**Annexure - VII**

## Additional Information

The one season environmental baseline data was collected by Environment Protection, Training and Research Institute (EPTRI), Hyderabad during Summer 2017. The details of Baseline stations is as given below.

### I. Number of locations for monitoring of BLD:

| Name of the Project | No of Monitoring Stations | | | | | |
|---|---|---|---|---|---|---|
| | Micro-Meteorological Studies | Ambient Air Quality Monitoring | Water Quality Monitoring | Noise Level Study | Soil Quality Monitoring | Traffic survey |
| Naini Coal Mine | 1 | 10 | 5 GW + 5 SW | 8 | 4 | 2 |

### II. Summary of environmental baseline data collected during summer 2017:

### A. Summary of monthly micro-meteorological data for Summer 2017:

| Month | Wind Speed (m/s) | | | Temperature (ºC) | | | Relative Humidity (%) | | | Rainfall (mm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Max | Calm % | Mean | Max | Min | Mean | Max | Min | Total | Hourly highest |
| March 2017 | 4.19 | 10.8 | 7.11 | 29.8 | 38.0 | 24.0 | 82.5 | 98.0 | 58.0 | 0.0 | 0.0 |
| April -2017 | 5.33 | 10.3 | 2.08 | 30.5 | 46.4 | 20.0 | 74.5 | 98.0 | 22.0 | 0.0 | 0.0 |
| May - 2017 | 5.38 | 10.8 | 2.42 | 31.2 | 42.0 | 23.0 | 71.3 | 95.0 | 22.0 | 0.6 | 0.2 |
| June - 2017 | 5.18 | 11.2 | 2.22 | 31.1 | 44 | 24 | 77.6 | 98.0 | 40.0 | 3.8 | 0.4 |

### B. Summary of micro-meteorological data generated for Summer 2017:

| S. No | Parameter (s) | Min | Max | Mean |
|---|---|---|---|---|
| 1. | Temperature (0C) | 20 | 46.4 | 30.70 |
| 2. | Wind Speed (m/s) | Calm (%) 3.14 | 11.2 | 5.12 |
| 3. | Relative Humidity (%) | 22 | 98.0 | 76.40 |
| 4. | Predominant wind direction for the entire study period | South South West (SSW) | | |
| 5. | Total Rainfall (mm) | 4.4 | | |

### C. Summary of Ambient Air Quality Data:

(All values in $\mu g/m^3$)

| Location | $PM_{10}$ | | | | | $PM_{2.5}$ | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Standards | Min | Max | Avg. | 98 percentile value | Standards | Min | Max | Avg. | 98 percentile value |
| Khanguria (CA1) | 100 | 62.5 | 76.3 | 70.41 | 76.3 | 60 | 37.5 | 43.8 | 41.2 | 43.8 |
| Taliposi (CA2) | 100 | 61.7 | 77.3 | 70.1 | 77.3 | 60 | 38.2 | 43.6 | 41.1 | 43.6 |
| Chhendipada (BA1) | 100 | 65.3 | 78.6 | 70.7 | 78.6 | 60 | 38.4 | 45.1 | 41.2 | 45.1 |
| Bahadasahi (BA2) | 100 | 43.2 | 53.4 | 48.9 | 53 | 60 | 31.2 | 42.8 | 36.8 | 42.8 |
| Mamuriasahi (BA3) | 100 | 42.8 | 50.1 | 47.4 | 50.1 | 60 | 21.4 | 32.1 | 26.3 | 32.1 |
| Kumbarasahi (BA4) | 100 | 48.2 | 58.4 | 52.8 | 58.4 | 60 | 24.5 | 29.4 | 26.9 | 29.4 |
| Kukurpeta high school (BA5) | 100 | 42.6 | 54.2 | 48.9 | 54.2 | 60 | 23.6 | 30.2 | 26.9 | 30.2 |
| Santarabandha NL College (BA6) | 100 | 42.1 | 57.8 | 48.1 | 57.8 | 60 | 23.6 | 29.3 | 26.9 | 29.3 |
| Karadabahal (BA7) | 100 | 41.2 | 59.3 | 51.4 | 59.3 | 60 | 21.5 | 29.3 | 25.5 | 29.3 |
| Brahmanbil (BA8) | 100 | 42.2 | 58.2 | 51.3 | 58.2 | 60 | 22.2 | 29.2 | 25.6 | 29.2 |

**(All values in μg/m$^3$)**

| Location | Standards | $SO_2$ | | | | Standards | $NO_x$ | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | Avg. | 98 percentile value | | Min | Max | Avg. | 98 percentile value |
| Khanguria (CA1) | 80 | 7.1 | 8.9 | 8.0 | 8.9 | 80 | 10.4 | 12.8 | 11.4 | 12.6 |
| Taliposi (CA2) | 80 | 7.2 | 9.3 | 8.1 | 9.3 | 80 | 10.2 | 12.9 | 11.2 | 12.9 |
| Chhendipada (BA1) | 80 | 7.5 | 9.8 | 9.0 | 9.8 | 80 | 10.5 | 13.7 | 12.9 | 13.7 |
| Bahadasahi (BA2) | 80 | 5.7 | 7.2 | 6.4 | 7.15 | 80 | 7.2 | 11.6 | 9.4 | 11.6 |
| Mamuriasahi (BA3) | 80 | 4.3 | 6.2 | 5.3 | 6.05 | 80 | 7.5 | 11.7 | 9.3 | 11.7 |
| Kumbarasahi (BA4) | 80 | 5.1 | 6.5 | 5.8 | 6.45 | 80 | 8.1 | 10.3 | 9.3 | 10.3 |
| Kukurpeta high school (BA5) | 80 | 4.2 | 6.2 | 4.9 | 6.2 | 80 | 8.1 | 11.1 | 9.3 | 11.1 |
| Santarabandha NL College (BA6) | 80 | 3.8 | 6.2 | 5.0 | 6.2 | 80 | 8.1 | 10.8 | 9.3 | 10.8 |
| Karadabahal (BA7) | 80 | 4.1 | 5.8 | 4.8 | 5.8 | 80 | 8.2 | 11.8 | 9.7 | 11.8 |
| Brahmanbil (BA8) | 80 | 4.1 | 5.7 | 4.8 | 5.7 | 80 | 8.1 | 11.2 | 9.3 | 11.2 |

**D. Water Quality Data:**

**(i) Surface Water Quality:**

## Physico-Chemical and Bacteriological Characteristics of Surface Water at Selected Locations in the Study Area

| S.No | Parameters | Unit | Test Method | Tolerance Limits IS: 2296-1982 | CPCB Water Quality Criteria | | | RESULT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Class C | Class A | Class B | Class C | SW-1 | SW-2 | SW-3 | SW-4 | SW-5 |
| | pH | - | 4500-$H^+$B | 6.5-8.5 | 6.5 -8.5 | 6.5 -8.5 | 6.5 - 9 | 7.4 | 7.2 | 6.9 | 7.1 | 7.1 |
| | Temperature | ºC | 2550. B | - | - | - | - | 25.1 | 25.1 | 25.2 | 25.2 | 25.3 |
| | Electrical Conductivity | µmos/cm | 2510-B | - | - | - | - | 861 | 504 | 702 | 444 | 311 |
| | Turbidity | NTU | 2130. B | - | - | - | - | 0.2 | 0.3 | 0.5 | 0.2 | 0.3 |
| | Chlorides as $Cl^-$ | mg/L | 4500-$Cl^-$.B | 600 | - | - | - | 45 | 60 | 92 | 30 | 22 |
| | Colour | Pt-co- | 2120. B | 300 | - | - | - | 5 | 10 | 10 | 5 | 10 |
| | Boron as B | mg/L | 3120-B | - | - | - | - | 0.04 | 0.03 | BDL | BDL | BDL |
| | Sulphates as $SO_4^{2-}$ | mg/L | 4500-$SO_4^{2-}$ .E | 400 | - | - | - | 64 | 9 | 38 | 7 | 6 |
| | Nitrates as $NO_3$ | mg/L | PDA | 50 | - | - | - | 1.6 | 6.1 | 13.2 | 2.6 | 3.4 |
| | Nitrites as $NO_2$ | mg/L | 4500-$NO_2^-$ .B | - | - | - | - | BDL | BDL | 0.33 | 0.13 | BDL |
| | Fluoride as $F^-$ | mg/L | 4500-$F^-$.C | 1.5 | - | - | - | 0.751 | 0.382 | 1.44 | 0.358 | 0.181 |
| | TDS at 180$^o$C | mg/L | 2540.C | 1500 | - | - | - | 525 | 295 | 438 | 272 | 180 |
| | Calcium as Ca | mg/L | 3500-Ca.B | - | - | - | - | 84 | 32 | 26 | 44 | 32 |
| | Magnesium as Mg | mg/L | 3500-Mg.B | - | - | - | - | 42 | 7.2 | 11 | 11 | 8.5 |
| | Mercury as Hg | mg/L | 3500-Hg.B | - | - | - | - | BDL | BDL | BDL | BDL | BDL |
| | Arsenic as As | mg/L | 3120-B | 0.2 | - | - | - | BDL | BDL | BDL | BDL | BDL |
| | Iron as Fe | mg/L | 3120-B | 50 | - | - | - | 0.16 | 0.18 | 1.26 | 0.14 | 0.18 |
| | Lead as Pb | mg/L | 3120-B | 0.1 | - | - | - | BDL | BDL | BDL | BDL | BDL |
| | Zinc as Zn | mg/L | 3120-B | 15 | - | - | - | 0.07 | 0.08 | 0.06 | 0.08 | 0.08 |
| | Cadmium as Cd | mg/L | 3120-B | - | - | - | - | BDL | BDL | BDL | BDL | BDL |
| | Chromium as Cr | mg/L | 3120-B | - | - | - | - | BDL | BDL | BDL | BDL | BDL |

| S.No | Parameters | Unit | Test Method | Tolerance Limits IS: 2296-1982 | CPCB Water Quality Criteria | | | RESULT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Class C | Class A | Class B | Class C | SW-1 | SW-2 | SW-3 | SW-4 | SW-5 |
| | Nickel as Ni | mg/L | 3120-B | - | - | - | - | BDL | BDL | BDL | BDL | BDL |
| | Total Coliforms | MPN/100mL | 9221A & B | 5000 | 50 or less | 500 or less | 5000 or less | 130 | 920 | 350 | 70 | 49 |
| | Fecal Coliforms | MPN/100mL | 9221 E | - | - | - | - | 79 | 540 | 240 | 23 | 23 |
| | E. Coli | Presence / Absence | 9221 F | - | - | - | - | Present | Present | Present | Absent | Absent |
| | **Pesticides:** α–BHC, β-BHC, γ-BHC, δ-BHC, o,p-DDT, p,p' –DDT, α-Endosulfan, β- Endosulfan, Aldrin, Dieldrin | µg/L | 6630. D | - | - | - | - | ND | ND | ND | ND | ND |
| | 2,4-D, Carboryl (Carbonate) Malathion Methyl Parathion Anilophos, Chloropyriphos | Qualitative analysis | 6630. D | - | - | - | - | ND | ND | ND | ND | ND |
| | Odour | TON | 2150. B | - | - | - | - | No odour observed | No odour observed | No odour observed | No odour observed | No odour observed |
| | Dissolved Oxygen | mg/L | 4500-O.C | 4 | 6 mg/l or more | 5 mg/l or more | 4 mg/l or more | 5.9 | 6.2 | 5.9 | 6.0 | 6.1 |
| | BOD for 3 days $20^{o}$ C | mg/L | IS 3025 | 3 | 2 mg/l or less | 3 mg/l or less | 3 mg/l or less | 4 | BDL | 4 | BDL | BDL |
| | Ammonical Nitrogen as N | mg/L | 4500-$NH_3$ -C | - | - | - | - | BDL | BDL | BDL | BDL | BDL |
| | TSS at $105^{o}$ C | mg/L | 2540. D | 1500 | - | - | - | 14 | 17 | 15 | 13 | 16 |
| | Total Phosphates | mg/L | 4500-P-D | - | - | - | - | BDL | BDL | BDL | BDL | BDL |
| | COD | mg/L | 5220. D | - | - | - | - | 24 | 18 | 24 | 18 | 16 |
| | Oil & Grease | mg/L | 5520. B | - | - | - | - | <1 | <1 | <1 | <1 | <1 |
| | Sodium as Na | mg/L | 3500-Na.B | - | - | - | - | 27 | 29 | 73 | 9 | 16 |
| | Potassium as K | mg/L | 3500-K.B | - | - | - | - | 7 | 8 | 6 | 5 | 4 |
| | Carbonates as $CO_3$ | mg/L | 2320. B | - | - | - | - | Nil | Nil | Nil | Nil | Nil |
| | Bi-carbonates as $HCO_3$ | mg/L | 2320. B | - | - | - | - | 173 | 32 | 194 | 179 | 137 |
| | **Polyaromatic** | µg/L | 6440.C | - | - | - | - | ND | ND | ND | ND | ND |

| S.No | Parameters | Unit | Test Method | Tolerance Limits IS: 2296-1982 | CPCB Water Quality Criteria | | | RESULT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Class C | Class A | Class B | Class C | SW-1 | SW-2 | SW-3 | SW-4 | SW-5 |
| | **Hydrocarbons (PAH's):**Acenaphthene, Acenaphthylene, Anthracene, B(a)A, B(a)P, B(b)F, B(k)F, Pyrene, Dibenz(a,h) anthracene, Fluoranthene, Fluorene, Indeno (1,2,3-(d) Pyrene,Naphthalene, phenanthrene, Pyrene. | | | | | | | | | | | |

*NTU – Nephelometric Turbidity Unit; TON – Threshold Odour Number; BDL – Below Detection Limit, Detection Limit – Boron – 0.05 mg/L; Nitrites – 0.02 mg/L; Ammonical Nitrogen – 5 mg/L; Phosphates – 0.02 mg/L; Bio chemical Oxygen Demand as BOD – 3 mg/L; Arsenic –0.02 mg/L; Lead – 0.04 mg/L; Cadmium – 0.01 mg/L; Chromium – 0.02 mg/L; Nickel – 0.02 mg/L; Zinc as Zn – 0.01 mg/L;; Mercury as Hg-0.02 mg/L , ND-Not Detected; Pesticides Detection Limit – 0.1 ppm.*

## (ii) Ground Water Quality Data:

### Physico-Chemical, Bacteriological Characteristics of Groundwater Collected within the Study Area

### Organoleptic and Physical Parameters

| S.No. | Parameters | Unit | Test Method | IS: 10500 Requirement (Acceptable Limit) | IS: 10500 Permissible Limits | RESULT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Brahmanbil **GW-1** | Santarabandha **GW-2** | Chhendipada **GW-3** | Changudia **GW-4** | Karadabahal **GW-5** |
| 1. | Colour | Pt-co- | 2120. B | 5 | 15 | <5 | <5 | <5 | <5 | <5 |
| 2. | Odour | TON | 2150. B | Agreeable | Agreeable | No odour observed | No odour observed | No odour observed | No odour observed | No odour observed |
| 3. | pH | - | 4500-$H^+$B | 6.5 to 8.5 | No relaxation | 7 | 6.7 | 7.1 | 6.8 | 6.9 |
| 4. | Taste | FTN | 2160. B | Agreeable | Agreeable | No flavor observed | No flavor observed | No flavor observed | No flavor observed | No flavor observed |
| 5. | Turbidity | NTU | 2130. B | 1 | 5 | 0.05 | 0.02 | 0.09 | 0.09 | 0.06 |
| 6. | Total Dissolved Solids at 180$^o$ C | mg/L | 2540.C | 500 | 2000 | 422 | 215 | 560 | 480 | 170 |

## General Parameters Concerning Substances Undesirable in Excessive Amounts

| S. No. | Parameters | Unit | Test Method | IS: 10500 Requirement (Acceptable Limit) | IS: 10500 Permissible Limits | RESULT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Brahmanbil **GW-1** | Santarabandha **GW-2** | Chhendipada **GW-3** | Changudia **GW-4** | Karadabahal **GW-5** |
| 1 | Aluminium as Al | mg/L | 3120-B | 0.03 | 0.2 | 0.05 | BDL | BDL | BDL | 0.09 |
| 2 | Anionic Detergents (as MBAS) | mg/L | IS:13428:2005K | 0.2 | 1.0 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 3 | Barium as Ba | mg/L | 3120. B | 0.7 | No relaxation | BDL | BDL | BDL | BDL | BDL |
| 4 | Boron as B | mg/L | 3120-B | 0.5 | 1.0 | BDL | BDL | BDL | BDL | BDL |
| 5 | Calcium as Ca | mg/L | 3500-Ca.B | 75 | 200 | 84 | 34 | 84 | 84 | 32 |
| 6 | Chlorides as $Cl^-$ | mg/L | 4500-$Cl^-$.B | 250 | 1000 | 27 | 47 | 90 | 32 | 23 |
| 7 | Copper as Cu | mg/L | 3120-B | 0.05 | 1.5 | 0.04 | BDL | 0.05 | 0.06 | BDL |
| 8 | Fluoride as $F^-$ | mg/L | 4500-$F^-$.C | 1.0 | 1.5 | 0.938 | 0.167 | 0.689 | 0.468 | 0.173 |
| 9 | Residual free chlorine | mg/L | 4500-$Cl^-$.B | 0.2 | 1.0 | BDL | BDL | BDL | BDL | BDL |
| 10 | Iron as Fe | mg/L | 3120-B | 0.3 | No relaxation | 0.21 | 0.16 | 0.15 | 0.24 | 0.23 |
| 11 | Magnesium as Mg | mg/L | 3500-Mg.B | 30 | 100 | 28 | 5 | 59 | 38 | 6 |
| 12 | Manganese as Mn | mg/L | 3120-B | 0.1 | 0.3 | BDL | BDL | BDL | BDL | BDL |
| 13 | Mineral oil | mg/L | IS:3025 (part 39) | 0.5 | No relaxation | Absent | Absent | Absent | Absent | Absent |
| 14 | Nitrates as $NO_3$ | mg/L | 4500-$NO_3^-$.B | 45 | No relaxation | 1.01 | 2.3 | 6.1 | 1.1 | 2.8 |
| 15 | Phenolic compounds as $C_6H_5OH$ | mg/L | 5530-D | 0.001 | 0.002 | BDL | BDL | BDL | BDL | BDL |
| 16 | Selenium as Se | mg/L | 3120-B | 0.01 | No relaxation | BDL | BDL | BDL | BDL | BDL |
| 17 | Silver as Ag | mg/L | 3120. B | 0.1 | No relaxation | BDL | BDL | BDL | BDL | BDL |
| 18 | Sulphates as $SO_4^{2-}$ | mg/L | 4500-$SO_4^{2-}$ .E | 200 | 400 | 5 | 5.9 | 16 | 8 | 8.3 |
| 19 | Sulfide as $S^{2-}$ | mg/L | 4500. $S^2$- G | - | - | BDL | BDL | BDL | BDL | BDL |
| 20 | Total Alkalinity as $CaCO_3$ | mg/L | 2320. B | 200 | 600 | 378 | 115 | 420 | 446 | 131 |
| 21 | Total Hardness as $CaCO_3$ | mg/L | 2340. C | 200 | 600 | 323 | 104 | 453 | 363 | 104 |
| 22 | Zinc as Zn | mg/L | 3120-B | 5 | 15 | 0.05 | 0.08 | 0.04 | 0.07 | 0.07 |

## Parameters Concerning Toxic Substances

| S. No. | Parameters | Unit | Test Method | IS: 10500 Requirement (Acceptable Limit) | IS: 10500 Permissible Limits | RESULT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Brahmanbil **GW-1** | Santarabandha **GW-2** | Chhendipada **GW-3** | Changudia **GW-4** | Karadabahal **GW-5** |
| 1 | Cadmium as Cd | mg/L | 3120-B | 0.003 | No relaxation | BDL | BDL | BDL | BDL | BDL |
| 2 | Cyanide as CN- | mg/L | 4500-$CN^-$.F | 0.05 | No relaxation | BDL | BDL | BDL | BDL | BDL |
| 3 | Lead as Pb | mg/L | 3120-B | 0.01 | No relaxation | BDL | BDL | BDL | BDL | BDL |
| 4 | Mercury as Hg | µg/L | 3500-Hg.B | 0.001 | No relaxation | BDL | BDL | BDL | BDL | BDL |
| 5 | Molybdenum as Mo | mg/L | 3120. B | 0.07 | No relaxation | BDL | BDL | BDL | BDL | BDL |
| 6 | Nickel as Ni | mg/L | 3120-B | 0.02 | No relaxation | BDL | BDL | BDL | BDL | BDL |
| 7 | **Pesticides:** α–BHC, β-BHC, γ-BHC, δ-BHC, o,p-DDT, p,p' –DDT, Endosulfan, β- Endosulfan, Aldrin, Dieldrin | µg/L | 6630. D | Absent | 0.001 | ND | ND | ND | ND | ND |
| | 2,4-D, Carboryl (Carbonate) Malathion Methyl Parathion Anilophos, Chloropyriphos | Qualitative analysis | 6630. D | Absent | 0.001 | ND | ND | ND | ND | ND |
| 8 | **Polyaromatic Hydrocarbons (PAH's):** Acenaphthene, Acenaphthylene, Anthracene, B(a)A, B(a)P, B(b)F, B(k)F, Pyrene, Dibenz(a,h) anthracene, Fluoranthene, Fluorene, Indeno (1,2,3-(d) Pyrene, Naphthalene, Phenanthrene, Pyrene, Methyl Naphthalene | µg/L | 6440.C | - | - | ND | ND | ND | ND | ND |
| 9 | Total Arsenic as As | mg/L | 3120-B | 0.01 | 0.05 | BDL | BDL | BDL | BDL | BDL |
| 10 | Total Chromium as Cr | mg/L | 3120-B | 0.05 | No relaxation | BDL | BDL | BDL | BDL | BDL |

## Bacteriological Quality of Drinking water

| S. No. | Parameters | Unit | Test Method | IS: 10500 Requirement (Acceptable Limit) | IS: 10500 Permissible Limits | RESULT | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Brahmanbil **GW-1** | Santarabandha **GW-2** | Chhendipada **GW-3** | Changudia **GW-4** | Karadabahal **GW-5** |
| 1 | *E. Coli* | Presence or Absence/ 100 mL | 9221 F | - | - | Absent | Absent | Absent | Absent | Absent |
| 2 | Total Coliforms | MPN/100 mL | 9221A & B | - | - | <1.8 | <1.8 | <1.8 | <1.8 | <1.8 |
| 3 | Fecal Coliforms | MPN/100 mL | 9221 E | - | - | <1.8 | <1.8 | <1.8 | <1.8 | <1.8 |

## Other Parameters

| S. No. | Parameters | Unit | Test Method | RESULT | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Brahmanbil **GW-1** | Santarabandha **GW-2** | Chhendipada **GW-3** | Changudia **GW-4** | Karadabahal **GW-5** |
| 1 | Electrical Conductivity | µmhos/cm | 2510-B | 685 | 360 | 974 | 766 | 287 |
| 2 | Orthophosphates | mg/L | 4500-P-D | BDL | BDL | BDL | BDL | BDL |
| 3 | Chemical Oxygen Demand | mg/L | 5220. D | 8 | 12 | 16 | 18 | 8 |
| 4 | Nitrites as $NO_2$ | mg/L | 4500-$NO_2^-$ .B | BDL | 0.05 | BDL | 0.028 | BDL |
| 5 | Sodium Na | mg/L | 3500 Na. B | 22 | 19.2 | 24.30 | 30.47 | 7 |
| 6 | Potassium as K | mg/L | 3500. K.B | 3 | 0.73 | 9.15 | 8.15 | 3.25 |
| 7 | Carbonates as $CO_3$ | mg/L | 2320. B | Nil | Nil | Nil | Nil | Nil |
| 8 | Bicarbonates as $HCO_3$ | mg/L | 2320. B | 378 | 116 | 420 | 446 | 131 |
| 9 | TSS at 105$^o$ C | mg/L | 2540. D | 9 | 11 | 8 | 10 | 9 |
| 10 | BOD for 3 days 20$^o$ C | mg/L | IS 3025 | BDL | BDL | BDL | BDL | BDL |
| 11 | Free Ammonia | mg/L | 4500-$NH_3$ -D | BDL | BDL | BDL | BDL | BDL |
| 12 | Sodium Absorption Ratio SAR | - | By calculation | 0.53 | 0.81 | 0.49 | 0.68 | 0.3 |

*NTU – Nephelometric Turbidity Unit; TON – Threshold Odour Number; FTN – Flavor Threshold Number; BDL – Below Detection Limit, Detection Limit – Phenols – 0.1 mg/L; Mercury – 20 µg/L; Cyanide – 0.05 mg/L. Hex. Chromium – 0.05 mg/L; Copper – 0.02 mg/L; Manganese – 0.01 mg/L; Cadmium – 0.01 mg/L; Selenium – 0.04 mg/L; Arsenic –0.04 mg/L; Lead – 0.04 mg/L; Aluminum – 0.04 mg/L; Chromium – 0.03 mg/L; Nickel – 0.03 mg/L; Residual free chlorine – 1 mg/L; Nitrites – 0.01 mg/L; Orthophosphates – 0.05 mg/L; ND-Not Detected; Detection Limit: Pesticides– 0.1 ppm; PAHs – 1 ppm.*Not Performed –PCBs, Trihalomethanes, Radioactive materials, Alachlor, Atrazine, Butachlor, Ethion, Monocrotophos.*

**Summary of Water Quality**

**Surface Water Quality**

The analysis results of surface water samples are compared with IS: 2296-1982, Tolerance limits. The analytical results of all the samples along with Tolerance limits for various parameters as per IS 2296-1982 standards are shown in the Table. The standard (IS2296-1982) has been withdrawn by IS, the surface water results were also compared with CPCB water quality criteria. Even though IS 2296-1982 has been withdrawn, the analyzed data has been compared with this standard, to have better understanding about the nature of surface water bodies in the study area, as CPCB water quality criteria, prescribes only few parameters.

***Comparison with IS: 2296-1982, Tolerance limits***

pH values were found to be in the range between 6.9 to 7.4. Colour, Nitrates, TSS, chlorides concentrations were well within the tolerance limits.

Total and fecal coliforms were present in all the surface water samples collected in the study area. *E. coli* was present in all the surface water samples collected within the study area, except samples collected at SW-4 & SW-5, *E. coli* was absent. The presence of coliforms indicates that the contamination might be due to the runoff water with bacteria in soil or sewage. Fecal coliforms and *E. coli* presence might be due to animal droppings or human fecal contamination.

***Comparison with CPCB water quality criteria***

In accordance with CPCB water quality criteria, parameters studied were pH, DO, BOD and total coliforms. It may be observed that all the surface water samples have

DO values ranging from 5.9 mg/L to 6.2 mg/L and BOD was found to be below 3 mg/L at all the locations, except for samples located at SW-1 & SW-3 is above 3 mg/L.

The surface water sample collected from the location, SW-5 fall under the CPCB water quality criteria Class–A (Drinking Water Source without conventional treatment but after disinfection) as total coliforms found to be less than 50 MPN/100 mL.

The surface water sample collected from the location SW-4, fall under the CPCB water quality criteria Class–B (Outdoor bathing (Organized) as total coliforms found to be more than 50 and less than 500 MPN/100 mL.

The surface water sample collected from the location SW-2, fall under the CPCB water quality criteria Class–C (Drinking water source after conventional treatment and

disinfection) as total coliforms found to be more than 500 and less than 5000 MPN/100 mL.

From the analytical results it can be observed that the surface water samples collected from all the locations require suitable treatment to make them potable.

**Groundwater Quality**

The analysis results of groundwater samples were compared with IS:10500 of Acceptable and Permissible limits, which are stipulated for water to be fit for drinking purpose with groundwater as source. The results along with the Acceptable and Permissible limits of various parameters as per the IS: 10500, 2012 standards are shown in the Table. The parameters at all the locations were below the permissible limits and within the standards, hence we have given acceptable limits.

pH values were in the range between 6.7 to 7.1 in the groundwater samples collected within the study area. The turbidity values were well within the permissible limits. The TDS concentration was observed to be below the permissible limit of 2000 mg/L for all the locations.

The total alkalinity concentration for the samples collected at all the locations were below the permissible limit of 600 mg/L and above the acceptable limit of 200mg/L at GW-1 (378 mg/L), GW-3 (420 mg/L) and GW-4 (446 mg/L). The total hardness concentration was observed to be within the permissible limit of 600 mg/L, for all the locations, where as samples collected at GW-1 (323 mg/L), GW-3 (453 mg/L), GW-4 (363 mg/L), above the acceptable limit of 200mg/L. The calcium and magnesium concentrations at all the locations were below the permissible limits of 200 mg/L and 100 mg/L.

The nitrates concentration in all the groundwater samples observed to be below the permissible limit of 45 mg/L. The sulphates concentration in all the groundwater samples observed to be below the permissible limit of 400 mg/L. The fluoride concentration in all the groundwater samples observed to be well within the permissible limit of 1.5 mg/L. The concentration of iron (as Fe) in all the groundwater samples observed to be below the permissible limit of 0.3 mg/L.

Cyanide, Anionic detergents, Hexavalent Chromium, Boron, and Mineral Oil were below their detectable limits.

The concentrations of heavy metals Cadmium (Cd), Manganese (as Mn), Copper (Cu), Lead (Pb), Zinc (as Zn), Selenium (as Se), Arsenic (as As), Chromium (Cr), Nickel (Ni) and Aluminum (as Al) were either below the detection limits or below the permissible limits.

**Groundwater quality at Brahmanbil (GW-1):**

Groundwater results indicate that the groundwater may be used for drinking purpose in the absence of any alternative drinking water source as few parameters exceeded the Acceptable limits; however, they are well within in the permissible limits. The groundwater at this location possesses temporary hardness due to the presence of bicarbonates of calcium and magnesium, which can be removed by boiling water.

**Groundwater quality at Santarabandha (GW-2):**

Groundwater results indicate that the groundwater may be used for drinking purpose in the absence of any alternative drinking water source as few parameters exceeded the Acceptable limits; however, they are well within in the permissible limits. The groundwater at this location possesses temporary hardness due to the presence of bicarbonates of calcium and magnesium, which can be removed by boiling water.

**Groundwater quality at Chhendipada (GW-3):**

Groundwater results indicate that the groundwater may be used for drinking purpose in the absence of any alternative drinking water source as few parameters exceeded the Acceptable limits; however, they are well within in the permissible limits. The groundwater at this location possesses temporary hardness due to the presence of bicarbonates of calcium and magnesium, which can be removed by boiling water.

**Groundwater quality at Changudia (GW-4):**

Groundwater results indicate that the groundwater may be used for drinking purpose in the absence of any alternative drinking water source as few parameters exceeded the Acceptable limits; however, they are well within in the permissible limits. The groundwater at this location possesses temporary hardness due to the presence of bicarbonates of calcium and magnesium, which can be removed by boiling water.

**Groundwater quality at Karadabahal (GW-5):**

Groundwater results indicate that the groundwater may be used for drinking purpose in the absence of any alternative drinking water source as few parameters exceeded the Acceptable limits; however, they are well within in the permissible limits. The groundwater at this location possesses temporary hardness due to the presence of bicarbonates of calcium and magnesium, which can be removed by boiling water.

## E. Noise Level Monitoring Data:

| S.No | Name of the station with code | Limits in dB (A) | | Day time noise levels in dB (A) | Night time noise levels in dB (A) |
|---|---|---|---|---|---|
| | | Day time | Night time | Day Leq | Night Leq |
| 1. | Khanguria (CN1) | 55 | 45 | 52.2 | 46.9 |
| 2. | Taliposi (CN2) | 55 | 45 | 54.8 | 38.1 |
| 3. | Chhendipada (BN1) | 55 | 45 | 54.3 | 44.6 |
| 4. | Bahadasahi (BN2) | 55 | 45 | 52.8 | 41.7 |
| 5. | Mamuriasahi (BN3) | 55 | 45 | 53.5 | 40.6 |
| 6. | Kumbarasahi (BN4) | 55 | 45 | 51.6 | 39.8 |
| 7. | Kukurpeta High School (BN5) | 55 | 45 | 48.1 | 44.9 |
| 8. | Santarabandha NL College (BN6) | 55 | 45 | 48.3 | 40.6 |

## F. Soil Quality Monitoring Data:

**Textural Class of Soil**

| S.No | Sampling Stations | Soil Texture | Soil Depth |
|---|---|---|---|
| 1 | Brahmanbil | Sandy Clay Loamy | 30 cms |
| 2 | Santarabandha | Clay | 30 cms |
| 3 | Khanguria | Clay | 30 cms |
| 4 | Kasidin | Sandy Clay Loamy | 30 cms |

**Physical Characteristics of Soil**

| S.No. | Sampling Stations | Particle Size Distribution | | | Water Holding Capacity (%) | Porosity (%) |
|---|---|---|---|---|---|---|
| | | Sand (%) | Silt (%) | Clay (%) | | |
| 1 | Brahmanbil | 54.4 | 10.9 | 34.5 | 36.0 | 49.0 |
| 2 | Santarabandha | 18.0 | 9.8 | 72.1 | 55.0 | 57.0 |
| 3 | Khanguria | 23.8 | 14.9 | 61.1 | 51.0 | 55.0 |
| 4 | Kasidin | 57.1 | 14.3 | 28.5 | 34.0 | 41.0 |

**Chemical Characteristics of Soil Extract**

| S.No. | Sampling Stations | pH | EC (mmhos/cm) | CEC (meq %) | SAR | Organic Carbon (%) |
|---|---|---|---|---|---|---|
| 1 | Brahmanbil | 6.9 | 0.168 | 21.1 | 0.04 | 5.1 |
| 2 | Santarabandha | 6.8 | 0.105 | 49.3 | 0.02 | 5.2 |
| 3 | Khanguria | 6.8 | 0.194 | 30.55 | 0.04 | 5.1 |
| 4 | Kasidin | 6.9 | 0.163 | 7.05 | 0.1 | 4.9 |

**Exchangeable Cations of Soil**

| S.No. | Sampling Stations | Ex-Ca | Ex-Mg | Ex-Na | Ex-K |
|---|---|---|---|---|---|
| | | (meq/100gr) | | | |
| 1 | Brahmanbil | 11.5 | 7.1 | 0.77 | 0.43 |
| 2 | Santarabandha | 38.1 | 9.3 | 0.52 | 0.25 |
| 3 | Khanguria | 21.8 | 5.6 | 0.83 | 0.28 |
| 4 | Kasidin | 2.8 | 0.8 | 0.72 | 0.34 |

**Fertility Status of Soils in Study Area**

| S.No. | Sampling Stations | N | $P_2O_5$ | $K_2O$ |
|---|---|---|---|---|
| | | Kg/ha | | |
| 1 | Brahmanbil | 50 | 0.41 | 381 |
| 2 | Santarabandha | 111 | 0.27 | 224 |
| 3 | Khanguria | 38 | 0.59 | 247 |
| 4 | Kasidin | 38 | 0.49 | 301 |

**Trace Metals Content in Soil**

| S.No. | Sampling Stations | Cd | Cr | Pb | Ni | Cu | Zn | Mn |
|---|---|---|---|---|---|---|---|---|
| | | mg/kg | | | | | | |
| 1 | Brahmanbil | BDL | 28 | 13 | 16 | 105 | 44 | 266 |
| 2 | Santarabandha | BDL | 20 | 9 | 14 | 82 | 30 | 342 |
| 3 | Khanguria | BDL | 21 | 10 | 13 | 59 | 22 | 194 |
| 4 | Kasidin | BDL | 33 | 9 | 12 | 64 | 24 | 234 |

**Critical limits for DTPA extractable micronutrients**

| Availability | Micronutrients (µg/g soil) | | | |
|---|---|---|---|---|
| | Zn | Cu | Fe | Mn |
| Very low | 0-0.5 | 0-0.1 | 0-2 | 0-0.5 |
| Low | 0.5-1 | 0.1-0.3 | 2-4 | 0.5-1.2 |
| Medium | 1-3 | 0.3-0.8 | 4-6 | 1.2-3.5 |
| High | 3-5 | 0.8-3 | 6-10 | 3.5-6 |
| Very High | >5 | >3 | >10 | >6 |

**DTPA Extractable Micro Nutrients**

| S.No. | Sampling Stations | Zn | Cu | Fe | Mn |
|---|---|---|---|---|---|
| | | (µg/g) | | | |
| 1 | Brahmanbil | 0.55 | 1.59 | 33 | 32 |
| 2 | Santarabandha | 3.72 | 2.17 | 15 | 92 |
| 3 | Khanguria | 0.97 | 0.90 | 14 | 29 |
| 4 | Kasidin | 1.81 | 1.20 | 12 | 43 |

**Micro Nutrients Status**

The micronutrients, *Viz*, Zn, Cu, Fe, Mn were analyzed in the study area and compared with standard critical limits, published by Department of Agriculture & Cooperation Ministry of Agriculture Government of India, New Delhi.

Zinc (Zn) values ranged from 0.55 to 3.72 µg/g, the minimum value was observed at Brahmanbil village and the maximum value was observed at Santarabandha village. The availability of Zn in the study area ranges from low to high.

Copper (Cu) values ranged from 0.90 to 2.17 µg/g, the minimum value was observed at Khanguria village and the maximum value was observed at Santarabandha village. The availability of Cu in the study area is in high range.

Iron (Fe) values ranged from 12 to 33 µg/g, the minimum value was observed at Kasidin village and the maximum value was observed at Brahmanbil village. The availability of Iron in the study area is in very high range.

Manganese (Mn) values ranged from 29 to 92 µg/g, the minimum value was observed at Khanguria village and the maximum value was observed at Santarabandha village. The availability of Manganese in the study area is in very high range.

**Physical Properties of Soil**

Air-dried and sieved samples were used for determination of physical properties of soil. Soil characteristics such as the texture of the soil vary from, clay and sandy clay loam.

The porosity and water holding capacity are in the range of 41-57% and 34-55% respectively. The range of porosity indicates a clayey soil with good water holding capacity for plant growth.

**Chemical Properties of Soil**

The collected soil samples were analyzed for various chemical properties. The parameters selected were pH, Electrical Conductivity, Cation Exchange Capacity (CEC), Sodium Adsorption Ratio (SAR), Organic carbon, Ex.Ca, Ex.Mg, Ex.Na, Ex.K and Nutrients.

pH is an important parameter which indicates the alkaline or acidic nature of soil. Soils collected from the villages in the study area are neutral in nature having pH in the range of 6.8 to 6.9.

The EC for the soil samples are in the range of 0.105-0.194 mmhos/cm. Cation exchange capacity which was found to be in the range of 7.05 to 49.3 meq%. Organic carbon was found to be in the range of 4.9 to 5.1 %.

**Nutrient Status**

The macro nutrients like Nitrogen (N) Phosphorus (P) Potassium (K) were analyzed in the study area and compared with standard soil classification, published by ICAR.

The Nitrogen values ranged from 38 to 111 kgha$^{-}$ reflecting that the values were observed to be in less to good category. The minimum value was observed at Khanguria and the maximum value was observed at Santarabandha.

The Phosphorus values ranged from 0.27 to 0.59 kg $ha^{-1}$ indicating that the values were in very less category. The maximum value was found at Khanguria and the minimum value was found at Santarabandha.

The Potassium values ranged from 224 to 381 kg $ha^{-1}$ indicating that values are observed to be in medium to more than sufficient category. The maximum value was found at Brahmanbil and the minimum value was observed at Santarabandha.

**Trace Metals**

The trace metals Cd, Cr, Pb, Zn, Mn were analyzed. Cd levels were below the detection limit of the ICPOES instrument sensitivity levels. The other metals were well within the soil permissible limits.

## G. Traffic Survey

The traffic density study has been carried out at Kosla, Angul (Odisha). The study has been done on a Working day and Non working days for 24 hrs. The vehicle details (type of vehicle, number of vehicles etc.) for working day and Non-working day has been studies Vehicular Traffic Survey.

**Location**: **Kosla, Angul (Odisha)**

**Duration**: 24 hrs (hourly interval)

**Date of monitoring:** 25.06.2017 to 26.06.2017 (Time period 06:00 AM to next day 06:00 AM) (Non-Working Day - Sunday).

| **SUNDAY- MONDAY: NON-WORKING DAY** | | | | | |
|---|---|---|---|---|---|
| **Time period 06:00 AM to next day 06:00 AM** | | | | | |
| **Date** | **Time** | **Two Wheelers** | **Three Wheelers** | **Light Motor Vehicles** | **Heavy Motor Vehicles** |
| 25.06.2017 | 06.00-07:00 | 105 | 29 | 43 | 63 |
| 25.06.2017 | 07.00-08:00 | 148 | 40 | 30 | 69 |
| 25.06.2017 | 08.00-09:00 | 149 | 28 | 45 | 49 |
| 25.06.2017 | 09.00-10:00 | 163 | 19 | 37 | 29 |
| 25.06.2017 | 10.00-11:00 | 212 | 34 | 59 | 27 |
| 25.06.2017 | 11.00-12:00 | 150 | 17 | 27 | 15 |
| 25.06.2017 | 12.00-13:00 | 138 | 14 | 26 | 28 |
| 25.06.2017 | 13.00-14:00 | 62 | 08 | 15 | 35 |
| 25.06.2017 | 14.00-15:00 | 124 | 19 | 50 | 26 |
| 25.06.2017 | 15.00-16:00 | 135 | 17 | 52 | 31 |
| 25.06.2017 | 16.00-17:00 | 158 | 18 | 44 | 48 |
| 25.06.2017 | 17.00-18:00 | 187 | 53 | 63 | 36 |
| 25.06.2017 | 18.00-19:00 | 164 | 62 | 73 | 24 |
| 25.06.2017 | 19.00-20:00 | 202 | 29 | 61 | 41 |
| 25.06.2017 | 20.00-21:00 | 154 | 48 | 48 | 34 |
| 25.06.2017 | 21.00-22:00 | 101 | 31 | 35 | 25 |
| 25.06.2017 | 22.00-23:00 | 63 | 29 | 21 | 33 |
| 25.06.2017 | 23.00-00:00 | 42 | 26 | 64 | 26 |
| 26.06.2017 | 00.00-01:00 | 15 | 32 | 23 | 28 |
| 26.06.2017 | 01.00-02:00 | 8 | 16 | 16 | 12 |
| 26.06.2017 | 02.00-03:00 | 0 | 19 | 28 | 18 |
| 26.06.2017 | 03.00-04:00 | 1 | 15 | 39 | 15 |
| 26.06.2017 | 04.00-05:00 | 13 | 27 | 43 | 11 |
| 26.06.2017 | 05.00-06:00 | 34 | 18 | 18 | 17 |
| **Total** | | **2528** | **648** | **960** | **740** |

**Location**: **Kosla, Angul (Odisha)**

**Duration**: 24 hrs (hourly interval)

**Date of monitoring:** 26.06.2017 to 27.06.2016 (Time period 06:00 AM to next day 06:00 AM) (Working day - Monday).

| MONDAY-TUESDAY: WORKING DAY | | | | | |
|---|---|---|---|---|---|
| Time period 06:00 AM to next day 06:00 AM | | | | | |
| **Date** | **Time** | **Two Wheelers** | **Three Wheelers** | **Light Motor Vehicles** | **Heavy Motor Vehicles** |
| 26.06.2017 | 06.00-07:00 | 167 | 40 | 73 | 37 |
| 26.06.2017 | 07.00-08:00 | 133 | 42 | 63 | 38 |
| 26.06.2017 | 08.00-09:00 | 185 | 08 | 42 | 74 |
| 26.06.2017 | 09.00-10:00 | 174 | 23 | 63 | 135 |
| 26.06.2017 | 10.00-11:00 | 28 | 12 | 43 | 107 |
| 26.06.2017 | 11.00-12:00 | 118 | 08 | 23 | 122 |
| 26.06.2017 | 12.00-13:00 | 83 | 07 | 17 | 73 |
| 26.06.2017 | 13.00-14:00 | 67 | 01 | 17 | 38 |
| 26.06.2017 | 14.00-15:00 | 59 | 03 | 13 | 49 |
| 26.06.2017 | 15.00-16:00 | 49 | 07 | 45 | 34 |
| 26.06.2017 | 16.00-17:00 | 83 | 13 | 24 | 34 |
| 26.06.2017 | 17.00-18:00 | 63 | 12 | 36 | 21 |
| 26.06.2017 | 18.00-19:00 | 84 | 31 | 44 | 38 |
| 26.06.2017 | 19.00-20:00 | 61 | 26 | 32 | 40 |
| 26.06.2017 | 20.00-21:00 | 83 | 35 | 58 | 43 |
| 26.06.2017 | 21.00-22:00 | 74 | 48 | 61 | 34 |
| 26.06.2017 | 22.00-23:00 | 112 | 16 | 59 | 25 |
| 26.06.2017 | 23.00-00:00 | 69 | 31 | 48 | 30 |
| 27.06.2017 | 00.00-01:00 | 26 | 24 | 34 | 28 |
| 27.06.2017 | 01.00-02:00 | 63 | 27 | 31 | 21 |
| 27.06.2017 | 02.00-03:00 | 12 | 16 | 29 | 16 |
| 27.06.2017 | 03.00-04:00 | 06 | 08 | 13 | 23 |
| 27.06.2017 | 04.00-05:00 | 18 | 19 | 36 | 26 |
| 27.06.2017 | 05.00-06:00 | 29 | 26 | 27 | 17 |
| **Total** | | **1846** | **483** | **931** | **1103** |