

**MINISTRY OF JAL SHAKTI,  
CENTRAL GROUND WATER AUTHORITY**

# **Standard Operating Procedures**

**Impact Assessment Report and  
Comprehensive Hydrogeological Report**



**February, 2022**

**Ministry of Jal Shakti**  
**Department of Water Resources, River Development & Ganga Rejuvenation**  
**Central Ground Water Authority**

**Standard Operating Procedure for Implementation of Guidelines**

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## FORMAT FOR COMPREHENSIVE HYDROGEOLOGICAL REPORT ON GROUND WATER CONDITIONS IN BOTH CORE AND BUFFER ZONES FOR MINING PROJECTS

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# Standard Operating Procedures for preparation of Impact Assessment Report and Comprehensive Hydrogeological Report

## Purpose of this Document

The main objective of the accreditation of the Groundwater Professionals and Institutions is to ensure that reports of acceptable standards are submitted by them for obtaining NOC from CGWA. During the last one year, it has been observed that despite the clear instructions mentioned in the guidelines as well as comments/ suggestions offered during the meetings of Expert Appraisal Committee, instructions/suggestions given to the consultants/Institutions in the special meetings organized with them and also after the scrutiny of reports, the quality of the reports is not up to the acceptable standards. This requires interventions from CGWA side and a lot of time is elapsed in scrutiny of reports. In order to facilitate the consultants/institutions in preparation of the Impact Assessment Report (IAR) and Comprehensive Report (CR) on ground water conditions in both core and buffer zones for Mining Projects this SOP has been prepared. This document provides guidance and a consistent, structured approach for preparation of a IAR and CR report in support of their proposal for NOC application.

IAR must be prepared by an **Accredited Consultant/Institution (AC) only. Also an AC can prepare a report only if the work order by the project proponent is issued to him/her/ institution.** The AC shall digitally sign and stamp a completed report which is submitted to the CGWA, and shall take professional responsibility for its content and the accuracy of the information contained therein. For issues of professionalism and data integrity, the AC is directed to follow the guidelines and codes of ethics maintained by the Policy Document of the **Accredited Consultant/Institutions.**

## Purpose of Submission of Reports

The objective of submission of the said reports was in line with the Hon'ble NGT directions wherein it was directed that there should be "no general permission for withdrawal of ground water, particularly to any commercial entity, without environment impact assessment of such activity on individual Assessment units in cumulative terms covering carrying capacity aspects by an expert committee".

All Impact Assessment Reports should include necessarily following aspects:

- i. Changes in water table elevation (including seasonal fluctuations)
- ii. Changes in groundwater flow direction
- iii. Reduction to infiltration/recharge/discharge rates and volumes on varying time scales (i.e., daily to annual depending upon proximal environmental features)
- iv. Change in baseflow (quantity and quality)
- v. Impact on water quality
- vi. Impact on nearby surface water bodies (wetlands, water courses or other significant features)

Thus, the purpose of the submission of the hydrogeological reports is to evaluate the potential for unacceptable impacts to occur as a result of the water withdrawal. The report must also propose contingency and mitigative measures that will be implemented in the event that unforeseen unacceptable impacts occur. It has been observed that most of the reports lay emphasis on the chapters other than the hydrogeology, aquifer carrying capacity and impact assessment. As such these reports do not serve the desired purpose and it takes a lot of time and effort in getting them in order. Also, the Maps and Charts prepared by such consultants are not in conformity with the standards prescribed by the international systems of symbology leading to different formats of figures and charts.

## Format for Impact Assessment Report

The **level of detail** required in the hydrogeological study is normally expected to be commensurate with the level of risk posed by the withdrawal of ground water by the industry/ infrastructure dewatering project, and level of uncertainty of the available information. In the report, the AC should provide clear rationale for the level of work performed and the methodology or study approach utilized. The consultant is expected to undertake field work to collect the requisite information from the field. If need be secondary data of Central/ State agencies may also be collected.

The AC should ensure that GW withdrawal may not cause irreversible impacts to the aquifer such as those that may occur if a confined aquifer is over-pumped. In addition, the withdrawal of ground water should not normally result in deterioration of quality of ground water on a neighbouring property. Even if the hydrogeological study demonstrates that there will not be any unacceptable impacts, the report must propose **contingency and mitigative measures** that will be implemented in the event of unforeseen unacceptable impacts.

Wherever feasible, the ministry encourages that water should be recycled and reused and should be **returned to its source** in order to conserve ground water resources. The study must also address the physical and water quality impacts to the natural environment that may result from a **discharge of the effluent on the Ground Water System**.

## 1. SALIENT FEATURES OF THE PROPOSAL

|      |   |  |
|------|---|--|
| 1.1  | <i>Application No.</i>  |  |
| 1.2  | <i>Accredited by</i>  |  |
| 1.3  | <i>Date of Accreditation</i>  |  |
| 1.4  | <i>Validity upto</i>  |  |
| 1.5  | <i>Work Order Date (Attach copy of the Work Order with masking details of charges)</i>  |  |
| 1.6  | <i>New/ Existing Project</i>  |  |
| 1.7  | <i>CTE issued date</i>  |  |
| 1.8  | <i>Alluvium/ Non-alluvium</i>   |  |
| 1.9  | <i>Block Name &amp; Category (GWRA, 2020)</i>   |  |
| 1.10 | <i>Ground water requirement</i>   |  |
| 1.11 | <i>Ground water Modelling Required (Yes/No)</i>   |  |
| 1.12 | <i>In case the report is prepared jointly by accredited Institute and Individual consultant, name/details of chapters prepared by the Individual consultant</i> |  |
| 1.13 | <i>Signature of the Consultant(s)</i>   |  |

## 2. ABOUT THE PROJECT

This section should identify and briefly describe the general location {Industrial belt, Block, District, State, coordinates} of the project, and intended use of the ground water withdrawal {Whether Existing or Proposed}, duration of study conducted and outline the scope of work performed. Project area and 5 Km radius/Square shall be demarcated on google map.

## **2.1 LANDUSE / LAND COVER OF THE SURROUNDING AREA**

This sub section will deal with the description and map of Landuse/ Land cover map of the area covering 5 km radius from the plant site.

## **2.2 DEM / TOPOGRAPHY**

This subsection will deal with the topography of the surrounding area within 5 km radius from the plant site giving the details of elevation of the surrounding area. DEM and. or topographic contour map of the area within 5 km radius shall be given here.

## **2.3 GEOMORPHOLOGY AND DRAINAGE 5 KM (RADIUS/SQUARE)**

This sub section will describe the geomorphology and drainage of the area and the text will be supported by Geomorphology and drainage maps.

## **2.4 DETAILS OF WETLANDS/ MAJOR WATER BODIES**

This sub section will give the details of wetlands/ major water bodies if any within the 5 km radius and give information on distance/ direction of the plant site from the designated wetland.

If the project site is within 500 metres from the designated wetland as per Ramasar Convention (list of sites available on the NOCA P porta), detailed proposal to avoid/ mitigate the adverse impact on the wetland due to the ground water withdrawal shall be furnished.

# **3. HYDROGEOLOGY**

## **3.1 GEOLOGICAL SETUP**

This should include area specific geology and will contain information and maps of both regional Geology and the local Geology of the area within 5 km radius (Circle/ square) of the plant site. The maps should be based on GSI or field investigation data}.

## **3.2 HYDROGEOLOGICAL SETUP**

The purpose of the GW survey is to collect baseline data that can help prevent and resolve interference complaints. The focus is on gathering current information about the existing hydrogeological conditions. Enhanced monitoring of wells may be performed where the focus would be on impacts that occur as a result of water withdrawal.

This section will deal with the ground water situation in and around the project area including water level and quality data and maps along with quality issues, if any. Hydrogeological map of the area covering 5 km radius from the plant site showing the aquifers available in the area and ground water table elevation contours and flow direction shall be given.

### 3.2.1. Aquifer characteristics

Information on type of aquifers, depth, thickness, porosity, permeability and storativity etc. shall be furnished in this sub section.

### 3.2.2. Ground water flow and aquifer interaction with surface water bodies

Information on ground water flow and details of ground water - surface water interconnection, if any, observed in the area shall be furnished.

### 3.2.3 Depth to water level

The consultants are supposed to measure water level in the study area, i.e. 5 KM radius/square in case of Industry/ infrastructure dewatering projects. Few wells can also be monitored outside the study area to extend the interpolations outside the study area. There should be at least 5-6 observation wells within the 5 Km radius study area and 3-4 outside the study area to be used for control points of water level & water table covering all directions. Water level data should not be collected during monsoon season (June - September).

This sub section shall give data on depth to ground water level (metres below ground level) collected from the field. Depth to water level map shall be prepared based on the data collected from the field. Depth to water level maps of pre-monsoon and post-monsoon seasons and also seasonal water level fluctuation map based on secondary data available shall also be incorporated in the report. These maps will also incorporate the primary data collected by the consultant, if the period of data collection coincides with the pre-monsoon/ post-monsoon. Season (pre-monsoon/ post-monsoon)/ month and year of data should be clearly mentioned on the maps.

### 3.2.4 Long term water level data analysis

This sub section will deal with the decadal water level trend analysis of both pre – monsoon and post – monsoon {based on State/CGWB data located within 5 km from project site and tapping same aquifer}. Hydrographs (line diagrams) of decadal water level data during pre-monsoon and post-monsoon seasons of a few select monitoring wells of Central/ State Government agencies showing the trend of water level variation should be given here.

### 3.2.5 Ground Water quality

This sub section will deal with the quality of ground water and shall include maps of electrical conductivity as contour and other Industry specific parameter as per the Annexures. Samples need to be collected by the consultant from the area covering 5 km radius of the plant site. No samples should be collected during monsoon season (June - September). Locations of samples may also be shown on the map. Samples should be analysed by NABL accredited laboratories only. The month and year of data collection may be mentioned on the map. Minimum of 6-7 samples may be collected from the study area and 2 -3 samples from outside the study area.

### 3.2.6 Water quality of nearby water bodies

Water samples from the nearby water bodies, if any, present in the study area should be collected and analysed from NABL accredited laboratory. Data should be presented and discussed here.

#### **4. DETAILS OF PROPOSED/EXISTING TUBEWELLS/ BOREWELLS**

This includes the table showing aquifer wise parameters, drilling depth, diameter, lithological log, details of pump lowered/ proposed to be lowered, H.P. of pump, well discharge (lps/Cub m/day) etc.

#### **5. PROPOSED DEWATERING PLAN IN CASE OF INFRASTRUCTURE DEWATERING PROJECTS**

##### **5.1 PLAN FOR DEWATERING**

This sub section will deal with the estimation of per day quantum of seepage that needs to be dewatered and clearly indicating the expected maximum depth from where dewatering will be done and specific period for which dewatering will be needed.

##### **5.2 USAGE OF PUMPED WATER**

This sub section will describe the proposed usage of pumped water for various uses like drinking, irrigation, recharge, runoff to the stream/ drain or any other use.

#### **6. IMPACT ASSESSMENT**

##### **6.1 IMPACT ON THE GROUND WATER REGIME**

This section will cover risks of the GW environmental degradation due to GW abstraction including likely impacts of proposed GW Withdrawal on surrounding area in next five years period, affected area and radius of influence.

##### **6.2 IMPACT ON SURFACE WATER SOURCES**

This section deals with impact of GW abstraction on the nearby surface water bodies & potential threats if any.

##### **6.3 IMPACT ON WATER QUALITY**

Impact of GW abstraction on the GW and SW quality regime.

##### **6.4 MITIGATION MEASURES**

Water conservation measures adopted/ proposed to be adopted to reduce/ reuse/save ground water need to be described here. Also measures for treatment of waste water and disposal of waste water by Industry may be furnished.

#### **6.5 SALINE WATER DISPOSAL STRATEGIES (IN CASE OF SALINE WATER ABSTRACTION)**

Brief details of technology and method to be adopted for disposal of reject/saline water and likely impact on surrounding water quality may be furnished in this section.

#### **6.6 GW MODELLING**

(To be included as per SOP given below, if applicable)

### **7. WATER BALANCE , RECYCLE AND REUSE**

This section will include brief write up on water requirement giving water balance including details of water required in the industrial process showing the make up water and blow down from the boiler/ cooling tower etc. along with the details of recycled water. This will also include details on capacity and flow chart of Sewage Treatment Plants / Effluent Treatment Plants / Combined Effluent Treatment Plants existing/ proposed within the project, details of water conservation measures to be adopted to reduce/ save the ground water and water balance with chart showing the usage of water for various processes.

### **8. SALINE WATER DISPOSAL STRATEGIES (IN CASE OF SALINE GW ABSTRACTION)**

Brief details of technology and method to be adopted for disposal of reject/saline water and likely impact on surrounding water quality. Also measures adopted/ suggested to protect the ambient ground/ surface water resources against pollution should be mentioned here.

### **9. ANY OTHER DETAILS PERTAINING TO THE PROJECT**

### **10. SUMMARY AND CONCLUSION**

This chapter must categorically include discussion on likely impact and mitigation measures.

### **11. ACCREDITATION CERTIFICATE**

Accreditation Certificate may be attached in the report.

## Format for Comprehensive Hydrogeological Report on ground water conditions in both core and buffer zones for Mining Projects

### 1. SALIENT FEATURES OF THE PROPOSAL

|      |   |  |
|------|---|--|
| 1.1  | <i>Application No.</i>  |  |
| 1.2  | <i>Accredited by</i>  |  |
| 1.3  | <i>Date of Accreditation</i>  |  |
| 1.4  | <i>Validity upto</i>  |  |
| 1.5  | <i>Work Order Date (Attach copy of the Work Order with masking details of charges)</i>  |  |
| 1.6  | <i>New/ Existing Project</i>  |  |
| 1.7  | <i>CTE issued date</i>  |  |
| 1.8  | <i>Alluvium/ Non-alluvium</i>   |  |
| 1.9  | <i>Block Name &amp; Category (GWRA, 2020)</i>   |  |
| 1.10 | <i>Ground water requirement</i>   |  |
| 1.11 | <i>Ground water Modelling Required (Yes/No)</i>   |  |
| 1.12 | <i>In case the report is prepared jointly by accredited Institute and Individual consultant, name/details of chapters prepared by the Individual consultant</i> |  |
| 1.13 | <i>Signature of the Consultant(s)</i>   |  |

### 2. ABOUT THE PROJECT

This section should identify and briefly describe the general location {Block/ taluka/ tehsil, District, State, coordinates} of the project, whether Existing or Proposed, duration of study conducted and outline the scope of work performed. Project site, core zone of 2 km radius and buffer zone of 10 Km radius/Square shall be demarcated on google map.\

## **2.1 LANDUSE / LAND COVER OF THE SURROUNDING AREA**

This sub section will deal with the description and map of Landuse/ Land cover map of the area core and buffer zones.

## **2.2 DEM / TOPOGRAPHY**

This subsection will deal with the topography of the core and buffer zones of the project site giving the details of elevation of the surrounding area. DEM and/ or topographic contour map of the area within 2 and 10 km radii shall be given here.

## **2.3 GEOMORPHOLOGY AND DRAINAGE**

This sub section will describe the geomorphology and drainage of the area and the text will be supported by Geomorphology and drainage maps.

## **2.4 DETAILS OF WETLANDS/ MAJOR WATER BODIES**

This sub section will give the details of wetlands/ major water bodies if any in the core and buffer zones and give information on distance/ direction of the project site from the designated wetland. If the project site is within 500 metres from the designated wetland as per Ramsar Convention (list of sites available on the NOCAP portal), detailed proposal to avoid/ mitigate the adverse impact on the wetland due to the ground water withdrawal shall be furnished.

# **3. HYDROGEOLOGY**

## **3.1 GEOLOGICAL SETUP**

This should include area specific geology and will contain information and maps of both regional Geology and the local Geology of the core zone covering area within 2 km radius and buffer zone covering 10 km radius (Circle/ square) from the project site. The maps should be based on GSI or field investigation data.

## **3.2 GEOPHYSICAL STUDIES**

This sub section will include details of Geophysical investigations including vertical electrical soundings carried out in and around the project area, and their analysis.

## **3.3 HYDROGEOLOGICAL SETUP**

The purpose of the GW survey is to collect baseline data that can help prevent and resolve interference complaints. The focus is on gathering current information about the existing

hydrogeological conditions. Enhanced monitoring of wells may be performed where the focus would be on impacts that occur as a result of ground water withdrawal.

This section will deal with the ground water situation in and around the project area including water level and quality data and maps along with quality issues, if any. Hydrogeological map of the area covering core and buffer zones within 2 km and 10 km radii from the project site showing the aquifers available in the area and ground water table elevation contours and ground water flow direction shall be given.

#### 3.3.1. Aquifer characteristics:

Information on type of aquifers, depth, thickness, porosity, permeability and storativity etc. shall be furnished in this sub section.

#### 3.3.2. Ground water flow and aquifer interaction with surface water bodies:

Information on ground water flow and details of ground water - surface water interconnection, if any, observed in the area shall be furnished.

#### 3.3.3 Depth to water level

The consultants are supposed to measure water level in the study area, i.e core zone of 2 KM and buffer zone of 10 KM radius/square. Few wells can also be monitored outside the study area to extend the interpolations outside the study area. There should be at least 10- 12 observation wells within the 10 Km radius study area and 4-5 outside the study area to be used for control points of water level & water table covering all directions. Water level data should not be collected during monsoon season (June - September).

This sub section shall give data on depth to ground water level (metres below ground level) collected from the field. Depth to water level map shall be prepared based on the data collected from the field. Depth to water level maps of pre-monsoon and post-monsoon seasons and also seasonal water level fluctuation map based on secondary data available shall also be incorporated in the report. These maps will also incorporate the primary data collected by the consultant, if the period of data collection coincides with the pre-monsoon/ post-monsoon. Season (pre-monsoon/ post-monsoon)/ month and year of data should be clearly mentioned on the maps.

#### 3.3.4 Long term water level data analysis

This sub section will deal with the decadal water level trend analysis of both pre – monsoon and post – monsoon {based on State/CGWB data located within 10 km from project site and tapping same aquifer}. Hydrographs (line diagrams) of decadal water level data during pre-monsoon and post-monsoon seasons of a few select monitoring wells of Central/ State Government agencies showing the trend of water level variation should be given here.

#### 3.3.5 Ground water quality

This sub section will deal with the quality of ground water and shall include maps of electrical conductivity as contour and other parameters as point value. Samples need to be collected by the consultant from the core and buffer zones. Locations of samples may also be shown on the map. Samples should be analysed by NABL accredited laboratories only. The month and year of data collection may be mentioned on the map. Minimum of 12-13 samples may be collected from the study area and 2 -3 samples from outside the study area.

#### 3.3.6 Water quality of nearby water bodies

Water samples from the nearby water bodies, if any, present in the study area should be collected and analysed from NABL accredited laboratory. Data should be presented and discussed here.

### 4. APPROVED MINE PLAN

This includes the Year wise mine plan including excavation depth, area and mine seepage KLD and KLY based on volume of excavation, permeability, GW Gradient around mine pit(s).

### 5. ESTIMATION OF MINE SEEPAGE AND ADVANCED DEWATERING PLAN

Type of mine (Open Cast/Underground)

Elevation of water table, mine pits

Details of Mine pit and tunnel (number of pits and tunnels with dimensions (Length, width, depth)

#### 5.1 ESTIMATION OF MINE SEEPAGE

Mine seepage should be calculated for 5 years as per approved mining plan. The details of calculated mine seepage is given below. Seepage calculations shall be made Pit Wise/Tunnel/Shaft.

**Table 5.1: Seepage from Walls of the Pit/Tunnel**

| Year   | Perion       | Working bench Reduce Level in respect to MSL (m) | Depth to Water RL (m) | Length of the Face (m) | Width of the Face (m) or Dia (m) in case of tunnel | Saturated Thickness (m) | GW Gradient (m/m) | *Hydraulic Conductivity (m/day) | Per Day Mine Seepage (Cub m/Day) | Annul Mine Seepage (Cub m/Year) |
|--------|--------------|--|-----------------------|------------------------|--|-------------------------|-------------------|---------------------------------|----------------------------------|---------------------------------|
| Year 1 | Pre monsoon  |  |                       |                        |  |                         |                   |                                 |                                  |                                 |
|        | Post monsoon |  |                       |                        |  |                         |                   |                                 |                                  |                                 |
| Year 2 | Pre monsoon  |  |                       |                        |  |                         |                   |                                 |                                  |                                 |
|        | Post monsoon |  |                       |                        |  |                         |                   |                                 |                                  |                                 |
| Year 3 | Pre monsoon  |  |                       |                        |  |                         |                   |                                 |                                  |                                 |
|        | Post monsoon |  |                       |                        |  |                         |                   |                                 |                                  |                                 |
| Year 4 | Pre monsoon  |  |                       |                        |  |                         |                   |                                 |                                  |                                 |
|        | Post monsoon |  |                       |                        |  |                         |                   |                                 |                                  |                                 |
| Year 5 | Pre monsoon  |  |                       |                        |  |                         |                   |                                 |                                  |                                 |
|        | Post monsoon |  |                       |                        |  |                         |                   |                                 |                                  |                                 |

The seepage may be estimated from the bottom of the mine pit and be added to the seepage from walls as calculated above.

**Table 5.2 Seepage from Bottom of the Pit**

| Year   | Perion       | *Hydraulic Conductivity (m/day) | Per Day Mine Seepage (Cub m/Day) | Annul Mine Seepage (Cub m/Year) |
|--------|--------------|---------------------------------|----------------------------------|---------------------------------|
| Year 1 | Pre monsoon  |                                 |                                  |                                 |
|        | Post monsoon |                                 |                                  |                                 |
| Year 2 | Pre monsoon  |                                 |                                  |                                 |
|        | Post monsoon |                                 |                                  |                                 |
| Year 3 | Pre monsoon  |                                 |                                  |                                 |
|        | Post monsoon |                                 |                                  |                                 |
| Year 4 | Pre monsoon  |                                 |                                  |                                 |
|        | Post monsoon |                                 |                                  |                                 |
| Year 5 | Pre monsoon  |                                 |                                  |                                 |
|        | Post monsoon |                                 |                                  |                                 |

**Table 5.3 Total Mine seepage**

| Year   | Perion       | Annul Mine Seepage (Cub m/Year) Table 5.1 + 5.2 |
|--------|--------------|---|
| Year 1 | Pre monsoon  |   |
|        | Post monsoon |   |
| Year 2 | Pre monsoon  |   |
|        | Post monsoon |   |
| Year 3 | Pre monsoon  |   |
|        | Post monsoon |   |
| Year 4 | Pre monsoon  |   |
|        | Post monsoon |   |
| Year 5 | Pre monsoon  |   |
|        | Post monsoon |   |

- Hydraulic Conductivity should be based on Pumping Testing carried out by the Consultant and CGWB exploration data. The pumping test duration should be sufficiently large to capture hydrogeological boundaries/water bodies in adjacent areas.
- Hydraulic Gradient should be calculated based on the ground water slope at the Mining Pit Area
- Year wise and bench wise mine seepage calculation as per approved mine plan (up to conceptual period)

## 5.2 ADVANCED DEWATERING PLAN IN CASE OF COAL/LIGNITE MINES

The details of the advanced dewatering plan along with proposed location of the bore wells including other hydrogeological details may be provided.

## 5.3 GW MODELLING CHAPTER TO BE INCLUDED AS PER SOP GIVEN BELOW, IF APPLICABLE

In case of discrepancies in the estimated seepage between Analytical (TIL) and Modelling studies, the higher values of the seepage shall be considered for grant of NOC.

## **6. MINE WATER MANAGEMENT**

This section will describe the existing/ proposed usage of water available from dewatering operations for various purposes like drinking, Irrigation benefitted area, Dust suppression, Green belt development, Recharge, Runoff to stream/drain etc. In case of drinking, the estimate of drinking water requirement as per NBC norms shall be furnished. In case of supply of water for irrigation, agreement with the farmers for supply of water and details of mode of transport of water shall be furnished. For green belt development details of area of green belt shall be furnished.

## **7. IMPACT OF MINE DEWATERING/ ABSTRACTION AND MITIGATION MEASURES**

### **7.1 IMPACT ON THE GROUND WATER REGIME**

This section will cover risks of the GW environmental degradation due to mining activities including likely impacts of proposed GW Withdrawal on surrounding area in next five years period, affected area and radius of influence.

### **7.2 IMPACT ON SURFACE WATER SOURCES**

This section deals with impact of mine dewatering on the nearby surface water bodies including diversion of existing channels, constructed dam/ barrages/ weir/ canals/ hydro - electric projects if any, change in land use [change in flood plain, lotic & lentic systems etc.] and current & potential threats if any.

### **7.3 IMPACT ON WATER QUALITY**

Impact of Mining on the GW and SW quality regime

### **7.4 MITIGATION MEASURES**

Water conservation measures adopted/ proposed to be adopted to reduce/ reuse/save ground water need to be described here. Also measures for treatment of mine water and disposal of wastewater by mine may be furnished.

### **7.5 SALINE WATER DISPOSAL STRATEGIES (IN CASE OF SALINE WATER ABSTRACTION)**

Brief details of technology and method to be adopted for disposal of reject/saline water and likely impact on surrounding water quality may be furnished in this section.

## **8. ANY OTHER DETAILS PERTAINING TO THE PROJECT.**

## **9. SUMMARY AND CONCLUSION**

This section must categorically include discussion on likely impact and mitigation measures.

## **10. ACCREDITATION CERTIFICATE**

# **SOP FOR MAPS AND CHARTS**

Maps are important components of the above two reports. The SOP for maps is provided below for uniformity in presenting the information by the applicants across all the area. Maps should be full page on A3 size with good resolution and should not be inserted between the text. Reference of all figures /maps should be included in text. Scale should be shown in all the maps.

## **1. PROJECT AREA**

All the maps for Impact Assessment Report shall be made in 5 KM radius/square in all cases and those for comprehensive hydrogeological report for mines shall be for core zone of 2 km radius and buffer zone of 10 Km radius from the project site.

## **2. BACKGROUND LAYERS**

All the maps should have layer of background information which should include Localities, Project Location, Major drainage and transport network. Symbolology of all back ground layers should be adopted as per symbolology of Google Map.

## **3. HYDROGEOLOGICAL MAP**

Hydrogeological maps should essentially have aquifer types, their potential and water table elevation (WTE) contours (meters above mean sea level). The maps should also depict GW flow directions perpendicular to WTE contours.

## **4. DEPTH TO WATER MAPS**

The depth to water map for pre and post water level is to be prepared as part of the reports.

The consultants are supposed to measure water level in the study area, 5 KM radius/square in case of Industry and 10 KM radius/square in case of Mining projects. Few wells can also be measured outside the study area to extend the interpolations outside the study area. In case of industries, there should be at least 5-6 observation wells within the 5Km radius study area and 3-4 outside the study area to be used for control points of water level & water table covering all directions. In case of mining the nos. of monitoring wells should be 10 - 12 within the core and buffer zone and 4-5 outside the buffer zone.

It is suggested that the filled contours maps of the following intervals should be prepared having the following colour scheme.

## Contour colour Shades

| Depth to Water Range Below Ground Level (m) | Colour Shades | RGB |
|---|---------------|-----|
| <2  | Blue shades   |     |
| 2-3   | Blue shades   |     |
| 3-5   | Blue shades   |     |
| 5-7   | Green Shades  |     |
| 7-10  | Green Shades  |     |
| 10-15                                       | Yellow Shades |     |
| 15-20                                       | Yellow Shades |     |
| 30-40                                       | Brown Shades  |     |
| 40-60                                       | Brown Shades  |     |
| 60-100                                      | Red Shades    |     |

In case the area is showing only one above defined range, the consultants can further refine the contour interval. Both the pre and post monsoon map should have same colour shade scheme.

## 5. WATER QUALITY MAPS

Water quality (WQ) maps in desired area of study should be provided in the report. Only EC & Chloride map should be presented as filled contours. Remaining parameter maps shall be presented as points marked with values on maps. The size of the points can be proportional to their concentration of the parameter observed in those locations.

Water Quality should be analysed in the study area, 5 KM radius/square in case of Industry and 10 KM radius/square in the Mining case. Samples may also be collected from a few wells located outside the study area to extend the interpolations outside the study area. In case of industries/ infrastructure dewatering projects, there should be at least 5-6 WQ observation wells within the 5Km radius study area and 3-4 outside the study area to be used for control points of water quality covering all directions. In case of mining the nos. of quality monitoring wells should be 10-12 within the buffer zone and 6-7 outside the buffer zone.

## 6. CHARTS

Hydrographs of the depth to water level need to be prepared for finding trend of depth to water levels with time. The hydrograph should be prepared based on the following method:

The hydrographs should be strictly XY line diagram with trend line and equation (Time Vs. Depth to Water Level). Secondary data of Central Ground Water Board or State Govt may be used for hydrographs and source should be properly mentioned.

Location of the hydrograph station(s) should be mentioned along with distance and direction from the unit.

## SOP FOR GROUND WATER MODELLING

GW Modelling studies are required to assess the impact of withdrawal on GW system on long term basin. Following are the criteria where modelling studies are required.

| Assessment Unit                                  | Aquifer Type | Quantum of Groundwater (m <sup>3</sup> /day) |
|--|--------------|--|
| Over-exploited, Critical and Semi-critical (OCS) | Non-Alluvium | >500   |
|  | Alluvium     | >1000  |
| Safe   | Non-Alluvium | >500   |
|  | Alluvium     | >2000  |

The chapter on the Modelling need to prepare based on the following lines:

### 1. BRIEF ABOUT THE MODEL AREA

This should include the basics of the area. Unnecessary information about the software used, its historical perspective, code etc need not be included in the chapter.

### 2. CONCEPTUAL MODEL

The conceptual model should include the following:

| Parameter                                       | Value  |
|---|--|
| <b>Grid</b>                                     | Nos of Column X Nos of Rows<br>Size of Grid<br>m x m ,<br>Nos of active grid and<br>Nos of Inactive grid |
| <b>Top of aquifer (m) range of elevation</b>    |  |
| <b>Bottom of aquifer (m) range of elevation</b> |  |
| <b>Initial Piezometric Heads (m amsl)</b>       | Layer 1<br>Layer 2<br>Layer 3  |
| <b>Aquifer Type</b>                             | Layer 1 :<br>Layer 2 :<br>Layer 3 :  |
| <b>Boundary Conditions Used</b>                 | Constant Head Boundary:<br>Constant Head boundary :<br>No flow boundary<br>GHB                           |
| <b>K (m/ Day)</b>                               | Layer 1 :  |

|  |                                     |
|--|-------------------------------------|
|  | Layer 2 :<br>Layer 3 :              |
| <b>Specific yield (%)</b>                        | Layer 1 :<br>Layer 2 :<br>Layer 3 : |
| <b>Storage Parameters</b>                        | Layer 1 :<br>Layer 2 :<br>Layer 3 : |
| <b>Recharge applied</b>                          | –mm/day                             |
| <b>Draft applied</b>                             |                                     |
| <b>Proposed Draft applied for the firm (NOC)</b> |                                     |

Nos of additional layers if any and the Boundary conditions in the above table may be added as per the requirement and feasibility.

### 3. CALIBRATION AND VALIDATION

- Model result-scenario generated for 5 to 10 year ,water level map, water budget  
Observed and predicted contours shape matching
- Table of observed head and calculated head
- Mass Balance table and graph to be explained

### 4. MODEL LIMITATION

- Input parameters K & S used in comparison to observed field parameters
- Reason for using a specific type of Boundary conditions.

### 5. CONCLUSION AND RECOMMENDATION

- RMS and normalised RMS error of the model
- Prediction for next 10 years in staggered manner.

### 6. SUBMISSION OF SOFT COPY OF THE MODEL

- All the consultants preparing GW model are essentially to submit the model backup along with its basic files to CGWA for archival.

## 7. INDICATIVE LIST OF FIGURES

All the reports should contain a list of figures after contents.

1. Location Map
2. Land use Map
3. DEM
4. Geomorphological map (including drainage and water bodies)
5. Geological map along with structural features
6. Hydrogeological map (Water table, aquifers, flow direction, yield) Pre & Post
7. Maps showing observation wells /key wells
8. Depth to water map (mbgl) for Pre-monsoon and Post-monsoon
9. Water level fluctuation map
10. Hydrographs of selected observation wells
11. Water Quality Map (EC –Contour)
12. Water Quality Map (Chloride –Contour)
13. Water Quality Map (Nitrate- Point values)
14. Water Quality Map (Fluoride - Point values)
15. Graphical presentation of water quality

Annexure-1  
Water Quality Parameter Required for Various Types of Industries

| DISCHARGING FACILITY           | Gas and Oil | Dairy Products | Grain Mills | Canned Fruits & Vegetables | Canned & Preserved Sea Foods | Sugar Processing | Textiles | Cement | Feedlots | Electroplating | Organic Chemicals | Inorganic Chemicals | Plastics & Synthetics | Soap & Detergents | Fertiliser Manufacturing | Petroleum Refining | Iron & Steel Manufacturing | Non Ferrous | Phosphate Manufacturing | Steam Electric Power Generating |
|--------------------------------|-------------|----------------|-------------|----------------------------|------------------------------|------------------|----------|--------|----------|----------------|-------------------|---------------------|-----------------------|-------------------|--------------------------|--------------------|----------------------------|-------------|-------------------------|---------------------------------|
| Water quality parameters       |             |                |             |                            |                              |                  |          |        |          |                |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |
| Biochemical Oxygen Demand, BOD | x           | x              | x           | x                          | x                            | x                | x        |        | x        |                | x                 | x                   | x                     | x                 | x                        | x                  |                            |             |                         |                                 |
| Total Suspended Solids         | x           | x              |             | x                          | x                            | x                | x        | x      |          | x              | x                 | x                   | x                     | x                 | x                        | x                  | x                          | x           | x                       | x                               |
| pH                             | x           | x              | x           | x                          | x                            | x                | x        | x      | x        | x              | x                 | x                   | x                     | x                 | x                        | x                  | x                          | x           | x                       | x                               |
| Faecal Coliforms               | x           | x              | x           | x                          | x                            | x                | x        | x      | x        | x              | x                 | x                   | x                     | x                 | x                        | x                  | x                          | x           | x                       | x                               |
| Oil & Grease                   | x           |                |             |                            | x                            |                  | x        |        |          |                | x                 |                     |                       | x                 |                          | x                  | x                          | x           | x                       | x                               |
| Temperature                    | x           | x              | x           | x                          | x                            | x                | x        | x      | x        |                | x                 | x                   | x                     | x                 |                          | x                  | x                          | x           | x                       | x                               |
| Chemical Oxygen Demand, COD    |             |                |             |                            |                              | x                | x        |        |          |                | x                 | x                   | x                     | x                 |                          | x                  |                            | x           |                         |                                 |
| Colour/Dye/Pigment             | x           | x              | x           | x                          | x                            | x                | x        | x      | x        | x              | x                 | x                   | x                     | x                 | x                        | x                  | x                          | x           | x                       | x                               |
| Elemental Phosphorus           |             |                |             |                            |                              |                  |          |        |          |                |                   |                     |                       |                   |                          |                    |                            |             | x                       |                                 |
| Total Phosphorus               |             |                |             |                            |                              | x                |          |        |          | x              |                   |                     |                       |                   | x                        |                    |                            |             | x                       | x                               |
| Ammonia (as N)                 |             |                |             |                            |                              |                  |          |        |          |                |                   | x                   |                       |                   | x                        | x                  | x                          | x           |                         |                                 |
| Organic Nitrogen as N          |             |                |             |                            |                              | x                |          |        |          |                |                   |                     |                       |                   | x                        |                    |                            |             |                         |                                 |
| Nitrate                        |             |                |             |                            |                              | x                |          |        |          |                |                   |                     |                       |                   | x                        |                    | x                          |             |                         |                                 |
| Flow                           | x           | x              | x           | x                          | x                            | x                | x        | x      | x        | x              | x                 | x                   | x                     | x                 | x                        | x                  | x                          | x           | x                       | x                               |
| Phenols                        |             |                |             |                            |                              |                  | x        |        |          |                | x                 |                     | x                     |                   |                          | x                  | x                          |             |                         |                                 |
| Sulphide                       |             |                |             |                            |                              |                  | x        |        |          |                |                   |                     |                       |                   |                          | x                  | x                          |             |                         |                                 |
| Total Chromium                 |             |                |             |                            |                              |                  | x        |        |          | x              |                   | x                   |                       |                   |                          | x                  |                            |             |                         |                                 |
| Chromium VI                    |             |                |             |                            |                              |                  |          |        |          | x              |                   | x                   |                       |                   |                          | x                  |                            |             |                         | x                               |
| Chrome                         |             |                |             |                            |                              |                  |          |        |          |                |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |
| Copper                         |             |                |             |                            |                              |                  |          |        |          | x              |                   | x                   | x                     |                   |                          |                    |                            |             |                         | x                               |
| Nickel                         |             |                |             |                            |                              |                  |          |        |          | x              |                   | x                   |                       |                   |                          |                    |                            |             |                         |                                 |
| Zinc                           |             |                |             |                            |                              |                  |          |        |          | x              |                   |                     | x                     |                   |                          |                    | x                          |             |                         | x                               |
| Zinc                           |             |                |             |                            |                              |                  |          |        |          |                |                   | x                   |                       |                   |                          |                    |                            |             |                         |                                 |
| Cn total                       |             |                |             |                            |                              |                  |          |        |          | x              |                   | x                   |                       |                   |                          |                    |                            |             |                         |                                 |
| Cyanide A                      |             |                |             |                            |                              |                  |          |        |          | x              |                   | x                   |                       |                   |                          |                    |                            |             |                         |                                 |
| Fluorine                       |             |                |             |                            |                              |                  |          |        |          | x              |                   | x                   | x                     |                   |                          |                    |                            | x           | x                       |                                 |
| Free Available Chlorine        |             |                |             |                            |                              |                  |          |        |          |                |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |
| Residual Chlorine              | x           |                |             |                            |                              |                  |          |        |          |                |                   |                     |                       |                   |                          |                    |                            |             |                         | x                               |
| Cadmium                        |             |                |             |                            |                              |                  |          |        |          | x              |                   | x                   |                       |                   |                          |                    | x                          |             |                         |                                 |
| Lead                           |             |                |             |                            |                              |                  |          |        |          | x              |                   | x                   |                       |                   |                          |                    | x                          | x           |                         |                                 |
| Iron                           |             |                |             |                            |                              |                  |          |        |          | x              |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |
| Tin                            |             |                |             |                            |                              |                  |          |        |          | x              |                   | x                   |                       |                   |                          |                    |                            |             |                         | x                               |
| Silver                         |             |                |             |                            |                              |                  |          |        |          | x              |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |
| Gold                           |             |                |             |                            |                              |                  |          |        |          | x              |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |
| Iridium                        |             |                |             |                            |                              |                  |          |        |          | x              |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |
| Palladium                      |             |                |             |                            |                              |                  |          |        |          | x              |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |
| Rhodium                        |             |                |             |                            |                              |                  |          |        |          | x              |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |
| Ruthenium                      |             |                |             |                            |                              |                  |          |        |          | x              |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |
| Mercury (total)                |             |                |             |                            |                              |                  |          |        |          |                |                   | x                   |                       |                   |                          |                    |                            |             |                         |                                 |
| Total Organic Carbon           |             |                |             |                            |                              |                  |          |        |          |                |                   | x                   |                       |                   |                          |                    | x                          |             |                         |                                 |
| Aluminium                      |             |                |             |                            |                              |                  |          |        |          |                |                   | x                   |                       |                   |                          |                    | x                          |             |                         |                                 |
| Arsenic                        |             |                |             |                            |                              |                  |          |        |          |                |                   | x                   |                       |                   |                          |                    | x                          |             | x                       |                                 |
| Selenium                       |             |                |             |                            |                              |                  |          |        |          |                |                   | x                   |                       |                   |                          |                    |                            |             |                         |                                 |
| Barium                         |             |                |             |                            |                              |                  |          |        |          |                |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |
| Manganese                      |             |                |             |                            |                              |                  |          |        |          |                |                   |                     |                       |                   |                          |                    | x                          |             |                         |                                 |
| Tannin                         |             |                |             |                            |                              |                  |          |        |          |                |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |
| Oil                            |             |                |             |                            |                              |                  |          |        |          |                |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |
| Settleable Solids              |             |                |             |                            |                              |                  |          |        |          |                |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |
| Surfactants                    |             |                |             |                            |                              |                  |          |        |          |                |                   |                     |                       |                   |                          |                    |                            |             |                         |                                 |

| DISCHARGING<br>FACILITY  | Fero Alloy manufacturing | Leather tanning & finishing | Glass | Asbestos manufacturing | Rubber processing | Timber products | Pulp, Paper & paperboard | Builders paper & paperboard mills | Meat products | Paving and roofing materials | Intensive chemical agriculture farm | Edible vegetable oils and fats | Hotels, Restaurants and Game Lodges |
|--------------------------|--------------------------|-----------------------------|-------|------------------------|-------------------|-----------------|--------------------------|-----------------------------------|---------------|------------------------------|-------------------------------------|--------------------------------|-------------------------------------|
| Water quality parameters |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| BOD                      |                          | x                           | x     |                        | x                 | x               | x                        | x                                 | x             | x                            |                                     | x                              | x                                   |
| TSS                      | x                        | x                           | x     | x                      | x                 | x               | x                        | x                                 | x             | x                            |                                     |                                | x                                   |
| pH                       | x                        | x                           | x     | x                      | x                 | x               | x                        | x                                 | x             | x                            | X                                   | x                              | x                                   |
| Faecal Coliforms         | x                        | x                           | x     | x                      | x                 | x               | x                        | x                                 | x             | x                            | x                                   | x                              | x                                   |
| Oil & Grease             |                          | x                           |       |                        | x                 | x               | x                        | x                                 | x             | x                            |                                     | x                              | x                                   |
| Temperature              | x                        | x                           | x     | x                      | x                 | x               | x                        | x                                 | x             | x                            |                                     | x                              | x                                   |
| COD                      |                          |                             | x     | x                      | x                 |                 |                          |                                   |               |                              |                                     | x                              |                                     |
| Colour/Dye/Pigment       | x                        | x                           | x     | x                      | x                 | x               | x                        | x                                 | x             | x                            | x                                   | x                              | x                                   |
| Elemental Phosphorus     |                          |                             |       |                        |                   |                 | x                        |                                   |               |                              | x                                   |                                |                                     |
| Total Phosphorus         |                          |                             | x     |                        |                   |                 |                          |                                   |               |                              | x                                   |                                | x                                   |
| Ammonia (as N)           | x                        |                             | x     |                        |                   |                 |                          |                                   | x             |                              | x                                   |                                | x                                   |
| Organic Nitrogen as N    |                          |                             |       |                        |                   |                 |                          |                                   |               |                              | x                                   |                                | x                                   |
| Nitrate                  |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Flow                     | x                        | x                           | x     | x                      | x                 | x               | x                        | x                                 | x             | x                            | x                                   | x                              | x                                   |
| Phenols                  | x                        |                             | x     |                        |                   | x               |                          |                                   |               |                              |                                     |                                |                                     |
| Sulphide                 |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Total Chromium           | x                        | x                           |       |                        | x                 |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Chromium VI              | x                        |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Chrome                   |                          | x                           |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Copper                   |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Nickel                   |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Zinc                     |                          |                             |       |                        | x                 |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Zinc                     |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Cyanide total            | x                        |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Cn                       |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Fluorine                 |                          |                             | x     |                        | x                 |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Free Available Chlorine  |                          |                             |       |                        |                   |                 | x                        | x                                 |               |                              |                                     |                                |                                     |
| Residual Chlorine        |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Cadmium                  |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Lead                     |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Iron                     |                          |                             | x     |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Tin                      |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Silver                   |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Gold                     |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Iridium                  |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Palladium                |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Rhodium                  |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Ruthenium                |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Mercury (total)          |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Total Organic Carbon     |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Aluminium                |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Arsenic                  |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Selenium                 |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Barium                   |                          |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Manganese                | x                        |                             |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Tannin                   |                          | x                           |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Oil                      |                          | x                           |       |                        |                   |                 |                          |                                   |               |                              |                                     |                                |                                     |
| Settleable Solids        |                          |                             |       |                        |                   |                 |                          | x                                 |               |                              |                                     |                                |                                     |
| Surfactants              |                          |                             |       |                        |                   |                 |                          |                                   |               |                              | x                                   | x                              |                                     |

| DISCHARGING FACILITY      | Bakeries & wheat confectioneries | Breweries (malt) | Soft drinks and carbonated waters | Sugar confectionery | Tobacco processing | Distilling & blending of spirits | Motor vehicle assembly | Paints, varnishes & lacquers | Batteries manufacture | Cosmetics | Printing, publishing & allied | Domestic sewage system | Pharmaceutical industries | Tea/Coffee Industries | Slaughter Houses | Combined sewage ( Domestic+ and Industrial effluent) |
|---------------------------|----------------------------------|------------------|-----------------------------------|---------------------|--------------------|----------------------------------|------------------------|------------------------------|-----------------------|-----------|-------------------------------|------------------------|---------------------------|-----------------------|------------------|--|
| Water quality parameters  |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  |  |
| BOD                       | x                                | x                | x                                 | x                   | x                  | x                                | x                      | x                            |                       |           | x                             | x                      | x                         | x                     | x                | x  |
| TSS                       | x                                | x                | x                                 | x                   |                    |                                  |                        | x                            | x                     |           |                               | x                      | x                         | x                     | x                | x  |
| pH                        | x                                | x                | x                                 | x                   | x                  | x                                | x                      | x                            | x                     | x         | x                             | x                      | x                         | x                     | x                | x  |
| Faecal Coliforms/Ecoli.   | x                                | x                | x                                 | x                   | x                  | x                                | x                      | x                            | x                     | x         | x                             | x                      | x                         | x                     | x                | x  |
| Oil & Grease              |                                  |                  |                                   |                     | x                  |                                  | x                      | x                            |                       |           | x                             | x                      |                           |                       | x                | x  |
| Temperature               | x                                | x                | x                                 | x                   | x                  | x                                | x                      | x                            | x                     | x         | x                             |                        |                           |                       | x                |  |
| COD                       |                                  | x                | x                                 | x                   |                    | x                                | x                      | x                            | x                     | x         | x                             | x                      | x                         | x                     | x                | x  |
| Colour/Dye/Pigment        | x                                | x                | x                                 | x                   | x                  | x                                | x                      | x                            | x                     | x         | x                             | x                      | x                         | x                     | x                | x  |
| Elemental Phosphorus      |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  |  |
| Total Phosphorus          |                                  |                  |                                   | x                   |                    |                                  |                        |                              |                       |           |                               | x                      |                           |                       | x                | x  |
| Ammonia (as N)            |                                  |                  |                                   |                     |                    |                                  |                        | x                            |                       |           |                               | x                      |                           |                       | x                | x  |
| Organic Nitrogen as N     |                                  |                  |                                   | x                   |                    |                                  |                        |                              |                       |           |                               |                        |                           | x                     | x                | x  |
| Nitrate                   |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Flow                      | x                                | x                | x                                 | x                   | x                  | x                                | x                      | x                            | x                     | x         | x                             | x                      | x                         | x                     | x                | x  |
| Phenols                   |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Sulphide/Sulphur          |                                  |                  |                                   | x                   |                    |                                  |                        |                              |                       |           | x                             |                        |                           |                       |                  | x  |
| Total Chromium            |                                  |                  |                                   |                     |                    |                                  |                        | x                            |                       |           |                               |                        |                           |                       |                  | x  |
| Chromium VI               |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Chrome                    |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Copper                    |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               | x                      |                           | x                     |                  | x  |
| Nickel                    |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        | x                         |                       |                  | x  |
| Zinc                      |                                  |                  |                                   |                     |                    |                                  |                        | x                            | x                     |           |                               |                        | x                         | x                     |                  | x  |
| Zinc A                    |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  |  |
| Cn total                  |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Cn A                      |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  |  |
| Fluorine                  |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Free Available Chlorine   |                                  |                  |                                   |                     |                    |                                  |                        |                              | x                     |           | x                             | x                      |                           |                       |                  | x  |
| Cadmium                   |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        | x                         |                       |                  | x  |
| Lead                      |                                  |                  |                                   |                     |                    |                                  | x                      | x                            | x                     |           | x                             |                        | x                         |                       |                  | x  |
| Iron                      |                                  |                  |                                   |                     |                    |                                  | x                      | x                            | x                     |           | x                             |                        |                           |                       |                  | x  |
| Tin                       |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Silver                    |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Gold                      |                                  |                  |                                   |                     |                    |                                  | x                      |                              |                       |           | x                             |                        |                           |                       |                  | x  |
| Iridium                   |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Palladium                 |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Rhodium                   |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Ruthenium                 |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Mercury                   |                                  |                  |                                   |                     |                    |                                  | x                      |                              |                       | x         | x                             |                        |                           |                       |                  | x  |
| Total Organic Carbon, TOC |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  |  |
| Aluminium                 |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Arsenic                   |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Selenium                  |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Barium                    |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Manganese                 |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Tannin                    |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       |           |                               |                        |                           |                       |                  | x  |
| Oil                       |                                  |                  |                                   |                     |                    |                                  |                        |                              |                       | x         |                               |                        |                           |                       |                  | x  |
| Settleable Solids         |                                  |                  |                                   |                     |                    |                                  | x                      |                              |                       |           | x                             |                        |                           |                       |                  |  |
| Surfactants               |                                  |                  |                                   |                     |                    |                                  |                        | x                            |                       |           |                               |                        |                           | x                     |                  | x  |