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FINAL REPORT ON STUDY AND ASSESSMENT OF CONTAMINATION OF WATER AND SOIL IN THE SURROUNDING AREA OF SPENT WASH STORAGE AND COMPOST YARD OF M/S. LOKNETE MARUTRAO GHULE PATIL DNYANESHWAR SAHAKARI SAKHAR KARKHANA LTD., VILLAGE: BHENDA BK., TAL. NEWASA, DIST. AHILYA NAGAR 414605

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DISCLAIMER

This report is based on the geo-physical studies and ground water sample analysis carried out at the locations mentioned in the report. The observations and recommendations mentioned in the report are based on and related to the abovementioned study.

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Executive Summary

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1.0 INTRODUCTION

Loknete Marutrao Ghule-Patil Dnyaneshwar Sahakari Sakhar Karkhana Limited (LNMG Dnyaneshwar SSKL) is a cooperative unit. It is located in village Bhenda (Bk), Taluka Newasa of Ahilya Nagar (previously known as Ahmednagar). This sugar factory was established in the year1974-75. Initial crushing capacity of the unit was 1250 TCD. The sugar factory expanded gradually and increased its cane crushing capacities. The same is provided in table 1.

Table 1: Sugar factory cane crushing capacity enhancement stages

Year	Capacity enhancement.
1981-82	1250 TCD to 2000 TCD
1990-91	2000 TCD to 3000 TCD
2000-01	3000 TCD to 5000 TCD
2008-09	5000 TCD to 6000 TCD
2017-18	6000 TCD to 7000 TCD

It has established a cogeneration unit of 12 MW in the year 2007-08. Further, the cogeneration unit was expanded by 19.5 MW (total 31.5 MW) in the year2017-18.

The sugar factory established a molasses based distillery unit of 45 KLPD (Kilo litres per day) in the year 1985-86. Currently, it is operated at 55 KLPD.

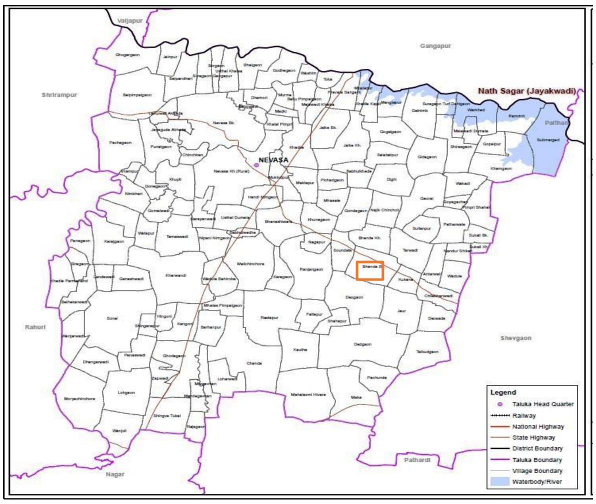

Figure 1: Site Location Map showing the study area in the red box in Newasa taluka map

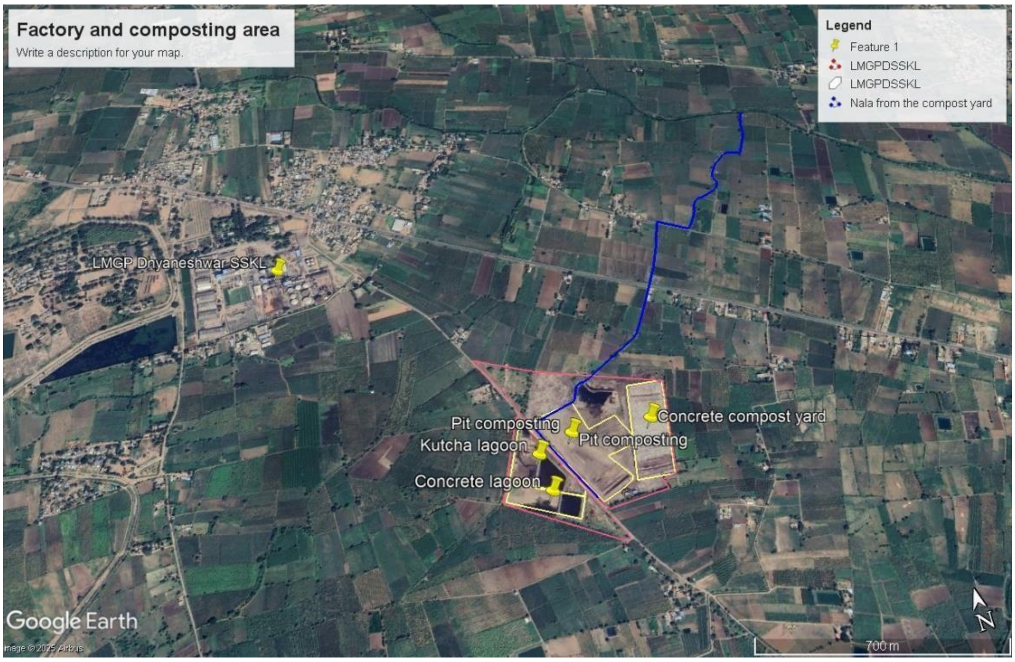

Figure 2: Satellite image of the LMGP Dnyaneshwar SSKL and surrounding area.

2.0 Introduction to the problem (Background)

As mentioned above, the distillery unit was established in the year 1985-86. Spent wash is a wastewater having high pollution potential gets generated during the manufacturing processes of molasses based distillery. In those periods, this spent wash was stored in the unlined *kutcha* lagoons/pits. Those pits/lagoons were unlined and allowed stored wastewater to percolate.

In 2003, the Central Pollution Control Board released a charter known as Corporate Responsibility for Environment Protection (CREP). In this charter it was advised that all molasses based distilleries will stop the practices of storage of spent wash in kutcha (unlined or pervious) lagoons. It was also advised to prepare impervious compost yard to replace all existing pit composting practices. The factory management adopted CREP guidelines and advice of CPCB, in response constructed HDPE lined, impervious lagoons as well as compost yard. In accordance the Management completely stopped the storage of spent wash in unlined, *Kutcha* lagoons. Besides, the management has also stopped the pit composting practices. The compost yard is also lined with HDPE sheet and its top finish is of RCC.

2.1 The problem

It was observed that the spent wash which was stored in the *kutcha* lagoon may have percolated in the ground and entered into the aquifer/s. Pit composting method used earlier for making the compost from spent wash and press mud cake might have also contributed to the ground water contamination. As a result, the dug and bore well water in the downstream of the spent wash storage lagoons and compost yard area was observed to be contaminated. Appearance (colour) of water from some of these water bodies also changed. This problem is faced by the people residing or having dug well/bore wells in the immediate downstream of the compost yard/spent wash storage lagoons.

2.2 Methodology of study

Initially team of experts from Vasantdada Sugar Institute (VSI) visited the site to understand the problem and to frame the scope of the study. This team was comprised of Prof. (Dr.) Nitin Karmalkar Retired Vice Chancellor of Savitribai Phule Pune University (SPPU), Dr. Raymond Duraiswami, Head of Department of Environmental Sciences of SPPU, Dr. Amol Deshmane, Scientist, VSI and Dr. Vivek Patil, Scientific Officer, VSI. This team took overview of the issue, discussed with locals and actually visited some of the ground water sources that were observed to be contaminated.

Sampling plan for water was mainly based on the visual observations during the pre-study as well as same observations by the locals. Often, the ground water characteristics changes with season and particularly during pre-monsoon and post-monsoon. Therefore, it was decided to collect ground water as well as soil samples during these two seasons for qualitative studies. In addition to ground water sampling - geo-physical investigation of the area for pre and post-monsoon was also planned to understand the extent of contamination.

According to the plan, the pre-monsoon study was carried out in the month of May 2024. initially the geology expert team visited your site and performed geo-investigation studies. Subsequently, the team of Department of Environment Sciences of VSI, visited the site during May 28 & 29, 2024. During the said visit, 36 ground water samples, one sample of surface water (from nala) and 17 soil samples were collected from the pre- determined locations of study area.

From the collected ground water samples about 17 samples (dug and bore well water) were collected in the immediate downstream areas of the existing compost yard. The sampling points were located within 1000m from the boundary of the compost yard. Approx. 10 ground water samples were collected from locations which are at >1000m away from the boundary of the compost yard. In addition, 08-09 samples were collected from the upstream areas or from the cross stream zones of the compost yard. This was mainly to understand the baseline characteristics of the ground water in the study area for pre-monsoon season.

The second cycle of water and soil sample collection for post monsoon/winter season was carried out in February 2025. Geo-investigation study was also carried out during the same time for its second cycle. Analysis of all collected samples of second cycle are in progress. Its reports and survey findings will be used further to assess the contamination.

3.0 OBSERVATIONS/FINDINGS

Ground water analysis reports were reviewed and three zones were considered based on the sampling locations. In Zone 1, location number GW 01 to 08 were considered. These locations observed in the upstream or cross stream zones (South, east and west of the spent wash tanks/compost yard). Hence, assuming that these locations would give general characteristics of ground water in the surrounding area. Zone 2: here, GW 10 to GW 27 are observed in the downstream of the compost yard - more or less within 1000 m distance. Therefore, these are assumed within high impact zone. In Zone 3, samples GW 28 to GW 36 are considered. These locations are in downstream of the compost yard but at more than 1000 m distance. This zonation may be helpful to understand the findings of the

3.1 Observations for ground water sampling Zone 1

Ground water monitoring Locations GW 01 to GW 08: Upstream and cross stream zones These locations are either in upstream of the compost yard/lagoons or not directly influenced by the spent wash storage and composting activity – even in the past years.

Figure 3: Satellite image showing the ground water monitoring locations of zone 1

Observations for the test results of water and soil samples collected during the first cycle

Ground water analysis reports were reviewed and three zones were considered based on the sampling locations. In Zone 1, location numbers GW 01 to 08 were considered. These locations observed in the upstream or cross stream zones. As assumed at the beginning of the study, these locations give general characteristics of ground water of the study area.

During pre-monsoon season, in this zone pH of collected water sample was observed from 7.7 to 8.6. Total Dissolved solids (TDS) reported in the range of 602 mg/L to 1442 mg/L. Hardness was in the range of 520 mg/L to 790 mg/L. Hardness and TDS is ultimately depends on calcium, magnesium as well as other cations and anions in the dissolved form. Therefore, values of Ca, Mg, Na, K, Chlorides and sulphate were observed matching to the trend of TDS and hardness. Colour is another important parameter. For all samples of zone 1, colour was below detection limit in colouring unit (CU) scale during this season.

In post monsoon season, Samples from location 2 6 and 8 which were dug well samples collected in this cycle. Based on the observations of pre=monsoon cycle, samples were collected from location in close proximity of the composting activity. Sample showed pH in slightly acidic zone between 6.5 to
6.7. TDS reported in the range of 825 mg/L to 3406 mg/L Hardness was reported in the range of 460 mg/L to 1450 mg/L Increase in the TDS and hardness of these samples, compared to pre-monsoon may be due to intense agricultural activity in the surrounding areas and run-off during irrigation. During this cycle, colour in the range of 5 to 50 reported for sample 2,6 and 8.

Soil analysis showed that soil organic carbon is high to very high range. Soil samples showed pH in alkaline range. Available phosphorous and potassium was in the very high range during post monsoon season. This may be due to application of synthetic fertilizers in the fields.

Geo-physical survey for zone 1

A total of 35 VES was undertaken in the Post Monsoon season of 2025. These were used in six-layer models, the graphs of which are presented as Annexure 1. The Post Monsoon (Fig. 1) modeled apparent resistivity graphs were studied and converted into 4 pseudo section profiles (Annexure 1). Post Monsoon vertical resistivity Surveys (VES) curves have been classified into 6 categories (Table 1).

Geo-physical surveys in the form of vertical electrical resistivity survey (VES) were undertaken at the study area during the Post Monsoon (2025) and Pre Monsoon (2024) seasons.

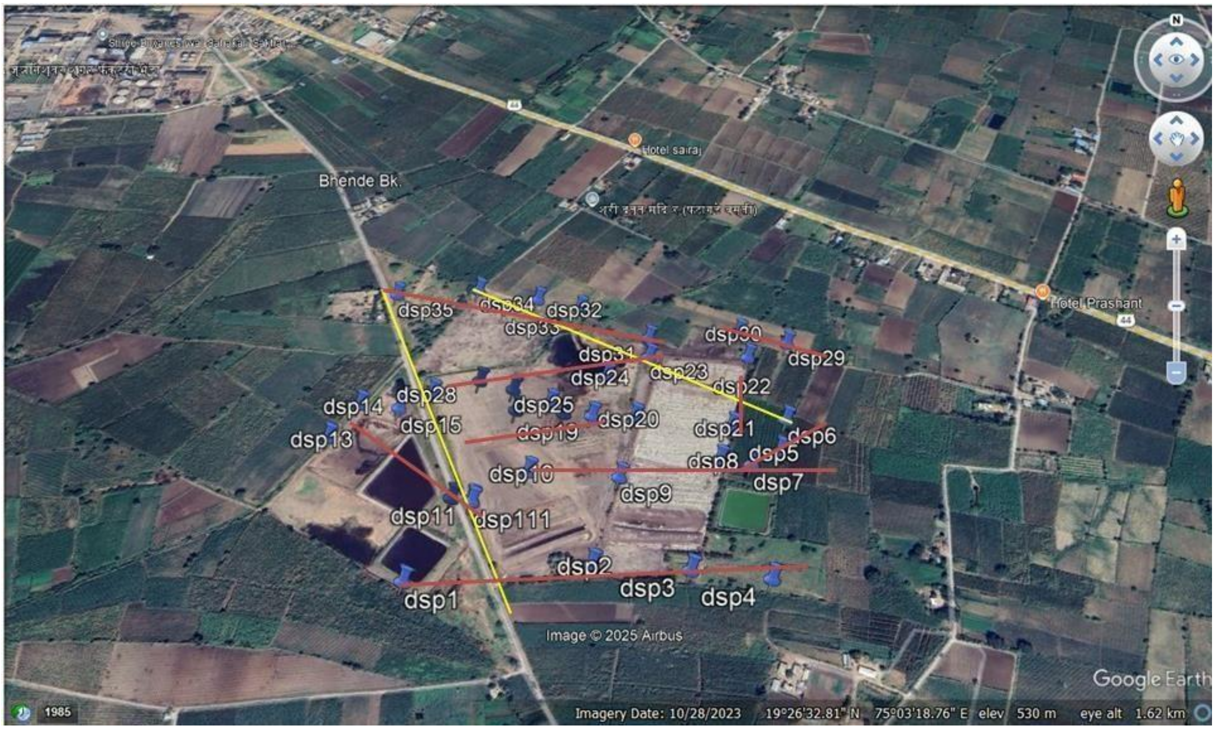

Figure 4: Locations of VES i.e. Geo-physical surveys

During the Pre Monsoon season, it is generally believed that the water table falls with depth due to increased evapo-transpiration (natural cause) and due to ground water abstraction for drinking and irrigation (anthropogenic cause). Hence, a detailed study consisting of systematic traverses across the compost yard was undertaken (DS1 - DS35. Besides this, 1 profile along a natural stream between the compost pit and the Sugar Factory (DS36 - DS41) was also undertaken to understand the nature of the aquifer in the uncontaminated condition. All these VES along several traverses have been utilized to analyze the potential contamination sites.

In this document an abbreviation for sampling point/spot is used. In case of DS, it is used for pre- monsoon spot and DSP is used for the same spot but for post monsoon season.

Profile I (DS1 - DS7)

The pit excavated near VES DS1 is responsible for the low apparent resistivity (15 - 21.5 Ωm) upto a depth of 31.6 m bgl. This low ρa zone extends well below 5.6 m bgl in VES DS2. The high apparent resistivity (46.4 - 73.6 Ωm) is seen in VES DS2 TO DS7.

Post-monsoon season Profile I (DSP1 - DSP10)

This profile is divided into three sections. Section 1 (DSP1- DSP4) runs in the east west direction from the storage tank to the southwest of the compost shed. In this section the moisture laden low apparent resistivity (ρa) < 24 Ωm is seen up to 12.6m bgl (below ground level). However, no leakage (moisture) seen below VES DSP 2 – DSP 4 where high resistivity formations were seen.

Section 2 of profile 1 DSP 05 and DSP 6 are present to the east of the compost yard. Here, high resistivity is seen in DSP 5, but DSP 6 show low ρa.

High resistivity along profiles VES DSP2, DSP3, DSP4, DSP5 and DSP7 indicate there is no leakage or contamination towards the south and east of the DSF compost area.

3.2 Ground Water Monitoring Locations: Immediate Downstream Zone i.e. Zone 2

GW 09 to GW 27: In this group Location GW10 to GW 16, GW 20 and GW 27 are observed in the immediate downstream areas of compost yard/storage lagoons. GW 09 is considered here only because it is located very close to the factory. This is to understand the characteristics of the water quality with respect to the regular factory operations.

GW 17 to GW 26 are in downstream but at further distance from the compost yard/storage lagoons and few locations in this group are observed in close proximity of the natural drainage that passes through the kutcha lagoon area.

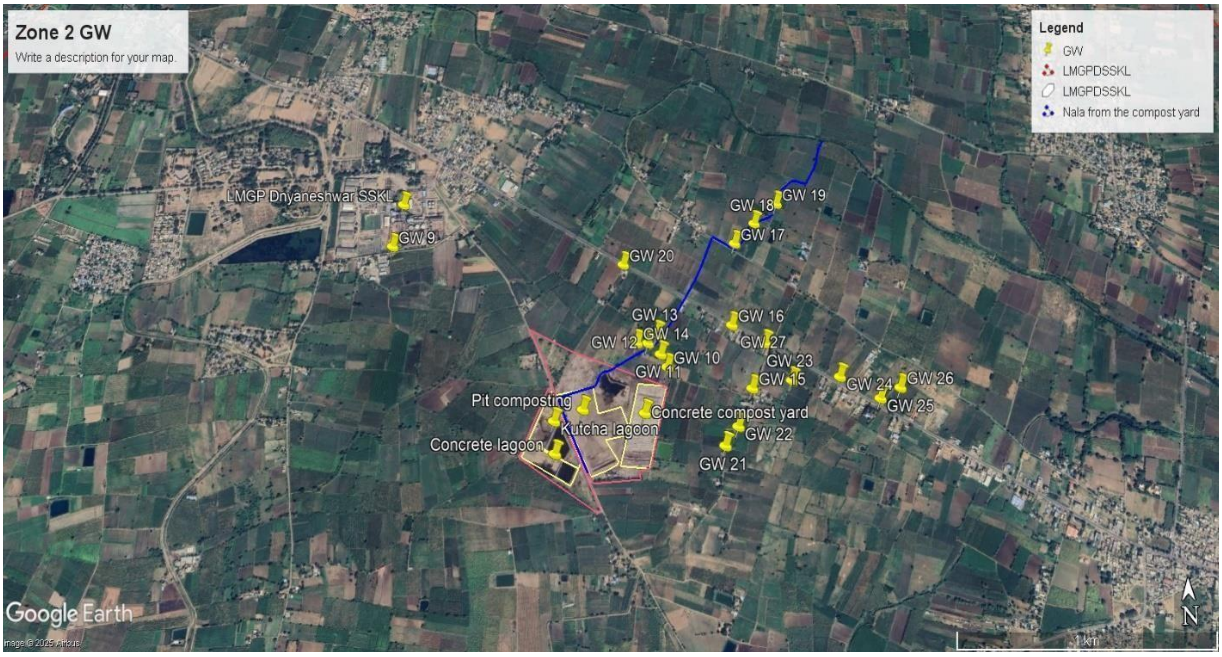

Figure 5: Satellite image showing the ground water monitoring locations of zone 2

This zone i.e. zone 2, is in the downstream of the spent wash storage tanks and the compost yard, located north of these structures. Here pH of samples reported in the range of 7.4 to 8.1. Electrical conductivity (EC) was reported 4.26 mmho/cm for sample 10 which was a dug well located very close to compost yard. Sample GW 11 and GW 12 which were bore well samples from proximate zone of the compost yard reported EC 4.16 and 3.53 mmho/cm. For other samples from this zone (number- wise sample GW 13, GW 14, GW 15, GW 16, GW 20 and GW 27) EC reported above 2.0 mmho/cm.

In this zone, Chemical oxygen demand (COD) for sample GW 10 reported at 2280 mg/L and BOD value for the same sample reported at 905 mg/L. It indicates, the probability of entrainment of run-off from compost yard. Dissolved oxygen level of this sample was 2.0 mg/L, compared to other samples of this zone this value is lowest. This sample reported TDS of 2118 mg/L and total hardness 1005 mg/L for pre-monsoon season. Colour which was another important parameter. This sample reported a value of >500 Colouring unit (CU). Phosphate, Silica (as SiO2) and Organic Nitrogen (TKN) was observed more compared to other samples of this zone.

Ground water (GW) Sample 11, 12, 13 and 20 are of bore well in the northern directions of the compost yard. Sample GW 11 and 12 are closer to sample GW 10 (Dug well). Sample GW 13 bore well is very close to a natural drainage that is originating from spent wash storage and flowing towards north. COD for sample 11 and 12 was reported 600 mg/L and 580 mg/L and BOD was at 228 mg/L and 266 mg/L respectively. Whereas COD, BOD of sample 13 – which located very close to a natural drainage was reported at 92 mg/L and 39 mg/L - much lower than sample GW 11 and GW 12. Sample GW 20 which is a bore well located further northwards of the sample GW 11,12 and 13. For this sample COD value reported was 540 mg/L and BOD 176mg/L. Colour at GW sample 20 was reported 500 CU during pre-monsoon sampling.

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Table 2: Pre-monsoon season results for GW sample locations 09 to 16 and 20,27

#	Para.	Unit	Dug well 09	Dug well 10	Bore well 11	Bore well 12	Bore well 13	Dug well 14	Dug well 15	Bore well 16	Bore well 20	Bore well 27
1	pH	-	7.84	8.10	7.59	7.43	7.49	7.95	7.42	7.56	7.85	7.57
2	EC	mmho s/cm	1.319	4.258	4.156	3.526	2.136	2.848	2.268	2.523	2.856	3.152
3	COD	mg/l	100	2280	600	580	92	440	1200	100	540	120
4	BOD (3 day)	mg/l	43	905	228	266	39	173	497	37	176	45
5	DO	mg/l	2.5	2.0	2.8	2.9	2.6	2.4	2.5	3.2	2.4	3.4
6	TDS	mg/l	586	2118	2418	2192	1190	1436	1798	1512	1798	1718
7	Total Hardness (as $CaCO_3$)	mg/l	460	1005	1700	1420	1340	1360	1240	1320	1440	1420
8	Colour	CU	BDL	>500	>500	200	25	200	200	BDL	500	BDL
9	Silica (SiO_2)	mg/l	3.68	93.17	16.15	16.15	18.94	19.88	16.36	17.81	19.25	8.82
10	Nitrogen (TKN)	mg/l	3.6	67.2	19.6	19.6	2.8	3.4	3.1	1.7	2.2	8.7

Table 3: Post-monsoon season results for GW sample locations 09 to 16 and 20,27

S.No	Para	Unit	Dug well 09	Dug well 10	Bore well 11	Bore well 12	Bore well 13	Dug well 14	Dug well 15	Bore well 16	Bore well 20	Bore well 27
1	pH	-	6.92	7.40	6.53	6.60	6.79	7.37	6.63	6.82	7.41	6.83
2	EC	mmhos/cm	1.135	15.30	3.426	3.757	3.683	2.259	2.432	4.505	1.761	1.515
3	COD	mg/l	36	5200	152	176	112	80	400	88	56	84
4	BOD (at 27 ^{0}C)	mg/l	11	1997	58	67	42	29	155	32	19	31
5	DO	mg/l	3.4	3.6	3.4	3.2	3.2	3.4	2.8	3.2	3.3	3.1
6	TDS	mg/l	896	3492	3298	2518	2796	2176	1982	3772	1582	1496
7	Total Hardness (as $CaCO_3$)	mg/l	470	4000	1620	1390	1380	1040	1080	1740	780	1850
8	Colour	CU	5	>500	50	50	50	50	200	10	10	10
9	Silica (SiO_2)	mg/l	29.36	19.67	27.35	26.29	29.27	31.28	33.30	29.84	27.54	29.75
10	N as Kjeldahl Nitrogen (TKN)	mg/l	17.1	1722	9.8	9.9	10.1	8.4	12.6	9.5	8.7	9

Samples collected for the same locations in post monsoon season, showed dilution effect for parameters such as COD, BOD for location 11 to 16 and for 20, 27. TDS and Total hardness values varied within a narrow range. For location 10, COD value observed increased compared to pre- monsoon. This may be due to surface run-off from compost yard and surrounding agriculture plots. overall, the test results of the ground water samples collected during pre-monsoon season for the abovementioned locations (i.e. sample 09 to 16 and sample 20, 27) indicates contamination in the bore well samples collected from location 11,12,13, 16,20 and 27. Dug well sample from location 10 observed affected highest as it is just few meters from the compost yard. In case of dug well samples, the sources of contamination include intrusion of surface run-off in addition to underground water currents.

Soil analysis results for this zone show that soils are rich in organic carbon (OC content >1.0%. Phosphorous and potash content also reported in high to very high zone.

Findings of Geo-physical survey for zone 2

Profile III (DS15 - DS21)

In Profile III, significant recharge is seen between DS16 and DS18 in this profile very low resistivity (~5.3 - 10 Ωm) is seen up to a depth of 31.6 m bgl. As in DS13 and DS14 relatively high resistivity zones are seen in DS19 - DS21.

Profile IV (DS22 - DS28)

In Profile IV shallow moisture zones up to 3 m are seen at VES DS22 - DS23. However, a large portion of the profile between DS25 - DS26 and DS28 show low apparent resistivity (5.88 - 10 Ωm) and extend up to 23.7 m bgl. This may be the zone from which surface leachate likely to be percolating into the lower shallow aquifer.

Profile V (DS29 - DS35)

High surface resistivity is seen at DS29 and DS34 in Profile V. However, leaky segments are seen between DS31 - DS33 and DS35 (ρa ~ 7.74 - 11.4 Ωm) up to a depth 23.7 m bgl.

In Pre Monsoon season the excavated unlined pit between DS1 and DS9 accumulates surface water/leachate and is recharged up to a depth of 31.6 m bgl. This area further recharges/connects in the subsurface (~7.5 - 31.6 m bgl) thereby spreading the contamination to the other areas (DS2 - DS5) in the eastern direction. Therefore, it is recommended that the open plot may be closed by filling/lining with black cotton soil thereby cutting recharge to the subsurface in the eastern directions.

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The region between DS1, DS8, DS10 - DS12, DS16 - DS18, DS25 - DS26, DS31 and DS33 constitute a surface area within the compost shed which shows high permeability. And this zone should also be lined by spreading of black cotton soil to prevent leachate from percolating into the shallow phreatic aquifer.

Potential leakage to the shallow aquifer/ground water is seen at DSP8, DSP9, DSP10, DSP11 and DSP12 to a depth of 15.8m. These locations are in the immediate downstream zone of the storage tanks (north direction). It is between storage area and existing compost yard.

Ground water observations on other locations of Zone 2

Ground water sample 16 and 27 is of bore well – located towards north-east of the compost site. COD, values at these locations were 100 mg/L and 120 mg/L; BOD values of 37 mg/L and 45 mg/L respectively. Colour was reported below detection limit for sample from these two locations. It indicates low or minor percolation of contaminants.

TDS value of ground water (GW) sample 10 to 16 was reported in the range of 1190 mg/L (sample 13) to 2418 mg/L (sample 11). Total hardness was reported >1,000 mg/L for GW sample 10 to 16. For ground water sample 20 and 27, TDS reported at 1798 mg/L and 1718 mg/L respectively.

GW sample 17, 18, 19 were collected dug and bore wells near to the same natural drainage where location 13 was situated. But these locations are >500 m downstream of location 13. GW location 21 to 26 were dug and bore wells located East of NE and East of the compost yard. pH of samples mentioned here observed in the range of 7.3 to 7.8. Electrical conductivity (EC) was reported >2.15 mmho/cm.

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Table 4: Pre-monsoon season results for GW sample locations GW 17 to 26

#	Para.	Unit	Dug well 17	Bore well 18	Bore well 19	Dug well 21	Dug well 22	Dug well 23	Bore well 24	Bore well 25	Dug well 26
1	pH	-	7.54	7.81	7.77	7.75	7.32	7.44	7.65	7.54	7.50
2	EC	mmhos/cm	3.128	3.162	2.367	2.626	2.156	2.452	2.805	3.258	2.068
3	COD	mg/l	100	116	140	48	92	120	100	80	88
4	BOD (3d)	mg/l	37	43	53	19	34	45	43	34	32
5	DO	mg/l	2.4	3.1	3.3	2.5	2.3	2.4	2.3	2.6	2.8
6	TDS	mg/l	1740	1828	1420	1360	1182	1582	1682	1872	1142
7	Total Hardness (as $CaCO_3$)	mg/l	1400	1780	1210	960	925	1460	1340	1520	1180
8	Colour	CU	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
9	Silica (SiO_2)	mg/l	8.20	14.18	12.17	6.89	14.08	17.39	14.12	8.28	8.86
10	N as Kjeldahl Nitrogen (TKN)	mg/l	1.4	1.5	2.0	1.7	2.5	BDL	BDL	2.5	1.7

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Table 5: Post monsoon season results for GW sample locations GW 17 to 26

#	Para.	Unit	Dug well 17	Bore well 19	Bore well 20	Dug well 21	Dug well 22	Dug well 23	Bore well 24	Bore well 25	Dug well 26
1	pH	-	6.89	6.65	7.41	6.89	6.72	6.80	6.87	6.74	6.67
2	EC	µmhos/cm	4.526	5.025	1.761	1.465	1.493	1.439	2.290	2.001	2.191
3	COD	mg/l	84	88	56	88	36	56	48	28	44
4	BOD (at 27 ^{0}C)	mg/l	31	32	19	32	11	19	16	8	15
5	DO	mg/l	3.0	3.2	3.3	2.6	2.4	2.5	3.6	2.8	3.2
6	TDS	mg/l	3350	1296	1582	2326	1956	2172	2636	2502	2436
7	Total Hardness (as CaCO3)	mg/l	1580	1760	780	1470	1230	1360	1450	1400	1270
8	Colour	CU	5	50	10	25	5	25	10	25	10
9	Silica (SiO2)	mg/l	18.33	27.35	27.54	30.71	30.61	29.94	32.72	30.99	34.06
10	N as Kjeldahl Nitrogen (TKN)	mg/l	8.7	12.2	8.7	10.6	9.5	14.3	11.5	7.1	8.1

Ground water samples 17 to 26, located at further distance towards North and north east of the compost yard showed contamination. This was indicated by COD, BOD values reported for those samples given here in table 4 and 5.

3.3 Ground water Samples from Zone 3

Ground water samples in the downstream at a distance of ≥1000 m away from the compost yard/storage lagoon site. It includes GW samples GW 28 to GW 36.

Table 6: Pre-monsoon results for ground water samples from Zone 3

#	Para.	Unit	Dug well 28	Dug well 29	Dug well 30	Dug well 31	Dug well 32	Dug well 33	Dug well 34	Dug well 35	Dug well 36
1	pH	-	7.42	7.41	7.26	7.62	8.66	8.10	7.77	7.34	7.56
2	EC	µmhos/cm	3.205	3.156	2.049	1.886	4.527	2.092	1.712	2.309	2.993
3	COD	mg/l	76	124	64	76	184	32	36	44	100

4	BOD (3d)	mg/l	27	47	23	32	70	13	15	17	43
5	DO	mg/l	3.6	2.7	2.4	2.5	2.7	2.1	2.6	2.1	2.5
6	TDS	mg/l	1902	1806	1124	1118	2686	1192	1008	1310	1702
7	Total Hardness (as CaCO3)	mg/l	1700	1640	780	700	1460	900	700	1100	1560
8	Colour	CU	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
9	Silica (SiO_2)	mg/l	11.76	6.43	8.05	6.27	11.01	8.01	12.04	8.69	6.45
10	N as Kjeldahl Nitrogen (TKN)	mg/l	2.8	2.7	1.7	2.8	1.7	2.5	2.0	3.1	2.2

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Table 7: Post-monsoon results for ground water samples from Zone 3

S.No	Para	Unit	Dug well 28	Dug well 29	Dug well 30	Dug well 31	Dug well 32	Dug well 33	Dug well 34	Dug well 35	Dug well 36
1	pH	-	6.93	6.90	7.13	7.74	6.91	6.68	6.76	7.06	6.76
2	EC	mmhos / cm	1.958	2.402	2.170	0.676	3.907	1.862	2.049	2.183	3.136
3	COD	mg/l	68	32	32	24	92	36	40	28	56
4	BOD (3d)	mg/l	24	10	10	7	34	11	13	8	19
5	DO	mg/l	3.0	2.6	2.5	3.1	3.2	2.9	2.8	2.7	2.8
6	TDS	mg/l	3820	2418	1928	802	3162	1468	1778	1894	2964
7	Total Hardness (as CaCO3)	mg/l	1600	1060	900	470	1540	650	1010	960	1470
8	Colour	CU	5	1	1	10	5	5	10	5	1
9	Silica (SiO_2)	mg/l	32.14	37.90	29.94	27.25	34.83	34.45	32.91	33.97	33.78
10	N as Kjeldahl Nitrogen (TKN)	mg/l	7.7	18.5	11.5	10.8	30	7.8	32.2	13.4	5.9

In the zone 3, all samples were of dug well samples. Test results for pre as well as post monsoon season were more or less in the same range as observed in other dug well samples of upstream (south) and cross steam (east and west of the compost site) locations. It indicates that, the contamination is not reached up to those locations.

One surface water was collected in one of the natural drainages (nalla) located in the north east of the site. This natural drain receives water, soil, sediments from spent wash storage area, compost yard as well as surrounding field of the area. Results of important parameters are furnished in the following table 8.

Table 8: Test results of surface water samples for Pre and post monsoon

#	Parameters	Unit	Pre-monsoon	Post monsoon
1	pH	-	7.37	6.99
2	EC	mmhos/cm	1.728	2.473
3	COD	mg/l	160	2680
4	BOD (at 27 ^{0}C)	mg/l	61	997
5	DO	mg/l	2.6	3.4
6	TDS	mg/l	1082	2914
7	Total Hardness (as CaCO3)	mg/l	340	1290
8	Colour	CU	BDL	250
9	Silica (SiO2)	mg/l	9.89	49.04
10	N as Kjeldahl Nitrogen (TKN)	mg/l	4.8	56.8

Surface water sample collected in post monsoon season showed higher electrical conductivity. COD, BOD values reported higher than the pre-monsoon sample. It indicates contamination of water through activities carried out in that season including industrial and agricultural activities. This is linked with colour which was measure at 250 CU for the said sample.

4.0 FINAL OBSERVATIONS FOR THE TEST RESULTS OF WATER AND SOIL SAMPLES

Ground water analysis reports were reviewed and three zones were considered based on the sampling locations. In Zone 1, location number GW 01 to 08 were considered. These locations observed in the upstream or cross stream zones. Hence, assumed that these locations would give general characteristics of ground water in the surrounding area. Zone 2: here, **GW 10 to GW 27 locations are observed in the downstream of the compost yard - more or less within 1000 m distance.** Therefore, assumed with high impact zone. In Zone 3, GW 28 to GW 36 were considered. These locations are in downstream of the compost yard but at more than 1000 m distance. This zonation may be helpful to understand the findings of the study.

In case of studied ground water, samples from zone 2 for parameters such as colour, COD, BOD, TDS indicates moderate to higher changes in physical and chemical appearance for samples GW 10, GW 11, GW 12, GW 13, GW, 14, GW 15 and GW 20, GW 27. Colour, COD, BOD values of samples from Dug wells from zone 2 indicates intrusion of spent wash/spent wash leachate into those waterbodies.geo-physical survey carried out in this study provided vital inputs to understand the causes of bore well water contamination of this zone. This study also helpful in formulating the remedial action for the same.

1. High resistivity along profiles VES 02, VES 03, VES 04, VES 05 and VES 07 indicate there is no leakage or contamination towards the south and east of the compost area. Similarly, high resistivity is seen at VES13, VES14, VES15, VES28 suggesting no contamination towards the west of the compost area.

2. Potential leakage to the shallow aquifer/ground water is seen at VES 08, VES 09, VES10, VES 11 and VES 12 to a depth of 15.8m similarly VES 06 to VES 20 and VES 31 to VES 34 and VES 32 shows very low resistivity values up to a depth of 12.6 bgl.

Figure 6: Image showing site recommended for leachate collection in yellow colored polygon

Figure 07 and 08: Image showing Locations DS 03, DS 08 - DS27 and **DS 30 to 32 for remedial action**

5.0 RECOMMENDATIONS/REMEDIAL ACTION

1. Location of leachate collection pit to be shifted or an additional pit to be constructed at a location of the entire compost yard. The location is marked in the figure 06.
2. It is also advised to plant few Eucalyptus trees in the open plot towards north of the compost yard. Plantation should be limited.
3. Fracture seal cementation using fast settling cement/black cotton soil under high pressure grouting is recommended between VES DS 03, DS 08 - DS27 up to 40m and DS32 - DS30 up to depth of 25m to restrict the leakage to deeper aquifer and spreading of the contamination.
4. Environment management cell must be strengthened in order to achieve compliances.
5. The Factory Management should monitor the disposal of spent wash, vigilantly. It should make alternative arrangements in case of failure of machinery, operating equipment, etc. The Management should develop a SOP (standard operating procedure) to deal with such situation and restore normalcy of operations at earliest.
6. The factory management must follow rules, regulation, guidelines and norms prescribed time to time by regulatory authorities. It should monitor all environment related compliances at least before start of the season, mid of the season and end of the season.

Report

संशोधनेन संवृद्धिः

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Chapter I
INTRODUCTION

1.0 INTRODUCTION

Loknete Marutrao Ghule-Patil Sahakari Sakhar Karkhana Limited is a cooperative unit. It is located in village Bhenda (Bk), Taluka Newasa of Ahilya Nagar (previously known as Ahmednagar). This sugar factory was established in the year1974-75. Initial crushing capacity of the unit was 1250 TCD. The sugar factory expanded gradually and increased its cane crushing capacities. The same is provided in table 1.

Table 1.1: Sugar factory cane crushing capacity enhancement stages

Year	Sugar Unit Capacity enhancement
1981-82	1250 TCD to 2000 TCD
1990-91	2000 TCD to 3000 TCD
2000-01	3000 TCD to 5000 TCD
2008-09	5000 TCD to 6000 TCD
2017-18	6000 TCD to 7000 TCD

Allied unit	Establishment Year	Capacity	Expansion	Capacity (at present)
Cogeneration unit i.e. bagasse based power plant	2007-08	12 MW	2017-18	12 MW + 19.5 MW = 31.5 MW
Molasses based Distillery	1985-86	45 Kilo litres per day (KLPD)		55 KLPD

1.1 SITE LOCATION MAP

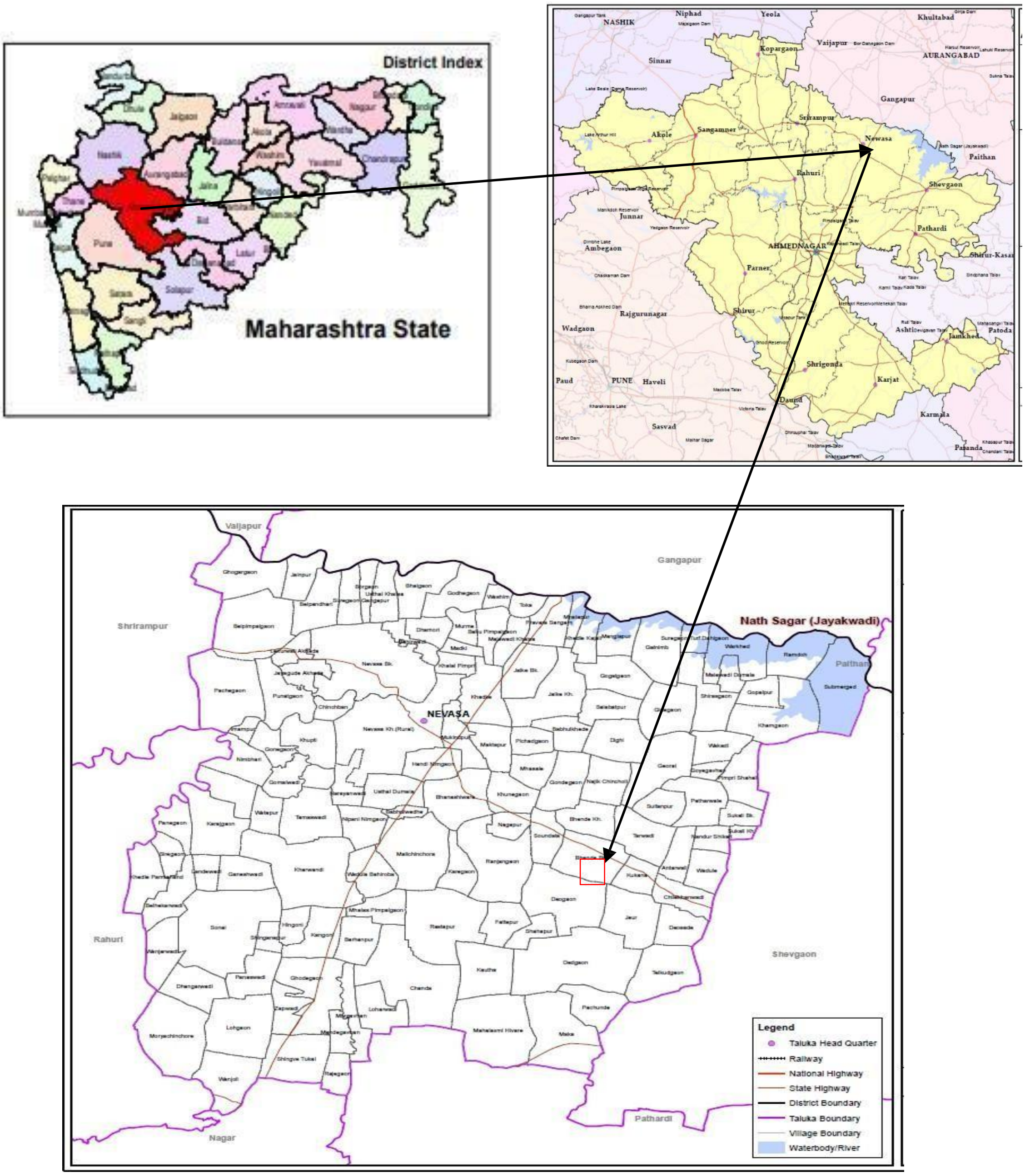


Figure 1.1: Site Location Map showing the study area in the red box in Newasa taluka map

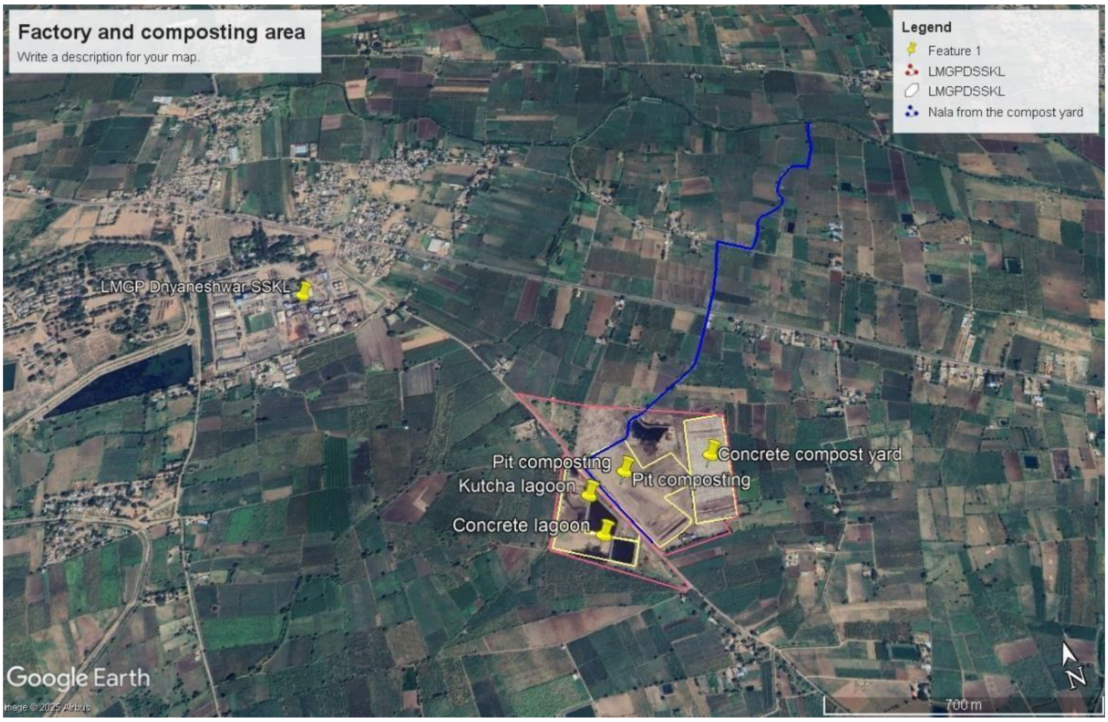


Figure 1.2 a and B: Satellite image of the LMGP Dnyaneshwar SSKL and b) Compost site of the factory and surrounding area.

1.2 STUDY AREA: PHYSIOGRAPHY

Physio-graphically the area forms part of Deccan Plateau. Part of Sahayadri hill ranges fall in the district. Western Ghat section in Akole taluka is hilly which extends to relatively flat areas in Shevgaon and Jamkhed talukas in the east. From the main Sahayadri range three spurs namely Kalsubai, Baleshwar and Harishchandgad stretch eastwards. Physiographically the district can be broadly divided in four major characteristic landforms viz., hill and ghat section (7.6% area); foothill zone (19.4% area); plateau (3.71% area) and plains (occupy 69.30% area). Newasa taluka is situated in the plains. It is located mainly in the Godavari and Pravara river basin.

1.3 GEO-MORPHOLOGY

The analysis of geomorphological data reveals that physio-graphically the area forms part of Deccan Plateau.

1.4 GEOLOGY

Major part of the district is underlain by the basaltic lava flows, which were formed by the intermittent fissure type eruptions during of upper Cretaceous to lower Eocene age. The Deccan Trap has succession of 19 major flows in the elevation range of 420 to 730 m above mean sea level (amsl). These flows are characterised by the prominent units of vesicular and massive Basalt. The Alluvium of Recent age also occurs as narrow stretch along the course of major rivers deposited over the Traps. Deccan Trap Basalt Deccan Traps occupy about 95% area of the district and it occurs as basaltic lava flows which are normally horizontally disposed over a wide stretch and give rise to table-land type of topography also known as plateau. These flows occur in layered sequence ranging in thickness from 15 to 50 m. Flows are represented by massive portion at bottom and vesicular portion at top and are separated from each other by marker bed known as bole bed. The thickness of weathering varies widely in the district from 5 to 25 m bgl (below ground level). The weathered and fractured trap occurring in topographic lows form the main aquifer in the district. Deccan Trap Basalt of late Cretaceous to Eocene age is the major rock formation in the district covering almost entire district. Recent Alluvium occurs as small patches, mostly along the river.

1.5 MAJOR AQUIFER SYSTEMS

There are two major aquifer systems in the district area namely Alluvium and Basalt. The map showing major aquifer systems of Ahmednagar district is shown in Figure 3.

- Alluvium

Alluvium occurs in small areas along banks and flood plains of major rivers like Godavari, Pravara, Mula rivers and their tributaries. Coarse grained detrital material like sand and gravel usually occurring as lenses forms good aquifer. The ground water occurs under water table conditions in flood plain deposits near the riverbanks. Confined conditions are also found wherever the thick clay deposits confine the ground water below it. Ground water exploration in Godavari-Pravara Alluvium reveals that the thickness of alluvium is less than 40m and the aquifer thickness are ranges between 5-8
m. The yield of the dug wells ranges from 50 to 100 m3/day.

- **Basalt**

The weathered and fractured part of basalt occurring in topographic lows form the main aquifer in the district. Ground water occurs under phreatic, semiconfined, and confined conditions. Generally, the shallower zones down to the depth of 35 m bgl form phreatic aquifer. The water bearing zones occurring between the depths of 9 and 35 m are weathered interflow or shear zones and yield water under semi- confined conditions. Deeper semi-confined to confined aquifers occur below the depth of 35 m as the bore wells drilled have shown presence of fractured zones at deeper depths at places. The vesicular portion of different lava flows varies in thickness from 5 to 24 m and forms the potential aquifer zones. However, the nature and density of vesicles, their distribution, inter-connection, depth of weathering and topography of the area are the decisive factors for occurrence and movement of ground water in vesicular units. The massive portion of basaltic flows are devoid of water, but ground water occurs in weathered, fractured, jointed or contain weaker zones in it. The yield of the dug wells ranges from 10 to 100m3/day, whereas bore wells yield is restricted upto 2.5 lps when favourably located.

Source: https://www.cgwb.gov.in/old_website/AQM/NAQUIM_REPORT/Maharshtra/1_Ahmednagar.pdf

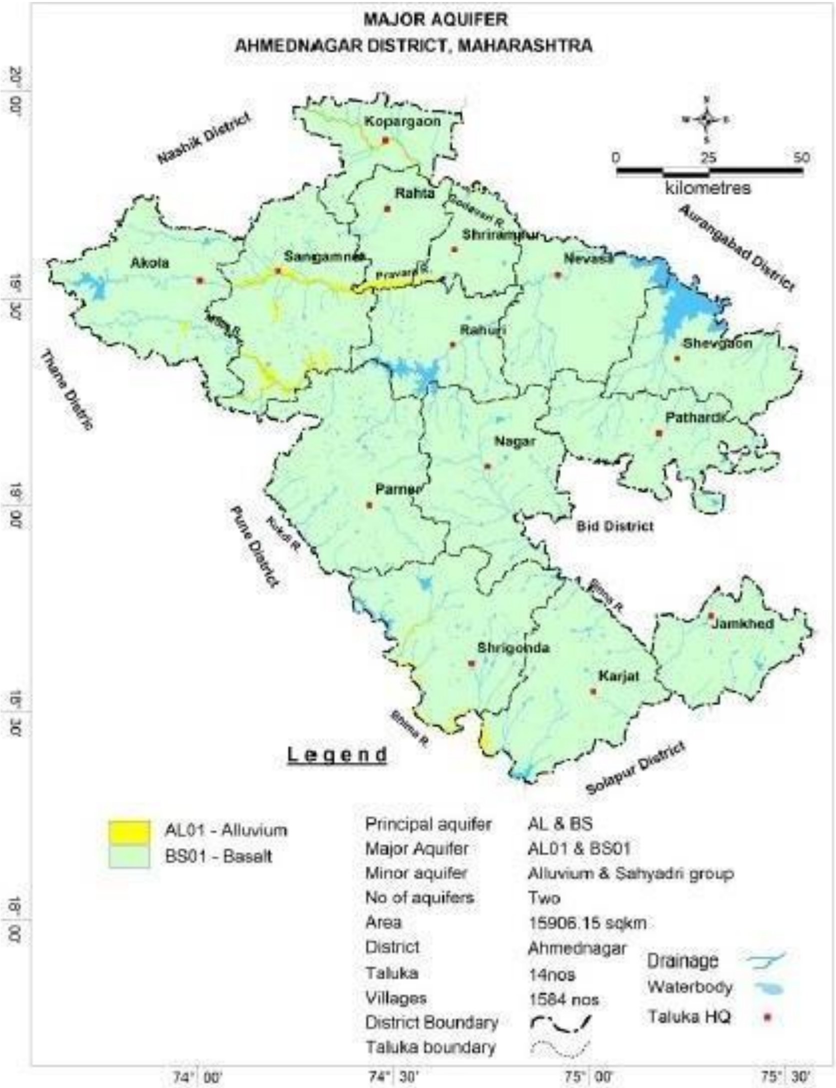


Figure 1.3: Major aquifers of Ahilya Nagar (Ahmednagar) district

1.6 SOIL

It has been observed that the major part of the area is occupied by clayey soil followed by clayey loam observed along the northern fringe of the area. The small portion of the area in eastern and southern part is occupied by sandy loam to sandy clay type of soil whereas sandy loam also occurs in very small patch in western boundary of the area.

Hydrology The State Govt. has constructed a number of minor irrigation structures. As per the Irrigation Department, Govt. of Maharashtra, 1,08,066 ha and 1,14,915 ha land was irrigated in Newasa talukas due to these minor irrigation structures respectively.

1.7 DRAINAGE

The district lies partly in Godavari basin and partly in Bhima basin. The northern part of the district is drained by Godavari River and its tributaries viz., Pravara, Mula, Adula and Mahalungi whereas the southern part is drained by Bhima River and its tributaries viz., Ghod and Sina. All the rivers have sub-parallel to sub-dendritic drainage pattern and the drainage density is quite high. Newasa taluka is drained by Godavari River and its tributaries viz., Pravara, Mula, Adula and Mahalungi.

The overall ground water movement in Newasa taluka is south to north-northeast i.e. towards Godavari river. However, except in southeast and east part of the Newasa taluka the ground water flow direction is observed towards east or southeast. It has been observed that the ground water flow direction follows the drainage and topography of the area. This indicates the topographic control for the ground water movement.

Table 1.2: Ground Water Characteristics of Nagar and Newasa Talukas (Year 2017)

Constituents	Shallow aquifer		Deeper aquifer	
	Min	Max	Min	Max
pH	7.9	8.2	7.3	8.0
EC	380	2146	557	3300
TDS	NA	NA	335	1235
TH	245	775	225	1235
Calcium	40	162	32	220
Magnesium	32	90	22	227
Potassium	0.1	4.8	0.03	0.3
Sodium	5	17	4	32
Bi carbonate	85	195	67	439
Carbonate	0	0	0	0
Chloride	67	393	57	503
Sulphate	4	149	3	793
Nitrate	28	50	46	80
Fluoride	0.1	0.27	0	1.10

Source:https://www.cgwb.gov.in/old_website/AQM/NAQUIM_REPORT/Maharshtra/Nagar%20and%20Newasa%20Taluka,%20Ahmednagar%20District,(Part-I).pdf

1.8 Climate and Rainfall

The climate of this district is characterized as hot tropical with extreme summer, mild winter, and general dryness throughout the year except during the south-west monsoon season, i.e., June to September. The Normal rainfall of the district is 574.6 mm spread over 47 to 50 rainy days in normal condition

1.8.1 Rainfall

From mid of June rain starts & ends on the end of October, winter season starts from November & ends on February & summer season starts on March & ends on mid of June. Air remains humid in rainy season, in winter dry & cold & in summer remains dry & hot. Average rainfall for the five years (2018-2022) for Newasa taluka is 763 mm.

Table 1.3: Rainfall pattern

Year	Jan	Feb	March	April	May	Jun	July	Aug	Sept	Oct	Nov	Dec
	Rain Fall in (mm)											
2018	0.0	0.0	0.0	0.0	2.2	153.5	58.7	83.5	40.5	5.6	20.3	0.0
2019	0.0	0.0	0.0	0.0	0.0	112.7	137.1	94.0	181.4	244.6	27.0	0.1
2020	0.0	0.0	12.2	1.1	8.3	264.5	223.0	104.9	262.0	149.3	8.0	0.0
2021	22.8	1.0	4.0	0.0	7.5	120.8	125.7	122.1	216.2	122.3	48.6	41.6
2022	0.0	0.0	1.2	0.1	1.9	108.2	114.3	102.6	269.1	194.6	0.0	0.0

Table 1.4: Data for Irrigation Infrastructure of Newasa (Year-2017):

Minor Irrigation Projects	KT Weir	Percolation Tank	Storage Tank	Lift Irrigation Schemes	Total	Total irrigation capacity/ Area under crop (Ha)
4	6	224	78	0	312	1,14,915

Source:https://www.cgwb.gov.in/old_website/AQM/NAQUIM_REPORT/Maharshtra/Nagar%20and%20Newasa%20Taluka,%20Ahmednagar%20District,(Part-I).pdf

Chapter II

THE STUDY

2.0 Introduction to the problem (Background)

As mentioned above, the distillery unit was established in the year 1985-86. Spent wash is a wastewater having high pollution strength gets generated during the manufacturing processes of molasses based distillery. In those periods, this spent wash was stored in the unlined *kutcha* lagoons/pits. Those pits/lagoons were unlined and allowing stored wastewater to percolate.

In 2003, the Central Pollution Control Board released a charter known as Corporate Responsibility for Environment Protection (CREP). In this charter it was advised to all molasses based distilleries to stop the practices of storage of spent wash in kutcha (unlined or pervious) lagoons. It was also advised to prepare impervious compost yard to replace existing pit composting practices. The factory management adopted CREP guidelines and advise of CPCB, and constructed HDPE lined, impervious lagoons as well as compost yard. The Management completely stopped the storage of spent wash in unlined, *Kutcha* lagoons. The management has stopped the pit composting practices. The compost yard is also lined with HDPE sheet and its top finish is of RCC.

2.1 The problem

It was observed that the spent wash which was stored in the *kutcha* lagoon may have percolated in the ground and entered into the aquifer/s. Pit composting method used earlier for making the compost from spent wash and press mud cake might have also contributed in the ground water contamination. As a result, the dug and bore well water in the downstream of the spent wash storage lagoons and compost yard area observed contaminated. Appearance (colour) of water from some of these water bodies is changed. This problem is faced by the people residing or having dug well/bore wells in the immediate downstream of the compost yard/spent wash storage lagoons.

2.2 Methodology of study

Initially team of experts from Vasantdada Sugar Institute (VSI) visited the site to understand the problem and to frame the scope of the study. This team was comprised of Prof. (Dr.) Nitin Karmalkar Retired Vice Chancellor of Savitribai Phule Pune University (SPPU), Dr. Raymond Duraiswamy, Head of Department of Environmental Sciences of SPPU, Dr. Amol Deshmane, Scientist, VSI and Dr. Vivek Patil, Scientific Officer, VSI. This team took overview of the issue, discussed with locals and actually visited some of the ground water sources observed contaminated.

Sampling plan for water was mainly based on the visual observations during the pre-study as well as same observations by the locals. Often, the ground water characteristics changes with season and particularly during pre-monsoon and post- monsoon. Therefore, it was decided to collect ground water as well as soil samples during these two seasons. In addition to ground water sampling. Geo-investigation study for pre and post-monsoon was also planned.

According to the plan in pre-monsoon study was carried out in the month of May 2024. initially the geology expert team visited the site and performed geo- investigation studies. Subsequently, the team of Department of Environment Sciences of VSI, visited the site during May 28 & 29, 2024. During the said visit, 36 ground water samples, one sample of surface water (from nala) and 17 soil samples were collected from the pre- determined locations of study area.

Sampling code, sample and its geograpical coordinates are provided in the following table.

Table 2.1: Sampling code, sample and its geograpical coordinates
Ground Water = GW; Surface water (SW) and Soil = S

Sample Code	Sample	Latitude / Longitude
GROUND WATER		
GW 1	Dug well	19^{0}26’4.73” N; 75^{0}2’44.64” E
GW 2	Dug well	19^{0}26’14.09” N; 75^{0}2’49.81” E
GW 3	Dug well	19^{0}26’11.64” N; 75^{0}2’27.26” E
GW 4	Dug well	19^{0}26’18.47” N; 75^{0}2’27.78” E
GW 5	Dug well	19^{0}26’46.71” N; 75^{0}2’31.34” E
GW 6	Dug well	19^{0}26’48.12” N; 75^{0}2’36.11” E
GW 7	Bore well	19^{0}26’3.13” N; 75^{0}3’6.30” E
GW 8	Dug well	19^{0}26’19.21” N; 75° 2'57.58"E

Sample Code	Sample	Latitude / Longitude
GW 9	Dug well	19°26'52.32"N; 75° 2'17.30"E
GW 10	Dug well	19^{0}26’34.44” N; 75^{0}2’57.81” E
GW 11	Bore well	19^{0}26’36.15” N; 75^{0}2’56.95” E
GW 12	Bore well	19^{0}26’37.67” N; 75^{0}2’55.17” E
GW 13	Bore well	19^{0}26’38.87” N; 75^{0}2’56.57” E
GW 14	Dug well	19^{0}26’37.76” N; 75^{0}2’53.57” E
GW 15	Dug well	19^{0}26’31.27” N; 75^{0}3’9.81” E
GW 16	Bore well	19^{0}26’39.69” N; 75^{0}3’7.62” E
GW17	Dug well	19^{0}26’51.02” N; 75^{0}3’9.03” E
GW 18	Bore well	19^{0}26’53.79” N; 75^{0}3’12.26” E
GW 19	Bore well	19^{0}26’56.57” N; 75^{0}3’15.92” E
GW 20	Bore well	19^{0}26’48.56” N; 75^{0}2’52.05” E
GW 21	Dug well	19^{0}26’24.19” N; 75^{0}3’5.36” E
GW 22	Dug well	19^{0}26’26.52” N; 75^{0}3’7.39” E
GW 23	Dug well	19^{0}26’32.10” N; 75^{0}3’15.60” E
GW 24	Bore well	19^{0}26’32.34” N; 75^{0}3’22.55” E
GW 25	Bore well	19^{0}26’29.39” N; 75^{0}3’27.96” E
GW 26	Dug well	19^{0}26’30.67” N; 75^{0}3’31.02” E
GW 27	Bore well	19^{0}26’37.11” N; 75^{0}3’12.26” E
GW 28	Dug well	19^{0}26’54.64” N; 75^{0}3’29.11” E
GW 29	Dug well	19^{0}26’59.95” N; 75^{0}3’28.73” E
GW 30	Dug well	19^{0}27’6.46” N; 75^{0}3’33.75” E
GW 31	Dug well	19^{0}27’10.79” N; 75^{0}3’34.70” E
GW 32	Dug well	19^{0}27’3.09” N; 75^{0}3’47.01” E
GW 33	Dug well	19^{0}27’13.22” N; 75^{0}2’56.01” E
GW 34	Dug well	19^{0}27’9.95” N; 75^{0}3’13.80” E
GW 35	Dug well	19^{0}27’8.25” N; 75^{0}3’16.93” E
GW 36	Dug well	19^{0}27’2.05” N; 75^{0}3’9.33” E

Sample Code	Sample	Latitude / Longitude
SURFACE WATER		
SW 1	Surface water (Nala)	$19^0$26'15.81" N: $75^0$4'29.38" E
SOIL		
S 01	Soil	19°26'36.15"N; 75° 2'56.50"E
S 02	Soil	19°26'36.87"N; 75° 2'54.78"E
S 03	Soil	19°26'38.40"N; 75° 2'53.50"E
S 04	Soil	19°26'35.85"N; 75° 2'54.54"E
S 05	Soil	19°26'36.40"N; 75° 2'52.82"E
S 06	Soil	19°26'35.01"N; 75° 2'51.69"E
S 07	Soil	19°26'34.24"N; 75° 2'52.12"E
S 08	Soil	19°26'20.57"N; 75° 2'49.97"E
S 09	Soil	19°27'15.72"N; 75° 3'12.14"E
S 10	Soil	19°26'30.74"N; 75° 3'1.00"E
S 11	Soil	19°26'34.63"N; 75° 3'0.68"E
S 12	Soil	19°26'29.49"N; 75° 2'59.12"E
S 13	Soil	19°26'36.65"N; 75° 3'9.66"E
S 14	Soil	19°26'40.89"N; 75° 3'14.48"E
S 15	Soil	19°26'44.05"N; 75° 2'59.96"E
S 16	Soil	19°26'47.98"N; 75° 2'53.42"E
S 17	Soil	19°26'50.18"N; 75° 2'56.36"E

From the collected ground water samples about 17 samples (dug and bore well water) were collected in the immediate downstream areas of the existing compost yard. The sampling points were located within 1000m from the boundary of the compost yard. Approx. 10 ground water samples were collected from locations which are at >1000m away from the boundary of the compost yard. In addition, 08- 09 samples were collected from the upstream areas or from the cross stream zones (considering surface runoff) of the compost yard. This was mainly to understand the baseline characteristics of the ground water in the study area.

The second cycle of water and soil sample collection for post monsoon/winter season was carried out in February 2025. Geo-investigation study was also carried out during the same time for its second cycle. The sampling of post monsoon was carried out partially based on the findings of first cycle of ground water analysis and geo- investigation. Particularly few locations from the south of the spent wash storage tank, where contamination was not reported in the first cycle- not considered significant for the second cycle. Hence, samples were not collected from those locations (GW 01, GW 03, GW 04,GW 05,GW 07 and GW 09). Other sampling locations were continued in the second cycle. Analysis of all collected samples of first (pre- monsoon) second cycle (post monsoon) are provided in Chapter III of this report. Geo-physical studies and its findings are provided in chapter IV of this report. Its reports and survey findings were used further to assess the contamination (Chapter V).

Chapter III

RESULTS OF WATER AND SOIL MONITORING

The GW, SW and soil samples collected during both the cycles were analyzed in the laboratory of Department of Environmental Sciences of Vasantdada Sugar Institute (VSI). After analysis of GW samples of first cycle it was observed that those samples can be placed in different categories depending upon the nature and extent of contamination. Such categorization/zonation was found helpful to explain the findings easier. It was also helpful in understanding the findings of the study. This zonation and simple logic behind it is discussed here.

3.1 Zone 1: Ground water (GW) monitoring Locations GW 01 to GW 08

These locations are either in upstream (considering runoff water from compost yard/storage tank) of the compost yard/lagoons or not directly influenced by the spent wash storage lagoons and composting activity. Those sampling locations were from the agricultural fields, mainly in S, SW, SE and NW of the spent wash storage and composting site. Visual and physical observation of the ground water and surrounding crop were indicating relatively no influence of spent wash storage and composting activities.

Figure 3.1: Satellite image showing the ground water monitoring locations of Zone 1 i.e. GW 01 to GW 08

Table 3.1: Test results of ground water samples collected from Zone 1during Pre-monsoon season

#	Para.	Unit	GW 01	GW 02	GW 03	GW 04	GW 05	GW 06	GW 07	GW 08
1	pH	-	7.72	7.53	7.95	8.47	8.03	8.44	7.51	8.62
2	EC	mmhos/cm	2.022	2.536	1.314	1.799	1.337	1.799	1.930	2.563
3	COD	mg/l	32	76	20	56	12	48	28	78
4	BOD (at 27 ^{0}C)	mg/l	13	32	08	16	BDL	19	08	24
5	DO	mg/l	3.1	2.9	3.1	3.0	3.0	2.9	2.4	2.2
6	TS	mg/l	1336	1582	834	1156	740	956	1182	1668
7	TDS	mg/l	1224	1408	680	932	602	826	1096	1442
8	TSS	mg/l	136	170	132	184	124	100	44	102
9	Total Hardness (as CaCO3)	mg/l	740	790	520	780	620	630	680	710
10	Calcium (as Ca)	mg/l	152.30	184.36	104.20	144.28	224.44	128.25	160.32	176.35
11	Magnesium (as Mg)	mg/l	87.48	80.19	77.76	102.06	104.58	75.33	68.04	65.61
12	Chloride (as Cl^-)	mg/l	289.91	354.89	164.95	229.93	159.95	279.91	209.93	339.89
13	Sulphate (SO_4^{-2})	mg/l	156.19	180	113.33	157.14	98.10	120.95	152.38	169.52
14	Phosphate (as $PO4^{-2}$)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

15	Total Alkalinity (as $CaCO_3$)	mg/l	240	270	255	320	505	360	237.5	230
16	Sodium (as Na)	mg/l	94.98	65.25	51.65	59.23	70.15	102.23	96.45	92.78
17	Potassium (as K)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
18	Residual Chlorine	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
19	Nitrate (as $NO3^{-2}$)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
20	Fluoride	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21	Copper (as Cu)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Cadmium (Cd)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Nickel (as Ni)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
24	Iron (as Fe)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
25	Zinc (as Zn)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
26	Manganese (Mn)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
27	Lead (Pb)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

28	Chromium (as Cr)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Colour	CU	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Silica (SiO2)	mg/l	5.17	15.52	17.28	11.88	10.27	22.77	18.01	18.84
31	N as Kjeldahl Nitrogen (TKN)	mg/l	3.4	3.4	1.1	2.2	1.7	9.0	3.4	7.3

In zone 1, most of the ground water samples were from dug well (except GW 07). Therefore, there was possibility of contamination of water from surface and air borne dust/leaf liter. The test results for colour showed below detection limit (BDL) value – which means no colour or water is more or less clear. This was one of the important test to get an idea of contamination of ground water due to storage of distillery spent wash or from composting activity. Based on the experience of distillery industries, usually where spent wash get percolate and enters into a ground water – the colour of water changes and shows shades of yallow-brown depending upon the percolation rate. Colour test was a primary parameter to check the ground water contamination due to spent wash storage and composting activity.

Further, preliminary observations of geo-physical survey of the first cycle study indicated that the ground water locations in the east and south of the spent wash storage areas are relatively unaffected considering geological strata. Hence, for the second cycle of ground water study, samples from location GW02, GW06 and GW08 were considered for comparison and further investigation cycle.

Table 3.2: Test results of ground water samples from Zone I for the second cycle i.e. Post- Monsoon - for GW02, GW 06 and GW08

S.No	Parameters	Unit	Dug well 02	Dug well 06	Dug well 08
1	pH	-	6.71	6.50	6.73
2	EC	mmho/cm	1.677	1.299	3.734
3	COD	mg/l	32	44	48
4	BOD (3d)	mg/l	10	15	16
5	DO	mg/l	3.5	3.2	3.3
6	TS	mg/l	1658	864	1794
7	TDS	mg/l	1464	826	1464
8	TSS	mg/l	22	20	18
9	Total Hardness (as CaCO3)	mg/l	860	460	1450
10	Calcium (as Ca)	mg/l	164.32	85.05	320.64
11	Magnesium (as Mg)	mg/l	109.35	44.08	157.95

12	Chloride (as Cl^-)	mg/l	309.90	149.95	789.76
13	Sulphate (as SO_4)	mg/l	413.86	168.32	524.75
14	Phosphate (as $PO4^{-2}$)	mg/l	BDL	BDL	BDL
15	Total Alkalinity (as CaCO3)	mg/l	275	300	175
16	Sodium (as Na)	mg/l	75.47	82.35	88.38
17	Potassium (as K)	mg/l	BDL	BDL	BDL
18	Residual Chlorine	mg/l	BDL	BDL	BDL
19	Nitrate (as $NO3^{-2}$)	mg/l	BDL	BDL	BDL
20	Fluoride	mg/l	BDL	BDL	BDL
21	Copper (as Cu)	mg/l	0.266	0.072	0.045
22	Cadmium (Cd)	mg/l	BDL	BDL	BDL
23	Nickel (as Ni)	mg/l	BDL	BDL	BDL
24	Iron (as Fe)	mg/l	0.600	0.584	BDL
25	Zinc (as Zn)	mg/l	0.099	0.146	0.106
26	Manganese (Mn)	mg/l	0.111	0.057	0.613
27	Lead (Pb)	mg/l	0.018	0.096	0.062
28	Chromium (as Cr)	mg/l	0.004	0.004	0.003
29	Colour	CU	5	5	50
30	Silica (SiO2)	mg/l	32.24	30.32	19.48
31	N as Kjeldahl Nitrogen (TKN)	mg/l	8.7	14.8	18.5

During pre-monsoon season, in this zone pH of collected water sample was observed from 7.7 to 8.6. Total Dissolved solids (TDS) reported in the range of 602 mg/L to 1442 mg/L. Hardness was in the range of 520 mg/L to 790 mg/L. Hardness and TDS is ultimately depends on calcium, magnesium as well as other cations and anions in the dissolved form. Therefore, values of Ca, Mg, Na, K, Chlorides and sulphate were observed matching to the trend of TDS and hardness.

In post monsoon season, samples of GW02, GW06 and GW08 showed pH in slightly acidic zone between 6.5 to 6.7. TDS reported in the range of 825 mg/L to 3406 mg/L

Hardness was reported in the range of 460 mg/L to 1450 mg/L Increase in the TDS and hardness of these samples, compared to pre-monsoon may be due to intense agricultural activity in the surrounding areas (ground water abstraction for irrigation and domestic purposes) and run-off during irrigation.

In the second cycle, GW 08 showed colour of 50 CU. This was mainly from the agricultural runoff during irrigation. Similar but relatively mild colour of 5 CU reported for location GW02 and GW 06. Apart from this, there were no significant changes reported in the chamical parameters studied during first (pre-monsson) cycle and the second. Test results of these samples were considered as the general characaterisitcs of ground water from the study area.

Figure 3.2: Representative sample of Zone 1- soil monitoring location 08 Table 3.3: Test results of Soil analysis for a representative sample from Zone 1

S. No	Parameters	Unit	Location Soil 08	
			Pre-monsoon	Post Monsoon
1	pH	--	8.59	8.29
2	Electrical conductivity	mmhos/cm	0.94	0.61
3	Organic Carbon	%	0.95	0.59

S. No	Parameters	Unit	Location Soil 08	
4	Organic matter	%	1.65	1.03
5	Water Content (Moisture)	%	7.05	5.27
6	Available Nitrogen	kg ha^{-1}	172	241.47
7	Available Phosphorus	kg ha^{-1}	117.6	182.0
8	Available Potassium	kg ha^{-1}	382.22	1,246.3
9	Copper as Cu	mg/kg	47.97	162.5
10	Manganese as Mn	mg/kg	21.83	691.8
11	Zinc as Zn	mg/kg	BDL	BDL
12	Iron as Fe	mg/kg	21.83	55.01

Soil analysis showed that soil organic carbon is high to very high range and presence of metals such as copper, manganese and iron. Soil samples showed pH in alkaline range. Available phosphorous and potassium was in the very high range during post monsoon season. This may be due to application of synthetic fertilizers in the fields.

Zone 2: GW 09 to GW 27

Ground water monitoring locations: Immediate downstream of spent wash storage and composting site at lower elevation – considered as a downstream of surface runoff

GW 09 to GW 27: In this zone, Location GW10 to GW 16, GW 20 and GW 27 were observed in the immediate downstream areas (considering surface runoff) of compost yard/storage lagoons. Sample of GW 09 collected because it was located very closer to the factory. Thus, it may help in understanding the characteristics of ground water quality in comparison with regular factory operations.

GW 17 to GW 26 were in also in the downstream (of surface runoff) but at further distance from the compost yard/storage tank/lagoons. Few sampling locations in this zone were observed in close proximity of a natural drainage that comes from the *kutcha* lagoon area (spent wash storage lagoon used previously).

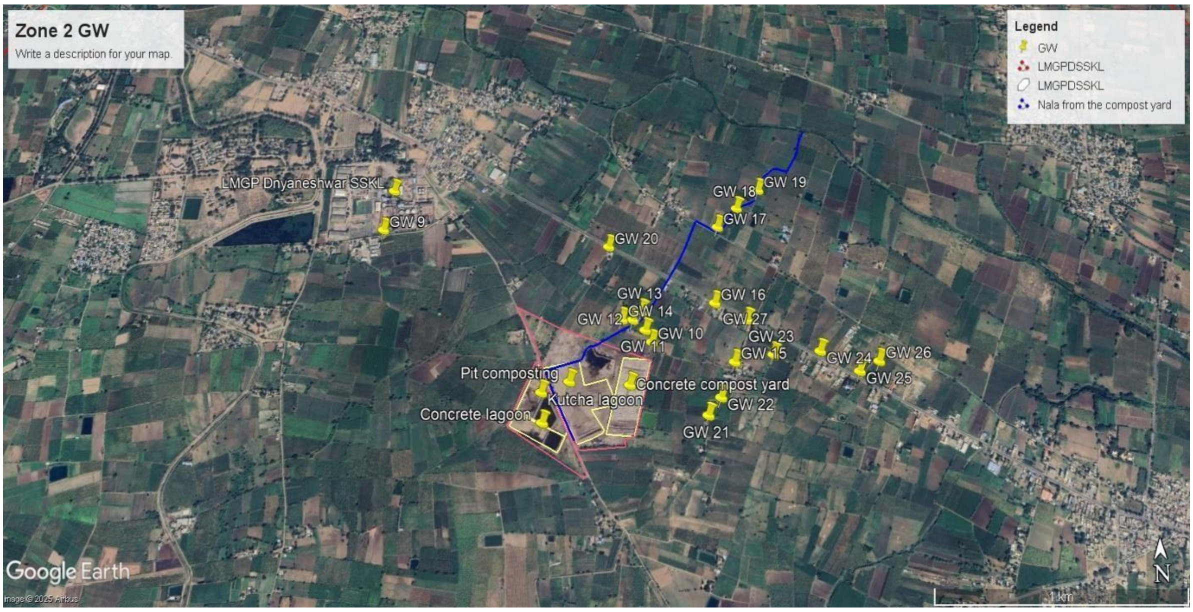


Figure 3.3: Satellite image showing the ground water monitoring locations of zone 2

Table 3.4: Test results of Ground water samples from zone 2 for Pre-monsoon

#	Para.	Unit	GW 09	GW 10	GW 11	GW 12	GW 13	GW 14	GW 15	GW 16	GW 20	GW 27
1	pH	-	7.84	8.10	7.59	7.43	7.49	7.95	7.42	7.56	7.85	7.57
2	EC	mmhos/cm	1.319	4.258	4.156	3.526	2.136	2.848	2.268	2.523	2.856	3.152
3	COD	mg/l	100	2280	600	580	92	440	1200	100	540	120
4	BOD (3d)	mg/l	43	905	228	266	39	173	497	37	176	45
5	DO	mg/l	2.5	2.0	2.8	2.9	2.6	2.4	2.5	3.2	2.4	3.4
6	TS	mg/l	636	2338	2532	2208	1298	1594	1836	1562	1812	1848
7	TDS	mg/l	586	2118	2418	2192	1190	1436	1798	1512	1798	1718
8	TSS	mg/l	46	88	158	156	204	132	168	176	154	192
9	Total Hardness (CaCO3)	mg/l	460	1005	1700	1420	1340	1360	1240	1320	1440	1420

10	Calcium (Ca)	mg/l	112.22	256.51	561.12	400.8	304.60	296.59	248.49	272.54	416.83	368.73
11	Magnesium (Mg)	mg/l	43.72	88.69	72.19	102.06	140.94	150.66	150.66	155.52	97.2	121.5
12	Chloride (Cl^-)	mg/l	199.94	699.78	829.74	729.77	509.84	549.83	665.79	544.83	789.76	919.71
13	Sulphate (as SO_4^{-2})	mg/l	113.33	200.95	185.71	180.00	170.48	189.52	243.81	181.90	173.33	181.90
14	Phosphate (as $PO4^{-2}$)	mg/l	BDL	25.33	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
15	Total Alkalinity (as $CaCO_3$)	mg/l	332.5	1825	625	325	340.00	362.5	425	290	400	242.5
16	Sodium (as Na)	mg/l	51.95	285.43	125.94	184.98	94.95	117.12	270.58	121.91	117.38	124.76
17	Potassium (as K)	mg/l	BDL	347.74	127.17	186.79	BDL	BDL	7.95	BDL	BDL	BDL
18	Residual Chlorine	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
19	Nitrate (as $NO3^{-2}$)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
20	Fluoride	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

21	Copper (as Cu)	mg/l	BDL	BDL	0.875	0.978	0.782	1.171	0.700	0.774	0.66	BDL
22	Cadmium (Cd)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Nickel (as Ni)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
24	Iron (as Fe)	mg/l	BDL	BDL	2.536	1.069	0.749	0.727	0.654	0.792	0.550	BDL
25	Zinc (as Zn)	mg/l	BDL	BDL	0.155	0.100	0.107	BDL	0.169	0.075	0.058	BDL
26	Manganese (Mn)	mg/l	0.300	1.465	4.843	3.672	3.267	7.884	0.207	BDL	0.047	BDL
27	Lead (Pb)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
28	Chromium (as Cr)	mg/l	BDL	BDL	0.147	0.236	BDL	BDL	0.014	0.280	0.032	BDL
29	Colour	CU	BDL	>500	>500	200	25	200	200	BDL	500	BDL
30	Silica (SiO2)	mg/l	3.68	93.17	16.15	16.15	18.94	19.88	16.36	17.81	19.25	8.82
31	Nitrogen (TKN)	mg/l	3.6	67.2	19.6	19.6	2.8	3.4	3.1	1.7	2.2	8.7

#	Para.	Unit	GW 17	GW 18	GW 19	GW 21	GW 22	GW 23	GW 24	GW 25	GW 26
1	pH	-	7.54	7.81	7.77	7.75	7.32	7.44	7.65	7.54	7.50
2	EC	mmho/cm	3.128	3.162	2.367	2.626	2.156	2.452	2.805	3.258	2.068
3	COD	mg/l	100	116	140	48	92	120	100	80	88
4	BOD (3d)	mg/l	37	43	53	19	34	45	43	34	32
5	DO	mg/l	2.4	3.1	3.3	2.5	2.3	2.4	2.3	2.6	2.8
6	TS	mg/l	1892	1926	1532	1472	1238	1620	1708	1952	1268
7	TDS	mg/l	1740	1828	1420	1360	1182	1582	1682	1872	1142
8	TSS	mg/l	134	132	172	56	152	64	78	116	200
9	Total Hardness (as $CaCO_3$)	mg/l	1400	1780	1210	960	925	1460	1340	1520	1180
10	Calcium (as Ca)	mg/l	480.96	416.38	432.86	240.48	176.35	368.73	280.56	344.68	304.60
11	Magnesium (as Mg)	mg/l	48.6	179.82	31.59	87.48	117.85	131.22	155.52	160.38	102.06
12	Chloride (as Cl^-)	mg/l	769.76	774.76	524.84	409.87	504.85	569.82	659.80	1054.67	479.85
13	Sulphate (SO_4^{-2})	mg/l	283.81	163.81	178.10	205.71	177.14	180.95	187.62	184.76	163.81
14	Phosphate (as $PO4^{-2}$)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
15	Total Alkalinity (as $CaCO_3$)	mg/l	265	252.5	240	225	195	122.89	99.77	205	245

16	Sodium (as Na)	mg/l	255.90	175.14	303.06	162.40	73.20	122.89	99.77	91.50	110.99
17	Potassium (as K)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
18	Residual Chlorine	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
19	Nitrate (as NO_3^{-2})	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
20	Fluoride	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21	Copper (as Cu)	mg/l	0.796	0.796	0.847	BDL	BDL	BDL	BDL	BDL	BDL
22	Cadmium (Cd)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Nickel (as Ni)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
24	Iron (as Fe)	mg/l	BDL	0.705	0.907	BDL	BDL	BDL	BDL	BDL	BDL
25	Zinc (as Zn)	mg/l	0.403	0.062	0.128	BDL	BDL	BDL	BDL	BDL	BDL
26	Manganese (Mn)	mg/l	0.066	0.062	0.331	BDL	BDL	BDL	BDL	BDL	BDL
27	Lead (Pb)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
28	Chromium (as Cr)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Colour	CU	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Silica (SiO_2)	mg/l	8.20	14.18	12.17	6.89	14.08	17.39	14.12	8.28	8.86
31	N as Kjeldahl Nitrogen (TKN)	mg/l	1.4	1.5	2.0	1.7	2.5	BDL	BDL	2.5	1.7

Table 3.5: Test results of Ground water samples from zone 2 for Post-monsoon

#	Para	Unit	GW 09	GW 10	GW 11	GW 12	GW 13	GW 14	GW 15	GW 16	GW 20	GW 27
1	pH	-	6.92	7.40	6.53	6.60	6.79	7.37	6.63	6.82	7.41	6.83
2	EC	mmho/cm	1.135	1.530	3.426	3.757	3.683	2.259	2.432	4.505	1.761	1.515
3	COD	mg/l	36	5200	152	176	112	80	400	88	56	84
4	BOD (3d)	mg/l	11	1997	58	67	42	29	155	32	19	31
5	DO	mg/l	3.4	3.6	3.4	3.2	3.2	3.4	2.8	3.2	3.3	3.1
6	TS	mg/l	680	5782	3256	2934	2624	2572	2406	4212	1872	4664
7	TDS	mg/l	896	3492	3298	2518	2796	2176	1982	3772	1582	1496
8	TSS	mg/l	20	22	20	18	22	26	24	20	22	24
9	Total Hardness (as CaCO3)	mg/l	470	4000	1620	1390	1380	1040	1080	1740	780	1850
10	Calcium (as Ca)	mg/l	84.16	240.48	292.58	288.57	296.59	240.48	220.44	505.00	136.27	505.00
11	Magnesium (as Mg)	mg/l	63.18	117.23	216.27	162.81	155.52	106.92	128.79	116.64	61.92	143.37
12	Chloride (as Cl^-)	mg/l	99.97	4198.70	879.73	799.75	649.80	449.86	559.83	899.72	369.89	989.69

13	Sulphate (as $SO4^{-2}$)	mg/l	222.77	564.36	580.20	512.87	486.14	367.33	356.44	641.58	346.53	627.72
14	Phosphate (as $PO4^{-2}$)	mg/l	BDL	10.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
15	Total Alkalinity (as CaCO3)	mg/l	250	5000	225	300	250	200	275	250	200	175
16	Sodium (as Na)	mg/l	57.59	107.25	94.34	125.12	123.14	87.38	67.52	147.96	78.45	79.54
17	Potassium (as K)	mg/l	BDL	4279.08	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
18	Residual Chlorine	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
19	Nitrate (as NO3 $^{-2}$)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
20	Fluoride	mg/l	BDL	17.36	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21	Copper (as Cu)	mg/l	0.030	0.314	0.052	0.039	0.034	0.037	0.041	0.043	0.015	BDL
22	Cadmium (Cd)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Nickel (as Ni)	mg/l	0.006	0.161	0.025	0.025	0.024	0.020	0.020	BDL	BDL	BDL
24	Iron (as Fe)	mg/l	0.473	3.010	0.025	0.141	0.155	0.365	0.365	0.602	0.217	0.218
25	Zinc (as Zn)	mg/l	0.112	0.165	0.091	0.219	0.093	0.110	0.110	0.107	0.087	0.052
26	Manganese (Mn)	mg/l	1.043	1.084	1.169	1.469	1.849	2.830	2.830	0.009	BDL	BDL
27	Lead (Pb)	mg/l	0.055	0.033	0.078	0.241	0.039	0.033	0.033	0.051	0.017	0.028

28	Chromium (as Cr)	mg/l	0.005	0.045	BDL	0.015	0.004	0.006	0.006	0.021	BDL	BDL
29	Colour	CU	5	>500	50	50	50	50	200	10	10	10
30	Silica (SiO2)	mg/l	29.36	19.67	27.35	26.29	29.27	31.28	33.30	29.84	27.54	29.75
31	N as Kjeldahl Nitrogen (TKN)	mg/l	17.1	1722	9.8	9.9	10.1	8.4	12.6	9.5	8.7	9

#	Parameters	Unit	Dug well 17	Bore well 19	Bore well 20	Dug well 21	Dug well 22	Dug well 23	Bore well 24	Bore well 25	Dug well 26
1	pH	-	6.89	6.65	7.41	6.89	6.72	6.80	6.87	6.74	6.67
2	EC	mmho/cm	4.526	5.025	1.761	1.465	1.493	1.439	2.290	2.001	2.191
3	COD	mg/l	84	88	56	88	36	56	48	28	44
4	BOD (3d)	mg/l	31	32	19	32	11	19	16	8	15
5	DO	mg/l	3.0	3.2	3.3	2.6	2.4	2.5	3.6	2.8	3.2
6	TS	mg/l	3820	4740	1872	2686	2452	3026	3428	406	2350
7	TDS	mg/l	3350	1296	1582	2326	1956	2172	2636	2502	2436
8	TSS	mg/l	18	32	22	26	20	18	16	24	28
9	Total Hardness (as CaCO3)	mg/l	1580	1760	780	1470	1230	1360	1450	1400	1270
10	Calcium (as Ca)	mg/l	288.57	376.75	136.27	288.57	272.54	400.8	320.64	340.68	304.60
11	Magnesium (as Mg)	mg/l	208.98	199.26	106.92	182.25	133.65	87.48	157.95	133.65	123.93
12	Chloride (as Cl^-)	mg/l	799.75	999.69	369.89	649.80	589.82	679.79	669.79	559.83	609.81
13	Sulphate (as SO_4^{-2})	mg/l	578.22	789.11	346.53	383.17	332.67	508.91	500.00	463.37	1130.69
14	Phosphate (as PO4 -2)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

#	Parameters	Unit	Dug well 17	Bore well 19	Bore well 20	Dug well 21	Dug well 22	Dug well 23	Bore well 24	Bore well 25	Dug well 26
15	Total Alkalinity (as CaCO3)	mg/l	325	225	200	175	150	200	150	175	200
16	Sodium (as Na)	mg/l	178.75	234.36	78.45	74.47	81.43	86.39	110.23	67.52	139.03
17	Potassium (as K)	mg/l	5.24	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
18	Residual Chlorine	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
19	Nitrate (as NO_3^{-2})	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
20	Fluoride	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21	Copper (as Cu)	mg/l	0.313	0.074	0.015	0.025	0.014	0.044	BDL	BDL	BDL
22	Cadmium (Cd)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Nickel (as Ni)	mg/l	BDL	0.018	BDL	BDL	BDL	BDL	BDL	BDL	BDL
24	Iron (as Fe)	mg/l	0.326	1.882	0.217	0.280	0.280	9.935	0.402	0.098	2.301
25	Zinc (as Zn)	mg/l	0.116	0.112	0.087	0.082	0.082	0.077	0.072	0.076	0.105
26	Manganese (Mn)	mg/l	0.062	1.073	BDL	0.218	0.218	0.569	BDL	BDL	0.278
27	Lead (Pb)	mg/l	0.029	0.024	0.017	0.015	0.015	0.016	0.010	0.010	0.012
28	Chromium (as Cr)	mg/l	BDL	BDL	BDL	BDL	BDL	0.031	BDL	BDL	BDL

#	Parameters	Unit	Dug well 17	Bore well 19	Bore well 20	Dug well 21	Dug well 22	Dug well 23	Bore well 24	Bore well 25	Dug well 26
29	Colour	CU	5	50	10	25	5	25	10	25	10
30	Silica (SiO2)	mg/l	18.33	27.35	27.54	30.71	30.61	29.94	32.72	30.99	34.06
31	N as Kjeldahl Nitrogen (TKN)	mg/l	8.7	12.2	8.7	10.6	9.5	14.3	11.5	7.1	8.1

This zone i.e. zone 2, is in the downstream (Considering surface runoff) of the spent wash storage tanks and the compost yard, located north of these structures. Test results for pH of GW samples of this zone reported in the range of 7.4 to 8.1. Electrical conductivity (EC) was reported 4.26 mmho/cm for sample 10 which was a dug well located very close to compost yard. Sample GW 11 and GW 12 which were bore well samples from proximate zone of the compost yard reported EC 4.16 and
3.53 mmho/cm. For other samples from this zone (number-wise sample GW 13, GW 14, GW 15, GW 16, GW 20 and GW 27) EC reported above 2.0 mmho/cm.

In this zone, Chemical oxygen demand (COD) for sample GW 10 reported at 2280 mg/L and BOD value for the same sample reported at 905 mg/L. It indicates, the probability of entrainment of run-off from compost yard. Dissolved oxygen level of this sample was 2.0 mg/L, compared to other samples of this zone this value is lowest. This sample reported TDS of 2118 mg/L and total hardness 1005 mg/L for pre-monsoon season. Colour which was another important parameter. This sample reported a value of >500 Colouring unit (CU). Phosphate, Silica (as SiO2) and Organic Nitrogen (TKN) was observed more compared to other samples of this zone.

Ground water (GW) Sample 11, 12, 13 and 20 are of bore well in the northern directions of the compost yard. Sample GW 11 and 12 are closer to sample GW 10 (Dug well). Sample GW 13 bore well is very close to a natural drainage that is originating from spent wash storage lagoons and flowing towards north. COD for sample GW 11 and GW12 was reported 600 mg/L and 580 mg/L and BOD was at 228 mg/L and 266 mg/L respectively. Whereas COD, BOD of sample 13 – which located very close to a natural drainage was reported at 92 mg/L and 39 mg/L - lower than sample GW 11 and GW 12. Sample GW 20 which is a bore well located further northwards of the sample GW 11,12 and 13. For this sample COD value reported was 540 mg/L and BOD 176mg/L. Colour at GW sample 20 was reported 500 CU during pre- monsoon sampling. The area where ground water contamination observed relatively higher compared to other locations is outlined in red polygon.

In case of studied ground water samples, parameter colour indicates changes in physical appearance for samples GW 10, GW 11, GW 12, GW 13, GW, 14, GW 15 and GW 20. Chemical oxygen demand i.e. COD for sample GW 10 was observed highest, which was 2280mg/L. other samples such as GW 11, GW 12, GW 14 and GW 15 reported with higher COD values compared with other baseline samples. Total dissolved solids and hardness observed to be above permissible limits of the IS 10500:2012 for many of the ground water samples. It includes samples from upstream zones.

From the analysis results, ground water monitoring locations GW 10 to GW 16 and GW 20, GW 27 where the water quality observed affected compared to ground water characteristics of other locations particularly from the locations of upstream zone.

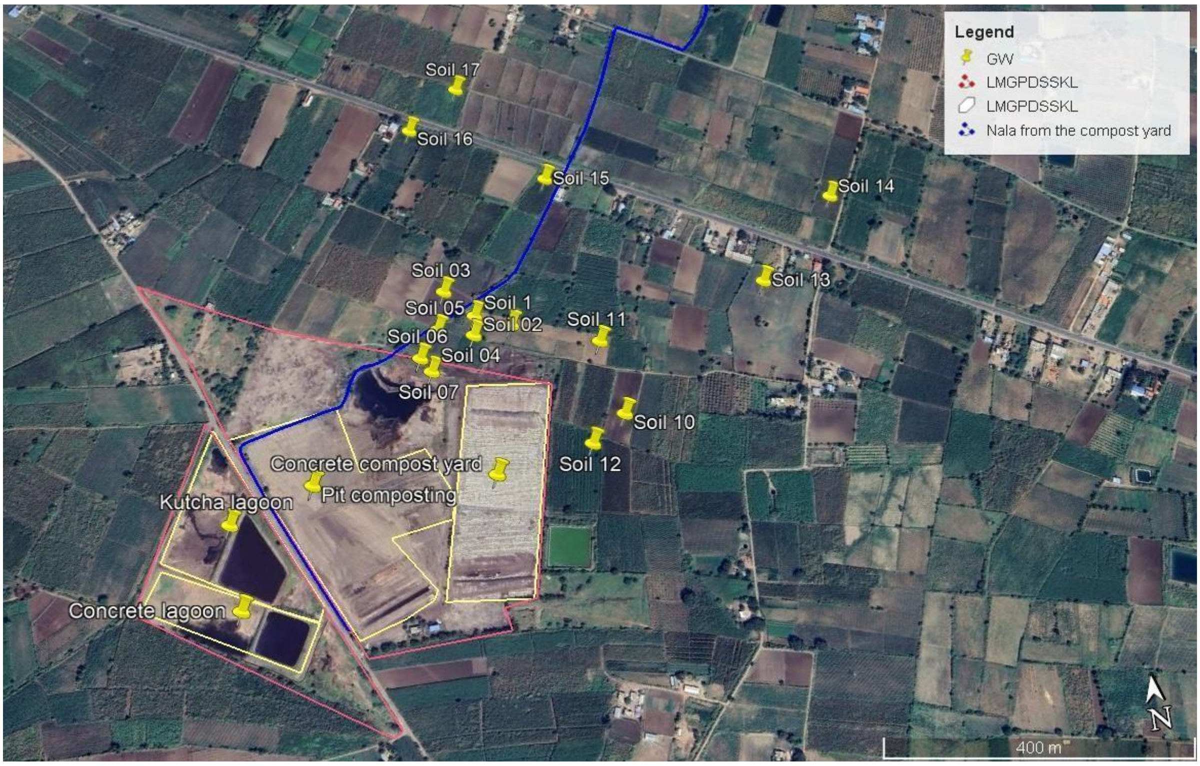


Figure 3.4: Satellite image showing the soil monitoring locations of zone 2 (soil sample number 01 to 07 and 10 to 17)

Table 3.6: Results of Soil analysis – representative samples from zone- 2 – Pre-monsoon

#	Parameters	Unit	S 01	S 02	S 03	S 04	S 05	S 06	S 07
1	pH	--	8.42	8.45	8.37	8.48	8.05	8.10	7.48
2	Electrical conductivity	Mmho /cm	1.479	1.554	1.515	1.186	1.818	6.896	12.48
3	Organic Carbon	%	0.83	0.98	1.40	0.67	0.83	1.30	2.11
4	Organic matter	%	1.44	1.68	2.42	1.16	1.44	2.24	3.64
5	Water Content (Moisture)	%	7.50	5.69	6.21	5.59	7.43	9.62	25.32
6	Available Nitrogen	kg ha^{-1}	265	204	342	279	166	210	690
7	Available Phosphorus	kg ha^{-1}	128.8	114.8	145.6	75.6	56	285.6	588
8	Available Potassium	kg ha^{-1}	458.67	363.11	463.44	180.60	468.22	659.34	764.45
9	Copper as Cu	mg/kg	BDL	BDL	BDL	2.047	BDL	BDL	BDL
10	Manganese as Mn	mg/kg	154.7	372.8	112.7	430	39.30	6.555	8.485
11	Zinc as Zn	mg/kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL
12	Iron as Fe	mg/kg	1589	7050	3459	10530	508.3	BDL	BDL

Test Results of Soil analysis for zone 2 – continuation

#	Parameters	Unit	S 10	S11	S 12	S 13	S 14	S 15	S 16	S 17
1	pH	--	8.34	8.48	8.34	8.29	8.44	8.56	8.38	8.48
2	Electrical conductivity	mmho/cm	0.326	1.698	0.921	0.884	1.253	1.78	0.568	1.009
3	Organic Carbon	%	0.85	1.03	1.05	1.09	0.73	1.37	0.62	1.01
4	Organic matter	%	1.47	1.78	1.82	1.89	1.26	3.04	1.08	1.75
5	Water Content (Moisture)	%	7.80	6.33	5.55	7.09	7.14	8.79	10.75	8.79
6	Available Nitrogen	Kg/ha	168	172	207	135	179	160	116	293
7	Available Phosphorus	Kg/ha	170.8	179.2	190.4	201.6	184.8	212.8	50.4	156.8
8	Available Potassium	Kg/ha	506.45	546.56	587.44	439.56	487.33	573.33	592.45	195.89
9	Copper (as Cu)	mg/kg	42.96	81.73	BDL	199.9	60.11	BDL	BDL	BDL
10	Manganese as Mn	mg/kg	120.5	626.3	12.21	856	302.6	BDL	120	100
11	Zinc as Zn	mg/kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
12	Iron as Fe	mg/kg	4,348	3,000	106.8	2,000	1,400	3,000	2,500	1,050

In case of soil, total 17 samples were collected. Of these mainly 15 samples were from the immediate downstream zone of the compost yard/lagoon. Two samples were collected from relatively cross stream zones i.e. S 08 and S 09. These two samples were considered as a baseline samples to understand general soil characteristics in the surrounding area. In case of soil, analysis results of sample 06 and 07 that collected from the old pit compost areas, show very high concentration of organic carbon, organic matter as well as NPK. For those locations, EC reported is on higher side (>3 mmho/cm or dS/m) indicating high amount of salts or ions present in the soil. In case of all other soil samples, the variation observed range bound in comparison with sample 08 and 09.

Table 3.7: Test results of representative soil samples from zone 2 for Post-monsoon

#	Parameters	Unit	S 01	S 02	S 03	S 04	S 05	S 06	S 07
1	pH	--	7.89	8.01	7.80	8.01	8.04	7.37	7.30
2	Electrical conductivity	mmhos/cm	1.205	1.076	1.697	0.957	0.939	16.78	18.44
3	Organic Carbon	%	0.81	0.77	0.50	0.61	1.02	3.80	3.86
4	Organic matter	%	1.39	1.33	0.86	1.06	1.76	6.55	6.65
5	Water Content (Moisture)	%	8.21	4.94	2.80	4.97	9.58	6.92	9.81
6	Available Nitrogen	kg ha^{-1}	163.07	232.06	175.61	153.66	169.34	605.24	987.84
7	Available Phosphorus	kg ha^{-1}	221.2	274.4	333.2	184.8	722.4	4,239.2	3,164
8	Available Potassium	kg ha^{-1}	113.83	637.88	1,216.87	209.02	637.88	28,164.8	19,136.41
9	Copper (as Cu)	mg/kg	161.7	157.2	155.2	165.4	139.9	187.5	148.2
10	Manganese (as Mn)	mg/kg	1,557	1,618	812.9	1,366	1,965	843.4	1,089
11	Zinc (as Zn)	mg/kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL
12	Iron (as Fe)	mg/kg	45,820	46,930	52,050	47,490	49,730	51,810	44,680

Continuation - Post-Monsoon Soil analysis zone 2

#	Parameters	Unit	S 10	S 11	S 12	S 13	S 14	S15	S 16	S 17
1	pH	--	7.90	7.86	8.09	7.97	8.16	7.98	8.05	7.89
2	Electrical conductivity	mmhos/cm	0.813	0.887	0.315	0.560	0.641	2.204	0.845	1.506
3	Organic Carbon	%	1.16	1.14	1.22	1.12	0.57	1.10	0.92	0.88
4	Organic matter	%	2.01	1.97	2.11	1.94	1.94	1.89	1.59	1.53
5	Water Content (Moisture)	%	11.31	6.97	9.98	5.41	5.68	6.35	10.71	6.58
6	Available Nitrogen	kg ha^{-1}	181.88	90.94	112.89	144.25	150.52	194.43	166.20	156.8
7	Available Phosphorus	kg ha^{-1}	263.2	630.0	425.6	165.2	190.4	42.0	182.0	201.6
8	Available Potassium	kg ha^{-1}	775.26	139.35	2,767.41	951.91	245.33	2,561.43	2,541.7	932.28
9	Copper (as Cu)	mg/kg	206.7	193.8	178.5	155	199.7	154.4	158.9	148.5
10	Manganese (as Mn)	mg/kg	1,466	948.2	1,102	632.1	700.5	678.6	846.9	765.1
11	Zinc (as Zn)	mg/kg	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
12	Iron (as Fe)	mg/kg	69,780	63,820	66,760	54,150	57,740	52,620	56,820	57,860

Ground water Samples from Zone 3: Ground water samples in the downstream at a distance of ≥1000 m away from the compost yard/storage lagoon site. It includes GW samples GW 28 to GW 36.

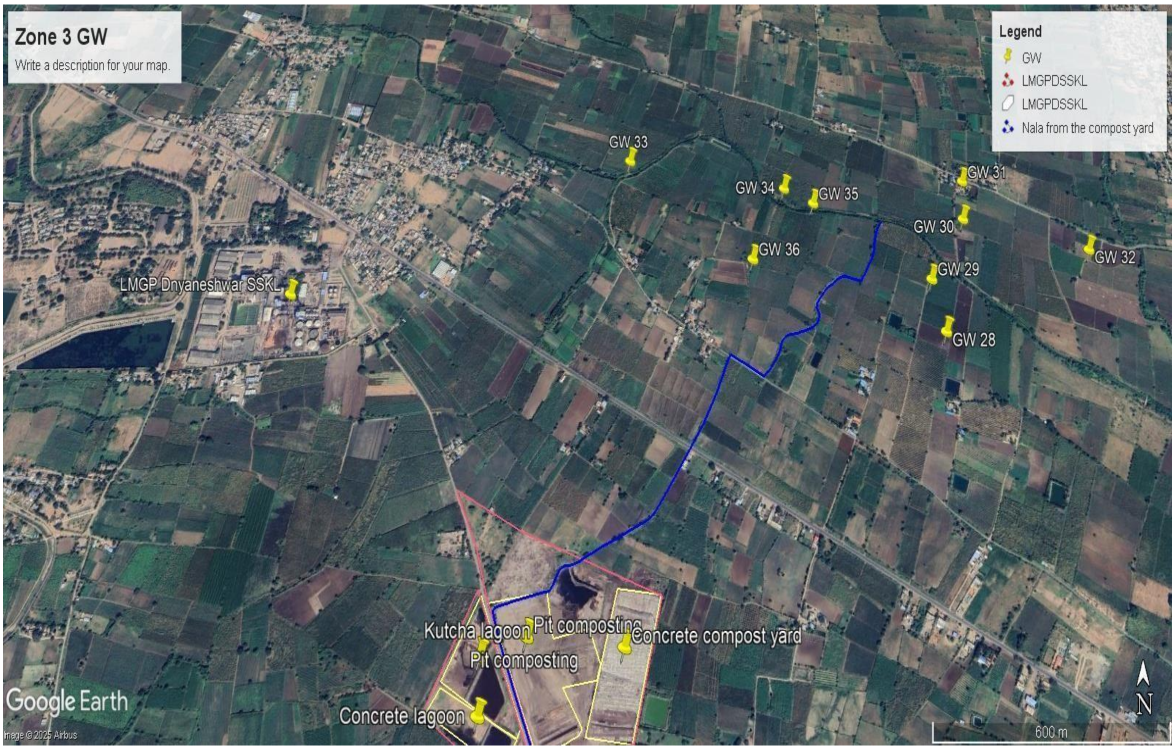


Figure 3.5: Satellite image showing ground water sampling locations of zone 3

Table 3.8: Test results of ground water samples from zone 3 - for Pre-monsoon season

#	Para meters	Unit	GW 28	GW 29	GW 30	GW 31	GW 32	GW 33	GW 34	GW 35	GW 36
1	pH	-	7.42	7.41	7.26	7.62	8.66	8.10	7.77	7.34	7.56
2	EC	mmho/cm	3.205	3.156	2.049	1.886	4.527	2.092	1.712	2.309	2.993
3	COD	mg/l	76	124	64	76	184	32	36	44	100
4	BOD (3d)	mg/l	27	47	23	32	70	13	15	17	43
5	DO	mg/l	3.6	2.7	2.4	2.5	2.7	2.1	2.6	2.1	2.5
6	TS	mg/l	1942	1882	1162	1172	2712	1248	1042	1396	1734

#	Parameters	Unit	GW 28	GW 29	GW 30	GW 31	GW 32	GW 33	GW 34	GW 35	GW 36
7	TDS	mg/l	1902	1806	1124	1118	2686	1192	1008	1310	170 2
8	TSS	mg/l	104	94	16	64	222	84	12	176	132
9	Total Hardness (as $CaCO_3$)	mg/l	1700	1640	780	700	1460	900	700	1100	156 0
10	Calcium (as Ca)	mg/l	352. 70	336. 67	192. 38	120. 24	264.5 2	200. 4	136. 27	192. 38	328. 65
11	Magnesium (as Mg)	mg/l	199. 26	194. 4	72.9	97.2	194.4	97.2	87.4 8	150. 66	179. 82
12	Chloride (as Cl^-)	mg/l	764. 76	729. 77	464. 86	459. 86	1439. 55	369. 89	469. 85	554. 83	719. 78
13	Sulphate (as SO_4^{-2})	mg/l	195. 24	180. 95	128. 57	204. 76	171.4 3	224. 76	120. 00	181. 90	174. 29
14	Phosphate (as PO_4^{-2})	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
15	Total Alkalinity (as $CaCO_3$)	mg/l	262. 5	280	320	222. 5	283	317. 5	295	345	240
16	Sodium (as Na)	mg/l	275. 50	284. 36	141. 69	231. 23	569.7 1	226. 37	122. 95	252. 87	281. 41
17	Potassium (as K)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
18	Residual Chlorine	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
19	Nitrate (as NO_3^{-2})	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

#	Para meters	Unit	GW 28	GW 29	GW 30	GW 31	GW 32	GW 33	GW 34	GW 35	GW 36
20	Fluoride	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21	Copper (as Cu)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Cadmium (Cd)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Nickel (as Ni)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
24	Iron (as Fe)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
25	Zinc (as Zn)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
26	Manganese (Mn)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
27	Lead (Pb)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
28	Chromium (as Cr)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Colour	CU	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Silica (SiO2)	mg/l	11.76	6.43	8.05	6.27	11.01	8.01	12.04	8.69	6.45
31	N as Kjeldahl Nitrogen (TKN)	mg/l	2.8	2.7	1.7	2.8	1.7	2.5	2.0	3.1	2.2

Test Results of Ground water samples Zone III – for Post Monsoon

#	Parameters	Unit	GW 28	GW 29	GW 30	GW 31	GW 32	GW 33	GW 34	GW 35	GW 36
1	pH	-	6.93	6.90	7.13	7.74	6.91	6.68	6.76	7.06	6.76
2	EC	mmhos/cm	1.958	2.402	2.170	0.676	3.907	1.862	2.049	2.183	3.136

#	Parameters	Unit	GW 28	GW 29	GW 30	GW 31	GW 32	GW 33	GW 34	GW 35	GW 36
3	COD	mg/l	68	32	32	24	92	36	40	28	56
4	BOD (3d)	mg/l	24	10	10	7	34	11	13	8	19
5	DO	mg/l	3.0	2.6	2.5	3.1	3.2	2.9	2.8	2.7	2.8
6	TS	mg/l	4564	2910	2198	964	2246	762	2454	2374	2764
7	TDS	mg/l	3820	2418	1928	802	3162	1468	1778	1894	2964
8	TSS	mg/l	26	20	22	32	28	26	24	22	24
9	Total Hardness (as CaCO3)	mg/l	1600	1060	900	470	1540	650	1010	960	1470
10	Calcium (as Ca)	mg/l	320.64	200.4	176.35	100.2	252.50	120.24	160.32	155.52	272.54
11	Magnesium (as Mg)	mg/l	194.4	136.08	111.78	53.46	221.13	85.05	148.23	128.25	191.97
12	Chloride (as Cl^-)	mg/l	899.72	649.80	599.81	349.89	1139.65	449.86	519.84	549.83	679.79
13	Sulphate (as SO_4^{2})	mg/l	683.17	460.40	377.23	124.75	58.42	307.92	404.95	389.11	603.96
14	Phosphate (as $PO4^{-2}$)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
15	Total Alkalinity (as CaCO3)	mg/l	200	200	250	1500	250	350	2500	2250	200
16	Sodium (as Na)	mg/l	241.31	278.05	230.39	76.26	516.39	281.03	236.35	240.32	288.98
17	Potassium (as K)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
18	Residual Chlorine	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

#	Parameters	Unit	GW 28	GW 29	GW 30	GW 31	GW 32	GW 33	GW 34	GW 35	GW 36
19	Nitrate (as NO3 -2)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
20	Fluoride	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21	Copper (as Cu)	mg/l	BDL	BDL	BDL	0.011	0.010	BDL	0.014	0.013	0.020
22	Cadmium (Cd)	mg/l	BDL	BDL	BDL	BDL	0.229	BDL	BDL	BDL	BDL
23	Nickel (as Ni)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
24	Iron (as Fe)	mg/l	0.126	0.131	0.187	0.355	0.229	0.126	0.756	0.122	0.601
25	Zinc (as Zn)	mg/l	0.090	0.064	0.061	0.070	0.058	0.052	0.074	0.056	0.077
26	Manganese (Mn)	mg/l	0.010	0.010	0.013	0.122	0.025	0.015	0.763	0.113	0.035
27	Lead (Pb)	mg/l	0.019	0.014	BDL	BDL	BDL	BDL	BDL	BDL	BDL
28	Chromium (as Cr)	mg/l	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Colour	CU	5	1	1	10	5	5	10	5	1
30	Silica (SiO2)	mg/l	32.14	37.90	29.94	27.25	34.83	34.45	32.91	33.97	33.78
31	N as Kjeldahl Nitrogen (TKN)	mg/l	7.7	18.5	11.5	10.8	30	7.8	32.2	13.4	5.9

In the zone 3, all samples were of dug well samples. Test results for pre as well as post monsoon season were more or less in the same range as observed in other dug well samples of south and east of the compost site. It indicates that, the contamination is not reached up to those monitored locations.

Surface water sample

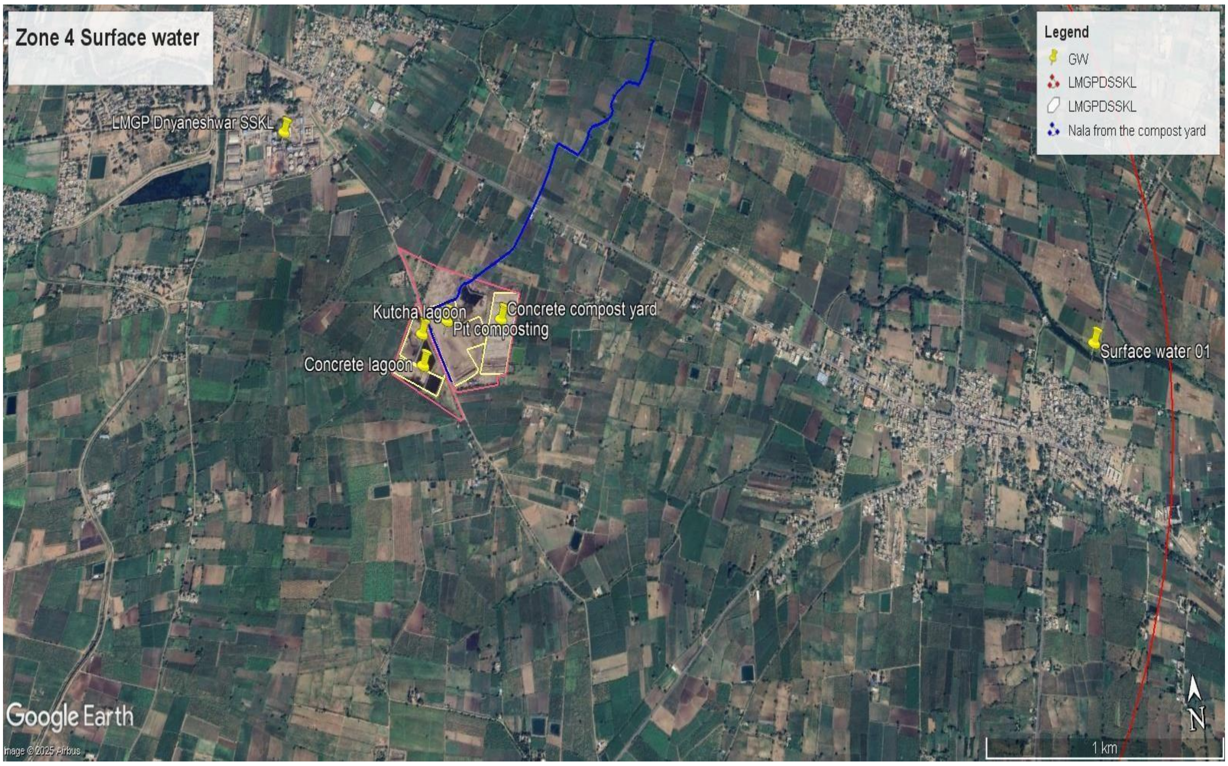


Figure 3.6: Satellite image showing surface water sampling location

Table 3.9: Test results of surface water sample – (pre and post monsoon)

#	Parameters	Unit	Pre-monsoon SW01	Post Monsoon SW01
1	pH	-	7.37	6.99
2	EC	mmhos/cm	1.728	2.473
3	COD	mg/l	160	2680
4	BOD (at 27 ^{0}C)	mg/l	61	997
5	DO	mg/l	2.6	3.4
6	TS	mg/l	1120	3422
7	TDS	mg/l	1082	2914
8	TSS	mg/l	40	24
9	Total Hardness (as CaCO3)	mg/l	340	1290

10	Calcium (as Ca)	mg/l	120.24	380.76
11	Magnesium (as Mg)	mg/l	9.72	82.62
12	Chloride (as Cl^-)	mg/l	304.91	1199.63
13	Sulphate (as SO4)	mg/l	179.05	128.71
14	Phosphate (as $PO4^{-2}$)	mg/l	7.01	4.29
15	Total Alkalinity (as CaCO3)	mg/l	255	750
16	Sodium (as Na)	mg/l	150.54	190.67
17	Potassium (as K)	mg/l	152.01	18.78
18	Residual Chlorine	mg/l	BDL	BDL
19	Nitrate (as $NO3^{-2}$)	mg/l	BDL	BDL
20	Fluoride	mg/l	BDL	BDL
21	Copper (as Cu)	mg/l	BDL	0.260
22	Cadmium (Cd)	mg/l	BDL	BDL
23	Nickel (as Ni)	mg/l	BDL	BDL
24	Iron (as Fe)	mg/l	BDL	0.927
25	Zinc (as Zn)	mg/l	BDL	0.073
26	Manganese (Mn)	mg/l	0.301	2.667
27	Lead (Pb)	mg/l	BDL	BDL
28	Chromium (as Cr)	mg/l	BDL	0.017
29	Colour	CU	BDL	250
30	Silica (SiO2)	mg/l	9.89	49.04
31	N as Kjeldahl Nitrogen (TKN)	mg/l	4.8	56.8

Surface water samples were collected from a natural *nala*. Sampling location was more than 1 km away from the spent wash storage and compost yard area. Many small drainages meet to this *nala.* Those drains were carrying agricultural runoff and wastewater from household/domestic activities discharged into this *nala.* The test reports of this sample showed the characteristics in aligned with physical observations.

Chapter IV

GEOPHYSICAL SURVEYS

4.1 About the Geophysical surveys (in brief)

Geophysical surveys were carried out in the form of Vertical Electrical Resistivity- Survey (VES). VES stands for Vertical Electrical Sounding. This is a measurement technique collects resistivity data at different depths beneath a single surface location. VES is a simple 1D resistivity technique. The surface position (the x- and y-location) remains fixed and only the depth of the data point varies (the z-position) during the survey. The field procedure for VES is very simple: starting with four electrodes, two for injecting current (A and B) and two for measuring voltage (M and N), the system is considered to be measuring the electrical properties (apparent resistivity) from a specific 'focus' point. This point has unique x-, y- and z-co-ordinates associated with it. By gradually expanding the distance between the current electrodes (A and B), whilst keeping the centre of the four electrode array in a fixed position, the apparent resistivity is measured at increasing depths (i.e. the x- and y-coordinates remain fixed whilst the z-value increases). This measurement technique is well established and works well. It is most commonly used for groundwater exploration and mapping geological structures like aquifers and clay layers. It can be useful in many application areas.

Basics of Working

1. **Electrode Setup**: Four electrodes (A, B, M, N) are placed in a line on the ground.
2. **Current Injection**: A known DC current (I) is injected into the ground through the outer electrodes (A and B).
3. **Potential Measurement**: The potential difference (ΔV) is measured between the inner electrodes (M and N).
4. **Varying Spacing**: The distance between the current electrodes (AB/2) is increased while keeping the center point fixed, allowing current to penetrate deeper into the subsurface.
5. **Apparent Resistivity Calculation**: The instrument calculates apparent resistivity (ρa) using the formula $\rho a = K^*(\Delta V/I)$, where K is the geometric factor.

The studies were carried out in the surrounding areas of compost yard, spent wash storage tanks/lagoons of the factory. Observations were recorded during Pre- Monsoon (May 2024) and Post-Monsoon (2025) seasons. The data and results are presented below.

4.2 Pre Monsoon season

During the Pre Monsoon season it is generally believed that the water table falls (goes down) with depth due to increased evapo-transpiration (natural cause) and due to ground water abstraction for drinking and irrigation (anthropogenic cause). Hence, a detailed study consisting of systematic traverses across the Dynaneshwar Sugar (DS) Factory compost yard was undertaken (DS1 - DS35). Besides this, 1 profile along a natural stream between the compost pit and the Sugar Factory (DS36 - DS41) was also undertaken to understand the nature of the aquifer in the uncontaminated condition. All these VES along several traverses have been utilized to analyze the potential contamination sites.

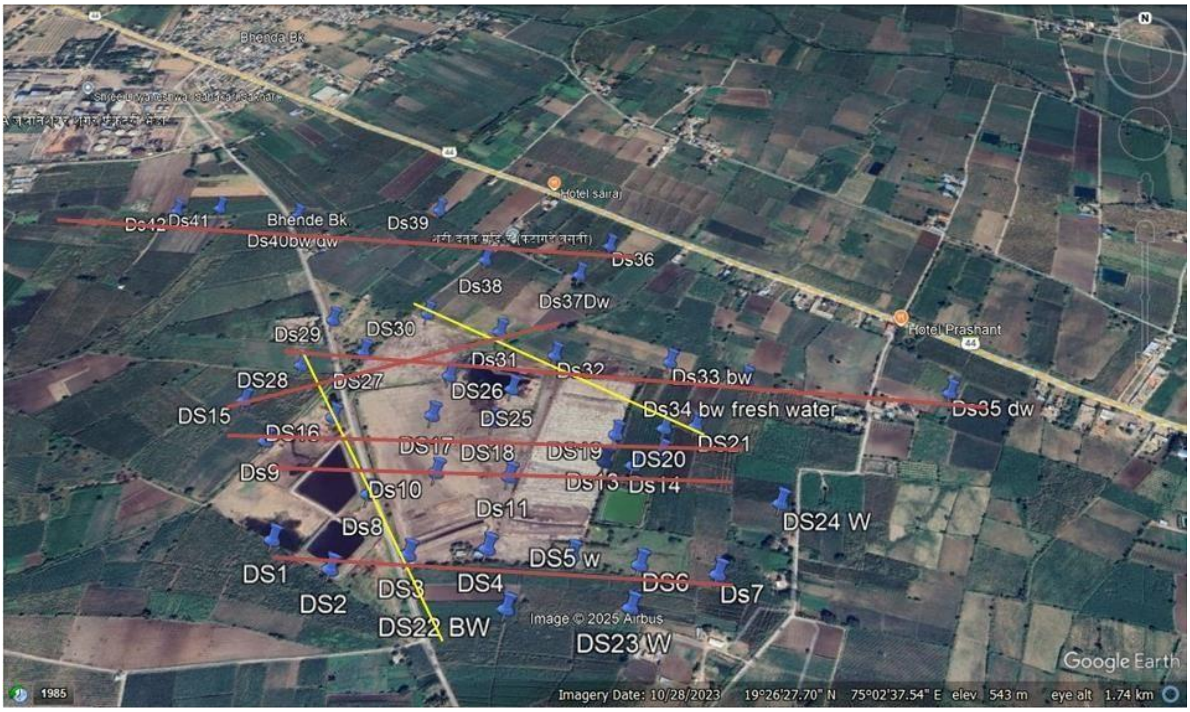
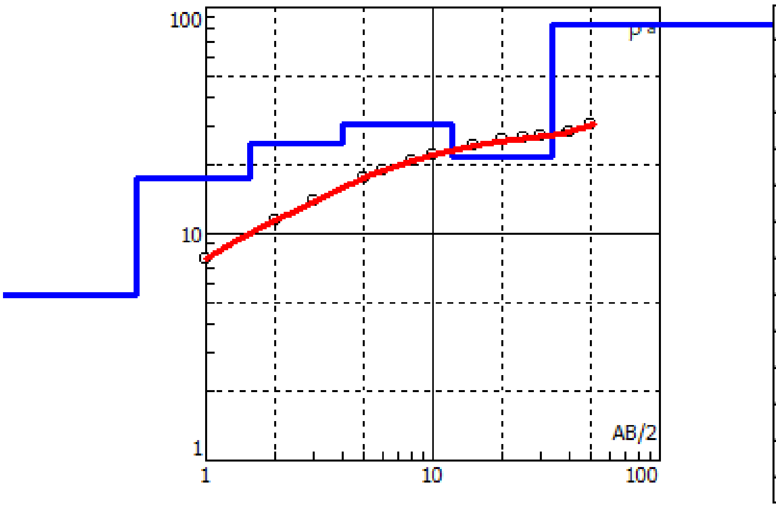


Fig. 4.1: The Sugar Factory compost yard with Pre Monsoon VES locations/points

1223



N	ρ	h	d	Alt
1	5.36	0.5	0.5	-0.5
2	17.7	1.06	1.56	-1.56
3	24.8	2.4	3.96	-3.962
4	30.6	8.11	12.1	-12.07
5	22	21.7	33.8	-33.81
6	84.2			

Ds1

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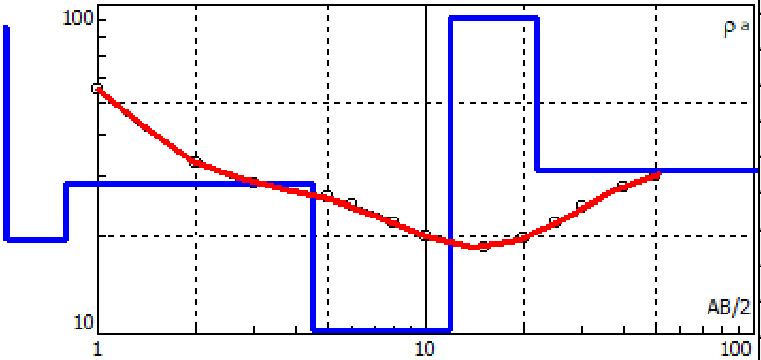
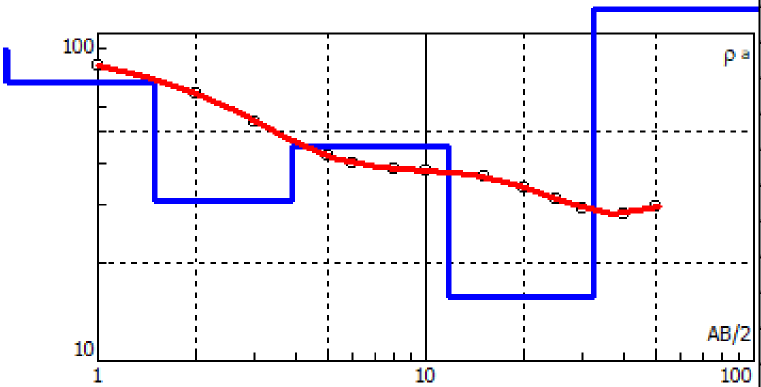



| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 85.8 | 0.5 | 0.5 | -0.5 |
| 2 | 19.4 | 0.296 | 0.796 | -0.7955 |
| 3 | 28.5 | 3.7 | 4.49 | -4.493 |
| 4 | 10.3 | 7.32 | 11.8 | -11.81 |
| 5 | 91.1 | 10.1 | 22 | -21.96 |
| 6 | 31.4 | | | |

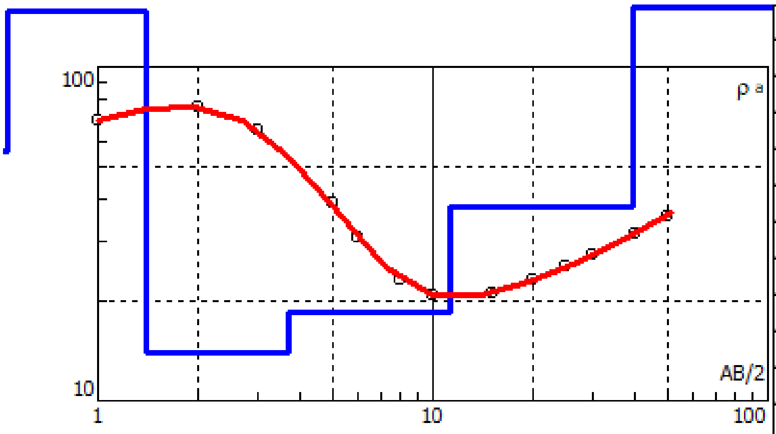
**Ds2**




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 89.1 | 0.5 | 0.5 | -0.5 |
| 2 | 70.5 | 0.991 | 1.49 | -1.491 |
| 3 | 30.8 | 2.44 | 3.93 | -3.932 |
| 4 | 45.3 | 7.79 | 11.7 | -11.72 |
| 5 | 15.7 | 20.7 | 32.4 | -32.43 |
| 6 | 119 | | | |

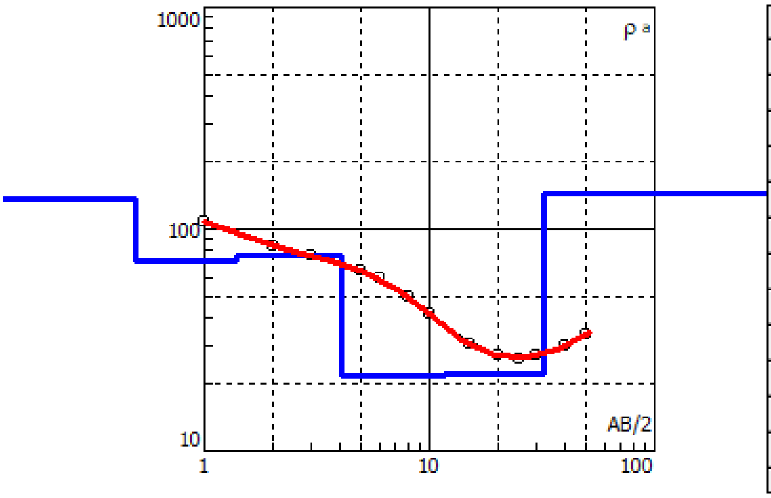
**ds3**

# 1224



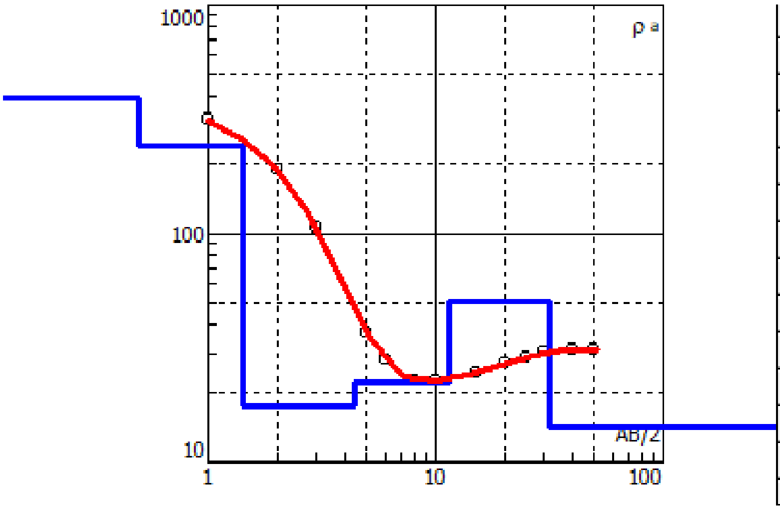

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 55.8 | 0.54 | 0.54 | -0.5396 |
| 2 | 146 | 0.845 | 1.38 | -1.384 |
| 3 | 14 | 2.34 | 3.73 | -3.726 |
| 4 | 18.3 | 7.54 | 11.3 | -11.26 |
| 5 | 38 | 28.3 | 39.6 | -39.56 |
| 6 | 151 | | | |

**ds4**



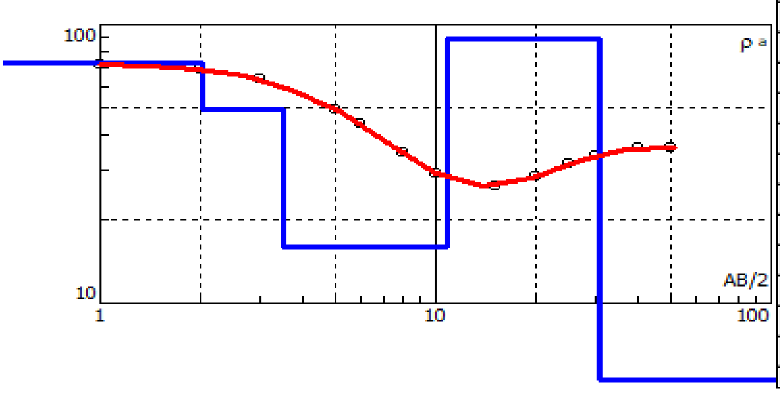

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 136 | 0.5 | 0.5 | -0.5 |
| 2 | 72.3 | 0.895 | 1.39 | -1.395 |
| 3 | 76.6 | 2.7 | 4.09 | -4.095 |
| 4 | 21.8 | 7.55 | 11.6 | -11.64 |
| 5 | 22.2 | 20.5 | 32.1 | -32.13 |
| 6 | 146 | | | |

**ds6**



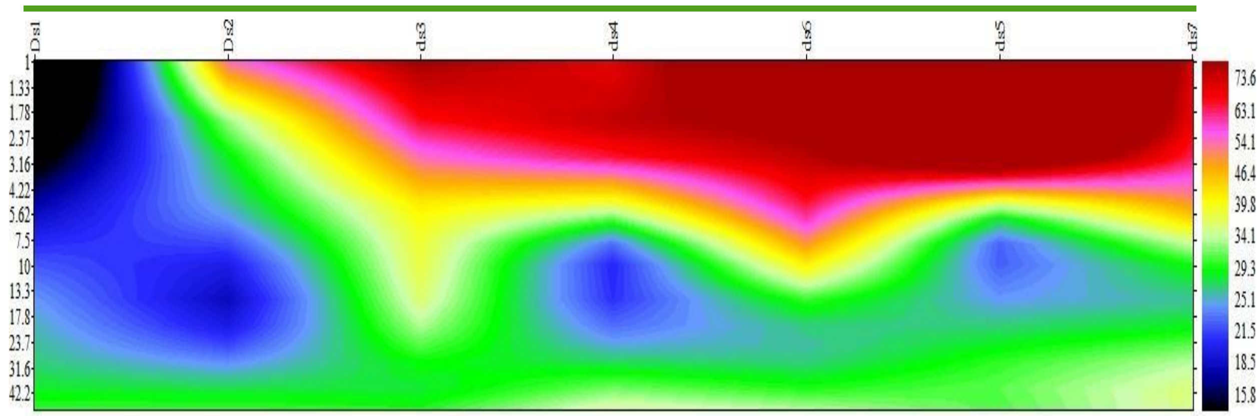

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 395 | 0.5 | 0.5 | -0.5 |
| 2 | 240 | 0.914 | 1.41 | -1.414 |
| 3 | 17.7 | 3.03 | 4.45 | -4.448 |
| 4 | 22.3 | 6.97 | 11.4 | -11.42 |
| 5 | 50.8 | 19.9 | 31.3 | -31.32 |
| 6 | 14.2 | | | |

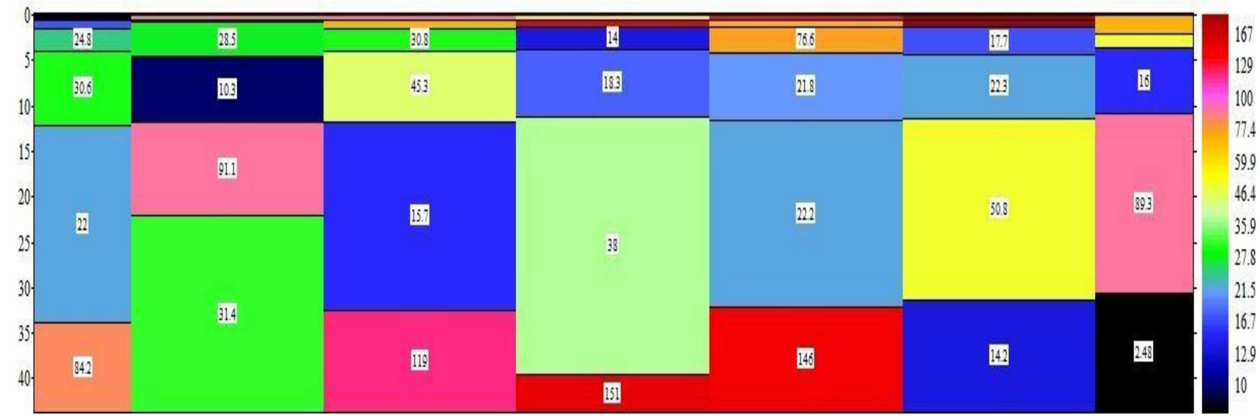
**ds5**




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 72.4 | 2.01 | 2.01 | -2.009 |
| 2 | 49.7 | 1.52 | 3.53 | -3.526 |
| 3 | 16 | 7.36 | 10.9 | -10.88 |
| 4 | 89.3 | 19.8 | 30.7 | -30.65 |
| 5 | 2.48 | | | |

**ds7**

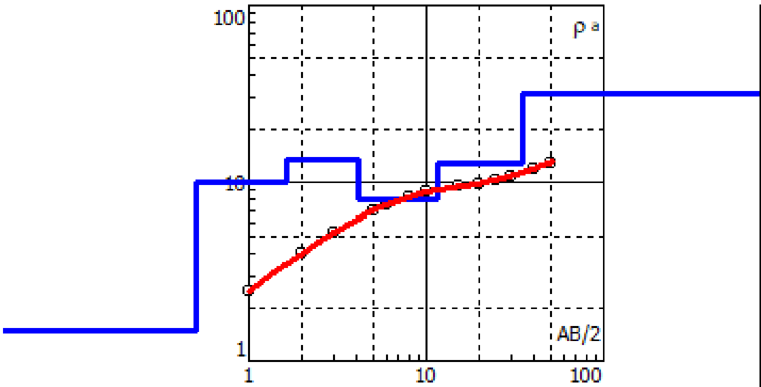


**Profile I (DS1 - DS7)**

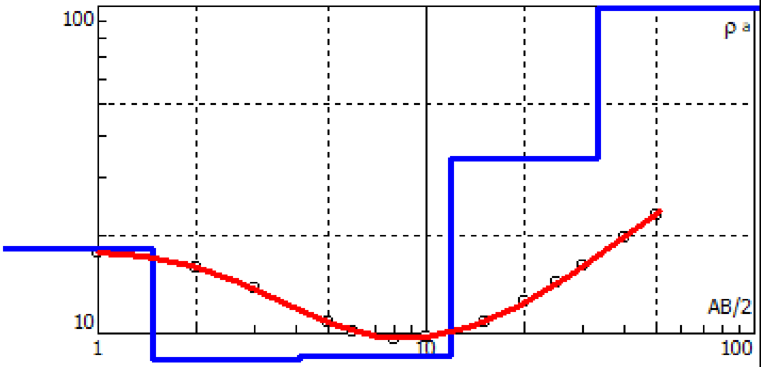
The pit excavated near VES DS1 is responsible for the low apparent resistivity (15 - 21.5 Ωm) upto a depth of 31.6 m bgl. This low ρa zone extends well below 5.6 m bgl in VES DS2. The high apparent resistivity (46.4 - 73.6 Ωm) is seen in VES DS2 to DS7.

**Locations/points DS8-DS14**




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 1.49 | 0.5 | 0.5 | -0.5 |
| 2 | 10.1 | 1.15 | 1.65 | -1.647 |
| 3 | 13.6 | 2.54 | 4.18 | -4.184 |
| 4 | 8.05 | 7.38 | 11.6 | -11.56 |
| 5 | 12.8 | 23.4 | 35 | -34.98 |
| 6 | 31.8 | | | |

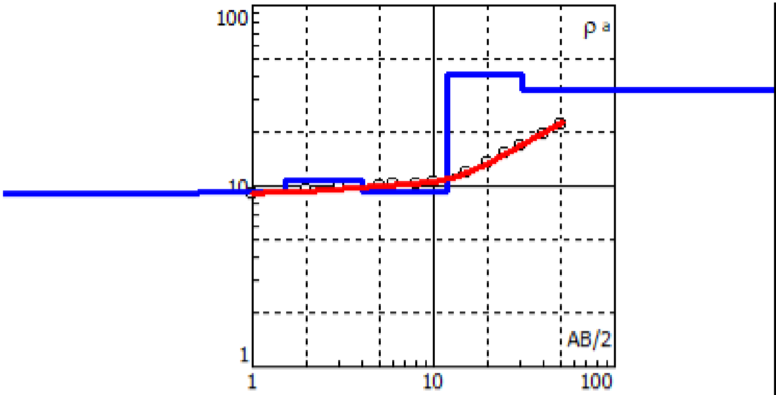
Ds8




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 18.2 | 0.5 | 0.5 | -0.5 |
| 2 | 18.2 | 0.96 | 1.46 | -1.46 |
| 3 | 8.27 | 2.66 | 4.12 | -4.123 |
| 4 | 8.56 | 7.76 | 11.9 | -11.88 |
| 5 | 34.2 | 21.6 | 33.5 | -33.52 |
| 6 | 99 | | | |

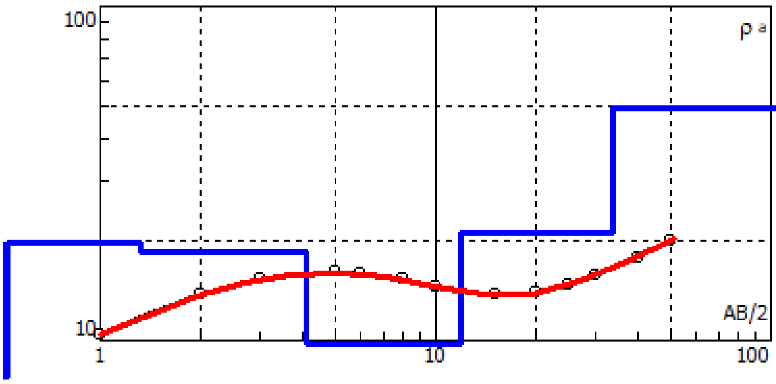
Ds9

# 1227



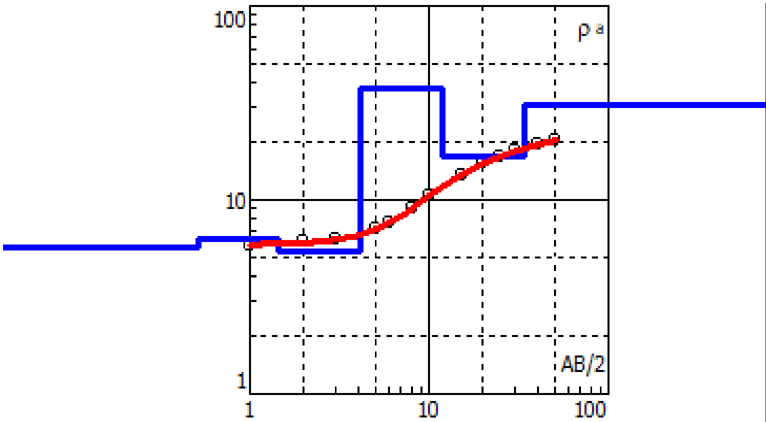

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 8.99 | 0.5 | 0.5 | -0.5 |
| 2 | 9.29 | 1 | 1.5 | -1.5 |
| 3 | 10.7 | 2.55 | 4.05 | -4.05 |
| 4 | 9.23 | 7.76 | 11.8 | -11.81 |
| 5 | 41.8 | 19.2 | 31 | -30.96 |
| 6 | 34.1 | | | |

**ds10**



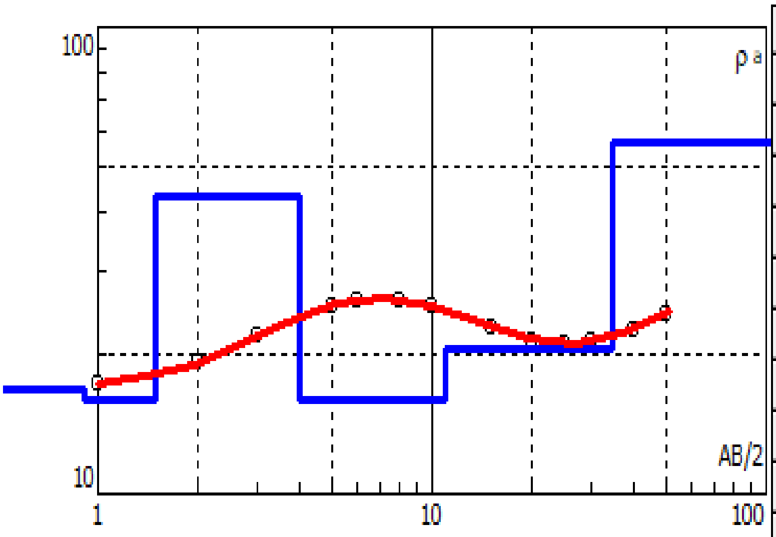

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 7.77 | 0.5 | 0.5 | -0.5 |
| 2 | 19.8 | 0.821 | 1.32 | -1.321 |
| 3 | 18.5 | 2.8 | 4.12 | -4.123 |
| 4 | 9.76 | 7.7 | 11.8 | -11.82 |
| 5 | 21 | 22.1 | 34 | -33.96 |
| 6 | 49.4 | | | |

**ds11**



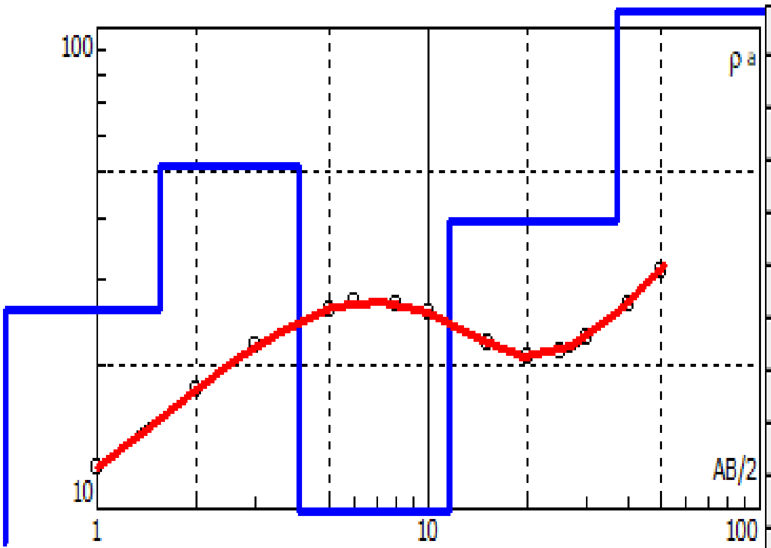

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 5.69 | 0.512 | 0.512 | -0.5116 |
| 2 | 6.25 | 0.949 | 1.46 | -1.461 |
| 3 | 5.45 | 2.67 | 4.13 | -4.13 |
| 4 | 37.1 | 7.73 | 11.9 | -11.86 |
| 5 | 16.8 | 22.3 | 34.2 | -34.17 |
| 6 | 30.7 | | | |

**ds12**



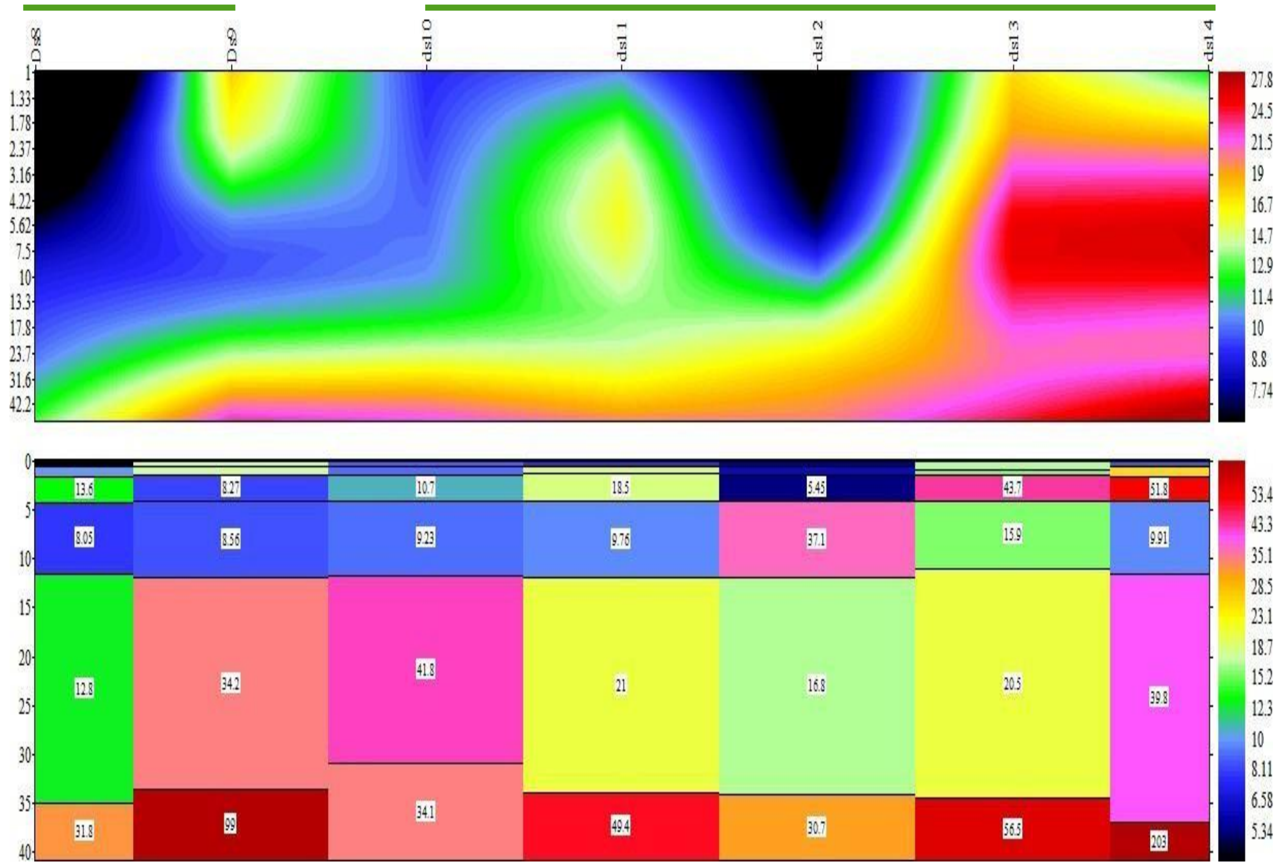

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 16.8 | 0.91 | 0.91 | -0.9101 |
| 2 | 15.8 | 0.572 | 1.48 | -1.483 |
| 3 | 43.7 | 2.54 | 4.03 | -4.026 |
| 4 | 15.9 | 6.95 | 11 | -10.97 |
| 5 | 20.5 | 23.5 | 34.5 | -34.47 |
| 6 | 56.5 | | | |

ds13




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 8.52 | 0.5 | 0.5 | -0.5 |
| 2 | 25.8 | 1.04 | 1.54 | -1.545 |
| 3 | 51.8 | 2.5 | 4.04 | -4.043 |
| 4 | 9.91 | 7.5 | 11.5 | -11.55 |
| 5 | 39.8 | 25.4 | 37 | -36.98 |
| 6 | 203 | | | |

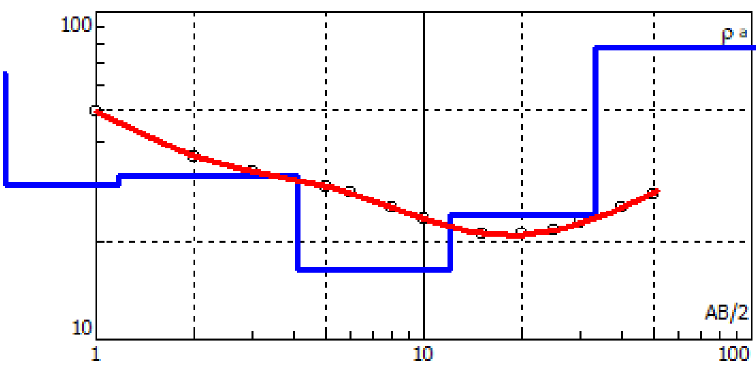
ds14




## Profile II (DS8 - DS14)

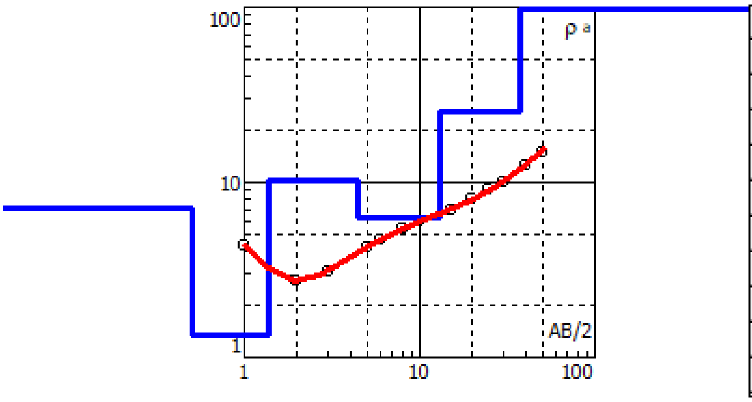
This profile is divisible to two segments. Segment 1 contains very low resistivity (~7.4 - 10 Ωm) below DS8 extending up to a depth 31.6 m on the surface (up to 4.5 m bgl). There is a moderately impervious layer at DS9. The second section between DS10 and DS14 shows low ρa. At DS10 and DS12 leaky zones in the open compost shed shows significant recharge. Towards the east (DS13 and DS14), the high resistivity zones similar to the post-monsoon VES (DSP8 and DSP7) are present.

## Locations/points DS 15 to DS 21



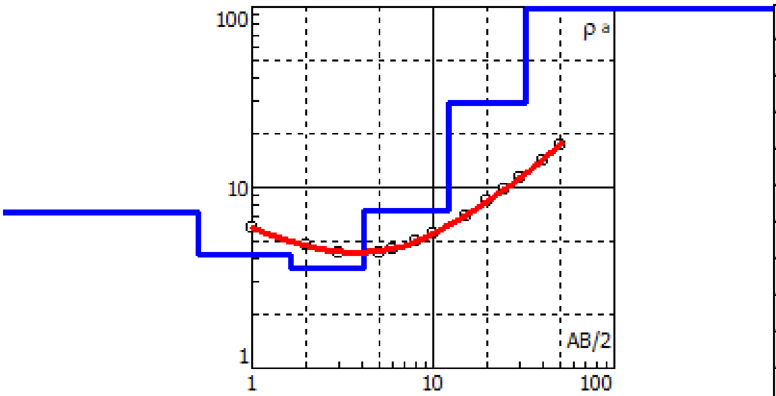

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 64.8 | 0.5 | 0.5 | -0.5 |
| 2 | 29.8 | 0.674 | 1.17 | -1.174 |
| 3 | 31.7 | 2.94 | 4.12 | -4.119 |
| 4 | 16.4 | 7.84 | 12 | -11.96 |
| 5 | 23.8 | 21.2 | 33.2 | -33.19 |
| 6 | 77.3 | | | |

ds15



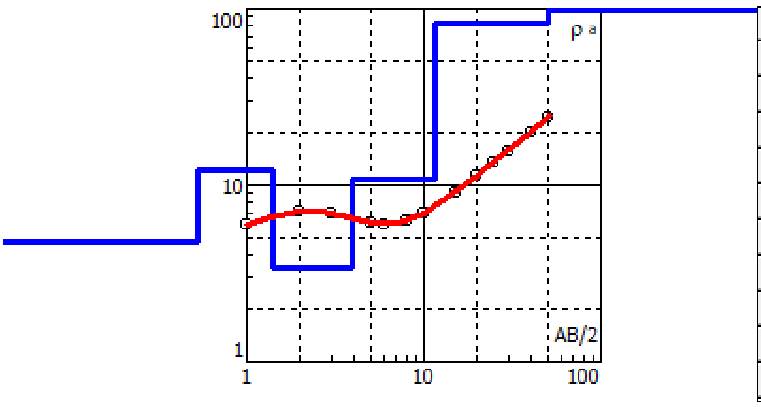

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 7.09 | 0.5 | 0.5 | -0.5 |
| 2 | 1.33 | 0.89 | 1.39 | -1.39 |
| 3 | 10.1 | 3.09 | 4.48 | -4.478 |
| 4 | 6.29 | 8.67 | 13.1 | -13.15 |
| 5 | 25.5 | 24.3 | 37.4 | -37.43 |
| 6 | 357 | | | |

ds16



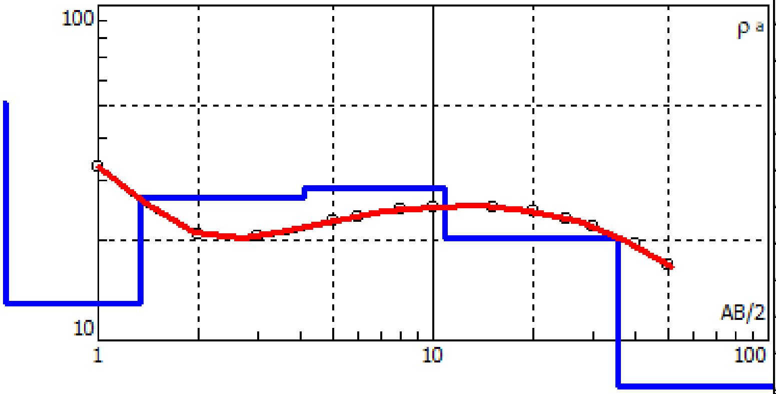

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 7.24 | 0.5 | 0.5 | -0.5 |
| 2 | 4.22 | 1.15 | 1.65 | -1.646 |
| 3 | 3.57 | 2.45 | 4.1 | -4.101 |
| 4 | 7.49 | 7.93 | 12 | -12.03 |
| 5 | 29.4 | 20.7 | 32.7 | -32.71 |
| 6 | 168 | | | |

ds17



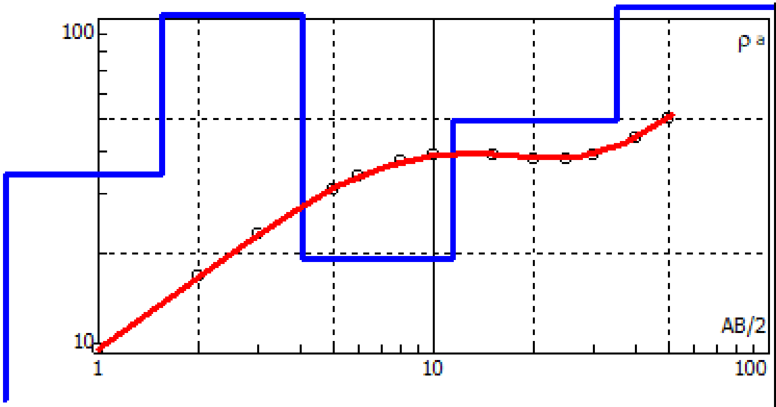

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 4.74 | 0.535 | 0.535 | -0.5354 |
| 2 | 12.3 | 0.859 | 1.39 | -1.394 |
| 3 | 3.41 | 2.59 | 3.98 | -3.98 |
| 4 | 10.7 | 7.57 | 11.6 | -11.55 |
| 5 | 81.8 | 38.5 | 50 | -50 |
| 6 | 297 | | | |

ds18



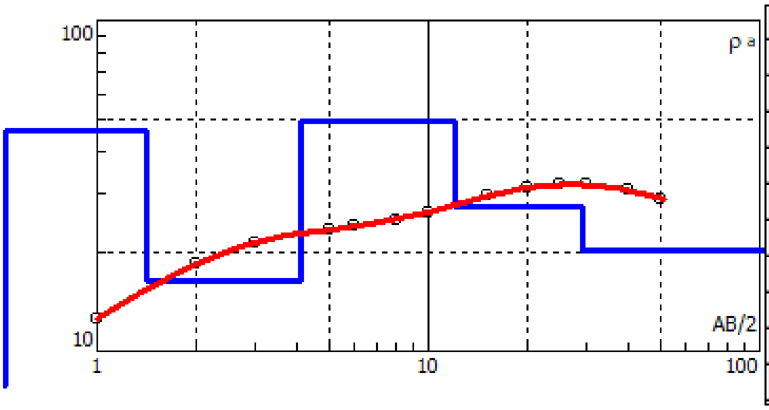

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 51 | 0.5 | 0.5 | -0.5 |
| 2 | 12.9 | 0.831 | 1.33 | -1.331 |
| 3 | 26.6 | 2.79 | 4.12 | -4.123 |
| 4 | 28.3 | 6.77 | 10.9 | -10.9 |
| 5 | 20.1 | 24.7 | 35.6 | -35.62 |
| 6 | 4.58 | | | |

**ds19**



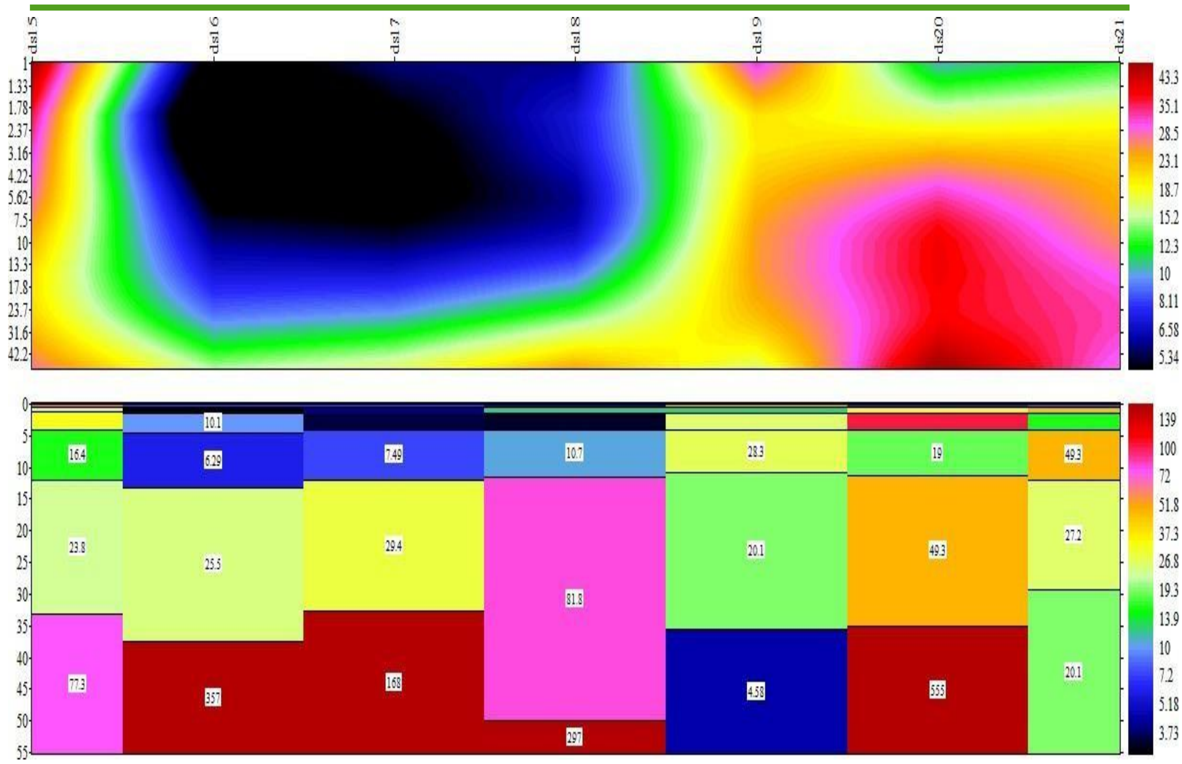

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 6.26 | 0.5 | 0.5 | -0.5 |
| 2 | 34.5 | 1.05 | 1.55 | -1.547 |
| 3 | 103 | 2.54 | 4.09 | -4.089 |
| 4 | 19 | 7.29 | 11.4 | -11.38 |
| 5 | 49.3 | 23.7 | 35.1 | -35.11 |
| 6 | 555 | | | |

**ds20**




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 7.91 | 0.502 | 0.502 | -0.5015 |
| 2 | 46.7 | 0.91 | 1.41 | -1.411 |
| 3 | 16.3 | 2.72 | 4.14 | -4.135 |
| 4 | 49.3 | 7.89 | 12 | -12.02 |
| 5 | 27.2 | 17.3 | 29.3 | -29.29 |
| 6 | 20.1 | | | |

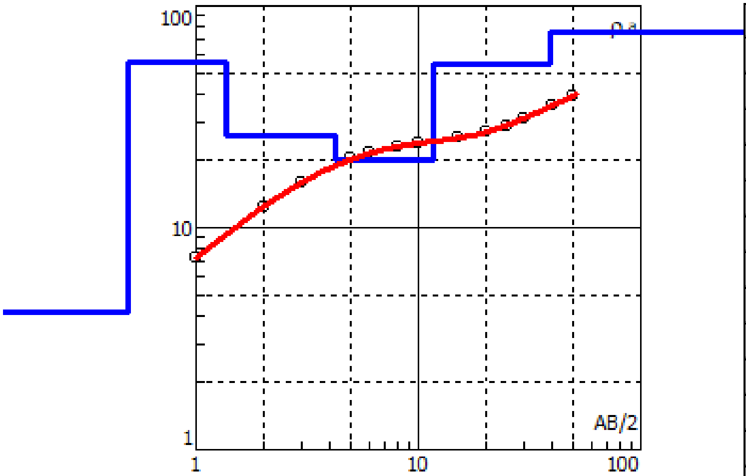
**ds21**




### Profile III (DS15 - DS21)

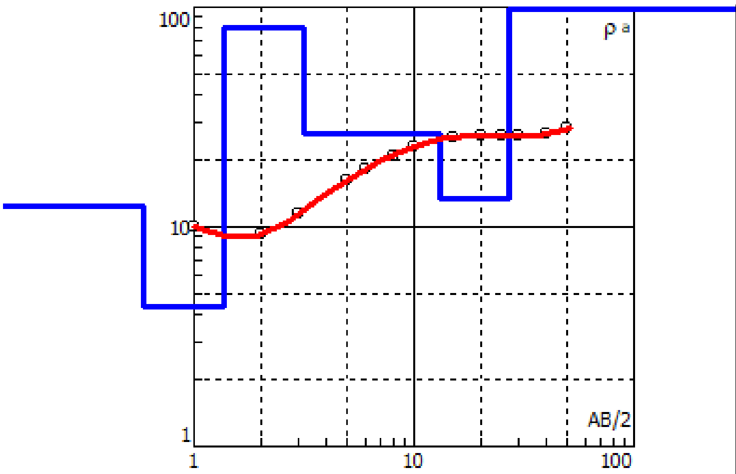
In Profile III, significant recharge is seen between DS16 and DS18 in this profile very low resistivity (~5.3 - 10 Ωm) is seen up to a depth of 31.6 m bgl. As in DS13 and DS14 relatively high resistivity zones are seen in DS19 - DS21.

### Locations Points DS 22 to DS28



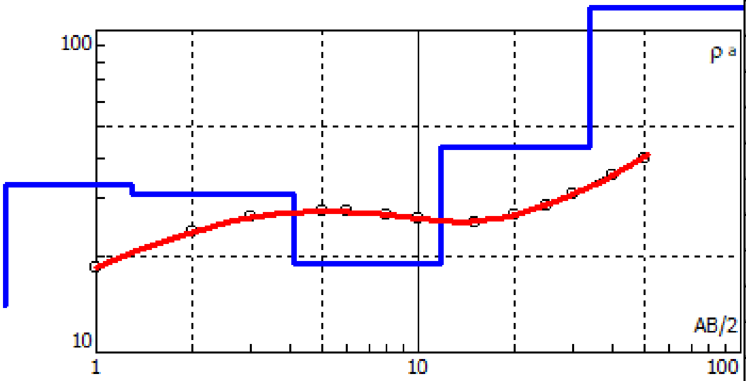

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 4.12 | 0.5 | 0.5 | -0.5 |
| 2 | 56.1 | 0.863 | 1.36 | -1.363 |
| 3 | 26 | 2.86 | 4.23 | -4.226 |
| 4 | 20.1 | 7.51 | 11.7 | -11.73 |
| 5 | 54.5 | 27.6 | 39.3 | -39.31 |
| 6 | 76.4 | | | |

ds22



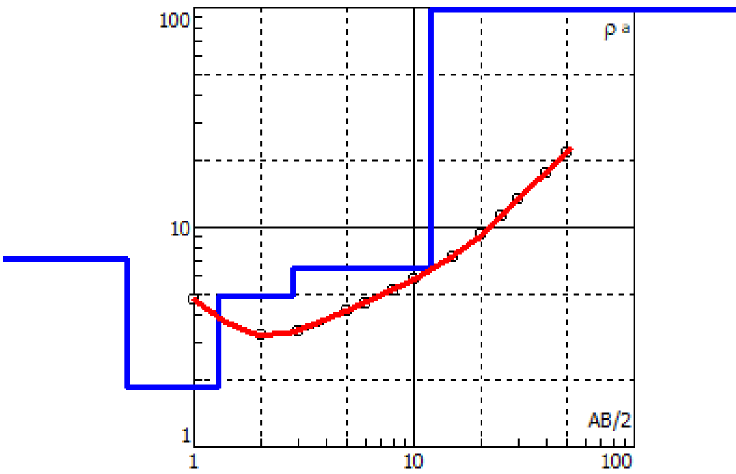

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 12.3 | 0.586 | 0.586 | -0.5858 |
| 2 | 4.34 | 0.78 | 1.37 | -1.365 |
| 3 | 79.9 | 1.79 | 3.15 | -3.151 |
| 4 | 26.5 | 10 | 13.2 | -13.16 |
| 5 | 13.4 | 14.1 | 27.2 | -27.22 |
| 6 | 107 | | | |

Ds23



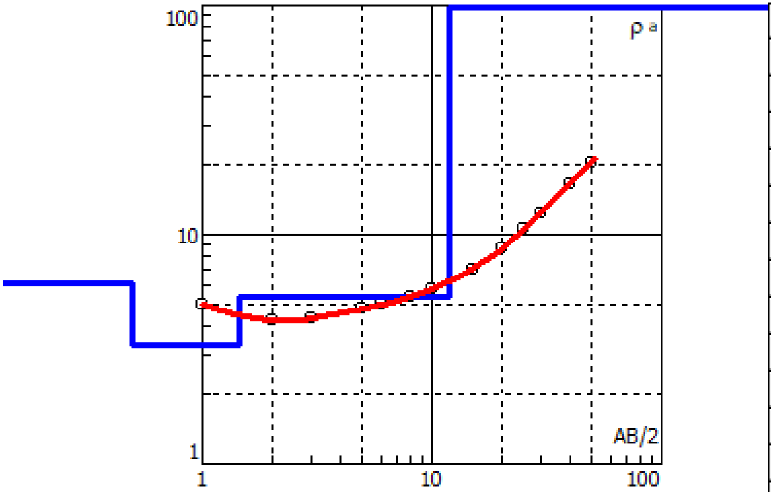

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 14 | 0.5 | 0.5 | -0.5 |
| 2 | 33.1 | 0.793 | 1.29 | -1.293 |
| 3 | 31 | 2.83 | 4.12 | -4.121 |
| 4 | 18.9 | 7.7 | 11.8 | -11.82 |
| 5 | 43.6 | 22.1 | 33.9 | -33.95 |
| 6 | 117 | | | |

Ds24



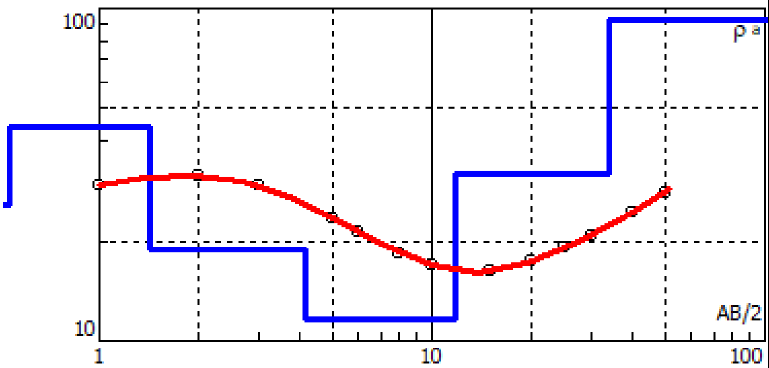

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 7.12 | 0.5 | 0.5 | -0.5 |
| 2 | 1.86 | 0.801 | 1.3 | -1.301 |
| 3 | 4.84 | 1.53 | 2.83 | -2.833 |
| 4 | 6.47 | 9.02 | 11.9 | -11.86 |
| 5 | 606 | 22.1 | 34 | -34 |
| 6 | 1565 | | | |

ds25



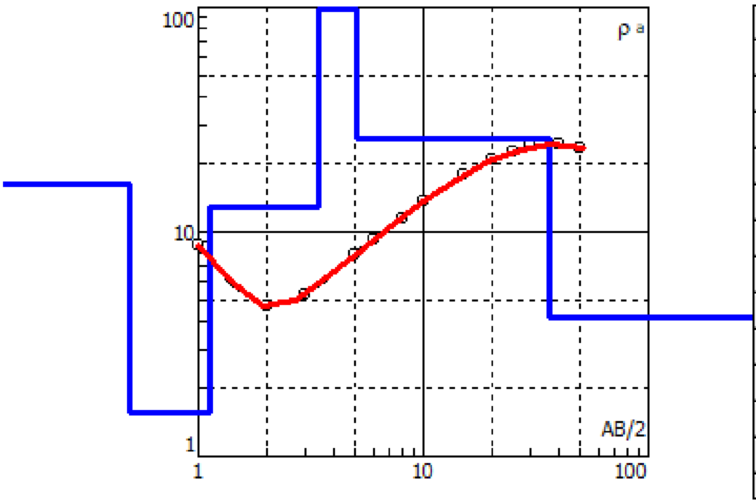

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 6.16 | 0.5 | 0.5 | -0.5 |
| 2 | 3.26 | 0.945 | 1.44 | -1.445 |
| 3 | 5.39 | 2.68 | 4.12 | -4.123 |
| 4 | 5.31 | 7.74 | 11.9 | -11.86 |
| 5 | 220 | 22.1 | 34 | -34 |
| 6 | 1645 | | | |

**ds26**




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 25.7 | 0.539 | 0.539 | -0.5392 |
| 2 | 44.1 | 0.879 | 1.42 | -1.418 |
| 3 | 18.8 | 2.76 | 4.17 | -4.175 |
| 4 | 11.6 | 7.66 | 11.8 | -11.83 |
| 5 | 31.8 | 22.3 | 34.1 | -34.13 |
| 6 | 92.3 | | | |

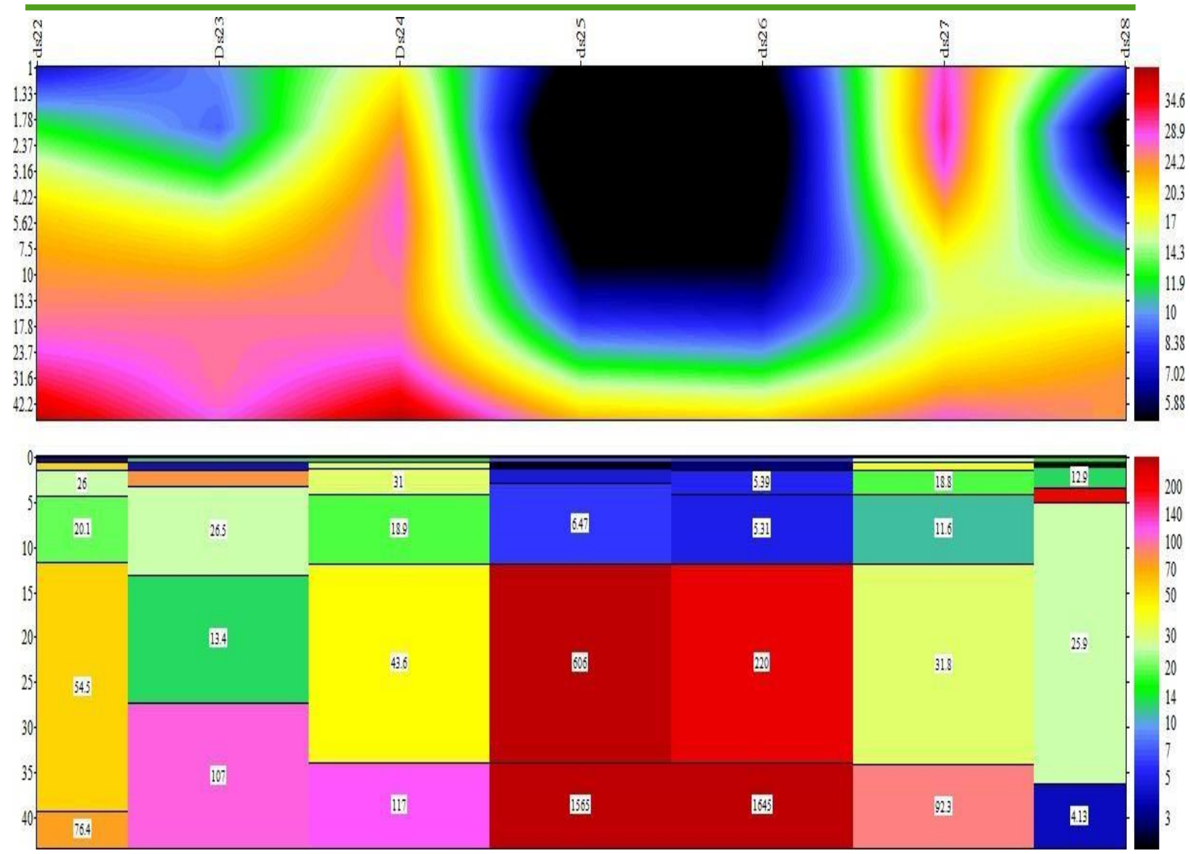
**ds27**




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 16.2 | 0.5 | 0.5 | -0.5 |
| 2 | 1.56 | 0.621 | 1.12 | -1.121 |
| 3 | 12.9 | 2.31 | 3.43 | -3.426 |
| 4 | 208 | 1.67 | 5.1 | -5.097 |
| 5 | 25.9 | 31.2 | 36.3 | -36.29 |
| 6 | 4.13 | | | |

**ds28**

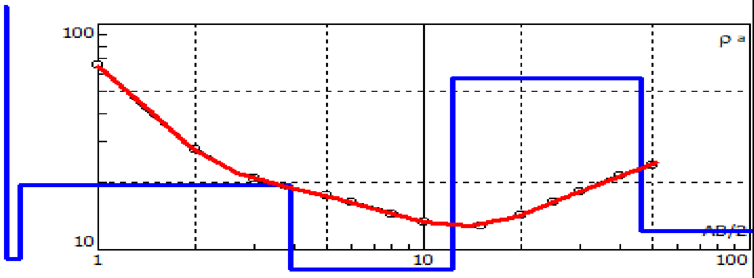
### Profile IV (DS22 – DS 28)




### Profile IV (DS22 - DS28)

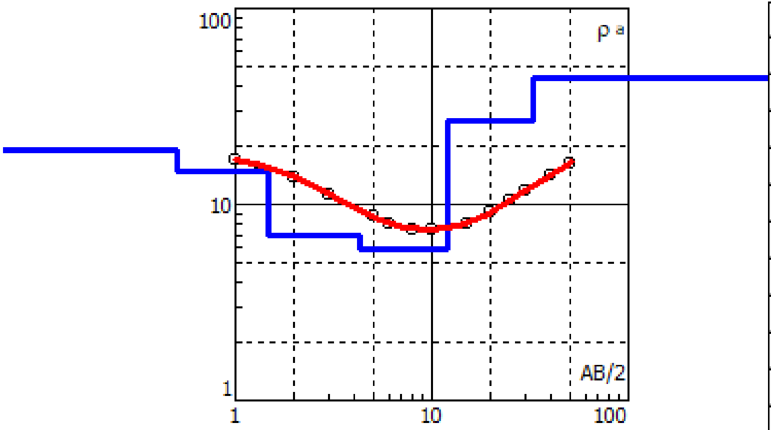
In Profile IV shallow moisture zones up to 3 m are seen at VES DS22 - DS23. However, a large portion of the profile between DS25 - DS26 and DS28 show low apparent resistivity (5.88 - 10 Ωm) and extend up to 23.7 m bgl. These may be the zone from which surface leachate maybe percolating into the lower shallow aquifer.

### Locations/points DS 29 to DS 35



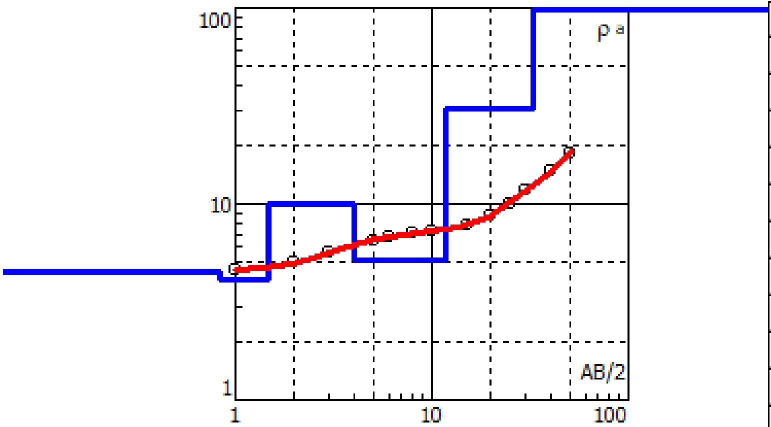

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 120 | 0.5 | 0.5 | -0.5 |
| 2 | 9.09 | 0.0773 | 0.577 | -0.5773 |
| 3 | 19.4 | 3.34 | 3.92 | -3.92 |
| 4 | 8.17 | 8.32 | 12.2 | -12.24 |
| 5 | 57.3 | 34.4 | 46.7 | -46.68 |
| 6 | 12.1 | | | |

Ds29



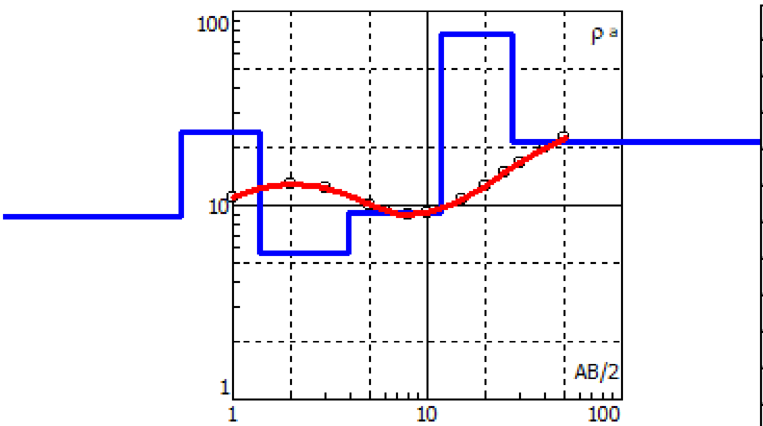

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 19.1 | 0.5 | 0.5 | -0.5 |
| 2 | 14.6 | 0.98 | 1.48 | -1.48 |
| 3 | 6.96 | 2.78 | 4.26 | -4.257 |
| 4 | 5.89 | 7.68 | 11.9 | -11.93 |
| 5 | 26.9 | 20.5 | 32.4 | -32.44 |
| 6 | 43.9 | | | |

Ds30




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 4.51 | 0.84 | 0.84 | -0.84 |
| 2 | 4.12 | 0.628 | 1.47 | -1.468 |
| 3 | 10 | 2.51 | 3.98 | -3.981 |
| 4 | 5.14 | 7.64 | 11.6 | -11.62 |
| 5 | 30.6 | 21.4 | 33 | -33.04 |
| 6 | 660 | | | |

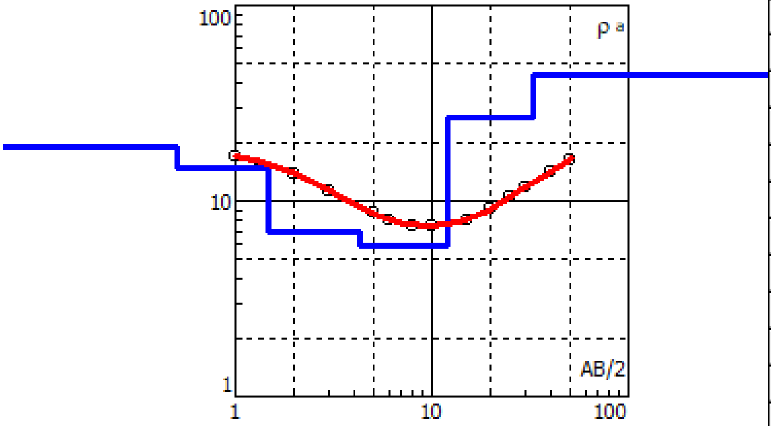
Ds31




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 8.63 | 0.538 | 0.538 | -0.5382 |
| 2 | 23.7 | 0.841 | 1.38 | -1.379 |
| 3 | 5.71 | 2.57 | 3.95 | -3.947 |
| 4 | 9.21 | 7.72 | 11.7 | -11.67 |
| 5 | 76.3 | 15.6 | 27.3 | -27.29 |
| 6 | 21.1 | | | |

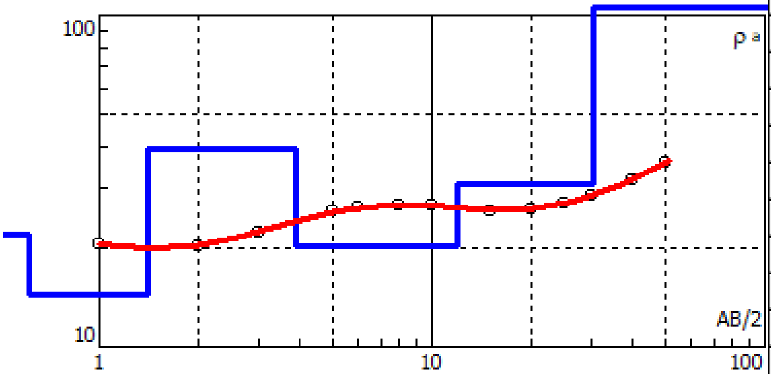
Ds32

# 1237



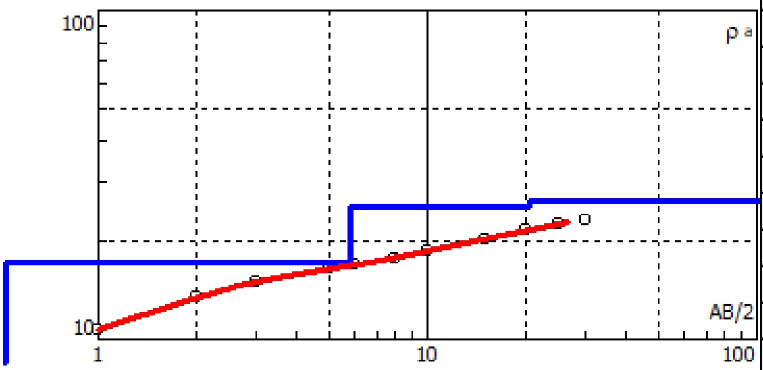

Ds30

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 19.1 | 0.5 | 0.5 | -0.5 |
| 2 | 14.6 | 0.98 | 1.48 | -1.48 |
| 3 | 6.96 | 2.78 | 4.26 | -4.257 |
| 4 | 5.89 | 7.68 | 11.9 | -11.93 |
| 5 | 26.9 | 20.5 | 32.4 | -32.44 |
| 6 | 43.9 | | | |




Ds34

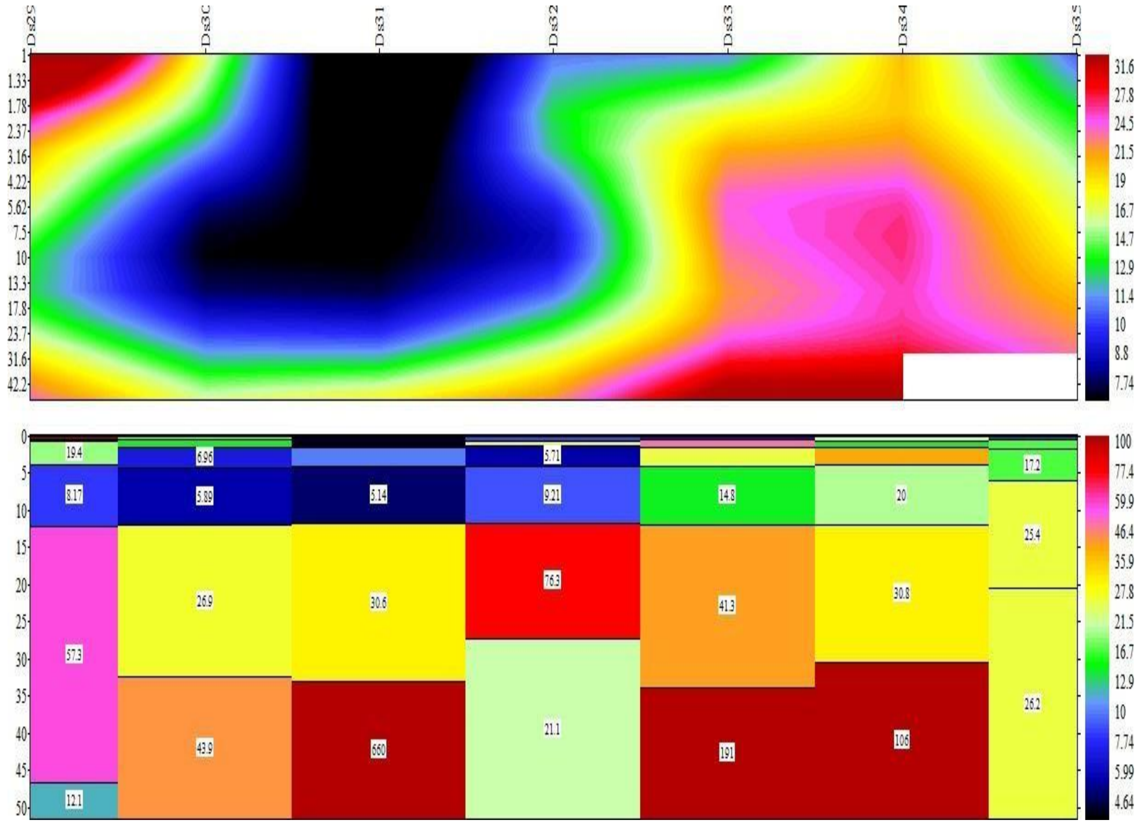
| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 21.8 | 0.613 | 0.613 | -0.613 |
| 2 | 14.4 | 0.788 | 1.4 | -1.401 |
| 3 | 39.7 | 2.49 | 3.89 | -3.895 |
| 4 | 20 | 7.95 | 11.8 | -11.84 |
| 5 | 30.8 | 18.6 | 30.5 | -30.46 |
| 6 | 106 | | | |




Ds35

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 8.46 | 0.5 | 0.5 | -0.5 |
| 2 | 17.1 | 1.22 | 1.72 | -1.721 |
| 3 | 17.2 | 4.15 | 5.87 | -5.867 |
| 4 | 25.4 | 14.5 | 20.4 | -20.4 |
| 5 | 26.2 | | | |

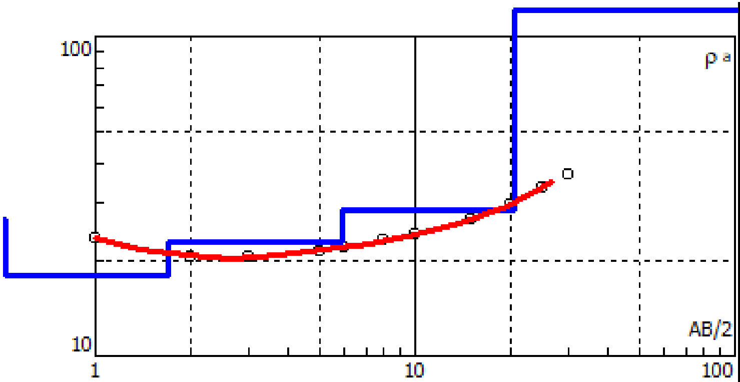
**Profile V (DS29 – DS 35)**




**Profile V (DS29 - DS35)**

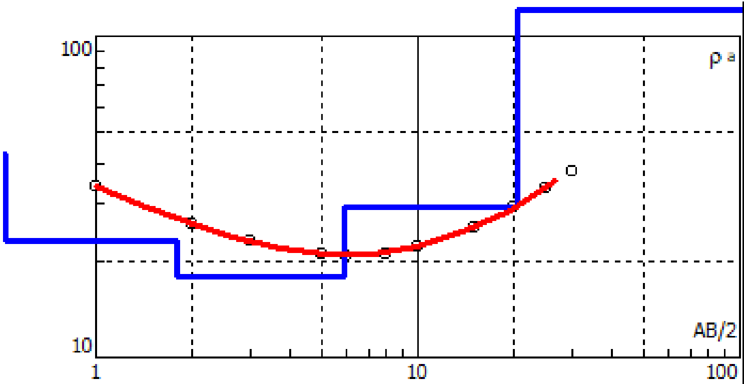
High surface resistivity is seen at DS29 and DS34 in Profile V. However, leaky segments are seen between DS31 - DS33 and DS35 (ρa ~ 7.74 - 11.4 Ωm) up to a depth 23.7 m bgl.

## Locations/points DS 36 to DS 42



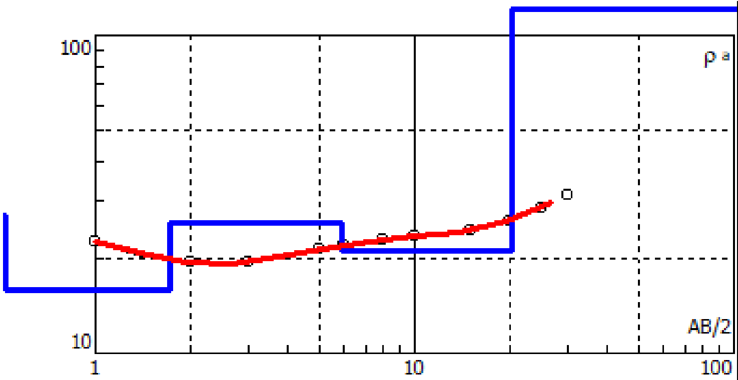

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 26.7 | 0.5 | 0.5 | -0.5 |
| 2 | 17.9 | 1.2 | 1.7 | -1.701 |
| 3 | 22.8 | 4.24 | 5.94 | -5.942 |
| 4 | 28.7 | 14.4 | 20.3 | -20.32 |
| 5 | 265 | | | |

Ds36




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 42.6 | 0.5 | 0.5 | -0.5 |
| 2 | 23 | 1.29 | 1.79 | -1.786 |
| 3 | 17.9 | 4.12 | 5.9 | -5.902 |
| 4 | 29.3 | 14.6 | 20.5 | -20.49 |
| 5 | 940 | | | |

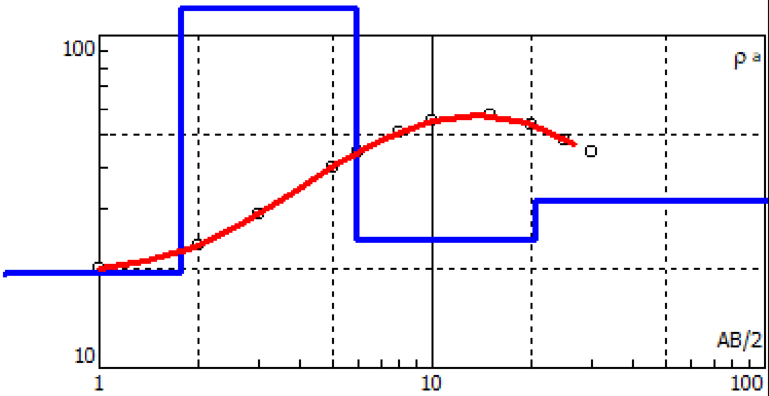
Ds37




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 27 | 0.5 | 0.5 | -0.5 |
| 2 | 15.8 | 1.21 | 1.71 | -1.709 |
| 3 | 25.6 | 4.2 | 5.91 | -5.91 |
| 4 | 21.1 | 14.3 | 20.2 | -20.18 |
| 5 | 291 | | | |

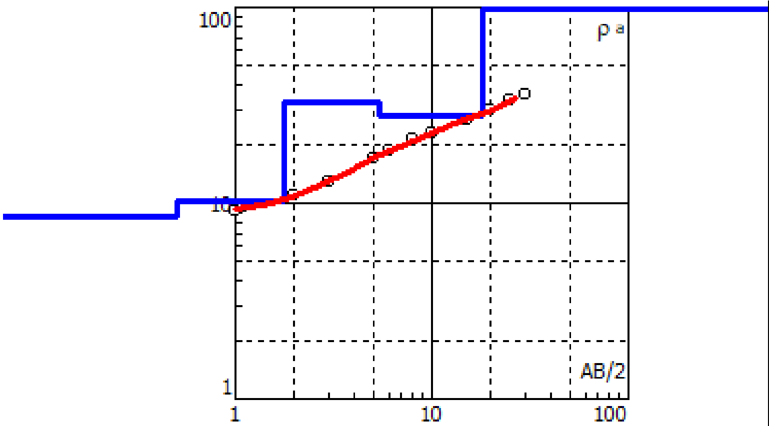
Ds38

# 1240



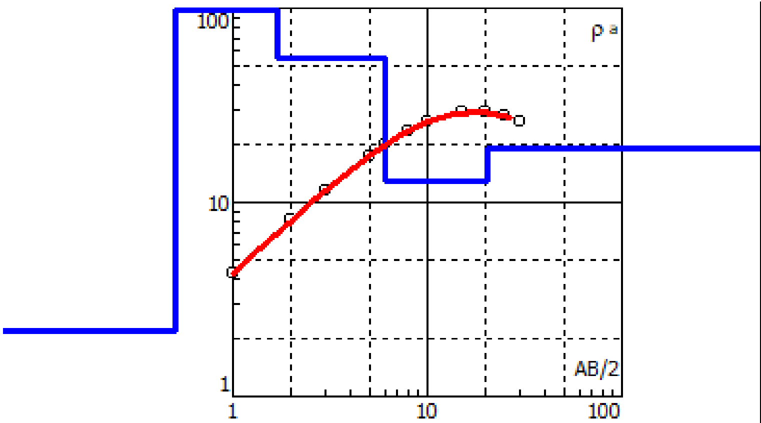

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 19 | 0.5 | 0.5 | -0.5 |
| 2 | 19.5 | 1.26 | 1.76 | -1.758 |
| 3 | 145 | 4.19 | 5.95 | -5.952 |
| 4 | 24.3 | 14.5 | 20.4 | -20.4 |
| 5 | 31.8 | | | |

Ds39



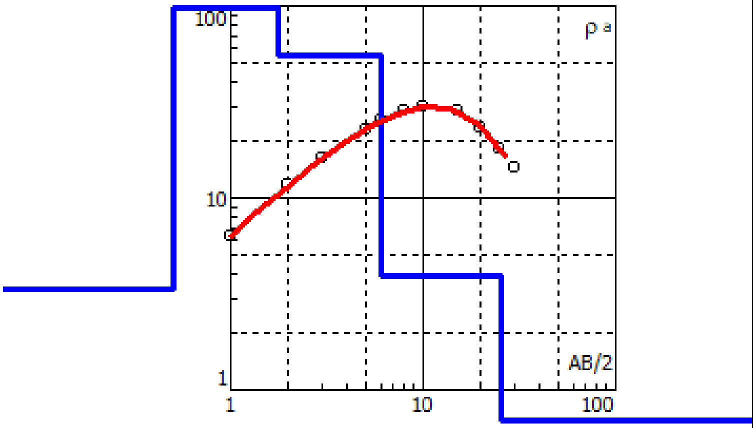

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 8.45 | 0.5 | 0.5 | -0.5 |
| 2 | 10.2 | 1.27 | 1.77 | -1.771 |
| 3 | 32.9 | 3.59 | 5.36 | -5.359 |
| 4 | 27.9 | 12.6 | 17.9 | -17.91 |
| 5 | 153 | | | |

Ds40




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 2.18 | 0.5 | 0.5 | -0.5 |
| 2 | 131 | 1.17 | 1.67 | -1.675 |
| 3 | 55.6 | 4.43 | 6.1 | -6.102 |
| 4 | 12.9 | 14.3 | 20.4 | -20.4 |
| 5 | 18.9 | | | |

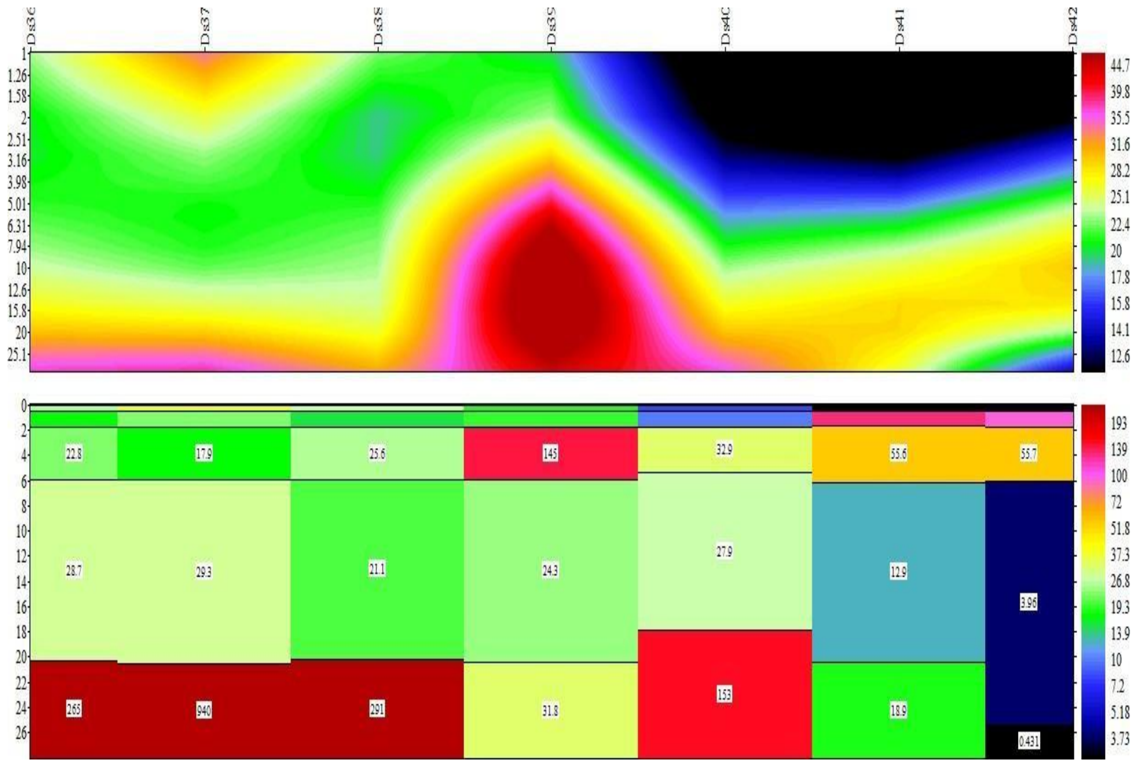
Ds41




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 3.33 | 0.5 | 0.5 | -0.5 |
| 2 | 98.4 | 1.27 | 1.77 | -1.77 |
| 3 | 55.7 | 4.26 | 6.03 | -6.026 |
| 4 | 3.96 | 19.4 | 25.4 | -25.42 |
| 5 | 0.431 | | | |

Ds42

**Profile VI (DS36 – DS42)**



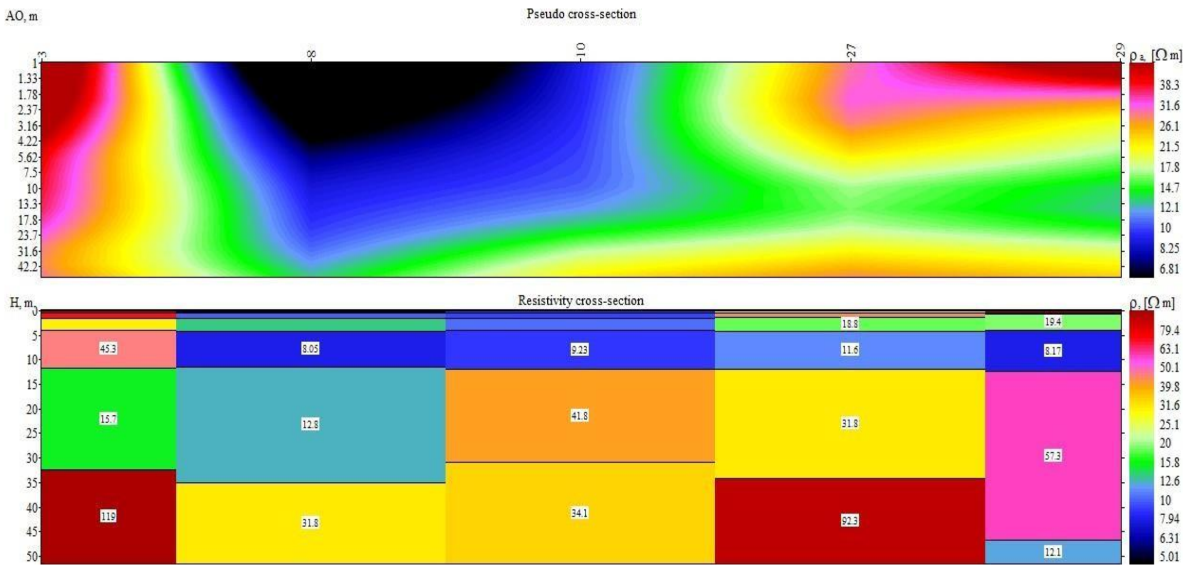

## Profile VI (DS36 - DS42)

This profile is taken along the natural stream that drains the region between the Dyaneshwar Sugar Factory and the compost yard. The resistivity profile VI shows a significant shallow aquifer upstream (DS35 - DS42) up to a depth of 6.3 m bgl. Several large diameters dug wells are present along this profile and water quality analysis from dug well along the stream show no contamination, suggesting that the low ρa values are related to the occurrence of a natural phreatic aquifer. Kindly note the downstream of the profile (from DS35 to DS36) shows moderate apparent resistivity (20 - 31.6 Ωm), suggesting meager extension of the up-profile aquifer system.

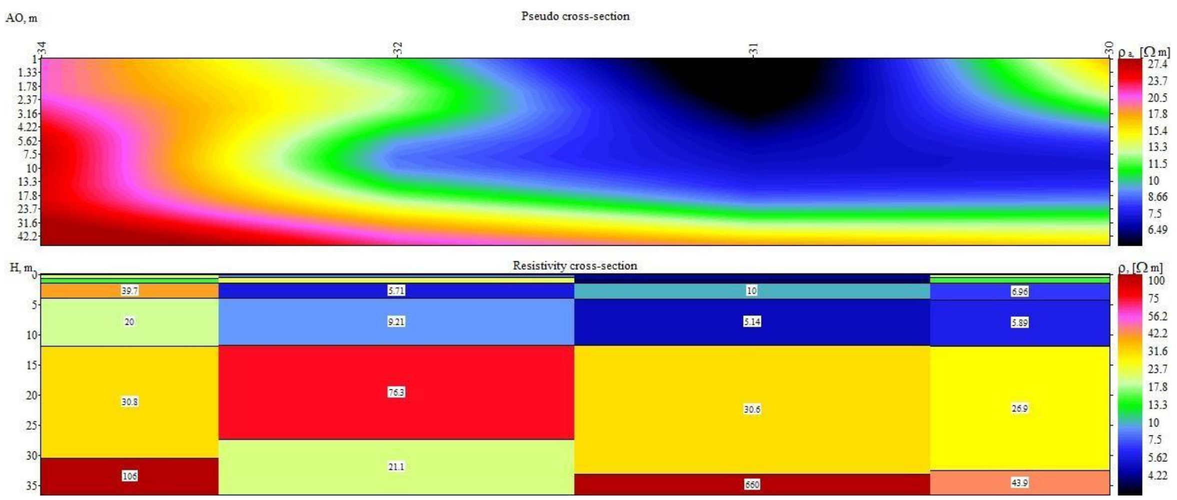
**Replotting**

This study helped in identifying potential deep recharge zones that might have been linked to potential leaks from the leachate produced at the compost yard of the factory. Those points/locations were identified from VES and profiles and the replotting of these profiles are presented below:

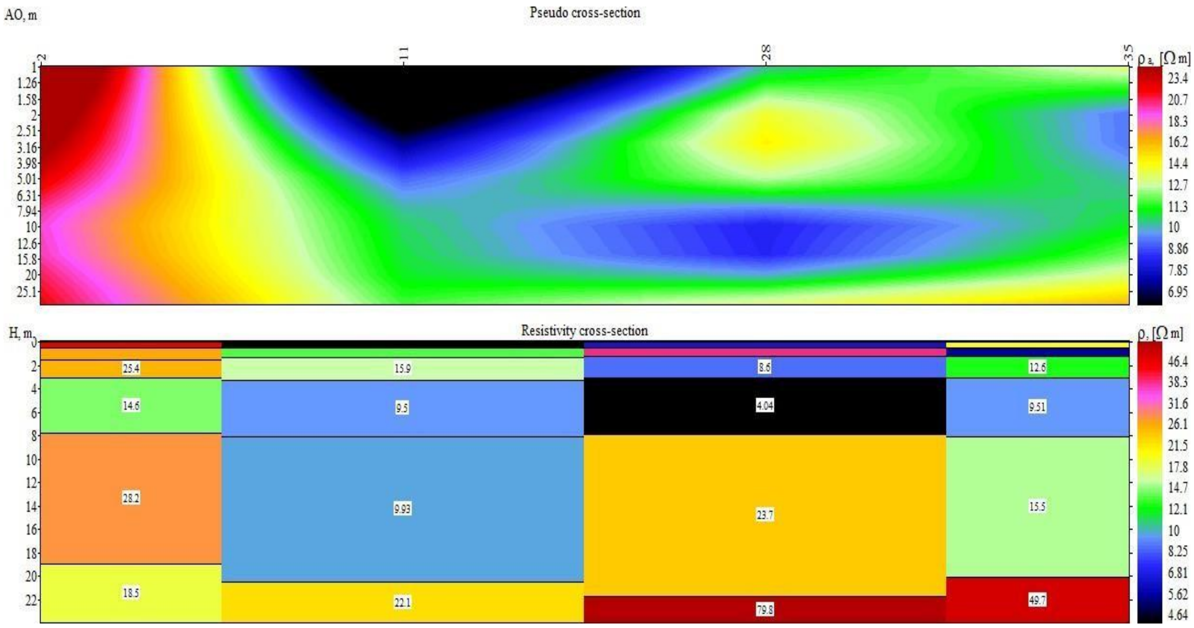
**Pre Monsoon** DS3-DS8-DS10-DS27-DS29



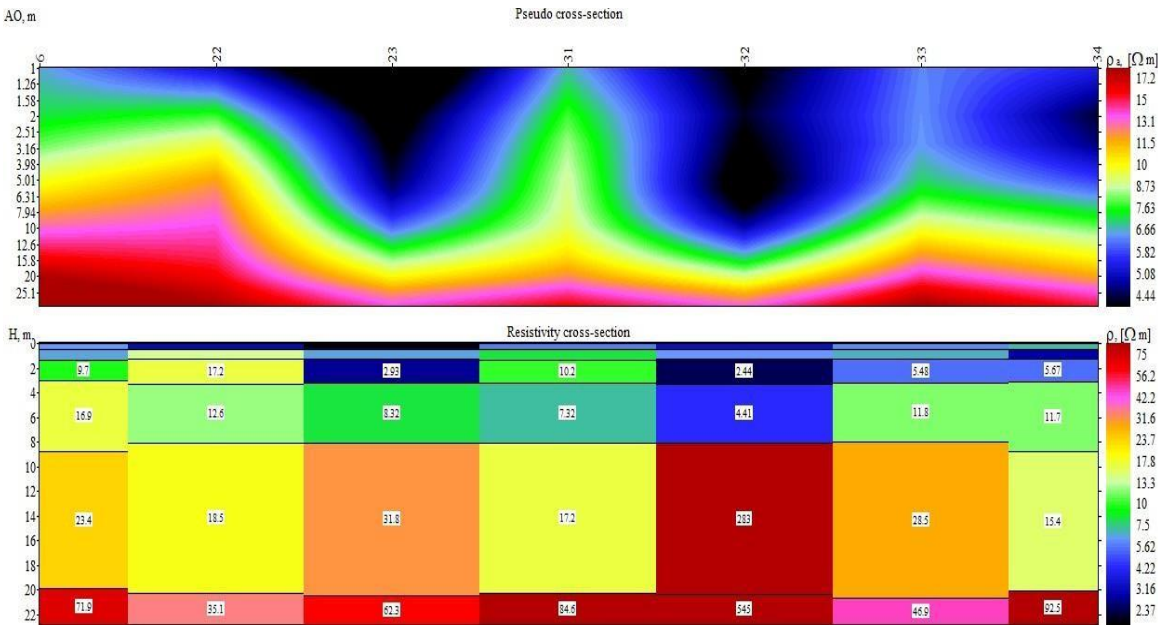

1) DS34-DS32-DS31-DS30



**Post Monsoon-** DSP2-DSP11-DSP28-DS35




1) DSP6-DSP22-DSP23-DSP31-DSP32-DSP33-DSP34



### Post Monsoon season

A total of 35 VES was undertaken in the Post Monsoon season of 2024-25 (Feb 2025). These were used in six layer models, the graphs of which are presented here (after the table). The Post Monsoon (Fig. 1) modeled apparent resistivity graphs were studied and converted into 4 pseudo section profiles. Post Monsoon vertical resistivity Surveys (VES) curves have been classified into 6 categories (Table 4.1).

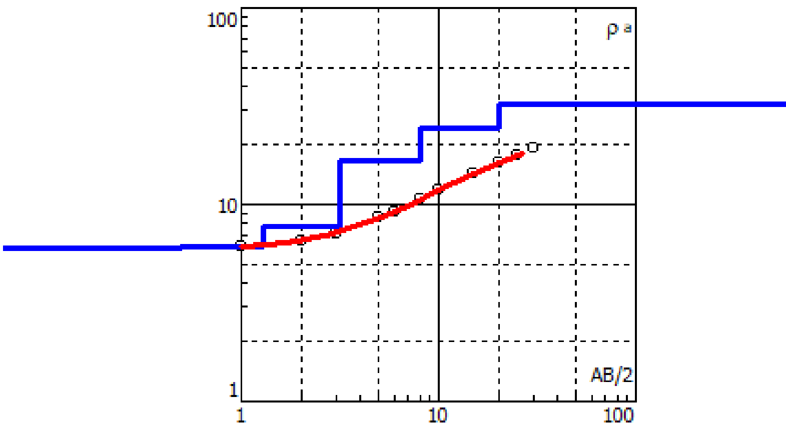

**Fig. 4.2: Locations/points of VES surveys - Post Monsoon season**

**Table 4.1: Season wise classification of VES curve types from the Compost site of the Dnyaneshwar SSKL**

| Post Monsoon | | | Pre Monsoon | | |
|---|---|---|---|---|---|
| Curve Type | VES number | % | Curve Type | VES number | % |
| LHHH | DSP1, DSP6, DSP8, DSP12, DSP21, DSP25, DSP29, DSP31, DSP33 | 25.7 | LHHH | DS1, DS8, DS10, DS12, DS35, DS40 | 14.3 |
| HLLH | DSP2, DSP7, DSP 10 | 8.6 | HLLH | DS2, DS3, DS5, DS6, DS7, DS9, DS15, DS29, DS30, DS37 | 23.8 |

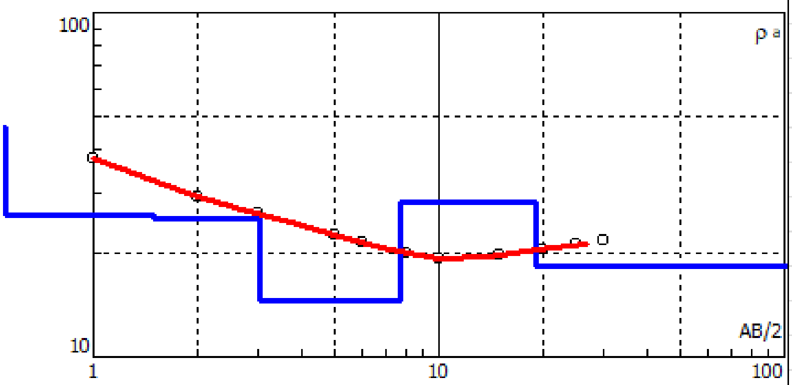
| | | | | | |
|---|---|---|---|---|---|
| LHLH | DSP9, DSP11, DSP19, DSP22, DSP23, DSP26, DSP27, DSP 26, DSP30, DSP32 | 28.6 | LHLH | DS4, DS11, DS13, DS14, DS20, DS22, DS24, DS31, DS32, DS33, DS34 | 26.2 |
| HLHH | DSP13, DSP14, DSP15, DSP16, DSP17, DSP18, DSP 24, DSP34, DSP35 | 25.7 | HLHH | DS16, DS17, DS18, DS25, DS26, DS36, DS38 | 16.7 |
| HLHL | DSP4, DSP5, DSP20 | 8.6 | HLHL | DS19, DS23, DS27, DS28 | 9.5 |
| LHHL | DSP3 | 2.9 | LHHL | DS 21, DS39, DS41, DS42 | 9.5 |

## Post monsoon VES plots and profiles.




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 6.042 | 0.5 | 0.5 | -0.5 |
| 2 | 6.08 | 0.7943 | 1.2943 | -1.2943 |
| 3 | 7.815 | 1.868 | 3.1623 | -3.1623 |
| 4 | 16.78 | 5.004 | 8.1663 | -8.1663 |
| 5 | 24.54 | 11.98 | 20.146 | 20.146 |
| 6 | 32.61 | | | |

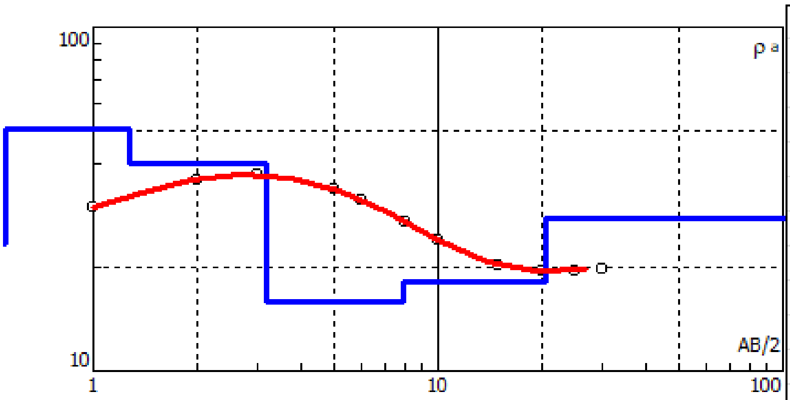
**dsp1**




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 46.4 | 0.5 | 0.5 | -0.5 |
| 2 | 26 | 1 | 1.5 | -1.502 |
| 3 | 25.4 | 1.53 | 3.03 | -3.029 |
| 4 | 14.6 | 4.75 | 7.78 | -7.781 |
| 5 | 28.2 | 11.2 | 19 | -18.99 |
| 6 | 18.5 | | | |

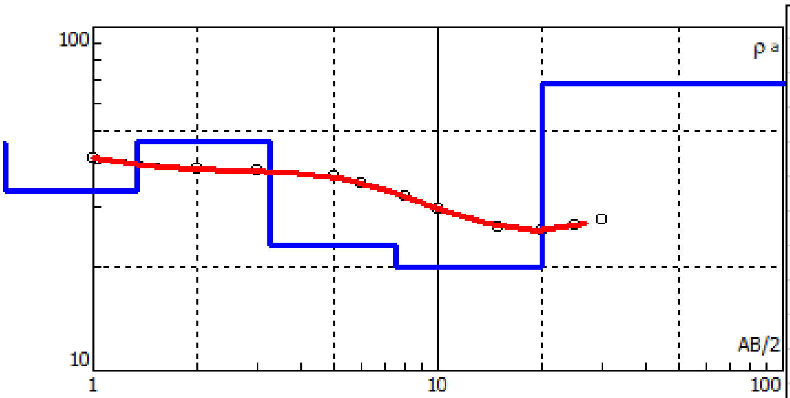
**dsp2**

# 1246



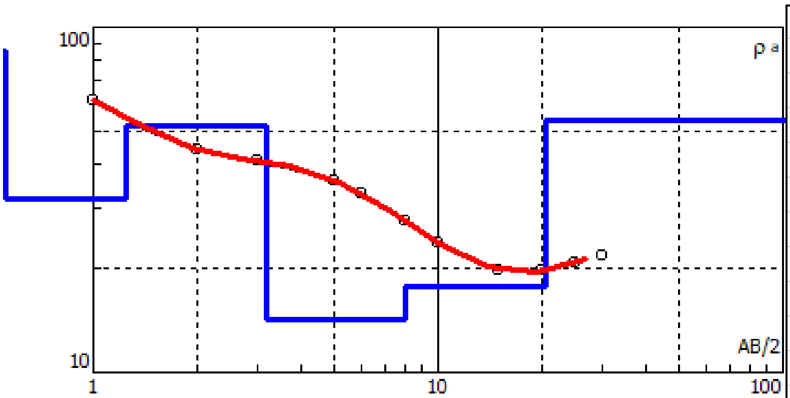

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 23.6 | 0.501 | 0.501 | -0.5006 |
| 2 | 50.4 | 0.769 | 1.27 | -1.269 |
| 3 | 39.9 | 1.92 | 3.19 | -3.188 |
| 4 | 16 | 4.77 | 7.95 | -7.954 |
| 5 | 18.1 | 12.6 | 20.5 | -20.54 |
| 6 | 27.8 | | | |

dsp3




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 45.7 | 0.524 | 0.524 | -0.5238 |
| 2 | 33.3 | 0.81 | 1.33 | -1.334 |
| 3 | 46.2 | 1.94 | 3.28 | -3.278 |
| 4 | 23.3 | 4.25 | 7.52 | -7.523 |
| 5 | 20 | 12.5 | 20.1 | -20.05 |
| 6 | 68.6 | | | |

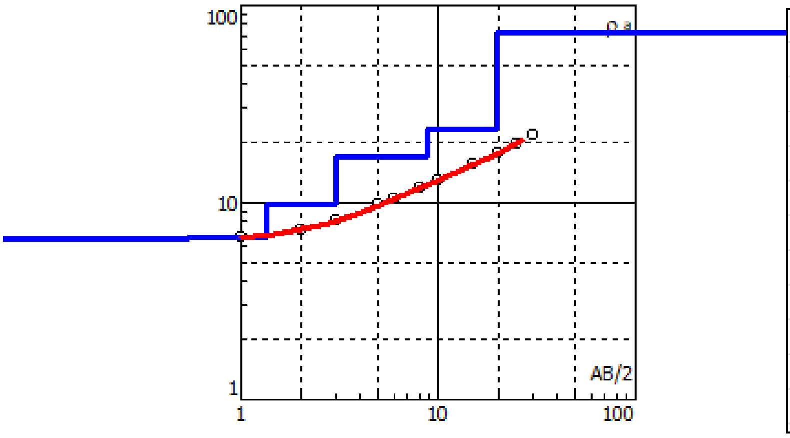
dsp4




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 84.8 | 0.5 | 0.5 | -0.5 |
| 2 | 32 | 0.743 | 1.24 | -1.243 |
| 3 | 51.8 | 1.94 | 3.19 | -3.187 |
| 4 | 14.3 | 4.84 | 8.03 | -8.029 |
| 5 | 17.8 | 12.4 | 20.4 | -20.45 |
| 6 | 53.8 | | | |

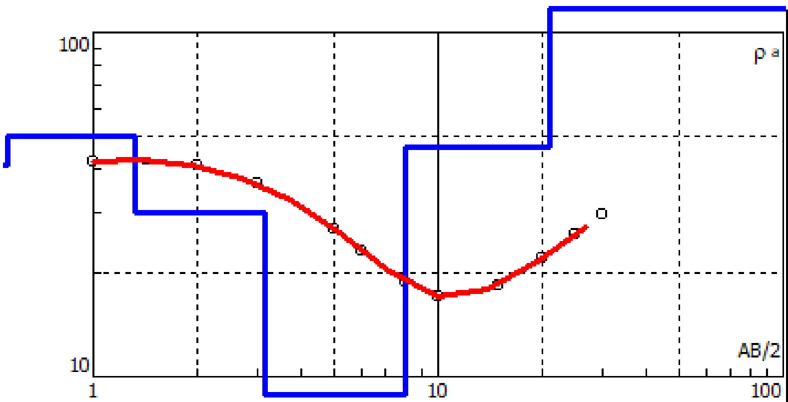
dsp5

# 1247



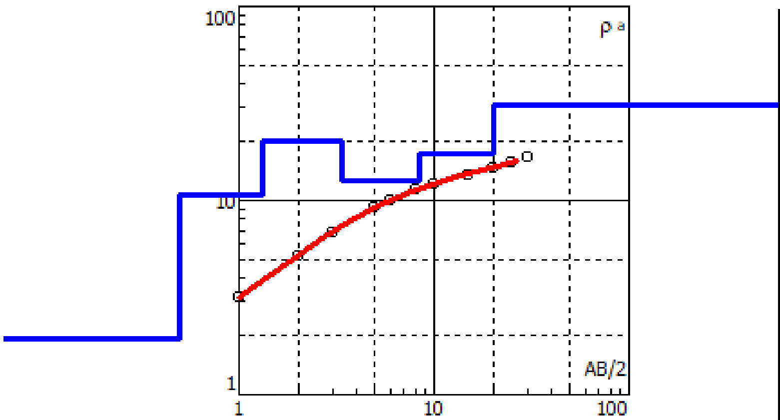

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 6.52 | 0.534 | 0.534 | -0.5342 |
| 2 | 6.6 | 0.801 | 1.34 | -1.336 |
| 3 | 9.7 | 1.66 | 3 | -3.001 |
| 4 | 16.9 | 5.79 | 8.79 | -8.789 |
| 5 | 23.4 | 11.1 | 19.9 | -19.93 |
| 6 | 71.9 | | | |

dsp6




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 40.8 | 0.563 | 0.563 | -0.5633 |
| 2 | 50.2 | 0.761 | 1.32 | -1.324 |
| 3 | 29.8 | 1.82 | 3.14 | -3.141 |
| 4 | 8.84 | 4.85 | 7.99 | -7.991 |
| 5 | 46.2 | 13.1 | 21.1 | -21.13 |
| 6 | 147 | | | |

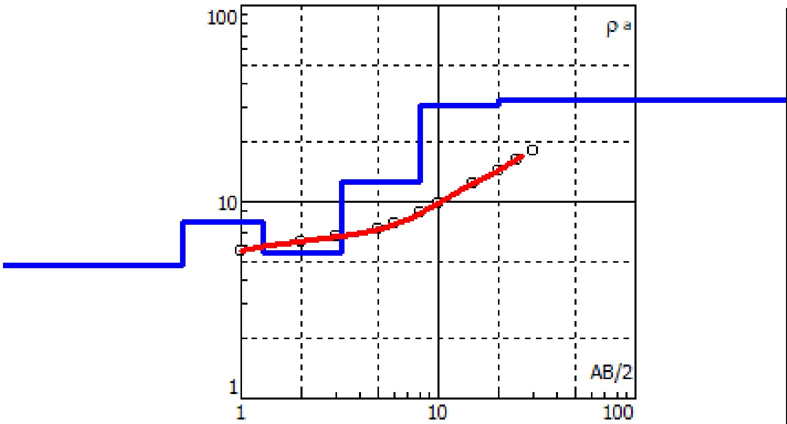
dsp7




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 1.95 | 0.5 | 0.5 | -0.5 |
| 2 | 10.7 | 0.811 | 1.31 | -1.311 |
| 3 | 20 | 2.06 | 3.37 | -3.372 |
| 4 | 12.7 | 5.03 | 8.4 | -8.398 |
| 5 | 17.4 | 11.6 | 20 | -20.03 |
| 6 | 31 | | | |

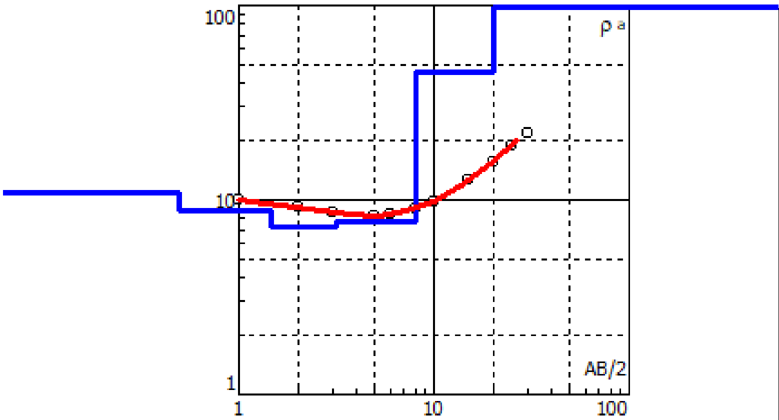
dsp8

# 1248




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 4.78 | 0.504 | 0.504 | -0.5038 |
| 2 | 7.85 | 0.781 | 1.28 | -1.285 |
| 3 | 5.45 | 1.92 | 3.21 | -3.209 |
| 4 | 12.7 | 4.83 | 8.04 | -8.037 |
| 5 | 30.8 | 12.4 | 20.4 | -20.4 |
| 6 | 33.2 | | | |

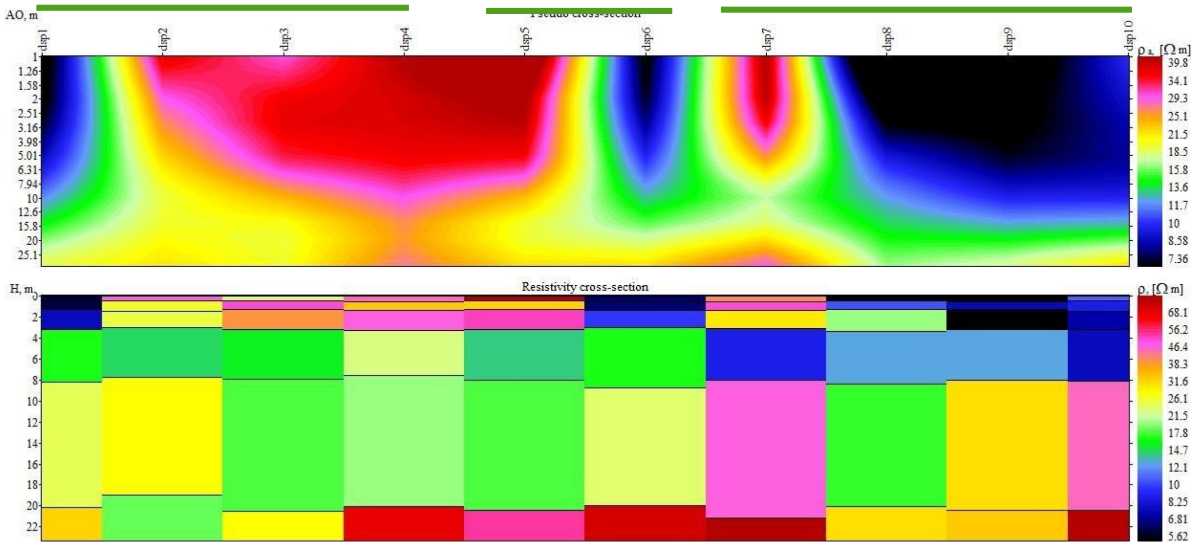
dsp9




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 10.9 | 0.5 | 0.5 | -0.5 |
| 2 | 8.89 | 0.954 | 1.45 | -1.454 |
| 3 | 7.33 | 1.74 | 3.19 | -3.193 |
| 4 | 7.72 | 4.9 | 8.1 | -8.096 |
| 5 | 45 | 12.3 | 20.4 | -20.4 |
| 6 | 249 | | | |

dsp10

**Profile I (DSP 1 to DSP 10)**




**Profile I (DSP1 - DSP10)**

This profile is divided into three sections. Section 1 (DSP1- DSP4) runs in the east west direction from the storage tank to the southwest of the compost shed. In this section the moisture laden low apparent resistivity (ρa) < 24 Ωm is seen up to 12.6m bgl (below ground level). However, no leakage (moisture) is seen below VES DSP2 - DSP4 were high resistivity formations are seen. Section 2 of profile 1 DSP5 and DSP6 are present to the east of the compost yard. Here high resistivity is seen in DSP5 but DSP6 show low ρa. Section 3 (DSP7 - DSP10) shows high resistivity at DSP7. DSP8 - DSP10 are well within the compost shed area and show low resistivity (ρa ~ 7.36 - 11.7 Ωm) indicating potential contamination to existing ground water.

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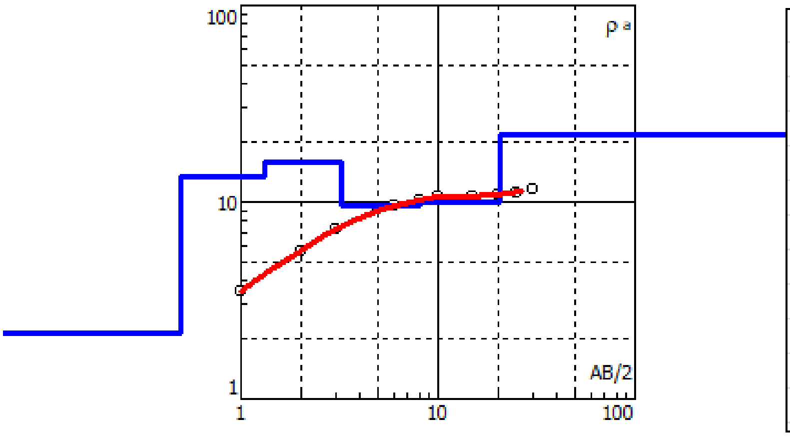
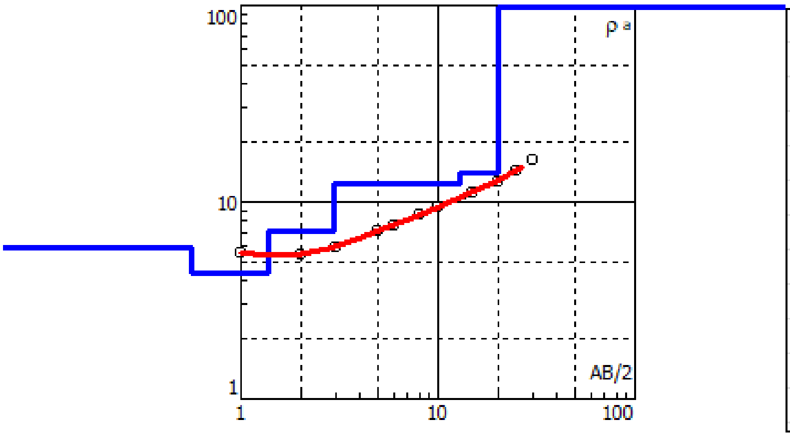
# 1250



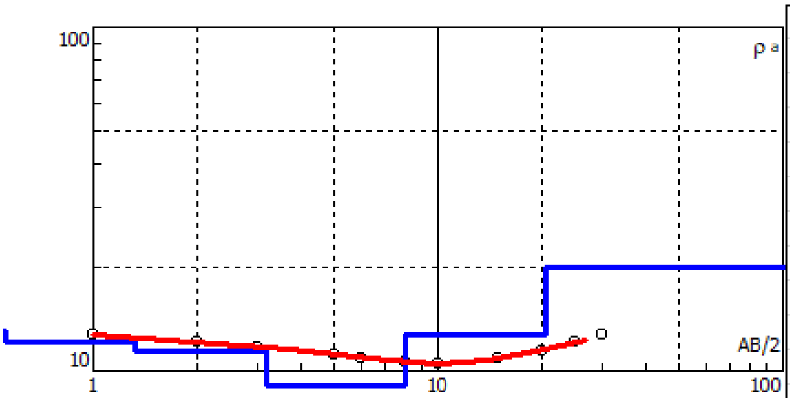

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 2.14 | 0.5 | 0.5 | -0.5 |
| 2 | 13.4 | 0.817 | 1.32 | -1.317 |
| 3 | 15.9 | 1.93 | 3.25 | -3.252 |
| 4 | 9.5 | 4.82 | 8.07 | -8.071 |
| 5 | 9.93 | 12.4 | 20.5 | -20.5 |
| 6 | 22.1 | | | |

dsp11



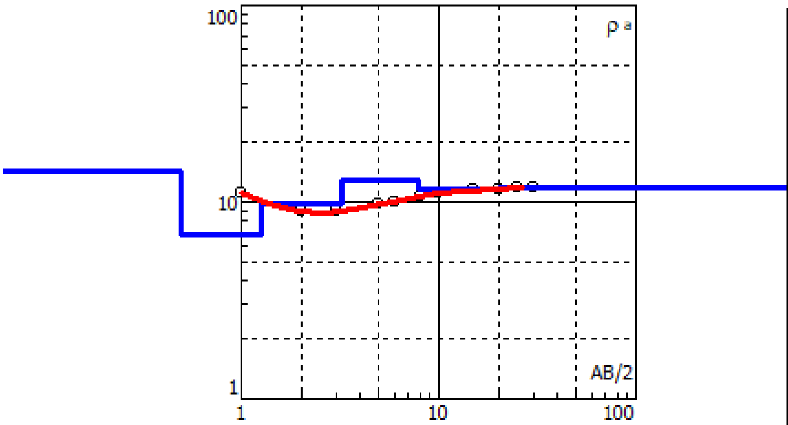

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 5.92 | 0.557 | 0.557 | -0.5571 |
| 2 | 4.38 | 0.808 | 1.36 | -1.365 |
| 3 | 7.15 | 1.6 | 2.97 | -2.966 |
| 4 | 12.4 | 9.92 | 12.9 | -12.89 |
| 5 | 14.1 | 7.17 | 20.1 | -20.06 |
| 6 | 150 | | | |

dsp12



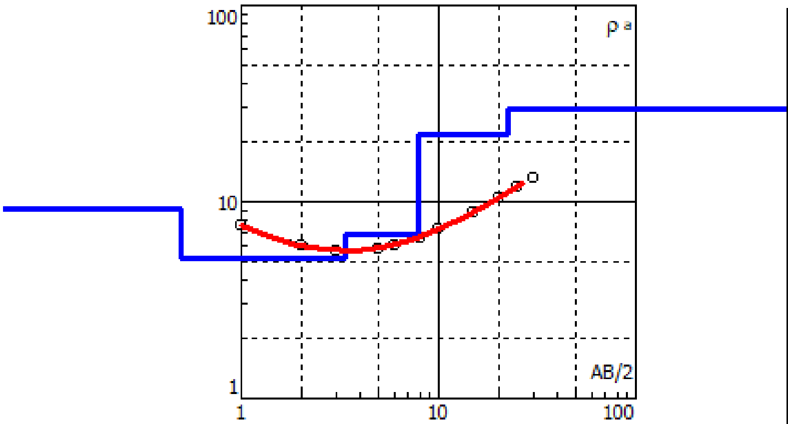

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 13.1 | 0.5 | 0.5 | -0.5 |
| 2 | 12.2 | 0.825 | 1.32 | -1.325 |
| 3 | 11.4 | 1.84 | 3.17 | -3.166 |
| 4 | 9.1 | 4.89 | 8.06 | -8.06 |
| 5 | 12.8 | 12.3 | 20.4 | -20.4 |
| 6 | 20 | | | |

dsp13



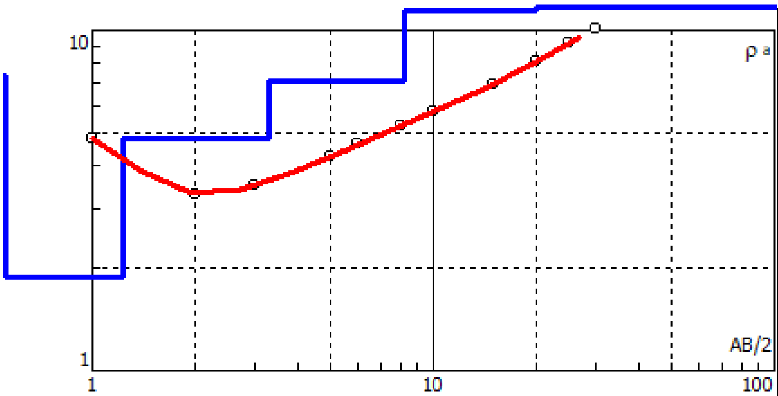

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 14.3 | 0.5 | 0.5 | -0.5 |
| 2 | 6.74 | 0.759 | 1.26 | -1.259 |
| 3 | 9.84 | 1.94 | 3.2 | -3.201 |
| 4 | 12.8 | 4.76 | 7.96 | -7.957 |
| 5 | 11.6 | 12.4 | 20.4 | -20.4 |
| 6 | 11.8 | | | |

dsp14




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 9.22 | 0.5 | 0.5 | -0.5 |
| 2 | 5.18 | 0.764 | 1.26 | -1.264 |
| 3 | 5.11 | 2.1 | 3.36 | -3.364 |
| 4 | 6.82 | 4.51 | 7.88 | -7.879 |
| 5 | 21.9 | 14.5 | 22.4 | -22.37 |
| 6 | 29.5 | | | |

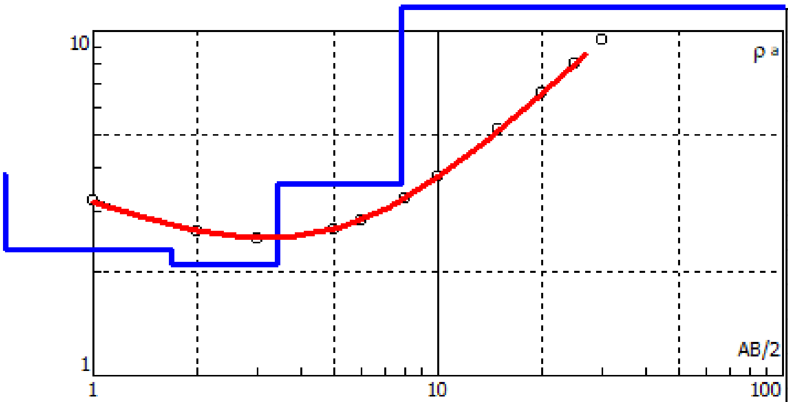
dsp15




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 7.36 | 0.5 | 0.5 | -0.5 |
| 2 | 1.88 | 0.735 | 1.24 | -1.235 |
| 3 | 4.84 | 2.05 | 3.28 | -3.281 |
| 4 | 7.13 | 4.97 | 8.25 | -8.247 |
| 5 | 11.4 | 11.7 | 20 | -19.97 |
| 6 | 37.3 | | | |

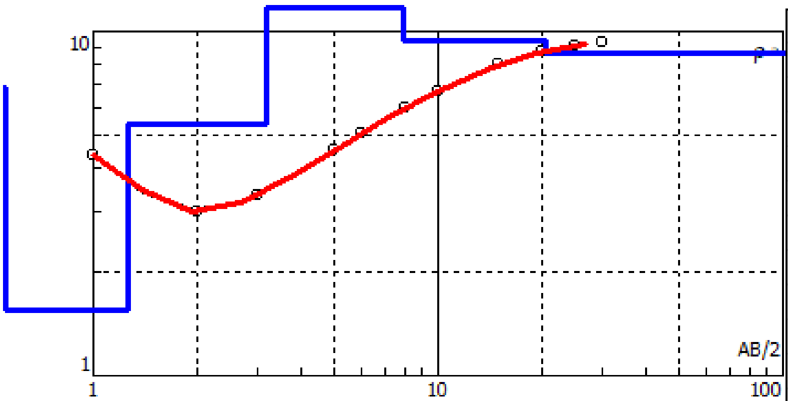
dsp16

# 1252



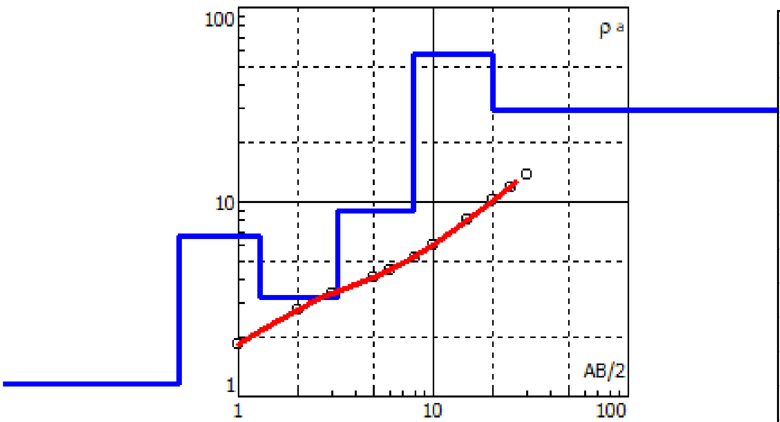

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 3.84 | 0.5 | 0.5 | -0.5 |
| 2 | 2.31 | 1.18 | 1.68 | -1.682 |
| 3 | 2.11 | 1.73 | 3.41 | -3.407 |
| 4 | 3.61 | 4.47 | 7.88 | -7.881 |
| 5 | 44 | 13.1 | 21 | -21.02 |
| 6 | 75.9 | | | |

dsp17



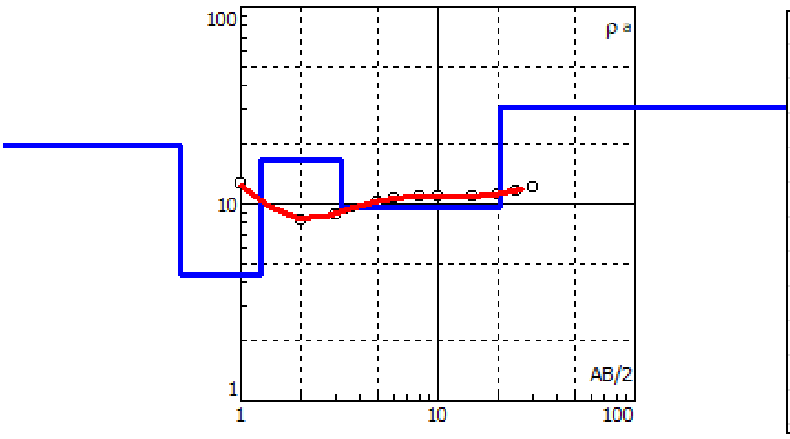

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 6.86 | 0.5 | 0.5 | -0.5 |
| 2 | 1.56 | 0.761 | 1.26 | -1.261 |
| 3 | 5.35 | 1.94 | 3.2 | -3.197 |
| 4 | 15.3 | 4.74 | 7.94 | -7.942 |
| 5 | 9.45 | 12.5 | 20.4 | -20.4 |
| 6 | 8.6 | | | |

dsp18




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 1.17 | 0.5 | 0.5 | -0.5 |
| 2 | 6.74 | 0.779 | 1.28 | -1.279 |
| 3 | 3.25 | 1.95 | 3.23 | -3.23 |
| 4 | 8.98 | 4.66 | 7.89 | -7.887 |
| 5 | 57.9 | 12.4 | 20.3 | -20.28 |
| 6 | 29.9 | | | |

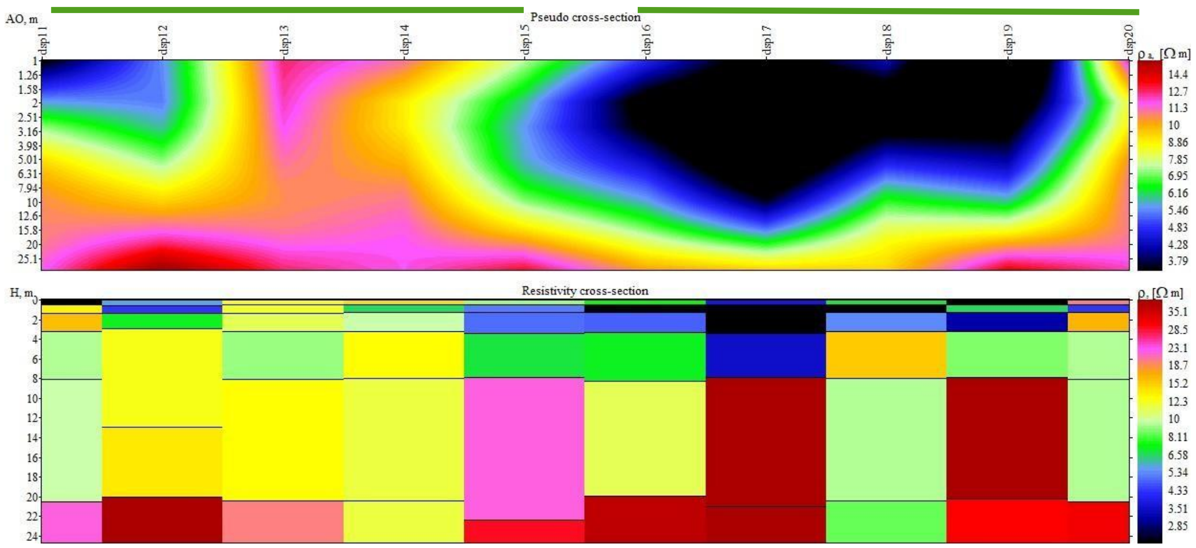
dsp19




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 19.7 | 0.5 | 0.5 | -0.5 |
| 2 | 4.36 | 0.758 | 1.26 | -1.258 |
| 3 | 16.6 | 1.97 | 3.23 | -3.232 |
| 4 | 9.63 | 4.84 | 8.07 | -8.072 |
| 5 | 9.6 | 12.4 | 20.5 | -20.48 |
| 6 | 30.7 | | | |

dsp20

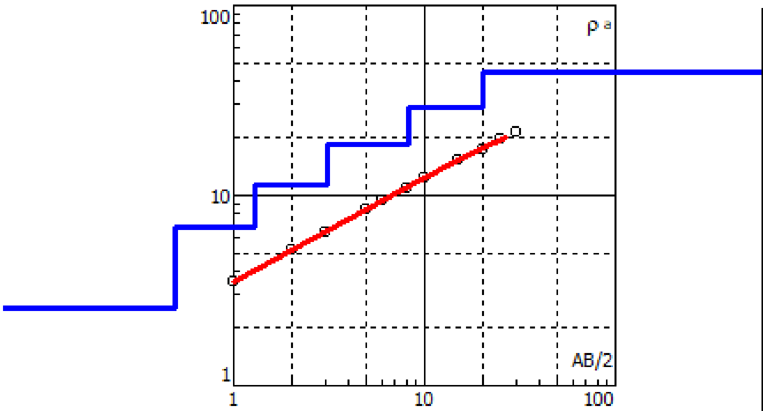
**Profile II (DSP 11 to 20)**




## Profile II (DSP11 - DSP20)

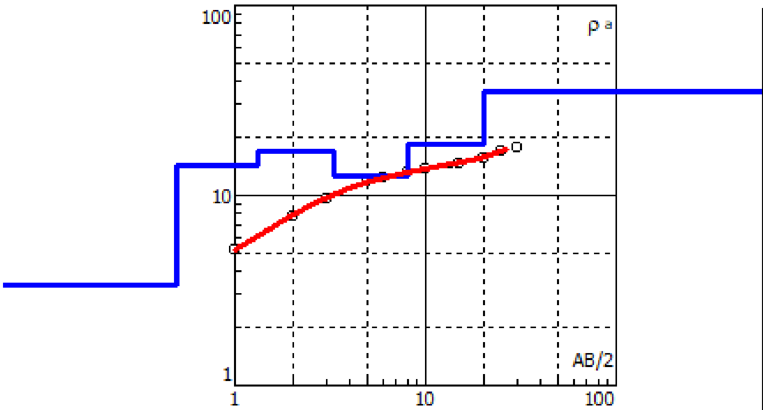
This profile is divided into two critical sections. Section 1 includes DSP11 to DSP15. It is clearly seen that some leakages up to 2m are seen close to the downstream side of the tanks. The remaining part of the profile that is DSP3 to DSP5 shows high resistivity values indicating no leakage. Profile DSP16 to DSP20 run across the open grounds of the compost shed and show low resistivity values (ρa ~ 3.79 - 6.95 Ωm) corresponding to an average depth of 12m.

# 1254



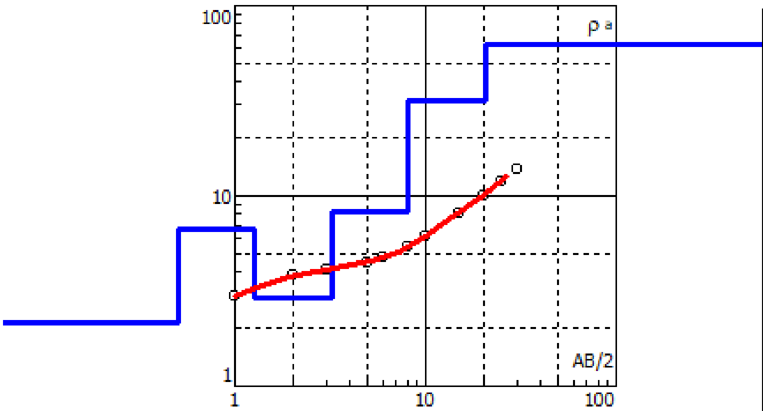

dsp21

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 2.53 | 0.5 | 0.5 | -0.5 |
| 2 | 6.77 | 0.794 | 1.29 | -1.294 |
| 3 | 11.3 | 1.79 | 3.08 | -3.082 |
| 4 | 18.4 | 5.19 | 8.27 | -8.272 |
| 5 | 29.1 | 11.8 | 20.1 | -20.09 |
| 6 | 44.5 | | | |




dsp22

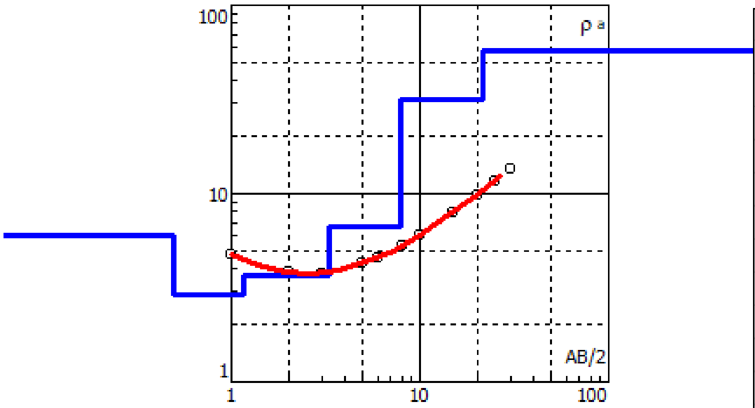
| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 3.35 | 0.5 | 0.5 | -0.5 |
| 2 | 14.5 | 0.811 | 1.31 | -1.311 |
| 3 | 17.2 | 1.96 | 3.27 | -3.268 |
| 4 | 12.6 | 4.87 | 8.14 | -8.139 |
| 5 | 18.5 | 12.1 | 20.3 | -20.29 |
| 6 | 35.1 | | | |




dsp23

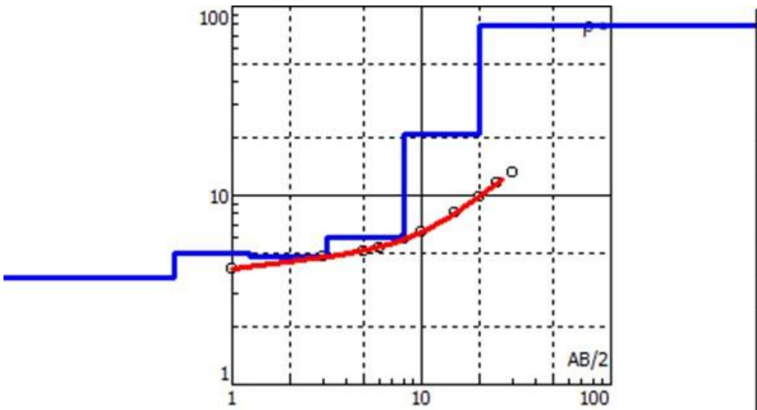
| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 2.17 | 0.503 | 0.503 | -0.5026 |
| 2 | 6.61 | 0.774 | 1.28 | -1.277 |
| 3 | 2.93 | 1.93 | 3.21 | -3.206 |
| 4 | 8.32 | 4.85 | 8.06 | -8.057 |
| 5 | 31.8 | 12.4 | 20.4 | -20.44 |
| 6 | 62.3 | | | |

# 1255



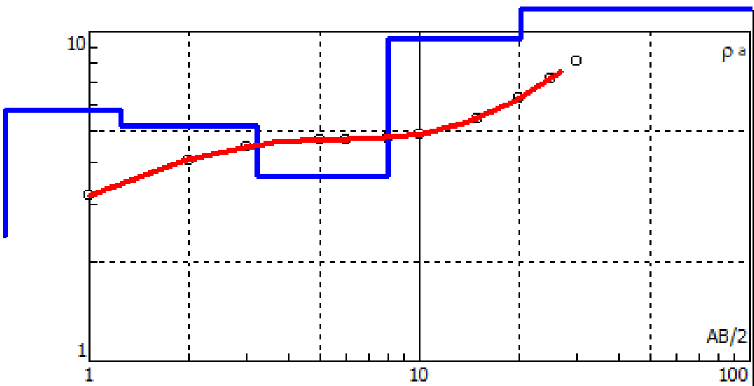

dsp24

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 6.01 | 0.5 | 0.5 | -0.5 |
| 2 | 2.92 | 0.651 | 1.15 | -1.151 |
| 3 | 3.66 | 2.17 | 3.33 | -3.326 |
| 4 | 6.6 | 4.57 | 7.89 | -7.892 |
| 5 | 31.4 | 13.5 | 21.4 | -21.38 |
| 6 | 57.8 | | | |



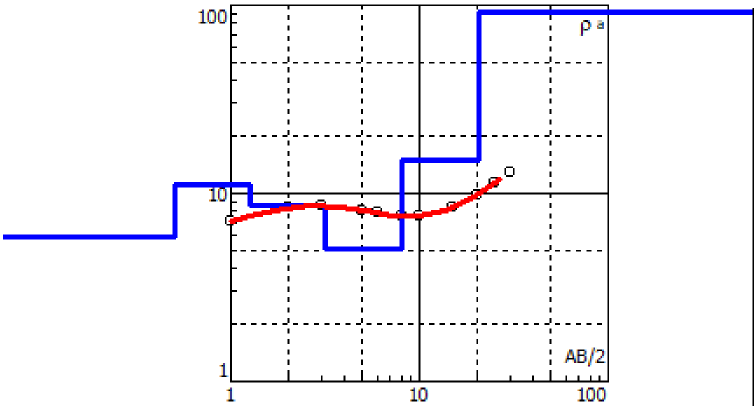

dsp25

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 3.67 | 0.5 | 0.5 | -0.5 |
| 2 | 4.98 | 0.751 | 1.25 | -1.251 |
| 3 | 4.7 | 1.94 | 3.19 | -3.186 |
| 4 | 5.98 | 4.89 | 8.07 | -8.072 |
| 5 | 21.2 | 12.3 | 20.4 | -20.39 |
| 6 | 78.4 | | | |



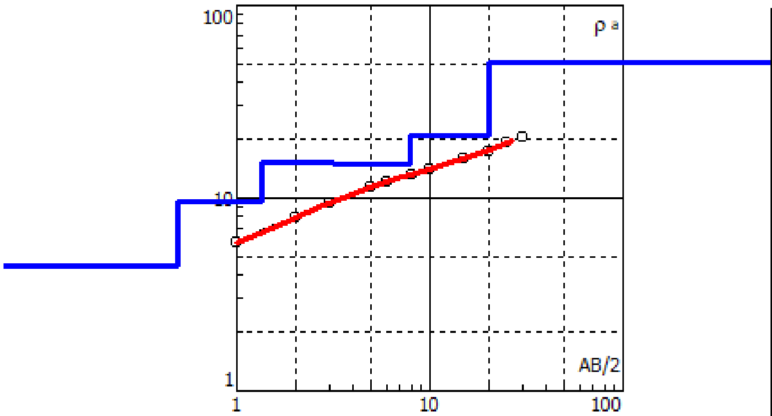

dsp26

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 2.41 | 0.5 | 0.5 | -0.5 |
| 2 | 5.8 | 0.742 | 1.24 | -1.242 |
| 3 | 5.18 | 1.97 | 3.21 | -3.213 |
| 4 | 3.65 | 4.86 | 8.07 | -8.075 |
| 5 | 9.52 | 12.3 | 20.4 | -20.39 |
| 6 | 38.3 | | | |



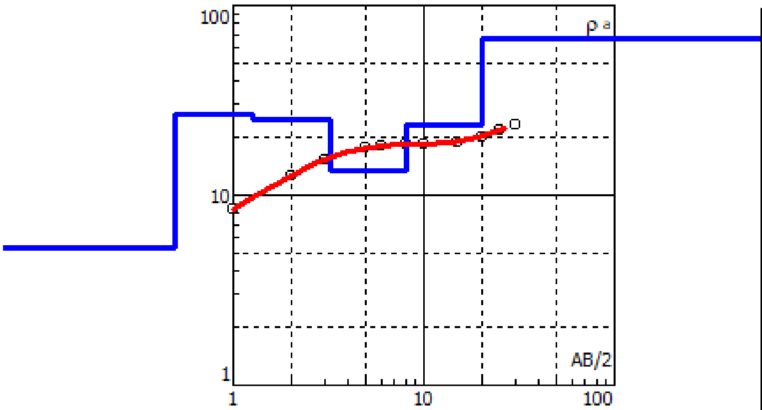

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 5.91 | 0.501 | 0.501 | -0.5009 |
| 2 | 11 | 0.769 | 1.27 | -1.27 |
| 3 | 8.54 | 1.92 | 3.19 | -3.19 |
| 4 | 5.08 | 4.87 | 8.06 | -8.064 |
| 5 | 14.9 | 12.4 | 20.4 | -20.43 |
| 6 | 92.3 | | | |

dsp27




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 4.49 | 0.5 | 0.5 | -0.5 |
| 2 | 9.54 | 0.842 | 1.34 | -1.342 |
| 3 | 15.2 | 1.85 | 3.19 | -3.194 |
| 4 | 14.9 | 4.78 | 7.97 | -7.974 |
| 5 | 21.2 | 12.3 | 20.3 | -20.29 |
| 6 | 50.9 | | | |

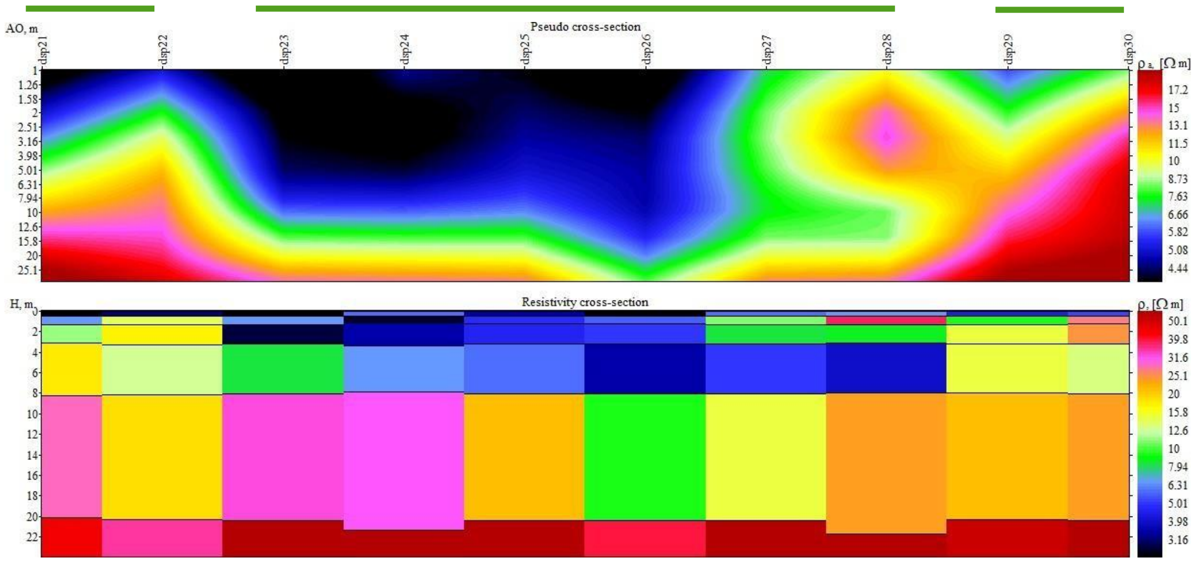
dsp29




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 5.31 | 0.5 | 0.5 | -0.5 |
| 2 | 26.8 | 0.764 | 1.26 | -1.264 |
| 3 | 25.1 | 1.94 | 3.2 | -3.204 |
| 4 | 13.4 | 4.87 | 8.07 | -8.073 |
| 5 | 23.6 | 12.3 | 20.4 | -20.38 |
| 6 | 66.8 | | | |

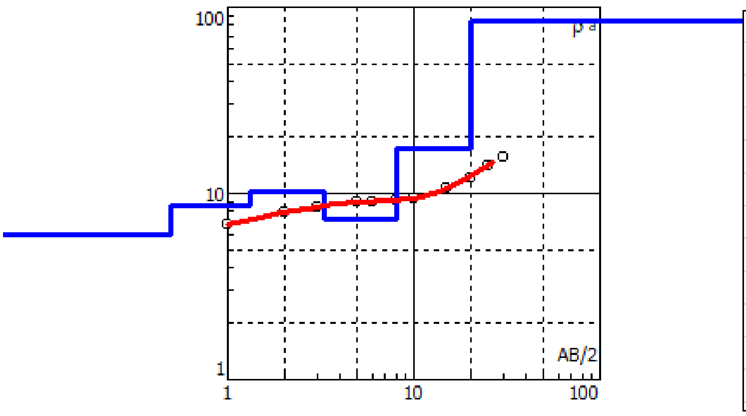
dsp30

## Profile III (DSP 21 to 30)



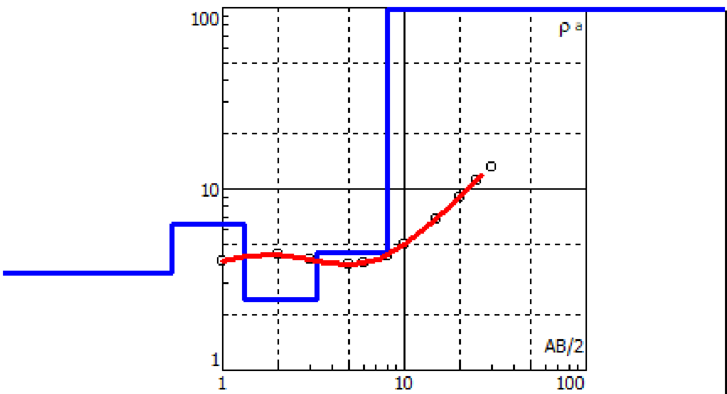

## Profile III (DSP21 - DSP30)

Profile III is divisible into three sections i.e. DSP21 - DSP22, DSP23 - DSP28 and DSP29 - DSP30. Very low apparent resistivity (less than 4.4 - 6.66 Ωm) is seen between section DSP21 to DSP27. Here the maximum depth of contamination is seen at DSP26 to a depth approx. 20m. High resistivity is seen at VES28.



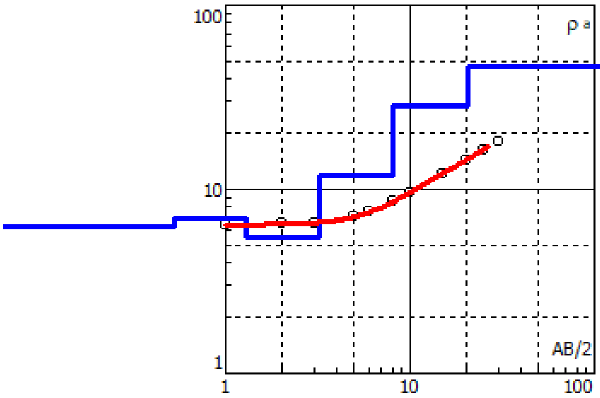

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 5.95 | 0.5 | 0.5 | -0.5 |
| 2 | 8.65 | 0.819 | 1.32 | -1.319 |
| 3 | 10.2 | 1.95 | 3.27 | -3.265 |
| 4 | 7.32 | 4.83 | 8.09 | -8.094 |
| 5 | 17.2 | 12.2 | 20.3 | -20.31 |
| 6 | 84.6 | | | |

dsp31



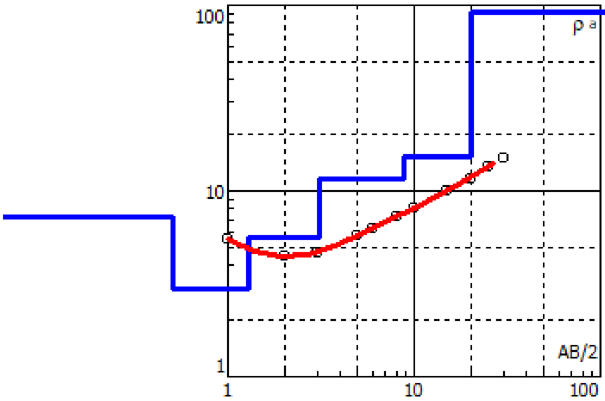

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 3.47 | 0.528 | 0.528 | -0.5277 |
| 2 | 6.32 | 0.779 | 1.31 | -1.306 |
| 3 | 2.44 | 1.98 | 3.28 | -3.282 |
| 4 | 4.41 | 4.85 | 8.14 | -8.136 |
| 5 | 283 | 12.3 | 20.4 | -20.4 |
| 6 | 545 | | | |

dsp32



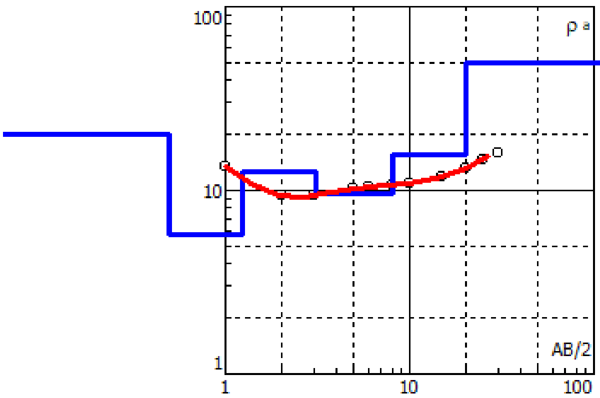

| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 6.22 | 0.53 | 0.53 | -0.53 |
| 2 | 6.9 | 0.771 | 1.3 | -1.301 |
| 3 | 5.48 | 1.91 | 3.21 | -3.215 |
| 4 | 11.8 | 4.82 | 8.04 | -8.038 |
| 5 | 28.5 | 12.6 | 20.7 | -20.66 |
| 6 | 46.9 | | | |

dsp33




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 7.26 | 0.508 | 0.508 | -0.5076 |
| 2 | 2.95 | 0.785 | 1.29 | -1.293 |
| 3 | 5.67 | 1.81 | 3.1 | -3.103 |
| 4 | 11.7 | 5.7 | 8.8 | -8.802 |
| 5 | 15.4 | 11.3 | 20.1 | -20.05 |
| 6 | 92.5 | | | |

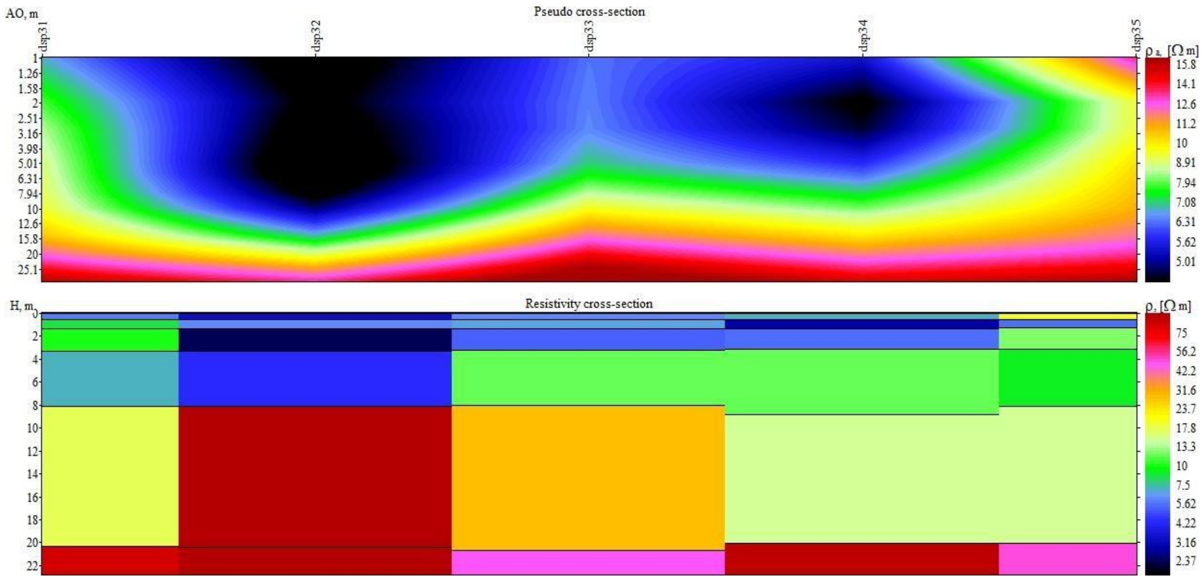
dsp34




| N | ρ | h | d | Alt |
|---|---|---|---|---|
| 1 | 20.1 | 0.5 | 0.5 | -0.5 |
| 2 | 5.74 | 0.727 | 1.23 | -1.227 |
| 3 | 12.6 | 1.89 | 3.12 | -3.12 |
| 4 | 9.51 | 5.02 | 8.14 | -8.138 |
| 5 | 15.5 | 11.9 | 20.1 | -20.08 |
| 6 | 49.7 | | | |

dsp35

**Profile IV (DSP 31 to 35)**




**Profile IV (DSP31 - DSP35)**

Profile IV is a critical section between DSP31 - DSP35. Except DSP35 which shows high resistivity all VES i.e., DSP31 - DSP35 show low resistivity (5 - 6.31 Ωm) suggesting significant leakage and subsurface accumulation.

# Chapter V

## SUMMARY AND RECOMMENDATIONS

Analysis reports of ground water samples were reviewed. For easier understanding of the study related to ground water contamination, sampled locations were separated into three zones. These zones were considered based on the surface runoff from the spent wash storage tanks and compost site. Before start of the study, it was assumed that the runoff water from spent wash storage area and compost site is a major factor that might have influenced ground water characteristics. Therefore, ground water sampling was planned in such a way so as to identify relatively non-affected/impact areas, actual impact areas and areas likely to get affected/impacted.

In Zone 1, location number GW 01 to 08 were considered. These locations were situated in the upstream or cross stream zones (considering surface runoff). Hence, assumed that these locations would give general characteristics of ground water in the surrounding area. These characteristics shows the baseline status of ground water of the study area.

Zone 2: here, **GW 10 to GW 27 locations are observed in the downstream of the compost yard - more or less within 1000 m distance.** As assumed in the beginning of the study ground water samples from this area observed affected. Water quality of some of the samples from this zone showed higher values for parameters such as colour, COD, BOD, TDS, etc. In Zone 3, GW 28 to GW 36 were considered. These locations are in downstream of the compost yard but at more than 1000 m distance. This zonation may be helpful to understand the findings of the study.

In case of studied ground water, samples from zone 2 for parameters such as colour, COD, BOD, TDS indicates moderate to higher changes in physical and chemical appearance for samples GW 10, GW 11, GW 12, GW 13, GW, 14, GW 15 and GW 20, GW 27. Colour, COD, BOD values of samples from Dug wells from zone 2 indicates intrusion of spent wash/spent wash leachate into those waterbodies.

Geo-physical survey carried out in this study provided vital inputs to understand the causes of Dug/bore well water contamination of this zone. This study also helpful in formulating the remedial action for the same.

1. High resistivity along profiles VES 02, VES 03, VES 04, VES 05 and VES 07 indicate there is no leakage or contamination towards the south and east of the compost area. This is the area where most of the samples of zone 1 are located.

2. Similarly, high resistivity is seen at VES13, VES14, VES15, VES28 suggesting no contamination towards the west of the compost area. This is the area, between the factory and compost yard. This is located in the east of the factory and GW 05, GW 06 and GW09 samples of Zone 1 show the ground water characteristics of the area.

3. Potential leakage to the shallow aquifer/ground water is seen at VES 08, VES 09, VES10, VES 11 and VES 12 to a depth of 15.8m similarly VES 06 to VES 20 and VES 31 to VES 34 and VES 32 shows very low resistivity values up to a depth of 12.6 bgl. These locations are plotted in the figure 5.1 (below). Most of the ground water samples of zone 2 are towards north of these points. Ground water samples of zone 2 are in the downstream considering the surface runoff from the spent wash storage and composting site.
4. Soil analysis reports reveals that the impact of the activity is seen mainly at two locations. Analysis results of S 06 and S 07, collected from the old pit compost areas, show very high concentration of organic carbon, organic matter as well as NPK. For those locations, EC reported is on higher side (>3 mmho/cm or dS/m) indicating high amount of salts or ions present in the soil. In case of all other soil samples, the variation observed range bound in comparison with S 08 and S 09 – which are considered as a baseline for the study area. Thus, in case of soil, the negative impact of the activity (spent wash storage and composting) is relatively low. Organic carbon, P and K content at many sampling locations observed high or very high range that assumed as a positive impact.


**Figure 5.1: Image is showing VES points in and around the compost yard and spent wash storage lagoon (DSP is a VES point for Dnyaneshwar Sugar)**


**Figure 5.2: Image showing site recommended for leachate collection in yellow colored polygon**



**Figure 5.3 A: Image showing Locations DSP 03, DSP 08 – DSP 27 and**

**Figure 5.3 B: DS 30 to 32 for remedial action**

## 5.0 RECOMMENDATIONS/REMEDIAL ACTION

1. Location of leachate collection pit to be shifted or an additional pit to be constructed at a location of the entire compost yard. The location is marked in the figure 06.
2. It is also advised to plant few Eucalyptus trees in the open plot towards north of the compost yard. Plantation should be limited.
3. Fracture seal cementation using fast settling cement/black cotton soil under high pressure grouting is recommended between VES DS 03, DS 08 - DS27 up to 40m and DS32 - DS30 up to depth of 25m to restrict the leakage to deeper aquifer and spreading of the contamination. Fracture seal cementation, or "fracture healing," is a geological and engineering process where open fractures in rock are filled with mineral deposits, reducing their permeability and restoring mechanical strength. It is a coupled process driven by chemical, mechanical, and geological factors, particularly in low-permeability formations. Fracture seal cementation involves injecting a cement-like material (natural minerals or engineered slurries) into rock fractures, forcing it into the opening under pressure to harden, and blocking fluid flow (particularly water in this case).
4. Environment management cell must be strengthened in order to achieve compliances.
5. The Factory Management should monitor the disposal of spent wash, vigilantly. It should make alternative arrangements in case of failure of machinery, operating equipment, etc. The Management should develop a SOP (standard operating procedure) to deal with such situation and restore normalcy of operations at earliest.
6. The factory management must follow rules, regulation, guidelines and norms prescribed time to time by regulatory authorities. It should monitor all environment related compliances at least before start of the season, mid of the season and end of the season.