	21.47519	78.81023		2023-24	EW	Basalt	Deccan Basalt	154	18.5	13.70-16.70, 65.52-68.6, 89.90-93	9.15	36	3.17	32.126	0.000309
33	Savner	Jatamkhora	21.47519	78.81023		2023-24	OW	Basalt	Deccan Basalt	150.9	18	16.7-19.8, 35-38.1	10.5		2.16		
34	Savner	Angewada	21.36504	78.94846		2023-24	Pz	Sandstone	Gondwana		104.5	25-31, 67-75 and 100-104	6.32		2.16	1.15	
35	Savner	Sarra	21.57142	79.00325		2023-24	Pz	Gneisses	Archean Gneisses	120	18	15-18, 80.60-83.60	3.4	27.77	14.88	43.87	
36	Savner	Kothulna	21.41987	79.03702		2023-24	EW	Gneisses	Archean Gneisses	200	30	16.70-19.80, 102.1-105.20	3	47.73	5.94	30.20	0.00000041
37	Savner	Kothulna	21.41988	79.037		2023-24	OW	Gneisses	Archean Gneisses	120.4	30	16.70-19.80, 108.2-111.30 & 117.40-120.40	3.07		2.16		
38	Savner	Khubala	21.46825	78.99309	360	2023-24	EW	Gneisses	Archean Gneisses	200	17.5	13.20-16.20 &93-96	2.1		0.38	0.16	
39	Savner	Khubala	21.46825	78.99309	360	2023-24	OW	Gneisses	Archean Gneisses	111.3	17.5	13.20-16.20 &93-96	3		0.14		
40	Savner	Badegaon	21.48448	78.97337	360	2023-24	EW	Gneisses	Archean Gneisses	200	24	30-33 &182-184	8.67	38.53	0.38	0.17	
41	Savner	Dudhabardi	21.42515	78.93866	323	2023-24	EW	Gneisses	Archean Gneisses	200	28	37.90-40.90 & 98.90-101.90	16.69		0.38	0.23	
42	Savner	Umri	21.42014	78.81331		2024-25	EW	Basalt	Deccan Basalt	141.8		7.60-10.60 & 41.10-44.20, 77.70-8.80	8.45			65.2563	0.000049
43	Savner	Umri	21.42014	78.81331		2024-25	OW	Basalt	Deccan Basalt			7.60-10.60 & 41.10-44.20, 77.70-80.80	9.93	42.82	3.17	67.73	0.001123
44	Savner	Raiwadi	21.53199	78.94229		2024-25	PZ	Gneisses	Archean Gneisses	120		95.80-98.90	14.7	31.08	4.43	6.44	

Annexure II: Aquifer-I, Water level Data of monitoring wells in Saoner Block, Nagpur district

Sr No.	Block	Village	Latitude	Longitude	Agency	Type of Well	Water Level May 2023 (mbgl)	Water Level Nov. 2023 (mbgl)
1	Saoner	Sawngi	21.37665	78.87833	KOW	DW	6.25	5.02
2	Saoner	Dudhabardi	21.37399	78.89277	KOW	DW	9.1	7.7
3	Saoner	Heti Surla	21.38898	78.89237	KOW	DW	11.3	8.9
4	Saoner	Heti (Nandaji)	21.3981	78.87215	KOW	DW	6	4.4
5	Saoner	Bhagi mari	21.40831	78.85613	KOW	DW	1.2	1.1
6	Saoner	Telankhedi	21.3922	78.82613	KOW	DW	5	2.8
7	Saoner	Saoner	21.39311	78.93434	KOW	DW	4.7	4.4
8	Saoner	Ajani	21.4014	78.93503	KOW	DW	8.1	7.4
9	Saoner	Sherdi	21.411	78.93908	KOW	DW	9.1	6.5
10	Saoner	Dudhabardi-2	21.42458	78.9403	KOW	DW	15.5	14.5
11	Saoner	Gadegaon	21.43457	78.94526	KOW	DW	13.7	12.8
12	Saoner	Karjhat	21.43708	78.96288	KOW	DW	20.3	19.8
13	Saoner	Nandapur	21.44413	78.9589	KOW	DW	16.1	17.4
14	Saoner	Khangaon	21.43285	78.92653	KOW	DW	8	4.5
15	Saoner	Parsodi	21.43134	78.90496	KOW	DW	8.4	5.4
16	Saoner	Khurajgaon	21.4196	78.90753	KOW	DW	14.4	13.25
17	Saoner	Mangse	21.41773	78.88082	KOW	DW	8.2	4.3
18	Saoner	Bhojapur	21.47044	78.85333	KOW	DW	7.7	4.6
19	Saoner	Narasala	21.43051	78.85104	KOW	DW	12.3	6.7
20	Saoner	Rampur	21.44188	78.85871	KOW	DW	4.3	2.7
21	Saoner	Jalalkheda	21.44371	78.83734	KOW	DW	8.8	2.3
22	Saoner	Pandheri	21.43502	78.83659	KOW	DW	6.95	4.7

Sr No.	Block	Village	Latitude	Longitude	Agency	Type of Well	Water Level May 2023 (mbgl)	Water Level Nov. 2023 (mbgl)
23	Saoner	Khapa (N)	21.43497	78.83658	KOW	DW	7.9	6.3
24	Saoner	Umari (B)	21.42283	78.80953	KOW	DW	5.5	5.4
25	Saoner	Nanda Gomukh	21.42173	78.77019	KOW	DW	7.9	7.8
26	Saoner	Agra	21.42948	78.72147	KOW	DW	14.3	9.1
27	Saoner	Malegaon	21.43021	78.72476	KOW	DW	7.5	6.4
28	Saoner	Saoner	21.39199	78.91069	KOW	DW	8.5	7.6
29	Saoner	Chatrapur	21.45144	78.77704	KOW	DW	3.9	3.5
30	Saoner	Jaitpur	21.45118	78.76617	KOW	DW	8.5	7.9
31	Saoner	Joga	21.45097	78.74749	KOW	DW	7.9	2.9
32	Saoner	Pardi	21.40245	78.90599	KOW	DW	7.9	6.1
33	Saoner	Saoner	21.38152	78.93389	KOW	DW	5.1	3.5
34	Saoner	Hatisarra	21.4552	78.9137	KOW	DW	13.1	4
35	Saoner	Asthi Bk.	21.45385	78.90157	KOW	DW	12	5.2
36	Saoner	Kelwad	21.45906	78.88643	KOW	DW	8.25	14.6
37	Saoner	Khairi	21.46601	78.93575	KOW	DW	13.8	14
38	Saoner	Kautha	21.47441	78.90587	KOW	DW	4.3	6.9
39	Saoner	Jaitgad	21.46934	78.87498	KOW	DW	7.8	4.8
40	Saoner	Bid Jatamkhera	21.47678	78.82937	KOW	DW	9.3	2.8
41	Saoner	Jatamkhera	21.47501	78.81037	KOW	DW	11.1	9.1
42	Saoner	Sawali	21.47939	78.79231	KOW	DW	3	1.2

Sr No.	Block	Village	Latitude	Longitude	Agency	Type of Well	Water Level May 2023 (mbgl)	Water Level Nov. 2023 (mbgl)
43	Saoner	Khursapar	21.48051	78.76336	KOW	DW	8.4	7.7
44	Saoner	Kharduka	21.49059	78.94639	KOW	DW	18.5	18.3
45	Saoner	Temburdoh	21.50178	78.95973	KOW	DW	14	14
46	Saoner	Raiwadi	21.5272	78.93984	KOW	DW	12	11.5
47	Saoner	Bichwa	21.56365	78.95386	KOW	DW	4.7	3.5
48	Saoner	Nagalwadi	21.57344	79.01801	KOW	DW	8.8	6.6
49	Saoner	Bhondetal	21.56805	79.00442	KOW	DW	1.4	1
50	Saoner	Tekadi	21.57784	78.94706	KOW	DW	5.3	4
51	Saoner	Sindevani Bk.	21.58661	78.92542	KOW	DW	5.2	4.5
52	Saoner	Sindevani Kh.	21.57929	78.9214	KOW	DW	7	6.5
53	Saoner	Warpani	21.57506	78.97051	KOW	DW	7.4	5
54	Saoner	Karmeta	21.56515	78.97182	KOW	DW	7.8	6.6
55	Saoner	Charkhairi	21.53422	78.96629	KOW	DW	9.6	7.4
56	Saoner	Surewani	21.55074	78.99553	KOW	DW	13.5	6.9
57	Saoner	Sironji	21.5559	78.9785	KOW	DW	12.3	9
58	Saoner	Sonpur	21.54492	78.97585	KOW	DW	6.5	5.4
59	Saoner	Maharkund	21.52146	78.98941	KOW	DW	5.3	2.2
60	Saoner	Sarra	21.57362	79.00484	KOW	DW	5.4	4.6
61	Saoner	Forest	21.57337	78.97546	KOW	DW	4.4	3

Sr No.	Block	Village	Latitude	Longitude	Agency	Type of Well	Water Level May 2023 (mbgl)	Water Level Nov. 2023 (mbgl)
62	Saoner	Chargaon	21.4906	78.96946	KOW	DW	6.1	2.15
63	Saoner	Raibasa	21.46937	78.84227	KOW	DW	6	3.2
64	Saoner	Asthi Kh.	21.46575	78.90281	KOW	DW	4.2	2.2
65	Saoner	Nandori	21.45276	78.92515	KOW	DW	8.9	4.3
66	Saoner	Pipla	21.48484	78.95878	KOW	DW	11.3	8
67	Saoner	Kodegaon	21.41611	78.96778	KOW	DW	8.9	8.38
68	Saoner	Khedi	21.41556	78.95389	KOW	DW	9	7.8
69	Saoner	Tighai	21.40056	78.97417	KOW	DW	6.85	6.2
70	Saoner	Wakodi	21.38056	79.00139	KOW	DW	15.1	15.3
71	Saoner	Dahegaon (Rangari)	21.29389	79.08083	KOW	DW	10.1	9.2
72	Saoner	Banegaon	21.26444	79.12528	KOW	DW	14.18	15.5
73	Saoner	Kaparkheda	21.27778	79.10806	KOW	DW	10	8.4
74	Saoner	Rohana	21.30417	79.09972	KOW	DW	16.6	17.2
75	Saoner	Pipla	21.30444	79.06889	KOW	DW	10.55	9.4
76	Saoner	Kodadongri	21.34444	79.03111	KOW	DW	12.9	12.5
77	Saoner	Waki darbar	21.36667	79.04083	KOW	DW	7.2	8.3
78	Saoner	Dohanghat	21.39778	79.02611	KOW	DW	18.9	18.8
79	Saoner	Bhendala	21.36111	79.01056	KOW	DW	12	11.45
80	Saoner	Patansavangi	21.34056	79.01389	KOW	DW	11.15	10.2
81	Saoner	Kusumbi	21.34056	78.9925	KOW	DW	5.8	5.06
82	Saoner	Takli	21.35306	78.99056	KOW	DW	12.48	15.2
83	Saoner	Kawadas	21.31611	79.04806	KOW	DW	18.3	15.1

Sr No.	Block	Village	Latitude	Longitude	Agency	Type of Well	Water Level May 2023 (mbgl)	Water Level Nov. 2023 (mbgl)
84	Saoner	Isapur	21.33	79.07222	KOW	DW	18.6	18.5
85	Saoner	Yeltur	21.34111	79.05222	KOW	DW	10.2	9.7
86	Saoner	Pardi	21.35083	79.06139	KOW	DW	8.2	17.05
87	Saoner	Itangoti	21.31722	79.005	KOW	DW	6.2	5.1
88	Saoner	Sillori	21.31306	78.97028	KOW	DW	8.5	5.8
89	Saoner	Brahapuri	21.31306	78.96194	KOW	DW	8.55	6.5
90	Saoner	Sonapur	21.32861	78.95389	KOW	DW	11.5	10
91	Saoner	Erangaon	21.32861	78.97028	KOW	DW	14.9	14.7
92	Saoner	Katodi	21.33694	78.96278	KOW	DW	5.2	19.9
93	Saoner	Patakakhedi	21.35861	78.95222	KOW	DW	9.8	9.6
94	Saoner	Gujarkhedi	21.37556	78.94361	KOW	DW	11.1	8.8
95	Saoner	Malegaon	21.36278	78.96028	KOW	DW	17.2	19.36
96	Saoner	Manegaon	21.36	78.97833	KOW	DW	15.4	12.5
97	Saoner	Gumgaon	21.39625	78.98993	KOW	DW	5.6	6.7
98	Saoner	Khapa	21.42103	78.98423	KOW	DW	17.1	16.3
99	Saoner	Bawangaon	21.43994	78.97577	KOW	DW	16.3	16.2
100	Saoner	Kochi	21.45845	78.96544	KOW	DW	14.1	14.4
101	Saoner	Badegaon	21.48316	78.96561	KOW	DW	9.8	6.1
102	Saoner	Hingna	21.47073	78.9789	KOW	DW	4.7	3.3
103	Saoner	Risala	21.47649	78.99228	KOW	DW	12.5	4.4
104	Saoner	Khubala	21.46017	78.98725	KOW	DW	13.45	14.6
105	Saoner	Umri Jambhalpani	21.4383	79.0012	KOW	DW	8.5	8.5

Sr No.	Block	Village	Latitude	Longitude	Agency	Type of Well	Water Level May 2023 (mbgl)	Water Level Nov. 2023 (mbgl)
106	Saoner	Khairi Punjabrao	21.42174	79.00668	KOW	DW	12.8	7.2
107	Saoner	Dhakara	21.43111	79.0229	KOW	DW	7.7	3.9
108	Saoner	Ramdongari	21.39851	79.00721	KOW	DW	18.5	14.5
109	Saoner	New Khapa	21.40992	78.98602	KOW	DW	18.2	9.7
110	Saoner	Kothulana	21.4182	79.03504	KOW	DW	10.25	2.1
111	Saoner	Nimtalai	21.42373	79.03657	KOW	DW	9.25	3.3
112	Saoner	Gadami	21.43969	79.04357	KOW	DW	10.25	13.35
113	Saoner	Pendhari	21.45531	79.04854	KOW	DW	8.5	14.8
114	Saoner	Hatikheda	21.44932	79.06167	KOW	DW	8.35	11.35
115	Saoner	Mohgaon	21.44905	79.02345	KOW	DW	9.75	10.6

Annexure III: Aquifer-II, Water level Data of monitoring wells in Saoner Block, Nagpur district

Sr No.	Tehsil	Village	Source	Agency	Latitude	Longitude	Water Level May 2023 (mbgl)	Water Level Nov. 2023 (mbgl)
1	Saoner	Bhagi mari	BW	KOW	21.40831	78.85613	1.6	1.1
2	Saoner	Kothulana	HP	KOW	21.41865	79.0363	9	2
3	Saoner	Tekadi	HP	KOW	21.57827	78.94801	6.3	2.2
4	Saoner	Maharkund	HP	KOW	21.52407	78.98485	6.7	2.2
5	Saoner	Mangse	HP	KOW	21.42082	78.88243	6	2.6
6	Saoner	Bid Jatamkhera	BW	KOW	21.47336	78.83277	7.36	2.7
7	Saoner	Bichwa	HP	KOW	21.5641	78.95517	7.1	2.7
8	Saoner	Sindevani Kh.	HP	KOW	21.57899	78.92239	5.9	2.9
9	Saoner	Bhondetal	HP	KOW	21.56876	79.00451	4.1	3
10	Saoner	Sarra	HP	KOW	21.57327	79.00514	11.3	3
11	Saoner	Chargaon	BW	KOW	21.49243	78.96794	8.7	3.25
12	Saoner	Khubala	HP	KOW	21.46593	78.99589	9	3.3
13	Saoner	Pendhari	HP	KOW	21.45466	79.04853	5	3.4
14	Saoner	Dhakara	HP	KOW	21.43064	79.02307	6	3.5
15	Saoner	Nimtalai	HP	KOW	21.42619	79.03725	30	3.8
16	Saoner	Kelwad	BW	KOW	21.46164	78.87978	12.8	4
17	Saoner	Kautha	HP	KOW	21.47493	78.90403	6.8	4.2
18	Saoner	Warpani	HP	KOW	21.5751	78.97154	8	4.3
19	Saoner	Karmeta	BW	KOW	21.54915	78.9746	6.9	4.6
20	Saoner	Sonpur	BW	KOW	21.53255	78.98098	10.1	5
21	Saoner	Umari (B)	BW	KOW	21.4196	78.81333	5.57	5.47
22	Saoner	Dahegaon (Rangari)	BW	KOW	21.28806	79.09056	6.15	5.5
23	Saoner	Narasala	HP	KOW	21.42811	78.85029	9	5.98
24	Saoner	Khapa (N)	HP	KOW	21.42439	78.8348	4	5.98
25	Saoner	Hatisarra	BW	KOW	21.46058	78.9138	12.6	6.1
26	Saoner	Sawngi	HP	KOW	21.37665	78.87833	6	6.22
27	Saoner	Sherdi	HP	KOW	21.41108	78.94054	5	6.35
28	Saoner	Raibasa	HP	KOW	21.46871	78.84381	9.8	6.58

Sr No.	Tehsil	Village	Source	Agency	Latitude	Longitude	Water Level May 2023 (mbgl)	Water Level Nov. 2023 (mbgl)
29	Saoner	Surewani	HP	KOW	21.54864	78.99673	12.1	6.6
30	Saoner	Nandori	HP	KOW	21.44907	78.92281	12.8	6.85
31	Saoner	Asthi Bk.	HP	KOW	21.45634	78.89793	10.1	6.9
32	Saoner	Borujwada	BW	KOW	21.37139	78.95	9.98	7.3
33	Saoner	Nagalwadi	HP	KOW	21.57333	79.01794	8	7.3
34	Saoner	Banegaon	BW	KOW	21.26472	79.13222	12.34	7.43
35	Saoner	Pandheri	HP	KOW	21.43518	78.8362	5	7.7
36	Saoner	Sironji	HP	KOW	21.55595	78.97876	11.8	8
37	Saoner	Saoner	BW	KOW	21.38806	78.91907	9.1	8.02
38	Saoner	Telankhedi	HP	KOW	21.39289	78.8254	2.8	8.1
39	Saoner	Kaparkheda	BW	KOW	21.27778	79.10806	9.24	8.2
40	Saoner	Jatamkhera	HP	KOW	21.47573	78.8116	9.9	8.2
41	Saoner	Umri Jambhalpani	HP	KOW	21.43933	78.99986	25	8.5
42	Saoner	Charkhairi	BW	KOW	21.53385	78.96667	8.8	8.7
43	Saoner	Khangaon	BW	KOW	21.42772	78.92304	7.35	8.9
44	Saoner	Khurajgaon	HP	KOW	21.41703	78.90663	10.5	9.1
45	Saoner	Patakakhedi	BW	KOW	21.35639	78.95222	9.33	9.22
46	Saoner	Yeltur	BW	KOW	21.33944	79.05111	9.48	9.4
47	Saoner	Dudhabardi	BW	KOW	21.37362	78.89261	15.9	9.8
48	Saoner	Khursapar	BW	KOW	21.47314	78.75893	9.9	9.8
49	Saoner	Rampur	HP	KOW	21.44273	78.86293	5	9.95
50	Saoner	Khairi Punjabrao	HP	KOW	21.42244	79.00669	15	10
51	Saoner	Salai	BW	KOW	21.422	78.78489	8.91	10.1
52	Saoner	Gosewadi	BW	KOW	21.36083	79.06917	11.2	10.72
53	Saoner	Forest	BW	KOW	21.57311	78.97505	8.1	11
54	Saoner	Gumgaon	HP	KOW	21.39785	78.99064	13	12.6
55	Saoner	Joga	BW	KOW	21.44779	78.74397	14.17	12.7
56	Saoner	Heti (Nandaji)	HP	KOW	21.39815	78.87608	9.1	12.95
57	Saoner	Khairi	BW	KOW	21.45892	78.92907	11.3	13
58	Saoner	Raiwadi	HP	KOW	21.52427	78.93714	8	13.46

Sr No.	Tehsil	Village	Source	Agency	Latitude	Longitude	Water Level May 2023 (mbgl)	Water Level Nov. 2023 (mbgl)
59	Saoner	Gadegaon	HP	KOW	21.43461	78.94523	14	13.91
60	Saoner	Brahapuri	BW	KOW	21.31306	78.96194	7.53	14.6
61	Saoner	Chatrapur	BW	KOW	21.44448	78.77534	16.2	14.7
62	Saoner	Jalalkheda	BW	KOW	21.44393	78.83757	16.5	14.9
63	Saoner	Bawangaon	HP	KOW	21.43941	78.97707	15	14.9
64	Saoner	Dudhabardi-2	HP	KOW	21.42553	78.93894	8	15.05
65	Saoner	Ajani	BW	KOW	21.4081	78.9354	8	15.1
66	Saoner	Parsodi	BW	KOW	21.43956	78.90434	9.23	15.1
67	Saoner	Malegaon	BW	KOW	21.36092	78.96395	14.5	16.1
68	Saoner	Nandapur	HP	KOW	21.44279	78.95917	5	17.4
69	Saoner	Nanda Gomukh	BW	KOW	21.42159	78.77006	16.6	17.5
70	Saoner	Khapa	HP	KOW	21.42305	78.98018	14	17.7
71	Saoner	Bhojapur	BW	KOW	21.42167	78.86939	16.3	18.01
72	Saoner	Rohana	BW	KOW	21.30444	79.10306	21.57	18.2
73	Saoner	Kharduka	HP	KOW	21.49052	78.94155	13	19.1
74	Saoner	Jaitpur	BW	KOW	21.44434	78.76382	21.3	19.8
75	Saoner	Karjhat	HP	KOW	21.43708	78.9621	5	20.12
76	Saoner	Sawali	BW	KOW	21.4767	78.7946	8	49.54
77	Saoner	Saoner	BW	KOW	21.37694	78.91547	20	16
78	Saoner	Ramdongari	HP	KOW	21.39918	79.0074	9	5.5
79	Saoner	Hatikheda	HP	KOW	21.44935	79.06134	12	9
80	Saoner	Kochi	BW	KOW	21.45529	78.95673	12	10
81	Saoner	Badegaon Chargaon	BW	KOW	21.49143	78.96812	21	16
82	Saoner	Risala	BW	KOW	21.47716	78.99566	4.4	4
83	Saoner	Gadami	BW	KOW	21.42894	79.03573	9	7
84	Saoner	Wakodi	HP	KOW	21.38944	79.00278	12.68	12.95
85	Saoner	Chandkapur	HP	KOW	21.28833	79.10056	9.89	8.1
86	Saoner	Pota & Sillewada	HP	KOW	21.29944	79.125	20.71	19.45
87	Saoner	Walni	HP	KOW	21.31111	79.09306	16.68	14.9
88	Saoner	Waki	HP	KOW	21.36361	79.03944	11.21	9.5

Sr No.	Tehsil	Village	Source	Agency	Latitude	Longitude	Water Level May 2023 (mbgl)	Water Level Nov. 2023 (mbgl)
89	Saoner	Dohanghat	HP	KOW	21.39806	79.02583	18.8	17.9
90	Saoner	Kusumbi	HP	KOW	21.33917	78.99361	8.4	7.91
91	Saoner	Takli	HP	KOW	21.35194	78.98917	10.21	9.25
92	Saoner	Kawadas	HP	KOW	21.31722	79.04778	21.37	20.6
93	Saoner	Itangoti	HP	KOW	21.31806	79.00444	5	6.4
94	Saoner	Sillori	HP	KOW	21.31167	78.97028	4.24	6.75
95	Saoner	Gujarkhedi	HP	KOW	21.37611	78.94389	8.4	6.93
96	Saoner	Malegaon	HP	KOW	21.36083	78.96361	13.18	13.75
97	Saoner	Manegaon	HP	KOW	21.35889	78.97972	12.69	12.1

Annexure IV: Ground Water Quality data of Shallow Aquifer of Saoner block, Nagpur district (Pre-Monsoon)

Sl.No	LOCATION	Latitude (N)	Longitude (E)	Source (DW/BW/DCB/TW/River/Lake etc)	Temp °C	Date of collection	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	U	SAR	RSC
								µS/cm		……mg/L……											(ppb)		
1	GUMGAON	21.396253	78.98993	DW	**33**	09.06.2023	7.66	948	607	330	62	43	58	3	0	366	50	49.02	7.239	0.59	NA	1.40	-0.60
2	KHAPA	21.421027	78.98451	DW	**31.3**	09.06.2023	7.74	1371	877	440	130	28	101	1	0	555	78	61.668	82.186	0.59	NA	2.09	0.30
3	BAWANGAON	21.439941	78.97577	DW	**31.3**	09.06.2023	7.55	1042	667	390	90	40	55	2	0	482	35	19.4435	44.698	0.97	NA	1.22	0.10
4	KOCHI	21.458451	78.965444	DW	**31.5**	09.06.2023	7.73	1054	675	415	62	63	39	1	0	458	25	40.257	44.334	0.83	NA	0.83	-0.80
5	BADEGAON	21.483161	78.965612	DW	**32.5**	09.06.2023	7.85	947	606	340	66	43	49	8	0	427	35	24.735	28.984	0.94	NA	1.15	0.20
6	HINGNA	21.470727	78.978895	DW	29.7	09.06.2023	7.71	956	612	355	40	62	34	12	0	427	32	25.2151	16.227	0.93	NA	0.78	0.80
7	RISALA	21.476983	78.99549	DW	**30.8**	10.06.2023	7.72	994	636	305	70	32	61	3	0	421	32	42.314	39.462	1.21	NA	1.52	0.80
8	KHUBALA	21.460151	78.987226	DW	**32.4**	10.06.2023	7.71	862	552	340	70	40	31	1	0	421	21	15.8131	24.579	0.94	NA	0.72	0.80
9	UMRI JAMBHALPANI	21.438297	79.001195	DW	**30.7**	10.06.2023	8.22	870	557	325	58	44	46	2	0	415	25	24.998	44.257	0.93	NA	1.10	2.50
10	KHAIRI PUNJABRAO	21.421744	79.006678	DW	**31.3**	10.06.2023	7.62	1648	1055	390	92	39	190	10	0	860	121	4.1248	6.969	1.26	NA	4.19	1.40
11	DHAKRA	21.43111	79.020898	DW	**33.2**	10.06.2023	7.72	982	628	390	70	52	36	2	0	427	50	32.5605	44.641	1.03	NA	0.80	-1.00
12	RAMDONGARI	21.39851	79.00721	DW	**34.6**	10.06.2023	7.73	880	563	340	74	38	40	3	0	354	32	43.6787	60.394	0.55	NA	0.95	1.20
13	NEW KHAPA	21.409918	78.986019	DW	**30.1**	10.06.2023	7.7	1154	739	350	54	52	83	3	0	488	60	43.247	40.435	0.59	NA	1.92	2.00
14	KOTHULANA	21.418198	79.03504	DW	**30.9**	12.06.2023	7.66	2017	1291	515	112	57	115	113	0	549	199	114.2	134.214	0.95	NA	2.20	-3.30
15	NIMTALAI	21.423725	79.036566	DW	**30.6**	12.06.2023	7.71	1480	947	360	120	15	91	96	0	482	131	52.1995	116.828	0.59	NA	2.08	1.10
16	GADAMI	21.439687	79.043572	DW	**34.4**	12.06.2023	7.84	1595	1021	605	34	126	85	4	0	506	142	62.726	129.328	1.13	NA	1.50	-4.80
17	PENDHARI	21.455311	79.048544	DW	**32.6**	12.06.2023	7.8	1052	673	375	58	56	61	3	0	445	57	38.6096	72.538	1.23	NA	1.37	-0.20
18	HATIKHEDA	21.44932	79.061673	DW	**31.6**	12.06.2023	7.77	1206	772	425	134	22	67	2	0	403	110	65.536	79.906	0.91	NA	1.40	-1.90
19	MOHGAON	21.449049	79.023451	DW	29.4	12.06.2023	7.47	966	618	335	56	47	65	4	0	445	67	24.569	31.51	0.93	NA	1.54	0.60
20	Hatisarra	21.4552	78.913695	DW	28.2	5/4/2023	7.74	799.5	512	225	48	26	73	3	0	348	53	44	15	0.95	3.23	2.10	1.20
21	Asthi Bk.	21.453852	78.901571	DW	29.5	5/4/2023	7.71	892.3	571	190	40	22	102	6	0	384	46	12	66	1.62	6.24	3.22	2.50
22	Kelwad	21.459056	78.886426	DW	28.3	5/4/2023	7.9	1047	670	150	30	18	168	3	0	482	35	76	46	1.92	7.43	5.97	4.90
23	Khairi	21.466009	78.935747	DW	29.9	5/4/2023	7.76	1494	956	290	42	45	185	2	0	561	121	65	77	1.11	5.09	4.71	3.40

Sl.No	LOCATION	Latitude (N)	Longitude (E)	Source (DW/BW/DCB/TW/River/Lake etc)	Temp °C	Date of collection	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	U	SAR	RSC
								µS/cm		……..mg/L……											(ppb)		
24	Kautha	21.474408	78.905865	DW	29.1	5/4/2023	7.62	895.1	573	350	64	46	25	5	0	305	43	68	84	1.18	2.67	0.59	-2.00
25	Jaitgad	21.469335	78.874981	DW	29.8	5/8/2023	7.33	1423	911	410	98	40	90	7	0	305	195	84	73	0.81	3.94	1.93	-3.20
26	Bid Jatamkhera	21.476783	78.829372	DW	29.4	5/8/2023	7.5	722.5	462	255	56	28	35	1	0	268	39	53	39	0.73	0.97	0.96	-0.70
27	Jatamkhera	21.475007	78.810373	DW	29.1	5/8/2023	7.34	888.5	569	300	62	35	48	2	0	275	71	69	60	0.54	1.36	1.21	-1.50
28	Sawali	21.479393	78.792313	DW	30	5/8/2023	7.82	832.1	533	320	82	28	32	3	0	360	60	23	27	0.56	1.45	0.79	-0.50
29	Khursapar	21.480513	78.763357	DW	28.3	5/8/2023	7.46	918.1	588	320	70	35	44	1	0	293	71	85	28	1.01	1.65	1.07	-1.60
30	Kharduka	21.490591	78.946389	DW	31	6/12/2023	8.04	633.4	405	195	18	36	55	2	0	323	39	11	11	1.07	2.30	1.70	1.40
31	Temburdoh	21.501778	78.959725	DW	30.9	6/12/2023	8.08	1051	673	165	12	33	168	4	0	610	39	18	10	1.65	16.36	5.67	6.70
32	Raiwadi	21.527204	78.939839	DW	30.9	6/12/2023	7.38	738.1	472	245	52	28	38	1	0	336	21	19	39	1.13	4.35	1.05	0.60
33	Bichwa	21.563645	78.95386	DW	31.6	6/12/2023	8.01	915.3	586	440	36	85	17	3	0	488	25	61	31	1.55	3.53	0.36	-0.80
34	Nagalwadi	21.57344	79.018013	DW	30.8	6/12/2023	7.49	839.9	538	285	18	58	44	3	0	439	21	23	6	0.86	2.71	1.14	1.50
35	Bhondetal	21.568053	79.0044168	DW	30.8	6/12/2023	7.62	818.4	524	290	36	49	47	1	0	470	18	12	7	1.00	3.20	1.20	1.90
36	Tekadi	21.57784	78.947058	DW	26.8	6/13/2023	7.55	1790	1146	615	68	108	98	3	0	567	142	93	143	1.04	8.48	1.72	-3.00
37	Sindevani Bk.	21.586614	78.925423	DW	30.1	6/13/2023	7.73	690.2	442	285	30	51	30	1	0	366	21	14	37	0.72	4.34	0.77	0.30
38	SindevaniKh.	21.579285	78.921396	DW	27.3	6/13/2023	7.72	919	588	300	36	51	62	3	0	391	53	42	43	0.90	3.82	1.55	0.40
39	Warpani/	21.575061	78.970509	DW	30.9	6/13/2023	7.7	1106	708	390	38	72	67	3	0	610	28	18	27	1.10	3.98	1.47	2.20
40	Karmeta	21.565153	78.971822	DW	29.7	6/13/2023	7.8	1030	659	365	34	68	79	1	0	604	25	24	30	1.06	5.05	1.81	2.60
41	Charkhairi	21.534224	78.966287	DW	29.3	6/13/2023	7.56	1134	726	420	144	15	28	7	0	214	131	45	148	0.46	4.80	0.60	-4.90
42	Surewani	21.550743	78.995531	DW	31.7	6/13/2023	7.38	1126	721	385	18	83	64	3	0	458	74	27	82	0.83	1.86	1.42	-0.20
43	Sironji	21.555898	78.978501	DW	31	6/13/2023	7.4	1592	1019	470	84	63	90	9	0	427	152	63	141	0.83	6.42	1.81	-2.40
44	Sonpur	21.544924	78.975854	DW	30.7	6/14/2023	7.48	668.6	428	215	40	28	49	1	0	330	28	21	16	1.02	2.39	1.45	1.10
45	Maharkund	21.521457	78.98941	DW	29.1	6/14/2023	7.7	450	288	190	42	21	10	4	0	220	21	20	9	0.91	0.67	0.32	-0.20
46	Sarra	21.57362	79.004838	DW	30.8	6/14/2023	7.4	703.2	450	230	34	35	41	3	0	360	25	13	7	0.56	1.93	1.16	1.30
47	Forest	21.573372	78.975455	DW	29.8	6/14/2023	7.92	545.9	349	220	20	41	22	1	0	293	14	13	13	1.14	6.76	0.65	0.40
48	Chargaon.	21.490597	78.969462	DW	31.8	6/14/2023	7.51	592.4	379	250	20	49	17	4	0	311	14	32	13	0.84	1.13	0.47	0.10
49	Raibasa	21.469365	78.842266	DW	29.7	6/16/2023	7.38	694.5	444	250	44	34	24	2	0	336	21	18	12	0.65	0.72	0.67	0.50

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								µS/cm		……..mg/L……											(ppb)		
50	Asthikh.	21.465752	78.902813	DW	30.1	6/16/2023	7.74	695	445	180	38	21	65	1	0	311	25	38	28	1.49	6.66	2.11	1.50
51	Nandori	21.452759	78.92515	DW	28.5	6/16/2023	7.48	755.6	484	195	26	32	61	2	0	317	35	36	19	0.82	2.17	1.91	1.30
52	Pipla	21.484839	78.958782	DW	28.9	6/16/2023	7.72	707.2	453	260	20	51	28	1	0	372	18	9	15	1.35	3.19	0.76	0.90
53	Soholi	21.278359	79.136506	DW	30.2	17-06-23	7.66	770.1	493	235	22	44	49	1	0	336	25	32	37	0.75	2.36	1.39	0.80
54	Singori	21.292178	79.138374	DW	31.5	17-06-2023	7.53	845.9	541	285	42	44	62	1	0	458	14	19	47	0.80	3.85	1.59	1.80
55	Tamaswadi	21.31691	79.142116	DW	30.2	17-06-2023	7.36	832.6	533	235	36	35	75	2	0	458	14	15	30	0.55	4.12	2.13	2.80
56	Hingna	21.303535	79.149093	DW	30.3	17-06-2023	7.73	926.4	593	115	30	10	153	3	0	543	18	9	19	0.72	4.45	6.22	6.60
57	Itgaon	21.332179	79.134557	DW	29.3	17-06-2023	7.68	766.3	490	220	14	45	70	2	0	445	14	10	10	0.64	4.55	2.05	2.90
58	Gundheri	21.329654	79.144495	DW	29.7	17-06-2023	7.58	992.8	635	315	26	61	61	5	0	391	57	50	57	0.90	4.56	1.49	0.10
59	Digalwadi	21.350819	79.13893	DW	31.1	17-06-2023	7.57	1941	1242	445	46	80	198	6	0	427	305	150	36	0.70	7.09	4.08	-1.90
60	Parsodi	21.354042	79.14831	DW	28.4	17-06-2023	7.66	778.2	498	240	32	39	56	2	0	354	35	24	37	0.76	3.78	1.57	1.00
61	Parsioni	21.361179	79.150101	DW	28.9	19-06-2023	7.825	448.8	287	195	40	23	15	4	0	226	18	37	2	0.78	2.09	0.45	-0.20
62	Parsioni-2	21.37056	79.154127	DW	29.3	19-06-2023	7.85	2694	1724	480	26	101	344	8	0	738	301	311	4	1.07	9.15	6.83	2.50
63	Bansingi	21.388556	79.139827	DW	28.7	19-06-2023	7.67	406.4	260	155	20	26	22	7	0	238	14	10	0	0.68	1.44	0.79	0.80
64	Karanbhad	21.373412	79.10894	DW	28.7	19-06-2023	7.61	1441	922	330	22	67	134	1	0	482	124	56	69	0.83	8.95	3.20	1.30
65	Dahegaon	21.376824	79.086089	DW	30.1	19-06-2023	7.74	629.4	403	250	18	50	19	1	0	293	18	23	33	0.92	2.77	0.53	-0.20
66	Chicholi	21.389497	79.056921	DW	28.1	20-06-2023	7.53	1234	790	350	34	64	85	7	0	433	82	62	74	1.11	3.66	1.97	0.10
67	Mahadul	21.388226	79.069073	DW	30.1	20-06-2023	7.71	938.2	600	400	34	77	31	2	0	366	39	44	50	1.01	3.42	0.68	-2.00
68	Dorli	21.284905	79.154093	DW	28.7	21-06-2023	7.82	810.3	519	225	38	32	82	2	0	445	21	28	24	0.777	3.08	2.39	2.80
69	Sonegaon	21.322262	79.150496	DW	29.1	21-06-2023	7.72	952	609	355	50	56	39	1	0	433	28	43	52	0.71	1.81	0.91	0.00
70	Pardi	21.335092	79.094135	DW	28.9	21-06-2023	7.72	626.4	401	280	48	39	34	2	0	397	14	18	15	0.58	2.67	0.88	0.90
71	Khandala	21.344547	79.097788	DW	31	22-06-2023	8.23	585.6	375	200	34	28	52	2	0	317	35	20	15	0.49	2.78	1.59	1.20
72	Kodegaon	21.41611111	78.96777778	DW	30	13-Jun-23	7.95	650	416	110	20	15	92	4	0	360	21	14	3	0.51	3.53	3.82	3.70
73	Khedi	21.41555556	78.95388889	DW	31	13-Jun-23	7.7	1082	692	395	48	67	54	1	0	506	46	39	48	0.54	3.41	1.18	0.40
74	Tighai	21.40055556	78.97416667	DW	32	13-Jun-23	7.65	871.2	558	250	30	43	78	2	0	433	25	41	26	0.52	2.87	2.14	2.10
75	Wakodi	21.38055556	79.00138889	DW	31	13-Jun-23	7.56	939.1	601	330	52	49	48	2	0	439	25	27	60	0.66	1.72	1.16	0.60

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								µS/cm		……..mg/L……											(ppb)		
76	Dahegaon (R)	21.29388889	79.08083333	DW	31	13-Jun-23	7.59	972.8	623	390	42	69	40	1	0	506	28	29	32	0.94	1.48	0.87	0.50
77	Banegaon	21.26444444	79.12527778	DW	30	13-Jun-23	7.59	1532	980	415	62	63	107	3	0	458	163	72	41	1.03	27.06	2.28	-0.80
78	Saoli	21.27833333	79.1325	DW	29	13-Jun-23	7.75	1050	672	415	30	83	25	2	0	421	28	40	106	0.79	2.17	0.53	-1.40
79	Singori	21.29194444	79.13805556	DW	32	14-Jun-23	7.66	748.6	479	230	34	35	50	1	0	378	18	11	23	0.74	2.58	1.44	1.60
80	Kaparkheda	21.27777778	79.10805556	DW	30	15-Jun-23	7.6	1446	925	470	26	98	69	1	0	549	89	62	54	0.67	3.15	1.38	-0.40
81	Rohana	21.30416667	79.09972222	DW	31	14-Jun-23	7.77	802	513	235	46	29	53	1	0	384	18	28	20	0.66	1.39	1.50	1.60
82	Pardi	21.33194444	79.0925	DW	30	14-Jun-23	7.49	745.2	477	285	56	35	24	1	0	360	18	16	40	0.62	2.47	0.62	0.20
83	Pipla	21.30444444	79.06888889	DW	30	14-Jun-23	7.74	1716	1098	490	52	87	139	1	0	641	149	61	87	0.77	3.93	2.74	0.70
84	Kodadongri	21.34444444	79.03111111	DW	31	14-Jun-23	7.9	785.8	503	215	14	44	65	2	0	421	21	7	13	0.78	2.72	1.94	2.60
85	Waki	21.36666667	79.04083333	DW	30	14-Jun-23	7.78	884.6	566	310	22	62	44	1	0	470	18	12	25	1.10	2.08	1.08	1.50
86	Dohanghat	21.39777778	79.02611111	DW	32	14-Jun-23	7.58	789.9	506	240	38	35	39	2	0	342	21	29	20	0.66	1.18	1.11	0.80
87	Bhendala	21.36111111	79.01055556	DW	32	14-Jun-23	7.85	651.7	417	200	18	38	48	2	0	342	18	12	18	0.63	2.91	1.49	1.60
88	Patansavangi	21.34055556	79.01388889	DW	30	14-Jun-23	7.71	471.4	302	205	30	32	12	1	0	250	21	14	2	0.56	0.79	0.36	0.00
89	Kusumbi	21.34055556	78.9925	DW	30	14-Jun-23	7.56	1043	668	315	44	50	105	1	0	519	74	12	46	0.54	3.45	2.58	2.20
90	Takli	21.35305556	78.99055556	DW	30	15-Jun-23	7.45	1611	1031	560	28	119	110	2	0	592	163	42	99	0.39	3.69	2.02	-1.50
91	Kawadas	21.31611111	79.04805556	DW	29	15-Jun-23	7.67	901.1	577	375	46	63	61	1	0	500	43	21	24	0.40	2.64	1.37	0.70
92	Isapur	21.33	79.07222222	DW	32	15-Jun-23	7.7	953.1	610	300	44	46	101	7	0	580	21	18	29	0.59	2.93	2.55	3.50
93	Yeltur	21.34111111	79.05222222	DW	28	15-Jun-23	7.45	1233	789	290	44	44	116	2	0	427	60	20	174	0.53	3.05	2.96	1.20
94	Gosewadi	21.35083333	79.06138889	DW	31	15-Jun-23	7.5	701.7	449	240	44	32	66	2	0	433	11	12	28	0.56	1.75	1.85	2.30
95	Itangoti	21.31722222	79.005	DW	29	15-Jun-23	7.8	984.9	630	425	56	69	44	3	0	458	64	17	80	0.43	1.39	0.92	-1.00
96	Sillori	21.31305556	78.97027778	DW	30	15-Jun-23	7.41	2186	1399	790	64	153	78	61	0	458	241	182	224	0.32	2.11	1.21	-8.30
97	Brahapuri	21.31305556	78.96194444	DW	31	15-Jun-23	7.68	1017	651	320	44	51	80	2	0	458	82	20	34	0.44	1.93	1.95	1.10
98	Sonapur	21.32861111	78.95388889	DW	34	16-Jun-23	7.59	1790	1146	360	54	55	225	4	0	458	255	184	17	0.45	2.95	5.15	0.30
99	Erangaon	21.32861111	78.97027778	DW	30	16-Jun-23	7.8	1428	914	300	66	33	177	4	0	549	188	26	6	0.50	2.58	4.44	3.00
100	Katodi	21.33694444	78.96277778	DW	31	16-Jun-23	7.56	764.7	489	215	32	33	75	10	0	433	39	16	3	0.59	3.80	2.24	2.80

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								µS/cm		……..mg/L……											(ppb)		
101	Patakakhedi	21.35861111	78.95222222	DW	30	16-Jun-23	7.63	1619	1036	475	62	78	119	2	0	574	138	36	125	0.42	10.34	2.37	-0.10
102	Gujarkhedi	21.37555556	78.94361111	DW	30	16-Jun-23	7.81	1175	752	465	34	92	65	1	0	622	50	25	51	0.43	4.58	1.31	0.90
103	Malegaon	21.36277778	78.96027778	DW	32	16-Jun-23	7.64	1321	845	440	60	70	71	2	0	458	160	26	28	0.37	4.36	1.48	-1.30
104	Manegaon	21.36	78.97833333	DW	32	16-Jun-23	7.45	1543	988	565	54	104	73	1	0	586	181	35	31	0.26	7.64	1.33	-1.70
105	Sawngi	21.37664944	78.87833056	DW	29	5/4/2023	7.17	1236	791	500	62	84	68	1	0	494	131	34	52	0.53	2.18	1.32	-1.90
106	Dudhabardi	21.37399361	78.892765	DW	30	5/4/2023	7.086	783.5	501	295	58	36	79	1	0	421	50	11	41	0.56	1.468	2.00	1.00
107	Telkamthi	21.37530083	78.85825556	DW	**31**	5/4/2023	7.181	1570	1005	765	80	137	51	1	0	580	170	51	106	0.56	2.9441	0.81	-5.80
108	Heti Surla	21.38898444	78.89237222	DW	**31**	5/4/2023	7.486	1008	645	395	52	64	64	7	0	549	46	13	46	0.65	2.8491	1.39	1.10
109	Heti (Nandaji)	21.398104	78.872152	DW	29	5/4/2023	7.201	871.5	558	355	60	50	38	2	0	452	43	10	44	0.67	1.6238	0.89	0.30
110	Bhagi mari	21.408313	78.856127	DW	**33**	5/4/2023	7.602	739.6	473	280	42	43	60	15	0	275	96	25	12	0.51	1.5709	1.56	-1.10
111	Pipla (Bhada)	21.407965	78.84451	DW	30	5/4/2023	7.388	704	451	260	52	32	34	1	0	372	25	4	20	0.88	1.7436	0.92	0.90
112	Telankhedi	21.392196	78.826126	DW	28	5/4/2023	7.573	611.4	391	265	52	33	18	1	0	317	25	1	35	0.66	0.734	0.47	-0.10
113	Saoner	21.393112	78.934335	DW	27	5/4/2023	8.08	992	635	310	38	52	117	2	0	635	35	15	18	0.54	1.68	2.90	4.20
114	Ajani	21.4014	78.93503	DW	**32**	5/6/2023	7.907	1052	673	370	46	62	102	1	0	610	50	16	70	0.54	2.227	2.30	2.60
115	Sherdi	21.410998	78.939075	DW	**890**	5/6/2023	7.327	1079	691	365	32	69	88	0	0	549	67	6	42	0.54	2.432	1.99	1.70
116	Dudhabardi-2	21.424579	78.9403	DW	**31**	5/6/2023	7.483	713.1	456	360	38	64	19	1	0	415	25	16	45	0.54	1.978	0.43	-0.40
117	Gadegaon	21.434573	78.945256	DW	30	5/6/2023	7.125	1320	845	510	52	92	55	1	0	519	135	33	41	0.50	5.37	1.06	-1.70
118	Karjhat	21.437082	78.962878	DW	**31**	5/6/2023	8.264	528	338	180	34	23	60	1	0	305	32	11	21	0.59	1.67	1.94	1.40
119	Nandapur	21.44279	78.959171	DW	29	5/6/2023	7.507	1271	813	490	50	89	58	1	0	506	96	22	103	0.67	0.52	1.14	-1.50
120	Khangaon	21.432846	78.926532	DW	28	5/6/2023	7.453	890.7	570	250	42	35	118	2	0	580	28	9	17	0.89	3.21	3.24	4.50
121	Parsodi	21.431344	78.904963	DW	29	5/6/2023	7.575	1425	912	115	36	6	333	1	0	915	32	15	16	0.92	5.18	13.51	12.70
122	Khurajgaon	21.4196	78.907526	DW	26	5/6/2023	7.532	1244	796	235	28	40	154	2	0	592	67	13	27	0.70	2.87	4.37	5.00
123	Mangse	21.417732	78.880815	DW	30	5/7/2023	7.86	1187	760	305	22	61	111	1	0	488	106	15	40	1.06	1.79	2.76	1.90
124	Bhojapur	21.470438	78.85333	DW	**33**	5/7/2023	7.531	555.1	355	250	26	45	11	0	0	287	25	14	14	0.58	0	0.29	-0.30
125	Narasala	21.430512	78.85104	DW	**31**	5/7/2023	7.312	828.7	530	245	38	36	18	1	0	220	43	18	45	0.63	0.84	0.50	-1.30

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								µS/cm		……..mg/L……											(ppb)		
126	Rampur	21.441882	78.858705	DW	**32**	5/7/2023	7.206	691.7	443	345	88	30	23	2	0	311	43	51	47	0.66	0.669	0.54	-1.80
127	Jalalkheda	21.443713	78.837342	DW	**32**	5/7/2023	7.139	682.4	437	330	96	22	28	1	0	415	21	29	25	0.64	0.715	0.67	0.20
128	Pandheri	21.435024	78.836588	DW	**34**	5/7/2023	6.948	1287	824	530	134	47	37	7	0	397	103	65	155	0.58	1.77	0.70	-4.10
129	Khapa (N)	21.434971	78.836576	DW	**34**	5/7/2023	7.435	313.4	201	160	48	10	18	1	0	128	35	29	3	0.61	0	0.62	-1.10
130	Umari (B)	21.422834	78.809527	DW	**32**	5/8/2023	7.2	875	560	385	84	43	29	0	0	391	57	38	37	0.62	1.703	0.65	-1.30
131	Salai	21.417896	78.788727	DW	29	5/8/2023	7.051	795.7	509	320	50	47	17	0	0	268	43	57	35	0.73	1.22	0.40	-2.00
132	Nanda Gomukh	21.421728	78.770189	DW	**32**	5/8/2023	6.924	964.2	617	350	112	17	25	1	0	226	71	63	61	0.27	1.186	0.59	-3.30
133	Tidangi	21.40072	78.776438	DW	**32**	5/8/2023	8.047	655.5	420	280	54	35	35	2	0	134	92	57	50	0.54	0.339	0.92	-3.40
134	Pipla (N)	21.39729	78.743221	DW	**33**	5/8/2023	7.097	1094	700	395	138	12	47	1	0	183	149	74	76	0.58	3.238	1.03	-4.90
135	Agra	21.429478	78.721471	DW	**31**	5/8/2023	7.563	392.8	251	150	48	7	35	1	0	220	21	27	4	0.71	0.097	1.24	0.60
136	Malegaon	21.430209	78.724761	DW	**31**	5/8/2023	7.814	735.6	471	65	20	4	145	2	0	281	110	9	6	3.57	0.448	7.83	3.30
137	Chatrapur	21.451437	78.777035	DW	29	5/9/2023	8.052	580.1	371	270	70	23	36	1	0	348	35	30	10	0.70	0.3558	0.96	0.30
138	Jaitpur	21.451177	78.766173	DW	**31**	5/9/2023	8.099	801.3	513	335	70	39	23	2	0	342	25	31	22	0.83	0.646	0.54	-1.10
139	Joga	21.450971	78.74749	DW	**31**	5/9/2023	7.488	468.6	300	220	60	17	23	2	0	287	18	15	3	0.73	1.57	0.66	0.30
140	Pardi	21.402449	78.905987	DW	**34**	5/9/2023	8.85	803.2	514	115	16	18	158	2	72	378	32	7	9	0.98	1.9	6.41	6.30
141	Saoner	21.381516	78.933893	DW	**31**	5/9/2023	7.384	1164	745	510	68	83	40	1	0	616	64	20	28	0.65	1.86	0.76	-0.10

Annexure V: Ground Water Quality data of Deeper Aquifer of Saoner block, Nagpur district (Pre-Monsoon)

Sl.No.	LOCATION	Latitude (N)	Longitude (E)	Source (DW/BW/DCB / TW/River/Lake etc)	Temp °C	Date of collection	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	U	SAR	RSC
								µS/cm		.....mg/L.....											(ppb)		
1	GUMGAON	21.3979	78.9906	BW	31.8	09.06.2023	7.78	881	564	210	54	18	77	1	0	323	50	35.45	10.937	0.64	NA	2.3	1.1
2	KHAPA	21.4230	78.9802	TW	31.2	09.06.2023	7.61	1206	772	435	156	11	75	2	0	452	64	42.642	114.492	0.52	NA	1.56	-1.3
3	BAWANGAON	21.4394	78.9771	TW	**31.3**	09.06.2023	7.81	990	634	375	80	43	51	1	0	452	25	21.786	76.118	0.97	NA	1.15	-0.1
4	KOCHI	21.4553	78.9567	BW	**30.9**	09.06.2023	7.79	1141	730	460	66	72	60	2	0	555	39	19.565	43.713	0.88	NA	1.21	-0.1
5	BADEGAON (Chargaon)	21.4914	78.9681	BW	**31.4**	09.06.2023	7.75	795	509	330	62	43	10	4	0	421	18	11.9996	0.642	0.96	NA	0.23	0.3
6	RISALA	21.4772	78.9957	BW	**33.1**	10.06.2023	7.61	1085	694	370	78	43	58	5	0	482	46	39.3546	43.615	1	NA	1.31	0.2
7	KHUBALA	21.4659	78.9959	TW	**32.4**	10.06.2023	7.84	960	614	330	56	46	61	3	0	464	32	18.809	21.652	1.42	NA	1.46	0.2
8	UMRI JAMBHALPANI	21.4393	78.9999	TW	**30.8**	10.06.2023	7.75	965	618	275	58	32	79	2	0	464	25	21.1905	28.699	0.97	NA	2.08	8.6
9	KHAIRI PUNJABRAO	21.4224	79.0067	TW	**39.9**	10.06.2023	7.79	1108	709	330	82	30	100	11	0	549	60	19.7821	62.674	1.2	NA	2.4	0.4
10	DHAKRA	21.4306	79.0231	TW	**34.5**	10.06.2023	7.76	1177	753	390	60	58	73	3	0	561	39	29.976	32.914	1.17	NA	1.62	-2
11	RAMDONGARI	21.3992	79.0074	TW	**32.1**	10.06.2023	7.93	991	634	395	80	47	39	3	0	415	39	31.356	77.716	0.44	NA	0.86	3.8
12	KOTHULANA	21.4187	79.0363	TW	**31.1**	12.06.2023	7.69	2124	1359	510	56	90	155	170	0	714	191	81.854	124.107	1.36	NA	2.99	-2.3
13	NIMTALAI	21.4262	79.0373	TW	**34.9**	12.06.2023	7.65	1352	865	425	64	64	68	4	0	427	103	71.0215	82.666	0.72	NA	1.43	0.9
14	GADAMI	21.4289	79.0357	BW	**33**	12.06.2023	7.59	1663	1064	570	40	114	102	9	0	574	156	73.9854	121.424	0.99	NA	1.86	-2
15	PENDHARI	21.4547	79.0485	TW	**32.6**	12.06.2023	7.76	1307	836	450	30	91	88	3	0	555	89	53.8781	70.378	1.12	NA	1.81	0.1
16	HATIKHEDA	21.4494	79.0613	TW	**31.3**	12.06.2023	7.51	1107	708	365	78	41	76	3	0	384	92	68.684	78.728	0.6	NA	1.73	-1
17	Hatisarra	21.4606	78.9138	BW	29.4	5/4/2023	7.52	1460	934	455	102	49	64	48	0	494	113	86	82	0.35	4.45	1.3	-1
18	Asthi Bk.	21.4563	78.8979	HP	28.1	5/4/2023	7.46	2052	1313	575	70	97	137	108	0	470	124	157	291	1.32	2.6	2.49	-3.8
19	Kelwad	21.4616	78.8798	BW	28.6	5/4/2023	8.171	1616	1034	410	24	85	135	3	0	268	273	103	64	0.61	0.94	2.9	-3.8
20	Khairi	21.4589	78.9291	BW	29.8	5/4/2023	7.94	766.7	491	165	34	19	95	2	0	342	50	32	28	0.89	3.08	3.23	2.3
21	Kautha	21.4749	78.9040	HP	30.4	5/4/2023	7.51	1230	787	430	60	68	42	7	0	342	71	97	124	1.2	3.83	0.89	-3

Sl.No.	LOCATION	Latitude (N)	Longitude (E)	Source (DW/BW/DCB / TW/River/Lake etc)	Temp °C	Date of collection	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	U	SAR	RSC
								µS/cm		.....mg/L.....											(ppb)		
22	Bid Jatamkhera	21.4734	78.8328	BW	31	5/8/2023	7.46	948.9	607	325	68	38	49	1	0	275	71	72	84	0.55	0.88	1.19	-2
23	Jatamkhera	21.4757	78.8116	HP	30.2	5/8/2023	7.89	857.4	549	110	16	17	115	22	0	189	113	99	5	0.58	0.94	4.76	0.9
24	Sawali	21.4767	78.7946	BW	30	5/8/2023	7.77	800.8	513	115	28	11	109	7	0	159	131	70	6	1.5	0.54	4.4	0.3
25	Khursapar	21.4731	78.7589	BW	31.3	5/8/2023	7.83	577.2	369	180	22	30	49	1	0	268	35	28	15	0.83	1.11	1.58	0.8
26	Kharduka	21.4905	78.9416	HP	31.6	6/12/2023	7.71	1052	673	320	66	38	81	2	0	519	43	26	39	1.11	2.03	1.97	2.1
27	Temburdoh	21.0502	78.9614	BW	30	6/12/2023	7.79	1059	678	370	32	70	78	2	0	622	25	21	24	1.45	14.09	1.75	2.8
28	Raiwadi	21.5243	78.9371	HP	27.9	6/12/2023	7.92	869.1	556	285	24	55	49	3	0	464	21	7	17	0.91	3.44	1.26	1.9
29	Bichwa	21.5641	78.9552	HP	31.2	6/12/2023	7.82	1536	983	540	24	117	60	6	0	610	89	52	82	0.87	3.89	1.12	-0.8
30	Nagalwadi	21.5733	79.0179	HP	30.9	6/12/2023	7.55	643.5	412	245	36	38	24	3	0	366	14	7	4	0.53	0.56	0.67	1.1
31	Bhondetal	21.5688	79.0045	HP	31	6/12/2023	7.69	897.3	574	245	38	36	87	3	0	494	25	25	18	0.97	3.87	2.42	3.2
32	Tekadi	21.5783	78.9480	HP	31.2	6/13/2023	7.6	748.4	479	245	42	34	58	10	0	439	18	10	20	0.98	7.81	1.61	2.3
33	Sindevani Bk.	21.5820	78.78.925556	HP	31.6	6/13/2023	7.51	794.7	509	250	38	38	56	5	0	360	57	20	17	0.75	6.85	1.54	0.9
34	SindevaniKh.	21.5790	78.9224	HP	31.1	6/13/2023	7.84	605.4	387	200	22	35	51	6	0	323	39	12	0	0.55	BDL	1.58	1.3
35	Warpani	21.5751	78.9715	HP	29.8	6/13/2023	7.87	1112	712	370	18	79	90	4	0	482	74	32	103	0.9	BDL	2.02	0.5
36	Karmeta	21.5492	78.9746	BW	27.3	6/13/2023	7.7	966.1	618	265	32	45	89	3	0	500	43	11	16	0.98	4.78	2.37	2.9
37	Charkhairi	21.5339	78.9667	BW	29.1	6/13/2023	7.04	468.3	300	200	50	18	9	0	0	250	11	15	3	0.4	0.41	0.27	0.1
38	Surewani	21.5486	78.9967	HP	31.6	6/13/2023	7.7	958.2	613	325	36	57	53	3	0	513	21	16	14	1.11	4.19	1.27	1.9
39	Sironji	21.5560	78.9788	HP	29.6	6/13/2023	8.2	1035	662	335	20	69	68	9	0	293	113	53	92	0.71	3.78	1.62	-1.9
40	Sonpur	21.5325	78.9810	BW	31.1	6/14/2023	7.19	492.6	315	180	38	21	21	1	0	256	18	10	2	0.64	0.31	0.69	0.6
41	Maharkund	21.5241	78.9849	HP	25.3	6/14/2023	7.35	607.9	389	180	36	22	20	41	0	268	39	15	11	0.58	0.22	0.66	0.8
42	Sarra	21.5733	79.0051	HP	30.1	6/12/2023	7.36	699.1	447	230	34	35	45	4	0	354	25	26	9	0.46	2.61	1.28	1.2
43	Forest	21.5731	78.9751	BW	29.8	6/14/2023	7.76	816	522	330	22	67	29	1	0	452	18	13	21	1.48	4.12	0.69	0.8

Sl.No.	LOCATION	Latitude (N)	Longitude (E)	Source (DW/BW/DCB / TW/River/Lake etc)	Temp °C	Date of collection	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	U	SAR	RSC
								µS/cm		.....mg/L.....											(ppb)		
44	Chargaon	21.4924	78.9679	BW	31	6/14/2023	7.66	972.3	622	335	56	47	38	3	0	397	46	34	46	1.03	3.37	0.91	-0.2
45	Raibasa	21.4687	78.8438	HP	29.9	6/16/2023	7.14	1519	972	455	48	81	106	8	0	378	177	92	134	0.66	12.06	2.17	-2.9
46	Nandori	21.4491	78.9228	HP	31.2	6/16/2023	7.69	902.4	578	295	48	43	44	7	0	372	46	30	46	0.92	2.92	1.11	0.2
47	Soholi	21.2788	79.1350	HP	30.1	17-06-2023	7.55	1091	698	345	42	58	53	1	0	360	53	82	63	0.75	2.29	1.24	-1
48	Singori	21.2925	79.1371	HP	31.7	17-06-2023	7.77	800.7	512	215	26	36	75	10	0	445	18	24	11	0.54	7.02	2.22	3
49	Tamaswadi	21.3132	79.1407	BW	31	17-06-2023	7.59	976.3	625	165	14	32	146	2	0	561	21	10	29	0.89	5.5	4.93	5.9
50	Hingna	21.3013	79.1546	HP	30.1	17-06-2023	7.86	783.1	501	165	28	23	94	2	0	256	89	60	0	0.54	1.5	3.17	0.9
51	Gundheri	21.3175	79.1379	BW	28.1	17-06-2023	7.76	790.9	506	185	50	15	86	1	0	439	14	14	12	0.69	3.46	2.75	3.5
52	Itgaon	21.3304	79.1343	BW	31	17-06-2023	7.86	773.2	495	215	18	41	71	2	0	433	18	12	16	0.68	8.15	2.1	2.8
53	Digalwadi	21.3522	79.1399	BW	27.3	17-06-2023	7.25	2683	1717	685	114	97	289	4	0	317	588	172	94	0.63	9.82	4.8	-8.5
54	Parsodi	21.3449	79.1473	BW	29.8	17-06-2023	7.41	998.5	639	280	32	49	70	5	0	323	78	51	62	1.06	3.2	1.81	-0.3
55	Parsioni	21.3720	79.1478	BW	28.7	19-06-2023	7.32	1510	966	500	144	34	87	11	0	372	142	73	123	0.66	9.42	1.69	-3.9
56	Parsioni-2	21.3734	79.1427	HP	31	19-06-2023	7.23	245.1	157	100	28	7	10	2	0	122	14	15	0	0.38	0.4	0.44	0
57	Karanbhad	21.3760	79.1038	BW	31	19-06-2023	7.89	818	524	200	20	36	97	1	0	476	21	13	7	1	4.79	2.97	3.8
58	Dahegaon	21.3721	79.0843	BW	30.8	19-06-2023	7.83	507.8	325	195	18	36	25	1	0	268	14	15	22	0.66	2.9	0.77	0.5
59	Chicholi	21.3919	79.0564	BW	30.6	20-06-2023	7.48	846.6	542	360	16	78	36	2	0	421	43	16	30	1.19	4.48	0.82	-0.3
60	Mahadul	21.3885	79.0691	BW	29.6	20-06-2023	7.79	864.7	553	340	20	70	37	1	0	360	57	52	30	1.06	5.3	0.87	-0.9
61	Dorli	21.2896	79.1637	BW	28.1	21-06-2023	7.71	715.7	458	215	42	27	68	3	0	360	21	15	29	0.6	3.13	2.02	1.6
62	Sonegaon	21.3207	79.1553	BW	30.5	21-06-2023	7.41	1093	700	460	70	69	39	3	0	372	96	19	77	0.54	4.37	0.79	-3.1
63	Khandala	21.3469	79.0982	HP	30.7	22-06-2023	8.27	722.8	463	165	18	29	102	3	0	366	71	11	1	0.66	BDL	3.44	2.7
64	Wakodi	21.3894	79.0028	HP	31	13-Jun-23	7.59	1081	692	320	48	49	85	1	0	525	32	28	54	0.58	1.31	2.07	2.2
65	Dahegaon (R)	21.2881	79.0906	BW	30	13-Jun-23	7.75	933.2	597	245	24	45	89	1	0	500	25	22	7	0.74	2.97	2.47	3.3
66	Banegaon	21.2647	79.1322	BW	30	13-Jun-23	7.48	1928	1234	615	70	107	82	1	0	537	199	64	104	0.73	1.82	1.43	-3.5

Sl.No.	LOCATION	Latitude (N)	Longitude (E)	Source (DW/BW/DCB / TW/River/Lake etc)	Temp °C	Date of collection	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	U	SAR	RSC
								µS/cm		.....mg/L.....											(ppb)		
67	Saoli	21.2783	79.1325	BW	32	13-Jun-23	7.71	843.6	540	315	40	52	36	2	0	336	25	60	70	0.97	1.86	0.89	-0.8
68	Singori	21.2922	79.1397	HP	32	13-Jun-23	7.52	800.7	512	240	26	43	64	2	0	464	11	5	14	0.69	1.2	1.79	2.8
69	Kaparkheda	21.2778	79.1081	BW	32.3	14-Jun-23	7.9	591.3	378	200	28	32	35	2	0	281	32	17	6	0.64	1.23	1.08	0.6
70	Chandkapur	21.2883	79.1006	HP	29	14-Jun-23	7.36	1177	753	375	58	56	61	2	0	391	78	64	66	0.92	2.53	1.37	-1.1
71	Pota & Sillewada	21.2994	79.1250	HP	32	14-Jun-23	7.42	1340	858	345	44	57	110	6	0	464	124	91	1	0.65	0.81	2.57	0.7
72	Rohana	21.3044	79.1031	BW	35	14-Jun-23	7.49	750.4	480	235	48	28	57	1	0	391	18	25	20	0.66	1.19	1.61	1.7
73	Walni	21.3111	79.0931	HP	32.4	14-Jun-23	7.41	1117	715	380	44	66	72	3	0	500	64	79	13	0.44	1.2	1.6	0.6
74	Waki	21.3636	79.0394	HP	32	14-Jun-23	7.75	1021	653	360	18	77	50	1	0	506	50	13	19	0.74	2.77	1.13	1.1
75	Dohanghat	21.3981	79.0258	HP	32	14-Jun-23	7.69	574.5	368	215	16	43	25	2	0	275	21	30	8	0.53	1.22	0.75	0.2
76	Kusumbi	21.3392	78.9936	HP	33	14-Jun-23	7.25	2015	1290	535	72	86	201	2	0	378	355	65	118	0.36	2.28	3.78	-4.5
77	Takli	21.3519	78.9892	HP	30	15-Jun-23	7.55	911.3	583	275	40	43	101	5	0	476	60	13	45	0.41	BDL	2.64	2.3
78	Kawadas	21.3172	79.0478	HP	31	15-Jun-23	7.42	2144	1372	910	72	177	99	4	0	592	199	190	254	0.3	4.02	1.43	-8.5
79	Yeltur	21.3394	79.0511	BW	30	15-Jun-23	7.51	808.6	518	210	38	28	104	1	0	476	25	15	32	0.74	3.77	3.12	3.6
80	Gosewadi	21.3608	79.0692	BW		15-Jun-23	7.6	585	374	205	38	27	55	1	0	366	14	10	8	0.72	0.13	1.68	1.9
81	Itangoti	21.3181	79.0044	HP	32.4	15-Jun-23	7.58	912.9	584	395	50	66	53	3	0	482	43	19	47	0.45	1.58	1.17	0
82	Sillori	21.3117	78.9703	HP	31	15-Jun-23	7.9	934.8	598	410	50	69	35	11	0	488	57	20	47	0.43	1.25	0.75	-0.2
83	Brahapuri	21.3131	78.9619	BW	30	16-Jun-23	7.74	963	616	205	32	30	120	2	0	488	46	16	41	0.58	1.78	3.64	3.9
84	Adasa	21.3336	78.9394	HP	32	16-Jun-23	7.24	1500	960	460	96	53	88	44	0	317	177	139	142	0.4	0.94	1.79	-4
85	Adasa	21.3297	78.9417	BW	30	16-Jun-23	7.14	878.3	562	260	82	13	41	29	0	281	78	19	71	0.4	0.8	1.1	-0.6
86	Patakakhedi	21.3564	78.9522	BW	31	16-Jun-23	7.5	1064	681	355	36	64	69	1	0	452	85	20	19	0.5	8.08	1.59	0.3
87	Borujwada	21.3714	78.9500	BW	30	16-Jun-23	7.63	1312	840	395	30	78	107	2	0	604	89	30	51	0.41	5.65	2.33	2
88	Gujarkhedi	21.3761	78.9439	HP	32	16-Jun-23	7.76	849.6	544	260	32	44	83	1	0	458	50	20	18	0.4	2.49	2.23	2.3
89	Malegaon	21.3608	78.9636	HP	31	16-Jun-23	7.66	1436	919	230	28	39	197	2	0	549	106	29	116	0.34	1.02	5.66	4.4

Sl.No.	LOCATION	Latitude (N)	Longitude (E)	Source (DW/BW/DCB / TW/River/Lake etc)	Temp °C	Date of collection	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	U	SAR	RSC
								µS/cm		……..mg/L……..											(ppb)		
90	Manegaon	21.3589	78.9797	HP	32	16-Jun-23	7.34	1734	1110	705	46	143	70	1	0	567	181	36	169	0.27	0	1.15	-4.8
91	Saoner	21.4715	78.9155	BW	**33**	5/4/2023	7.02	1687	1080	460	66	72	204	2	0	696	202	30	35	0.68	4.49	4.14	2.2
92	Sawngi	21.3766	78.8783	HP	29	5/4/2023	6.935	1668	1068	730	164	78	23	2	0	513	167	65	151	0.55	5.426	0.36	-6.2
93	Dudhabardi	21.3736	78.8926	BW	**31**	5/4/2023	7.136	768.4	492	325	70	36	18	2	0	378	28	15	38	0.53	1.123	0.44	-0.3
94	Heti (Nandaji)	21.3982	78.8761	HP	**35**	5/4/2023	6.892	830.5	532	375	120	18	35	1	0	189	89	46	105	0.59	2.597	0.79	-4.4
95	Bhagi mari	21.4083	78.8561	BW	30	5/4/2023	7.344	809.3	518	290	34	50	34	1	0	305	50	23	39	0.86	1.097	0.86	-0.8
96	Pipla (Bhada)	21.4072	78.8442	BW	29	5/4/2023	7.254	838.5	537	315	112	9	33	2	0	146	110	51	76	0.72	1.917	0.8	-3.9
97	Telankhedi	21.3929	78.8254	HP	29	5/4/2023	6.968	877.4	562	350	108	19	40	3	0	268	74	29	78	0.65	2.26	0.93	-2.6
98	Ajani	21.4081	78.9354	BW	30	5/6/2023	7.823	1250	800	335	28	64	126	2	0	616	78	3	40	0.88	0	2.98	3.4
99	Sherdi	21.4111	78.9405	HP	**34**	5/6/2023	7.382	965.8	618	250	34	40	111	1	0	519	46	17	24	0.51	2.07	3.06	3.5
100	Dudhabardi-2	21.4255	78.9389	HP	**31**	5/6/2023	7.518	230.6	148	150	30	18	9	7	0	140	32	0	3	0.29	0	0.32	-0.7
101	Gadegaon	21.4346	78.9452	HP	**31**	5/6/2023	7.128	1352	865	510	50	94	57	1	0	513	131	26	68	0.69	4.934	1.1	-1.8
102	Karjhat	21.4371	78.9621	HP	**34**	5/6/2023	7.542	1303	834	525	56	94	39	1	0	488	149	12	59	0.52	2.331	0.74	-2.5
103	Nandapur	21.4441	78.9589	HP	**34**	5/6/2023	7.241	1315	842	395	48	67	111	1	0	622	82	23	62	0.75	4.143	2.44	2.3
104	Khangaon	21.4272	78.9230	BW	**32**	5/6/2023	7.304	1032	660	180	46	16	105	78	0	458	64	0	52	0.81	2.82	3.42	3.9
105	Parsodi	21.4396	78.9043	BW	**35**	5/6/2023	7.256	1705	1091	365	24	74	179	3	0	580	135	43	128	1.01	6.03	4.06	2.2
106	Khurajgaon	21.4170	78.9066	HP	**33**	5/6/2023	7.11	2037	1304	555	46	107	201	39	0	525	269	36	163	0.42	6.382	3.71	-2.5
107	Mangse	21.4208	78.8824	HP	28	5/7/2023	7.527	862.2	552	380	30	74	55	1	0	427	71	11	42	0.87	1.127	1.24	-0.6
108	Bhojapur	21.4217	78.8694	BW	**34**	5/7/2023	7.502	598.7	383	280	22	55	21	1	0	268	39	0	39	0.65	1.17	0.54	-1.2
109	Narasala	21.4281	78.8503	BW	**34**	5/7/2023	7.169	1068	684	270	46	38	59	1	0	287	110	3	44	0.54	2.04	1.57	-0.7
110	Rampur	21.4427	78.8629	HP	**35**	5/7/2023	7.199	1060	678	410	114	30	63	26	0	323	64	160	66	0.41	2.43	1.35	-2.9
111	Jalalkheda	21.4439	78.8376	BW	**32**	5/7/2023	7.251	543.7	348	290	96	12	14	1	0	378	11	0	7	0.66	1.62	0.36	0.4
112	Pandheri	21.4352	78.8362	HP	**33**	5/7/2023	7.02	1399	895	470	166	13	60	33	0	470	96	85	79	0.62	1.921	1.21	-1.7

Sl.No.	LOCATION	Latitude (N)	Longitude (E)	Source (DW/BW/DCB / TW/River/Lake etc)	Temp °C	Date of collection	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	U	SAR	RSC
								µS/cm		……..mg/L……..											(ppb)		
113	Khapa (N)	21.4244	78.8348	HP	**34**	5/7/2023	7.075	788.9	505	310	102	13	33	4	0	323	53	27	50	0.5	1.452	0.81	-0.9
114	Umari (B)	21.4196	78.8133	BW	**32**	5/8/2023	7.242	822	526	295	114	2	52	12	0	409	43	40	25	0.71	1.43	1.32	0.8
115	Salai	21.4220	78.7849	BW	**32**	5/8/2023	7.956	654.8	419	85	26	5	116	2	0	256	82	14	3	0.46	0	5.49	2.5
116	Nanda Gomukh	21.4216	78.7701	BW	**35**	5/8/2023	6.883	661.9	424	310	96	17	24	0	0	287	50	47	30	0.74	0.32	0.58	-1.5
117	Tidangi	21.3981	78.7821	BW	**34**	5/8/2023	6.778	1073	687	470	174	9	28	1	0	159	163	86	66	0.49	2.444	0.55	-6.8
118	Pipla (N)	21.3981	78.7441	BW	**32**	5/8/2023	7.333	458.1	293	205	64	11	16	0	0	238	21	20	9	0.64	0.52	0.48	-0.2
119	Agra	21.4267	78.7160	HP	**35**	5/8/2023	6.948	821.9	526	375	118	19	30	1	0	232	96	58	64	0.52	1.509	0.67	-3.7
120	Malegaon	21.2466	78.7159	BW	**33**	5/8/2023	7.644	848.1	543	225	36	33	100	2	0	342	110	28	22	2.22	0.48	2.91	1.1
121	Saoner	21.3920	78.9107	BW	**32**	5/9/2023	7.319	1202	769	380	58	57	106	1	0	641	64	17	22	1.06	1.808	2.37	2.9
122	Saoner	21.3881	78.9191	BW	**32**	5/9/2023	7.47	1060	678	515	52	94	50	1	0	592	74	44	33	0.66	1.515	0.96	-0.6
123	Chatrapur	21.4445	78.7753	BW	**31**	5/9/2023	7.389	1404	899	380	92	36	100	52	0	494	145	85	37	0.64	1.801	2.23	0.5
124	Jaitpur	21.4443	78.7638	BW	**34**	5/9/2023	8.388	616.5	395	95	20	11	111	2	36	207	50	36	5	2	0.178	4.96	2.7
125	Joga	21.4478	78.7440	BW	**32**	5/9/2023	7.757	673.5	431	140	22	21	97	2	0	354	25	32	13	0.95	1.111	3.55	3

Annexure VI: Ground Water Quality data of Shallow Aquifer of Saoner block, Nagpur district (post-monsoon)

S.No	LOCATION	LATITUDE	LONGITUDE	pH	EC	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	U	SAR	RSC
					µS/cm	……..mg/L……..												ppb		
1	Telgaon	21.3742	78.8097	7.15	1215	778	505	142	36	34	1	0	342	128	80	105	0.3	7.996	0.65	-4.5
2	Sawngi	21.3766	78.8783	7.75	1212	776	485	82	68	69	1	0	494	106	57	38	0.36	8.054	1.36	-1.6
3	Sawngi	21.3784	78.8804	7.44	1132	724	455	66	70	50	1	0	415	99	68	61	0.36	8.181	1.02	-2.3
4	Heti Surla	21.389	78.8924	7.6	1087	696	440	54	74	57	1	0	543	35	12	77	0.48	8.61	1.18	0.1
5	Heti (Nandaji)	21.3994	78.8758	7.72	512	327	230	52	24	16	1	0	268	21	28	5	0.42	1.768	0.45	-0.2

S.No	LOCATION	LATITUDE	LONGITUDE	pH	EC	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	U	SAR	RSC
					µS/cm	.....mg/L.....												ppb		
6	Ajani	21.4014	78.935	8.03	1152	737	365	44	62	101	1	0	561	50	22	93	0.38	1.088	2.3	1.9
7	Ajani	21.4096	78.935	7.93	1162	744	305	36	52	139	1	0	604	50	31	34	0.56	0.81	3.45	3.8
8	Dudhabardi-2	21.4246	78.9403	7.76	862	552	230	46	28	78	2	0	378	43	27	47	0.4	BDL	2.24	1.6
9	Dudhabardi-2	21.4275	78.9422	7.81	858	549	205	54	17	101	1	0	433	35	22	34	0.57	BDL	3.08	3
10	Nandapur	21.4428	78.9592	7.69	1344	860	515	66	85	59	1	0	433	99	67	134	0.6	2.547	1.14	-3.2
11	Nandapur	21.4416	78.9583	7.93	968	620	265	58	29	101	1	0	488	35	23	40	0.9	1.171	2.69	2.7
12	Narasala	21.4305	78.851	7.26	888	568	365	98	29	24	1	0	348	50	39	64	0.4	BDL	0.56	-1.6
13	Narasala	21.4285	78.8505	7.61	886	567	380	112	24	24	0	0	342	50	48	61	0.36	BDL	0.54	-2
14	Rampur	21.4419	78.8587	7.55	839	537	330	94	23	26	1	0	305	28	69	65	0.59	BDL	0.61	-1.6
15	Rampur	21.4461	78.856	7.25	651	416	275	74	22	18	0	0	299	14	47	29	0.36	BDL	0.47	-0.6
16	Pandheri	21.435	78.8366	7.42	1235	790	430	96	46	46	15	0	366	92	80	103	0.42	BDL	0.97	-2.6
17	Pandheri	21.4339	78.8398	7.64	1089	697	405	64	60	50	0	0	354	85	69	85	0.53	BDL	1.07	-2.3
18	Nanda Gomukh	21.4217	78.7702	7.63	993	635	385	80	45	34	0	0	317	71	61	74	0.27	BDL	0.76	-2.5
19	Nanda Gomukh	21.4176	78.7711	7.57	804	514	290	56	36	39	0	0	281	50	52	61	0.3	BDL	1.01	-1.2
20	Pipla (N)	21.3973	78.7432	7.75	774	495	245	40	35	49	1	0	299	50	53	12	0.43	BDL	1.36	0
21	Pipla (N)	21.3981	78.7422	7.46	1218	780	440	106	43	53	1	0	281	128	79	128	0.32	BDL	1.1	-4.2
22	Malegaon	21.4302	78.7248	7.54	957	612	285	56	35	68	2	0	317	78	61	51	1.08	BDL	1.74	-0.5
23	Malegaon	21.431	78.7315	7.51	1185	758	435	110	39	46	6	0	348	106	76	89	0.3	BDL	0.95	-3
24	Malegaon	21.4313	78.7314	7.88	743	475	195	50	17	74	2	0	299	35	69	6	0.74	BDL	2.31	1
25	Khapa	21.421	78.9845	7.64	1296	829	375	46	63	106	1	0	433	103	52	105	0.53	2.493	2.38	-0.4
26	Hatisarra	21.4629	78.9296	7.67	681	436	315	66	36	10	2	0	354	14	11	41	1.07	0.678	0.26	-0.5
27	Hatisarra	21.4623	78.9167	7.65	1299	831	435	96	47	88	10	0	580	64	47	78	1.09	3.239	1.83	0.8
28	Asthi Bk.	21.4562	78.8965	7.67	539	345	235	50	27	20	2	0	214	28	32	42	0.44	0.631	0.57	-1.2
29	Kelwad	21.4614	78.8708	7.63	3718	2380	1190	140	204	286	2	0	732	539	241	348	1.01	4.265	3.61	-11.8
30	Kautha	21.4755	78.905	7.82	1790	1146	630	64	114	120	4	0	592	128	94	187	1.85	3.598	2.09	-2.9
31	Bid Jatamkhera	21.4734	78.8289	7.35	918	588	365	84	38	28	0	0	372	43	32	81	0.44	0.355	0.65	-1.2
32	Jatamkhera	21.4744	78.8153	7.67	903	578	385	90	39	23	1	0	421	28	29	67	0.51	0.421	0.5	-0.8
33	Bichwa	21.56	78.9561	7.57	1090	698	295	50	41	99	1	0	500	71	21	21	0.59	4.119	2.51	2.3

S.No	LOCATION	LATITUDE	LONGITUDE	pH	EC	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	U	SAR	RSC
					µS/cm	.....mg/L.....												ppb		
34	Tekadi	21.5752	78.947	7.6	987	632	285	50	39	74	3	0	433	57	26	37	1.33	6.93	1.91	1.4
35	Warpani	21.5739	78.9686	7.67	1087	696	335	56	47	73	6	0	537	43	12	40	0.91	2.374	1.74	2.1
36	Surewani	21.5486	78.9956	7.56	1410	902	525	74	83	56	2	0	500	113	50	111	0.95	2.195	1.06	-2.3
37	Raibasa	21.4696	78.8432	7.59	844	540	320	52	46	22	1	0	427	14	9	28	0.34	0.311	0.54	0.6
38	Digalwadi	21.3492	79.1385	7.63	1226	785	360	38	64	103	1	0	384	142	50	63	0.67	2.986	2.37	-0.9
39	Parsodi	21.3485	79.1471	7.84	701	448	270	60	29	22	1	0	311	21	20	40	0.64	1.213	0.58	-0.3
40	Parsioni	21.3737	79.1476	7.68	1040	666	385	30	75	48	33	0	403	64	20	72	0.42	1.41	1.05	-1.1
41	Chicholi	21.3891	79.0572	8.04	1583	1013	450	42	84	140	2	0	549	113	100	121	1.46	3.146	2.87	0
42	Khedi	21.4156	78.9539	7.91	952	609	390	66	55	53	1	0	476	50	42	41	0.39	1.608	1.17	0
43	Wakodi	21.3806	79.0014	7.84	782	500	265	50	34	71	2	0	433	21	8	38	0.45	0.735	1.89	1.8
44	Wakodi	21.3839	79.02	7.83	754	483	345	38	61	34	1	0	421	21	18	35	0.98	0.625	0.79	0
45	Saoli	21.2783	79.1325	7.78	826	529	405	78	51	11	1	0	275	35	69	121	0.72	0.296	0.24	-3.6
46	Saoli	21.2781	79.1364	7.67	782	501	310	62	38	37	2	0	342	35	41	51	0.46	1.609	0.92	-0.6
47	Kaparkheda	21.2778	79.1081	7.64	1168	748	445	70	66	73	1	0	470	92	72	62	0.37	4.704	1.51	-1.2
48	Kaparkheda	21.2808	79.1094	7.8	1309	838	565	84	86	53	1	0	494	92	98	80	0.45	5.503	0.97	-3.2
49	Pipla	21.3044	79.0689	7.74	2907	1860	965	136	152	225	1	0	708	390	141	258	0.43	8.714	3.15	-7.7
50	Pipla	21.3097	79.065	7.77	1688	1080	615	76	103	116	2	0	586	149	103	148	0.69	3.883	2.04	-2.7
51	Kusumbi	21.3406	78.9925	7.55	1295	829	390	50	64	136	1	0	616	92	66	45	0.77	5.683	3	2.3
52	Kusumbi	21.3431	78.9908	7.87	1024	655	450	68	68	45	1	0	427	57	58	111	0.45	1.224	0.93	-2
53	Takli	21.3531	78.9906	7.6	1615	1034	520	72	83	138	2	0	561	170	81	114	0.22	1.03	2.63	-1.2
54	Takli	21.3506	78.9892	7.67	1057	676	370	48	61	79	3	0	403	99	80	48	0.26	0.095	1.79	-0.8
55	Yeltur	21.3411	79.0522	7.6	1460	934	360	54	55	140	2	0	433	92	30	252	0.24	3.74	3.21	-0.1
56	Itangoti	21.3172	79.005	7.84	1065	682	425	86	51	48	3	0	415	71	69	79	0.26	0.398	1.02	-1.7
57	Sillori	21.3131	78.9703	7.52	2383	1525	840	152	112	91	81	0	494	319	148	208	0.18	2.929	1.37	-8.7
58	Sillori	21.3119	79.9658	7.71	1057	676	470	104	51	25	1	0	445	71	42	77	0.4	0.543	0.5	-2.1
59	Patakakhedi	21.3586	78.9522	7.71	1709	1094	540	78	84	138	1	0	555	184	76	145	0.23	2.763	2.58	-1.7
60	Patakakhedi	21.3603	78.9561	7.79	1175	752	480	70	74	61	1	0	452	135	39	80	0.32	1.874	1.2	-2.2
61	Gujarkhedi	21.3756	78.9436	7.7	1237	792	520	52	95	81	1	0	616	64	43	77	0.28	1.17	1.54	-0.3

S.No	LOCATION	LATITUDE	LONGITUDE	pH	EC	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	U	SAR	RSC
					µS/cm	.....mg/L.....												ppb		
62	Gujarkhedi	21.3764	78.9419	7.87	1285	822	570	68	97	68	1	0	720	64	27	24	0.26	1.219	1.24	0.4

Annexure VII: Ground Water Quality data of Deeper Aquifer of Saoner block, Nagpur district (post-monsoon)

S.No	LOCATION	LATITUDE	LONGITUDE	pH	EC	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	U	SAR	RSC
					µS/cm	.....mg/L.....												ppb		
1	Sawngi	21.3766	78.8783	7.3	1489	953	630	130	74	30	2	0	403	149	97	143	0.3	9.97	0.52	-6
2	Sawngi	21.3742	78.8814	7.54	1170	749	475	114	46	32	2	0	433	57	60	122	0.23	9.89	0.63	-2.4
3	Heti (Nandaji)	21.3982	78.8761	7.27	1186	759	475	122	41	41	1	0	403	85	67	112	0.36	7.49	0.82	-2.9
4	Pipla (Bhada)	21.4072	78.8442	7.66	527	337	225	60	18	18	1	0	238	28	29	13	0.41	2.52	0.51	-0.6
5	Pipla (Bhada)	21.4066	78.8438	7.73	630	403	260	50	33	23	1	0	293	28	33	16	0.49	1.71	0.61	-0.4
6	Telankhedi	21.3929	78.8254	7.83	837	536	270	82	16	58	3	0	403	28	29	24	0.69	3.93	1.54	1.2
7	Telankhedi	21.3925	78.8228	7.67	1324	847	540	74	86	42	3	0	555	71	60	92	0.47	8.31	0.79	-1.7
8	Gadegaon	21.4346	78.9452	7.49	1364	873	475	116	45	69	1	0	476	113	70	74	0.53	1.81	1.37	-1.7
9	Gadegaon	21.4228	78.944	7.5	750	480	295	92	16	26	1	0	342	35	25	35	0.37	BDL	0.67	-0.3
10	Karjhat	21.4371	78.9621	7.64	1014	649	400	68	56	51	2	0	433	85	37	39	0.31	BDL	1.12	-0.9
11	Nandapur	21.4441	78.9589	7.77	1761	1127	560	102	74	114	14	0	616	128	120	108	0.43	3.16	2.1	-1.1
12	Khangaon	21.4272	78.923	7.83	1369	876	300	60	36	100	91	0	561	78	56	68	0.5	0.78	2.52	3.2
13	Khangaon			7.83	932	596	270	62	28	59	33	0	409	57	45	16	0.37	BDL	1.57	1.3
14	Parsodi	21.4396	78.9043	8.04	1854	1187	340	54	50	251	5	0	677	113	119	137	0.95	2.92	5.92	4.3
15	Khurajgaon	21.417	78.9066	7.34	2395	1533	645	130	78	167	71	0	635	269	159	158	0.16	0.05	2.86	-2.5
16	Rampur	21.4427	78.8629	7.55	1762	1128	625	206	27	84	33	0	348	85	427	46	0.15	0.78	1.46	-6.8
17	Rampur	21.4444	78.8621	7.99	892	571	315	46	49	46	1	0	421	35	55	1	0.44	BDL	1.14	0.6
18	Pandheri	21.4352	78.8362	7.69	1549	991	470	112	46	60	75	0	476	99	91	166	0.39	BDL	1.2	-1.6
19	Pandheri	21.4357	78.8365	7.64	1394	892	490	106	55	64	3	0	415	106	85	134	0.45	BDL	1.25	-3
20	Khapa (N)	21.4244	78.8348	7.74	887	568	360	78	40	24	1	0	342	57	41	61	0.37	BDL	0.55	-1.6
21	Khapa (N)	21.4245	78.8348	7.7	794	508	295	56	38	34	4	0	293	50	46	56	0.37	BDL	0.86	-1.1
22	Agra	21.4267	78.716	7.63	1045	669	425	64	64	30	1	0	360	99	69	28	0.19	BDL	0.63	-2.6

S.No	LOCATION	LATITUDE	LONGITUDE	pH	EC	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	U	SAR	RSC
					µS/cm	.....mg/L.....												ppb		
23	Agra	21.4268	78.7153	7.55	1240	794	435	70	63	49	1	0	391	71	80	109	0.25	BDL	1.03	-2.3
24	Jaitpur	21.4443	78.7638	8	722	462	105	18	15	105	2	0	293	43	50	2	1.29	BDL	4.44	2.7
25	Jaitpur	21.4443	78.7638	7.9	735	470	115	22	15	107	2	0	317	35	47	1	1.38	BDL	4.33	2.9
26	TISHTI KH	21.3756	78.7952	7.86	1186	759	95	18	12	187	4	0	287	163	60	4	2.53	BDL	8.32	2.8
27	TISHTI KH	21.3725	78.7867	7.53	1230	787	460	122	38	41	1	0	305	156	117	2	0.36	BDL	0.82	-4.2
28	BAWANGAON	21.4394	78.9771	7.61	818	523	275	48	38	48	1	0	397	21	7	55	0.86	2.65	1.26	1
29	Khairi Punjabrao	21.4224	79.0067	7.65	1068	684	245	40	35	118	2	0	506	53	9	64	1.36	6.13	3.27	3.4
30	Gadami	21.4289	79.0357	7.44	1285	822	570	42	113	56	2	0	513	106	62	72	1.07	17.47	1.03	-3
31	Nimtalai	21.4262	79.0373	7.47	1280	819	405	80	50	88	3	0	488	92	57	65	0.67	18.92	1.9	-0.1
32	Hatikheda	21.4494	79.0613	7.49	975	624	315	66	36	69	2	0	348	82	49	61	0.54	3.28	1.68	-0.6
33	Pendhari	21.4547	79.0485	7.68	1128	722	415	40	77	82	3	0	482	78	41	67	1.24	18.06	1.75	-0.4
34	Kothulana	21.4187	79.0363	7.43	1612	1032	370	56	56	90	125	0	506	145	53	117	1.01	14.28	2.03	0.9
35	Ramdongari	21.3992	79.0074	7.46	1000	640	350	90	30	57	3	0	409	46	49	78	0.32	2.28	1.32	-0.3
36	Wakodi	21.3894	79.0028	7.78	1028	658	295	50	41	87	1	0	452	43	41	66	0.42	0	2.2	1.5
37	Wakodi	21.385	79.0019	7.81	827	529	240	42	33	87	1	0	519	14	4	13	0.4	0	2.43	3.7
38	Banegaon	21.2647	79.1322	7.59	1587	1016	590	82	94	87	1	0	494	149	138	96	0.55	1.74	1.55	-3.7
39	Banegaon	21.265	79.1256	7.52	1280	819	490	66	79	59	2	0	415	106	110	79	0.44	4.42	1.17	-3
40	Saoli	21.2783	79.1325	7.7	636	407	265	42	39	39	2	0	287	21	52	56	0.53	2.02	1.05	-0.6
41	Chandkapur	21.2883	79.1006	7.63	1225	784	425	84	52	66	4	0	397	92	100	79	0.71	4.82	1.39	-2
42	Kusumbi	21.3392	78.9936	7.37	2256	1444	545	114	63	205	2	0	488	319	134	125	0.09	2.84	3.81	-2.9
43	Kusumbi	21.3383	78.9944	7.79	1225	784	390	64	56	103	2	0	391	163	101	11	0.12	0.95	2.28	-1.4
44	Kawadas	21.3172	79.0478	7.83	2244	1436	885	96	157	113	1	0	647	213	146	258	0.16	2.21	1.65	-7.1
45	Kawadas	21.3169	79.0469	7.88	1198	767	445	42	83	93	2	0	592	64	33	60	0.19	0	1.91	0.8
46	Yeltur	21.3508	79.0611	7.78	769	492	225	42	29	70	1	0	427	14	14	24	0.38	0.42	2.03	2.5
47	Itangoti	21.3181	79.0044	7.83	1019	652	380	38	69	58	3	0	445	57	48	66	0.22	0	1.29	-0.3
48	Itangoti	21.315	79.0042	7.97	564	361	265	40	40	30	3	0	372	14	10	0	0.31	0	0.8	0.8
49	Sillori	21.3117	78.9703	7.79	861	551	380	82	43	35	13	0	409	57	50	40	0.19	0	0.77	-0.9
50	Adasa	21.3336	78.9394	7.44	1456	932	440	82	57	100	45	0	378	191	133	69	0.13	0	2.07	-2.6

S.No	LOCATION	LATITUDE	LONGITUDE	pH	EC	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F	U	SAR	RSC
					µS/cm	.....mg/L.....												ppb		
51	Adasa	21.3297	78.9417	7.28	925	592	290	60	34	35	32	0	293	85	31	65	0.27	0.14	0.9	-1
52	Borujwada	21.3714	78.95	7.65	1574	1007	515	60	89	138	1	0	714	43	83	116	0.24	1.34	2.65	1.4
53	Malegaon	21.3608	78.9636	7.81	1542	987	265	42	39	235	2	0	592	121	70	114	0.23	0.6	6.29	4.4
54	Manegaon	21.3589	78.9797	7.67	1823	1167	770	160	90	78	1	0	635	177	97	151	0.15	1.18	1.23	-5
55	Manegaon	21.3592	78.9797	7.53	1796	1149	750	118	111	84	1	0	641	177	100	121	0.15	0	1.33	-4.5

Annexure VIII: Trace elements data of Sanoer block, Nagpur district

S.No	LOCATION	SAMPLE_ID	LATITUDE	LONGITUDE	B	Al	Cr	Mn	Fe	Ni	Cu	Zn	As	Se	Sr	Mo	Ag	Cd	Ba	Hg	206 [Pb]	207 [Pb]	208 Pb	238 U
					ppb																			
1	GUMGAON	DW	21.39625	78.98993	40.42	10.73	BDL	8.2	BDL	BDL	1.2	5.75	0.44	1.71	410.81	BDL	BDL	0.02	17.13	0.05	0.16	0.13	0.15	1.56
2	GUMGAON	BW	21.39785	78.99064	40.26	14.41	BDL	35.97	1160.4	BDL	2.93	423.06	0.12	0.83	252.54	0.26	BDL	0.02	1.75	0	1.77	1.87	1.83	0.84
3	KHAPA	TW	21.42305	78.98018	92.97	BDL	BDL	2.08	BDL	BDL	BDL	125.81	0.02	0.92	548.28	0.07	BDL	BDL	7.2	0.01	BDL	BDL	BDL	0.82
4	KHAPA	DW	21.42103	78.98451	66	0.01	BDL	BDL	BDL	BDL	BDL	3.77	0.53	0.72	574.61	0.2	BDL	BDL	7.58	0.01	BDL	BDL	BDL	1.96
5	BAWANGAON	DW	21.43994	78.97577	20.34	BDL	BDL	BDL	BDL	BDL	0.4	3.52	0.52	0.5	515.08	1.11	BDL	0.01	7.92	BDL	BDL	BDL	BDL	2.8
6	BAWANGAON	TW	21.43941	78.97707	3.4	BDL	BDL	69.75	BDL	2.99	BDL	134.6	0.05	0.17	485.73	0.36	BDL	0.18	7.11	BDL	BDL	BDL	BDL	3.3
7	KOCHI	BW	21.45529	78.95673	31.81	BDL	BDL	2.7	BDL	BDL	BDL	10.2	1	0.22	707.14	1.42	BDL	0.02	4.92	BDL	BDL	BDL	BDL	2.72
8	KOCHI	DW	21.45845	78.96544	BDL	BDL	BDL	BDL	BDL	BDL	0.12	1.28	0.44	0.32	645.53	BDL	BDL	BDL	14.53	BDL	BDL	BDL	BDL	2.75
9	BADEGAON	DW	21.48316	78.96561	42.35	BDL	BDL	BDL	BDL	BDL	BDL	0.13	0.35	0.7	564.29	0.73	BDL	BDL	36	BDL	BDL	BDL	BDL	3.79
10	BADEGAON (Chargaon)	BW	21.49143	78.96812	BDL	BDL	BDL	145.38	BDL	BDL	1.14	1681.73	0.05	0.28	139.64	BDL	BDL	0.16	68.44	BDL	BDL	BDL	BDL	0
11	HINGNA	DW	21.47073	78.9789	12.95	BDL	BDL	9.3	BDL	BDL	0.53	85.18	0.11	0.15	434.94	0.21	BDL	0.01	66.1	BDL	BDL	BDL	BDL	4.18
12	RISALA	DW	21.47698	78.99549	15.65	4.53	BDL	1.5	BDL	BDL	1.11	11.95	0.08	1.04	418.21	BDL	BDL	0.01	88.98	BDL	BDL	BDL	BDL	4.76
13	RISALA	BW	21.47715	78.99567	39.35	BDL	BDL	84.95	BDL	BDL	0.56	244.65	0.02	0.3	623.05	0.24	BDL	0.07	184.22	BDL	BDL	BDL	BDL	5.05
14	KHUBALA	DW	21.46015	78.98723	10.73	BDL	BDL	5.95	BDL	BDL	BDL	25.42	0.12	0.26	592.75	0.23	BDL	0.01	41.85	BDL	BDL	BDL	BDL	3.8
15	KHUBALA	TW	21.46593	78.99589	22.52	BDL	BDL	149.29	BDL	BDL	0.31	277.5	0.01	0.22	1069.33	3.61	BDL	0.06	96.27	0	BDL	BDL	BDL	5.81
16	UMRI JAMBHALPANI	TW	21.43933	78.99986	11.62	BDL	BDL	31.48	BDL	BDL	0.15	167.21	0.01	0.3	444.03	0.24	BDL	0.03	26.83	BDL	BDL	BDL	BDL	4.85
17	UMRI JAMBHALPANI	DW	21.4383	79.0012	BDL	BDL	BDL	0.61	BDL	BDL	BDL	19.78	0.06	0.37	513.68	BDL	BDL	0	33.08	BDL	BDL	BDL	BDL	4.53

S.No	LOCATION	SAMPLE _ID	LATITUDE	LONGITUDE	B	Al	Cr	Mn	Fe	Ni	Cu	Zn	As	Se	Sr	Mo	Ag	Cd	Ba	Hg	206 [Pb]	207 [Pb]	208 Pb	238 U
					ppb																			
18	KHAIRI PUNJABRAO	DW	21.42174	79.00668	116.04	BDL	BDL	BDL	BDL	BDL	2.26	7.16	0.54	0.34	734.56	0.01	BDL	0	41.68	BDL	BDL	BDL	BDL	0.49
19	KHAIRI PUNJABRAO	TW	21.42244	79.00669	50.85	BDL	BDL	16.15	BDL	BDL	0	38.63	0.09	0.26	596.84	0.41	BDL	0	9.69	0.03	BDL	BDL	BDL	5.94
20	DHAKRA	TW	21.43064	79.02307	54.9	BDL	BDL	0.87	BDL	BDL	BDL	5.36	0.01	0.17	608.63	0.85	BDL	BDL	4.64	BDL	BDL	BDL	BDL	6.81
21	DHAKRA	DW	21.43111	79.0209	15.32	0.16	BDL	BDL	BDL	BDL	BDL	0.21	0.08	0.59	999.96	0.02	BDL	BDL	36.07	BDL	BDL	BDL	BDL	5.9
22	RAMDONGARI	DW	21.39851	79.00721	12.41	BDL	BDL	BDL	BDL	BDL	BDL	10.85	0.51	0.56	391.27	BDL	BDL	BDL	12.34	BDL	BDL	BDL	BDL	2.45
23	RAMDONGARI	TW	21.39918	79.0074	21.33	BDL	BDL	BDL	BDL	BDL	0.19	2.02	0.16	0.64	398.6	BDL	BDL	BDL	27.18	BDL	BDL	BDL	BDL	1.79
24	NEW KHAPA	DW	21.40992	78.98602	44.09	BDL	BDL	BDL	BDL	BDL	0.39	2.68	0.67	0.23	612.63	0.8	BDL	0.03	23.59	BDL	BDL	BDL	BDL	2.82
25	KOTHULANA	TW	21.41865	79.0363	319.47	BDL	BDL	BDL	BDL	BDL	0.38	0.42	0.12	2.69	1320.68	32.04	BDL	0.01	72.33	BDL	BDL	BDL	BDL	10.52
26	KOTHULANA	DW	21.4182	79.03504	212.37	BDL	BDL	BDL	BDL	BDL	BDL	0.6	0.11	2.92	1151.52	36.5	BDL	0	246.93	BDL	BDL	BDL	BDL	5.43
27	NIMTALAI	DW	21.42373	79.03657	102.07	BDL	BDL	BDL	BDL	BDL	0.45	11.23	0.77	0.56	557.03	13.06	BDL	0.01	112.7	BDL	BDL	BDL	BDL	2.9
28	NIMTALAI	TW	21.42619	79.03725	82.36	BDL	BDL	BDL	BDL	BDL	BDL	2.85	0.08	0.25	747	2.87	BDL	0	15.58	BDL	BDL	BDL	BDL	11.3
29	GADAMI	DW	21.43969	79.04357	45.75	BDL	BDL	BDL	BDL	BDL	1.25	2.21	0.09	1.17	1446.9	0.64	BDL	0.03	39.66	BDL	BDL	BDL	BDL	22.08
30	GADAMI	BW	21.42894	79.03573	64.81	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.03	1.46	1525.09	0.07	BDL	BDL	50.59	BDL	BDL	BDL	BDL	20.99
31	PENDHARI	DW	21.45531	79.04854	44.4	BDL	BDL	3.19	BDL	BDL	1.04	1.6	0.12	1.17	1204.79	0.18	BDL	0.01	199.53	BDL	BDL	BDL	BDL	17.28
32	PENDHARI	TW	21.45466	79.04853	30.1	BDL	BDL	BDL	BDL	BDL	0.18	11.86	0.02	0.57	852.93	1.06	BDL	BDL	122.77	BDL	BDL	BDL	BDL	10.25
33	HATIKHEDA	DW	21.44932	79.06167	69.86	BDL	BDL	BDL	BDL	BDL	0.74	1.68	0.09	2.35	1405.83	BDL	BDL	0	94.05	BDL	BDL	BDL	BDL	5.91
34	HATIKHEDA	TW	21.44935	79.06134	100.62	BDL	BDL	0.32	BDL	BDL	0.8	45.05	0.02	2.86	646.07	BDL	BDL	0.02	88.17	BDL	BDL	BDL	BDL	2.09
35	MOHGAON	DW	21.44905	79.02345	23.65	BDL	BDL	BDL	BDL	BDL	0.02	4.18	0.15	0.81	357.18	BDL	BDL	BDL	53.32	BDL	BDL	BDL	BDL	4.71
36	Soholi	DW	21.27836	79.13651	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.27	0.27	430.14	0.32	BDL	BDL	13.29	BDL	BDL	BDL	BDL	1.64
37	Soholi	HP	21.27883	79.13495	24.03	BDL	BDL	14.99	BDL	BDL	0.52	61.32	0.11	7.21	149.12	0.46	BDL	0	1.35	BDL	BDL	BDL	BDL	0.24
38	Singori	DW	21.29218	79.13837	25.66	BDL	BDL	0.89	BDL	BDL	BDL	3.73	0.3	0.87	156.39	0.29	BDL	BDL	1.67	BDL	BDL	BDL	BDL	1.55
39	Singori	HP	21.29246	79.13713	20.29	BDL	BDL	0.19	BDL	BDL	0.22	39.11	0.23	2.39	52.75	1.49	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.85
40	Tamaswadi	DW	21.31691	79.14212	19.24	2.05	BDL	BDL	BDL	BDL	BDL	4.32	0.11	0.31	553.57	0.13	BDL	BDL	5.14	BDL	BDL	BDL	BDL	4.24
41	Tamaswadi	BW	21.31315	79.14069	16.45	BDL	BDL	BDL	BDL	BDL	BDL	0.37	0.29	0.17	397.7	1.37	BDL	BDL	4.36	BDL	BDL	BDL	BDL	5.38
42	Hingna	DW	21.30354	79.14909	30.79	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.22	0.14	260.48	1.18	BDL	BDL	1.04	BDL	BDL	BDL	BDL	3.71

S.No	LOCATION	SAMPLE _ID	LATITUDE	LONGITUDE	B	Al	Cr	Mn	Fe	Ni	Cu	Zn	As	Se	Sr	Mo	Ag	Cd	Ba	Hg	206 [Pb]	207 [Pb]	208 Pb	238 U
					ppb																			
43	Hingna	HP	21.30127	79.15458	59.01	43.84	BDL	198.02	728.03	BDL	40.63	504.57	0.11	0.05	345.99	0.92	BDL	0.19	14.54	BDL	2.31	2.44	2.4	0.48
44	Gundheri	BW	21.31753	79.13793	19.04	4.6	BDL	10.85	BDL	BDL	1.03	39.79	0.27	0.09	413.95	0.54	BDL	0.01	2.23	BDL	0.12	0.1	0.12	3.14
45	Itgaon	DW	21.33218	79.13456	22.91	BDL	BDL	BDL	BDL	BDL	0.31	0.46	0.16	0.18	544.11	0.38	BDL	BDL	8.91	BDL	BDL	BDL	BDL	4.58
46	Itgaon	BW	21.33043	79.13428	37.86	BDL	BDL	BDL	BDL	BDL	0.36	BDL	0.39	0.43	136.04	0.64	BDL	BDL	2.08	BDL	BDL	BDL	BDL	5.48
47	Gundheri	DW	21.32965	79.1445	49.11	94.96	BDL	6.12	43.09	BDL	1.02	20.48	0.16	0.83	852.87	BDL	BDL	0.02	12.42	BDL	0.34	0.34	0.35	4.39
48	Digalwadi	DW	21.35082	79.13893	36.47	89.66	BDL	382.97	34	BDL	3.78	20.23	0.47	0.2	1241.3	0.43	0.1	1.04	56.33	BDL	1.02	1.06	1.05	5.2
49	Digalwadi	BW	21.35224	79.13995	20.92	BDL	BDL	0.28	BDL	BDL	BDL	BDL	0.02	0.11	1646.69	BDL	BDL	BDL	53.87	BDL	BDL	BDL	BDL	4.67
50	Parsodi	DW	21.35404	79.14831	18.79	9.41	BDL	0.09	BDL	BDL	BDL	0.09	0.06	0.16	552.33	BDL	BDL	BDL	11.5	BDL	BDL	BDL	BDL	3.12
51	Parsodi	BW	21.34489	79.1473	49.55	192.69	BDL	7.67	109.76	1.75	1.1	7.64	0.04	0.9	585.46	BDL	BDL	0.02	55.01	BDL	1.75	1.8	1.8	2.47
52	Parsioni	DW	21.36118	79.1501	14.68	81.3	BDL	26.16	50.95	BDL	1.32	30.5	0.43	0.15	394.82	BDL	BDL	0.03	35.75	BDL	0.68	0.69	0.7	1.35
53	Parsioni	BW	21.372	79.14785	106.02	41.76	BDL	550	52.23	BDL	1.59	30.77	0.1	1.01	1082.64	BDL	BDL	0.34	11.77	BDL	7.87	8.43	8.2	7.98
54	Parsioni-2	DW	21.37056	79.15413	267.02	1.22	BDL	3.38	27.93	BDL	0.21	42.89	0.37	0.13	1533.38	BDL	BDL	0.01	28.5	BDL	0	BDL	BDL	15.33
55	Parsioni-2	HP	21.37339	79.1427	BDL	25.89	BDL	141.79	5159.23	BDL	3.88	1660.03	0.04	0.08	82.07	BDL	BDL	0.16	18.99	BDL	5.17	5.48	5.37	0.16
56	Bansingi	DW	21.38856	79.13983	27.1	202.32	BDL	21.41	180.13	BDL	1.59	25.4	1.27	0.2	401.7	BDL	BDL	0.02	56.32	BDL	0.57	0.58	0.59	1.27
57	Karanbhad	DW	21.37341	79.10894	114.96	43.03	BDL	6.58	BDL	BDL	1.15	12.44	0.13	1.25	925.66	BDL	BDL	0.01	5.95	BDL	0.56	0.57	0.58	10.08
58	Karanbhad	BW	21.37597	79.10381	73.08	21.58	BDL	10.7	BDL	BDL	BDL	161.67	0.01	0.79	429.58	BDL	BDL	0.01	6.37	BDL	0.56	0.59	0.59	7.12
59	Dahegaon	DW	21.37682	79.08609	2.32	258.95	BDL	11.15	288.82	BDL	1.36	4.41	0.03	0.26	623.26	BDL	BDL	0.02	8	BDL	0.32	0.3	0.32	2.59
60	Dahegaon	BW	21.37208	79.08426	1.73	246.9	BDL	8.08	144.3	BDL	2.47	14.19	0.03	0.31	520.87	BDL	BDL	0.05	15.57	BDL	1.68	1.75	1.73	2.52
61	Chicholi	DW	21.3895	79.05692	112.06	2.01	BDL	BDL	BDL	BDL	BDL	3.17	0.07	1.1	1062.94	BDL	BDL	0	65.26	BDL	BDL	BDL	BDL	3.44
62	Chicholi	BW	21.3919	79.0564	15.73	14.43	BDL	0.75	BDL	BDL	0.13	3.69	0.03	0.2	577.35	BDL	BDL	0.01	1.24	BDL	0.18	0.16	0.18	4.24
63	Mahadul	DW	21.38823	79.06907	8.94	BDL	BDL	BDL	BDL	BDL	BDL	0.02	0.15	0.1	600.9	BDL	BDL	0.01	16.29	BDL	BDL	BDL	BDL	2.63
64	Mahadul	BW	21.38849	79.06907	6.05	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.02	0.15	740.63	0.04	BDL	BDL	20.16	BDL	BDL	BDL	BDL	6.26
65	Dorli	DW	21.28491	79.15409	3.98	BDL	BDL	BDL	BDL	BDL	BDL	0.31	0.31	0.83	402.13	0.26	BDL	0	3.1	BDL	BDL	BDL	BDL	2.66
66	Dorli	BW	21.28962	79.16366	BDL	BDL	BDL	BDL	BDL	BDL	BDL	V	0.18	0.26	385.62	BDL	BDL	BDL	3.26	BDL	BDL	BDL	BDL	3.03
67	Sonegaon	DW	21.32226	79.1505	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.32	0.25	581.92	BDL	BDL	BDL	6.27	BDL	BDL	BDL	BDL	2.18
68	Sonegaon	BW	21.32068	79.15529	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	V	0.31	883.29	BDL	BDL	BDL	13.77	BDL	BDL	BDL	BDL	4.45

S.No	LOCATION	SAMPLE _ID	LATITUDE	LONGITUDE	B	Al	Cr	Mn	Fe	Ni	Cu	Zn	As	Se	Sr	Mo	Ag	Cd	Ba	Hg	206 [Pb]	207 [Pb]	208 Pb	238 U
					ppb																			
69	Pardi	DW	21.33509	79.09414	8.22	0.25	BDL	BDL	BDL	BDL	BDL	BDL	0.4	0.15	517.91	BDL	BDL	BDL	10.5	BDL	BDL	BDL	BDL	2.69
70	Khandala	DW	21.34455	79.09779	11.42	BDL	BDL	BDL	BDL	BDL	BDL	0.67	0.27	0.26	603.33	BDL	BDL	BDL	11.67	BDL	BDL	BDL	BDL	2.49
71	Khandala	HP	21.34689	79.09822	32.14	BDL	BDL	BDL	BDL	BDL	BDL	172.84	BDL	0.07	436.54	2.71	BDL	0	32.66	BDL	BDL	BDL	BDL	1.91
72	Kodegaon	DW	21.41611	78.96778	70.1	3.34	BDL	2.21	BDL	BDL	1.22	16.09	0.86	0.14	274.48	BDL	BDL	0.07	17.62	BDL	0.02	BDL	0.02	0.89
73	Khedi	DW	21.41556	78.95389	36.2	BDL	BDL	BDL	BDL	BDL	0.07	0.97	0.4	0.12	844.07	BDL	BDL	0.01	5.5	BDL	BDL	BDL	BDL	3.47
74	Tighai	DW	21.40056	78.97417	78.83	BDL	BDL	BDL	BDL	BDL	0.11	4.32	0.15	0.5	490.64	BDL	BDL	0	43.78	BDL	BDL	BDL	BDL	2.59
75	Wakodi	DW	21.38056	79.00139	12.69	BDL	BDL	BDL	BDL	BDL	0.36	3.76	0.44	0.22	420.34	BDL	BDL	0.03	8.67	BDL	BDL	BDL	BDL	1.51
76	Wakodi	HP	21.38944	79.00278	54.36	BDL	BDL	3.24	BDL	BDL	BDL	57.24	0.16	0.29	371.44	0.46	BDL	0	3.73	BDL	BDL	BDL	BDL	0.76
77	Dahegaon (R)	DW	21.29389	79.08083	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.84	1.3	0.48	512.52	0.05	BDL	BDL	11.7	BDL	BDL	BDL	V	1.13
78	Dahegaon (R)	BW	21.28806	79.09056	15.56	BDL	BDL	BDL	BDL	BDL	BDL	0.36	0.3	0.77	421.21	1.15	BDL	BDL	13.05	BDL	BDL	BDL	BDL	2.51
79	Banegaon	DW	21.26444	79.12528	85.46	2.8	0.4	0.21	0.49	0.4	0.25	1.64	0.16	0.7	931.96	2.41	0.01	0	30.48	0.01	0	0.01	0	47.66
80	Banegaon	BW	21.26472	79.13222	105.78	1.11	4.48	0.05	0.23	0.33	0.21	17.35	0.44	0.61	872.46	0.86	0	0	18.01	BDL	BDL	BDL	BDL	3.37
81	Saoli	DW	21.27833	79.1325	29.83	1.11	2.67	0.03	0.22	0.14	0.37	3.2	0.53	0.31	826.2	1.16	0	0	25.88	BDL	BDL	BDL	BDL	2.33
82	Saoli	BW	21.27833	79.1325	23.49	1.49	2.03	0.03	0.36	0.21	0.47	2.31	0.4	0.18	538.72	1.68	0	0	14.66	BDL	BDL	BDL	BDL	2.11
83	Singori	HP	21.29222	79.13972	51.12	0.18	0.07	12.31	0.22	0.75	0.44	73.76	0.11	0.14	277.18	1.28	0	0	4.11	BDL	BDL	BDL	BDL	0.54
84	Singori	DW	21.29194	79.13806	47.74	1.82	0.51	0.73	0.18	0.22	0.24	8.14	0.36	0.37	446.82	1.29	0	0	5.43	BDL	BDL	BDL	BDL	2.81
85	Kaparkheda	DW	21.27778	79.10806	68.1	0.66	2.24	0.04	0.21	0.35	0.25	2.85	0.64	1.09	878.11	0.7	0	0	21.8	BDL	BDL	BDL	BDL	3.14
86	Kaparkheda	BW	21.27778	79.10806	32.44	30.81	0.2	0.05	0.25	0.4	1.29	6.03	0.5	0.14	248.7	2.95	0.01	0.03	28.65	BDL	BDL	BDL	BDL	1.55
87	Chandkapur	HP	21.28833	79.10056	76.8	2	0.01	51.97	0.22	3.17	2.68	157.14	0.22	0.1	546.02	2.91	0	0.08	40.88	BDL	BDL	BDL	BDL	0.56
88	Pota & Sillewada	HP	21.29944	79.125	48.67	0.1	0.01	5.15	0.47	0.2	0.2	261.32	0.04	BDL	777.77	7.37	0	0.02	86.88	BDL	BDL	BDL	BDL	0.06
89	Rohana	BW	21.30444	79.10306	42.29	12.87	1.32	0.96	6.06	0.32	1.42	70.75	0.27	0.94	247.64	1.14	0	0.01	15.93	BDL	0.04	0.04	0.04	0.09
90	Rohana	DW	21.30417	79.09972	38.95	1.69	1.76	0.15	0.56	0.1	0.18	37.22	0.39	0.91	293.08	0.8	0	0	16.42	BDL	BDL	BDL	BDL	1.62
91	Pardi	DW	21.33194	79.0925	40.33	1.79	2.64	0.04	0.21	0.04	0.14	4.47	0.4	0.07	595.55	0.51	0	0	9.46	BDL	BDL	BDL	BDL	2.77
92	Walni	HP	21.31111	79.09306	66.6	0.13	0.09	35.26	0.4	1.53	0.35	148.46	0.07	0.18	666.74	0.82	0	0	72.98	BDL	BDL	BDL	BDL	1.17
93	Pipla	DW	21.30444	79.06889	93.74	0.49	4.49	2.76	0.22	0.2	0.4	17.94	1.1	0.24	731.06	1.18	0	0	18.54	BDL	BDL	BDL	BDL	4.15

S.No	LOCATION	SAMPLE_ID	LATITUDE	LONGITUDE	B	Al	Cr	Mn	Fe	Ni	Cu	Zn	As	Se	Sr	Mo	Ag	Cd	Ba	Hg	206 [Pb]	207 [Pb]	208 Pb	238 U
					ppb																			
94	Kodadongri	DW	21.34444	79.03111	81.25	1.58	0.22	0.08	0.28	0.01	0.27	6.22	0.43	0.04	386.36	1.24	0	0	19.06	BDL	BDL	BDL	BDL	2.03
95	Waki	HP	21.36361	79.03944	47.5	0.24	0.01	17.84	0.24	0.52	0.84	113.43	0.32	0.01	495.58	1.95	0	0	6.68	BDL	BDL	BDL	BDL	2.39
96	Waki	DW	21.36667	79.04083	32.17	0.25	5.16	1.45	0.21	0.07	0.27	19.58	1.29	0.16	442.99	1.17	0	0	20.72	BDL	0.02	0.02	0.02	1.68
97	Dohanghat	HP	21.39806	79.02583	21.78	0.15	0.24	6.4	0.13	0.3	0.2	2280.23	0.16	0.07	208.02	0.85	0	0.06	4.53	BDL	BDL	BDL	BDL	0.05
98	Dohanghat	DW	21.39778	79.02611	33.97	1.86	0.47	0.28	0.18	BDL	0.14	108.14	0.6	0.09	266.48	0.8	0.01	0.01	5.49	BDL	BDL	BDL	BDL	0.85
99	Bhendala	DW	21.36111	79.01056	52.63	1.14	0.22	0.08	0.41	0.05	5.19	11.09	0.28	0.24	320.47	0.57	0.01	0	11.47	BDL	BDL	BDL	BDL	2.81
100	Patansavangi	DW	21.34056	79.01389	18.96	2.47	0.28	1.98	0.54	BDL	0.71	14.45	0.78	BDL	299.05	0.36	0.01	0	3.77	BDL	BDL	BDL	BDL	0.06
101	Kusumbi	HP	21.33917	78.99361	88.64	0.14	0.01	143.7	0.45	4.02	0.39	336.75	0.14	BDL	837.96	0.75	0	0.01	1.97	BDL	BDL	BDL	BDL	0.18
102	Kusumbi	DW	21.34056	78.9925	81.28	1.05	0.15	14.91	0.18	0.34	0.16	42.12	0.29	BDL	713.48	0.48	0	0	4.58	BDL	BDL	BDL	BDL	3.63
103	Takli	HP	21.35194	78.98917	92.88	0.24	0.01	11.09	0.18	0.4	0.08	15.35	0.05	0.31	256.2	3.35	0	0	3.39	BDL	BDL	BDL	BDL	0.2
104	Takli	DW	21.35306	78.99056	28.13	0.04	0	19.54	0.21	0.51	0.24	84.27	0.08	0.09	350.38	2.41	0	0	7.4	BDL	BDL	BDL	BDL	1.93
105	Kawadas	DW	21.31611	79.04806	121.67	0.77	0.7	0.63	0.19	0.14	0.25	12.32	0.22	0.5	860.42	1.22	0	0	2.83	BDL	BDL	BDL	BDL	4.43
106	Kawadas	HP	21.31722	79.04778	77.92	1.8	0.7	0.07	0.17	BDL	0.16	8.28	0.51	0.57	619.78	1.78	0	0	7.44	BDL	0	0	0	3.24
107	Isapur	DW	21.33	79.07222	139.53	0.05	0.01	94.73	0.22	1.25	0.29	865.01	0.13	4.8	1006.89	1.31	0	0.09	2.68	BDL	BDL	0	BDL	2.06
108	Yeltur	BW	21.33944	79.05111	99.66	0.88	6.69	3.45	0.25	BDL	0.14	42.91	0.56	0.39	507.32	1.96	0	0.01	7.43	BDL	BDL	BDL	BDL	3.73
109	Yeltur	DW	21.34111	79.05222	94.96	2.52	0.12	0.06	0.14	0.18	0.46	5.34	0.12	0.06	504.43	0.26	0	0	8.58	BDL	BDL	BDL	BDL	4.85
110	Gosewadi	DW	21.35083	79.06139	92.09	0.54	0.13	0.04	0.17	0.14	0.48	3.95	0.17	0.1	648.23	0.51	0	0	27.3	BDL	BDL	BDL	BDL	4.41
111	Gosewadi	BW	21.36083	79.06917	49.02	0.5	1.6	0.07	0.24	BDL	0.17	3.16	0.56	0.36	408.45	0.92	0	0	9.42	BDL	BDL	BDL	BDL	2.5
112	Itangoti	HP	21.31806	79.00444	98.21	1.58	4.46	1.12	0.58	0.44	0.42	38.41	0.67	1.02	779.64	1.38	0.01	0.02	2.53	BDL	0.02	0.02	0.02	1.86
113	Itangoti	DW	21.31722	79.005	114.37	0.33	0.01	57.67	0.27	0.98	0.42	21.54	0.12	0.29	710.02	1.63	0	0	8.8	BDL	0	0	0	1.79
114	Sillori	HP	21.31167	78.97028	89.5	0.05	0.01	30.52	0.23	0.53	0.58	505.56	0.05	6.47	839.58	1.42	0	0.04	12.93	BDL	0.01	0.01	0.01	1.76
115	Sillori	DW	21.31306	78.97028	177.16	0.58	1.03	0.04	0.25	0.04	0.28	4.61	0.24	2.22	2457.71	3.55	0	0	8.78	BDL	BDL	BDL	BDL	4.06
116	Brahapuri	DW	21.31306	78.96194	78.63	2.57	1.98	0.15	0.71	0.09	0.39	7.45	0.23	1.77	734.58	1.04	0.01	0.01	4.69	BDL	0.01	0.01	0.01	2.52
117	Brahapuri	BW	21.31306	78.96194	141.82	0.4	0.28	0.27	0.16	BDL	0.08	2.13	0.22	0.73	518.19	1.12	0	0	15.75	BDL	BDL	BDL	BDL	2.67
118	Adasa	HP	21.33361	78.93944	73.09	0.8	0.01	422.78	0.59	2.31	2.77	3363.52	0.12	1.42	339.1	0.8	0	0.13	49.43	BDL	0.23	0.26	0.25	0.01

S.No	LOCATION	SAMPLE_ID	LATITUDE	LONGITUDE	B	Al	Cr	Mn	Fe	Ni	Cu	Zn	As	Se	Sr	Mo	Ag	Cd	Ba	Hg	206 [Pb]	207 [Pb]	208 Pb	238 U
					ppb																			
119	Adasa	BW	21.32972	78.94167	57.12	1.23	0.45	5.06	0.28	0.02	0.15	57.34	0.05	1.39	381.29	0.16	0.01	0.01	130.26	BDL	0	0	0	0.76
120	Sonapur	DW	21.32861	78.95389	183.29	2.26	0.17	0.05	0.22	BDL	0.15	1.74	0.19	0.29	848.55	0.77	0	0	12.79	BDL	0	0	0	3.81
121	Erangaon	DW	21.32861	78.97028	121.76	0.53	0.05	0.03	0.24	BDL	0.39	2.17	0.7	BDL	521.74	1.23	0	0	8.98	BDL	BDL	BDL	BDL	2.61
122	Katodi	DW	21.33694	78.96278	82.81	0.57	0.15	0.03	0.18	0.05	0.19	17.97	0.04	0.25	638.58	0.53	0	0.01	48.57	BDL	BDL	BDL	BDL	3.72
123	Patakakhedi	BW	21.35639	78.95222	89.68	0.28	0.2	0.05	0.19	BDL	0.05	2.26	0.19	0.74	1006.92	0.49	0	0	5.32	BDL	BDL	BDL	BDL	6.52
124	Patakakhedi	DW	21.35861	78.95222	110.72	1.09	0.6	0.02	0.22	BDL	0.49	4.54	0.33	0.11	1245.71	0.68	0	0	16.12	BDL	BDL	BDL	BDL	6.6
125	Borujwada	BW	21.37139	78.95	111.79	3.2	0.14	0.13	0.37	BDL	0.17	4.79	0.22	BDL	822.98	0.62	0	0	5.48	BDL	BDL	BDL	BDL	3.99
126	Gujarkhedi	DW	21.37556	78.94361	76.76	1.11	1.55	0.4	0.19	BDL	0.13	7.76	0.46	0.33	647.34	1.66	0	0	2.67	BDL	0	0	0	3.86
127	Gujarkhedi	HP	21.37611	78.94389	81.96	0.03	0	34.95	0.15	0.46	0.07	107.06	0.08	BDL	429.89	3.16	0	0.01	8.5	BDL	BDL	BDL	BDL	3.09
128	Malegaon	HP	21.36083	78.96361	145.54	0.24	0.01	41.23	0.18	BDL	0.24	62.73	0.08	BDL	457.62	0.74	0	0.02	17.26	BDL	0.01	0.02	0.02	1.68
129	Malegaon	DW	21.36278	78.96028	68.96	1.65	0.66	0.2	0.19	0.19	0.29	28.32	0.36	BDL	907.69	1.14	0	0.03	11.23	BDL	BDL	BDL	BDL	3.39
130	Manegaon	HP	21.35889	78.97972	61.22	0.05	0.15	21.26	0.26	1.07	0.31	381.17	0.13	0.11	583.56	1.05	0	0.05	6.27	BDL	0.01	0.01	0.01	1.94
131	Manegaon	DW	21.36	78.97833	66.7	0.33	11.77	0.07	2.54	1.19	0.13	4.46	0.38	0.04	795.37	0.91	0	0	4.71	BDL	0	0	0	6.23

Annexure IX: Village wise Supply Side Interventions in Saoner Taluka

(Normal Rainfall 1.009 m; Runoff Coefficient- 0.11)

Sr. no.	Name of Villages	Area identified for AR Km2 (WL>3m Post23	Runoff generated (MCM)	50 %for existing + 5% eflows	Post-monsoon Water Level	Unsaturated thickness	Volume of unsaturated zone Hard Rock	Recharge Potential	Runoff available for recharge	No. of PT	No. of CD	No. of RS	Total Structures	Volume of Water expected to be conserved / recharged @ 75% efficiency
1	Ajani	4.52	0.38	0.17	7.4	4.4	19.86662	1.39	0.17	0	2	2	4	0.13
2	Angewada	2.37	0.20	0.09	9.1	6.1	14.45168	1.01	0.09	0	1	1	2	0.07
3	Ashti Bk.	3.51	0.29	0.13	5.2	2.2	7.731712	0.12	0.12	0	1	1	2	0.09
4	Badegaon	10.22	0.85	0.38	6.1	3.1	31.67378	0.48	0.38	1	4	4	9	0.29
5	Bawangaon	6.54	0.54	0.24	16.2	13.2	86.27232	1.29	0.24	0	3	3	6	0.18
6	Belori Kh.	2.44	0.20	0.09	6.5	3.5	8.551045	0.60	0.09	0	1	1	2	0.07
7	Bhanegaon	7.67	0.64	0.29	15.5	12.5	95.93181	1.44	0.29	0	3	3	6	0.22
8	Bhendala	7.65	0.64	0.29	11.45	8.45	64.62766	4.52	0.29	0	3	3	6	0.21
9	Bhojapur	3.17	0.26	0.12	4.6	1.6	5.079878	0.10	0.10	0	1	1	2	0.08
10	Bichawa	5.71	0.47	0.21	3.5	0.5	2.852796	0.04	0.04	0	0	0	0	0.03
11	Bidachichghat	0.96	0.08	0.04	12.3	9.3	8.884638	0.62	0.04	0	0	0	0	0.03
12	Bidkawadas	0.55	0.05	0.02	15.1	12.1	6.614088	0.46	0.02	0	0	0	0	0.02
13	Borgaon Jangli	6.11	0.51	0.23	3.2	0.2	1.222492	0.02	0.02	0	0	0	0	0.02
14	Borujwada	3.56	0.30	0.13	8.8	5.8	20.67677	1.45	0.13	0	2	2	4	0.10
15	Bramhpuri	1.90	0.16	0.07	6.5	3.5	6.65075	0.47	0.07	0	1	1	2	0.05
16	Champa	4.21	0.35	0.16	5.5	2.5	10.52435	0.74	0.16	0	2	2	4	0.12
17	Chandkapur (CT)	5.15	0.43	0.19	8.4	5.4	27.80949	1.95	0.19	0	2	2	4	0.14
18	Chhatrapur	5.11	0.43	0.19	3.5	0.5	2.553559	0.05	0.05	0	1	1	2	0.04
19	Chichghat	1.51	0.13	0.06	7.6	4.6	6.946253	0.49	0.06	0	1	1	2	0.04
20	Chicholi (CT)	3.35	0.28	0.13	10.5	7.5	25.09888	1.76	0.13	0	1	1	2	0.09
21	Chorkhairi	4.53	0.38	0.17	7.4	4.4	19.94755	0.30	0.17	0	2	2	4	0.13

Sr. no.	Name of Villages	Area identified for AR Km2 (WL>3m Post23	Runoff generated (MCM)	50 %for existing + 5% eflows	Post-monsoon Water Level	Unsaturated thickness	Volume of unsaturated zone Hard Rock	Recharge Potential	Runoff available for recharge	No. of PT	No. of CD	No. of RS	Total Structures	Volume of Water expected to be conserved / recharged @ 75% efficiency
22	Dahegaon(Rangari)	3.54	0.29	0.13	9.2	6.2	21.92411	1.53	0.13	0	2	2	4	0.10
23	Dhakara	2.69	0.22	0.10	3.9	0.9	2.418888	0.04	0.04	0	0	0	0	0.03
24	Dohanghat	4.21	0.35	0.16	18.8	15.8	66.49032	4.65	0.16	0	2	2	4	0.12
25	Dudhbardi	1.28	0.11	0.05	7.7	4.7	6.003515	0.42	0.05	0	1	1	2	0.04
26	Erangaon	3.35	0.28	0.13	14.7	11.7	39.2344	2.75	0.13	0	1	1	2	0.09
27	Gadami	1.54	0.13	0.06	13.35	10.35	15.97884	0.24	0.06	0	1	1	2	0.04
28	Gadegaon	2.61	0.22	0.10	12.8	9.8	25.59304	1.79	0.10	0	1	1	2	0.07
29	Gosewadi	7.31	0.61	0.27	16.2	13.2	96.44902	6.75	0.27	0	3	3	6	0.21
30	Gujarkhedi	3.31	0.28	0.12	3.3	0.3	0.994227	0.07	0.07	0	1	1	2	0.05
31	Gumgaon	3.32	0.28	0.12	6.7	3.7	12.27167	0.86	0.12	0	1	1	2	0.09
32	Hattisarra	2.98	0.25	0.11	4	1	2.982032	0.04	0.04	0	1	1	2	0.03
33	Hetikheda	3.31	0.28	0.12	11.35	8.35	27.66578	0.41	0.12	0	1	1	2	0.09
34	Hetisurla	8.52	0.71	0.32	8.9	5.9	50.24366	3.52	0.32	0	4	4	8	0.24
35	Hingna	2.25	0.19	0.08	3.3	0.3	0.675163	0.01	0.01	0	0	0	0	0.01
36	Isapur	5.43	0.45	0.20	18.5	15.5	84.24024	5.90	0.20	0	2	2	4	0.15
37	Itangoti	4.74	0.39	0.18	5.1	2.1	9.945897	0.70	0.18	0	2	2	4	0.13
38	Jaitgad	6.81	0.57	0.26	4.8	1.8	12.25492	0.18	0.18	0	2	2	4	0.14
39	Jaitpur	4.84	0.40	0.18	7.9	4.9	23.73967	0.47	0.18	0	2	2	4	0.14
40	Jakhewada	1.25	0.10	0.05	4.6	1.6	1.995351	0.04	0.04	0	0	0	0	0.03
41	Jatamkhora	5.22	0.43	0.20	9.1	6.1	31.83441	0.64	0.20	0	2	2	4	0.15
42	Junewani	2.82	0.23	0.11	3.2	0.2	0.564008	0.01	0.01	0	0	0	0	0.01
43	Karajghat	2.78	0.23	0.10	19.8	16.8	46.77859	3.27	0.10	0	1	1	2	0.08
44	Katodi	3.84	0.32	0.14	19.9	16.9	64.97449	1.95	0.14	0	2	2	4	0.11

Sr. no.	Name of Villages	Area identified for AR Km2 (WL>3m Post23	Runoff generated (MCM)	50 %for existing + 5% eflows	Post-monsoon Water Level	Unsaturated thickness	Volume of unsaturated zone Hard Rock	Recharge Potential	Runoff available for recharge	No. of PT	No. of CD	No. of RS	Total Structures	Volume of Water expected to be conserved / recharged @ 75% efficiency
45	Kawadas	4.96	0.41	0.19	15.1	12.1	60.0169	4.20	0.19	0	2	2	4	0.14
46	Kawatha	7.17	0.60	0.27	6.9	3.9	27.97044	0.42	0.27	0	3	3	6	0.20
47	Kelwad	6.78	0.56	0.25	14.6	11.6	78.6727	1.18	0.25	0	3	3	6	0.19
48	Khairi (Dhalgaon)	7.39	0.61	0.28	14	11	81.24669	5.69	0.28	0	3	3	6	0.21
49	Khairi (Panjabrao)	2.34	0.19	0.09	7.2	4.2	9.825418	0.15	0.09	0	1	1	2	0.07
50	Khangaon	4.87	0.41	0.18	4.5	1.5	7.301219	0.51	0.18	0	2	2	4	0.14
51	Khapa (Janabai)	2.21	0.18	0.08	9.7	6.7	14.83681	0.30	0.08	0	1	1	2	0.06
52	Khapa (M Cl)	5.69	0.47	0.21	16.3	13.3	75.62967	2.27	0.21	0	2	2	4	0.16
53	Khapa (Narsala)	2.39	0.20	0.09	6.3	3.3	7.885154	0.16	0.09	0	1	1	2	0.07
54	Kharduka	1.30	0.11	0.05	18.3	15.3	19.87729	0.30	0.05	0	1	1	2	0.04
55	Khedi	2.02	0.17	0.08	7.8	4.8	9.696763	0.29	0.08	0	1	1	2	0.06
56	Khubala	11.13	0.93	0.42	14.6	11.6	129.1602	1.94	0.42	1	5	5	11	0.31
57	Khurajgaon	5.24	0.44	0.20	13.25	10.25	53.68085	3.76	0.20	0	2	2	4	0.15
58	Khursapar	6.04	0.50	0.23	7.7	4.7	28.3918	0.57	0.23	0	3	3	6	0.17
59	Kirnapur	2.53	0.21	0.09	3.2	0.2	0.506323	0.01	0.01	0	0	0	0	0.01
60	Kocchi	5.38	0.45	0.20	14.4	11.4	61.34629	0.92	0.20	0	2	2	4	0.15
61	Kodadongri	3.39	0.28	0.13	12.5	9.5	32.20534	2.25	0.13	0	1	1	2	0.10
62	Kodegaon	8.11	0.68	0.30	8.38	5.38	43.62943	3.05	0.30	0	4	4	8	0.23
63	Kormeta	2.88	0.24	0.11	6.6	3.6	10.35896	0.16	0.11	0	1	1	2	0.08
64	Kusumbi	2.18	0.18	0.08	5.06	2.06	4.497935	0.07	0.07	0	1	1	2	0.05
65	Kusumbi	4.17	0.35	0.16	5.06	2.06	8.587809	0.60	0.16	0	2	2	4	0.12
66	Malegaon	6.42	0.53	0.24	6.4	3.4	21.81892	0.44	0.24	0	3	3	6	0.18
67	Malegaon	5.76	0.48	0.22	19.36	16.36	94.17577	6.59	0.22	0	3	3	6	0.16
68	Manegaon	3.58	0.30	0.13	12.5	9.5	34.00263	2.38	0.13	0	2	2	4	0.10

Sr. no.	Name of Villages	Area identified for AR Km2 (WL>3m Post23	Runoff generated (MCM)	50 %for existing + 5% eflows	Post-monsoon Water Level	Unsaturated thickness	Volume of unsaturated zone Hard Rock	Recharge Potential	Runoff available for recharge	No. of PT	No. of CD	No. of RS	Total Structures	Volume of Water expected to be conserved / recharged @ 75% efficiency
69	Mangsa	5.59	0.47	0.21	4.3	1.3	7.263767	0.15	0.15	0	2	2	4	0.11
70	Mohagaon (Jangali)	2.90	0.24	0.11	10.6	7.6	22.00956	0.33	0.11	0	1	1	2	0.08
71	Nagalwadi	3.29	0.27	0.12	6.6	3.6	11.84136	0.18	0.12	0	1	1	2	0.09
72	Nanda Gomukh	7.78	0.65	0.29	7.8	4.8	37.33418	0.75	0.29	0	3	3	6	0.22
73	Nanda Kh.	2.18	0.18	0.08	4.2	1.2	2.614287	0.18	0.08	0	1	1	2	0.06
74	Nandapur	4.46	0.37	0.17	17.4	14.4	64.24773	4.50	0.17	0	2	2	4	0.13
75	Nandori	2.82	0.24	0.11	4.3	1.3	3.670165	0.26	0.11	0	1	1	2	0.08
76	Narsala	1.65	0.14	0.06	6.7	3.7	6.08651	0.12	0.06	0	1	1	2	0.05
77	Nimtalai	1.94	0.16	0.07	3.3	0.3	0.582346	0.01	0.01	0	0	0	0	0.01
78	Pandharakhedi	3.07	0.26	0.12	17.05	14.05	43.17508	3.02	0.12	0	1	1	2	0.09
79	Pandhari (J)	3.58	0.30	0.13	4.7	1.7	6.087539	0.12	0.12	0	1	1	2	0.09
80	Pardi (Rithi)	2.41	0.20	0.09	6.1	3.1	7.459144	0.52	0.09	0	1	1	2	0.07
81	Parsodi	3.76	0.31	0.14	5.4	2.4	9.025931	0.63	0.14	0	2	2	4	0.11
82	Patakakhedi	4.00	0.33	0.15	9.6	6.6	26.40686	0.79	0.15	0	2	2	4	0.11
83	Patansavangi	10.44	0.87	0.39	10.2	7.2	75.19109	5.26	0.39	1	5	5	11	0.29
84	Pendhari	2.29	0.19	0.09	14.8	11.8	27.01246	0.41	0.09	0	1	1	2	0.06
85	Pipala (Bhadao)	1.32	0.11	0.05	8	5	6.609476	0.13	0.05	0	1	1	2	0.04
86	Pipla (da-B)	4.44	0.37	0.17	9.4	6.4	28.39822	1.99	0.17	0	2	2	4	0.12
87	Pipla (Rithi)	1.19	0.10	0.04	9.2	6.2	7.357025	0.51	0.04	0	1	1	2	0.03
88	Pohana	1.74	0.14	0.07	5.2	2.2	3.823192	0.08	0.07	0	1	1	2	0.05
89	Pota	2.89	0.24	0.11	16.3	13.3	38.40741	2.69	0.11	0	1	1	2	0.08
90	Raibasa	9.35	0.78	0.35	3.2	0.2	1.870785	0.03	0.03	0	0	0	0	0.02
91	Raiwadi	3.92	0.33	0.15	11.5	8.5	33.28731	0.50	0.15	0	2	2	4	0.11

Sr. no.	Name of Villages	Area identified for AR Km2 (WL>3m Post23	Runoff generated (MCM)	50 %for existing + 5% eflows	Post-monsoon Water Level	Unsaturated thickness	Volume of unsaturated zone Hard Rock	Recharge Potential	Runoff available for recharge	No. of PT	No. of CD	No. of RS	Total Structures	Volume of Water expected to be conserved / recharged @ 75% efficiency
92	Rajana (Halad)	2.50	0.21	0.09	12.3	9.3	23.25469	1.63	0.09	0	1	1	2	0.07
93	Rajegaon	2.96	0.25	0.11	5.6	2.6	7.686506	0.12	0.11	0	1	1	2	0.08
94	Ramdongari	5.31	0.44	0.20	14.5	11.5	61.08504	0.92	0.20	0	2	2	4	0.15
95	Ranala	3.63	0.30	0.14	6.3	3.3	11.97113	0.84	0.14	0	2	2	4	0.10
96	Risala	3.50	0.29	0.13	4.4	1.4	4.894766	0.07	0.07	0	1	1	2	0.06
97	Rohana	2.70	0.23	0.10	17.2	14.2	38.40911	2.69	0.10	0	1	1	2	0.08
98	Salai	4.27	0.36	0.16	7.6	4.6	19.63671	0.39	0.16	0	2	2	4	0.12
99	Sarra	2.73	0.23	0.10	4.6	1.6	4.371642	0.07	0.07	0	1	1	2	0.05
100	Savner (M Cl)	12.46	1.04	0.47	4.4	1.4	17.44187	0.35	0.35	1	4	4	9	0.26
101	Sawangi	3.00	0.25	0.11	5.02	2.02	6.052528	0.12	0.11	0	1	1	2	0.08
102	Sherdi	2.17	0.18	0.08	6.5	3.5	7.610585	0.53	0.08	0	1	1	2	0.06
103	Sillewada (CT)	3.05	0.25	0.11	16.5	13.5	41.20358	2.88	0.11	0	1	1	2	0.09
104	Sillori	4.80	0.40	0.18	5.8	2.8	13.44549	0.94	0.18	0	2	2	4	0.13
105	Sindewani Bk.	3.05	0.25	0.11	4.5	1.5	4.57546	0.07	0.07	0	1	1	2	0.05
106	Sindewani Kh.	1.84	0.15	0.07	6.5	3.5	6.456994	0.10	0.07	0	1	1	2	0.05
107	Sironji	3.68	0.31	0.14	9	6	22.10095	0.33	0.14	0	2	2	4	0.10
108	Sonpur	5.11	0.43	0.19	10	7	35.7818	0.54	0.19	0	2	2	4	0.14
109	Surewani	0.46	0.04	0.02	6.9	3.9	1.813444	0.03	0.02	0	0	0	0	0.01
110	Takali	5.14	0.43	0.19	15.2	12.2	62.7563	4.39	0.19	0	2	2	4	0.14
111	Tekadi	1.55	0.13	0.06	4	1	1.550048	0.02	0.02	0	0	0	0	0.02
112	Tembhurdoh	8.03	0.67	0.30	14	11	88.34549	1.33	0.30	0	4	4	8	0.23
113	Tigai	3.73	0.31	0.14	6.2	3.2	11.931	0.84	0.14	0	2	2	4	0.10
114	Umari	2.48	0.21	0.09	5.4	2.4	5.950092	0.42	0.09	0	1	1	2	0.07

Sr. no.	Name of Villages	Area identified for AR Km2 (WL>3m Post23	Runoff generated (MCM)	50 %for existing + 5% eflows	Post-monsoon Water Level	Unsaturated thickness	Volume of unsaturated zone Hard Rock	Recharge Potential	Runoff available for recharge	No. of PT	No. of CD	No. of RS	Total Structures	Volume of Water expected to be conserved / recharged @ 75% efficiency
115	Umari (Bharatpur)	10.03	0.83	0.38	5.3	2.3	23.0578	0.46	0.38	1	4	4	9	0.28
116	Umari jambhalpani	5.20	0.43	0.19	8.5	5.5	28.59787	0.43	0.19	0	2	2	4	0.15
117	Waghoda (CT)	2.08	0.17	0.08	8.3	5.3	11.01023	0.77	0.08	0	1	1	2	0.06
118	Wagholi	3.77	0.31	0.14	3.3	0.3	1.131802	0.02	0.02	0	0	0	0	0.01
119	Waki	6.40	0.53	0.24	8.3	5.3	33.92173	2.37	0.24	0	3	3	6	0.18
120	Wakodi	8.92	0.74	0.33	15.3	12.3	109.7172	1.65	0.33	1	4	4	9	0.25
121	Walani (CT)	4.76	0.40	0.18	14.2	11.2	53.33508	3.73	0.18	0	2	2	4	0.13
122	Warpani	5.53	0.46	0.21	5	2	11.05298	0.17	0.17	0	2	2	4	0.12
123	Weltur	4.06	0.34	0.15	9.7	6.7	27.20358	1.90	0.15	0	2	2	4	0.11
	Total	518.53	43.16	19.42	1117.33	748.33	3301.66	147.99	17.42	6	200	200	406	13.06

Annexure X(a): Categorisation of village based on the current available ground water source

1. Basic Information										2. Assessement of demand and supply										
Sr No.	Gram Panchayat	Latitude	Longitude	Population	Aquifer Type Soft Rock/ Hard Rock	Dug Well/TW/BW	Sustainable throughout the year? Yes/ No	Average pumping hours/day	Water Quality Issue Saline /F/Fe/ NO3/ As	Population	Per capita water supply (minimum 55 LPCD)	Nos of days	Annual Demand (cubic metre/year)	No. of Structures (DW/ BW/TW)	Discharge Cubic m/hr	Nos of Running Hours/ day	Annual Extraction (cubic metre/year)	Loss (15% of b)	Actual water supplied	Supply-Demand Gap	Gap between demand and supply (%)
										1	2	3	(1*2*3)/1000 = (a)	1	2	3	1*2*3*365 = (b)	(C)	d=b-c	(d)-(a)	
1	Aajni (Se)	21.4028	78.93244	2339	Hardrock	DW	Yes	8	NO	2339	55	365	46955.43	4	10.8	8	126144	18921.6	107222.4	60266.98	128
2	Badegaon	21.48081	78.96181	3931	Hardrock	DW, TW	Yes	8	NO	3931	55	365	78914.83	3	14.4	8	126144	18921.6	107222.4	28307.58	36
3	Bhanegaon	21.26577	79.13502	7636	Soft Rock	DW	Yes	12	NO	7636	55	365	153292.7	2	23	12	201480	30222	171258	17965.3	12
4	Bhendala	21.36271	79.01598	1346	Soft Rock	DW	Yes	8	NO	1346	55	365	27020.95	1	16	8	46720	7008	39712	12691.05	47
5	Bichwa	21.56326	78.95676	813	Hardrock	DW	Yes	8	F= 1.55	813	55	365	16320.98	1	10.8	8	31536	4730.4	26805.6	10484.63	64
6	Bramhpuri	21.31624	78.9616	873	Soft Rock	DW	Yes	4	NO	873	55	365	17525.48	2	10.8	4	31536	4730.4	26805.6	9280.125	53
7	Borujwada	21.37657	78.95489	1603	Soft Rock	DW, TW	Yes	4	NO	1603	55	365	32180.23	4	10.8	4	63072	9460.8	53611.2	21430.98	67
8	Champa	21.29585	79.00641	941	Soft Rock	DW	Yes	4	NO	941	55	365	18890.58	4	10.8	4	63072	9460.8	53611.2	34720.63	184
9	Chicholi (CT)	21.26982	79.11676	20962	Soft Rock	DW	Yes	12	NO	20962	55	365	420812.2	5	23	12	503700	75555	428145	7332.85	2
10	Dahegaon (Rangari)	21.28552	79.08277	8398	Soft Rock	DW	Yes	12	NO	8398	55	365	168589.9	2	23	12	201480	30222	171258	2668.15	2
11	Isapur	21.33673	79.0703	2191	Soft Rock	TW	Yes	8	NO	2191	55	365	43984.33	1	23	8	67160	10074	57086	13101.68	30
12	Itangoti	21.3133	78.99853	847	Soft Rock	DW	Yes	4	NO	847	55	365	17003.53	3	10.8	4	47304	7095.6	40208.4	23204.88	136
13	Gadegaon	21.43333	78.94445	1456	Hardrock	DW, TW	Yes	4	NO	1456	55	365	29229.2	7	9	4	91980	13797	78183	48953.8	167
14	Gadmi	21.44552	79.04502	2046	Hardrock	DW	Yes	8	NO	2046	55	365	41073.45	4	9	8	105120	15768	89352	48278.55	118
15	Gosewadi	21.36439	79.06162	745	Soft Rock	DW	Yes	4	NO	754	55	365	15136.55	2	10.8	4	31536	4730.4	26805.6	11669.05	77
16	Gumgaon	21.39282	78.98759	344	Soft Rock	DW	Yes	4	Fe >1	344	55	365	6905.8	1	10.8	4	15768	2365.2	13402.8	6497	94
17	Hattisarra	21.4624	78.91441	1732	Hardrock	DW	Yes	4	F=1.62	1732	55	365	34769.9	4	10.8	4	63072	9460.8	53611.2	18841.3	54
18	Jaitpur	21.45002	78.76575	1068	Hardrock	DW,TW	Yes	4	NO	1068	55	365	21440.1	3	10.8	4	47304	7095.6	40208.4	18768.3	88

1. Basic Information										2. Assessement of demand and supply											
Sr No.	Gram Panchayat	Latitude	Longitude	Population	Aquifer Type Soft Rock/ Hard Rock	Dug Well/TW/BW	Sustainable throughout the year? Yes/ No	Average pumping hours/day	Water Quality Issue Saline /F/Fe/ NO3/ As	Population	Per capita water supply (minimum 55 LPCD)	Nos of days	Annual Demand (cubic metre/year)	No. of Structures (DW/ BW/TW)	Discharge Cubic m/hr	Nos of Running Hours/ day	Annual Extraction (cubic metre/year)	Loss (15% of b)	Actual water supplied	Supply-Demand Gap	Gap between demand and supply (%)
										1	2	3	(1*2*3)/1000 = (a)	1	2	3	1*2*3*365 = (b)	(C)	d=b-c	(d)-(a)	
19	Joga	21.4525	78.74411	830	Hardrock	DW	Yes	4	NO	830	55	365	16662.25	2	10.8	4	31536	4730.4	26805.6	10143.35	61
20	Kelwad	21.45512	78.87815	8259	Hardrock	DW	Yes	8	F=1.92	8259	55	365	165799.4	2	23	12	201480	30222	171258	5458.575	3
21	Kharduka	21.48937	78.94384	613	Hardrock	DW	Yes	4	NO	613	55	365	12305.98	2	10.8	4	31536	4730.4	26805.6	14499.63	118
22	Khairi (Dhal)	21.47034	78.93232	2164	Hardrock	DW	Yes	8	NO	2164	55	365	43442.3	2	14.4	8	84096	12614.4	71481.6	28039.3	65
23	Khairi(P)	21.42904	79.00874	1410	Hardrock	DW	Yes	4	NO	1410	55	365	28305.75	4	10.8	4	63072	9460.8	53611.2	25305.45	89
24	Khangaon	21.42712	78.92126	1754	Hardrock	DW	Yes	8	NO	1754	55	365	35211.55	2	10.8	8	63072	9460.8	53611.2	18399.65	52
25	Khapa (Narsala)	21.42097	78.83918	614	Hardrock	DW	Yes	4	NO	614	55	365	12326.05	2	10.8	4	31536	4730.4	26805.6	14479.55	117
26	Khubala	21.46338	79.00061	3546	Hardrock	DW	Yes	8	NO	3546	55	365	71185.95	5	10.8	8	157680	23652	134028	62842.05	88
27	Khurajgaon	21.41528	78.90693	1642	Soft Rock	DW	Yes	8	NO	1642	55	365	32963.15	2	10.8	8	63072	9460.8	53611.2	20648.05	63
28	Khursapar	21.47741	78.75954	905	Hardrock	DW	Yes	8	NO	905	55	365	18167.88	1	10.8	8	31536	4730.4	26805.6	8637.725	48
29	Kirnapur	21.40798	79.02863	636	Hardrock	DW	Yes	4	NO	636	55	365	12767.7	2	10.8	4	31536	4730.4	26805.6	14037.9	110
30	Kocchi	21.45845	78.96544	1890	Hardrock	DW	Yes	12	NO	1890	55	365	37941.75	1	14.4	12	63072	9460.8	53611.2	15669.45	41
31	Kodegaon	21.40634	78.95896	1547	Soft Rock	DW	Yes	8	NO	1547	55	365	31056.03	1	21	8	61320	9198	52122	21065.98	68
32	Kothulana	21.41842	79.03862	2186	Hardrock	DW	Yes	12	NO	2186	55	365	43883.95	1	21	12	91980	13797	78183	34299.05	78
33	Kotodi	21.33916	78.96573	1202	Soft Rock	DW	Yes	4	NO	1202	55	365	24130.15	3	10.8	4	47304	7095.6	40208.4	16078.25	67
34	Kusumbi	21.33627	78.99316	832	Soft Rock	DW	Yes	4	NO	832	55	365	16702.4	2	10.8	4	31536	4730.4	26805.6	10103.2	60
35	Malegaon (Jo)	21.43031	78.734	888	Hardrock	DW	Yes	8	F=3.57	888	55	365	17826.6	1	10.8	8	31536	4730.4	26805.6	8979	50
36	Malegaon(T)	21.37202	78.96901	2492	Soft Rock	DW	Yes	8	NO	2492	55	365	50026.9	3	10.8	8	94608	14191.2	80416.8	30389.9	61
37	Manegaon	21.36535	78.98234	2354	Soft Rock	DW	Yes	8	NO	2354	55	365	47256.55	3	10.8	8	94608	14191.2	80416.8	33160.25	70
38	Mangsa	21.42138	78.88416	2464	Soft Rock	DW	Yes	8	NO	2464	55	365	49464.8	2	14.4	8	84096	12614.4	71481.6	22016.8	45

1. Basic Information										2. Assessement of demand and supply											
Sr No.	Gram Panchayat	Latitude	Longitude	Population	Aquifer Type Soft Rock/ Hard Rock	Dug Well/TW/BW	Sustainable throughout the year? Yes/ No	Average pumping hours/day	Water Quality Issue Saline /F/Fe/ NO3/ As	Population	Per capita water supply (minimum 55 LPCD)	Nos of days	Annual Demand (cubic metre/year)	No. of Structures (DW/ BW/TW)	Discharge Cubic m/hr	Nos of Running Hours/ day	Annual Extraction (cubic metre/year)	Loss (15% of b)	Actual water supplied	Supply-Demand Gap	Gap between demand and supply (%)
										1	2	3	(1*2*3)/1000 = (a)	1	2	3	1*2*3*365 = (b)	(C)	d=b-c	(d)-(a)	
39	Nandagomukh	21.41847	78.76502	4690	Hardrock	DW	Yes	8	NO	4690	55	365	94151.75	3	18	8	157680	23652	134028	39876.25	42
40	Nandori	21.44936	78.92217	1647	Hardrock	DW	Yes	8	NO	1647	55	365	33063.53	3	10.8	8	94608	14191.2	80416.8	47353.28	143
41	Nimtalai	21.42634	79.0431	1564	Hardrock	DW	Yes	8	NO	1564	55	365	31397.3	2	10.8	8	63072	9460.8	53611.2	22213.9	71
42	Patakakhedi	21.35199	78.95061	1516	Soft Rock	DW	Yes	8	NO	1516	55	365	30433.7	3	10.8	8	94608	14191.2	80416.8	49983.1	164
43	Pandhari	21.4608	79.04797	386	Hardrock	DW	Yes	4	NO	386	55	365	7748.95	1	10.8	4	15768	2365.2	13402.8	5653.85	73
44	Parsodi	21.43573	78.89826	1048	Hardrock	DW	Yes	4	NO	1048	55	365	21038.6	3	10.8	4	47304	7095.6	40208.4	19169.8	91
45	Patansavangi	21.33346	79.02133	12982	Soft Rock	DW	Yes	12	NO	12982	55	365	260613.7	4	23	12	402960	60444	342516	81902.35	31
46	Pipla	21.30987	79.07114	4739	Soft Rock	DW	Yes	12	NO	4739	55	365	95135.43	2	18	12	157680	23652	134028	38892.58	41
47	Pota	21.30557	79.11632	17734	Soft Rock	DW	Yes	12	NO	17734	55	365	356010.1	4	23	12	402960	60444	342516	-13494.1	-4
48	Rampuri	21.4421	78.86631	1145	Hardrock	DW	Yes	8	NO	1145	55	365	22985.88	2	10.8	8	63072	9460.8	53611.2	30625.33	133
49	Rohana	21.31303	79.10807	1867	Soft Rock	DW	Yes	8	NO	1867	55	365	37480.03	2	10.8	8	63072	9460.8	53611.2	16131.18	43
50	Salai	21.42239	78.78921	1205	Hardrock	DW	Yes	8	NO	1205	55	365	24190.38	2	10.8	8	63072	9460.8	53611.2	29420.83	122
51	Sarra	21.57374	78.99894	2268	Hardrock	DW	Yes	8	NO	2268	55	365	45530.1	3	10.8	8	94608	14191.2	80416.8	34886.7	77
52	Sawali	21.47009	78.78889	1147	Hardrock	DW	Yes	8	NO	1147	55	365	23026.03	2	10.8	8	63072	9460.8	53611.2	30585.18	133
53	Sawngi(H)	21.37612	78.87965	2944	Hardrock	DW	Yes	8	NO	2944	55	365	59100.8	3	10.8	8	94608	14191.2	80416.8	21316	36
54	Sillewada (CT)	21.292	79.12132	8274	Soft Rock	DW	Yes	12	NO	8274	55	365	166100.6	2	23	12	201480	30222	171258	5157.45	3
55	Sillori	21.31345	78.97736	1010	Soft Rock	DW	Yes	8	NO	1010	55	365	20275.75	2	10.8	8	63072	9460.8	53611.2	33335.45	164
56	Sindewani	21.58694	78.93263	1280	Hardrock	DW	Yes	4	NO	1280	55	365	25696	3	10.8	4	47304	7095.6	40208.4	14512.4	56
57	Sironji	21.55684	78.98149	1592	Hardrock	DW	Yes	8	NO	1592	55	365	31959.4	3	10.8	8	94608	14191.2	80416.8	48457.4	152
58	Sonpur	21.54111	78.97889	659	Hardrock	DW	Yes	4	NO	659	55	365	13229.43	2	10.8	4	31536	4730.4	26805.6	13576.18	103

1. Basic Information										2. Assessement of demand and supply											
Sr No.	Gram Panchayat	Latitude	Longitude	Population	Aquifer Type Soft Rock/ Hard Rock	Dug Well/TW/BW	Sustainable throughout the year? Yes/ No	Average pumping hours/day	Water Quality Issue Saline /F/Fe/ NO3/ As	Population	Per capita water supply (minimum 55 LPCD)	Nos of days	Annual Demand (cubic metre/year)	No. of Structures (DW/ BW/TW)	Discharge Cubic m/hr	Nos of Running Hours/ day	Annual Extraction (cubic metre/year)	Loss (15% of b)	Actual water supplied	Supply-Demand Gap	Gap between demand and supply (%)
										1	2	3	(1*2*3)/1000 = **(a)**	1	2	3	1*2*3*365 = **(b)**	**(C)**	**d=b-c**	**(d)-(a)**	
59	Takli	21.3535	78.99688	2457	Soft Rock	DW	Yes	8	NO	2457	55	365	49324.28	2	14.4	8	84096	12614.4	71481.6	22157.33	45
60	Telangkhedi	21.39401	78.82626	657	Hardrock	DW	Yes	4	NO	657	55	365	13189.28	2	10.8	4	31536	4730.4	26805.6	13616.33	103
61	Tembhurdoh	21.51016	78.95629	1465	Hardrock	DW	Yes	4	F= 1.65	1465	55	365	29409.88	3	10.8	4	47304	7095.6	40208.4	10798.53	37
62	Tighai	21.39486	78.97319	445	Soft Rock	DW	Yes	4	NO	445	55	365	8933.375	1	10.8	4	15768	2365.2	13402.8	4469.425	50
63	Umari (Bharatpur)	21.42088	78.81504	2818	Hardrock	DW	Yes	12	NO	2818	55	365	56571.35	2	10.8	12	94608	14191.2	80416.8	23845.45	42
64	Umri(Ja)	21.44109	79.00474	1476	Hardrock	DW	Yes	8	NO	1476	55	365	29630.7	3	10.8	8	94608	14191.2	80416.8	50786.1	171
65	Waghoda (CT)	21.3663	78.93194	8693	Soft Rock	DW	Yes	12	NO	8693	55	365	174512	2	23	12	201480	30222	171258	-3253.98	-2
66	Waki	21.37438	79.03956	2323	Soft Rock	DW	Yes	8	NO	2323	55	365	46634.23	2	14.4	8	84096	12614.4	71481.6	24847.38	53
67	Wakodi	21.38492	79.00412	3637	Soft Rock	DW	Yes	8	NO	3637	55	365	73012.78	3	14.4	8	126144	18921.6	107222.4	34209.63	47
68	Walani (CT)	21.32072	79.08697	3536	Soft Rock	DW	Yes	8	NO	3536	55	365	70985.2	3	14.4	8	126144	18921.6	107222.4	36237.2	51
69	Weltur	21.34335	79.05167	725	Soft Rock	DW	Yes	8	NO	725	55	365	14554.38	1	10.8	8	31536	4730.4	26805.6	12251.23	84

Annexure X(b): Categorisation of village based on the current available ground water source

Sr No.	Gram Panchayat	Latitude	Longitude	4. Risk Assessement																	
				Normal Annual Rainfall	Rainfall Categorisation	Risk	Tube / Bore well Discharge	Discharge categorisation	Risk	Whether source is available throughout the year	Geomorphology	Depth to Water Level (m bgl)	WL Category	Iron (ppm)	Category	Fluoride (ppm)	Category	Arsenic (ppb)	Category	Sustainability
				(mm)	>750, 750-500, <500	>750=low, 750-500=med., <500 High	(lps)	>3, 3-1, <1	>3=low, 3-1=med., <1 High	Yes/No	Plain/Valley/ High slop/Hill		<20, 20-40, >40		<1, >1		<1.5, >1.5		<10, >10	Safe/At Risk/High Risk
1	Aajni (Se)	21.4028	78.93244	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	7.5	<20	BDL	<1	0.54	<1.5	0.4	<10	Safe
2	Badegaon	21.48081	78.96181	1008	>750	Low	4	>3	low	Yes	Plain	6.1	<20	BDL	<1	0.94	<1.5	0.35	<10	Safe
3	Bhanegaon	21.26577	79.13502	1008	>750	Low	6	>3	low	Yes	Plain	15.5	<20	0.00049	<1	1.03	<1.5	0.44	<10	At Risk
4	Bhendala	21.36271	79.01598	1008	>750	Low	4.5	>3	low	Yes	Plain	11.45	<20	0.00041	<1	0.63	<1.5	0.28	<10	Safe
5	Bichwa	21.56326	78.95676	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	3.5	<20			1.55	>1.5			Safe
6	Bramhpuri	21.31624	78.9616	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	6.5	<20	0.00071	<1	0.44	<1.5	0.23	<10	Safe
7	Borujwada	21.37657	78.95489	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	9.98	<20	0.00037	<1			0.22	<10	Safe
8	Champa	21.29585	79.00641	1008	>750	Low	3	1 to 3	Medium	Yes	Plain									Safe
9	Chicholi (CT)	21.26982	79.11676	1008	>750	Low	6	>3	low	Yes	Plain	12.2	<20	BDL	<1	1.11	<1.5	0.07	<10	At Risk
10	Dahegaon(Rangari)	21.28552	79.08277	1008	>750	Low	6	>3	low	Yes	Plain	10.1	<20	BDL	<1	0.94	<1.5	1.3	<10	At Risk
11	Isapur	21.33673	79.0703	1008	>750	Low	6	>3	low	Yes	Plain	18.6	<20	0.00022	<1	0.59	<1.5	0.13	<10	Safe
12	Itangoti	21.3133	78.99853	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	6.2	<20	0.00058	<1	0.43	<1.5	0.67	<10	Safe
13	Gadegaon	21.43333	78.94445	1008	>750	Low	2.5	1 to 3	Medium	Yes	Plain	13.7	<20	-		0.5	<1.5	-		Safe
14	Gadmi	21.44552	79.04502	1008	>750	Low	2.5	1 to 3	Medium	Yes	Plain	10.25	<20	BDL	<1	1.03	<1.5	0.09	<10	Safe
15	Gosewadi	21.36439	79.06162	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	11.2	<20	0.00024	<1	0.59	<1.5	0.56	<10	Safe
16	Gumgaon	21.39282	78.98759	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	5.6	<20	1.1604	>1	0.59	<1.5	0.44	<10	Safe
17	Hattisarra	21.4624	78.91441	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	13	<20			1.62	>1.5			At Risk
18	Jaitpur	21.45002	78.76575	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	8.5	<20			0.83	<1.5			Safe
19	Joga	21.4525	78.74411	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	7.9	<20			0.73	<1.5			Safe
20	Kelwad	21.45512	78.87815	1008	>750	Low	6	>3	low	Yes	Plain	8.2	<20			1.92	>1.5			At Risk

Sr No.	Gram Panchayat	Latitude	Longitude	4. Risk Assessement																	
				Normal Annual Rainfall	Rainfall Categorisation	Risk	Tube / Bore well Discharge	Discharge categorisation	Risk	Whether source is available throughout the year	Geomorphology	Depth to Water Level (m bgl)	WL Category	Iron (ppm)	Category	Fluoride (ppm)	Category	Arsenic (ppb)	Category	Sustainability
				(mm)	>750, 750-500, <500	>750=low, 750-500=med., <500 High	(lps)	>3, 3-1, <1	>3=low, 3-1=med., <1 High	Yes/No	Plain/Valley/ High slop/Hill		<20, 20-40, >40		<1, >1		<1.5, >1.5		<10, >10	Safe/At Risk/High Risk
21	Kharduka	21.48937	78.94384	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	18.5	<20			1.07	<1.5			Safe
22	Khairi(Dhal)	21.47034	78.93232	1008	>750	Low	4	>3	low	Yes	Plain	13.8	<20	BDL	<1	1.1	<1.5	0.54	<10	Safe
23	Khairi(P)	21.42904	79.00874	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	12.8	<20	BDL	<1	1.26	<1.5	0.09	<10	Safe
24	Khangaon	21.42712	78.92126	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	8	<20			0.89	<1.5			Safe
25	Khapa (Narsala)	21.42097	78.83918	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	7.9	<20	BDL	<1	0.61	<1.5	0.53	<10	Safe
26	Khubala	21.46338	79.00061	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	13.45	<20	BDL	<1	0.94	<1.5	0.12	<10	Safe
27	Khurajgaon	21.41528	78.90693	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	14.4	<20			0.7	<1.5			Safe
28	Khursapar	21.47741	78.75954	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	8.4	<20			1.01	<1.5			Safe
29	Kirnapur	21.40798	79.02863	1008	>750	Low	3	1 to 3	Medium	Yes	Plain									Safe
30	Kocchi	21.45845	78.96544	1008	>750	Low	4	>3	low	Yes	Plain	14.1	<20	BDL	<1	0.83	<1.5	1	<10	Safe
31	Kodegaon	21.40634	78.95896	1008	>750	Low	6	>3	low	Yes	Plain	8.9	<20	BDL	<1	0.51	<1.5	0.86	<10	Safe
32	Kothulana	21.41842	79.03862	1008	>750	Low	6	>3	low	Yes	Plain	10.25	<20	BDL	<1	0.95	<1.5	0.12	<10	Safe
33	Kotodi	21.33916	78.96573	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	14.9	<20	0.00024	<1	0.59	<1.5	0.7	<10	Safe
34	Kusumbi	21.33627	78.99316	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	5.8	<20	0.00045	<1	0.54	<1.5	0.29	<10	Safe
35	Malegaon(Jo)	21.43031	78.734	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	7.5	<20			3.57	>1.5			At Risk
36	Malegaon(T)	21.37202	78.96901	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	17.2	<20	0.00019	<1	0.37	<1.5	0.36	<10	Safe
37	Manegaon	21.36535	78.98234	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	15.4	<20	0.00254	<1	0.26	<1.5	0.38	<10	Safe
38	Mangsa	21.42138	78.88416	1008	>750	Low	4	>3	low	Yes	Plain	8.2	<20			1.06	<1.5			Safe
39	Nandagomukh	21.41847	78.76502	1008	>750	Low	5	>3	low	Yes	Plain	7.9	<20			0.27	<1.5			Safe
40	Nandori	21.44936	78.92217	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	16.1	<20			0.82	<1.5			Safe
41	Nimtalai	21.42634	79.0431	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	9.25	<20	BDL	<1	0.59	<1.5	0.77	<10	Safe

Sr No.	Gram Panchayat	Latitude	Longitude	4. Risk Assessement																	
				Normal Annual Rainfall	Rainfall Categorisation	Risk	Tube / Bore well Discharge	Discharge categorisation	Risk	Whether source is available throughout the year	Geomorphology	Depth to Water Level (m bgl)	WL Category	Iron (ppm)	Category	Fluoride (ppm)	Category	Arsenic (ppb)	Category	Sustainability
				(mm)	>750, 750-500, <500	>750=low, 750-500=med., <500 High	(lps)	>3, 3-1, <1	>3=low, 3-1=med., <1 High	Yes/No	Plain/Valley/ High slop/Hill		<20, 20-40, >40		<1, >1		<1.5, >1.5		<10, >10	Safe/At Risk/High Risk
42	Patakakhedi	21.35199	78.95061	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	9.8	<20	0.00022	<1	0.42	<1.5	0.33	<10	Safe
43	Pandhari	21.4608	79.04797	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	8.5	<20	BDL	<1	0.58	<1.5	0.12	<10	Safe
44	Parsodi	21.43573	78.89826	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	8.4	<20	0.110	<1	0.92	<1.5	0.06	<10	Safe
45	Patansavangi	21.33346	79.02133	1008	>750	Low	6	>3	low	Yes	Plain	11.15	<20	0.00054	<1	0.56	<1.5	0.78	<10	Safe
46	Pipla	21.30987	79.07114	1008	>750	Low	5	>3	low	Yes	Plain	10.55	<20	0.00022	<1	0.77	<1.5	1.1	<10	Safe
47	Pota	21.30557	79.11632	1008	>750	Low	6	>3	low	Yes	Plain	20.71	20-40	0.00047	<1	0.65	<1.5	0.04	<10	At Risk
48	Rampuri	21.4421	78.86631	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	4.3	<20			0.66				Safe
49	Rohana	21.31303	79.10807	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	16.6	<20	0.00606	<1	0.66	<1.5	0.39	<10	Safe
50	Salai	21.42239	78.78921	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	10.3	<20			0.73	<1.5			Safe
51	Sarra	21.57374	78.99894	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	7.8	<20			1.1	<1.5			Safe
52	Sawali	21.47009	78.78889	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	3	<20			0.56	<1.5			Safe
53	Sawngi(H)	21.37612	78.87965	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	11.3	<20			0.65	<1.5			Safe
54	Sillewada (CT)	21.292	79.12132	1008	>750	Low	6	>3	low	Yes	Plain	20.71	20-40	0.00047	<1	0.65	<1.5	0.04	<10	At Risk
55	Sillori	21.31345	78.97736	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	8.5	<20	0.00025	<1	0.32	<1.5	0.24	<10	Safe
56	Sindewani	21.58694	78.93263	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	7	<20			1.04	<1.5			Safe
57	Sironji	21.55684	78.98149	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	13.5	<20			0.83	<1.5			Safe
58	Sonpur	21.54111	78.97889	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	6.5	<20			1.02	<1.5			Safe
59	Takli	21.3535	78.99688	1008	>750	Low	4	>3	low	Yes	Plain	12.48	<20	0.00021	<1	0.39	<1.5	0.08	<10	Safe
60	Telangkhedi	21.39401	78.82626	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	5	<20			0.66	<1.5			Safe
61	Tembhurdoh	21.51016	78.95629	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	14	<20			1.65	>1.5			At Risk
62	Tighai	21.39486	78.97319	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	6.85	<20	BDL	<1	0.52	<1.5	0.15	<10	Safe

Sr No.	Gram Panchayat	Latitude	Longitude	4. Risk Assessement																	
				Normal Annual Rainfall	Rainfall Categorisation	Risk	Tube / Bore well Discharge	Discharge categorisation	Risk	Whether source is available throughout the year	Geomorphology	Depth to Water Level (m bgl)	WL Category	Iron (ppm)	Category	Fluoride (ppm)	Category	Arsenic (ppb)	Category	Sustainability
				(mm)	>750, 750-500, <500	>750=low, 750-500=med., <500 High	(lps)	>3, 3-1, <1	>3=low, 3-1=med., <1 High	Yes/No	Plain/Valley/ High slop/Hill		<20, 20-40, >40		<1, >1		<1.5, >1.5		<10, >10	Safe/At Risk/High Risk
63	Umari (Bharatpur)	21.42088	78.81504	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	5.5	<20			0.62	<1.5			Safe
64	Umri (Ja)	21.44109	79.00474	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	16.3	<20	BDL	<1	0.97	<1.5	0.52	<10	Safe
65	Waghoda (CT)	21.3663	78.93194	1008	>750	Low	6	>3	low	Yes	Plain	11.1	<20							At Risk
66	Waki	21.37438	79.03956	1008	>750	Low	4	>3	low	Yes	Plain	7.2	<20	0.00024	<1	1.1	<1.5	1.29	<10	Safe
67	Wakodi	21.38492	79.00412	1008	>750	Low	4	>3	low	Yes	Plain	15.1	<20	BDL	<1	0.66	<1.5	0.44	<10	Safe
68	Walani (CT)	21.32072	79.08697	1008	>750	Low	4	>3	low	Yes	Plain	16.68	<20	0.0004	<1	0.44	<1.5	0.07	<10	Safe
69	Weltur	21.34335	79.05167	1008	>750	Low	3	1 to 3	Medium	Yes	Plain	10.2	<20	0.00025	<1	0.53	<1.5	0.56	<10	Safe

Annexure XI: VES Results in Parts of Saoner Taluka, Nagpur District (2023-24)

VES No.	District	Village	Taluka	Latitude	Longitude	Layers	Resistivity (Ohm m)	Thickness (m)	Depth (m)		Probable Lithology
									From	To	
1	Nagpur	Champa	Saoner	21.2915058	79.0069586	I	11.9	3.09	0	3.09	Top Soil
						II	4.68	34.3	3.09	37.4	clay
						III	153		37.4		High resistivity zone
2	Nagpur	Sillori	Saoner	21.3122484	78.9660057	I	19.6	1	0	1	Top Soil
						II	5.46	1.87	1	2.87	clay
						III	11.3	20.9	2.87	23.8	Gondwana Sandstone
						IV	74.2		23.8		Sandstone with interbeds of shales
3	Nagpur	Chincholi CT	Saoner	21.263971	79.116148	I	20.97	1	0	1	Top Soil
						II	2.48	0.5902	1	1.59	clay
						III	13.94	31.49	1.59	33.1	Gondwana Sandstone
						IV	3432		33.1		High resistivity zone
4	Nagpur	Ronala	Saoner	21.29839	79.098809	I	14.43	1.697	0	1.7	Top Soil
						II	6.355	18.83	1.7	20.5	clay
						III	21.71		20.5		Gondwana Sandstone
5	Nagpur	Ishapur	Saoner	21.336571	79.066067	I	47	1.32	0	1.32	Top Soil
						II	9.72	10.6	1.32	11.9	Weathered sandstone
						III	6.92	35.3	11.9	47.2	Sandstone with interbeds of shales
						IV	670		47.2		High resistivity zone
6	Nagpur	Ghosewadi	Saoner	21.36091	79.065211	I	23.5	1	0	1	Top Soil
						II	44.5	5.32	1	6.32	Weathered sandstone
						III	83.5	6.99	6.32	13.3	Sandstone with interbeds of shales
						IV	14.4	24.2	13.3	37.5	Gondwana Sandstone
						V	8045		37.5		High resistivity zone
7	Nagpur	Bhendala	Saoner	21.365685	79.015904	I	35.8	1	0	1	Top Soil
						II	150	1.87	1	2.87	Sandstones

VES No.	District	Village	Taluka	Latitude	Longitude	Layers	Resistivity (Ohm m)	Thickness (m)	Depth (m) From	Depth (m) To	Probable Lithology
						III	8.39	65.4	2.87	68.3	Weathered sandstone
						IV	46.5		68.3		Saturated Gondwana
8	Nagpur	Wagholi	Saoner	21.404677	79.040808	I	63.7	1	0	1	Top Soil
						II	79.1	7.28	1	8.28	Weathered Granite Gneiss
						III	447	59.8	8.28	68.1	Hard Granite gneiss
						IV	13.3		68.1		Fractured Granite gneiss
9	Nagpur	Khapa	Saoner	21.43131	78.989922	I	10.4	16.5	0	16.5	Top Soil
						II	35.5	52.4	16.5	68.9	Weathered Granite Gneiss
						III	1066		68.9		Hard Granite gneiss
10	Nagpur	Dhakara	Saoner	21.417379	79.014657	I	9.256	1.084	0	1.08	Top Soil
						II	24.61	24.79	1.08	25.9	Weathered Granite Gneiss
						III	4953		25.9		Hard Granite gneiss
11	Nagpur	Kodegaon	Saoner	21.413058	78.955372	I	8.57	1	0	1	Top Soil
						II	5.68	30.2	1	31.2	Weathered Granite Gneiss
						III	684		31.2		Hard Granite gneiss
12	Nagpur	Parsodi	Saoner	21.439168	78.896795	I	4.14	7.6	0	7.6	Top Soil
						II	12.1	43.8	7.6	51.4	Weathered Granite Gneiss
						III	352		51.4		Hard Granite gneiss
13	Nagpur	Jatamkhora	Saoner	21.472887	78.809211	I	19.96	1.388	0	1.39	Top Soil
						II	44.63	4.575	1.39	5.96	Weathered Basalt
						III	157.1	15.83	5.96	21.8	Massive Basalt
						IV	48.76		21.8		Fractured/Vesicular Basalt
14	Nagpur	Joga	Saoner	21.443953	78.737541	I	23.5	1	0	1	Top Soil
						II	141	1.87	1	2.87	Massive Basalt
						III	12.1	5.37	2.87	8.25	Fractured/Vesicular Basalt
						IV	478		8.25		Massive Basalt

VES No.	District	Village	Taluka	Latitude	Longitude	Layers	Resistivity (Ohm m)	Thickness (m)	Depth (m) From	Depth (m) To	Probable Lithology
15	Nagpur	Umari (Bhartapur)	Saoner	21.428805	78.817127	I	23.71	2.631	0	2.63	Top Soil
						II	88.56	4.225	2.63	6.86	Weathered Basalt
						III	12.69	11.05	6.86	17.9	Weathered/Vesicular Basalt
						IV	60.67		17.9		Weathered/Vesicular Basalt
16	Nagpur	Nanda Gomukh	Saoner	21.424151	78.766517	I	125	2.84	0	2.84	Top Soil
						II	247	8.57	2.84	11.4	Massive Basalt
						III	26.8	34.6	11.4	46	Weathered/Fractured Basalt
						IV	2325		46		massive Basalt
17	Nagpur	Khairi Dhalgoan	Saoner	21.460765	78.921426	I	12.32	1	0	1	Top Soil
						II	9.386	6.412	1	7.41	Weathered Granite gneiss
						III	522.5	12.02	7.41	19.4	Hard Granite gneiss
						IV	4.153		19.4		Fractured granite gneiss
18	Nagpur	Chargaon	Saoner	21.491894	78.970408	I	151.5	1.176	0	1.18	Top Soil
						II	68.22	21.37	1.18	22.6	Weathered Granite gneiss
						III	4926		22.6		Hard Granite gneiss
19	Nagpur	Kormeta	Saoner	21.559085	78.966751	I	10.5	1	0	1	Top Soil
						II	90.3	1.87	1	2.87	Weathered Granite gneiss
						III	11.6	21.3	2.87	24.1	Fractured granite gneiss
						IV	324		24.1		Hard Granite gneiss
20	Nagpur	Bichawa	Saoner	21.571982	78.9579	I	72	1	0	1	Top Soil
						II	127	22.9	1	23.9	Weathered Granite gneiss
						III	480		23.9		Hard Granite gneiss
21	Nagpur	Sarra	Saoner	21.571958	79.010882	I	57.6	1	0	1	Top Soil
						II	7.94	7.25	1	8.25	clay

VES No.	District	Village	Taluka	Latitude	Longitude	Layers	Resistivity (Ohm m)	Thickness (m)	Depth (m)		Probable Lithology
									From	To	
						III	17	15.4	8.25	23.7	Weathered Granite gneiss
						IV	2762		23.7		Hard Granite gneiss
22	Nagpur	Sonpur	Saoner	21.541547	78.970237	I	14.05	1.262	0	1.26	Top Soil
						II	3.793	1.425	1.26	2.69	clay
						III	20.48	15.29	2.69	18	Weathered Granite gneiss
						IV	8000		18		Hard Granite gneiss
23	Nagpur	Raiwadi	Saoner	21.532283	78.943579	I	708	1	0	1	Top Soil
						II	3484	1.87	1	2.87	Hard Granite gneiss
						III	38.5	5.37	2.87	8.25	Fractured Granite gneiss
						IV	158		8.25		Hard Granite gneiss
24	Nagpur	Angewada	Saoner	21.368423	78.945449	I	24.7	1.01	0	1.01	Top Soil
						II	14.5	3.07	1.01	4.08	Weathered sandstone
						III	6.38	38.3	4.08	42.4	clay
						IV	15.4		42.4		Gondwana Sandstone
25	Nagpur	Saoner	Saoner	21.373753	78.95546	I	53.7	1	0	1	Top Soil
						II	1.12	0.243	1	1.24	clay
						III	5.33	43.8	1.24	45.1	Saturated Gondwana
						IV	12.8		45.1		Gondwana Sandstone
26	Nagpur	Ajani	Saoner	21.397833	78.93605	I	4.125	1	0	1	Top Soil
						II	6.264	53.42	1	54.4	Weathered Basalt
						III	24.17		54.4		Weathered/Fractured Basalt
27	Nagpur	Umari	Saoner	21.421846	78.813525	I	6.85	1	0	1	Top Soil
						II	4.04	8.85	1	9.85	clay
						III	61.3		9.85		Gondwana Sandstone
28	Nagpur	Katodi	Saoner	21.341432	78.968578	I	16.6	1	0	1	Top Soil
						II	7.22	7.27	1	8.27	clay

VES No.	District	Village	Taluka	Latitude	Longitude	Layers	Resistivity (Ohm m)	Thickness (m)	Depth (m) From	Depth (m) To	Probable Lithology
						III	16.1	15.4	8.27	23.7	Weathered sandstone
						IV	66.9		23.7		Gondwana Sandstone
29	Nagpur	Mohagaon	Saoner	21.360305	78.982345	I	40.1	6.31	0	6.31	Top Soil
						II	20.6	8.4	6.31	14.7	Weathered sandstone
						III	1737		14.7		Gondwana Sandstone
30	Nagpur	Wakodi	Saoner	21.387011	79.005412	I	10.4	1	0	1	Top Soil
						II	4.6	13.8	1	14.8	clay
						III	22.5		14.8		Weathered sandstone
31	Nagpur	New Khapa	Saoner	21.408982	78.988865	I	8.75	2.87	0	2.87	Top Soil
						II	4.23	20.8	2.87	23.7	clay
						III	122		23.7		Gondwana Sandstone
32	Nagpur	Badegaon	Saoner	21.483456	78.977193	I	25	1.23	0	1.23	Top Soil
						II	9.28	22.6	1.23	23.8	Weathered Granite gneiss
						III	916		23.8		Hard Granite gneiss
33	Nagpur	Kodegaon	Saoner	21.409903	78.961515	I	12.23	1	0	1	Top Soil
						II	3.913	1.671	1	2.67	clay
						III	9.028	4.464	2.67	7.14	Weathered sandstone
						IV	5.012	43.86	7.14	51	Gondwana Sandstone
						V	13.69		51		Saturated Gondwana
34	Nagpur	Saoner	Saoner	21.382217	78.9476	I	5.525	8.249	0	8.25	Top Soil
						II	8.006	60.68	8.25	68.9	Weathered Basalt
						III	8.235		68.9		Weathered/Fractured Basalt
35	Nagpur	Heti	Saoner	21.400817	78.88195	I	70.3	1	0	1	Top Soil
						II	2.46	1.87	1	2.87	clay
						III	11.5	20.8	2.87	23.7	Weathered Basalt
						IV	13.4		23.7		Weathered/Fractured Basalt
36	Nagpur	Rampuri	Saoner	21.44655	78.859483	I	36.6	1	0	1	Top Soil

VES No.	District	Village	Taluka	Latitude	Longitude	Layers	Resistivity (Ohm m)	Thickness (m)	Depth (m) From	Depth (m) To	Probable Lithology
						II	268	1.67	1	2.67	Massive Basalt
						III	29	16.7	2.67	19.3	Weathered/Fractured Basalt
						IV	52.6	31.9	19.3	51.2	Moderately weathered/fractured basalt
						V	13.8		51.2		Saturated Gondwana
37	Nagpur	Narsala Khapa	Saoner	21.420183	78.832367	I	9.39	1	0	1	Top Soil
						II	2311	7.31	1	8.31	Massive Basalt
						III	70.6		8.31		Moderately weathered/fractured basalt
38	Nagpur	Pipla Bhadi	Saoner	21.406567	78.8409	I	29.4	4.74	0	4.74	Top Soil
						II	89	7.14	4.74	11.9	Moderately Weathered Basalt
						III	23.8	17.1	11.9	29	Weathered/Fractured Basalt
						IV	73		29		Massive Basalt
39	Nagpur	Telangkhedi	Saoner	21.414783	78.832883	I	233	1.66	0	1.66	Top Soil
						II	554	28	1.66	29.6	Massive Basalt
						III	61.6		29.6		Moderately weathered/fractured basalt
40	Nagpur	Umari (BH)	Saoner	21.412767	78.814317	I	5.25	1	0	1	Top Soil
						II	3116	6.14	1	7.14	Massive Basalt
						III	178		7.14		Massive Basalt
41	Nagpur	Chatrapur	Saoner	21.441627	78.77331	I	24	1.14	0	1.14	Top Soil
						II	83.3	2.65	1.14	3.79	Moderately Weathered Basalt
						III	1237	26.9	3.79	30.7	Massive Basalt
						IV	13.3		30.7		Weathered/Fractured Basalt
42	Nagpur	Junewadi	Saoner	21.387693	78.803227	I	28.3	2.67	0	2.67	Top Soil
						II	69	4.46	2.67	7.14	weathered basalt
						III	17.1	11.9	7.14	19.1	Fractured Basalt

VES No.	District	Village	Taluka	Latitude	Longitude	Layers	Resistivity (Ohm m)	Thickness (m)	Depth (m)		Probable Lithology
									From	To	
						IV	56.2		19.1		Moderately weathered/fractured basalt
43	Nagpur	Sawali (MHO)	Saoner	21.476433	78.796733	I	26.8	1	0	1	Top Soil
						II	19.7	0.709	1	1.71	Weathered Basalt
						III	133		1.71		Massive Basalt
44	Nagpur	Pipla	Saoner	21.313804	79.081915	I	44.4	1	0	1	Top Soil
						II	6.35	1.62	1	2.62	clay
						III	9.56	15.4	2.62	18	Weathered sandstone
						IV	145	28.9	18	46.9	Gondwana Sandstone
						V	24		46.9		Saturated Gondwana
45	Nagpur	Pota	Saoner	21.303686	79.110202	I	95.1	1.05	0	1.05	Top Soil
						II	8.17	16.7	1.05	17.8	Weathered sandstone
						III	85.9		17.8		Sandstone with interbeds of shales
46	Nagpur	Bhanegaon	Saoner	21.256211	79.140444	I	14.5	1	0	1	Top Soil
						II	11	18.1	1	19.1	Weathered sandstone
						III	249		19.1		High resistive sandstone
47	Nagpur	Kawadas	Saoner	21.327267	79.049525	I	8.251	1.81	0	1.81	Top Soil
						II	5.843	31.78	1.81	33.6	clay
						III	14.25		33.6		Weathered sandstone
48	Nagpur	Weltur	Saoner	21.348365	79.050345	I	20	2.33	0	2.33	Top Soil
						II	4.96	28.5	2.33	30.8	clay
						III	1632		30.8		Gondwana Sandstone
49	Nagpur	Kodadongri	Saoner	21.348353	79.032905	I	63	1.06	0	1.06	Top Soil
						II	5.66	20.3	1.06	21.4	clay
						III	1876		21.4		Gondwana Sandstone
50	Nagpur	Patamsaongi	Saoner	21.33757	79.008804	I	11.9	1	0	1	Top Soil
						II	5.19	3.68	1	4.68	clay

VES No.	District	Village	Taluka	Latitude	Longitude	Layers	Resistivity (Ohm m)	Thickness (m)	Depth (m) From	Depth (m) To	Probable Lithology
						III	8.58	52	4.68	56.7	Weathered sandstone
						IV	31.3		56.7		Gondwana Sandstone
51	Nagpur	Belori Kh	Saoner	21.317026	79.024293	I	684	1.94	0	1.94	Top Soil
						II	13.5	29.5	1.94	31.4	Weathered sandstone
						III	59		31.4		Gondwana Sandstone
52	Nagpur	Itangoti	Saoner	21.312601	79.003419	I	8.99	1.88	0	1.88	Top Soil
						II	5.51	15.6	1.88	17.4	clay
						III	296	24.8	17.4	42.3	Saturated Gondwana
						IV	1.6		42.3		clay
53	Nagpur	Sillori	Saoner	21.312469	78.977322	I	21.3	1	0	1	Top Soil
						II	7.3	5.65	1	6.65	Weathered sandstone
						III	3.68	6.75	6.65	13.4	clay
						IV	27.1		13.4		Gondwana Sandstone
54	Nagpur	Sawarmendha	Saoner	21.275638	79.019819	I	7.041	1.377	0	1.38	Top Soil
						II	2.143	6.226	1.38	7.6	clay
						III	6.6	47.08	7.6	54.7	Weathered sandstone
						IV	27.84		54.7		Gondwana Sandstone
55	Nagpur	Bhojapuri	Saoner	21.423899	78.867734	I	28.13	12.92	0	12.9	Top Soil
						II	12.58	14.74	12.9	27.7	Weathered Basalt
						III	58.02	34.36	27.7	62	Moderately weathered/fractured basalt
						IV	1.962		62		clay
56	Nagpur	Sawangi	Saoner	21.373991	78.886445	I	61.4	1	0	1	Top Soil
						II	12	1.67	1	2.67	Weathered Basalt
						III	40.4	4.46	2.67	7.14	Moderately weathered/fractured basalt
						IV	16.2	43.8	7.14	50.9	Fractured Basalt

VES No.	District	Village	Taluka	Latitude	Longitude	Layers	Resistivity (Ohm m)	Thickness (m)	Depth (m) From	Depth (m) To	Probable Lithology
						V	38.4		50.9		Moderately weathered/fractured basalt
57	Nagpur	Saoner Town	Saoner	21.39744	78.898223	I	37.58	1.845	0	1.85	Top Soil
						II	2.476	1.701	1.85	3.55	clay
						III	9.764	96.45	3.55	100	Weathered sandstone
						IV	37.83		100		Gondwana Sandstone
58	Nagpur	Waki	Saoner	21.384168	79.045652	I	138.5	1	0	1	Top Soil
						II	19.31	1.52	1	2.52	Weathered Granite gneiss
						III	6.946	4.531	2.52	7.05	clay
						IV	32.81	21.75	7.05	28.8	Fractured Granite gneiss
						V	381.1		28.8		Hard Granite gneiss
59	Nagpur	Gumgaon	Saoner	21.397982	78.98492	I	93.3	1.03	0	1.03	Top Soil
						II	19	7.86	1.03	8.89	Weathered sandstone
						III	52.2	7.91	8.89	16.8	Gondwana Sandstone
						IV	14.5		16.8		Saturated Gondwana
60	Nagpur	Malegaon	Saoner	21.375974	78.971048	I	13	1	0	1	Top Soil
						II	5.77	49.9	1	50.9	Weathered sandstone
						III	19.3		50.9		Gondwana Sandstone
61	Nagpur	Telangkhedi	Saoner	21.399911	78.820484	I	22.78	1	0	1	Top Soil
						II	53.25	1.671	1	2.67	Weathered Basalt
						III	25.18	16.46	2.67	19.1	Weathered/Fractured Basalt
						IV	300.2	31.85	19.1	51	Massive Basalt
						V	1.626		51		clay
62	Nagpur	Salai	Saoner	21.416275	78.798312	I	25.9	1	0	1	Top Soil
						II	13.4	6.14	1	7.14	Weathered Basalt
						III	4.53	11.9	7.14	19.1	clay

VES No.	District	Village	Taluka	Latitude	Longitude	Layers	Resistivity (Ohm m)	Thickness (m)	Depth (m)		Probable Lithology
									From	To	
						IV	58.6		19.1		Moderately weathered/fractured basalt
63	Nagpur	Khursapur	Saoner	21.470843	78.763209	I	73.8	3.1	0	3.1	Top Soil
						II	168	19.5	3.1	22.6	Massive Basalt
						III	30.5	17.9	22.6	40.5	weathered/fractured basalt
						IV	151		40.5		Massive Basalt
64	Nagpur	Kocchi	Saoner	21.457022	78.972195	I	4.39	4.41	0	4.41	Top Soil
						II	54.8	25.5	4.41	29.9	Weathered Granite gneiss
						III	3925		29.9		Hard Granite gneiss
65	Nagpur	Nandapur	Saoner	21.45063	78.945848	I	84.5	1.09	0	1.09	Top Soil
						II	7.8	8.41	1.09	9.51	clay
						III	32	96	9.51	106	Weathered Granite gneiss
						IV	4262		106		Hard Granite gneiss
66	Nagpur	Kelwad	Saoner	21.456023	78.872978	I	92.62	2.001	0	2	Top Soil
						II	1.952	1.039	2	3.04	clay
						III	6.72	69.18	3.04	72.2	Weathered Basalt
						IV	1177		72.2		Massive Basalt

Annexure III: Farmer Feedback form

①

Annexure -III

Farmer Feedback Form

Photograph			
Name	Pawan Talwar		
Village	Kumgaon		
Block	Saoner		
District	Nagpur		
Address			
Mobile Number (optional)	9326925430		
Type and number of structures			
Type	Dugwell 60 feet.		
Number	1 nos.		
(coordinates of the structures are to be obtained by the field officer)	21.398323 78.990557		
Drill time discharge (lps)	24 hrs.		
Depth of installation of pump	~~60 Feet~~ 1.5 HP.		
Casing depth (Bore wells) HR	60 feet.		
Fracture encountered depth-HR			
Slotted pipe depths (TW) SR			
Average water levels – pre-monsoon	14 feet.		
Average water levels – post-monsoon	9 feet.		
The well is used for			
Is water available throughout the year	Yes.		
If not for how many months water is available			
Pumping Duration 2-3 ~~Days~~ hrs.			
	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)		~~2 Hours~~ 3 hrs.	

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Kharif (no of months to be specified)		2 hrs.	
Others (no of months to be specified)			
Area Irrigated			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	2 Acres.	Tuwar, Kapas	
Khariff (no of months to be specified)	2 Acres.	Onion, methi, palak	
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop	Onion, methi, palak.	Tuwar, Kapas.	
Area under crop			
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop	- do -	- do -	
Area under crop			
Reasons for change in cropping pattern in last 20 years.			
If the cropping pattern is to be changed, which are the suitable crops that can be grown	No change.		
Available Market for the crop			
Average unit cost of production			
Average unit cost of selling			
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	o Is it connected to grid No. o If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	o Do you get free electricity for irrigation? o Do you pay a fixed charge o If a fixed charge is paid, what is the per month charge 500/- o If unit-based charges are paid what is the average monthly charges in rupees o During kharif---500/- o During Rabi----500/-		
Diesel No.	o Average consumption of diesel (liters) per month o During Kharif o During Rabi		

Water Market*	o Do you share the pumped water with other farmers o If yes No. o For how many days do you share pumped water in Kharif o For how many days do you share pumped water in Rabi Period o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers No. o If yes o For how many days do you receive pumped water in Kharif o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc
- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.	

→ Water level down.

→ No quality issues.

→ Mine discharge into the Nala. ✪
Nala is near water supply well.

→ Quality issue may occur in near future.

→

(Bhagyashree Salve)
Sc - 'B'

(2)

Annexure -III

Farmer Feedback Form

Photograph Dugwell pumping test spot - 1.			
Name	Gautam Dhanraj Mankar. / Ratna Mankar		
Village	Bamangaon		
Block	Saoner		
District	Nagpur		
Address			
Mobile Number (optional)	9970337784		
Type and number of structures			
Type	Dug well 2 Nos.	50-60 feet.	
Number			
(coordinates of the structures are to be obtained by the field officer)	1 HP pump.	2-HP. pump.	
Drill time discharge (lps)			
Depth of installation of pump	35 feet.	40 feet.	
Casing depth (Bore wells) HR	50-60 feet.		
Fracture encountered depth-HR			
Slotted pipe depths (TW) SR			
Average water levels – pre-monsoon	40 feet.		
Average water levels – post-monsoon	8 feet.		
The well is used for	Agriculture, Domestic, Drinking.		
Is water available throughout the year	Yes.		
If not for how many months water is available			
Pumping Duration	2-3 hrs.		
	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	2-3 hrs.		

23

Kharif (no of months to be specified)	4 hrs.		
Others (no of months to be specified)			
Area Irrigated 7 Acres.			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	7 Acres	Kapas, Tuvar.	
Khariff (no of months to be specified)	4 7 Acres.	Brinjal, Chowla, Bhendi,	
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Prevailing Cropping pattern in the village	Kharif No change.	Rabi	Other
Type of Crop			
Area under crop			
Reasons for change in cropping pattern in last 20 years.			
If the cropping pattern is to be changed, which are the suitable crops that can be grown			
Available Market for the crop	Nagpur / Khapa / Saoner		
Average unit cost of production			
Average unit cost of selling			
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	o Is it connected to grid o If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	o Do you get free electricity for irrigation? o Do you pay a fixed charge o If a fixed charge is paid, what is the per month charge 5000/- o If unit-based charges are paid what is the average monthly charges in rupees o During kharif---- 7-8000/- o During Rabi----- 5000/- /year.		
Diesel	o Average consumption of diesel (liters) per month o During Kharif o During Rabi		

Water Market*	o Do you share the pumped water with other farmers o If yes No. o For how many days do you share pumped water in Kharif o For how many days do you share pumped water in Rabi Period o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers No. o If yes o For how many days do you receive pumped water in Kharif o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc
- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.	

→ WL lowen down
→ No health issues.
→ No stn.
→ Neam Kochi dam.

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Annexure -III

Farmer Feedback Form

Photograph		
Name	Jitendra Godbole	Ravindra Suresh Kahade
Village	Kochi	
Block	Savner	
District	Nagpur	
Address	At - Kathi	
Mobile Number (optional)	9834912553	8999231225
Type and number of structures		
Type	Dugwell	
Number	1	
(coordinates of the structures are to be obtained by the field officer)		
Drill time discharge (lps)		
Depth of installation of pump	5HP 60 feet.	
Casing depth (Bore wells) HR	9 feet.	
Fracture encountered depth-HR	50 feet.	
Slotted pipe depths (TW) SR		
Average water levels – pre-monsoon	18 feet.	
Average water levels – post-monsoon	10 feet.	
The well is used for	Agriculture.	
Is water available throughout the year	Yes.	
If not for how many months water is available		

Pumping Duration

	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	Everyday.	3-4 hrs.	

1000 liters.
30 minutes.

23

Kharif (no of months to be specified)	Same.		
Others (no of months to be specified)			
Area Irrigated			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	2 months.	कपास, गेहू चणा संत्री	2 Acres.
Khariff (no of months to be specified)	4 months.	कपास गेहू चणा.	2 Acres.
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop	कपास, गेहू, चणा	संत्रा, मोसंबी	
Area under crop	>200 Acres	200 Acres.	
Reasons for change in cropping pattern in last 20 years.	Same pattern.		Jowar 20 yrs no farming.
If the cropping pattern is to be changed, which are the suitable crops that can be grown			Cotton in replacement of Jowar.
Available Market for the crop			Nagpur.
Average unit cost of production	1500		
Average unit cost of selling	7000 – 10000		
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	Is it connected to grid No. o If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	o Do you get free electricity for irrigation? o Do you pay a fixed charge o If a fixed charge is paid, what is the per month charge 5000/- o If unit-based charges are paid what is the average monthly charges in rupees o During kharif---- 5000/- o During Rabi-----2000/-		
Diesel	o Average consumption of diesel (liters) per month o During Kharif o During Rabi		

Water Market*	o Do you share the pumped water with other farmers o If yes o For how many days do you share pumped water in Kharif 2-4 days o For how many days do you share pumped water in Rabi Period o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers No. o If yes o For how many days do you receive pumped water in Kharif o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc

- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.

→ Magnesium issues quality issues.
→ Dependancy on ground water.

4

Annexure -III

Farmer Feedback Form

Photograph			
Name	Bhagwan Raut.		
Village	Hedikheda		
Block	Savner		
District	Nagpur		
Address			
Mobile Number (optional)	9309816536		
Type and number of structures			
Type	Dug well	50 feet.	
Number	1	Pump - 5 HP	
(coordinates of the structures are to be obtained by the field officer)			
Drill time discharge (lps)			
Depth of installation of pump	~~200~~ feet.		
Casing depth (Bore wells) HR	50 feet.		
Fracture encountered depth-HR	25 feet		
Slotted pipe depths (TW) SR			
Average water levels – pre-monsoon	30 feet		
Average water levels – post-monsoon	20 ~~30~~ feet.		
The well is used for	Agriculture, Drinking		
Is water available throughout the year	Yes.		
If not for how many months water is available			

Pumping Duration			
	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	8 hrs.		

23

Kharif (no of months to be specified)	5-6 hrs.		
Others (no of months to be specified)			
Area Irrigated 8 Ac.			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	8 Aa	Cotton, Tuwar, Rice, Vegetables,	
Khariff (no of months to be specified)	@ 2-3	Vegetables.	
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Reasons for change in cropping pattern in last 20 years.			
If the cropping pattern is to be changed, which are the suitable crops that can be grown			
Available Market for the crop	Savner, Nagpur		
Average unit cost of production	50000/- Ac.		
Average unit cost of selling	60000/Ac.		
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	o Is it connected to grid o If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	o Do you get free electricity for irrigation? ✓ Do you pay a fixed charge o If a fixed charge is paid, what is the per month charge o If unit-based charges are paid what is the average monthly charges in rupees 4000/ 3 months o During kharif---- o During Rabi-----		
Diesel	o Average consumption of diesel (liters) per month o During Kharif o During Rabi		

Water Market*	o Do you share the pumped water with other farmers o If yes No. o For how many days do you share pumped water in Kharif o For how many days do you share pumped water in Rabi Period o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers o If yes No. o For how many days do you receive pumped water in Kharif o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc

- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.

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Annexure -III

Farmer Feedback Form

Photograph			
Name	Madhukar Rao Kothinanji Akre		
Village	Khapa		
Block	Savner		
District	Nagpur.		
Address			
Mobile Number (optional)	9373646927		
Type and number of structures			
Type	Dugwell	65 feet.	
Number	1		
(coordinates of the structures are to be obtained by the field officer)	7HP motor.		
Drill time discharge (lps)			
Depth of installation of pump	65 feet.		
Casing depth (Bore wells) HR	65 feet.		
Fracture encountered depth-HR	60 feet.		
Slotted pipe depths (TW) SR			
Average water levels – pre-monsoon	2 feet.		
Average water levels – post-monsoon	6 feet.		
The well is used for			
Is water available throughout the year	Yes.		
If not for how many months water is available			
Pumping Duration	8 hrs.		
	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	28 hrs.		

23

Kharif (no of months to be specified)	8 hrs.		
Others (no of months to be specified)			
Area Irrigated 3 Acres.			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	1 Acres.	Chana.	
Khariff (no of months to be specified)	3 Acres.	Kapas, Tuwar.	
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop	Santra,		
Area under crop	Mosambi. (2.5 Acres)		
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Reasons for change in cropping pattern in last 20 years.	Santra not fruitful.		
If the cropping pattern is to be changed, which are the suitable crops that can be grown			
Available Market for the crop	Khapa/ Khairi Punjasnao.		
Average unit cost of production	1 lakh.		
Average unit cost of selling	2 Lakh.		
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	o Is it connected to grid o If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	o Do you get free electricity for irrigation? o Do you pay a fixed charge o If a fixed charge is paid, what is the per month charge o If unit-based charges are paid what is the average monthly charges in rupees 12000/yr. o During kharif---10000/yr o During Rabi-----2000/yr.		
Diesel	o Average consumption of diesel (liters) per month o During Kharif o During Rabi		

Water Market*	o Do you share the pumped water with other farmers o If yes No. o For how many days do you share pumped water in Kharif o For how many days do you share pumped water in Rabi Period o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers o If yes No. o For how many days do you receive pumped water in Kharif o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc
- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.	

⇒ GW used for drinking
⇒ No water related issues.
→ 12000 lit / 7 minutes in 7 HP pump.

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Annexure -III

Farmer Feedback Form

Photograph			
Name	Tusar Bayantrao Bagde.		
Village	Baolegaon.		
Block	Savner		
District	Nagpur		
Address			
Mobile Number (optional)	8888902305		
Type and number of structures			
Type	Dug well	70 feet.	
Number	1	pump 3 HP.	
(coordinates of the structures are to be obtained by the field officer)			
Drill time discharge (lps)	200l/ 30 sec.		
Depth of installation of pump	70 feet.		
Casing depth (Bore wells) HR	70 feet.		
Fracture encountered depth-HR	30 feet.		
Slotted pipe depths (TW) SR			
Average water levels – pre-monsoon	10 feet from to lower.		
Average water levels – post-monsoon	20 feet		
The well is used for	Agriculture, Drinking.		
Is water available throughout the year	Yes.		
If not for how many months water is available			
Pumping Duration	8hrs.		
	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	8hrs.		

23

Kharif (no of months to be specified)	4 hrs.		
Others (no of months to be specified)			
Area Irrigated	4.5 Acres.		
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	4.5 Acres.		
Khariff (no of months to be specified)	2 Acres.		
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop	Kapas, tuwar.	Sanfana.	
Area under crop	Santra.	Mosambi	
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop	—	—	
Area under crop			
Reasons for change in cropping pattern in last 20 years.			
If the cropping pattern is to be changed, which are the suitable crops that can be grown			
Available Market for the crop	Nagpur, Saonen, Khairi.		
Average unit cost of production	2.5 Lakhs.		
Average unit cost of selling	3 Lakhs.		
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	o Is it connected to grid o If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	o Do you get free electricity for irrigation? o Do you pay a fixed charge o If a fixed charge is paid, what is the per month charge 20000/— o If unit-based charges are paid what is the average monthly charges in rupees o During kharif---— o During Rabi-----		
Diesel	o Average consumption of diesel (liters) per month o During Kharif o During Rabi		

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Water Market*	o Do you share the pumped water with other farmers o If yes No. o For how many days do you share pumped water in Kharif o For how many days do you share pumped water in Rabi Period o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers o If yes No. o For how many days do you receive pumped water in Kharif o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc
- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.	

→ WL lower down. ✓
→ No health issues. ✓
→ Surface water used. ✓
→ Water supply well - 2. ✓
1 CD.; No Jalsampad.

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(7)

Annexure -III

Farmer Feedback Form

Photograph			
Name	Arbind Dhoke		
Village	Hingna		
Block	Sarner		
District	Nagpur		
Address			
Mobile Number (optional)	9767078912		
Type and number of structures			
Type	Dug well	50 feet.	
Number	1	pump - 3 HP.	
(coordinates of the structures are to be obtained by the field officer)			
Drill time discharge (lps)	200 l/5 min.		
Depth of installation of pump	45 feet.		
Casing depth (Bore wells) HR	45 feet.		
Fracture encountered depth-HR			
Slotted pipe depths (TW) SR			
Average water levels – pre-monsoon	30 feet.		
Average water levels – post-monsoon	20 feet.		
The well is used for	Agriculture, Drinking, Domestic.		
Is water available throughout the year	Yes.		
If not for how many months water is available			
Pumping Duration	5 hrs.		
	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	2 hrs.		

23

Kharif (no of months to be specified)	5-6 hrs.		
Others (no of months to be specified)			
Area Irrigated 4.5 Acres..			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	1 Acres.	~~Cotton~~ Bhengli Chawla.	
Khariff (no of months to be specified)	4.5 Acres.	Cotton, Turmeric	
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop	Same		
Area under crop			
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Reasons for change in cropping pattern in last 20 years.	Same.		
If the cropping pattern is to be changed, which are the suitable crops that can be grown			
Available Market for the crop	Khapa, Sawner.		
Average unit cost of production	2 Lakhs/year.		
Average unit cost of selling	4 Lakhs/year.		
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	o Is it connected to grid o If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	o Do you get free electricity for irrigation? o Do you pay a fixed charge o If a fixed charge is paid, what is the per month charge 7-8000/-yr. o If unit-based charges are paid what is the average monthly charges in rupees o During kharif---- o During Rabi-----		
Diesel	o Average consumption of diesel (liters) per month o During Kharif o During Rabi		

Water Market*	o Do you share the pumped water with other farmers o If yes No. o For how many days do you share pumped water in Kharif o For how many days do you share pumped water in Rabi Period o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers o If yes ✓ o For how many days do you receive pumped water in Kharif 5 day. o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc
- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.	

→ No health issues.
→ Khehda Nala dam / Kochi dam.
→ 2 CD., 1 CD damaged.

(8)

Annexure -III

Farmer Feedback Form

Photograph			
Name	Anand Rao Shyam Rao Vaidle.		
Village	Khubala		
Block	Savner		
District	Nagpur		
Address			
Mobile Number (optional)			
Type and number of structures			
Type	Dug well	50 feet.	
Number	1	Pump 3 H.P.	
(coordinates of the structures are to be obtained by the field officer)			
Drill time discharge (lps)			
Depth of installation of pump	50 feet.		
Casing depth (Bore wells) HR	40 feet		
Fracture encountered depth-HR	20 feet.		
Slotted pipe depths (TW) SR			
Average water levels – pre-monsoon	35 feet ~~from below~~		
Average water levels – post-monsoon	~~30 feet~~ 30 feet.		
The well is used for	Agriculture, Drinking, Domestic.		
Is water available throughout the year	Yes.		
If not for how many months water is available			
Pumping Duration	3 hrs.		
	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	3 hrs.		

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Kharif (no of months to be specified)	2 hrs.		
Others (no of months to be specified)			
Area Irrigated 7 Acres.			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	7 Acres.	Tuwar, Cotton, Alkd. Barbati, Vegetable.	
Khariff (no of months to be specified)	—	—	
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop	Same.		
Area under crop			
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Reasons for change in cropping pattern in last 20 years.			
If the cropping pattern is to be changed, which are the suitable crops that can be grown			
Available Market for the crop	Kalamna, Nagpur.		
Average unit cost of production	2 Lakhs.		
Average unit cost of selling	2 Lakhs.		
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	o Is it connected to grid o If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	o Do you get free electricity for irrigation? o Do you pay a fixed charge o If a fixed charge is paid, what is the per month charge o If unit-based charges are paid what is the average monthly charges in rupees 12000 – 15000/- yr. o During kharif---- o During Rabi-----		
Diesel	o Average consumption of diesel (liters) per month o During Kharif o During Rabi		

Water Market*	o Do you share the pumped water with other farmers o If yes No. o For how many days do you share pumped water in Kharif o For how many days do you share pumped water in Rabi Period o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers dugwell. o If yes ✓ o For how many days do you receive pumped water in Kharif o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs) 5000/yr. 2 months.
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc

- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.

→ No health issues.

→ WL decline.

→

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(9)

Annexure -III

Farmer Feedback Form

Photograph			
Name	Rochan Lanjewar		
Village	Risala		
Block	Saunen		
District	Nagpur		
Address			
Mobile Number (optional)	9637453077		
Type and number of structures			
Type	Dugwell	30-35 feet.	
Number	1	Diesel pump.	
(coordinates of the structures are to be obtained by the field officer)			
Drill time discharge (lps)			
Depth of installation of pump			
Casing depth (Bore wells) HR	20 feet.		
Fracture encountered depth-HR	15 feet.		
Slotted pipe depths (TW) SR			
Average water levels – pre-monsoon	25-30 feet.		
Average water levels – post-monsoon	10 feet.		
The well is used for	Agriculture, Drinking.		
Is water available throughout the year	Yes.		
If not for how many months water is available			
Pumping Duration	3 hrs.		

	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	—		

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Kharif (no of months to be specified)	3 hrs.		
Others (no of months to be specified)			
Area Irrigated 6 Acres.			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	—		
Khariff (no of months to be specified)	6 Acres.	Tuwar, Cotton.	
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop	Sanatan	Sanatan.	
Area under crop			
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop	Tuwar, Cotton		
Area under crop			
Reasons for change in cropping pattern in last 20 years.			
If the cropping pattern is to be changed, which are the suitable crops that can be grown			
Available Market for the crop	Khairi, Khapa.		
Average unit cost of production	60,000 - 70,000/- yrs.		
Average unit cost of selling	1,70 lakh.		
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	o Is it connected to grid o If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	o Do you get free electricity for irrigation? o Do you pay a fixed charge o If a fixed charge is paid, what is the per month charge o If unit-based charges are paid what is the average monthly charges in rupees o During kharif---- o During Rabi-----		
Diesel ✓	o Average consumption of diesel (liters) per month 300 lit/month o During Kharif 300 lit/mn. o During Rabi		

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Water Market*	o Do you share the pumped water with other farmers o If yes No o For how many days do you share pumped water in Kharif o For how many days do you share pumped water in Rabi Period o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers No. o If yes o For how many days do you receive pumped water in Kharif o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc

- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.

→ No health issues.
→ GW is better

(10)

Annexure -III

Farmer Feedback Form

Photograph			
Name	Premdash Vishwanath Pawnipagheer.		
Village	Khairi Punjabrao.		
Block	Savner		
District	Nagpur.		
Address			
Mobile Number (optional)	8957306311		
Type and number of structures			
Type	Dug well	40-45 feet	
Number	1	pump - 3HP.	
(coordinates of the structures are to be obtained by the field officer)			
Drill time discharge (lps)			
Depth of installation of pump	40-42 feet.		
Casing depth (Bore wells) HR	13-14 feet.		
Fracture encountered depth-HR	10-12 feet.		
Slotted pipe depths (TW) SR			
Average water levels – pre-monsoon	40 feet.		
Average water levels – post-monsoon	25-30 feet.		
The well is used for	Agriculture,		
Is water available throughout the year	Yes.		
If not for how many months water is available			
Pumping Duration	4.5 hr.		
	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	4.5 hr.		

23

Kharif (no of months to be specified)	–		
Others (no of months to be specified)			
Area Irrigated 3.5 Acres.			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	2 Acres.	Wheat, vegetables.	
Khariff (no of months to be specified)	1.5 Acres.	Cotton, Tuwer.	
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Reasons for change in cropping pattern in last 20 years.			
If the cropping pattern is to be changed, which are the suitable crops that can be grown			
Available Market for the crop	Khapa, Savner.		
Average unit cost of production	1.5 lakh.		
Average unit cost of selling	2.5 lakh.		
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	o Is it connected to grid o If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	o Do you get free electricity for irrigation? o Do you pay a fixed charge o If a fixed charge is paid, what is the per month charge 1500/month. o If unit-based charges are paid what is the average monthly charges in rupees o During kharif----– o During Rabi-----1500/month.		
Diesel	o Average consumption of diesel (liters) per month o During Kharif o During Rabi		

Water Market*	○ Do you share the pumped water with other farmers ○ If yes No. ○ For how many days do you share pumped water in Kharif ○ For how many days do you share pumped water in Rabi Period ○ On an average how much do you charge per annum (in Rs)
	○ Do you receive additional water from boreholes of nearby farmers ○ If yes No. ○ For how many days do you receive pumped water in Kharif ○ For how many days do you receive pumped water in Rabi Period ○ On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc

- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.

→ WL declined. / water Scarcity.

→ No health issues.

CD - 1

(IV)

Annexure -III

Farmer Feedback Form

Photograph			
Name	Suryabhan Laxman		
Village	Dhalbana		
Block	Savner		
District	Nagpur		
Address			
Mobile Number (optional)	~~9881681~~ ~~9766106588~~ 9916103280		
Type and number of structures			
Type	Dugwell	45 feet.	
Number	1	pump - 3 HP.	
(coordinates of the structures are to be obtained by the field officer)			
Drill time discharge (lps)			
Depth of installation of pump	40 feet.		
Casing depth (Bore wells) HR	40 feet.		
Fracture encountered depth-HR	35 feet.		
Slotted pipe depths (TW) SR			
Average water levels – pre-monsoon	~~35~~ feet 40 feet.		
Average water levels – post-monsoon	~~35~~ feet. 43.5 feet		
The well is used for	Agriculture, Drinking, Domestic.		
Is water available throughout the year	Yes.		
If not for how many months water is available			
Pumping Duration 4 hr.			
	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	2 hr.		

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Kharif (no of months to be specified)	4 hr.		
Others (no of months to be specified)			
Area Irrigated 2.5 Acres.			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	2.5	Tuwar, Cotton	
Khariff (no of months to be specified)	-	-	
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Reasons for change in cropping pattern in last 20 years.			
If the cropping pattern is to be changed, which are the suitable crops that can be grown			
Available Market for the crop	Khajni		
Average unit cost of production	1.5 Lakh.		
Average unit cost of selling	75000/-		
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	○ Is it connected to grid ○ If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	○ Do you get free electricity for irrigation? ✓ Do you pay a fixed charge ○ If a fixed charge is paid, what is the per month charge ○ If unit-based charges are paid what is the average monthly charges in rupees 6000/6 months. ○ During kharif---- ○ During Rabi-----		
Diesel	○ Average consumption of diesel (liters) per month ○ During Kharif ○ During Rabi		

Water Market*	o Do you share the pumped water with other farmers o If yes No. o For how many days do you share pumped water in Kharif o For how many days do you share pumped water in Rabi Period o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers No o If yes o For how many days do you receive pumped water in Kharif o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc

- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.

→ No health issues.

→ HP water - drinking water source.

→

Annexure -III

Farmer Feedback Form

Photograph			
Name	Subham Lanjewar.		
Village	Umri		
Block	Savner		
District	Nagpur.		
Address			
Mobile Number (optional)	7498628354		
Type and number of structures			
Type	Dug well	Bore 60-70 feet.	
Number	1	pump - 5 Hp.	
(coordinates of the structures are to be obtained by the field officer)			
Drill time discharge (lps)			
Depth of installation of pump	50 feet.		
Casing depth (Bore wells) HR	50 feet.		
Fracture encountered depth-HR			
Slotted pipe depths (TW) SR			
Average water levels – pre-monsoon	40 feet.		
Average water levels – post-monsoon	30 feet.		
The well is used for	Agriculture, Drinking,	Domestic.	
Is water available throughout the year	Yes.		
If not for how many months water is available			
Pumping Duration	2 hrs.		

	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	3 hrs.		

23

Kharif (no of months to be specified)	2 hrs.		
Others (no of months to be specified)			
Area Irrigated 2 Ha Acres			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	1.5 Acre	Beans, Tuwar, Kapas.	
Khariff (no of months to be specified)	2 Acres.	Gawar.	
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Reasons for change in cropping pattern in last 20 years.			
If the cropping pattern is to be changed, which are the suitable crops that can be grown			
Available Market for the crop	Saoner / Nagpur.		
Average unit cost of production	4-5 Lakh.		
Average unit cost of selling	6-7 Lak.		
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	o Is it connected to grid o If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	o Do you get free electricity for irrigation? ✓ o Do you pay a fixed charge o If a fixed charge is paid, what is the per month charge 2000/- o If unit-based charges are paid what is the average monthly charges in rupees o During kharif---- o During Rabi-----		
Diesel	o Average consumption of diesel (liters) per month o During Kharif o During Rabi		

Water Market*	o Do you share the pumped water with other farmers o If yes No. o For how many days do you share pumped water in Kharif o For how many days do you share pumped water in Rabi Period o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers o If yes No. o For how many days do you receive pumped water in Kharif o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc No
- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.	

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Annexure -III

Farmer Feedback Form

Photograph		
Name	Mohan Bawankadi	
Village	Pendhari	
Block	Savner	
District	Nagpur	
Address		
Mobile Number (optional)	9561587873	
Type and number of structures		
Type	Dug well	50 feet.
Number	1	pump - 3HP.
(coordinates of the structures are to be obtained by the field officer)		
Drill time discharge (lps)		
Depth of installation of pump	45 feet.	
Casing depth (Bore wells) HR	45 feet.	
Fracture encountered depth-HR	25 feet.	
Slotted pipe depths (TW) SR		
Average water levels – pre-monsoon	35 feet.	
Average water levels – post-monsoon	25 feet.	
The well is used for	Agriculture, Drinking.	
Is water available throughout the year	Yes.	
If not for how many months water is available		

Pumping Duration			
	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	2-3 hrs.		

23

Kharif (no of months to be specified)	—		
Others (no of months to be specified)			
Area Irrigated 60 1.5 Ac.			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	1.5 Ac.	Vegetables eg. (Moscumbi, Sandna)	
Khariff (no of months to be specified)	1.5 Ac.	Vegetables (Moscumbi Sandna) Cotton, Turmeric	
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Reasons for change in cropping pattern in last 20 years.			
If the cropping pattern is to be changed, which are the suitable crops that can be grown			
Available Market for the crop	Sawner.		
Average unit cost of production	1.5 /yrs.		
Average unit cost of selling	3 /yrs.		
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	○ Is it connected to grid ○ If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	○ Do you get free electricity for irrigation? ○ Do you pay a fixed charge ○ If a fixed charge is paid, what is the per month charge ○ If unit-based charges are paid what is the average monthly charges in rupees 2000/2500/3months ○ During kharif---- ○ During Rabi-----		
Diesel	○ Average consumption of diesel (liters) per month ○ During Kharif ○ During Rabi		

Water Market*	○ Do you share the pumped water with other farmers ○ If yes No. ○ For how many days do you share pumped water in Kharif ○ For how many days do you share pumped water in Rabi Period ○ On an average how much do you charge per annum (in Rs)
	○ Do you receive additional water from boreholes of nearby farmers No. ○ If yes ○ For how many days do you receive pumped water in Kharif ○ For how many days do you receive pumped water in Rabi Period ○ On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc
- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.	

→ water level down in Summer.

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Annexure -III

Farmer Feedback Form

Photograph			
Name	Dunga Das		
Village	Kodli		
Block	Savner		
District	Nagpur.		
Address			
Mobile Number (optional)	9049533252		
Type and number of structures			
Type	1 Dugwell	50 feet. 3 HP.	
Number			
(coordinates of the structures are to be obtained by the field officer)			
Drill time discharge (lps)	6 hrs.		
Depth of installation of pump	50 feet.		
Casing depth (Bore wells) HR	10 feet.		
Fracture encountered depth-HR			
Slotted pipe depths (TW) SR			
Average water levels – pre-monsoon	38 feet.		
Average water levels – post-monsoon	~~50 feet~~. 31 feet.		
The well is used for			
Is water available throughout the year	Yes.		
If not for how many months water is available			
Pumping Duration	6 hrs.		
	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	6hr.		

23

Kharif (no of months to be specified)	6 hrs.		
Others (no of months to be specified)			
Area Irrigated 12 ½ Acres.			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	4 @ Acres	Wheat, Chana, Brinjal.	
Khariff (no of months to be specified)	12 Acres	Kapas, Tuwar.	
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop	Sames.	Totamatoes	
Area under crop		Vegetables.	
Reasons for change in cropping pattern in last 20 years.			
If the cropping pattern is to be changed, which are the suitable crops that can be grown	Sopnatoes		
Available Market for the crop	Khapa / Nagpur.		
Average unit cost of production	2 Lakhs / year.		
Average unit cost of selling			
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	o Is it connected to grid o If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	o Do you get free electricity for irrigation? ✓ o Do you pay a fixed charge o If a fixed charge is paid, what is the per month charge 5000/- 3 months o If unit-based charges are paid what is the average monthly charges in rupees o During kharif---10000/- year. o During Rabi-----		
Diesel	o Average consumption of diesel (liters) per month o During Kharif o During Rabi		

Water Market*	o Do you share the pumped water with other farmers o If yes ✓ o For how many days do you share pumped water in Kharif o For how many days do you share pumped water in Rabi Period o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers o If yes No. o For how many days do you receive pumped water in Kharif o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc
- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.	

→ No health issues.

(15)

Annexure -III

Farmer Feedback Form

			Photograph
Name	Rahul Dhanraj Kawade.		
Village	Gadegi		
Block	Savner		
District	Nagpur.		
Address			
Mobile Number (optional)	8806526218		
Type and number of structures			
Type	Dug well	50 feet	
Number	1	pump - 3HP.	
(coordinates of the structures are to be obtained by the field officer)			
Drill time discharge (lps)			
Depth of installation of pump	50 feet.		
Casing depth (Bore wells) HR	40 feet.		
Fracture encountered depth-HR	30 feet.		
Slotted pipe depths (TW) SR			
Average water levels – pre-monsoon	40 feet.		
Average water levels -- post-monsoon	25 feet.		
The well is used for	Agriculture, Drinking.		
Is water available throughout the year	Yes.		
If not for how many months water is available			
Pumping Duration	8hr.		
	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	8 hrs.		

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Kharif (no of months to be specified)	—		
Others (no of months to be specified)			
Area Irrigated 8 Acres.			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	8 Acr.	Cotton, Tuwar.	
Khariff (no of months to be specified)		Jawar, Bajra, Wheat.	
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Reasons for change in cropping pattern in last 20 years.			
If the cropping pattern is to be changed, which are the suitable crops that can be grown			
Available Market for the crop	Saunsar, Nagpur		
Average unit cost of production	50,000/Acr.	4 Lakh	
Average unit cost of selling	8 Lakh.		
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	○ Is it connected to grid ○ If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	○ Do you get free electricity for irrigation? ✓ Do you pay a fixed charge ○ If a fixed charge is paid, what is the per month charge ○ If unit-based charges are paid what is the average monthly charges in rupees 4000/3month. ○ During kharif---- ○ During Rabi-----		
Diesel	○ Average consumption of diesel (liters) per month ○ During Kharif ○ During Rabi		

Water Market*	o Do you share the pumped water with other farmers o If yes No. o For how many days do you share pumped water in Kharif o For how many days do you share pumped water in Rabi Period o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers o If yes No. o For how many days do you receive pumped water in Kharif o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc
- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.	

→ No health issues.

→ WL is lower Summer.

→ No CD, .

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(16)

Annexure -III

Farmer Feedback Form

Photograph		
Name	Deben Nanhani Gadge	
Village	Nimtalai	
Block	Savner	
District	Nagpur.	
Address		
Mobile Number (optional)	9970428010	
Type and number of structures		
Type	Dugwell	50 feet
Number	1	pump = 5HP.
(coordinates of the structures are to be obtained by the field officer)		
Drill time discharge (lps)		
Depth of installation of pump	50 feet.	
Casing depth (Bore wells) HR	18 feet.	
Fracture encountered depth-HR	25 feet.	
Slotted pipe depths (TW) SR		
Average water levels – pre-monsoon	42-43 feet.	
Average water levels -- post-monsoon	30 feet.	
The well is used for	Agriculture.	
Is water available throughout the year	Yes.	
If not for how many months water is available		
Pumping Duration	3-4 hrs.	

	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	3-4 hrs.		

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Kharif (no of months to be specified)	4-5 hrs.		
Others (no of months to be specified)			
Area Irrigated 4 Acres.			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	4 Acres.	Cotton, Tuwar.	
Khariff (no of months to be specified)	—		
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop		Soyabean.	
Area under crop			
Prevailing Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop			
Reasons for change in cropping pattern in last 20 years.			
If the cropping pattern is to be changed, which are the suitable crops that can be grown			
Available Market for the crop	Sawner.		
Average unit cost of production	25000/yr/Acre		
Average unit cost of selling	50000/yr. Acre		
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	o Is it connected to grid o If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	o Do you get free electricity for irrigation? o Do you pay a fixed charge o If a fixed charge is paid, what is the per month charge o If unit-based charges are paid what is the average monthly charges in rupees 2600-2700/yr- o During kharif---- 3000-3500/yrs. o During Rabi-----		
Diesel	o Average consumption of diesel (liters) per month o During Kharif o During Rabi		

Water Market*	o Do you share the pumped water with other farmers o If yes No. o For how many days do you share pumped water in Kharif o For how many days do you share pumped water in Rabi Period o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers o If yes No. o For how many days do you receive pumped water in Kharif o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc
- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.	

→ GW Level is very down during Summer.
→ Water Supply wells.
→ No health issues.

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Annexure -III

Farmer Feedback Form

Photograph			
Name	Hatitchandra Dhanjoy Choudhury.		
Village	Kothulana		
Block	Savner		
District	Nagpur		
Address			
Mobile Number (optional)	9665-212900		
Type and number of structures			
Type	Dug well	55 feet	
Number	1	Pump- 3HP.	
(coordinates of the structures are to be obtained by the field officer)			
Drill time discharge (lps)			
Depth of installation of pump	55 feet.		
Casing depth (Bore wells) HR	40 feet.		
Fracture encountered depth-HR	35 feet.		
Slotted pipe depths (TW) SR			
Average water levels – pre-monsoon	~~20 feet~~ 38 feet.		
Average water levels – post-monsoon	28 feet.		
The well is used for	Agriculture, Drinking.		
Is water available throughout the year	Yes.		
If not for how many months water is available			
Pumping Duration	8 hrs.		
	Number of days pump is operated (days) of each well	What is the average pumping duration (in hours) of each well	Instantaneous Discharge Measurement (to be carried out by the field officer) in lps
Rabi (no of months to be specified)	8 hrs		

Kharif (no of months to be specified)	Ekm,		
Others (no of months to be specified)			
Area Irrigated 1.06 Hec			
	Area Irrigated	Type of crop taken	Remarks
Rabi (no of months to be specified)	1 Ha.	Dhemos, Chouloi,	
Khariff (no of months to be specified)	1.06 Ha	Cotton. Tuwar. Soyabean.	
Others (no of months to be specified)			
Cropping patterns (past and present) in the village			
Traditional Cropping pattern in the village	Kharif	Rabi	Other
Type of Crop			
Area under crop		Brinjal, Cabbage	
Prevailing Cropping pattern in the village	Kharif	Rabi Mirchi, Bhindi, Methi, Palak.	Other
Type of Crop			
Area under crop			
Reasons for change in cropping pattern in last 20 years.			
If the cropping pattern is to be changed, which are the suitable crops that can be grown			
Available Market for the crop	Sawner,		
Average unit cost of production	25000/1 Acre.		
Average unit cost of selling	40000/1 Acre.		
Existing MSP and other related information	Crop wise details are to be collected		
Other subsidies, facilities, restrictions.			
Source of Energy			
Solar	○ Is it connected to grid ○ If yes how much incentive do you get per month on an average for feeding electricity to the grid (Rs per month)		
Electric	○ Do you get free electricity for irrigation? ○ Do you pay a fixed charge ○ If a fixed charge is paid, what is the per month charge ○ If unit-based charges are paid what is the average monthly charges in rupees 15000/Yr. ○ During kharif---- ○ During Rabi-----		
Diesel	○ Average consumption of diesel (liters) per month ○ During Kharif ○ During Rabi		

Water Market*	o Do you share the pumped water with other farmers o If yes Yes. o For how many days do you share pumped water in Kharif No. o For how many days do you share pumped water in Rabi Period 100 hrs. o On an average how much do you charge per annum (in Rs)
	o Do you receive additional water from boreholes of nearby farmers o If yes No. o For how many days do you receive pumped water in Kharif o For how many days do you receive pumped water in Rabi Period o On an average how much do you pay per annum (in Rs)
Other issues/Remarks	e.g. common problems in drilling of wells, common health issues in the area etc
- Feedback of the local users will form an important input for problem identification and characterization. Feedbacks are to be obtained in case of Urban areas, Industrial clusters also. Feedbacks on drinking water availability, dependence on ground water etc are also to be obtained. The above feedback form can be customized to the type of priority area and objective of the study.	

→ No health issues.
→ TDS of borewell is nearabout 1000.
Surface water / HP / Dugwell. / water filter.

Annexure XIIIII: Location of Proposed Recharge Structures as per the Village wise Supply side Intervention.

Sr No.	DISTRICT	TALUKA	VILLAGE	Structure	LATTITUDE	LONGITUDE
1	Nagpur	Savner	Badegaon	Percolation tank with Recharge shaft	21.484546	78.9598911
2	Nagpur	Savner	Khubala	Percolation tank with Recharge shaft	21.457296	78.9974814
3	Nagpur	Savner	Patansaongi	Percolation tank with Recharge shaft	21.333347	79.023414
4	Nagpur	Savner	Saoner (MCI)	Percolation tank with Recharge shaft	21.387057	78.910768
5	Nagpur	Savner	Wakodi	Percolation tank with Recharge shaft	21.388194	79.0103817
6	Nagpur	Savner	Pipala (Bhadao)	Percolation tank with Recharge shaft	21.405453	78.826784

Sr No.	DISTRICT	TALUKA	VILLAGE	Structure	LATTITUDE	LONGITUDE
1	Nagpur	Savner	Malegaon	Check Dam with Recharge Shaft	21.43030872	78.73399986
2	Nagpur	Savner	Malegaon	Check Dam with Recharge Shaft	21.43030872	78.73399986
3	Nagpur	Savner	Malegaon	Check Dam with Recharge Shaft	21.43030872	78.73399986
4	Nagpur	Savner	Khapa (Janabai)	Check Dam with Recharge Shaft	21.40944936	78.7452628
5	Nagpur	Savner	Nanda Gomukh	Check Dam with Recharge Shaft	21.41847142	78.76502361
6	Nagpur	Savner	Nanda Gomukh	Check Dam with Recharge Shaft	21.41847142	78.76502361
7	Nagpur	Savner	Nanda Gomukh	Check Dam with Recharge Shaft	21.41847142	78.76502361
8	Nagpur	Savner	Jaitpur	Check Dam with Recharge Shaft	21.45002011	78.7657512
9	Nagpur	Savner	Jaitpur	Check Dam with Recharge Shaft	21.45002011	78.7657512
10	Nagpur	Savner	Khursapar	Check Dam with Recharge Shaft	21.47741471	78.75954052
11	Nagpur	Savner	Khursapar	Check Dam with Recharge Shaft	21.47741471	78.75954052
12	Nagpur	Savner	Khursapar	Check Dam with Recharge Shaft	21.47741471	78.75954052
13	Nagpur	Savner	Chhatrapur	Check Dam with Recharge Shaft	21.44820028	78.78267167
14	Nagpur	Savner	Salai	Check Dam with Recharge Shaft	21.42239357	78.78921103
15	Nagpur	Savner	Salai	Check Dam with Recharge Shaft	21.42239357	78.78921103
16	Nagpur	Savner	Jatamkhora	Check Dam with Recharge Shaft	21.47759293	78.81110712
17	Nagpur	Savner	Jatamkhora	Check Dam with Recharge Shaft	21.47759293	78.81110712
18	Nagpur	Savner	Umari (Bharatpur)	Check Dam with Recharge Shaft	21.42087574	78.81504476
19	Nagpur	Savner	Umari (Bharatpur)	Check Dam with Recharge Shaft	21.42087574	78.81504476
20	Nagpur	Savner	Umari (Bharatpur)	Check Dam with Recharge Shaft	21.42087574	78.81504476
21	Nagpur	Savner	Umari (Bharatpur)	Check Dam with Recharge Shaft	21.42087574	78.81504476
22	Nagpur	Savner	Umari (Bharatpur)	Check Dam with Recharge Shaft	21.42087574	78.81504476
23	Nagpur	Savner	Pipala (Bhadao)	Check Dam with Recharge Shaft	21.40868218	78.83791728
24	Nagpur	Savner	Khapa (Narsala)	Check Dam with Recharge Shaft	21.42096653	78.83918306
25	Nagpur	Savner	Pandhari (J)	Check Dam with Recharge Shaft	21.43612009	78.8362165
26	Nagpur	Savner	Jaitgad	Check Dam with Recharge Shaft	21.48052318	78.87266396
27	Nagpur	Savner	Jaitgad	Check Dam with Recharge Shaft	21.48052318	78.87266396
28	Nagpur	Savner	Kelwad	Check Dam with Recharge Shaft	21.45511571	78.87815241
29	Nagpur	Savner	Kelwad	Check Dam with Recharge Shaft	21.45511571	78.87815241
30	Nagpur	Savner	Kelwad	Check Dam with Recharge Shaft	21.45511571	78.87815241
31	Nagpur	Savner	Kawatha	Check Dam with Recharge Shaft	21.48440574	78.90545423
32	Nagpur	Savner	Kawatha	Check Dam with Recharge Shaft	21.48440574	78.90545423
33	Nagpur	Savner	Kawatha	Check Dam with Recharge Shaft	21.48440574	78.90545423
34	Nagpur	Savner	Ashti Bk.	Check Dam with Recharge Shaft	21.44852946	78.90145544

Sr No.	DISTRICT	TALUKA	VILLAGE	Structure	LATTITUDE	LONGITUDE
35	Nagpur	Savner	Parsodi	Check Dam with Recharge Shaft	21.43573075	78.89825958
36	Nagpur	Savner	Parsodi	Check Dam with Recharge Shaft	21.43573075	78.89825958
37	Nagpur	Savner	Narsala	Check Dam with Recharge Shaft	21.4259958	78.85012143
38	Nagpur	Savner	Bhojapur	Check Dam with Recharge Shaft	21.42192257	78.86265686
39	Nagpur	Savner	Pohana	Check Dam with Recharge Shaft	21.42965448	78.86920315
40	Nagpur	Savner	Hattisarra	Check Dam with Recharge Shaft	21.46239567	78.91441046
41	Nagpur	Savner	Khairi (Dhalgaon)	Check Dam with Recharge Shaft	21.47033915	78.9323233
42	Nagpur	Savner	Khairi (Dhalgaon)	Check Dam with Recharge Shaft	21.47033915	78.9323233
43	Nagpur	Savner	Khairi (Dhalgaon)	Check Dam with Recharge Shaft	21.47033915	78.9323233
44	Nagpur	Savner	Kharduka	Check Dam with Recharge Shaft	21.48937447	78.94384335
45	Nagpur	Savner	Tembhurdoh	Check Dam with Recharge Shaft	21.51016134	78.95628804
46	Nagpur	Savner	Tembhurdoh	Check Dam with Recharge Shaft	21.51016134	78.95628804
47	Nagpur	Savner	Tembhurdoh	Check Dam with Recharge Shaft	21.51016134	78.95628804
48	Nagpur	Savner	Tembhurdoh	Check Dam with Recharge Shaft	21.51016134	78.95628804
49	Nagpur	Savner	Raiwadi	Check Dam with Recharge Shaft	21.53070497	78.93693394
50	Nagpur	Savner	Raiwadi	Check Dam with Recharge Shaft	21.53070497	78.93693394
51	Nagpur	Savner	Rajegaon	Check Dam with Recharge Shaft	21.54714283	78.95393799
52	Nagpur	Savner	Warpani	Check Dam with Recharge Shaft	21.57581256	78.94398062
53	Nagpur	Savner	Warpani	Check Dam with Recharge Shaft	21.57581256	78.94398062
54	Nagpur	Savner	Sindewani Kh.	Check Dam with Recharge Shaft	21.57420544	78.92322871
55	Nagpur	Savner	Sindewani Bk.	Check Dam with Recharge Shaft	21.58693508	78.93263294
56	Nagpur	Savner	Kormeta	Check Dam with Recharge Shaft	21.57104854	78.97958514
57	Nagpur	Savner	Sarra	Check Dam with Recharge Shaft	21.57374065	78.99893964
58	Nagpur	Savner	Nagalwadi	Check Dam with Recharge Shaft	21.57491247	79.02158424
59	Nagpur	Savner	Sironji	Check Dam with Recharge Shaft	21.55684272	78.98149381
60	Nagpur	Savner	Sironji	Check Dam with Recharge Shaft	21.55684272	78.98149381
61	Nagpur	Savner	Sonpur	Check Dam with Recharge Shaft	21.54111115	78.9788878
62	Nagpur	Savner	Sonpur	Check Dam with Recharge Shaft	21.54111115	78.9788878
63	Nagpur	Savner	Chorkhairi	Check Dam with Recharge Shaft	21.5339582	78.95947751
64	Nagpur	Savner	Chorkhairi	Check Dam with Recharge Shaft	21.5339582	78.95947751
65	Nagpur	Savner	Risala	Check Dam with Recharge Shaft	21.48348402	79.00068583
66	Nagpur	Savner	Badegaon	Check Dam with Recharge Shaft	21.48081013	78.96181265
67	Nagpur	Savner	Badegaon	Check Dam with Recharge Shaft	21.48081013	78.96181265
68	Nagpur	Savner	Badegaon	Check Dam with Recharge Shaft	21.48081013	78.96181265
69	Nagpur	Savner	Badegaon	Check Dam with Recharge Shaft	21.48081013	78.96181265
70	Nagpur	Savner	Kocchi	Check Dam with Recharge Shaft	21.45913185	78.95959505
71	Nagpur	Savner	Kocchi	Check Dam with Recharge Shaft	21.45913185	78.95959505
72	Nagpur	Savner	Pipla (Rithi)	Check Dam with Recharge Shaft	21.4735549	78.94365453
73	Nagpur	Savner	Nandapur	Check Dam with Recharge Shaft	21.44659407	78.94670491
74	Nagpur	Savner	Nandapur	Check Dam with Recharge Shaft	21.44659407	78.94670491
75	Nagpur	Savner	Nanda Kh.	Check Dam with Recharge Shaft	21.4400845	78.92520479
76	Nagpur	Savner	Khangaon	Check Dam with Recharge Shaft	21.42711618	78.92126094
77	Nagpur	Savner	Khangaon	Check Dam with Recharge Shaft	21.42711618	78.92126094
78	Nagpur	Savner	Mangsa	Check Dam with Recharge Shaft	21.4213836	78.8841577
79	Nagpur	Savner	Mangsa	Check Dam with Recharge Shaft	21.4213836	78.8841577

Sr No.	DISTRICT	TALUKA	VILLAGE	Structure	LATTITUDE	LONGITUDE
80	Nagpur	Savner	Khurajgaon	Check Dam with Recharge Shaft	21.41527604	78.90692927
81	Nagpur	Savner	Khurajgaon	Check Dam with Recharge Shaft	21.41527604	78.90692927
82	Nagpur	Savner	Hetisurla	Check Dam with Recharge Shaft	21.39251697	78.8811392
83	Nagpur	Savner	Hetisurla	Check Dam with Recharge Shaft	21.39251697	78.8811392
84	Nagpur	Savner	Hetisurla	Check Dam with Recharge Shaft	21.39251697	78.8811392
85	Nagpur	Savner	Hetisurla	Check Dam with Recharge Shaft	21.39251697	78.8811392
86	Nagpur	Savner	Sawangi	Check Dam with Recharge Shaft	21.37611941	78.87964943
87	Nagpur	Kalameshwar	Dudhabardi	Check Dam with Recharge Shaft	21.36615891	78.8905615
88	Nagpur	Savner	Savner (M Cl)	Check Dam with Recharge Shaft	21.38476862	78.91442997
89	Nagpur	Savner	Savner (M Cl)	Check Dam with Recharge Shaft	21.38476862	78.91442997
90	Nagpur	Savner	Savner (M Cl)	Check Dam with Recharge Shaft	21.38476862	78.91442997
91	Nagpur	Savner	Savner (M Cl)	Check Dam with Recharge Shaft	21.38476862	78.91442997
92	Nagpur	Savner	Umari	Check Dam with Recharge Shaft	21.36993325	78.92129574
93	Nagpur	Savner	Waghoda (CT)	Check Dam with Recharge Shaft	21.36629877	78.93194376
94	Nagpur	Savner	Angewada	Check Dam with Recharge Shaft	21.3640726	78.9414488
95	Nagpur	Savner	Patakakhedi	Check Dam with Recharge Shaft	21.35198942	78.95060871
96	Nagpur	Savner	Patakakhedi	Check Dam with Recharge Shaft	21.35198942	78.95060871
97	Nagpur	Savner	Katodi	Check Dam with Recharge Shaft	21.33915886	78.96573296
98	Nagpur	Savner	Katodi	Check Dam with Recharge Shaft	21.33915886	78.96573296
99	Nagpur	Savner	Bramhpuri	Check Dam with Recharge Shaft	21.31624218	78.96160319
100	Nagpur	Savner	Erangaon	Check Dam with Recharge Shaft	21.32682046	78.97461122
101	Nagpur	Savner	Sillori	Check Dam with Recharge Shaft	21.31345274	78.9773606
102	Nagpur	Savner	Sillori	Check Dam with Recharge Shaft	21.31345274	78.9773606
103	Nagpur	Savner	Itangoti	Check Dam with Recharge Shaft	21.31330033	78.99853466
104	Nagpur	Savner	Itangoti	Check Dam with Recharge Shaft	21.31330033	78.99853466
105	Nagpur	Savner	Ajani	Check Dam with Recharge Shaft	21.40280262	78.93244172
106	Nagpur	Savner	Ajani	Check Dam with Recharge Shaft	21.40280262	78.93244172
107	Nagpur	Savner	Sherdi	Check Dam with Recharge Shaft	21.41663643	78.93879342
108	Nagpur	Savner	Gadegaon	Check Dam with Recharge Shaft	21.43332849	78.94445152
109	Nagpur	Savner	Karajghat	Check Dam with Recharge Shaft	21.43558907	78.96422749
110	Nagpur	Savner	Khedi	Check Dam with Recharge Shaft	21.41893057	78.95533522
111	Nagpur	Savner	Kodegaon	Check Dam with Recharge Shaft	21.40633868	78.95895774
112	Nagpur	Savner	Kodegaon	Check Dam with Recharge Shaft	21.40633868	78.95895774
113	Nagpur	Savner	Kodegaon	Check Dam with Recharge Shaft	21.40633868	78.95895774
114	Nagpur	Savner	Kodegaon	Check Dam with Recharge Shaft	21.40633868	78.95895774
115	Nagpur	Savner	Khapa (M Cl)	Check Dam with Recharge Shaft	21.42034644	78.97907561
116	Nagpur	Savner	Khapa (M Cl)	Check Dam with Recharge Shaft	21.42034644	78.97907561
117	Nagpur	Savner	Bawangaon	Check Dam with Recharge Shaft	21.43838316	78.98463981
118	Nagpur	Savner	Bawangaon	Check Dam with Recharge Shaft	21.43838316	78.98463981
119	Nagpur	Savner	Bawangaon	Check Dam with Recharge Shaft	21.43838316	78.98463981
120	Nagpur	Savner	Khubala	Check Dam with Recharge Shaft	21.46338176	79.00061075
121	Nagpur	Savner	Khubala	Check Dam with Recharge Shaft	21.46338176	79.00061075
122	Nagpur	Savner	Khubala	Check Dam with Recharge Shaft	21.46338176	79.00061075
123	Nagpur	Savner	Khubala	Check Dam with Recharge Shaft	21.46338176	79.00061075
124	Nagpur	Savner	Khubala	Check Dam with Recharge Shaft	21.46338176	79.00061075

Sr No.	DISTRICT	TALUKA	VILLAGE	Structure	LATTITUDE	LONGITUDE
125	Nagpur	Savner	Umari jambhalpani	Check Dam with Recharge Shaft	21.44108853	79.00474038
126	Nagpur	Savner	Umari jambhalpani	Check Dam with Recharge Shaft	21.44108853	79.00474038
127	Nagpur	Savner	Mohagaon (Jangali)	Check Dam with Recharge Shaft	21.45007998	79.02776935
128	Nagpur	Savner	Khairi (Panjabrao)	Check Dam with Recharge Shaft	21.4290401	79.00874215
129	Nagpur	Savner	Gujarkhedi	Check Dam with Recharge Shaft	21.38088218	78.93953778
130	Nagpur	Savner	Borujwada	Check Dam with Recharge Shaft	21.37656599	78.9548898
131	Nagpur	Savner	Patakakhedi	Check Dam with Recharge Shaft	21.35198942	78.95060871
132	Nagpur	Savner	Tigai	Check Dam with Recharge Shaft	21.39485667	78.9731856
133	Nagpur	Savner	Tigai	Check Dam with Recharge Shaft	21.39485667	78.9731856
134	Nagpur	Savner	Gumgaon	Check Dam with Recharge Shaft	21.39282218	78.98758875
135	Nagpur	Savner	Rajana (Halad)	Check Dam with Recharge Shaft	21.40762171	78.99769477
136	Nagpur	Savner	Ramdongari	Check Dam with Recharge Shaft	21.41006794	79.00863577
137	Nagpur	Savner	Ramdongari	Check Dam with Recharge Shaft	21.41006794	79.00863577
138	Nagpur	Savner	Pendhari	Check Dam with Recharge Shaft	21.46080376	79.04796825
139	Nagpur	Savner	Hetikheda	Check Dam with Recharge Shaft	21.45463674	79.05952928
140	Nagpur	Savner	Gadami	Check Dam with Recharge Shaft	21.44552102	79.04501608
141	Nagpur	Savner	Kusumbi	Check Dam with Recharge Shaft	21.43569499	79.04651716
142	Nagpur	Savner	Kusumbi	Check Dam with Recharge Shaft	21.43569499	79.04651716
143	Nagpur	Savner	Kusumbi	Check Dam with Recharge Shaft	21.43569499	79.04651716
144	Nagpur	Savner	Wakodi	Check Dam with Recharge Shaft	21.38492018	79.00412176
145	Nagpur	Savner	Kodadongri	Check Dam with Recharge Shaft	21.34913052	79.03658663
146	Nagpur	Savner	Wakodi	Check Dam with Recharge Shaft	21.38492018	79.00412176
147	Nagpur	Savner	Wakodi	Check Dam with Recharge Shaft	21.38492018	79.00412176
148	Nagpur	Savner	Wakodi	Check Dam with Recharge Shaft	21.38492018	79.00412176
149	Nagpur	Savner	Dohanghat	Check Dam with Recharge Shaft	21.38968512	79.02781404
150	Nagpur	Savner	Dohanghat	Check Dam with Recharge Shaft	21.38968512	79.02781404
151	Nagpur	Savner	Waki	Check Dam with Recharge Shaft	21.37437866	79.03955565
152	Nagpur	Savner	Waki	Check Dam with Recharge Shaft	21.37437866	79.03955565
153	Nagpur	Savner	Waki	Check Dam with Recharge Shaft	21.37437866	79.03955565
154	Nagpur	Savner	Gosewadi	Check Dam with Recharge Shaft	21.36438962	79.06162141
155	Nagpur	Savner	Gosewadi	Check Dam with Recharge Shaft	21.36438962	79.06162141
156	Nagpur	Savner	Gosewadi	Check Dam with Recharge Shaft	21.36438962	79.06162141
157	Nagpur	Savner	Isapur	Check Dam with Recharge Shaft	21.33672669	79.07030353
158	Nagpur	Savner	Isapur	Check Dam with Recharge Shaft	21.33672669	79.07030353
159	Nagpur	Savner	Yeltur	Check Dam with Recharge Shaft	21.34334582	79.05167156
160	Nagpur	Savner	Yeltur	Check Dam with Recharge Shaft	21.34334582	79.05167156
161	Nagpur	Savner	Bhendala	Check Dam with Recharge Shaft	21.36271109	79.0159817
162	Nagpur	Savner	Bhendala	Check Dam with Recharge Shaft	21.36271109	79.0159817
163	Nagpur	Savner	Bhendala	Check Dam with Recharge Shaft	21.36271109	79.0159817
164	Nagpur	Savner	Patansavangi	Check Dam with Recharge Shaft	21.33345687	79.02132842
165	Nagpur	Savner	Patansavangi	Check Dam with Recharge Shaft	21.33345687	79.02132842
166	Nagpur	Savner	Patansavangi	Check Dam with Recharge Shaft	21.33345687	79.02132842
167	Nagpur	Savner	Patansavangi	Check Dam with Recharge Shaft	21.33345687	79.02132842
168	Nagpur	Savner	Patansavangi	Check Dam with Recharge Shaft	21.33345687	79.02132842
169	Nagpur	Savner	Kawadas	Check Dam with Recharge Shaft	21.32318767	79.05020913

Sr No.	DISTRICT	TALUKA	VILLAGE	Structure	LATTITUDE	LONGITUDE
170	Nagpur	Savner	Kawadas	Check Dam with Recharge Shaft	21.32318767	79.05020913
171	Nagpur	Savner	Pipla (da-B)	Check Dam with Recharge Shaft	21.30986981	79.07114101
172	Nagpur	Savner	Pipla (da-B)	Check Dam with Recharge Shaft	21.30986981	79.07114101
173	Nagpur	Savner	Ranala	Check Dam with Recharge Shaft	21.29570905	79.08942369
174	Nagpur	Savner	Ranala	Check Dam with Recharge Shaft	21.29570905	79.08942369
175	Nagpur	Savner	Dahegaon(Rangari)	Check Dam with Recharge Shaft	21.28552386	79.08277065
176	Nagpur	Kamptee	Nanda	Check Dam with Recharge Shaft	21.27117848	79.08213845
177	Nagpur	Savner	Champa	Check Dam with Recharge Shaft	21.29585144	79.00640621
178	Nagpur	Savner	Champa	Check Dam with Recharge Shaft	21.29585144	79.00640621
179	Nagpur	Savner	Belori Kh.	Check Dam with Recharge Shaft	21.31427351	79.0170979
180	Nagpur	Savner	Takali	Check Dam with Recharge Shaft	21.35350417	78.99687732
181	Nagpur	Savner	Takali	Check Dam with Recharge Shaft	21.35350417	78.99687732
182	Nagpur	Savner	Manegaon	Check Dam with Recharge Shaft	21.3653535	78.98233641
183	Nagpur	Savner	Manegaon	Check Dam with Recharge Shaft	21.3653535	78.98233641
184	Nagpur	Savner	Malegaon	Check Dam with Recharge Shaft	21.37201865	78.96901435
185	Nagpur	Savner	Malegaon	Check Dam with Recharge Shaft	21.37201865	78.96901435
186	Nagpur	Savner	Malegaon	Check Dam with Recharge Shaft	21.37201865	78.96901435
187	Nagpur	Savner	Walani (CT)	Check Dam with Recharge Shaft	21.32072007	79.08697486
188	Nagpur	Savner	Walani (CT)	Check Dam with Recharge Shaft	21.32072007	79.08697486
189	Nagpur	Savner	Rohana	Check Dam with Recharge Shaft	21.31302949	79.10806854
190	Nagpur	Savner	Pota	Check Dam with Recharge Shaft	21.30557032	79.11631947
191	Nagpur	Savner	Sillewada (CT)	Check Dam with Recharge Shaft	21.2920024	79.12132005
192	Nagpur	Savner	Chandkapur (CT)	Check Dam with Recharge Shaft	21.28569202	79.10281191
193	Nagpur	Savner	Chandkapur (CT)	Check Dam with Recharge Shaft	21.28569202	79.10281191
194	Nagpur	Savner	Chicholi (CT)	Check Dam with Recharge Shaft	21.26982378	79.11675959
195	Nagpur	Savner	Bhanegaon	Check Dam with Recharge Shaft	21.26576773	79.13501869
196	Nagpur	Savner	Bhanegaon	Check Dam with Recharge Shaft	21.26576773	79.13501869
197	Nagpur	Savner	Bhanegaon	Check Dam with Recharge Shaft	21.26576773	79.13501869
198	Nagpur	Savner	Chichghat	Check Dam with Recharge Shaft	21.3792505	79.05628611
199	Nagpur	Savner	Nandori	Check Dam with Recharge Shaft	21.4493589	78.92216905
200	Nagpur	Savner	Pandharakhedi	Check Dam with Recharge Shaft	21.34861945	78.97414663

भारत सरकार
Government of India
जल शक्ति मंत्रालय,
Ministry of Jal Shakti,
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग,
Department of Water Resources,
River Development and
Ganga Rejuvenation

केंद्रीय भूमि जल बोर्ड

Central Ground Water Board

NAQUIM 2.0

Central Ground Water Board Central Region

New secretariat Building

Civil Lines, Nagpur

Maharashtra – 440001

Email: rdcr-cgwb@nic.in