Uniform Drinking Water Quality Monitoring Protocol

GOVERNMENT OF INDIA

MINISTRY OF DRINKING WATER AND SANITATION

NEW DELHI

FEBRUARY 2013

राज्य मंत्री (स्वतंत्र प्रभार)
पेयजल एवं स्वच्छता
भारत सरकार
नई दिल्ली

सत्यमेव जयते

MINISTER OF STATE (INDEPENDENT CHARGE)
FOR DRINKING WATER & SANITATION
GOVERNMENT OF INDIA
NEW DELHI

भरतसिंह सोलंकी
Bharatsinh Solanki

MESSAGE

Good quality of drinking water is essential for human life. Initially our efforts were concentrated on increasing the availability and access to drinking water. Now that more than 85% of rural households have access to drinking water within or near their premises, we need to give greater emphasis on providing safe drinking water on continuous basis.

This implies that water quality is duly tested and certified in well equipped water quality testing laboratories at the State, district and Sub-divisional levels. In this context, the Ministry of Drinking Water and Sanitation has earmarked 3% of the National Rural Drinking Water Programme (NRDWP) funds allocated to States for water quality monitoring and surveillance which interalia include establishment/upgrading of laboratories at various levels.

The erstwhile Department of Drinking Water Supply had issued Operational and Executive guidelines on setting up district water quality testing laboratories. These were very broad and did not fully cover the actual methodology of analyzing various parameters and instrumentation required. The Uniform Water Quality Monitoring Protocol notified in 2005 by the Water Quality Assessment Authority also did not focus on drinking water. These facts warranted the Ministry to develop a separate "Uniform Drinking Water Quality Monitoring Protocol" so as to standardize the requirements for setting up and functioning of laboratories at various levels. Though the Protocol is suggestive in nature, this would be very useful for laboratory personnel, water supply engineers and policy makers working in the drinking water sector to improve drinking water quality testing to ensure better quality of drinking water supply.

I hope all the concerned stakeholders will benefit by referring to the Protocol.

(Bharatsinh Solanki)

New Delhi

15th February 2013

पंकज जैन, आई.ए.एस.
PANKAJ JAIN I.A.S.

सत्यमेव जयते

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FOREWORD

The Uniform Water Quality Monitoring Protocol was notified in the year 2005, by the Ministry of Water Resources following the provisions made under the Environment (Protection) Act, 1986. However, this protocol focused more on pollution aspect of water bodies and was not specific to the requirements of drinking water quality. Therefore a need was felt to prepare a Uniform Drinking Water Quality Monitoring Protocol taking into the consideration the alarming increase of contamination of drinking water sources whether through man-made or natural factors and their adverse impacts on human health.

As on 1/4/2012, about 5 crore rural people in 1.04 lakh habitations are yet to be covered with safe drinking water as some of the existing sources are contaminated with arsenic, fluoride, iron, dissolved solids or nitrates. Emerging contaminants like pesticides, chromium, cadmium, uranium, nickel, selenium, aluminum, mercury, etc. are posing a great challenge for supplying safe drinking water. Acute Diarrhoeal Diseases due to bacteriological contamination is more frequently observed due to insanitary conditions and Japanese Encephalitis/Acute Encephalitis Syndrome (JE/AES) is another challenge being faced by the rural drinking water sector.

There is an urgent need to strengthen/set up more laboratories and also improve the quality of existing laboratories so that quality of drinking water is ensured in all villages. The current attempt made is to suggest standardization of the requirements of manpower, space, chemicals, glassware, instrumentation at the State, District and Sub-divisional level laboratories, so that the capacity of State officials is developed for conducting easier, accurate, convenient and faster analysis of drinking water quality.

This document will be immensely useful to engineers, chemists and policy makers working in the drinking water sector both rural and urban areas.

(Pankaj Jain)

New Delhi,

15th February 2013.

T.M. Vijay Bhaskar, *I.A.S.*
Joint Secretary
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भारत सरकार
पेयजल एवं स्वच्छता मंत्रालय
राजीव गांधी राष्ट्रीय पेयजल मिशन
Government of India
Ministry of Drinking Water and Sanitation
Rajiv Gandhi National Drinking Water Mission

Message and Acknowledgments

Considering the rising importance of ensuring drinking water quality, the Government of India has earmarked 3% of State allocation of National Rural Drinking Water Programme (NRDWP) for Water Quality Monitoring and Surveillance. Therefore, sufficient funds are now available with the State Governments to set-up and upgrade water quality testing facilities and conduct regular testing. In this regard, in pursuance of this Ministry's mandate to provide technical assistance to State Governments, the Uniform Drinking Water Quality Monitoring Protocol has been prepared to guide States in various aspects of assessing drinking water quality.

The Protocol provides guidance on aspects like minimum infrastructure required for building space, manpower, instrumentation, chemical, glassware to be provided in laboratories at different levels, sampling and testing procedures etc. However, these are indicative and suggestive in nature. States can decide their own norms based on State rules, resources and State specific requirements. This Protocol is therefore not compulsory in nature and does not confer any rights on any individuals. I hope this will be used by State PHEDs/ Boards dealing with rural water supply, policy planners, Universities and others in improving drinking water quality in the country.

On behalf of the Ministry of Drinking Water and Sanitation, I would like to profoundly thank Dr. S.R. Wate, Director, Dr. Pawan Labhasetwar and other scientists of National Environmental Engineering Research Institute, Nagpur for helping in preparation of the draft Protocol. I also thank all State level Chief Chemists who have provided their valuable inputs as per field realities for preparation of the Protocol. Lastly, I thank Shri. D. Rajasekhar, Deputy Adviser (WQ) and Dr. Brajesh Shrivastava, Consultant (WQ) of the Ministry for the hard work put in by them in compiling and finalising the Protocol right from the conception stage.

(T.M. Vijay Bhaskar)

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PREFACE

Provision of safe drinking water vis-à-vis health protection has more relevance in rural India from view point of chemical and microbial risk. The most effective means of ensuring safe drinking water is through the use of water safety plan which effectively utilizes water quality data in planning preventive and corrective actions. The Ministry of Environment & Forests, Government of India has notified the Uniform Protocol on Water Quality Monitoring Order, 2005; however, some critical issues in the previous notification warrant specialized guidance on provision of safe drinking water in the country. In view of the above, Ministry of Drinking Water and Sanitation, Government of India constituted a committee to evolve a Uniform Drinking Water Quality Monitoring Protocol with emphasis on water quality and safety.

The purpose of this document is to describe various elements of laboratory management practices to ensure that the data generated is comparable, scientifically correct and in a form that can be used in implementing interventions to improve water quality. The document besides general protocol for a monitoring programme also includes details on water quality testing laboratory, infrastructure and staff requirements.

The protocol on sampling as well analytical methods for the important physical, chemical and microbial parameters have been brought together in a convenient form with emphasis on field techniques. This document signifies need for setting-up laboratories at State, District and Sub-district level as well as quality control for regular testing and surveillance of drinking water sources. It is also proposed in the protocol to apply water safety plan so as to utilize water quality data for continuously improving water quality.

It is hoped that the approaches and methods described in this protocol will be beneficial to stakeholders and personnel working in various drinking water testing laboratories. It will also provide guidance to the persons at different managerial levels to tackle water quality-affected habitations by adopting proper interventions based on available water quality data.

Cooperation rendered by the Committee Members, officials of Ministry of Drinking Water and Sanitation and Mr D. Rajasekhar, convener of the Committee is gratefully acknowledged.

(S.R. Wate)
Chairman, Uniform Drinking Water Quality Monitoring
Protocol Formulation Committee

CONTENTS

LIST OF ANNEXURES

ABBREVIATIONS

AAS:	Atomic Absorption Spectrophotometer
ADD:	Acute Diarrhoeal Diseases
AES:	Acute Encephalitis Syndrome
AMD:	Atomic Mineral Division
APHA:	American Public Health Association
AR:	Analytical Reagent
ASTM:	American Standards for Testing & Materials
BARC:	Bhabha Atomic Research Centre
BIS:	Bureau of Indian Standards
BOD:	Biological Oxygen Demand
BRC:	Block Resource Centre
BRIT:	Board of Radiation & Isotope Technology
COD:	Chemical Oxygen Demand
CPCB:	Central Pollution Control Board
CRC:	Cluster Resource Centre
DAE:	Department of Atomic Energy
DO:	Dissolved Oxygen
GC:	Gas Chromatography
GIS:	Geographical Information System
GP:	Gram Panchayat
HPLC:	High Pressure Liquid Chromatography
ICP:	Inductive Coupled Plasma
ISO:	International Standards for Organizations
JE:	Japanese Encephalitis
LR:	Laboratory Reagent
NRDWP:	National Rural Drinking Water Programme
NABL:	National Accreditation Board for Laboratories
NEERI:	National Environmental Engineering Research Institute
NGO:	Non Government Organisation
PRL:	Physical Research Laboratory

R&D:	Research & Development
SAR:	Sodium Absorption Ratio
SPCB:	State Pollution Control Board
TDS:	Total Dissolved Solids
VSWC:	Village Water & Sanitation Committee
WHO:	World Health Organization
WSP:	Water Safety Plans
WQMS:	Water Quality Monitoring & Surveillance

1.0 Introduction

Drinking-water supply agencies are usually required to verify that the quality of water supplied to the consumers meets specific numerical standards. Yet, by the time, water quality analysis is completed and results indicate that the water is not safe to drink; thousands of people may have consumed that water putting them on risk. Moreover, even with frequent monitoring, the vast majority of water distributed to consumers will never be tested. **Therefore reliance on only end-of-pipe monitoring is inadequate to address the problem in totality.**

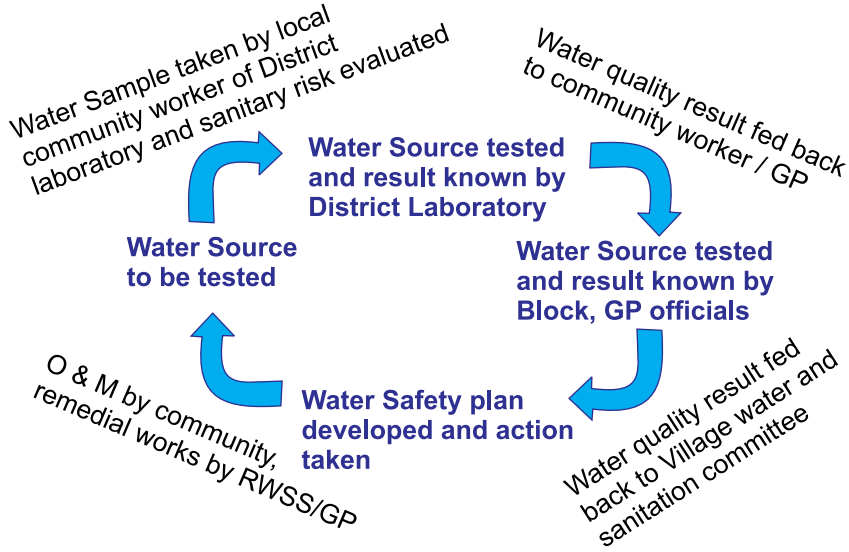
In above context, it is relevant to quote some sentences from Guidelines for Drinking-water Quality, Fourth Edition, published by the World Health Organization (WHO) which states that *"The most effective means of consistently ensuring the safety of a drinking-water supply is through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer."* in 2011.

Such approaches are termed as Water Safety Plan (WSP). The purpose of a Water Safety Plan (WSP) is to consistently ensure the safety and acceptability of a drinking-water supply. This is done by eliminating/minimizing potential risk of contamination in raw water sources, water treatment plants, catchment, distribution network, storage, collection and handling. WSP is an essential tool in providing safe water to the people for all types of water supply systems i.e. large piped drinking water supplies, small community supplies, stand-alone household systems such as wells and also in rain harvesting systems. Water safety plan aims to minimize risks of contamination via sanitary surveillance and can be conjoined with water quality monitoring for ensuring safe water to the communities. This means that the water quality data is useful along with Water Safety Plans (WSP) for preventive and curative management measures.

Conjoined approach of using WSP with Water Quality Monitoring is an important tool which extends its application beyond the creation of water quality database. This can be achieved by shifting emphasis of drinking-water quality management to a holistic risk-based approach. Such an approach is called WSPs. **Wide spread implementation of WSPs can contribute to reducing the portion of the disease burden attributed to poor quality of drinking-water.**

Water quality monitoring resulting in identifying sources of contamination and implementation of corrective actions and subsequent verification comprises of components of water safety plan. In this

case, utility of water quality monitoring is extended to provision of safe water to the community. A framework of water safety in rural context is prepared and presented below:



2.0 Drinking water quality monitoring

Bureau of Indian Standards (BIS), has specified drinking water quality standards in India to provide safe drinking water to the people. It is necessary that drinking water sources should be tested regularly to know whether water is meeting the prescribed standards for drinking or not and, if not, then, the extent of contamination/ unacceptability and the follow-up required. Apart from BIS specification for drinking water, there is one more guideline for water quality, brought out by Ministry of Water Resources, Government of India in 2005. This is known as Uniform Protocol for Water Quality Monitoring. **A need has arisen to have a separate uniform protocol for Drinking Water Quality Monitoring in view of increasing risk of geogenic and anthropogenic contamination.**

Keeping in view requirement of preparing Uniform Drinking Water Quality Monitoring Protocol, Ministry of Drinking Water and Sanitation (MDWS), Government of India constituted an Expert Group (Annexure I) and Dr S.R. Wate, Director, NEERI was nominated as Chairman of the Group. The group held several meetings and prepared the Protocol which was subjected to internal and external review and comments were received on the protocol. These comments were thoroughly analysed and appropriately considered in the Protocol.

The Drinking Water Quality Monitoring protocol describes specific requirements for monitoring drinking water quality with a view to ensure provision of safe drinking water to the consumers. In addition, this document also includes requirements for setting-up laboratories at State, District and Sub-district level and their quality control for regular testing and surveillance of drinking water sources. The purpose of this document is to describe various elements of laboratory management practices to ensure that the data generated is comparable and scientifically correct and in a form that can then be used to result in interventions to improve water quality. The

protocol will be helpful at the grass-root level for the personnel working in various drinking water testing laboratories. In addition, it will provide guidance to the persons at different managerial levels to tackle water quality-affected habitations by adopting water safety approach.

There are about 50 lakh reported public drinking water sources in the country. Considering many unreported and/or private sources, the total number of drinking water sources in rural India may exceed 60 lakh. If these are to be tested twice in a year (for bacteriological analysis) and once a year (Pre-monsoon) for chemical analysis, 120 lakh water samples have to be tested in the country in a year. As reported by States, about 1,869 district and sub-district water testing laboratories (including labs other than PHED labs) exist in the country, though many of them are still not fully functional. If all such laboratories are made fully functional and considering a capacity of 3,000 samples to be tested in a year per laboratory, the number of sources that could be tested in a year would be 3,000x 1869 = 56 lakh samples i.e. about 50%. Therefore, under National Rural Drinking Water Programme (NRDWP), provision for setting up new sub-district level laboratories has been made to bridge the gap. Further, the decentralized Water Quality Monitoring & Surveillance Programme started in the year 2005-06 envisages indicative testing of all drinking water sources (both public and private) using simple field test kits and only positively tested samples to be referred to District and Sub-district water testing laboratories for confirmation. Sanitary inspection is also a part of this programme.

It is proposed in the protocol to apply concepts of water safety plan so as to utilize water quality data for continuously improving water quality. If water quality monitoring indicates a contaminated water source, an improvement plan will be prepared and implemented. Follow-up water quality monitoring will also be carried out after implementation of the improvement plan to determine efficacy of the plan in providing safe water to the community.

It is well established that microbial contamination imposes immediate disease burden in India though chemical contaminants like arsenic and fluoride are also having tangible chronic health effects in sporadic though numerous habitations in India. **Therefore sanitary inspection should also be given due importance in establishing sanitary risk to the water sources.** This will also help in implementing corrective actions if sanitary risks are found high and water quality monitoring establishes microbial contamination.

2.1 Definition of drinking water quality

BIS has set specifications in its IS–10500 standards for drinking water. The revised edition of IS 10500: 2012 standard shall be followed in Uniform Drinking Water Quality Monitoring protocol. Some parameters apart from those mentioned in IS 10500: 2012 may also be measured if the States deem it necessary. This standard has two limits i.e. desirable limits and maximum permissible or cause for rejection limits. If any parameter exceeds the cause for rejection limit, that water is considered unfit for human consumption. Broadly speaking water is defined as unfit for drinking as per Buearu of Indian Standards, IS-10500-2012, if it is bacteriologically contaminated (presence of indicator

bacteria particularly E-coli, viruses etc.) or if chemical contamination exceeds maximum permissible limits (e.g. excess fluoride [>1.5mg/l], Total Dissolved Solids (TDS) [>2,000mg/l], iron [>0.3 mg/l], manganese[>0.3 mg/l], arsenic [>0.05mg/l], nitrates [>45mg/l] etc.). In rural areas, about 85% of drinking water sources are ground water based and in the short-term, chemical constituents in groundwater do not change much, therefore testing once in a year for chemical contaminants is adequate.

In Japanese Encephalitis/ Acute Encephalitis Syndrome (JE/AES) and Acute Diarrhoeal Diseases (ADD) affected districts, sanitary inspections should be made mandatory once in a month by the Village Water & Sanitation Committee (VWSC)/ Gram Panchayat (GP) especially during monsoon and post monsoon seasons. Strict surveillance and remedial action by the Water Supply agency is also mandatory during this period.

It is highly desirable that all States/UTs supply drinking water with the quality constituents at least within the cause for rejection limits of IS-10500:2012 and graduate steadily to supply drinking water within the desirable limits. For all new/existing piped water supply schemes, design requirements of water treatment plants should take care of supplying drinking water with quality parameters within the "desirable" limits of IS-10500:2012. **Annexure-II** provides acceptable & permissible units for some of the important parameters. For other parameters, BIS standard IS-10500:2012 may be referred to.

2.2 Sanitary Inspection

A sanitary inspection is an on-site inspection of a water supply facility to identify actual and potential source of contamination. The physical structure and operation of the system and external environmental factors (such as latrine location) are evaluated. This information can be used to select appropriate remedial action to improve or protect the water supply.

Sanitary inspections should be carried out for all new sources of water before they are used for drinking water and on a regular basis. Thereafter, inspections should be carried out by a suitably trained person using a simple, clear report form. **The sanitary inspection forms are given in Annexure III.** These forms consist of a set of questions which have "yes" or "no" answers. The questions are structured so that the "yes" answers indicate that there is risk of contamination and "no" answers indicate that the particular risk is absent. Each "yes" answer scores one point and each "no" answer scores zero point. At the end of the inspection the points are added up, and the higher the total of identified risks, the greater the risk of contamination.

The results of sanitary inspections and the remedial actions that need to be taken to improve conditions should be discussed with the community. In small water supply schemes, it is often possible for community members to carry out most of the inspections themselves using a standard form. The information gathered can then be sent to the sub-district, district or state level surveillance agency, which should also **undertake a minimum of two annual inspections along with microbial water quality monitoring to check the reliability of the information.**

3.0 Need to revise Uniform Protocol on Water Quality Monitoring Order, 2005

Vide notification dated 17/6/2005, the Ministry of Environment & Forests, Government of India has notified the Uniform Protocol on Water Quality Monitoring Order, 2005, which is applicable to all organizations and any other body monitoring surface and ground water quality. Drinking water quality whether from a groundwater or surface water (including rain-water) source, may be different spatially following a variety of factors influencing it. Further, some of the pollution load indicators like Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) etc. and agriculture quality water indicators like Sodium Absorption Ratio (SAR), Phosphorous (P) and Potassium (K) etc. are not required for drinking water quality monitoring. Therefore, these were aptly not mentioned in the BIS standard for drinking water ie., IS-10500-2012. Water of higher standards is required for drinking purposes, especially with respect to microbial quality. However, the existing Uniform Protocol on Water Quality Monitoring relies more on BOD and COD surrogate to biological and chemical contamination. Furthermore, in order to maintain bacteria free drinking water, there has to be certain concentration of residual chlorine, if chlorination is adopted as unit process for disinfection in the water treatment plants. This parameter is not monitored as per the Uniform Protocol on Water Quality Monitoring Order, 2005. These issues warrant specialized guidance on requirements for drinking water quality testing in the Country. Therefore, there is a need to evolve a Uniform Drinking Water Quality Monitoring Protocol for emphasis on and relevance to drinking water quality and amend the Uniform Protocol on Water Quality Monitoring Order, 2005 with respect to the following requirements:

- Specific laboratory requirements at State, district and sub-district drinking water testing laboratories
- Frequency of testing of drinking water sources of important parameters
- Suggestive list of instrumentation, glassware, equipments, chemicals
- Simple messaging formats for Village Water & Sanitation Committees (VWSC), Block Resource Centres (BRC), Cluster Resource Centres (CRC), Gram Panchayats (GP) on risks assessments and follow-up corrective actions
- Awareness generation amongst the community not to consume water for cooking and drinking purposes from the contaminated sources.
- Corrective actions for chemical contaminants by identifying safe source and identifying suitable treatment technologies

The State-level Water Quality Review Committee constituted as per the notification of Water Quality Assessment Authority (WQAA) shall monitor the action taken by the SPCB/CPCB (State/Central Pollution Control Board) on abatement of pollution of drinking water sources. The action taken report shall be submitted to the State Water and Sanitation Mission (SWSM) and Public Health Engineering Department (PHED) periodically under intimation to the Ministry of Drinking Water and Sanitation, Government of India.

Roles and responsibility of various stakeholders are identified and presented in Table 1.

Table 1 : Roles and responsibility of various stakeholders

	Technical	Administrative	Political
National	• **MDWS** – Guidance on implementation of Uniform Water Quality Monitoring Protocol including corrective actions;	• **MDWS** - Ensure water quality monitoring is well captured in IMIS and that this work all fits into the broader context of safe and sustainable water for all as enshrined in NRDWP Need for regular coordination of States on existing and emerging threats to water quality in India	• Need for Union Minister to regularly re-affirm the importance of water quality on human health and to strive for convergence with other Ministries such as Water Resources, Health, Education and Women & Child Development
	• Periodic updates of the Protocol Ensure follow-up of Drinking Water Quality Standards of BIS	• Allocation of funds under water quality monitoring affected habitations based on water quality data Convergence with other Ministries	
State	• **Engineer-in-Chief and Chief Engineer(s) of PHED** have responsibility to ensure water supplied stayed safe - hence the need to empower State Chief Chemist to run the State lab and manage the District and sub-District labs.	**State Secretary in charge of rural drinking water supply** is held accountable for the safety of this supply under his/her charge. State Secretary must ensure the national guidelines for water quality are adhered to in the State and must ensure communication campaigns around safe water handling and storage are in place; convergence with other Depts such as Health, Education and Women & Child Development Finalise instruments and chemical/glassware procurement policy and ensure consideration of district requirements Minimise outsourcing of water quality monitoring and strengthening State, District and Sub-district laboratories by adopting suitable HR policy Organise periodic training programmes and refresher courses in reference laboratories	Need for **State Minister to** regularly re-affirm the importance of water quality on human health and to strive for convergence with other Depts such as Water Resources, Health, Education and Women & Child Development
	• **E-in-C** is accountable for all test results submitted on line in IMIS and hence to ensure accuracy of results and cross-verification of all labs is undertaken regularly. **State Chemists** must ensure proper functioning of all labs in the States and stand-over Quality Assurance mechanisms of these labs - hence round robin lab testing and regular technical evaluations need to be carried out to ensure this.	• Ensure Close coordination between engineers and Chemists / Microbiologists	
District and Sub-District	**Ex. Engineer (EE) PHED:** • Oversight to water quality supply is safe water by ensuring regular sample collection and testing and feedback to community.		Local **MLAs and MPs** are key advocates to raise awareness and demand for safe water; they should ensure water supply in their constituencies meet the required standards and also advocate for safe water in their speeches

	Technical	Administrative	Political
	• Ensure NRDWP funds on WQ spent as per guidelines with priority focus on quality-affected habitations.		
	• Ensure entry of results to IMIS. He must guide JEs on O&M that is beyond capacity of GP		
	• Communication campaigns around safe water, based on sanitary survey findings, are implemented		
	• District Water safety and security plan is in place and being followed.		
	AEs/JEs • Implement such corrective action within a stipulated time period of the water quality threat being identified.		
	Chemist • Ensure quality assurance in his lab, that due process is followed in terms of health, safety, sample collection, analysis, calibration of equipment, necessary duplicate and blanks are tested etc. as well as safe disposal of waste from the lab. They must notify to GP and EE serious water quality threats, e.g. gross bacteriological pollution, as soon as test results are available.	**District Collector** should hold a twice yearly review of water safety and corrective measures (pre and post monsoon) to ensure the District inhabitants are getting access to safe water. He/She needs to ensure that this is happening in both the easy-to-reach villages as well as in isolated areas, tribal areas, hilly areas, in villages with large SC/ST communities. Serious problems arising from this should be brought to the notice of the Secretary in charge as well as the Chief Secretary. Equity issues need to be addressed.	
GP / village	• **VWSC/Hand-pump** mechanic or others as specified in the Protocol must take samples and provide to lab for testing	The **ASHA, ANM, AWW, teachers must** link with the VWSC on communication and awareness activities around safe water and its benefits to the villagers	The **Sarpanch** is vital in ensuring safe water. They must ensure timely O&M as per the fund devolved to them. With the support of the **Ward Members**, the Sarpanch must review water quality test results in the GP and ensure the necessary corrective action has been undertaken by the VWSC or the PHED. They must ensure that Water Safety plans are properly implemented and regularly reviewed by the village.
	• They must ensure feedback of testing results to the villagers and act on the recommendations of the findings such as on sanitary risks identified.	The **GP Secretary** may support the Sarpanch on water quality status review and to advise on fund availability for corrective actions.	
	• They also must link with the **ASHA, ANM, AWW, teachers** on communication and awareness activities around safe water and its benefits to the villagers.		

	Technical	Administrative	Political
	• Sanitation is another key communication issue as open defecation impacts directly on water quality		
	• Must maintain water sources to avoid contamination		
	• The Block Resource Centres **(BRC)** staff must work with the VWSC to support them in their action planning, implementation and monitoring; they may guide VWSC on technical issues and support them to organise awareness campaigns around safe water and sanitation		

4.0 Functions of a Drinking Water Quality Testing Laboratory

Well defined functions of a drinking water-testing laboratory are to:

- Determine the water quality for drinking and domestic use. These can be classified into following activities:
  - o Collection of water samples from the field with suitable preservation
  - o Sanitary surveillance
  - o Water sample storage with suitable preservation and analysis
  - o Data analysis
- Delineate areas of contamination (hotspots);
- Determine the risk of pollution from various sources
- Communication of results to the concerned Junior Engineer (JE), Executive Engineer/Zila Parishad) and to Gram Panchayat for corrective actions.
- Follow-up water quality monitoring after implementation of corrective actions particularly if source is bacteriologically contaminated

4.1 Functions of State Water Quality Monitoring Laboratory

There should be a **State level drinking water quality testing laboratory in each State which will have capability of analyzing a full range of physical, chemical, and microbiological parameters specific to drinking water quality.** This laboratory shall be a referral institute to analyze specific or new/emerging water quality problems and not routine water quality analysis. It should also perform the duties of the **State Referral Institute** as mentioned in the guidelines of National Rural Drinking Water Programme. The state laboratories will also monitor the performance of district and sub district laboratories and ensure Quality Assurance-& Quality Control (QAQC) in these laboratories. They

will be responsible for quality assurance of testing and supervision of water quality surveillance and monitoring using field test kits at the grass roots level in the Gram Panchayats.

However, learnings from the field indicate that **field test kits** have their own problems and government supported laboratories need to be strengthened. However, **the use of field test kits and H2S vials cannot be ignored as they not only serve the purpose of initial screening of contamination but also are an effective tool for awareness generation amongst the community to consume only safe drinking water and maintain.** For this purpose, it will select/establish a few baseline/reference stations in the state, based on hydro-geological characteristics and monitor the water quality in specific hotspots while strengthening community based water quality monitoring programme. Specific Research & Development (R&D) interventions like creation of **water quality hotspots** using Geographical Information System (GIS) platform shall also be taken-up by the State laboratory. Obviously, the instrumentation required at the **State laboratory shall be more sophisticated than other laboratories.** This will include analysis of heavy metals and toxic elements by advance spectrophotometric techniques, pesticides by Gas Chromatography (GC) / High Pressure Liquid Chromatography (HPLC), more specific bacteriological and virological examination, etc. This laboratory shall also co-ordinate with Department of Atomic Energy (DAE) approved laboratories for monitoring radioactive elements such as uranium in drinking water. The State laboratory shall be headed by a senior level experienced Chief Water Analyst/Chief Chemist/ Chief Microbiologist and he / she shall preferably report directly to the Engineer-in-Chief of the concerned Department.

4.2 Functions of District and Sub-district Laboratory

District and Sub-district laboratories shall undertake drinking water quality monitoring of the sources under their jurisdiction. These laboratories will analyze physico-chemical and microbiological parameters in drinking water sources as prescribed under IS-10500-2012. District and Sub-district laboratories will be under the administrative control of the Assistant Chemist. District and Sub-district laboratories will also provide a support service pertaining to water quality in remote areas using on-site or laboratory based analytical equipment. These laboratories will share all data to the relevant stakeholders in the State and also enable Gram Panchayats to undertake sanitary surveillance and verify these by testing their own drinking water sources and spread awareness about water quality in rural areas. **The district and sub-district laboratories shall share their data on microbiological testing of drinking water sources with the District and State Public Health Departments and also with other laboratories established/ proposed under Food Security Act, etc.**

5.0 Requirements for Setting-up Water Quality Testing Laboratory

5.1 Water Quality Field Test Kit

All Gram Panchayats and water quality testing laboratories should use Water Quality Field Test Kits for primary investigation.

5.1.1 Multi-parameter Water Quality Field Test Kits

Multi-parameter Water Quality Field Test Kit is used for physico-chemical analysis. The kit offers quantitative and semi-quantitative results. Quantitative test includes total hardness, total alkalinity and chloride tests. Semi-quantitative tests are used for remaining parameters using color comparison charts. This kit can carry out 100 tests for 11 parameters listed below:

i. Turbidity by visual comparison method
ii. pH by pH strips colour comparison method
iii. Total Hardness by Titrimetric method
iv. Total Alkalinity by Titrimetric method
v. Chloride by Titrimetric method
vi. Ammonia by visual comparison method (Optional)
vii. Phosphate by visual comparison method (Optional)
viii. Residual Chlorine by visual colour comparison method
ix. Iron by visual colour comparison method
x. Nitrate by visual colour comparison method
xi. Fluoride by visual colour comparison method

A separate arsenic field test kit is also available in the market, which could be used in States where arsenic is detected in drinking water sources.

The colour comparator is quick and easy to use. The kit is used in conjunction with tablet reagents and colour charts to test different parameters. Just add a tablet reagent to the test sample, place the tube in the comparator and match the colour against the appropriate colour disc. The kits are portable, easy to carry anywhere, easy to operate and do not require any kind of energy or power. Even a layman can use it comfortably and not require any technical support. The kit provides includes a User's manual with simple step-by-step instructions on how to conduct the water quality tests. This makes it easy for people to use and does not require a high level of training.

All positively tested samples using field test kits (with certain probability of contamination) shall be referred to the nearest district/ sub-divisional water quality testing laboratory for confirmation. Mere analysis of drinking water using field test kits alone shall not be binding for any official purpose.

5.1.2 Bacteriological Test Vials

A simple bacteriological test vial indicates the presence/ absence of pathogens in water samples. This is simple field test kit to indicate the presence of bacterial colonies in water. The principle of test is similar to that of Presumptive Coliform Test. It does not attempt to find pathogens but only shows the indicator for the presence of pathogens. The test kit can be used for any water irrespective of its source, including chlorinated water. The test can detect very low bacterial contamination with high specificity and sensitivity. The advantage of the method is its simplicity, low cost and ability to be performed

in the absence of a typical microbiology laboratory or field laboratory, test tubes or other containers holding the test material and can be used in the field by minimally trained personnel.

The latest intervention is the availability of reusable bacterial vials, which could also be used, so as to reduce dumping of plastic/ glass bottles.

5.2 Water Quality Analysis Requirements

5.2.1 Parameters to be monitored

Parameters to be monitored at State, District and Sub-district laboratories are provided in Annexure III and methods, instruments and chemicals required for these parameters are provided in Annexure IV. However, thirteen basic minimum parameters that need to be tested for drinking water quality will be pH, turbidity, TDS, Total Hardness, alkalinity, fluoride, chloride, sulphate, nitrate, arsenic, iron, total coliforms and E-coli. **For establishing a baseline status in the country, it is suggested that all district and sub-district level water quality testing laboratories conduct drinking water quality analysis once each in pre-monsoon and post-monsoon seasons in a year for chemical parameters and bacteriological as suggested in Annexure IV and then subsequently monitor only those parameters which are found to be present or the concentrations nearing the desirable limits.** The State level laboratory shall concentrate on analysis of specific parameters of local importance like pesticides, toxic substances, bacteriological and virological parameters, Poly Aromatic Hydrocarbons (PAH), Poly Chlorinated Biphenyls (PCB), Disinfection bi-products like Tri Chloro Methanes (TCM), etc. .

5.2.2 Protocol for Sampling

There are many important factors for accurate analysis of the sample. These factors include proper collection of the samples, method of storage and protocol for microbial and chemical analysis, data analysis and interpretation. If any of these steps are carried out with insufficient care, the result will be inaccurate and, the entire operation will result in wastage of energy, time and money. The general precautions in the Bureau of Indian Standards i.e., IS-3025/1622 and/or Standard Methods for the Examination of Water & Wastewater- latest edition [Published jointly by American Public Health Association (APHA), and Americal Society for Testing and Materials (ASTM) shall be referred to for detailed information on sampling and testing procedures.

5.2.3 General Guidelines and Precautions for drinking water sampling

- Collect a sample that conforms to the requirement of the sampling programme and handle it carefully so that it does not deteriorate or get contaminated during its transport to the laboratory. Before filling the container, rinse it two or three times with the water being collected.

Representative samples of some sources can only be obtained by making composites of samples collected over a period of time or at a number of different sampling points.

- ❖ While collecting a sample from the distribution system, flush lines adequately, taking into consideration the diameter and length of the pipe to be flushed and the velocity of flow.
- ❖ Collect samples from tube-wells only after sufficient pumping (purging) to ensure that the sample represents the ground water source.
- ❖ When samples are to be collected from a river or stream, analytical results may vary with depth, flow, distance from the banks. In surface water bodies, water samples should preferably be collected at 0.2 times the depth of the water body from the top.
- ❖ Make detailed record of every sample collected (with unique code and Global Positioning System coordinates). Identify each container and record information like date, time and exact location (Block, habitation, Panchayat, Village, Code number, weather condition and stream-flow etc).
- ❖ State may undertake one time survey for recording GPS coordinates of drinking water sources by a suitable agency.

5.2.4 Quantity of Sample to be Collected

Samples for chemical & bacteriological analysis should be collected separately as the method of sampling and preservation is completely different from each other. The interval between collection and analysis of the sample should be shortest possible.

Quantity of sample for General Analysis : 2 litre (non-acidified).

Quantity of sample for Bacteriological Analysis : 250 ml in sterilized bottles.

Quantity of sample for Metals Analysis : 1000 ml acidified sample for metal analysis.

5.2.5 Analytical Quality Control

The basic objective of a water analysis laboratory is to produce accurate data describing the physical-chemical characteristics of water samples under study. Quality assurance is the total programme for assuring the reliability of analytical data. Guidelines discussed in this document can all be considered as contributing to the overall programme of quality assurance. Another essential component of a quality assurance is analytical quality control which refers to the routine application of procedures for controlling the measurement process.

Internal quality control or statistical quality control is the most important component of any laboratory quality control programme. Experience indicates that 10-20% of the resources of a laboratory should be devoted to such work. Suitable approaches to internal quality control should be followed.

External quality control is best applied after incorporating internal quality control practices in the laboratory, and consists in the periodic analysis of reference samples. These reference samples may not be different from the control samples which the laboratory has been preparing for its own.

5.2.6 Annual Analysis load

For State level: To establish baseline status, State level laboratories shall monitor all drinking water quality parameters as specified in **Annexure-IV** once in a year. Thereafter, depending upon the occurrence of specific parameters in drinking water sources and their local relevance, number of the parameters or frequency of analysis for some of the parameters may be reduced as deemed appropriate by the respective State Government. Services of State level laboratories would be utilized particularly for analysis of specific parameters like metals, pesticides, radioactive substances like Uranium, bacteriological investigation etc and not for general parameters (which could be analysed in District and Sub district level drinking water quality laboratories).

For District & Sub-district level: About 3000 samples/year

The targeted number of water samples is indicative in nature and shall depend upon the local conditions.

5.2.7 Frequency of testing

State level Laboratory

- Monitoring for heavy metals, pesticides and specific contaminants of local importance.
- Analysis/Evaluation/ Impact assessment of specific contaminants
- Virological examination of drinking water sources of such areas where contamination is likely (Peri-urban/ rural area having surface water based drinking water sources and possibility of untreated/ partially treated sewage discharged from urban areas polluting the source) and linked to key follow-up actions.

District and Sub-district Laboratory

- Twice a year for water quality hot spot areas. Monitoring is to be intensified, if following criteria are met:
    - sanitary risk exceeds 3 out of 10 risks (as per Sanitary inspection formats given in the Protocol) and/or H2S (Hydrogen Sulphide) vial result is positive
    - waterborne diseases are reported by community using source water
    - Source is rejected by community due to taste, odour, colour etc
    - Source water is reported to be contaminated in the last monitoring or exceeded 0.8 times the standard
    - To verify efficacy of the water quality improvement interventions undertaken
- **Twice a year/source for bacteriological parameters and once a year for chemical parameters with positive detects triggering clear pre-defined interventions. However, for establishing the base line status, all parameters as mentioned in Annexure IV shall be analysed once**

during pre-monsoon and post-monsoon season duly registering the GPS co-ordinates and depth of ground water.

- In-vitro UV laminar-flow chamber shall be used for testing microbiological parameters and for preparation of organic media.
- Discrete monitoring during calamities, especially for residual chlorine.

5.2.8 Recording and reporting of data

The laboratories shall keep records of submitted samples and completed analysis in a manner that provides for easy data retrieval ability. All laboratory data sheets shall be dated and signed by the concerned Chemist and the Head of the Laboratory or his designee. All data entries shall be done preferably at the respective laboratory level into the standardized formats of IMIS.

- It is highly desirable to generate water sampling reports through a standardized format which can also be hyperlinked easily to the IMIS through the internet.
- All laboratories (i.e. State level laboratory, District laboratories & Sub-district laboratories in each State) shall report the analysis periodically into **Integrated Management Information System (IMIS)** of Ministry of Drinking Water and Sanitation.
- The water analysis report for all drinking water sources shall mention the desirable and permissible limits of IS-10500-2012 (as mentioned in **Annexure-II**) along with actual observation of each physical/ chemical/ bacterial constituent. There shall be a foot note indicating the fitness of drinking water for human consumption.
- Test Reports should be sent to the concerned Junior Engineer (JE), Executive Engineer (EE) and to the concerned Gram Panchayat (GP) for taking up corrective action.
- Provision for sending SMS alerts to the JE/EE and GP in cases of samples found to have contamination beyond permissible limits may be made.
- The database shall have a feature of generating **special reports** for assessing the performance of a laboratory periodically.
- It would be advisable if the water quality results are displayed at the Gram Panchayat office.
- Reporting should also include action taken if source is found contaminated. Follow-up monitoring results should also be included.
- State laboratory may also consider to undertake **regular technical evaluation checks / audits** of District laboratories – e.g. quality of analysis, repeatability statistics etc., to maintain a quality assurance oversight in the data as confidence in the quality of the data is key to the effectiveness and reputation of the water quality monitoring and surveillance systems.
- A citizen corner already exists in the website of the Ministry. Any compliant on drinking water quality in rural areas of the country can be posted for taking up corrective action by clicking the icon "Public grievances".

5.3 Infrastructure requirements

A suggestive list of standard methods & chemicals required is given at **Annexure-V**.

The suggestive list of minimum infrastructure requirements for setting-up a drinking water quality testing laboratory is provided in Annexure VI. *(These requirements are only suggestive in nature and the State Government may decide on the appropriate infrastructure facility to be provided in laboratories to carry-out drinking water analysis and for getting accreditation from NABL/ISO).*

5.3.1 Specification for laboratory and other infrastructural requirements

(These are only suggestive in nature anticipating the basic requirements needed for NABL accreditation)

i) **Physical facility:** The design of the laboratory shall depend upon the volume of analytical work required to be done. In deciding the requirement of space, due attention shall be given to the space needed for permanently installed equipment and smooth performance of analytical work by the laboratory personnel. While constructing the new laboratory, or modifications being made in the existing laboratory, provision for future expansion should also be made.

ii) **Location of laboratory:** The location and contact details of all laboratories within a district should be prominently displayed by sign boards, posters, wall paintings etc near bus stations, Railway stations, Gram Panchayat offices, Schools and other important public places. The location should be such that adequate natural lighting and ventilation should be available. The location of all laboratories shall be given wide publicity so that the common man can is aware where water quality analysis could be done. A standard design of laboratories may be prepared.

iii) **Renovation/Upgrading existing laboratories and establishment of new laboratories:** NRDWP (National Rural Drinking Water Programme) funds (Programme or Support) shall not be used for construction of buildings for district/ sub-divisional laboratories. However, renovation/refurbishment cost of existing building (if required) for laboratories is allowed from NRDWP-3% WQMS funds. Building cost for State level laboratory may be allowed on case specific basis. Wherever laboratory is established in private premises, the payment for rent/ electricity/ water charges can be booked under NRDWP-3 % WQMS funds.

iv) **Floor space:** Floor space for laboratory is mentioned in Annexure V. Use of smooth tiles on floors should be avoided.

v) **Walls of laboratory:** The walls should be finished smooth in light colour and should have sufficient thickness and provision for built in cabinets. A Standard Do's and Don'ts chart should be placed in a clearly visible manner.

vi) **Lighting:** All work rooms including passages in the laboratory should be well lighted. There should be sufficient number of windows provided in the laboratory area (except microbiological lab) with transparent window glasses. Translucent roofs are now available to facilitate adequate illumination during daytime. This may be thought of, while planning the roof of the laboratory. Adequate provision of artificial lighting should be provided to supplement natural light. Additional plug points should be provided for extra lighting if needed. (online voltage stabilizer may be considered)

vii) **Fuel gas supply:** Provision for supply of fuel gas and gas burners on the work benches shall be provided wherever required.

viii) **Balance room:** The digital balance shall be placed on a separate table in a cubicle or enclosure in the laboratory.

ix) **Media preparation and sterilization room:** For bacteriological analysis, additional facilities for media preparation, centrifuging, sterilization by autoclaving etc. are mandatory and separate enclosure for accommodating these facilities needs to be provided.

x) **First Aid Box:** All laboratories must ensure that they have adequately equipped first aid box with proper medicines/bandages/ eye wash. The first aid box should be placed such that it is easily accessible to all staff members. Laboratory should also invariably have First Aid Chart.

xi) **Library:** Each State Laboratory shall have a computerized library facility having all Standard Operating Procedures (SOPs) and books/journals/periodicals related to drinking water quality, water related diseases and water quality monitoring and surveillance. Adequate number of IEC material on consumption of safe drinking water, personal and environmental hygiene may be kept for distribution to rural people who visit the laboratories.

xii) **Accreditation:** Laboratories at all levels (i.e. State, District and Sub district) shall strive for accreditation in a phased manner. **State level laboratories shall be given top priority for obtaining accreditation by NABL/ ISO-9001 at an early date.** As previously mentioned, a system of continuously checking the quality of data produced by labs should be in place, including checking of records (including duplicate and blanks testing) and follow-up on samples testing positive for contamination.

5.3.2 Work tables and benches

Suitable laboratory furniture's shall be procured by State, District or Sub district laboratories as per local requirement and should be such that they can be easily maintained clean. Adequate provision should be kept for storing chemicals and reagents.

5.3.3 Instruments

Instruments required are provided in **Annexure VII.** (These are only suggestive in nature and addition/deletions with advancement in technology may be made as deemed appropriate by the State Government.

5.3.4 Maintenance

The States shall develop an appropriate AMC policy for maintenance, calibration, repairs of instrumentation available in the laboratories.

5.3.5 Glassware

The list of glassware required is provided in **Annexure VIII.** *The list is only indicative in nature. The approximate quantity of the glassware mentioned there is for 2 years period. This may vary with the routine parameters that have to be analyzed. Subsequent procurement could be based on actual needs.*

5.3.6 Chemicals for State, District and Sub-district laboratories

The list of chemicals for State, District and Sub-district laboratories is provided in **Annexure IX**. ***The list is only indicative in nature.*** Any additional chemicals if required, may also be procured. ***The approximate quantity/volume of the chemicals mentioned there is 2 years . This may vary with the routine parameters that are intended for testing. Subsequent procurement could be based on actual needs.*** **However, it is mandatory to standardize procurement strategy by the States so that adequacy of chemicals is ensured at all times. Laboratories should have at least 3 months backup of chemicals.** Also States should ensure that only Laboratory Reagent (LR)/Analytical Reagent (AR) grade chemicals are used for water quality testing.

This is also suggested that each laboratory should keep sufficient stock of disinfectants like Bleaching Powder, Potassium Permanganate and unhydrated lime with adequate precautions so that these can be used by the **trained laboratory professionals in drinking water sources as per the need.**

Chemicals used for Field Test Kit shall invariably include date of manufacture, batch number and expiry date.

The Ministry of Drinking Water and Sanitation may conduct visits to cross-verify the quality of chemicals used in the laboratories.

5.4 Human Resources

Staff needs for an effective water quality assessment laboratory vary a great deal and there is no reliable method of determining the number of staff necessary to serve a given population, or the number needed for taking a given quantity of samples in different types of water supply systems. To estimate needs in terms of human resources, the following factors have to be taken into account:

- Analytical parameters
- Schedule of on-site analysis, camp analysis and laboratory analysis
- Sample preservations
- Frequency of sampling
- Geomorphology of the area
- Demographic conditions
- Size and complexity of the supply system
- Distance of sampling points and water supply systems

- Condition of road and traffic
- Type of vehicle used
- Season and climate
- Sampling facilities
- Degree of training to the staff conducting surveillance

5.4.1 Staffing Pattern

Staffing pattern shall be based on State norms. A suggestive guideline for staff required for various levels of laboratories are as below which may be provided in a phased manner:

State Level Water Testing Laboratory:

- Chief Chemist/Chief Water Analyst: 1
- Senior Chemist/Senior Water Analyst : 1
- Chemist/Water Analyst : 2
- Microbiologist/ Bacteriologist: 1
- Laboratory Assistant: 3
- Data Entry Operator: 2
- Lab Attendant: 2
- Sampling Assistants (contractual or task based field staff) : 2

District/Sub District Level Water Testing Laboratory:

- Chemist/Water Analyst : 1
- Microbiologist/ Bacteriologist: 1
- Laboratory Assistant: 2
- Lab Attendant : 1
- Data entry operator : 1
- Sampling Assistants (contractual or task based field staff) : 2

These positions can be filled with regular or contractual personnel or services obtained from manpower agencies or outsourced to NGOs etc. **However, all States should ensure that at least one regular post of Water Analyst/Chemist is made available and filled in each Water Testing Laboratory.** If the same is not available, States should consider creating post of one regular Chemist/Water Analyst in each laboratory.

5.4.2 Suggested desirable qualification for Laboratory Staff:

- Chief Chemist/ Chief Water Analyst: Post Graduation in Chemistry/Bioscience.
- Senior Chemist: Graduation in Science with Chemistry
- Microbiologist/ Bacteriologist: Graduation in Science (with Biology) .
- Laboratory Assistant: .Class XII with Science

- ❖ Sampling Assistant: . Class X
- ❖ Laboratory Attendant: VIII class
- ❖ Data entry operator : Higher Secondary passed with skills in MS Office and Internet operations

5.4.3 Roles and responsibilities of laboratory personnel

District laboratory plays a pivotal role in ensuring adequate monitoring of water quality and water safety in the entire rural water supply system. In addition to administering the field operational groups and providing leadership and overview for the quality system, the district laboratory team is responsible for allocating resources needed to ensure that the water quality monitoring is undertaken with an objective of undertaking corrective action in ensuring safe water provision to the community. The head of the district laboratory will be coordinating with the Executive Engineer and interventions in improving water supply in the district will be based on the results received from the district laboratory. To maintain the quality system, Executive Engineer should support the staff by promoting team work, facilitating exchange of information from both inside and outside the field organization, and providing training and necessary resources to meet expectations of quality.

5.4.4 Specific roles and responsibilities of the district laboratory staff are described below

The titles shown are functional descriptions of the roles that individuals play in discharging their duty rather than the particular title of any individual/post.

Chemist/Water Analyst/: Water Analyst/Chemist will be the Head of the District/Sub-district laboratory and will be reporting to SE/EE. He/she will provide laboratory-wide overview to ensure that the tasks assigned to the laboratory is properly followed. In addition, the Water Analyst / Chemist is responsible for ensuring that laboratory staff members recognize and understand their respective roles and have the requisite training needed to properly carry out their functions and responsibilities. He/she is also responsible for the following activities:

- Upkeep of the central repository of Water Quality Analysis Manual, Standard Operating Procedures(SOPs), and other related documentation
- Maintain equipment and ensure that chemicals/glassware/consumables are procured in time by ensuring quality
- Supervise and guide reporting staff on sampling, water quality analysis, data analysis, identification of standard corrective actions based on water quality analysis data
- Analyze sanitary surveillance data after selective field check
- Plan corrective actions in consultation with Executive Engineer and the Gram Panchayats (GPs) and ensure allocation of funds for corrective actions

- Compile details of water treatment technologies and corrective actions
- Recheck water quality data after corrective actions
- Reporting water quality affected habitations to Engineers and GP.
- Data analysis Upload water quality data in IMIS
- Provide assistance to laboratory management and staff for solving water quality/safety related issues.

The Chief Chemist/Chief Water Analyst in the State laboratory and one Water Analyst/ Chemist in all District laboratories should be a Government Officer. His/her pay band may be decided by the concerned State Government.

The Water Analyst/ Chemist in District/Sub-divisional laboratories, if outsourced, may be provided a monthly remuneration of Rs 15,000 to Rs 20,000 (at 2012 rates) depending upon the skills required for conducting chemical analysis.

Microbiologist: Microbiologist will carry out the microbiological analysis of drinking water samples. She will ensure that Sampling Assistant is trained for the protocol of collecting, and transporting the samples to the laboratory. Microbiologist will also ensure that Microbiological laboratory is fumigated periodically and the sanctity of the microbiological laboratory is maintained. Microbiologist may be paid a monthly remuneration of Rs 10,000 to Rs 15,000 (at 2012 rates).

Laboratory Assistants: Laboratory Assistants will be responsible for preparing reagent solutions and in assisting Chemist and Microbiologist in carrying out analysis. Lab Assistant may be paid a monthly remuneration of Rs 8,000 to Rs 10,000 (at 2012 rates).

Sampling Assistant (Field Staff): These include the field sampling personnel, the members of the staff who transport, log-in, store or otherwise handle but do not analyze samples, and the analysts who prepare and analyze samples in the field. They are individually responsible for following the policies, methods and procedures as described in the Manual as it pertains to their roles and responsibilities and for adhering to the appropriate SOPs. Each member of the field staff is responsible for identifying and reporting any quality problems that he/she encounters to the irrespective team leader. The Sampling Assistants may be provided monthly remuneration of Rs 6,000 to Rs 8,000. He/She should be well trained by the State/District laboratory chemists. In order to collect and bring water samples to the laboratory, they may be provided with a suitable hired vehicle.

Laboratory Attendant: Laboratory Attendant would be an outsourced/contractual staff who would clean the glassware's and would help in maintaining the laboratory in clean condition. He could be paid a monthly remuneration of Rs 4,000 to Rs 6,000 per month.

Data Entry Operator: Data Entry Operator would be an outsourced / contractual staff who will ensure that all data as per IMIS formats are reported timely on IMIS of the website. He/She will keep record of all of the samples collected and analysed in laboratory on computer. He/She would be paid a monthly remuneration of Rs 6,000 to Rs 8,000.

The above proposed remuneration pattern is suggestive in nature and the States could lower/raise them depending upon the local need and due justification thereof be recorded and approved in the State level Scheme Sanctioning Committee meeting.

5.4.5 Provision of outsourcing of laboratory staff

State may hire services of an agency for providing staff services for carrying out analysis of drinking water sources for chemical and bacteriological testing. States may engage NGOs (if they have good infrastructure and testing facilities of drinking water sources) for analysis of drinking water samples. All costs of outsourced/contractual staff for laboratories including mobility allowances as well as engagement of NGOs for analysis of drinking water samples is allowed under NRDWP (3 % WQM & S Funds). **Salary of regular staff should be met from State Government funds.**

5.4.6 Sampling of drinking water

Sampling may be done by Sampling Assistant. If they are not available, Staff working in District /Sub district laboratory should identify some local villagers /students and train them in sampling procedures for different type of parameters (chemical and bacteriological). After training, they may be allocated cluster of GP's to bring the samples in a planned manner. Laboratory staff should also ensure that the samplers who are assigned work of collecting samples are provided 1 Litre (acidified sample), 2 Litre (non-acidified sample) and 250 mL (sterilized) bottles, ice boxes and necessary chemicals for addition in samples.

While taking samples from drinking water sources or consumers, the samplers should take the signatures of the operator, GP member or household member in the register to verify genuineness of the sample.

5.4.7 Mobility Allowance for collection of samples

Sampling Assistants may be provided a Mobility Allowance of Rs 500-1000 per month over and above the monthly salary if suitable vehicle is not made available for sample collection.

5.5 Funding

Under the National Rural Drinking Water Programme (NRDWP) guidelines, 3% of funds allocated to the States is earmarked for Water Quality Monitoring and Surveillance (WQMS) which include activities like setting up of State level laboratory (building cost permitted on case to case basis), new district/sub-divisional laboratories (building cost to be borne by the State Government, rental charges could be booked under this fund), upgrading of existing water quality testing laboratories of the State PHEDs/Board/RWSS department which interalia include procurement of equipment, instrumentation, chemicals, glassware, consumables, hiring of outsourced manpower (regular staff to be paid salaries by State Government) and hiring of vehicles for transportation of water samples collected from the field to the laboratory. These funds can also be used for procurement of field test

kits wherever such kits distributed earlier are no longer functional/ inadequate in number and for procurement of chemical refills and bacteriological vials.

It is suggested that all district water quality testing laboratories shall have a regular Chemist paid from State Government funds. Salary of regular staff should be met from State Government funds. Any services, expenditure incurred on WQMS in excess of the 3 % WQMS allocation should be met from State Government funds. All items mentioned in this Protocol are suggestive in nature and the State can decide the staff requirement qualifications, instrumentation, chemicals, glassware, building depending upon the extent of contamination of drinking water sources and keeping in view the availability of 3% NRDWP (WQMS) funds.

6.0 Safety measures to be followed in Laboratory

6.1 Precautions with Hazardous Chemicals:

- All containers must be clearly labeled and read before opening. If dispensing into another container, put label along with warning.
- Minimal stocks not exceeding 500 ml of corrosive or flammable solvents only may be kept in work room. Keep rest of the volume/quantity in safe place.
- Glacial acetic acid must be regarded as a flammable solvent.
- Ether and low boiling point flammable liquids must not be kept in fridge.
- Large containers of corrosive or flammable liquids should never be put on high shelves or where they can be knocked down or fall. Also, never put liquids that react violently together closely.
- Never carry bottles by neck alone. Open bottles with care.
- When diluting concentrated sulphuric acid or other strong acids, it should be added to water in heat resistant vessel. Gloves and safety glasses should be used at such times.
- Paint circles on shelves for keeping bottles in the right places.

6.2 Spillage of Hazardous Chemicals:

- If amount/volume of spillage is small, dilute with water or detergent.
- If amount is large, protective aprons, rubber gloves and boots should be worn and treatment carried out according to wall chart showing how to manage chemical spillage.
- Hydrochloric acid and sulphuric acid can be neutralized with anhydrous sodium carbonate then shovel into a plastic bucket which is subsequently diluted by water and run to waste.
- Ammonia solution, ethanol, methanol and formalin are best treated by diluting with water, collection and running to waste. Windows must be opened.
- Phenols must be diluted with at least 20 times the volume of tap water before draining.

6.3 Avoidance of Hazards of Equipment

- Only trained staff should operate the equipment.
- Operating instructions should be available for each instrument.
- Check the autoclave filled with water to correct level before loading.
- If fire breaks out, nearby electrical equipment should immediately be switched off and disconnected.
- Take care to avoid live wires.
- When not in use, switch off and withdraw plug from socket.
- Avoid use of multi-adaptors. If necessary to use they must be fitted with fuses.

6.4 Using Fire extinguishers

- Water extinguishers are suitable for fires involving ordinary combustible materials e.g. wood, paper, textile, upholstery. Never use on electrical fires or liquids that will catch fire.
- Dry powder extinguishers or sand are suitable for liquids on fire, electrical fires and burning metals.

6.5 First Aid

- First Aid Chart should be mounted on a nearby wall in the laboratory.
- First Aid box must always be equipped and should be accessible to Laboratory Staff. An emergency eye wash bottle with a bottle of sterilized water should be readily available.
- A Universal poison antidote is useful. Activated aluminum oxide or a tin of evaporated milk should be readily available. A tin opener and some waterproof dressing material should also be readily available.

6.6 Additional safety/hygiene requirements:

- Safety instructions and precautions to be followed in laboratory must be displayed inside the laboratory.
- BIS specifications (IS 10500:2012)-Drinking Water Specification, IS 3025 -Method of Sampling & Test-Physical & Chemical, IS 1622- Methods of Sampling & Microbiological examination of water) and APHA Manual should be made available in each laboratory. NRDWP Support fund may be used for procurement of these specifications.
- Date of preparation of reagent solutions and date of expiry for each solution prepared should be clearly mentioned on bottles wherein chemical solution is kept.
- Under no circumstances, sanctity of the laboratory should be violated.. Unauthorized persons should not enter into laboratory. Eating should not be allowed in laboratory space meant for analysis.
- A clean and well maintained toilet MUST be attached to the laboratory with hand washing facility and soap.

- Laboratory should also have AC fitted when significant number of test are required to be done.
- Personal hygiene is a must for all staff of laboratory, especially for Microbiologist. All laboratory staff should wear gloves during preparation of solution and testing (requirement is parameter specific). Staff should be provided white lab coat/aprons which should be washed at regular intervals.
- Drinking water samples should only be tested after proper calibration of the instruments.

7.0 Treatment Technology for Laboratory Wastewater

Wastewater from chemical laboratories is generally composed of organic and inorganic matter, and a wide range of chemicals and heavy metals, and is one of the most difficult wastewaters for treating. If a chemical waste cannot be transported safely without treatment, it needs to be treated at its present site. If the chemical waste originates in a laboratory, it should be treated there. In some cases, on-site treatment has been performed under special permits issued by the regulatory agency.

A good safety program requires constant care in disposal of laboratory waste. Corrosive materials should never be poured down a sink or drain. These substances can corrode the drain pipe and/or trap. Corrosive acids should be poured down corrosion-resistant sinks and sewers using large quantities of water to dilute and flush the acid. Hazardous chemicals/substances must be disposed of by methods that comply with local environmental regulations. Confirm the local requirements before disposal.

Laboratories should maintain a comprehensive listing of wastewater discharges that includes sources and locations of the discharges, analytical or other data characterizing the nature and volume of the discharge. After careful consideration, management can determine that limited drain disposal of nonhazardous substances is acceptable. **USEPA, 2000 provides following general guidelines:**

- Use drain disposal only if the drain system flows to a wastewater treatment plant and not into a septic tank system or a storm water sewer system that potentially flows directly into surface water.
- Make sure that the substances being disposed of are compatible with each other and with the piping system.
- Discharge only those compounds that are soluble in water (such as aqueous solutions), that are readily biodegradable, are low in toxicity, and contain no metals that can make the sludge toxic.

Laboratory wastewater neutralization is significant before discharge. Therefore, the discharge of weak corrosive solutions ($5.5<pH<12.0$) to the laboratory sinks in small quantities (less than one liter per hour) is permissible. Corrosive solutions with pH ranges ($2.0<pH<5.5$) and ($12.0<pH<12.5$) must be neutralized before sink/drain disposal. Corrosive solutions with pH ranges ($pH<2.0$) and ($pH>12.5$) at the conclusion of the lab process must be managed as hazardous waste.

The coagulation-flocculation (CF) process is a versatile method used either alone or combined with biological treatment, in order to remove suspended solids and organic matter as well as providing high color removal in wastewater. Likewise, coagulation followed by flocculation process is an effective way for removing high concentration of organic pollutants. **Ozonation** is one of the chemical processes in which the mechanism of ozone is used to transform harmful chemicals to less harmful compounds. However, chlorination may also be adopted if ozonation facility is not available. It has been used for the disinfection, oxidation of inorganic and organic compounds, including taste, odor, color and particle removal. In this technology, the treatment is carried out in batch process. In this process pH is adjusted followed by ferric sulphate dose, stirring time is 2 minutes at 500 rpm and after settling of flocs, ozonation/chlorination is carried out of clarified water for 15 minutes.

Annexures

Annexure I

Expert Group

Dr. S.R. Wate, Director, CSIR-NEERI	Chairman
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Shri M.N. Krishnamoorthy, Deputy Director Panchayati Raj Engineering Department, Bangalore	Member
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Mr. Sharad Rode, Asstt. S.E., Nagpur	Member
Dr. (Mrs.) Tmt. V. Tamilarasi Chief Water Analyst, TWAD Board, Chennai	Member
Dr. Pawan Labhasetwar, Scientist & Head (WT&MD), CSIR-NEERI	Member
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In addition support from following officials of CSIR-NEERI was also received.

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Dr. Paras Pujari, Senior Scientist, CSIR-NEERI

Dr. Srimanth Kagne, Scientist, CSIR-NEERI

Mr. P.M. Patni, Project Officer, WT&MD, CSIR-NEERI

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Annexure II

Bureau of Indian Standards
Drinking Water – Specifications for some of the important parameters
IS 10500 – 2012 (Second revision)

S. No.	Characteristic	Unit	Requirement (Acceptable Limit)	Permissible Limit in the absence of alternate source
1	Total Dissolved Solids (TDS)	Milligram/litre	500	2000
2	Colour	Hazen unit	5	15
3	Turbidity	NTU	1	5
4	Total Hardness	Milligram/litre	200	600
5	Ammonia	Milligram/litre	0.5	0.5
6	Free Residual Chlorine	Milligram/litre	0.2	1.0
7	pH	--	6.5-8.5	6.5-8.5
8	Chloride	Milligram/litre	250	1000
9	Fluoride	Milligram/litre	1.0	1.5
10	Arsenic	Milligram/litre	0.01	0.05
11	Iron	Milligram/litre	0.3	0.3
12	Nitrate	Milligram/litre	45	45
13	Sulphate	Milligram/litre	200	400
14	Selenium	Milligram/litre	0.01	0.01
15	Zinc	Milligram/litre	5.0	15.0
16	Mercury	Milligram/litre	0.001	0.001
17	Lead	Milligram/litre	0.01	0.01
18	Cyanide	Milligram/litre	0.05	0.05
19	Copper	Milligram/litre	0.05	1.5
20	Chromium	Milligram/litre	0.05	0.05
21	Nickel	Milligram/litre	0.02	0.02
22	Cadmium	Milligram/litre	0.003	0.003
23	E-Coli or Thermotolerant coliforms	Number/ 100 ml	NIL	NIL

Note : Please refer to BIS Standard IS-10500- 2012 (second revision) for other parameters

Annexure III

1. Sanitary Inspection Form for Piped Water

I. Type of Facility PIPED WATER

1. General Information: Zone: Area:
2. Code Number
3. Date of Visit
4. Water samples taken? …….. Sample Nos. ……

II. Specific Diagnostic Information for Assessment

(Please indicate at which sample sites the risk was identified) Risk Sample No

1. Do any tapstands leak? Y/N ……
2. Does surface water collect around any tapstand? Y/N ……
3. Is the area uphill of any tapstand eroded? Y/N ……
4. Are pipes exposed close to any tapstand? Y/N ……
5. Is human excreta on the ground within 10m of any tapstand? Y/N ……
6. Is there a sewer within 30m of any tapstand? Y/N……
7. Has there been discontinuity in the last 10 days at any tapstand?Y/N ……
8. Are there signs of leaks in the mains pipes in the Parish? Y/N……
9. Do the community report any pipe breaks in the last week?Y/N ……
10. Is the main pipe exposed anywhere in the Parish? Y/N ……

Total Score of Risks ..../10

Risk score: 9-10 = Very high; 6-8 = High; 3-5 = Medium; 0-3 = Low

III. Results and Recommendations:

The following important points of risk were noted :(list nos. 1-10)

Signature of surveyor:

Comments: .....

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2. Sanitary Inspection Form for Piped Water with Service Reservoir

I. Type of Facility PIPED WATER WITH SERVICERESERVOIR

1. General Information: Zone: Area:
2. Code Number:
3. Date of Visit:
4. Water samples taken? …….. Sample Nos. ……

II. Specific Diagnostic Information for Assessment

(Please indicate at which sample sites the risk was identified) Risk Sample No

1. Do any standpipes leak at sample sites? Y/N ……
2. Does water collect around any sample site? Y/N ……
3. Is area uphill eroded at any sample site? Y/N ……..
4. Are pipes exposed close to any sample site? Y/N ……
5. Is human excreta on ground within 10m of standpipe? Y/N ……
6. Sewer or latrine within 30m of sample site? Y/N ……
7. Has there been discontinuity within last 10 days at sample site? Y/N ……
8. Are there signs of leaks in sampling area? Y/N ……
9. Do users report pipe breaks in last week? Y/N ……
10. Is the supply main exposed in sampling area? Y/N……
11. Is the service reservoir cracked or leaking? Y/N ……
12. Are the air vents or inspection cover insanitary? Y/N ……

Total Score of Risks ..../12

Risk score: 10-12 = Very high; 8-10 = High; 5-7 = Medium; 2-4 = Low; 0-1 = Very Low

III. Results and Recommendations:

The following important points of risk were noted:

(list nos. 1-12)

Signature of surveyor:

Comments: .....

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3. Sanitary Inspection Form for Hydrants and Tanker trucks

I. Type of Facility HYDRANTS AND TANKER TRUCKS

1. General Information: Zone: Area:
2. Code Number:
3. Date of Visit:
4. Is water samples taken? …….. Sample Nos. …… Thermotolerant Coliform Grade……

II. Specific Diagnostic Information for Assessment

Risk

1. Is the discharge pipe dirty? Y/N……..
2. Is the discharge water dirty/ smelly/ coloured? Y/N……
3. Is the delivery nozzle dirty or in poor condition? Y/N……
4. Are there any leaks close to the riser pipe of the hydrant? Y/N……
5. Is the base of the riser piped for the hydrant sealed with a concrete apron?.Y/N……
6. Is the tanker ever used for transporting other liquids? Y/N…….
7. Is the inside of the tanker dirty? Y/N……..
8. Does the tanker fill through an inspection cover on the tanker? Y/N……..
9. Is there direct contact of hands of supplier with discharge water? Y/N……..
10. Does the tanker leak? Y/N……

Total Score of Risks …./10

Risk score: >8/10 = Very high; 6-8/10 = High; 4-7/10 = Intermediate; 0-3/10 = Low

III. Results and Recommendations:

The following important points of risk were noted:

(list nos. 1-10)

And the authority advised on remedial action

Signature of surveyor:

Comments: .....

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4. Sanitary Inspection Form for Gravity-fed Piped Water

I. Type of Facility GRAVITY-FED PIPED WATER

1. General Information: System name:
2. Code Number
3. Date of Visit
4. Water samples taken? …….. Sample Nos. ……

II. Specific Diagnostic Information for Assessment

(please indicate at which sample sites the risk was identified) Risk Sample No

1. Does the pipe leak between the source and storage tank? Y/N……
2. Is the storage tank cracked, damaged or leak? Y/N……
3. Are the vents and covers on the tank damaged or open? Y/N……
4. Do any tapstands leak? Y/N ……
5. Does surface water collect around any tapstand? Y/N ……
6. Is the area uphill of any tapstand eroded? Y/N ……
7. Are pipes exposed close to any tapstand? Y/N ……
8. Is human excreta on the ground within 10m of any tapstand?Y/N ……
9. Has there been discontinuity in the last 10 days at any tapstand?Y/N ……
10. Are there signs of leaks in the main supply pipe in the system?Y/N ……
11. Do the community report any pipe breaks in the last week?Y/N ……
12. Is the main supply pipe exposed anywhere in the system?Y/N ……

Total Score of Risks …./12

Risk score: 10-12 = Very high; 8-10 = High; 5-7 = Medium; 2-4 = Low;0-1 = Very Low

III. Results and Recommendations:

The following important points of risk were noted:

(list nos. 1-12)

Signature of surveyor:

Comments: .....

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5. Sanitary Inspection Form for Deep borehole with Mechanized Pumping

I. Type of Facility DEEP BOREHOLE WITH MECHANISEDPUMPING

1. General Information: Supply zone: Location:
2. Code Number:
3. Date of Visit:
4. Water sample taken? …….. Sample No. …… FC/100ml ……..

II. Specific Diagnostic Information for Assessment Risk

1. Is there a latrine or sewer within 100m of pumphouse? Y/N……..
2. Is the nearest latrine unsewered? Y/N…….
3. Is there any source of other pollution within 50m? Y/N……
4. Is there an uncapped well within 100m? Y/N……
5. Is the drainage around pumphouse faulty? Y/N……..
6. Is the fencing damaged allowing animal entry? Y/N…….
7. Is the floor of the pumphouse permeable to water? Y/N……..
8. Does water forms pools in the pumphouse? Y/N……
9. Is the well seal insanitary? Y/N……..

Total Score of Risks …./9

Risk score: 7-9 = High; 3-6 = Medium; 0-2 = Low

III. Results and Recommendations:

The following important points of risk were noted:

(list nos. 1-9)

Signature of surveyor:

Comments: .....

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6. Sanitary Inspection Form for Borehole with Hand pump

I. Type of Facility BOREHOLE WITH HANDPUMP

1. General Information: Zone: Location:
2. Code Number:

3. Date of Visit:

4. Water sample taken? …….. Sample No. …… FC/100ml ……..

II. Specific Diagnostic Information for Assessment Risk

1. Is there a latrine within 10m of the borehole? Y/N…….
2. Is there a latrine uphill of the borehole? Y/N…….
3. Are there any other sources of pollution within 10m of borehole? Y/N……
   (e.g. animal breeding, cultivation, roads, industry etc)
4. Is the drainage faulty allowing ponding within 2 m of the borehole? Y/N……
5. Is the drainage channel cracked, broken or need cleaning? Y/N……..
6. Is the fence missing or faulty? Y/N…….
7. Is the apron less than 1m in radius? Y/N……..
8. Does spilt water collect in the apron area? Y/N……..
9. Is the apron cracked or damaged? Y/N……..
10. Is the handpump loose at the point of attachment to apron? Y/N…….

Total Score of Risks …./10

Risk score: 9-10 = Very high; 6-8 = High; 3-5 = Medium; 0-3 = Low

III. Results and Recommendations:

The following important points of risk were noted:

(list nos. 1-10)

Signature of surveyor:

Comments: .....

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7. Sanitary Inspection Form for Protected Spring

I. Type of Facility PROTECTED SPRING

1. General Information: Zone: Location:
2. Code Number:
3. Date of Visit:
4. Water sample taken? …….. Sample No. …… FC/100ml ……..

II. Specific Diagnostic Information for Assessment Risk

1. Is the spring unprotected? Y/N……..
2. Is the masonry protecting the spring faulty? Y/N……..
3. Is the backfill area behind the retaining wall eroded? Y/N……..
4. Does spilt water flood the collection area? Y/N……...
5. Is the fence absent or faulty? Y/N……..
6. Can animals have access within 10m of the spring? Y/N……
7. Is there a latrine uphill and/or within 30m of the spring? Y/N……
8. Does surface water collect uphill of the spring? Y/N……..
9. Is the diversion ditch above the spring absent or non-functional? Y/N…….
10. Are there any other sources of pollution uphill of the spring? Y/N……..
    (e.g. solid waste)

    Total Score of Risks …./10

    Risk score: 9-10 = Very high; 6-8 = High; 3-5 = Medium; 0-3 = Low

III. Results and Recommendations:

The following important points of risk were noted:

(list nos. 1-10)

Signature of surveyor:

Comments: .....

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8. Sanitary Inspection Form for Rainwater collection and Storage

I. Type of Facility RAINWATER COLLECTION AND STORAGE

1. General Information: Zone: Location:
2. Code Number:
3. Date of Visit:
4. Water sample taken? …….. Sample No. …… FC/100ml ……..

II. Specific Diagnostic Information for Assessment Risk

1. Is rainwater collected in an open container? Y/N……

2. Are there visible signs of contamination on the roof catchment? Y/N……..
   (e.g. plants, excreta, dust)
3. Is guttering that collects water dirty or blocked? Y/N…….
4. Are the top or walls of the tank cracked or damaged? Y/N……
5. Is water collected directly from the tank (no tap on the tank)? Y/N……
6. Is there a bucket in use and is this left where it can become contaminated? Y/N……
7. Is the tap leaking or damaged? Y/N……..
8. Is the concrete floor under the tap defective or dirty? Y/N……
9. Is there any source of pollution around the tank or water collection area? Y/N……
10. Is the tank cleans inside? Y/N……..

Total Score of Risks …./10

Risk score: 9-10 = Very high; 6-8 = High; 3-5 = Medium; 0-3 = Low

III. Results and Recommendations:

The following important points of risk were noted:

(list nos. 1-10)

Signature of surveyor:

Comments: .....

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9. Sanitary Inspection Form for Piped Water Supply with service reservoir and mechanized pumping

I. Type of Facility Piped Water Supply with service reservoir and mechanized pumping

1. General Information: Zone: Location:
2. Code Number:
3. Date of Visit:
4. Water sample taken? …….. Sample No. …… FC/100ml ……..

II.

1. Does the pipe leak between the source and storage tank? Y/N……
2. Does surface water collect around any tapstand? Y/N ……

3. Can animals have access within 10m of the reservoir ? Y/N------
4. Does open defecation is prevalent or cattle-dung is observed within 50 m of the reservoir? Y/N……..
5. Is there a sewer within 30m of any tapstand or reservoir ? Y/N--------
6. Are the pipes corroded ? Y/N--------
7. Are there signs of leaks in the mains pipes in the Parish? Y/N…….
8. Are the reservoirs used for human and cattle bathing ? Y/N--------
9. Are the buried pipes ever checked for leakage ? Y/N--------
10. Are storage tanks are cleaned at specified intervals ? Y/N--------

Total Score of Risks …./10

Risk score: 9-10 = Very high; 6-8 = High; 3-5 = Medium; 0-3 = Low

10. Sanitary Inspection Form for the source of Dugwell (Ringwell)

I. Type of Facility : Dugwell/Ringwell

1. General Information: Zone: Location:
2. Code Number:
3. Date of Visit:
4. Water sample taken? …….. Sample No. …… FC/100ml ……..

II. Specific Diagnostic Information for Assessment Risk

1. Is there a latrine or sewer within 30m of the dugwell? Y/N……
2. Is the wall of the well lined properly and the well covered adequately ? Y/N……..
3. Does open defecation is prevalent or cattle-dung is found within 50 m of the ringwell? Y/N……..
4. Does the well have raised concrete/cemented platform around its fence ? Y/N----
5. Is there any water drainage facility available around platform of the well and does the drainage facility leads to water stagnation within 30 m of the wall ? Y/N……..
6. Does the well have fixed stainless steel/aluminium buckets with chain pulley around its fence for drawing water? Y/N…….
7. Is the well deep ? Y/N…….
8. Does the water of the well appears visibly clean ? Y/N……...
9. Is there any other source of pollution within 10 m of the well? (e.g. animal breeding, cultivation, roads, industry etc) Y/N……..

10. Was the well chlorinated during last 7 days Y/N……..

Total Score of Risks …./10

Risk score: 9-10 = Very high; 6-8 = High; 3-5 = Medium; 0-3 = Low

III. Results and Recommendations:

The following important points of risk were noted:

(list nos. 1-10)

Signature of surveyor:

Comments: .....

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Annexure IV

List of Parameters to be monitored

Sl. N.	Parameters	Whether req. at State lab.	Whether req. at District lab.	Whether req. at Sub-district
Physical parameters				
1	Temperature	Yes	Yes	Yes
2	Colour	Yes	Yes	Yes
3	Odour	Yes	Yes	Yes
4	Taste	Yes	Yes	Yes
5	Turbidity	Yes	Yes	Yes
6	pH	Yes	Yes	Yes
Chemical parameters				
7	TDS/Elect. Conductivity	Yes	Yes	Yes
8	Total Alkalinity	Yes	Yes	Yes
9	Chloride	Yes	Yes	Yes
10	Fluoride	Yes	Yes	Yes
11	Ammonia	Yes	Yes	No
12	Nitrate	Yes	Yes	Yes
13	Nitrite *	Yes	No	No
14	Sulphate	Yes	Yes	Yes
15	Silica	Yes	No	No
16	Sodium	Yes	Yes*	No
17	Potassium	Yes	Yes*	No
18	Boron *	Yes	No	No
21	Calcium (as Ca)	Yes	No	No
22	Magnesium (as Mg)	Yes	No	No
23	Total Hardness	Yes	Yes	Yes
24	Sulphide	Yes	No	No
26	Chloramines (as Cl2)	Yes	No	No
	Heavy metals			
27	Iron	Yes	Yes	Yes
28	Manganese	Yes	Yes	Yes
29	Copper	Yes	Yes*	No
30	Total Chromium (as Cr)	Yes	Yes*	No
31	Cadmium	Yes	No	No
32	Lead	Yes	Yes*	No
33	Nickel	Yes	Yes*	No
34	Total Arsenic (as As)	Yes	Yes	Yes*
35	Mercury	Yes	No	No

Sl. N.	Parameters	Whether req. at State lab.	Whether req. at District lab.	Whether req. at Sub-district
36	Barium	Yes	No	No
37	Zinc	Yes	Yes*	No
38	Aluminum *	Yes	Yes*	No
39	Antimony *	Yes	No	No
40	Selenium	Yes	Yes*	No
41	Silver	Yes	Yes*	No
42	Molybednum (as Mo)	Yes	No	No
	Microbiological			
43	Total coliforms	Yes	Yes	Yes
44	E-coli / Thermotolerant coliforms	Yes	Yes	Yes
45	Virus	Yes*	No	No
46	V.Cholera, S.Typhi, S.Dysentrae, Staphiloccocus, F.Streptococci, G.Lamblia testing – may be included in the State level laboratory and viral parameters in certain cases. States to decide depending upon the disease burden			
	Specific parameters			
47	Total Pesticide Residue	Yes	No	No
48	Radioactive elements	**	No	No
49	Cyanide	Yes	No	No
50	Poly Aromatic Hydrocarbons (PAH) *	Yes	No	No
51	Free Residual Chlorine	Yes	Yes	Yes
52	Polychlorinated Biphenyls	Yes	No	No
53				
54	NDMA*	Yes*	No	No
55	Anionic Detergents (as MBAS *)	Yes	No	No
56	Oils& Grease*	Yes	Yes	No
57	Dissolved Oxygen (DO)	Yes*	Yes*	No
58	Biological Oxygen Demand (BOD)	Yes*	Yes*	No
59	Chemical Oxygen Demand (COD)	Yes*	Yes*	No
60	Mineral oil	Yes	No	No
61	Phenolic Compound (as C6 H5OH)	Yes	No	No
62	Trihalomethanes: a. Bromoform b. Dibromomethane c. Bromodichloromethane d. Chloroform	Yes	No	No
Individual Pesticides* (to be tested once in a year)				
63	Alachlor	Yes	No	No
64	Atrazine	Yes	No	No
65	Aldrin/Deildrin	Yes	No	No
66	Alpha HCH	Yes	No	No
67	Beta HCH	Yes	No	No

Sl. N.	Parameters	Whether req. at State lab.	Whether req. at District lab.	Whether req. at Sub-district
68	Butachlor	Yes	No	No
69	Chloropyriphos	Yes	No	No
70	Delta HCH	Yes	No	No
71	2,4- Dichlorophenoxyacetic acid	Yes	No	No
72	DDT (o, p and p,p iomers of DDT, DDE and DDE)	Yes	No	No
73	Endosulfan (alpha, beta and sulphate)	Yes	No	No
74	Ethion	Yes	No	No
75	Gamma –HCH (Lindane)	Yes	No	No
76	Isoproturon	Yes	No	No
77	Malathion	Yes	No	No
78	Methyl parathion	Yes	No	No
79	Monocrotophos	Yes	No	No
80	Phorate	Yes	No	No
Total Number of Parameters to be monitored		78	34	19

* Indicate discrete sampling. Water quality monitoring to be continued only if these are traced in drinking water sources.

** To be converged with AMD/BARC/PRL/BRIT and other DAE approved laboratories. Alternatively, BARC/ BRIT can be requested to provide technical support in providing uranium testing facility by upgrading existing laboratories

The suggestion of "No" above is only general in nature. Depending upon the occurrence of different parameters locally, the same may be monitored regularly.

District and Sub District laboratories will carry out analysis of the above parameters at least once in Pre Monsoon and Post Monsoon season to establish a baseline survey. However, in case of detection of any pollutants listed above, the parameters would be analysed on routine basis. It is mandatory for District and Sub District laboratories to carry out analysis of at least 13 basic water quality parameters viz., pH, Total Dissolved Solids, Turbidity, Chloride, Total Alkalinity, Total hardness, Sulphate, Iron, Arsenic, Fluoride, Nitrate, Total coliforms and Thermotolerant coliform or E-Coli.

\# **State** laboratories may monitor Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) in surface water if eutrophication is observed/reported. These parameters may also be of importance at the downstream of industrial areas/discharge of treated/partially treated/untreated sewage from urban local bodies.

Annexure V

Standard Methods and Chemicals required for parameters

S.N.	Parameters	Standard Method	Chemicals Required	
	Physical parameters			
1	Temperature			
2	Colour	Visual comparison method	1.	Potassium Chloroplatinate Crystallised cobaltous Chloride
			2.	Conc. Hydrochloric acid
3	Odour	Threshold water test		
4	Taste	Flavour Rating Assessment		NaCl
5	Turbidity	Nephelometric method	1.	Hydrazine sulphate
			2.	Hexamethylene tetramine
6	pH	Electrometric method	1.	pH 4 buffer tablet
			2.	pH 7 buffer tablet
			3.	pH 9.2 buffer tablet
	Chemical parameters			
7	TDS/Elect. Conductivity	Instrumental Method		Potassium Chloride
8	Total Alkalinity	Titration method	1.	Sulphuric acid Phenolphthalein indicator
			2.	Mixed indicator
9	Chloride	Argentometric method	1.	Potassium chromate Silver nitrate
			2.	Sodium Chloride
10	Fluoride	Ion selective electrode method	1.	Sodium Fluoride
			2.	Total Ionic Strength Adjustment Buffer (TISAB)
			3.	CDTA
			4.	Ammonium Acetate
			5.	Conc. Hydrochloric acid
		Sodium 2-(parasulphophenylazo)-1,8-dihydroxy-3,6- naphthalene disulphonate (SPADNS) method	1.	Conc. Sulphuric acid
			2.	Silver sulphate
			6.	SPADNS solution
			7.	Zirconyl acid reagent: ZrOCl2.8H2O & Conc. HCl
			8.	Sodium arsenite
11	Ammonia (as total ammonia-N) mg/l (Analysis required for surface water only)	As mentioned in IS 3025 (part 34) Distillation followed by analysis by Phenate method on visible Spectrophotometer at 640 nm with a light path of 1 cm or greater as mentioned in IS 3025 (Part 340. **The Nesslerization method which has also been mentioned in IS 3025 (part 34) should be avoided due to use of Mercury salt.**	1.	Phenol solution
			2.	Sodium Nitroprusside
			3.	Trisodium citrate
			4.	Sodium Hydroxide
			5.	Anhydrous Ammonium Chloride

S.N.	Parameters	Standard Method	Chemicals Required	
12	Nitrate	1. Chromotropic acid method 2. Devarda's alloy reduction method	1.	Urea
			2.	Anhydrous sodium sulphate
			3.	Antimony metal
			4.	Choromotropic acid
			5.	Sulphuric acid concentrated nitrate free
			6.	Kjeldal assembly
			7.	Sodium hydroxide
			8.	Devarda's alloy
			9.	Borate buffer
13	Nitrite *	Colorimetric method	1.	Sulphanilamide reagent: sulphanilamide & conc. HCl 500mg N-(1-naphthyl)-ethylenediamine
			2.	Sodium oxalate
			3.	Sodium nitrite
15	Sulphate	Turbidimetric method	1.	Barium chloride crystals, 20-30 mesh.
			2.	Anhydrous sodium sulphate
			3.	Magnesium chloride
			4.	Sodium Acetate
			5.	Potassium Nitrate
			6.	Glacial Acetic Acid
			7.	Glycerol
16	Silica	Molybdosiliicate Method	1.	Sodium metasilicate nanohydrate
			2.	Sodium Bicarbonate
			3.	Sodium Bisulphate
			4.	Sulphuric acid
			5.	Hydrochloric acid
			6.	Ammonium Molybdate
			7.	Sodium sulphite
			8.	1 Amino 2 Nepthy 4 Sulphonic Acid
			9.	Sodium sulphite
			10.	Sodium Hydroxide
			11.	Oxalic acid
			12.	Potassium chromate
			13.	Sodium borate decahydrate
17	Sodium	Flame emission photometric method		Sodium chloride
18	Potassium	Flame Photometric method		Potassium chloride
19	Boron *	Carmine method or ICP method	1.	Sulphuric acid
			2.	Hydrochloric acid
			3.	Carmine reagent

S.N.	Parameters	Standard Method	Chemicals Required	
20	Calcium (as Ca)	EDTA Titrimetric method	1.	Sodium hydroxide
			2.	Murexide indicator/ Patton and Reeders indicator
			3.	Eriochrome Blue Black R indicator
			4.	Disodium ethylenediamine tetraacetate
21	Magnesium (as Mg)	Preferable to calculate by difference of total hardness and calcium hardness		
22	Total Hardness	EDTA Titrimetric method	1.	Buffer solution
			2.	Eriochrome black T indicator/Calgamite indicator
			3.	Calcium carbonate
			4.	Methyl Red
			5.	Disodium salt of EDTA
			6.	Conc HCl
			7.	NaCl.
			8.	Murexide indicator
			9.	Sodium hydroxide 2N
	Toxic metals			
24	Iron	Phenanthroline method or As per IS 15303: 2002 Electrothermal atomic absorption method UV/Visible Spectrophotometer	1.	Conc. Hydrochloric acid .
			2.	Hydroxylamine hydrochloride
			3.	Ammonium acetate
			4.	Conc. (glacial) acetic acid
			5.	Sodium acetate 1,10-phenanthroline monohydrate
			6.	Ferrous ammonium sulphate
			7.	Conc. Sulphuric acid
25	Manganese	AAS/ICP method/ UV/Visible Spectrophotometer Persulphate Method	1.	Mercuric sulphate
			2.	Conc. Nitric acid
			3.	85% phosphoric acid
			4.	Silver nitrate
			5.	Ammonium persulphate:.
			6.	Potassium permanganate
			7.	Hydrogen peroxide: 30%
			8.	Conc. Nitric acid
			9.	Conc. Sulphuric acid
			10.	Sodium nitrite
			11.	Sodium oxalate
			12.	Sodium bisulphate
26	Copper	ICP/AAS/ UV/Visible Spectrophotometer		Standard metal solution
27	Total Chromium (as Cr)	ICP/AAS/ Spectrophotometer UV/Visible Spectrophotometer		Potassium dichromate Standard metal solution

S.N.	Parameters	Standard Method	Chemicals Required	
28	Cadmium	ICP/AAS/ Spectrophotometer UV/Visible Spectrophotometer		Standard metal solution
29	Lead	ICP/AAS Spectrophotometer		Standard metal solution
30	Nickel	ICP/AAS Spectrophotometer UV/Visible Spectrophotometer	1.	Ammonium Hydroxide
			2.	Citric Acid
			3.	Dymethylglyoxime
			4.	Chloroform
31	Total Arsenic	Silver diethyldithiocarbamate (SDDC) method using spectrophotometer (for sub district laboratory only) UV/Visible Spectrophotometer ICP/AAS/Spectrophotometer	1.	Anhydrous Sodium acetate
			2.	Acetic acid
			3.	Sodium acetate trihydrate
			4.	Sodium borohydride
			5.	Sodium Hydroxide
			6.	Conc. Hydrochloric acid
			7.	Lead acetate
			8.	Silver diethyldithiocarbamate
			9.	Morpholine
			10.	Chloroform
			11.	Sodium arsenite
			12.	Sodium arsenate
32	Mercury	Cold-vapor Atomic Absorption Spectrometric method/Mercury Analyser		Standard metal solution
33	Barium *	As per IS 15302: 2002 Atomic Absorption method		
34	Zinc	ICP/AAS/ Spectrophotometer		
35	Aluminum *	As per IS 15303: 2002 Electrothermal atomic absorption method		Aluminium potassium sulfate
		Eriochrome cyanine R method	1.	Sulphuric acid
			2.	Ascorbic acid
			3.	Sodium acetate
			4.	Acetic acid
			5.	Eriochrome cyanine: R
			6.	Methyl orange indicator
			7.	Bromocresol green indicator
			8.	EDTA (sodium salt of ethylenediamine-tetraacetic acid dihydrate)
			9.	Sodium hydroxide:
36	Antimony *	As per IS 15303: 2002 Electrothermal atomic absorption method		

S.N.	Parameters	Standard Method	Chemicals Required	
37	Selenium	Spectrophotometric method (2-3 Diammino-napthalate method) for district laboratory AAS (hydride generation method)/ ICP method	1.	Sodium selenite
			2.	Hydrogen Peroxide
			3.	3. Ammonium Hydroxide
			4.	4.DAN Solution
			5.	5.Hydroxylamine
			6.	+EDTA solution
			7.	Ammonium or potassium persulphate
			8.	Sodium Borohydride
38	Silver	ICP/AAS method Dithiozone method	1.	Carbon tetrachloride
			2.	Dithiozone solution
			3.	Ammonium Thiocyanate
			4.	Urea
			5.	Hydroxylamine sulphate solution
			6.	AgNO3 Anhydrous
39	Molybednum	ICP/AAS method		
40	Barium	ICP/AAS method		
Microbiological				
41	Total coliforms	Multiple Dilution Technique Membrane Filtration Technique Plate Count with colony counter	1.	M-Endo Agar
			2.	Ethyl Alcohol
			3.	BGLB
			4.	Peptone
42	Thermotolerant coliforms/ E-coli	MPN (Most Probable Number) or (Membrane Filtration Method)	1.	M-FC Agar
			2.	Rosolic Acid
			3.	EMB Agar
			4.	MacConkey Agar/Broth
43	MS2 phase (indicating Virological contamination)	Polymerase Chian Reaction (PCR) Method (as mentioned in Annex B, Clause 4.2.7, IS 10500: 2012)	1.	Aluminium chloride
			2.	HCl/NaOH (extra-pure)
			3.	Sodium phosphate dibasic
			4.	Sodium dihydrogen phosphate monohydrate
			5.	Citric Acid
			6.	L-Arginine
			7.	Urea-Arginine Phosphate Buffer
			8.	Magnesium Chloride
			9.	McII vaines Buffer (pH 5.0)
44	V.Cholera, S.Typhi, S.Dysentrae, Staphiloccocus, F.Streptococci, G.Lamblia testing – Optional, may be included in the State level laboratory	1. Multiple Dilution Technique 2. Membrane Filtration Technique	1.	TCBS Agar
			2.	XLD Agar
			3.	Bismuth Sulphite Agar
			4.	Salmonella Shigella Agar
			5.	KF Streptococcus Agar
			6.	Mannitol Salt Agar
			7.	Lactose Lauryl Tryptose broth

S.N.	Parameters	Standard Method	Chemicals Required	
	Specific parameters			
45	Pesticide Residues (18 pesticides as per IS 10500: 2012)	HPLC / GC-MS USEPA method		
46	Radioactive elements	To be analysed by outsourcing to GOI approved laboratory as per IS 14194 for following : Gross beta activity measurement (Part 1: 1994) Gross alpha activity measurement (Part 2: 1994)		
47	Cyanide	Cyanide-Selective Electrode method	1.	Potassium cyanide
			2.	Sodium hydroxide
			3.	Potassium nitrate
			4.	Potassium hydroxide
48	Poly Aromatic Hydrocarbons (PAH)*	HPLC/ GS-MS		
49	Polychlorinated Biphenyls (PCB)	HPLC/GC-MS		
50	Chloramine	HPLC		
51	Residual Chlorine	Iodometric method Orthotoludene method	1.	Acetic acid, conc. (glacial)
			2.	Potassium iodide,
			3.	Sodium thiosulphate
			4.	Starch indicator
			5.	Anhydrous potassium biiodate
			6.	Sulphuric acid
			7.	Potassium dichromate
			8.	Orthotoludene
52	Phenolic compounds*	Chloroform extraction method	1.	Phosphoric acid 5%
			2.	Methyl orange
			3.	Sulphuric acid
			4.	Sodium chloride:
			5.	Chloroform
			6.	Ethyl ether:, AR grade
			7.	Sodium hydroxide
			8.	Anhydrous Potassium bromate
			9.	Potassium bromide crystals
			10.	Hydrochloric acid:
			11.	Sodium thiosulphate
			12.	Starch solution
			13.	Ammonium hydroxide
			14.	Potassium monohydrogen phosphate
			15.	Potassium hydrogen phosphate
			16.	4-aminoantipyrine

S.N.	Parameters	Standard Method	Chemicals Required	
			17.	Potassium ferricyanide
			18.	Sodium sulphate
			19.	Potassium iodide
53	Anionic Surfactant / Detergents/ MBAS *	Methylene Blue Active Substances (MBAS)	1.	Alkylbenzene Sulfonate (LAS) solution
			2.	Phenolphthalein Indicator solution, alcoholic
			3.	Sodium Hydroxide
			4.	Sulphuric acid
			5.	Chloroform
			6.	Methylene Blue
			7.	Sodium phosphate, monobasic monohydrate,
			8.	Methanol
			9.	Hydrogen Peroxide
54	Oils & Grease*	Partition-gravimetric method	1.	Hydrochloric acid
			2.	n-hexane
			3.	Petroleum ether
			4.	Anhydrous sodium sulphate
55	Trihalomethanes: a. Bromoform b. Dibromomethane c. Bromodichlorom--ethane d. Chloroform	GC/MS method	1.	Methyl Alcohol
			2.	Standard solutions of Bromoform,Dibromo-methane, Bromo-dichloromethane and Chloroform
56.	NDMA (N-Nitrosodiethyl Amine)	EPA Method 1625/ Isotope dilution technique and liquid -liquid extraction followed by analysis on GC/MS, Alternatively EPA Method 521		Standard Isotopic Solution of NDMA
57.	Dissolved Oxygen (DO)	Winkler Method as mentioned in IS 3025 (Part 38)	1.	Manganous Sulphate
			2.	otassium fluoride
			3.	Sodium Iodide
			4.	Sodium thiosulphate
			5.	Sodium Azide
			6.	Aluminium Potassium Sulphate
			7.	Starch indicator
58	Biological Oxygen Demand (BOD)	As mentioned in IS 3025 (Part 44)		All chemicals mentioned for DO analysis
59	Chemical Oxygen Demand (COD)	As mentioned in IS 3025 (Part 58)	1.	Potassium dichromate
			2.	Silver Sulphate
			3.	Ferrous Ammonium Sulphate
			4.	Mercury sulphate
			5.	Ferroin indicator

Concerned department in States may also procure additional chemicals not mentioned in this protocol but which might be required for carrying out analysis.

Annexure VI

Recommended infrastructure requirements for setting up laboratory

Sl.N.	Infrastructure	State Laboratory	District Laboratory	Sub-District Laboratory
1.	Space for Analysis	80 m2 (including 20 m2 for biological)	60 m2(including 20 m2 for biological testing)	50m2(including 10m2 for biological testing)
	Space for Storage (in m2)	45	25	20
	Space for office & library (in m2)	45	15	10
	Total space req. (in m2)	170	100	80
2.	No. of Computers	03 (include 1 system for library)	01	01
3.	Internet	Yes	Yes	Yes
4.	No. of UPS	02	01	01
5.	Inverters (back up time= 3 hrs)	02	02	01
6.	Printer	02	01	01
7.	Telephone facility	Yes	Yes	Yes
8.	Fax	Yes	Yes	Yes
9.	AC	Yes	Yes	Yes
10.	Provision for Fume hood	Yes	Yes	May not be needed at this level
11.	Provision for gas connection	Yes	Yes	Yes (only LPG)

@ : State laboratory may like to upgrade for virological examination in a phased manner.

All laboratories shall invariably adopt roof-top rainwater harvesting structure and include waste-water/ spent-water treatment before being disposed off and also adopt proper SLWM (Solid and Liquid Waste Management) procedures for safe disposal of plastics, bio-waste etc.

Annexure VII

Recommendations on Instruments requirement in laboratories

Sl. N.	Item	Specifications	State lab	District lab	Sub-district lab
1.	pH meter (both lab based and potable type)	Digital Display (0-14 range)	Yes	Yes	Yes
2.	TDS/Conductivity meter (both lab based and potable type)	Direct reading digital display	Yes	Yes	Yes
3.	Nephelometer (Turbidimeter)	Direct reading Range:0-100 NTU	Yes	Yes	Yes
4.	Digital balance	Single pan Cap.200 gr. Tarring device Accuracy-0.0001gm	Yes	Yes	Yes
5.	UV-Visible Spectrophotometer	Should cover wavelength of important metals/ ions	Yes	Yes	Yes
6.	Refrigerator	295 lts. Cap.	Yes (2 Nos)	Yes	Yes
7.	Water still	Stainless steel Cap. 5 lts/hr.	Yes	Yes	Yes
8.	Voltage stabilizer/ Inverters	Standard make	3 Nos.	2 Nos.	2 Nos.
9.	Hot plate	Big size	2 Nos.	1 No.	1 No.
10.	Heating mentle	Cap. 1 lt.	Yes	Yes	Yes
11.	Water bath	Big size(12 holes) Temp.50 to 1000 C	Yes	Yes	Yes
12.	Hot air oven	Standard make- Big size	4 Nos.	2 Nos.	2 Nos.
13.	Bacteriological Incubator	Temp.control device Range 0 to 500 C Medium size	2 Nos.	02 No.	02 No.
14.	Autoclave	Medium size steel cabinet	2 Nos.	1 No.	1 No.
15.	Magnetic stirrer	With speed control and Teflon paddle	2 Nos.	01	01
16	Microscope	Binocular	Yes	Yes	No
17.	Vacuum pump	1 HP cap.	Yes	Yes	Yes
18.	Flame Photometer	--	Yes	Yes	No
19.	Atomic Absorption Spectro-photometer (AAS) with electrode lamps	--	Yes	No/Yes#	No
20.	Inductively coupled plasma-optical emission spectrometry (ICP-OES)	---	Yes/No	No	No
21.	UV Laminar Air Flow chamber for bacteriological analysis	--	Yes	Yes	Yes
22.	Milipore Filtration assembly with a Vacuum pump	--	Yes	No	No
23.	Plate count and colony counter	Standard make	Yes	Yes	Yes

Sl. N.	Item	Specifications	State lab	District lab	Sub-district lab
24 (a)	Arsenic testing instrumentation (portable type)		Yes	Yes^	Yes^
24 (b)	Hydride generator with all accessories		Yes	Yes**	No
25.	DO meter	Digital	Yes	No	No
26.	Coolbox with icepacks		Yes	Yes	Yes
27.	Specific Ion meter along with electrodes (for Fluoride and Nitrate etc.)	Digital	Yes	Yes	Yes
28.	Fume coup board		Yes	Yes	No
29.	GC-MS/HPLC	Digital	Yes	No	No
30.	Auto Burette & Auto-Pippette		Yes	Yes	Yes
31.	Uranium Analyzer	Digital	Yes^	No/Yes#	No
32.	Thermometers		Yes	Yes	Yes
33.	Single Stage distillation Apparatus	-	Yes	Yes	Yes
34.	Double distillation Apparatus	-	Yes	Yes	Yes
35.	Argon, Nitrogen & Oxygen Gas Cylinders (To be used with AAS/ Advanced Spectrophotometer)	-	Yes	Yes	No
36.	Kjeldal distillation apparatus		Yes	Yes	No
37.	Pressure Pump		Yes	Yes	No
38.	Membrane filtration		Yes	Yes	No
39.	PCR Machine		Yes	No	No
40.	Deep Freezer (-20oC)		Yes	No	No
41.	Micropipette		Yes	No	No
42.	Centrifuge		Yes	Yes	Yes
43.	Reflux Apparatus/COD Digester	---	Yes	Yes*	No

\# Wherever heavy metals contamination/ uranium is found to be high

** Wherever arsenic contamination is found to be high

*** Where pesticides/uranium are detected.

^ Wherever applicable

Annexure VIII

Recommendations on Glassware requirement

Sl.N.	Item	State lab	District lab	Sub-district lab
1.	Conical flask Cap. 100 ml 250 ml 500 ml 1000 ml	24 50 24 10	16 30 16 06	12 20 12 03
2.	Beakers Cap. 100 ml 250 ml 500 ml 1 lt. 2 lt	24 24 24 12 06	16 16 16 08 04	12 12 12 04 02
3.	Pipette Cap. 5 ml 10 ml 20 ml 25 ml 50 ml 00 ml	12 20 12 12 06 04	08 12 08 08 04 02	04 08 04 04 02 02
4.	Pipette (Graduated) Cap. 1 ml 5 ml 10 ml 20 ml	06 10 12 06	04 06 08 04	02 04 04 02
5.	Burette (ordinary) 25 ml 50 ml 100 ml	12 12 02	08 08 01	04 04 01
6.	Burette (Automatic) Cap. 50 ml	3	Not Req.	Not Req.
7.	Desiccators	6	4	3
8.	Reagent Bottles 100 ml 250 ml Cap. 500 ml 1 lit 2 lit	25 50 36 24 10	20 35 24 10 06	15 30 18 06 03
9.	Sample bottles (food grade plastic) Cap. 250 ml 500 ml 1 lit 2 lit	(Need based) 50 50 50 24	35 35 15 08	30 30 12 05
10.	Test Tubes (Packet of 100)	01	01	01
11.	Durham tubes	500	300	200
12.	Round bottom flask Cap. 250 ml	12	08	04

Sl.N.	Item	State lab	District lab	Sub-district lab
13.	Measuring cylinders (graduated) Cap. 10 ml 50ml 100 ml 250 ml 500 ml 1 lit 2 lit	10 10 10 10 10 10 05	6 6 6 6 6 6 3	4 4 4 4 4 4 3
14.	Measuring flask 5 ml for As Cap.10 ml 25 ml 50 ml 100 ml 250 ml 500 ml 1000 ml	05 24 24 12 12 12 12 10	05 15 15 15 15 15 15 06	05 12 12 12 12 12 12 04
15.	Funnels 3” dia 4” dia 5 “ dia	12 12 5	08 08 3	05 05 2
16.	Porcelain dish Medium size Big size	10 06	07 03	05 03
17.	Crucibles	12	08	06
18.	Distillation flask (Kjeldalh unit)	One	Not Req.	Not Req.
19.	Standard joints (grouted) Bends	24 12	24 12	24 12
20.	Glass rods (Packet of 50)	02	01	01
21.	Glass beads	1 kg	0.5 kg	0.5 kg
22.	Nessler cylinders 50 ml 100 ml	100 100	70 70	50 50
23.	Thermometers 100°C 250°C 500°C	12 12 06	08 08 03	05 05 02
24.	Wash bottle	30Nos	20Nos	15Nos
25.	Separating flask	12 Nos	08Nos	04Nos
26.	Single stage water distillation apparatus (Either glass or steel)	02	01	01
	Double distillation water apparatus	01	01.	01.
27.	Petri dishes	100 Nos	70 Nos	40 Nos
28.	Pressure vessel (50 Litre capacity)	1	1	Not Required
29.	Stoppered Bottles for Dissolved Oxygen	20	--	---

Annexure IX

Recommendations on Chemicals requirement

Sl. N.	Name of Chemical	State Laboratory	District Laboratory	Sub-district Laboratory
1	Acetic acid, glacial	(15x500 ml)	(10x500 ml)	(6x500 ml)
2	Alizarin Red S	(2x500 g)	(1x500 g)	(1x500 g)
3	Ascorbic acid	(5x100 g)	(3x100 g)	(2x100 g)
4	Absolute alcohol	(10x500 ml)	(7x500 ml)	(5x500 ml)
5	Aluminium Potassium Sulphate	(5x500 g)	(3x500 g)	(2x500 g)
6	Ammonium Acetate	(10x500 g)	(7x500 g)	(5x500 g)
7	Ammonium Chloride	(10x500 g)	(7x500 g)	(5x500 g)
8	Ammonium Hydroxide	(15x500 g)	(10x500 g)	(7x500 g)
9	Ammonium Purpurate / Muroxide	(7x100 g)	(5x100 g)	(3x100 g)
10	Arsenic Trioxide	(5x500 g)	(4x500 g)	(2x500 g)
11	Barium Chloride	(15x 500 g)	(12x 500 g)	(10x 500 g)
12	Bromocresol green indicator	(5x100 g)	(3x100 g)	(2x100 g)
13	Boric Acid	(4x500 g)	(3x500 g)	(2x500 g)
14	Calcium Chloride (fused)	(7x500 g)	(5x500 g)	(5x500 g)
15	Calcium Chloride	(4x500 g)	(3x500 g)	(2x500 g)
16	Disodium Ethylenediaminetetra Acetate (EDTA)	(7x500 g)	(7x500 g)	(7x500 g)
17	Erichrome Black T	(5x10 g)	(5x10 g)	(5x10 g)
18	Eriochrome cyanine: R	(5x10 g)	(3x10 g)	----
19	Ferrous Ammonium Sulphate	(5x500 g)	(3x500 g)	(2x500 g)
20	Hydrochloric Acid	(7x2.5 L)	(5x2.5 L)	(3x2.5 L)
21	Hydroxylamine Hydrochloride	(5x500 g)	(3x100 g)	(2x500 g)
22	Hydrogen Peroxide	(5x500 ml)	(3x500 ml)	(2x500 ml)
23	Electrolytic Iron	(3x100 g)	(2x100 g)	(1x100 g)
24	Lead Acetate	(3x500 g)	(2x500 g)	(1x500 g)
25	Methyl Orange Indicator/ Methyl Red indicator	(7x100 g)	(5x100 g)	(5x100 g)
26	Phenolphthalein Indicator/ P&R indicator	(7x100 g)	(5x100 g)	(5x100 g)
27	Potassium Hydroxide	(10x500 g)	(7x500 g)	(5x500 g)
28	1-10, Phenanthroline, Monohydrate	(10x10 g)	(7x10 g)	(7x10 g)
29	Potassium permanganate	(5x100 g)	(3x100 g)	(2x100 g)
30	Potassium Iodide	(5x500 g)	(3x500 g)	(2x500 g)
31	Potassium Chromate	(5x500 g)	(3x500 g)	(2x500 g)
32	Potassium Hydrogen Phthalate	(3x500 g)	(2x500 g)	(1x500 g)
33	Stannous Chloride	(5x100 g)	(3x100 g)	(2x100 g)
34	Silver diethyl-dithio-carbamate	(5x100 g)	(3x100 g)	-----
35	Sodium Hydroxide	(10x500 g)	(7x500 g)	(5x500 g)
36	Silver Nitrate	(10x250 g)	(7x250 g)	(5x250 g)
37	Sodium Acetate	(5x500 g)	(3x500 g)	(2x500 g)

Sl. N.	Name of Chemical	State Laboratory	District Laboratory	Sub-district Laboratory
38	Sodium Thiosulphate	(10x500 g)	(7x500 g)	(5x500 g)
39	Starch (Soluble)	(10x500 g)	(7x500 g)	(5x500 g)
40	Sodium Fluoride (Anhydrous)	(5x500 g)	(3x500 g)	(2x500 g)
41	Sodium Arsenate	(4x100 g)	(3x100 g)	(2x100 g)
42	SPADNS	(3x100 g)	(2x100 g)	(2x100 g)
43	Zirconyl Oxychloride, Octohydrate (ZrOCl2. 8H2O)	(5x100 g)	(3x100 g)	(2x100 g)
44	Sodium Sulphate (anhydrous)	(5x500 g)	(3x500 g)	(2x500 g)
45	Sulphuric acid (sp. gr. 1.84)	(7x2.5 L)	(5x2.5 L)	(3x2.5 L)
46	Sulphuric acid (Fuming) Oleum (if specifically required)	(5x250 g)	(3x250 g)	(2x250 g)
47	Sodium Chloride	(5x500 g)	(3x500 g)	(2x500 g)
48	Potassium Dichromate	(5x500 g)	(3x500 g)	(2x500 g)
49	Calcium Carbonate (anhydrous)	(7x500 g)	(5x500 g)	(4x500 g)
50	Phenol, white	(5x500 g)	(3x500 g)	(2x500 g)
51	Potassium Nitrate	(5x500 g)	(3x500 g)	(2x500 g)
52	Sodium Sulphate,	(5x500 g)	(3x500 g)	(2x500 g)
53	pH Indicator paper, Range 2-14 with comparator	(5 rolls)	(3 rolls)	(2 rolls)
54	Methylated spirit	(10x500 ml)	(7x500 ml)	(5x500 ml)
55	MacConkey broth, dehydrated (Hi-media)	(10x500 ml)	(7x500 ml)	(5x500 ml)
56	Total Ionic Strength Adjustment Buffer (TISAB)	(15x500 ml)	(10x500 ml)	(7x500 ml)
57	Oxalic acid	(5x100 g)	(3x100 g)	(2x100 g)
58	Silver sulphate	(5x100 g)	(3x100 g)	(2x100 g)
59	Sodium arsenite	(4x100 g)	(3x100 g)	(2x100 g)
60	Potassium dihydrogen phosphate	(5x100 g)	(3x100 g)	(2x100 g)
61	Ammonium molybdate	(7x100 g)	(5x100 g)	(3x100 g)
62	Nitric acid	(7x2.5 L)	(5x2.5 L)	(3x2.5 L)
63	Ammonium metavanadate	(7x100 g)	(5x100 g)	(3x100 g)
64	Anhydrous potassium nitrate	(5x100 g)	(3x100 g)	(2x100 g)
65	Sulphanilamide	(5x100 g)	(3x100 g)	(2x100 g)
66	Sodium nitrite	(5x100 g)	(3x100 g)	(2x100 g)
67	Sodium oxalate	(5x100 g)	(3x100 g)	(2x100 g)
68	Sodium metasilicate nanohydrate	(5x100 g)	(3x100 g)	(2x100 g)
69	Sodium bicarbonate	(5x100 g)	(3x100 g)	(2x100 g)
70	Sodium borate decahydrate	(5x100 g)	(3x100 g)	(2x100 g)
71	Sodium Tetraborate	(5x100 g)	(3x100 g)	(2x100 g)
72	Glycerol	(7x100 ml)	(3x100 ml)	(2x100 ml)
73	Potassium chloride	(5x100 g)	(3x100 g)	(2x100 g)
74	Carmine reagent	(5x100 gm)	(3x100 gm)	------
75	Ammonium solution	(10x100 ml)	(7x100 ml)	(5x100 ml)

Sl. N.	Name of Chemical	State Laboratory	District Laboratory	Sub-district Laboratory
79	Mercury Sulfate	(5x100 g)	(3x100 g)	(2x100 g)
80	Silver Nitrate	(10x250 g)	(7x250 g)	(5x250 g)
81	Sodium bisulphate	(5x100 g)	(3x100 g)	(2x100 g)
82	Sodium Acetate	(10x500 g)	(7x500 g)	(4 x500g)
83	Zinc metal	(5x100 g)	(3x100 g)	-----
84	Potassium ferricyanide	(5x100 g)	(3x100 g)	(2x100 g)
85	Zincon (2-carboxy-2'-hydroxy-5'-sulfoformazyl benzene)	(5x100 g)	(3x100 g)	----
86	Methanol	(5x500 ml)	(2x500 ml)	(2x500 ml)
87	Phosphoric acid	(5x100 ml)	(3x100 ml)	(2x100 ml)
88	Anhydrous potassium bi-iodate	(5x100 g)	(3x100 g)	(2x100 g)
89	Chloroform	(7x500 ml)	(3x500 ml)	(2x500 ml)
90	Ethyl ether	(5x500 ml)	(5x500 ml)	(3x100 ml)
91	Anhydrous potassium bromide	(5x100 g)	(3x100 g)	-----
92	Potassium ferricyanide	(5x100 g)	(3x100 g)	(2x100 g)
93	Alkylbenzene Sulfonate (LAS) solution	(10x100 ml)	(4x100 ml)	----
94	Methylene Blue	(5x10 g)	(3x10 g)	(2x10 g)
95	Sodium phosphate, monobasic monohydrate	(5x100 g)	(3x100 g)	(2x100 g)
96	N-hexane	(5x100 ml)	(3x100 ml)	(2x100 ml)
97	Petroleum ether	(5x100 ml)	(3x100 ml)	(2x100 ml)
98	M-Endo Agar	(3x500gm)	(2x500gm)	(1x500gm)
99	M-FC Agar	(3x500gm)	(2x500gm)	(1x500gm
100	EMB Agar	(3x500gm)	(2x500gm)	(1x500gm)
101	MacConkey Agar	(3x500gm)	(2x500gm)	(1x500gm)
102	TCBS Agar	(4x500gm)	(3x500gm)	(2x500gm)
103	XLD Agar	(3x500gm)	(2x500gm)	(1x500gm)
104	Bismuth Sulphite Agar	(3x500gm)	(2x500gm)	(1x500gm)
105	Salmonella Shigella Agar	(3x500gm)	(2x500gm)	(1x500gm)
106	KF Streptococcus Agar	(3x500gm)	(2x500gm)	(1x500gm)
107	Mannitol Salt Agar	(5x500gm)	(3x500gm)	(3x500gm)
108	Lactose Lauryl Tryptose broth	(3x500gm)	(2x500gm)	(1x500gm)
109	Ethyl Alcohol	(10x500 ml)	(7x500 ml)	(4x 500 ml)
110	Rosolic Acid	(5x100 ml)	(3x100 ml)	(2x100 ml)
111	Bromocresol purple	(5x100 ml)	(3x100 ml)	(2x100 ml)
112	TTC solution	(5x100 ml)	(3x100 ml)	(2x100 ml)
113	Brilliant Green Bile Growth	(5x100 ml)	(3x100 ml)	(2x100 ml)
114	E. C. Broth	(5x100 ml)	(3x100 ml)	(2x100 ml)
115	Luaryl Sulphate Broth	(5x100 ml)	(3x100 ml)	(2x100 ml)
116	Phosphoric acid 5% H3PO4	(10x500 ml)	(5x500 ml)	----
117	Anhydrous KBrO3	(3x500 gm)	(2x500 ml)	----

Sl. N.	Name of Chemical	State Laboratory	District Laboratory	Sub-district Laboratory
118	Sodium arsenite (NaAsO2)	(4x500 gm)	(2x500 gm)	(2x500 gm)
119	Urea	(10x500 gm)	(5x500 gm)	-----
120	Antimony metal	(5 x 1 gm)	(3 x 1 gm)	(2 x 1 gm)
121	Choromotropic acid	(5 x 100 gm)	(3 x 100 gm)	(2 x 100 gm)
122	Devarda's alloy	(10 x10gm)	(5 x 10gm)	(3 x 10 gm)
123	Borate buffer	(10x500 ml)	(5x500 ml)	(2x 500 ml)
124	Anhydrous sodium sulphate	(10x500 gm)	(5x500 gm)	(3x500 gm)
125	CCl4	(6x500 ml)	(2x500 ml)	-----
126	Dithiozone solution	(3x500 ml)	(5x500 ml)	----
127	NH4CNS	(10x500 gm)	(4x500 gm)	-----
128	AgNO3 Anhydrous	(5x100 gm)	(5x100 gm)	(5x100 gm)
129	K2HPO4	(5x500 gm)	(5x500 gm)	(1x500 gm)
130	KH2PO4	(5x500 gm)	(5x500 gm)	(1x500 gm)
131	Potassium ferricyanide K3Fe(CN)6	(5x500 gm)	(5x500 gm)	(1x500 gm)
132	Azomethane	(5 x 500 gm)	------	----
133	Silver diethyl-dithiocarbamate AgSCSN(C2H5)2	(3 x 500 gm)	(3 x 500 gm)	(3 x 500 gm)
134	Ammonium or potassium persulphate	(4 x 250 gm)	(3 x 250 gm)	----
135	2-3 Diaminonaphtheline (DAN) Solution	(4 x 100 ml)	(2 x 100 ml)	-----
136	Hydroxylamine sulphate	(5x500 gm)	(5x500 gm)	(2x500 gm)
137	Sodium Nitroprusside	(5x500 gm)	--	--
138	Trisodium citrate	(5 x 500 gm)	--	--
139	Phosphate Buffer	(3x500 ml)	---	--
140	Ferroin indicator	(3x250 ml)	--	--

References:

1. Standard Methods for the Examination of Water and Wastewater, 21st Edition, 2005. APHA, AWWA, WEF. 2005.
2. Bureau of Indian Standards (BIS) IS:10500:2012, Drinking Water Specification. 2012.
3. World Health Organization (WHO), Guidelines for Drinking-water Quality 4th Edition, 2011.
4. Uniform drinking water quality monitoring protocol- Draft by Ministry of Drinking Water and Sanitation, 2005.
5. BIS IS 3025-50:2001 Methods Of Sampling And Test (physical And Chemical) For Water And Wastewater, 2012
6. BIS IS: 1622 -1981 (Reaffirmed 1996) Methods of Sampling and Microbiological Examination of Water, 2009
7. Guidance manual for drinking water quality monitoring and assessment. 2nd Edition, 2010, NEERI, Nagpur.
8. National Rural Drinking Water Programme (NRDWP), 2009, Govt. of India.
9. American Society for Testing and Materials (ASTM)
10. U.S. Environmental Protection Agency (USEPA) (2000) Science Policy Council Handbook: Peer Review, 2nd Edition, EPA 100-B00-001, Washington, DC: U.S. Environmental Protection Agency, December 2000.