ANDHRA PRADESH POLLUTION CONTROL BOARD
D. No. 33-26-14 D/2, Near Sunrise Hospital, Pushpa Hotel Centre,
Chalamalavari Street, Kasturibaipet, Vijayawada - 520 010
Website: pcb.ap.gov.in

Lr. No. 529/APPCB/VSP/ELR/Polavaram/2005- **dt. 08 -01-2021.**

To

The Registrar General,
Ho',ble National Green Tribunal,
Faridkot House, Copernicus Marg,
New Delhi – 110001.

Respected Sir,

Sub: APPCB- Report on the order dt 18.09.2020 issued by the Hon'ble National Green Tribunal in O.A.NO. 857 of 2018 w.r.t. POLAVARAM IRRIGATION PROJECT – Report on the observations made by the Four Member Committee and Dirctions issued by the Andhra Pradesh Pollution Control Board — Submitted- Reg.

Ref: Hon'ble National Green Tribunal order dt. 18.09.2020.

With reference to the orders issued by the Hon'ble National Green Tribunal in O.A.NO. 857 of 2018 w.r.t. POLAVARAM IRRIGATION PROJECT, the report on the observations made by the Four Member Committee and Directions issued by the Andhra Pradesh Pollution Control Board is enclosed for kind information.

Yours faithfully,

Encl: As above.

Sd/-

MEMBER SECRETARY.

-// t.c.f.b.o.//-

Jt. Chief Environmental Engineer (UH-1)

REPORT ON ORDERS ISSUED BY THE HON'BLE NATIONAL GREEN TRIBUNAL IN O.A.NO. 857 of 2018 w.r.t. POLAVARAM IRRIGATION PROJECT – OBSERVATIONS MADE BY THE FOUR MEMBER COMMITTEE and TASK FORCE , APPCB DIRECTIONS

INDEX

REPORT ON ORDERS ISSUED BY THE HON'BLE NATIONAL GREEN TRIBUNAL IN O.A.NO. 857 of 2018 w.r.t. POLAVARAM IRRIGATION PROJECT – OBSERVATIONS MADE BY THE FOUR MEMBER COMMITTEE and TASK FORCE , APPCB DIRECTIONS DT. 03.11.2019

PREAMBLE:

The Hon'ble National Green Tribunal, Principal Bench, New Delhi issued directions on 01.11.2018 and 14.11.2018 in 0.A.No.857/2018 & M.A.No.1624/2018 in the matter of Dr. Pentapati Pulla Rao Vs Union of India and Ors. The Joint Committee submitted their report on 29.12.2018 in compliance with the above order. Further, the Hon'ble NGT heard the matter on 19.02.2019 and ordered the Joint Committee to re-visit the site and verify the compliance on action taken report and furnish a fresh report. The Joint committee made a visit on 24-04-2019 and submitted the report.

The Hon'ble NGT vide order dated 10-05-2019 had directed to verify the claims of the project proponent and submit the report by 31-07-2019. The issue was further heard by the Hon'ble NGT on 27.09.2019 and 07.11.2019 and orders were passed directing the Committee to verify further and submit the report by 31-01-2020. The Joint Inspection was conducted on 22.01.2020 and submitted the report to Hon'ble NGT. Again the issue was further heard by the Hon'ble NGT on 18.09.2020 and directed to submit the report by 11.01.2021.

Details of the project:

The Environmental Clearance (EC) to the proposed project has been accorded vide Lr.No.J-12011/74/2005-IA.1, Dt. 25.10.2005 and subsequently, revised in the year 2009 vide MoEF&CC LiNo.J-12011/74/2005-1A.1, Dt.09.03.2009. Consent for Establishment (CFE) was accorded by the A.P. Pollution Control Board vide Order No. 529/APPCBNSP/ELR/Polavaram/2005, Dated 18.10.2005. The total land requirement for the project is 46,060 hectares comprising of 3279 Ha of Forest Land. Forestry Clearance (FC) for the diversion of 3731.07 Ha. (3473 Ha. notified Forest Area plus 258.07 Ha. deemed Forest Land) has been obtained from the MoEF&CC vide letter No.8-123/2005-FC, Dt.28.07.2010. Further, requisite permission / NOC has been obtained from the Standing Committee of National Board for Wildlife (3267 Ha FC Land) vide Lr.No.F.N0.6-3/2002 WL-I(pt), Dt.06.07.2006.The State of Andhra Pradesh had acquired an additional land of 203 Acres in Moolalanka of Polavaram Village vide Notification 2016 as per the provisions of the Right to Fair Compensation and Transparency in land acquisition and Re-habitation & Resettlement Act, 2013 and handed over to the project proponent for the purpose of dumping of muck and is being in use.

In addition, a land area of 83.45 acres is acquired for Polavaram Irrigation Project vide Proceedings dt.18.02.2018 issued by Collector & District Magistrate, West Godavari. The Committee is of the opinion that since the land is used presently for agriculture purpose by the farmers, the Project Authority should avoid utilizing the land for dumping or for any non-agriculture purpose. Presently, paddy cultivation is going on in the above said land

adjacent to the existing dumping site. PIP informed that decision is not yet taken on returning the unutilized land if any, i.e., 83.45 Acs which was earlier proposed for dumping.

The Committee also held discussions with Forest Officers and it appears that the Papikonda National Park is located at around 8 Km. from the Moolalanka dumping site. It is also learnt that Eco-Sensitive Zone around the Papikonda National Park yet to be notified.

The project is intended to provide irrigation facilities to 2.91 Lakh hectares in Visakhapatnam and East Godavari Districts under Left Main Canal and West Godavari and Krishna Districts under Right Main Canal. Further, it also comprises of generation of Hydel Power of 960 MW and 80 TMC diversion of Godavari water to River Krishna for stabilizing the existing command under Prakasam Barrage and to provide drinking water facilities to 540 enroute villages together water supply to Visakhapatnam City and to industries enroute.

About, 5 TMC ft. and 1.5 TMC ft. of water respectively be lifted from the pond of Polavaram Project by the States of Odisha and Chattisgarh. Reportedly total 1,93,350 persons are likely to be affected by this project, out of that 1,75,275 in Andhra Pradesh and 6,319 persons from Odisha and 11,766 persons from Chattisgarh. The project activity commenced in the year 2005- 2006. As per the information of project Authority, total expenditure incurred is Rs.17,026.79 Crores and cost of the project as per 2017 -18 price level is Rs. 55,656.87 Crores (as per CWC).

Hon'ble NGT vide order dated 18.09.2020 in OA No. 857of 2018 issued the following directives:

"The matter was considered earlier. Vide order dated 01-11-2018, a four-member Joint Committee was constituted comprising the Central Pollution Control Board (CPCB), the Andhra Pradesh State Pollution Control Board (APPCB) the PCCF and the District Collector, West Godavari. The Committee gave its report which was directed to be acted upon vide order dated 19.2.2019 and a status report was directed to be filed. Status report dated 3.5.2019 was considered vide order dated 10.5.2019 and further directions were issued. Thereafter on 27.9.2019, report dated 30.7.2019 was considered and the matter was deferred to 7.11.2019 and then to 20.2.2020. Thereafter the matter has been put up today.

No further status report has been filed by the State PCB or any other authority. This may be now done before the next date by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/ OCR Support PDF and not in the form of Image PDF.

List again on 11.01.2021."

In compliance to above orders, status report on observations of Four Member Committee on 22.01.2020 is enclosed as **Annexure - I** and Status report on Task Force direction dated 03.11.2019 is enclosed as **Annexure-II** for kind information.

The Board issued a Show Cause Notice dt.15.12.2020 to the Chief Engineer, Polavaram Irrigation Project for non-compliance of directions issued by the Board **(Annexure - III).**

The Board subsequently reviewed the status of the directions issued to the project authorities in the External Advisory Committee (Task Force) meeting held on 21-12-2020. A copy of the directions issued vide order dt. 08-01-2021 to the Polavaram Irrigation Project is enclosed for kind information **(Annexure - IV).**

Field Observations:

The Polavaram Irrigation Project (PIP) officials informed that the project construction work started during 2005-06 and present progress of Polavaram Head Works is 66.93%, Left Main Canal is 68.34%, Right Main Canal is 91.69%. The overall progress so far made in the project is 71.88%. As per the construction schedule, concrete in Spillway including construction of bridge, concrete in spill channel and construction of Coffer dams should have been completed by May, 2019. But all these works are lagging behind. The main Earth Cum Rock Fill Dam (ECRF) was scheduled to be completed by the end of 2021. Meanwhile the entire work was terminated and pre-closed. Fresh tenders were invited by the State Government vide NIT No.01/2019-20, Dt.17.08.2019. A new agency/contractor was identified and entrusted the work vide agreement No.01/2019-20 dt. 08-11-2019. Presently, the project works are under progress.

This is submitted for favour of kind information.

Sd/-
MEMBER SECRETARY

-// t.c.f.b.o.//-

Jt. Chief Environmental Engineer (UH-1)

Annexure-I

Action taken Report on Observations of the 4 Member Joint Committee on 31-08-2019

Sl. No.	Recommendations of the Committee during Polavaram site visit on 11.12.2018	Remarks/Observation of the 4 Member Joint Committee on 24.07.2019	Remarks/Observation of the 4 Member Joint Committee on 22.01.2020	Present Status
1	Observed disposal of muck without proper height, leveling and gradient	The project authority failed to submit any action taken report every15 days as suggested by the four member joint committee during 25.04.2019. However, it is reported that the excavation work has been stopped due to monsoon.	It is reported that contract of main dam package work was terminated and pre-closed during August, 2019. Fresh tenders were called for and balance works were awarded to the new agency vide agreement No.01/2019 20, dt.08.11.2019. The PIP has informed that they will ensure. • Work to maintain proper slopes of existing muck dumps will be started immediately and will be completed within one month. • After resumption of works by the new contractor, muck will be disposed maintaining the proper slopes as suggested by the Committee.	Slopes of existing muck dumps opposite of B.C. Colony were taken up and completed in March, 2020. But during recent heavy floods in October, 2020, some portion of sloping works got disturbed and need to be taken up gain. 800 bamboo tree saplings have been planted over the slopes for stabilisation in September, 2020. Photo graphs are enclosed. Further, dumping of muck has not taken place at dumping yard near B.C Colony. During the last working season in 2019-20, the excavated earth has been utilised for formation of internal ring bund, as a part of working arrangement by the agency.
2	No vegetation / greenbelt have been made on the dumps to stabilize and to prevent air pollution	The Committee inspected BC Colony area. No major plantation activity noticed for a length of 1200 mts. Stretch along kademma drain.	The Government of Andhra Pradesh issued GO. RT No. 35, dated 21.01.2020 giving administrative sanction for Rs. 306.5 Lakhs for "Rising of plantation and 3-year maintenance at	The Superintending Engineer has issued work order for raising of plantation in Mulalanka dump yard to the divisional forest officer, Eluru vide Work Order

		It was informed by Project Authority that they have planted about 400 plants during the period. Photographs of plantation enclosed. However, in the meeting the Project Authority informed that the Comprehensive plantation programme at a cost of Rs.2.74 Cr. is in pipeline which is to be taken up after receipt of orders of the government.	Mulalanka dump yard. Tendering process is yet to be started by the PIP. After completion of tendering process and award of work, plantation will be started. GO Copy Annexed **(Annexure-A).** The government has also sanctioned an amount of Rs. 84.45 Lakhs for carrying out "Ambient Air Quality Monitoring and water quality tests etc.". The work order in this regard addressed to CSIR, NEERI, Hyderabad dt.20.01.2020 is attached as **(Annexure — B)**	No.SE/PIPHW/OT1/AEE1/EIA Vol.12/01/ 2020-21 dt 10.09.2020. Copy of the work order is enclosed **(Annexure - C).** 800 bamboo tree saplings have been planted over the slopes for stabilisation in September, 2020.
3	The Project Authority may re-look at the utilization of 87 Acres acquired adjacent to the existing dumping site (Moolalanka dump site)	The committee observed that no dumping activity is happening in the 87 Acres of additional area of Moolalanka lands. The Committee opines that the Project Authority shall put up a proposal to the Government for the withdrawal of acquired land since, as per the revised plan there is no such requirement. The Project Authority is yet to initiate follow up action in this regard.	During the earlier inspections, the project authorities were repeatedly informing the Committees that the land in question is in the final state of award, and same was informed in their ATRs. During the review meeting on 22.01.2020, the Revenue Divisional Officer, Jamgareddugidem, West Godavari District has informed to the Committee that the 87 acres in question was acquired by GoAP vide order dt.18.02.2018. However, the land area mentioned in the award order was 85.35 acres. The Committee is of the opinion that since the land is used presently for agriculture by the farmers the Project Authority should avoid utilizing the land for ' dumping or for any non-agriculture purpose.	Presently, paddy cultivation is going on in the 87 acres of land adjacent to the existing dumping site. PIP informed that decision is not yet taken on returning the unutilized land, if any, out of the 87 Acs which is earlier proposed for dumping. Photographs are enclosed.

4	The Project Authority shall immediately prepare an action plan regarding feasibility of utilizing the excavated material within the Project area and the feasibility of using the land already demarcated near the "O" point.	The progress and quantity of reutilization of muck as suggested in the previous meeting is not submitted by the Project Authority.	During the review, the PIP has informed that • The balance works were entrusted to the New Agency on dt.08.11.2019. The new agency has started Spillway concrete works and dewatering of Spill channel initially and soon will start other works. • A total quantity of 130 Lakh Cum of Rock muck dumps are available at site on right side and further about 17.2 Lakh Cum of useful rock muck will come from excavation 902 Hill and about 60 lakhCum will come from excavation' at power house foundations making the total rock muck available to the tuna of about 207.2 lakh cum. • So far 41.49 Lakh cum of rock muck has been utilized in partially executed Upstream and Downstream Cofferdams. Further 207 lakh cum of rock muck will be required for the construction of balance cofferdams, ECRF dam in gap-II, upstream left side guide bund of Approach Channel and for the river protection works. The total rock muck will be utilized in the above works from February, 2020 to December,2021. The Government land demarked near the zero point cannot be utilized for dumping as the excavated muck has to be transported through Polavaram village. The land will be utilized for the future needs of the project appropriately	Not submitting specific reutilisation muck on regular basis. During the last working season in 2019-20, the excavated earth has been utilised for formation of internal ring bund, as a part of working arrangement by the agency. No Dumping is observed at zero point. As informed by PIP that 207 Lakh Cu.m. of rock muck will be required for the construction of i) balance cofferdams, ii) ECRF dam in gap-II, iii) upstream left side guide bund of Approach Channel and iv) for the river protection works. The total rock muck will be utilized in the above works.

5	Project Authority made the commitment and assured before the Committee that henceforth ie., 11-12-2018 onwards dumping of mucks will not be done near the BC colony area.	The project Authority shall continue to abide by their commitment.	The Project Authority shall continue to abide by their commitment	Complied. Further dumping of muck has not taken place at dumping yard near B.C Colony.
6	The project authority shall regularly carry out air quality monitoring in line with National Ambient Air Quality Monitoring Programme and submit reports to MOEF & CC/APPCB.	No comprehensive AAQM has implemented by the project authority. However M/s. NEERI, Hyderabad was engaged for May 2019 and M/s Envi Tech Pvt Ltd for June 2019 for monitoring AAQM at 5 places including BC colony. Photographs and analysis reports enclosed (Copy enclosed as Annexure –C). The committee examined the reports submitted and found that PM_{10} and $PM_{2.5}$ exceeded at four places out of five places monitored in May 2019. To get conclusive evidence, a comprehensive AAQM is required.	The Ambient Air Quality Management (AAQM) has been conducted in five places in May, June and July of 2019 and on 18.01.2020. The study reports of May, June & July have already been submitted and the latest reports are also submitted to APPCB and Polavaram Project Authority on dt.21.01.2020. The GoAP have accorded administrative sanction vide G.O.RT.No.35, dt.21.01.2020 for rs.406.21 Lakhs for the Estimate for carrying out the Air Quality Monitoring water quality tests by M/s. NEERI Hyderabad for rs.84.45 lakhs plus GST and plantation including providing Tree guards, watering and maintenance for 3 years at Mulalanka dump yard for Rs.306.50 lakhs. The work order was placed on M/s. NEERI, Hyderabad vide work order No.SE/ PIPHMOTVAEEVEIANol.11/01/2019- 20, Dt.20.01.2020 for carrying out the AAQM and water quality studies for one year Hence, the reports prepared by NEERI, Hyderabad, by collecting data of Air environment, Noise	The NEERI has submitted interim report in the month December, 2020. Based on the primary data collected during the study period, following conclusions are drawn by the NEERI in the report: • The ambient air quality at all locations in the study area are found to be within National Ambient Air Quality Standards (NAAQS) w.r.to gaseous pollutants (SO2, NO2, O3, CO, NH3 and C6H6). The higher values of particulate matter (PM10 and PM2.5) in terms of maximum concentrations in the study area may be due to the vehicular movement and unpaved roads. • In the villages and residential colonies surrounding the Polavaram project, it is observed that the daytime noise levels vary between 50.2-52.9 dB(A), 50.1-54.5 dB(A) & 51.6-53.8 dB(A) and night time noise levels vary between 43.1-45.0 dB(A), 42.8-44.8 dB(A) & 40.8-44.0 dB(A) during February, March and November 2020, respectively. The noise levels are compared with CPCB limits for residential

			environment, Ground water and surface water environment and soil environment on line with National Ambient Air Quality Monitoring Programme will be submitted to APPCB & MoEF regularly as suggested by the Committee	areas. The noise levels are observed to be within the CPCB standards for residential areas. • The observed Leq values of day time noise levels during February, March and November 2020 respectively are varying between 64.2-70.2 dB(A), 62.6-66.6 dB(A) and 59.4-68.6 dB(A). The night time noise levels are within the range of 52.2-67.9 dB(A), 53.6-60.9 dB(A) and 50.7-60.7 dB(A), respectively, during February, March and November 2020 near the construction activities of Polavaram project. It is observed that daytime and night time noise levels are exceeding the CPCB limits for commercial zone at most of the sites. These higher noise levels are attributed to operation of DG sets, Excavators, Cranes, Crushers, movement of Trucks, vehicles, and concrete mixers etc. in connection with ongoing construction activities of Polavaram. • The groundwater quality at most of the sampling locations for various parameters was well within the permissible limit of BIS except for TDS, calcium hardness, nitrate. • Iron and Manganese concentrations at some locations in groundwater were observed to be more than permissible limit of the BIS which may be attributed to the dominant Rocks.

				• The river water quality showed values within the range. Phytoplankton and zooplankton showed significant diversity in the study area. • Soil texture in the study area varies from loamy sand, sandy clay loam, clay and sand, whereas, loamy sand and sandy clay loam are the prominent textural class **Future Work:** • The sampling work for all the components are per the schedule will be carried out. • Analysis of the samples for various environmental components will be continued. A copy of the NEERI, December, 2020 report is enclosed for kind information **(Annexure - D).**
7	Strengthening of dump sites with proper heights and slopes along with vegetative cover may be planned immediately in consultation with technical experts	Progress as suggested in Point No.2 may be compiled.	Progress as suggested in Point No.2 may be complied.	Slopes of existing muck dumps opposite of B.C. Colony were taken up and completed in March, 2020. But during recent heavy floods in October, 2020, some portion of sloping works got disturbed and need to be taken up gain.

				800 bamboo tree saplings have been planted over the slopes for stabilisation in September, 2020. Photo graphs are enclosed. Further dumping of muck has not taken place at dumping yard near B.C Colony. During the last working season in 2019-20, the excavated earth has been utilised for formation of internal ring bund, as a part of working arrangement by the agency. The Superintending Engineer has issued work order for raising of plantation in Mulalanka dump yard to the divisional forest officer, Eluru vide Work Order No.SE/PIPHW/OT1/AEE1/EIA Vol.12/ 01/ 2020-21 dt 10.09.2020 **(Annexure - C).**
8	The Committee has verified the restoration of roads after development of cracks as reported in the project approach road during the last monsoon season. The report obtained from Central Design Organization, Vijayawada, AP.	As informed, report from IIT Delhi is still awaited on the permanent protective measures on the sliding of embankments. Opinion of experts may be followed.	It is reported by the Project Authority that the problem of sliding of right sided bank of spill channel was studied by Prof Ayothiramam of IIT, Delhi and the report furnished by him for providing 35m depth of stone columns was discussed in the 111th DDRP meeting. The agency expressed its inability to construct stone columns to a depth of 35m as recommended by IT, Delhi and proposed alternative structures to Earthen Embankment Various alternatives were discussed by the members of the panel and it was decided that the agency shall submit the alternative ground improvement technique or	Recommendations are not yet finalized.

			any suitable option in consultation with Ill Delhi and CSMRS. Prof Ramana IIT„ Delhi and Mrs. R.Chitra, CSMRS, Delhi have been addressed to furnish suitable option for arresting slipping of banks and they are planned to inspect the site after dewatering of Spill channel. The dewatering of spill channel was started from 16.12.2019 by installing 28 pumps of total capacity about 4000 HP and will be completed. by dt.14.02.2020. Necessary protective measures will be taken up as per their suggestions	
9	Adequate dust suppression measures like providing water spraying may be arranged till good vegetative cover attained. Similarly, water spraying may be arranged for wetting the approach " roads/village roads etc. at the project areas and nearby villages"	It is reported that being the monsoon season, the wetting of roads/ village roads are temporarily suspended. About 5 tankers are engaged as emergency measure in this regard.	During inspection the committee has observed the spraying of water on approach road to suppress the dust. The PIP further informed that after resumption of earth work the number of tankers engaged will be increased according to the requirement as suggested by the committee	About 5 tankers are engaged for wetting of roads/ village roads.

Annexure - II

ACTION TAKEN REPORT ON THE TF DIRECTIONS DT. 03.11.2019 ISSUED BY APPCB IN O.A.No.857 OF 2018 IN THE HON'BLE NATIONAL GREEN TRIBUNAL

S I No	Direction	Compliance submitted by Polavaram Irrigation Project	Compliance observed by APPCB
1	The PIP authority shall submit action taken report on proper disposal of muck every 15 days as recommended by the Joint committee	PIP authorities have been submitting Action taken reports on proper disposal of muck every 15days as recommended by the Joint Committee.	Complied. The Project Authorities have submitted the ATR on disposal of muck every fifteen days up to November, 2020.
2	The dumpsites shall be strengthened with proper heights and slopes along with vegetative cover immediately with Technical experts.	i) As per the suggestion of the Forest Authorities, StyloHameta Grass seeds were sprinkled over the slopes for growing vegetative cover for stabilisation of slopes opposite of BC colony. ii) As promised to the committee, the works to maintain proper slopes of existing muck dumps were taken up and completed up to opposite of B.C.Colony. iii) As per the suggestion made and with the help of Forest authorities, 800 bamboo tree saplings have been planted over the slopes for stabilisation in September, 2020.	Partially complied. Slopes of existing muck dumps opposite of B.C. Colony were taken up and completed in March, 2020. But during recent heavy floods in October,2020, some portion of sloping works got disturbed and need to be taken up gain. 800 bamboo tree saplings have been planted over the slopes for stabilisation in September, 2020. Photo graphs are enclosed.

			Further dumping of muck has not taken place at dumping yard near B.C Colony. During the last working season in 2019-20, the excavated earth has been utilised for formation of internal ring bund, as a part of working arrangement by the agency.
3	The Project Authority may re-look at the utilization of 87 Acres acquired adjacent to the existing dumping site (Moolalanka dump site)	Presently, the land is under the possession of Land owners only and they have been cultivating the lands. As reported earlier, after finalization of balance drawings of Pilot channel and Spill channel right side slope, exact quantities can be finalized and a decision can be taken on returning the unutilized land if any, out of the 85.35Acs proposed land for dumping.	Partially complied. Presently, paddy cultivation is going on in the 87 acres of land adjacent to the existing dumping site. PIP informed that decision is not yet taken on returning the unutilized land if any, out of the 87 Acs which is earlier proposed for dumping. Photographs are enclosed.
4	The Project Authority shall submit report every month on progress achieved and quantity of reutilization of muck. The feasibility of using the land already demarcated near the O point shall be furnished.	Through Action Taken reports, every month/fort night, progress achieved and quantity of reutilisation muck are being submitted regularly. During the last working season in 2019-20 , the excavated earth has been utilised for formation of internal ring bund, as a part of working arrangement by the agency. As reported earlier, the Government land demarked near the O point will be utilised for the future needs of the project appropriately.	Partially complied. Not submitting specific reutilisation muck on regular baiss. During the last working season in 2019-20, the excavated earth has been utilised for formation of internal ring bund, as a part of working arrangement by the agency. No Dumping is observed at zero point. As informed by PIP that 207 Lakh Cu.M. of rock muck

			will be required for the construction of i) balance cofferdams, ii) ECRF dam in gap-II, iii) upstream left side guide bund of Approach Channel and iv) for the river protection works. The total rock muck will be utilized in the above works.
5	As committed by the Project Authority, dumping of mucks shall not be done near the B.C.Colony area and Reserve forest area and Eco sensitive Zones.	As committed and as submitted earlier, dumping of muck near B.C.Colony has been stoppedcompletely.	Complied. Further dumping of muck has not taken place at dumping yard near B.C Colony.
6	The PIP shall engage MoEF recognized/ Reputed environmental agencies for conducting Ambient Air Quality Monitoring, Water quality monitoring etc.,regularly and submit Environment compliance reports to MoEF/APPCB.	Work order was issued to NEERI, Hyderabad which is a central government agency, on 21.01.2020 for conducting "Ambient Air Quality Monitoring and Water quality tests etc." regularly for one year,for Rs.84.45 lakhs. NEERI, Hyderabad has been conducting the tests regularly and Environment compliance reports will be submitted to MoEF/APPCB soon.	A copy of the NEERI, December, 2020 report is enclosed for kind information **(Annexure - D).**

7	The recommendations of IIT Delhi regarding permanent protective measures on the sliding of embankments shall be duly followed and progress shall be reported.	The recommendations are not yet finalized but,as suggested the recommendations will be followed.	Not complied. Not yet finalized the recommendations of IIT delhi.
8	Adequate dust suppression measures like providing water spraying shall be carried out till good vegetative cover is attained. Similarly, water spraying shall be arranged regularly for wetting the approach roads/village roads etc at project areas and nearby villages, for control of dust emissions due to vehicular movement and shall maintain records and submit reports. The frequency of wetting of roads shall be increased depending on the	Presently earth wok excavation has not yet started due to stagnation of water in the spill channel. After dewatering, the earth work excavation will be resumed. The details will be informed. As per the present conditions, five water tankers have been engaged for spraying water on the approach roads to suppress the dust. As and when required more no of tankers will be used for suppression of dust in the project area/nearby villages.	About 5 tankers are engaged for wetting of roads/ village roads. Frequency needs to be increased.

	weather conditions, so as to avoid fugitive dust emission during vehicular movement.		
9	The PIP shall submit action plan for Solid Waste Management for the entire project area covering labour colonies, canteens & other offices etc.,	Two bins i.e., one for disposal of dry solid waste and another for disposal of wet solid waste were provided at Labour colonies, canteens, offices etc., Both the solid wastes have been handed over to the local authorities for recycling.	Not complied. No proper action plan. no solid waste processing facilities.
10	The PIP shall submit action plan for treatment of domestic waste water generated from labour colonies, canteens & other offices etc.,	It is planned to treat Domestic waste water at colonies by decentralized waste water treatment plant i.e., by passing through 1. settler, 2. Anaerobic baffled reactor and 3. planted gravel filter bed.	Not complied. No specific proposal is received so far. .
11	The PIP shall impart following measures to 9 No. of stone crushers existing in the project premises: a) Wetting of premises of stone crushers, roads to avoid dust emissions due to vehicular movement.	a) Wetting is being done daily at the premises of stone crushers and on the approach roads using sprinkler type water tankers.	Partially complied. Except wetting, no concrete measures like cladding, wind breaking walls etc. are provided. The Board issued a Show Cause Notice dt.15.12.2020 to the Chief Engineer, Polavaram Irrigation Project for non-compliance of directions issued by the Board

	b) Provide cladding to primary crushers, secondary crushers, screens, dust tank etc., c) Wind breaking walls around crushers to control dust emissions.	b) To be provided c) To be provided	**(Annexure - III).** Not complied. Not complied.
12	The PIP shall install Ambient Air Quality Monitoring stations at BC colony, Chandranna colony, Labour colony and project office and shall submit reports to Regional Office, Eluru and MoEF regularly.	NEERI, Hyderabad has been conducting the Ambient Air Quality tests by installing the equipment at i) BC colony, ii) project site near Check post, iii) CWC office premises iv) Irrigation quarters and v) Purushothapatnam village. Due to COVID-19 and prevailing lockdown conditions and also as per the Government orders, the field work was not carried out in the months of April, May, 2020. Due to heavy rains in this area the tests have not been done during September and October 2020.Now NEERI, Hyderabad began conducting field tests from 16th November,2020 and the reports will be submitted soon.	A copy of the NEERI, December, 2020 report is enclosed for kind information **(Annexure - D).**
13	Drilling operations should be carried out using the machines equipped with dust extraction system only.	Complied with the suggestions made. Drilling operations have been done using the machinery equipped with dust extractions systems as directed by the committee.	Complied.

14	The stone crushers shall be provided with air pollution control systems as per central pollution control board (CPCB) guidelines and shall operate only with valid consent of APPCB.	Stone crushers are being operated as per the guidelines of central pollution control board with valid consent of APPCB by taking precautionary measures of wetting the approach roads and premises frequently by the water tankers.	Not complied. About 9 crushers are existing but without cladding and dust containment measures and also without having CFO of the Board. The Board issued a Show Cause Notice dt.15.12.2020 to the Chief Engineer, Polavaram Irrigation Project for non-compliance of directions issued by the Board **(Annexure - III).**
15	Avenue plantation and green belt shall be developed in project area and surroundings as per the conditions stipulated.	The Government of Andhra Pradesh have accorded administrative sanction vide G.O.RT.No.35 dt.21.01.2020 (Annexure No.2) for Rs 306.5 Lakhs for "Raising of plantation and 3-year maintenance at Mulalanka dump yard". The Chief Engineer, PIPHW has accorded Technical sanction to the estimate vide proceedings no. CE/PIPHW/DCE/OT-1/AEE-2/126SE Dated 21.01.2020. The Superintending Engineer, PIPHW Circle, Dowlaiswaram has addressed the Principal Chief conservator of Forests (HoFF), Andhra Pradesh, to issue necessary orders to the concerned Divisional Forest Officer (DFO) to take up the plantation at Mulalanka dump yard, Polavaram.	Not complied.

16	Internal Monitoring team (Environment Cell) shall be constituted to monitor issues pertaining to environment and pollution and for ensuring implementation of the conditions specified by the MoEF and A.P. Pollution Control Board.	A multi disciplinary committee with Superintending Engineer as the Convenor and Officials from State Forest department, Principal Scientist, Horticultural research station, Ambajipeta; Principal Scientist, Horticultural research station ,Kovur, Head of Department of Zoology, Nannayya university, Rajahmundry and Engineers of polavaram Irrigation project as members, is looking after implementation of the environmental issues along with other things .The committee has been submitting the reports on Environment and& Forest to MoEF regularly.	Not complied. No exclusive Environmental monitoring cell is formed.

Moolalanka Dump Yard view from B.C, colony (Paddy cultivation is in progress in the 87 acres of land proposed earlier for dumping which exists between dumping yard and BC colony)

Moolalanka Dump Yard view from B.C, colony

Moolalanka Dump Yard view from B.C, colony (wherein certain slopes got damaged)

Moolalanka Dump Yard

PROPOSED LAND OF 87 ACRES ADJACENT TO THE EXISTING DUMPING SITE

PROPOSED LAND OF 87 ACRES ADJACENT TO THE EXISTING DUMPING SITE

Approach Channel Ring Bund (excavated muck utilized for bund formation)

WETTING OF ROADS WITH WATER TANKERS

WETTING OF ROADS WITH WATER TANKERS

PLANTATION AT MOOLA LANKA DUMP YARD (Earlier Photos)

Bamboo SAPLINGS OF PLANTATION

POZZOLONA 200 TPH STONE CRUSHER NEAR LABOUR CAMP WITHOUT CLADDING

POZZOLONA 200 TPH STONE CRUSHER NEAR LABOUR CAMP WITHOUT CLADDING

APPCB OFFICIALS INSPECTION OF SITE NEAR MOOLA LANKA DUMP YARD.

ZERO POINT LOCATION

SPILLWAY PRESET STATUS

File No.APPCB-GVS/19/2017-EE-APPCB-WG

Annex - III

A.P.POLLUTION CONTROL BOARD
REGIONAL OFFICE, ELURU

13-02, K.S.R.Thota
Gavaravaram,
Eluru – 534 003
Phone : 08812 - 249668
E-mail: roelr-ee1@appcb.gov.in

ENVIRONMENTAL ENGINEER (FAC)

SC.Notice No. O.A.No.857 of 2018/APPCB/RO- ELR/ 2020- **Dt.15.12.2020**

SHOWCAUSE NOTICE

Sub: APPCB – RO - ELR – Polavaram Irrigation Project, Ramalahpeta (V), Polavaram (M), West Godavari District – Hon'ble NGT order in O.A.No. 857 of 2018 – Non-compliance of Board directions dated 03.11.2019 – Show Cause Notice - Issued – Reg.,

Ref:
1) Hon'ble NGT order dated 10.05.2019 in O.A No 857 of 2018
2) Joint Inspection of the committee held on 24.07.2019 at Polavaram Multipurpose Project Andhra Pradesh
3) TF Directions Order No.129/APPCB/UH-II/TF/ELR/2019-1339 dated 03.11.2019.
4) Joint Inspection of the committee held on 22.01.2020 at Polavaram Multipurpose Project Andhra Pradesh.
5) Hon'ble NGT order dated 18.09.2020 in O.A No 857 of 2018.
6) Instructions of JCEE (UH-I), APPCB, Board Office, Vijayawada through mail dated 13.11.2020.
7) Instructions of JCEE (UH-II), APPCB, Board Office, Vijayawada through mail dated 02.12.2020.

* * *

WHEREAS an irrigation project is being constructed in the name and style of Polavaram Irrigation Project located at Ramalahpeta (V), Polavaram (M), West Godavari District, Andhra Pradesh.

WHEREAS vide reference 1st cited, the Hon'ble National Green Tribunal has issued certain directions vide order dated 10.05.2019 in O.A.No.857 of 2018 with a direction to the State Pollution Control Board, State of Andhra Pradesh and Polavaram Project Authority to conduct Joint Inspection and pass appropriate directions in the interest of Environment and ecology.

WHEREAS vide reference 2nd cited, the Board Officials, A.P. Water Resources Department and Polavaram project Authority jointly inspected the Polavaram Project site on 14.10.2019 and furnished joint inspection report.

WHEREAS vide reference 3rd cited, the Board has reviewed status of Pollution Control measures taken by the Polavaram Project with regard to the Hon'ble National Green Tribunal orders vide O.A.No.857 of 2018 before External Advisory Committee (Task Force) in its meeting held on 15.10.2019 and issued directions to the project on 03.11.2019 for non-compliance of Board directions.

WHEREAS vide reference 5th cited, the Hon'ble National Green Tribunal has issued certain directions vide order dated 18.09.2020 in O.A.No.857 of 2018. The details of the order as furnished below:

"The matter was considered earlier. Vide order dated 01.11.2018, a four member Joint Committee was constituted comprising the Central Pollution Control Board (CPCB), the Telangana State Pollution Control Board (TSPCB) the PCCF and the District Collector, Khammam. The Committee gave its report which was directed to be acted upon vide order dated 19.2.2019 and a status report was directed to be filed. Status report dated 3.5.2019 was considered vide order dated 10.5.2019 and further directions were issued. Thereafter on

27.9.2019 report dated 30.7.2019 was considered and the matter was deferred to 7.11.2019 and then to 20.2.2020. Thereafter the matter has been put up today. No further status report has been filed by the State PCB or any other authority. This may be now done before the next date by e-mail at judicial-ngt@gov.in preferably in the form of searchable PDF/ OCR Support PDF and not in the form of Image PDF on or before 12.01.2021."

WHEREAS vide reference 4th cited, the Board Officials, A.P. Water Resources Department and Polavaram project Authority jointly inspected the Polavaram Project site on 22.01.2020.

WHEREAS the Board Officials inspected the project and its surroundings on 18.11.2020 made the following compliance:

S I No	Direction	Compliance observed by APPCB as on 18.1.2020
1	The PIP authority shall submit action taken report on proper disposal of muck every 15 days as recommended by the Joint committee	Complied.
2	The dumpsites shall be strengthened with proper heights and slopes along with vegetative cover immediately with Technical experts.	Partially complied. Slopes of existing muck dumps opposite of B.C. Colony were taken up and completed in March, 2020. But during recent heavy floods in October,2020, some portion of sloping works got disturbed and need to be taken up gain. 800 bamboo tree saplings have been planted over the slopes for stabilisation in September, 2020. Further dumping of muck has not taken place at dumping yard near B.C Colony. During the last working season in 2019-20, the excavated earth has been utilised for formation of internal ring bund, as a part of working arrangement by the agency. Vegetation on the slopes is not yet started.
3	The Project Authority may re-look at the utilization of 87 Acres acquired adjacent to the existing dumping site (Moolalanka dump site)	Partially complied. Presently, paddy cultivation is going on in the 87 acres of land adjacent to the existing dumping site. PIP informed that decision is not yet taken on returning the unutilized land if any, out of the 87 Acs which is earlier proposed for dumping.
4	The Project Authority shall submit report every month on progress achieved and quantity of reutilization of muck. The feasibility of using the land already demarcated near the O point shall be furnished.	Partially complied. Not submitting specific reutilisation muck on regular basis. During the last working season in 2019-20, the excavated earth has been utilised for formation of internal ring bund, as a part of working arrangement by the agency.

		No Dumping is observed at zero point. As informed by PIP that 207 Lakh Cu.M. of rock muck will be required for the construction of i) balance cofferdams, ii) ECRF dam in gap-II, iii) upstream left side guide bund of Approach Channel and iv) for the river protection works. The total rock muck will be utilized in the above works.
5	As committed by the Project Authority, dumping of mucks shall not be done near the B.C.Colony area and Reserve forest area and Eco sensitive Zones.	Complied. Further dumping of muck has not taken place at dumping yard near B.C Colony.
6	The PIP shall engage MoEF recognized/ Reputed environmental agencies for conducting Ambient Air Quality Monitoring, Water quality monitoring etc., regularly and submit Environment compliance reports to MoEF/APPCB.	Partially complied. NEERI has conducted Ambient Air Quality Monitoring in February and March 2020 only. But reports are yet to be submitted. Presently NEERI has been conducting field tests form 16.11.2020. (Interim report for the month of February,2020)
7	The recommendations of IIT Delhi regarding permanent protective measures on the sliding of embankments shall be duly followed and progress shall be reported.	Not complied. Not yet finalized the recommendations of IIT delhi.
8	Adequate dust suppression measures like providing water spraying shall be carried out till good vegetative cover is attained. Similarly, water spraying shall be arranged regularly for wetting the approach roads/village roads etc at project areas and nearby villages, for control of dust emissions due to vehicular movement and shall maintain records and submit reports. The frequency of wetting of roads shall be increased depending on the weather conditions, so as to avoid fugitive dust emission during vehicular movement.	Partially complied. About 5 tankers are engaged for wetting of roads/ village roads. Frequency needs to be increased.
9	The PIP shall submit action plan for Solid Waste Management for the entire project area covering labour colonies, canteens & other offices etc.,	Not complied. No proper action plan. no solid waste processing facilities.
10	The PIP shall submit action plan for treatment of domestic waste water generated from labour colonies, canteens & other offices etc.,	Not complied. No specific proposal is received so far. .
11	The PIP shall impart following measures to 9 No. of stone crushers existing in the project premises: a) Wetting of premises of stone crushers, roads to avoid dust emissions due to vehicular movement. b) Provide cladding to primary crushers, secondary crushers, screens, dust tank etc., c) Wind breaking walls around crushers to control dust emissions.	Partially complied. Except wetting, no concrete measures like cladding, wind breaking walls etc. are provided. Not complied. Not complied.

12	The PIP shall install Ambient Air Quality Monitoring stations at BC colony, Chandranna colony, Labour colony and project office and shall submit reports to Regional Office, Eluru and MoEF regularly.	Partially complied. NEERI has conducted Ambient Air Quality Monitoring in February and March 2020 only. But reports are yet to be submitted. Presently NEERI has been conducting field tests form 16.11.2020. (Interim report for the month of February,2020)
13	Drilling operations should be carried out using the machines equipped with dust extraction system only.	Complied.
14	The stone crushers shall be provided with air pollution control systems as per central pollution control board (CPCB) guidelines and shall operate only with valid consent of APPCB.	Not complied. About 9 crushers are existing but without cladding and dust containment measures and also without having CFO of the Board.
15	Avenue plantation and green belt shall be developed in project area and surroundings as per the conditions stipulated.	Not complied.
16	Internal Monitoring team (Environment Cell) shall be constituted to monitor issues pertaining to environment and pollution and for ensuring implementation of the conditions specified by the MoEF&CC and A.P.Pollution Control Board.	Not complied. No exclusive Environmental monitoring cell is formed.

WHEREAS vide reference 7th cited, this office was instructed to issue show cause notice to Polavaram Irrigation Project for non-compliance of the Board directions.

In view of the above, you are directed to show cause as why action should not be initiated against your industry under section 33(A) of Water (Prevention and Control of Pollution) Amendment Act, 1988 and under section 31(A) of Air (Prevention and Control of Pollution) Amendment Act, 1987 for non compliance of Board directions.

Your reply to the above notice shall reach this office within 7 days from the date of receipt of this notice, failing which necessary action will be initiated against your project under section 33(A) of Water (Prevention and Control of Pollution) Amendment Act, 1988 and under section 31(A) of Air (Prevention and Control of Pollution) Amendment Act, 1987 in the interest of Public Health and Environment.

ENVIRONMENTAL ENGINEER (FAC)

To
The Chief Engineer,
Polavaram Irrigation Project,
Ramalahpeta (V),
Polavaram (M), West Godavari District.

Copy to
1. The Joint Chief Environmental Engineer, (UH-I), Head Office, Vijayawada for information and necessary action.
2. The Joint Chief Environmental Engineer, (UH-II), Head Office, Vijayawada for information and necessary action.
3. The Joint Chief Environmental Engineer, Zonal Office, Visakhapatnam for information and necessary action.

Signed by Bokka Bulli Saritha
Date: 15-12-2020 12:53:04
Reason: Approved

Annex - IV

ANDHRA PRADESH POLLUTION CONTROL BOARD
D.No.33-26-14, D/2, Near Sunrise Hospital, Pushpa Hotel Centre,
Chalamalavari street, Kasturibaipet, Vijayawada – 520 010

Phone:0866-2463200.
Grams : Kalusya Nivarana
Website :www.appcb.ap.nic.in

Order No.129/APPCB/UH-II/TF/ELR/2020- **Date: 08.01.2021.**

DIRECTIONS

Sub: **APPCB – TF - HO –** Polavaram irrigation project, Ramalahpeta (V), Polavaram (M), West Godavari District, Andhra Pradesh – Non-compliance of Board directions and consent conditions – Legal hearing held on 21.12.2020 – **Directions** – Issued – Reg.

Ref:
1. Order No.129/APPCB/UH-II/TF/ELR/2016, dt.30.11.2016.
2. The Hon'ble NGT issued order dt.01.11.2018 in the matter of O.A.No.857 of 2018.
3. Joint inspection team inspected the Polavaram Project on 11.12.2018.
4. Order No.129/APPCB/UH-II/TF/ELR/2018-1942, dated 27.02.2019.
5. The Hon'ble NGT issued order dt.19.02.2019 in the matter of O.A.No.857 of 2018.
6. The Hon'ble NGT issued order dt.10.05.2019 in the matter of O.A.No.857 of 2018.
7. TF Directions Order No.129/APPCB/UH-II/TF/ELR/2019-1339 dated 03.11.2019.
8. The RO, Eluru report dated 21.11.2020.
9. External Advisory Committee (Task Force) Meeting held on 21.12.2020.

***

WHEREAS you are operating project in the name & style of Polavaram irrigation project is a multi-purpose reservoir project contemplated across the River Godavari near Ramalahpeta (V), Polavaram (M), West Godavari District, Andhra Pradesh.

WHEREAS vide reference 1st cited, O.A.No.309 of 2015 was filed in the Hon'ble NGT on the pollution at Polavaram dam work site and the same was disposed with a direction to APPCB to conduct Joint Inspection and pass appropriate directions in the interest of Environment and ecology. Subsequently the Board issued directions to the project on 30.11.2016.

WHEREAS vide reference 2nd cited, the Hon'ble NGT by order dated 01.11.2018 constituted the committee with officials of CPCB, APPCB, MoEF&CC and District Collector, West Godavari District to submit actual report. The committee inspected the project on 11.12.2018 and submitted the report on 26.12.2018 vide reference 3rd cited.

WHEREAS vide reference 4th cited, the Board issued directions to the Polavaram Irrigation Project dated 27.02.2019 based on the observations of the committee.

WHEREAS vide reference 5th cited, the Hon'ble NGT order issued dated 19.02.2019 directed the project authority to comply with the recommendations of the committee and also directed the committee to file further report. The Joint Committee report was once again submitted on 29.04.2019.

WHEREAS vide reference 6th cited, the Hon'ble NGT vide order dated 10.05.2019, directed to file further report by 31.07.2019. The Committee inspected the site on 24.07.2019 and expressed displeasure on the progress. The case was heard on 27.09.2019 and ordered as follows:

> "The State Pollution Control Board filed a report on 30.07.2019 on behalf of the committee indicating that though the excavation work has been stopped due to monsoon, the project proponent failed to submit action taken reports. No major plantation activity was undertaken as required, additional land which is not required be returned, muck be utilized properly, dumping of muck be stopped and AAQM be

implemented, protective measures taken on the sliding of embankments, measures are also required for dust separation".

WHEREAS vide reference 7th cited, the Board reviewed the Project authority and issued the directions dt 03.11.2019. The case was again heard on 07.11.2019 and then on 20.02.2020 and thereafter on 18.09.2020 and observed that no further status report has been filed by the State PCB or any other authority and directed to file the report before the next hearing on 11.01.2021.

WHEREAS vide reference 8th cited, RO, Eluru submitted compliance of the directions issued by the Board vide report dt 21.11.2020:

1. The Project Authorities have been submitting the ATR on disposal of muck every fifteen days up to September, 2020.
2. Slopes of existing muck dumps opposite of B.C. Colony were taken up and completed in March, 2020. But during recent heavy floods in October 2020, some portion of sloping works got disturbed and need to be taken up gain. 800 Bamboo Tree Saplings have been planted over the slopes for stabilization in September, 2020. Further dumping of muck has not taken place at dumping yard near B.C Colony. During the last working season in 2019-20, the excavated earth has been utilized for formation of internal ring bund, as a part of working arrangement by the agency. Vegetation on the slopes is not yet started.
3. Presently, paddy cultivation is going on in the 87 acres of land adjacent to the existing dumping site. PIP informed that decision is not yet taken on returning the unutilized land if any, out of the 87 Acs which is earlier proposed for dumping.
4. The Project Authority not submitting specific reutilisation muck on regular basis submit report every month on progress achieved and quantity of reutilization of muck. The feasibility of using the land already demarcated near the O point shall be furnished.
5. During the last working season in 2019-20, the excavated earth has been utilized for formation of internal ring bund, as a part of working arrangement by the agency. No Dumping is observed at zero point. As informed by PIP that 207 Lakh Cu.M. of rock muck will be required for the construction of i) balance cofferdams, ii) ECRF dam in gap-II, iii) upstream left side guide bund of Approach Channel and iv) for the river protection works. The total rock muck will be utilized in the above works.
6. NEERI has conducted Ambient Air Quality Monitoring in February and March 2020 only. But reports are yet to be submitted. Presently NEERI has been conducting field tests form 16.11.2020.
7. The PIP not yet finalized the recommendations of IIT Delhi.
8. About 5 tankers are engaged for wetting of roads/ village roads. Frequency needs to be increased.
9. The PIP not submitted action plan for Solid Waste Management for the entire project area covering labour colonies, canteens & other offices etc.,
10. The PIP not submitted action plan for treatment of domestic waste water generated from labour colonies, canteens & other offices etc.,
11. The PIP partially complied measures to 9 No. of stone crushers existing in the project premises.
12. The PIP partially complied Ambient Air Quality Monitoring stations at BC colony, Chandranna colony, Labour colony and project office and submitted reports to Regional Office, Eluru and MoEF regularly.
13. The PIP complied drilling operations to be carried out using the machines equipped with dust extraction system only.
14. The PIP not provided air pollution control systems as per central pollution control board (CPCB) guidelines and shall operate only with valid consent of APPCB.
15. The PIP not developed avenue plantation and green belt in project area and surroundings as per the conditions stipulated.
16. The PIP not constituted internal monitoring team (Environment Cell) to monitor issues pertaining to environment and pollution and for ensuring implementation of the conditions specified by the MoEF and A.P.Pollution Control Board.

WHEREAS legal hearing was conducted before the External Advisory Committee (Task Force) of A.P. Pollution Control Board in its meeting held on 21.12.2020. The representatives of the Polavaram Irrigation Project (PIP), Polavaram (M), West Godavari District Sri Nagi Reddy, S.E attended the Legal Hearing. The committee noted that the Board reviewed the Project authority and issued the directions dt 03.11.2019, the PIP has been wetting the premises of the stone crushers but has not provided cladding and wind breaking walls. The AEE RO Eluru informed

that the NGT has directed the State PCB and other respondents to file the report before the next hearing on 11.01.2021. They informed that no dumping activity is happening in the 87 Acres of additional area of Molalanka lands. Further, it was informed that Avenue Plantation is started with the co-ordination of Forest department near B.C Colony of Polavaram for a length of 1200 m stretch along Kademma Drain. Further informed that the Ambient air quality is being monitored by NEERI and as not submitted there will be monitored after excavation activity starts in the project area.

After detailed review the committee recommended to issue the directions to the facility. The Board hereby issues following directions under Sec.33 (A) of Water (Prevention and Control of Pollution) Amendment Act, 1988 and under Sec.31 (A) of Air (Prevention & Control of Pollution) Amendment Act, 1987:

1. ***The stone crushers shall be provided with air pollution control systems as per Central Pollution Control Board (CPCB) guidelines and shall operate only with valid consent of APPCB.***
2. ***The PIP shall impart following measures to 9 no. of stone crushers existing in the project premises immediately:***

a. ***Wetting of premises of stone crushers, roads to avoid dust emissions due to vehicular movement.***
b. ***Shall Provide cladding to primary crushers, secondary crushers, screens, dust tank etc.,***
c. ***Shall provide Wind breaking walls around crushers to control dust emissions***

3. ***The PIP authority shall submit action taken report on proper disposal of muck every 15 days as recommended by the Joint Committee.***
4. ***The disturbed portion of the sloping works at the BC colony shall be strengthened with proper heights and slopes along with vegetative cover.***
5. ***The project authority to relook at the utilization of 87 acres acquired adjacent to the existing dumping site. (Moolkalanka dump site).***
6. ***As committed by the Project authority, dumping of mucks shall not be done near BC colony area and Reserve forest area and Eco Sensitive Zones.***
7. ***The recommendations of IIT Delhi regarding permanent protective measures on the sliding of embankments shall be duly followed and progress shall be reported.***
8. ***The PIP during the earth work excavation shall take Adequate dust suppression measures like providing water spraying shall be carried out till good vegetative cover is attained. Similarly, water spraying shall be arranged regularly for wetting the approach roads/ village roads etc at project areas and nearby villages, for control of dust emissions due to vehicular movement and shall maintain records and submit reports. The frequency of wetting of roads shall be increased depending on the weather conditions, so as to avoid fugitive dust emission during vehicular movement.***
9. ***The PIP shall install Ambient Air Quality Monitoring stations at B.C colony, Chandranna Colony, Labour colony and Project Office and shall submit reports to Regional Office, Eluru and MoEF regularly.***
10. ***Drilling operations should be carried out using the machines equipped with dust extraction systems only.***
11. ***Avenue plantation and green belt shall be developed in project area and surroundings as per the conditions stipulated.***
12. ***Internal monitoring team (Environment Cell) shall be constituted to monitor issues pertaining to environment and pollution and for ensuring implementation of the conditions specified by the MoEF and A.P. Pollution Control Board.***

You are hereby directed to note that, should you violate any one of the directions mentioned above, your unit will be closed under Sec.33 (A) of Water (Prevention & Control of Pollution) Amendment Act, 1988 and Sec.31 (A) of Air (Prevention & Control of Pollution) Amendment Act, 1987 without any further notice, in the interest of Public Health and Environment.

This Order comes into effect from today i.e., 08.01.2021.

Sd/-
MEMBER SECRETARY

To
Polavaram irrigation project,
Ramalahpeta (V), Polavaram (M),
West Godavari District,
Andhra Pradesh.

//T.C.F.B.O. //

JOINT CHIEF ENVIRONMENTAL ENGINEER
UH-II

Annex-'A'

GOVERNMENT OF ANDHRA PRADESH
ABSTRACT

Water Resources Department - Polavaram Irrigation Project-Polavaram-West Godavari District – Carrying out the Air Quality Monitoring and Water Quality Tests – preparation of reports to MoEF and APPCB & Raising of plantation and 3 year maintenance at Mulalanka dump yard for an amount of Rs.406.201 Lakhs – Administrative sanction - Orders – Issued.

WATER RESOURCES (Proj.I) DEPARTMENT

G.O.RT.No. 35 **Dated: 21-01-2020**

Read the following:-

1. From the Chief Engineer, PIPHW Unit, Polavaram, Lr.No.CE/PIPHW/DCE2/OT3 /AEE1/M1/2019/145M Dated.23-04-2019.
2. From the Chief Engineer, PIP Head works Unit, Polavaram. Lr.No.CE /PIPHW/ DCE-2/OT3/AEE1/AAQ/492M Dated.17.10.2019.
3. From the Chief Engineer, PIP Head Works Unit, Polavaram Lr.No.CE /PIPHW /DCE/OT1/AEE2/AAQ/10M Dt:02.01.2020.

*****

ORDER:

In the references read above, the Chief Engineer, Polavaram Irrigation Project Head Works, Polavaram has stated the Ministry of Environmental & Forests has granted clearance to the Polavaram Irrigation Project on 25-10-2005 and mentioned that the clearances is subject to the implementation of environmental safe guards have to be implemented while doing the earth work excavation as well as dumping of excavated soils as part of the Environmental Impact Assessment.

2. He has further stated that the OA No.857 of 2018 has been filed by Dr.P.Pulla Rao towards the pollution effects of dumping activity being performed in Polavaram Irrigation Project. In this regard, a 4 member committee constituted by the Hon'ble NGT, New Delhi has been visited the site on 11-12-2018 and observations were communicated vide O.A.No.857 of 2018 on Dt.29-12-2018.

3. He has further stated that the Principal Scientist, NEERI, Hyderabad and his team members have inspected the Polavaram Irrigation Project site on 01-02-2019 regarding Air Quality Monitoring, Noise level, Water Quality tests and preparation of reports to MOEF and APPCB.

4. As per the suggestion of the team the Superintending Engineer, PIPHW Circle, Dowlaiswaram has submitted the estimate for 1) Carrying out the Air Quality Monitoring and Water Quality Tests – preparation of reports to MOEF and APPCB and 2) Raising of plantation and 3 year maintenance at Mulalanka dump yard. (The detailed provisions are annexed to this order) .

(p.t.o)

5. The rates for the above item of works are adopted as supplied by the Forest Department Forest Schedule of Rates for the year 2018-19. The total Estimate amount including these two components and GST 18.00% is Rs.4.2297 crores and the Chief Engineer, PIPHW has requested the Government for favour of according administrative approval.

6. Government after careful examination, hereby accord administrative sanction for the works "1) Carrying out the Air Quality Monitoring and Water Quality Tests – preparation of reports to MOEF and APPCB & 2) Raising of plantation and 3 year maintenance at Mulalanka dump yard" for an amount of Rs.406.201 Lakhs subject to the Chief Engineer, Polavaram Irrigation Project Head Works shall ensure i) correctness of quantities, rates and data proposed in the estimates and ii) Supporting data for the rates for certain items i.e watch & ward etc are not furnished. The same shall be arrived.

7. The expenditure shall be chargeable to Head of Account "DA 4700 – Capital Outlay on Major Irrigation 01-Major Irrigation – Commercial – MH(120) – Polavaram Barrage – GH (11)- State Development Plan – SH (26) D & A works – GH (12) Central Assistance to State Development Plan (CASDP) SH (26) Dam & Appurtenant works – 530 Major Works – 531 Other Expenditure".

8. The Chief Engineer, Polavaram Irrigation Project Head Works, Polavaram shall take necessary action accordingly.

9. This order issues with the concurrence of the Finance (FMU.WR.I) Department, vide their U.O.No. FIN01-FMU0PC(WR3)/61/2019-FMU-WR-III , dated 13.01.2020.

(BY ORDER AND IN THE NAME OF THE GOVERNOR OF ANDHRA PRADESH)

ADITYA NATH DAS
SPECIAL CHIEF SECRETARY TO GOVERNMENT

To
The Chief Engineer, Polavaram Irrigation Project Head Works, Polavaram
Copy To:
The Accountant General, A.P, Hyderabad,
The Pay & Accounts Office, A.P, Ibrahimpatnam, Vijayawada,
The Director of Works & Accounts, Vijayawada,
Finance (FMU-WR III) Department,
SF/SC.

//FORWARDED::BY ORDER//

SECTION OFFICER

(Annexure to G.O.Rt.No. Water Resources (Project.I) Department, dt. 21/01/2020)

1) Carrying out the Air Quality Monitoring and Water Quality Tests – preparation of reports to MOEF and APPCB with the following provisions:

1. To identify the monitoring locations for air, water and soil quality based on local meterology, land cover/topography and other available information.

2. To monitor air quality (AAQ), noise levels and water quality, soil quality at identified locations in and around Polavaram Irrigation Project Head works site, Polavaram.

3. To assess the AAQ levels, noise levels and water quality, soil quality in and around near Polavaram Mulalanka dump yard site and suggest suitable mitigation measures, if required.

4. The environmental quality data will be generated in the project site on monthly basis in the year excluding monsoon season (June-August). The environment assessment includes generation of data on the air, noise and water environments of the study area.

5. The total budgetary offer for carrying monitoring and assessment of environmental measures in one year is Rs.84.45 lakhs plus GST extra as applicable at the time of payment. And

2) Raising of plantation and 3 year maintenance at Mulalanka dump yard vide letter dated.17.04.2019 with the following provisions.

1. Provision for Alignment & fixing planting point for avenue plants.
2. Provision for Cost and collection of stakes including cost, collection, transportation and fixing in the pit.
3. Provision for Cost of tall plants & grafted fruit bearing trees.
4. Provision for Transportation charges of plants.
5. Provision for planting the bag plants, tree guards & etc.,
6. Provision for Replacement of casualities @ 20%
7. Provision for Application of Fertilizers, Chemicals & etc.,
8. Provision for Watch & Ward Charges.
9. Provision for 1 st year maintenance charges.
10. Provision for 2 nd year maintenance charges.
11. Provision for 3 rd year maintenance charges.

ADITYA NATH DAS
SPECIAL CHIEF SECRETARY TO GOVERNMENT

Annex-B

GOVERNMENT OF ANDHRA PRADESH
WATER RESOURCES DEPARTMENT

From:
Sri M. Nagi Reddy, ME, MIE.,
Superintending Engineer,
PIPHW Circle
Dowlaiswaram 533125
Ph#/FAX: 0883 2417559(8)/
0883-2417557
Email: seishw@gmail.com

To:
CSIR National Environmental Research Institute,
Zonal Laboratory, IICT Campus,
Tarnaka, Hyderabad 500007.
Telangana State, India

Work Order No.SE/PIPHW/OT1/AEE1/EIA/Vol.11/ 01/2019-20. Dt.21.01.2020.

Gentlemen,

Sub:- Water Resources Department – Polavaram Irrigation Project- Polavaram Head Works – West Godavari District – Carrying out Air Quality Monitoring and Water Quality Tests – preparation of reports to MoEF and APPCB – Work Order Issued – Reg.

Ref:- 1. G.O RT No. 35, Water Resources Department, Dt, 21.01.2020.
2. Your Quotation Lr. No. HZC/Polavaram/2019/110, Dt.08.02.2019 furnished to the Executive Engineer, PIPHW Division No3 Polavaram West Godavari District, Andhra Pradesh.

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Your Quotation for "Compliance Monitoring and Assessment of Ambient Air Quality, Noise Levels and Water Quality in and around Polavaram Irrigation Project Head Works site, Polavaram, West Godavari District, Andhra Pradesh" for an amount of Rs. 84.45 Lakhs + GST furnished vide reference 2nd cited along with terms of Payment conditions is hereby accepted.

You are directed to proceed with the subject work immediately duly contacting the Executive Engineer, PIPHW Division No 3, Polavaram, West Godavari, Andhra Pradesh.

The Terms & Conditions

1. To Identify the monitoring locations for Air, Water and soil Quality based on local meteorology, Land Cover, Topography and other available information.
2. To Monitor Air Quality (AAQ), noise levels and water quality, soil quality at identified locations in and around Polavaram Irrigation Project Head Works site, Polavaram.
3. To assess the AAQ Levels, noise levels and water quality, soil quality at identified locations in and around near Polavaram Mulalanka Dump Yard site and suggest suitable mitigation measures if required.

P.T.O

4. The environmental quality data shall be generated in the project site on monthly basis during the year excluding monsoon season. The environment assessment includes generation of the data on the air, noise and water environments of study area.
5. The amount quoted Rs. 84.45 Lakhs + GST is inclusive of all incidental charges and Taxes. No Extra cost shall be paid on any account.
6. Necessary statutory deductions such as Income Tax etc., shall be made from the payments released against the subject work.

Encl: Other Terms & Conditions.

Yours faithfully,
Sd/- M.Nagi Reddy, 21.01.2020,
Superintending Engineer,
PIPHW Circle, Dowlaiswaram.

Copy submitted to Engineer-in-Chief, PIP, Dowlaiswaram for favour of information.

Copy submitted to Chief Engineers PIPHW Unit, Polavaram for favour of information and requested to issue necessary ratification for entrustment of the subject work to CSIR National Environmental Research Institute, Hyderabad.

Copy to Executive Engineer, PIPHW, Division No. 3, Polavaram for information and is instructed to see that the work is completed in terms of the quotation furnished by the Agency and Terms and Conditions of the Work Order.

Copy to Sub-Treasury officer, Polavaram and Pay and Accounts Officer, Eluru, West Godavari for information and necessary action. The expenditure shall be charged to Head of Account "4700 - Capital Outlay on Major Irrigation 01 – Major Irrigation – Commercial – MH(120) – Polavaram Barrage – GH (12) Central Assistance to State Development Plan(CASDP) - SH(26) D & A Works — 530 Major Works – 531 Other Expenditure".

Sd/- M.Nagi Reddy, 21.01.2020,
Superintending Engineer,
PIPHW Circle, Dowlaiswaram.

// t.c.f //

K. Venkateswara 21/1/2020
Dy. Superintending Engineer,
PIPHW Circle, Dowlaiswaram.

21/1/2020

Other Terms & Conditions to the work Order No. 01/2019-20, Dt. 21.01.2020

1. Objectives:

a. To identify the monitoring locations for air, water and soil quality based on local meteorology, land cover/topography and other available information/charts

b. To monitor ambient air quality (AAQ), noise levels and water quality, soil quality at identified locations in and around project site.

c. To assess the AAQ levels, noise levels and water quality, soil quality in and near Polavaram dumping site and suggest suitable mitigation measures, if required.

2. Scope of Work:

The environmental quality data shall be generated in the project site on monthly basis in the year excluding monsoon season (June-August). The environmental assessment includes generation of data on the air, noise and water environments of the study area. The data collection will be done for

Terrestrial Environment

a. Air Environment
b. Noise Environment
c. Groundwater and surface water Environment
d. Soil Environment

Terrestrial Environment
Air Environment

- Selection of sampling stations: About three AAQ stations will be selected based on the local meteorology, dumping site area, accessibility, availability of electricity and local people's support.
- The ambient air quality (AAQ) monitoring stations will be established and 24hr sample collection shall be done for following parameters: Particulate Matter (size less than 10 µm or PM_{10}), Particulate Matter (size less than 2.5 µm or $PM_{2.5}$), Sulphur dioxide (SO2), Nitrogen dioxide (NO2), Ozone (03), Carbon monoxide (CO), Ammonia (NH3), Benzene (C6H6), Particulate metals like lead (Pb), Arsenic (As) and Nickel (Ni) and particulate associated Benzo-alpha-pyrene (BaP), as per National Ambient Air Quality Standards (NAAQS) Criteria by Central Pollution Control Board (CPCB), New Delhi.
- The samples shall be collected each station for every month except monsoon season (June-August) as per CPCB guidelines.
- Collection of hourly meteorological data comprising wind speed, wind direction, temperature, relative humidity, cloud cover, solar insolation and rainfall (from secondary data sources or from nearest IMD station).

- Total samples for AAQ in a year 3 (stations) X 8 (twice in a week for one month) X 9 (months excluding June-August) = 216.
- Delineation of mitigation measures after assessing the AAQ levels.

Noise environment

- Day Time and Night time noise levels shall be monitored at each station, twice a week for one month, preferably at the ambient air quality monitoring sites and selected locations.
- Total samples for noise levels in a year = 10 (stations) X 4 (once in a week for one month) X 2 (day and night) X 9 (months excluding June-August) = 720.
- Delineation of mitigation measures after assessing the noise levels

Groundwater environment

- Groundwater shall be collected at the representative locations and shall be analyzed for the following parameters: pH, TSS, TDS, Fluoride, salinity, total alkalinity, Total hardness, sulphates, nitrate, phosphate, Chloride, total coliforms, **DO,** BOD, heavy metals like Fe, B, Ni, Zn, **Pb,** Cr, Cu, As, Mn, Hg.
- Measurement of groundwater levels in bore wells once in a month in identified quarter
- Total samples for Groundwater quality in a year= 10 (stations) X 9 (months excluding June-August) = 90
- Recommendations on water conservation measures
- Delineation of mitigation measures after assessing the water quality.

Soil environment

- Assessment of Soil quality in the study area shall be carried out at selected stations for physico-chemical parameters like pH, Conductivity, Organic Carbon, Texture, Bulk Density, Particle Density, Porosity, water holding capacity, Soluble Cations (Calcium, Magnesium, Sodium, and Potassium), Sulphates, Chlorides, available N, P & K, Sodium Absorption Ratio (SAR).
- Total samples for soil quality in a year= 5 (stations) X 2 (pre- and post-monsoon seasons in a year) = **10**

Surface water Environment

- Surface water shall be collected at the available locations and shall be analyzed for the following parameters: pH, TDS, Fluoride, salinity, total alkalinity, Total hardness, sulphates, nitrate, phosphate, Chloride, total coliforms, DO, BOD, heavy metals like Fe, B, Ni. Zn Pb, Cr, Cu, As. Mn, Hg.
- Sediment samples shall be characterized for Texture, Total Organic Carbon and heavy metals (Al, As, Cr, Mn, Fe, Co, Cd, Pb, Ni, Cu, Zn)
- Biological Environment:
  - Phytoplankton count, major genera and generic diversity
  - Zooplankton count, major genera and group diversity

- Numerical and biomass density per unit area, identification of species and species diversity of benthic fauna in sediments.

- Total samples for surface water and sediments = 5 (stations) X 2 (surface water and sediment) X 3 (pre-and post-monsoon seasons and winter season in a year) = 30

3. Reporting:

- **Periodical Reports:** Quarterly reports shall be submitted within 45 days after completion of sampling for that quarter.
- **Draft Report:** Draft report shall be submitted within 45 days after completion of field studies for last quarter.
- **Final Report:** Final report shall be submitted within 20 days after receiving comments/ suggestions from the Superintending Engineer, P.I.P.H.W. Circle, Dowlaiswaram on draft report.

4. Deliverables:

Compliance report of air quality, noise level, water quality.

5. Inputs by Water resources department:

Following information and assistance **shall** be provided by Water resources department:

- All the permissions/assistance for NEERI staff to enter in to Polavaram Project Site and surrounding area during sampling work.
- Arrangement for electricity facilities for keeping ambient air quality instruments.
- Maps showing location of dumping site and other activities of the Polavaram project in digitized form/AutoCAD
- Existing environmental data from previous EIA/EMP reports, a copy of EC, and other secondary information available with by Executive Engineer, P.I.P.H.W. Divn. No. III, Polavaram for the present work.
- Technical persons to be deputed for assisting NEERI team during monitoring and meetings
- Any other information available with by **Executive Engineer, P.I.P.H.W. Divn. No. III, Polavaram** that is in interest of use for conducting studies
- Assistance for undertaking site inspection, field data collection at villages.

6. Award Price:

The award price for the entire scope of work is Rs. 84.45 lakhs **(Rupees Eighty four lakhs and forty five thousand only),** excluding GST

7. Reports:

Quarterly Reports: Soft copy through e-mail.

Draft report: 01 hard copy with a soft copy on CD.

Final report: 05 hard copies with a soft copy on CD (2 Nos.).

8. Time Schedule: The time schedule for the completion of the project is 18 months from the date of receipt of advance along with the work order.

09. Terms and Conditions of Payment:

Instalment	Amount (Rs.)	Mode	Schedule
1St Instalment	50% of project cost + GST (@ 18.00%)	Advance payment	To be paid along with work order
2nd Instalment	40% of project cost + GST (@ 18.00%)	On Submission of **"Draft Report"**	13 months from the date of commencement of Study
3rd Instalment	10% of project cost + GST (@ 18.00%)	On Submission of **"Final Report"**	14 months from the date of commencement of Study
Total	**84,45,000/- + GST**		

10. Payment shall be made to NEERI, Hyderabad

11. All the Invoices, along with the related documents for claiming payments shall be addressed to:

The Executive Engineer,
P.I.P.H.W. Circle, Division No 3,
Polavaram, West Godavari District,
Andhra Pradesh - 534315.

12. **Rights on data:** All the data generated under this project is the sole property of the Water Resources Department. Results, reports, data and other deliverables developed under this study are the property of Polavaram Irrigation project. Hence, no information on the study shall be parted with anybody.

Sd/- M.Nagi Reddy, 21.01.2020,
Superintending Engineer,
PIPHW Circle, Dowlaiswaram.

// t.c.f //

K. Kalyanasundaram 21/1/2020.
Dy. Superintending Engineer,
PIPHW Circle, Dowlaiswaram.
21/1/2020

Annex - C

By RPAD

GOVERNMENT OF ANDHRA PRADESH
WATER RESOURCES DEPARTMENT

From:
Sri M. Nagi Reddy, ME, MIE.,
Superintending Engineer,
PIPHW Circle
Dowlaiswaram 533125
Ph#/FAX: 0883 2417559(8)/
0883 -2417557
Email: seishw@gmail.com

To:
Divisional Forest Officer
Social Forestry Division,
Eluru, West Godavari District.

Work Order No.SE/PIPHW/OT1/AEE1/EIA/Vol.12/01/2020-21, Dt.10.09.2020.

Gentlemen,

Sub:- Water Resources Department – Polavaram Irrigation Project- Polavaram Head Works – West Godavari District – Entrustment of work of "Raising of Plantation and 3 years maintenance at Mulalanka Dump yard" to State Forest Department – Work Order Issued – Reg.

Ref:-
1. G.O RT No. 35, Water Resources Department, Dt, 21.01.2020.
2. Chief Engineer, PIPHW, Polavaram, Technical Sanction to the Estimate vide Proceeding No. CE/PIPHW/DCE/OT-1/AEE-2/126^{SE}, Dt. 21.01.2020.
3. T.O Lr. No. SE/PIPHW/OT-1/AEE1/EIA/Vol.11/100^{M}, Dt. 14.02.2020.
4. Principal Chief Conservator of Forests (HoFF). Guntur Lr. No. EFSO2-2053/08/2018/NC-1(i), Dt. 19.02.2020.
5. Principal Conservator of Forest, Guntur Ref NoEFSO2-20053/08/ 2018/NC1(ii), Dt. 20.02.2020 addressed to Conservator of Forest, Rajahmundry.
6. DFO, Eluru, letter Ref. No.42/2020/DM, Dt. 13.03.2020.
7. DFO, Eluru, letter addressed to the Conservator of Forest, Rajahmundry, Ref No.42/2020/DM, Dt. 19.05.2020.
8. DFO, Eluru letter No. Rc. No.42/2020/DM, Dt. 15.07.2020.
9. T.O Lr. No. SE/PIPHW/OT-1/AEE1/EIA/Vol.12/360^{CE}, Dt. 24.07.2020.
10. CE, PIP, Dowlaiswaram Memo No. CE/PIP/DCE-1/OT-3/AEE-3/AAQ & Plantation/Vol.2, Dt. 04.08.2020.
11. Executive Engineer, PIPHW, Division 3, Polavaram Lr. No.147^{SE}, Dt.5.8.2020.

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With reference to 4th cited, it is to inform that the Principle Conservator of Forest, Guntur has agreed in-principle to take up the work i.e, Raising and Maintenance of Plantation for 3 years over 200 Acres at Mulalanka Dump yard at Polavaram Project Head Works, West Godavari District with the funds provided by the AP Water Resources Department.

The Chief Engineer, PIP, Dowlaiswaram has permitted to entrust the work of Raising of Plantation and 3 years maintenance at Mulalanka dump yard to the state Forest Department as per Technical Sanction Proceedings vide reference 2nd cited.

In this connection, the subject work i.e, Raising of Plantation and 3 years maintenance at Mulalanka dump yard is herewith entrusted to the State forest Department for Total amount of Rs. 3,04,62,892/- including GST at 12% (As per Technical Sanction). The item wise work details and related amounts are tabulated below:

S. No.	Item of Work	Amount in Rs.
1	Raising of Plantation at Mulalanka Dumping Area of Polavaram Irrigation Project	Rs. 1,76,74,398/-
2	1st year maintenance of Plantation at Mulalanka Dumping Area of Polavaram Irrigation Project	Rs. 63,55,244/-
3	2nd year maintenance of Plantation at Mulalanka Dumping Area of Polavaram Irrigation Project	Rs. 27,63,769/-
4	3rd year maintenance of Plantation at Mulalanka Dumping Area of Polavaram Irrigation Project	Rs. 4,05,600/-
	Total in Rs.	Rs. 2,71,99,011/-
	GST @12%	Rs. 32,63,881/-
	Grand Total in Rs.	Rs.3,04,62,892/-

The entrustment of work is subjected to the following Terms and Conditions:

I. Raising of Plantation:

Scope of Work includes:

1. The Plant Species must be suitable to the native soil of dumped material.
2. The saplings shall be planted at a spacing of 5 m x 5 m covering 400 nos per Ha.
3. Watch and ward shall be provided.
4. Tree guards shall be provided to protect the plants.
5. Replacement of casualties at 20% during the raising year.
6. Repairs to tree guards, application of fertilizers, chemicals, soil working including weeding, watering to the plants and etc.,

II. 1st year maintenance:

Scope of work includes

1. Replacement of causalities at 25% during the 1st year maintenance.
2. Repairs and subsequent repairs to tree guards.

3. Watch and ward shall be provided.
4. Application of fertilizers, chemicals, soil working including weeding, watering to the plants and etc.,

III. 2nd year maintenance:

Scope of work includes

1. Repairs to tree guards.
2. Watch and ward shall be provided.
3. Application of fertilizers, chemicals, soil working including weeding, watering to the plants and etc.,

IV. 3rd year maintenance:

Scope of work includes

1. Watch and ward shall be provided.
2. Application of fertilizers, chemicals, soil working including weeding, watering to the plants and etc.,

The watch and ward under 3rd year maintenance of plantation shall be permitted with prior permission of the Executive Engineer, PIPHW, Division No 3, Polavaram. The watch and ward engaged for 3rd year maintenance shall carryout pruning of epidemic branches and repairs to the tree guards in addition to the protection of Plantation.

Mode of Payment:

i. For Raising of Plantation an amount of Rs. 1,76,74,398/- + GST 12% will be paid in advance immediately after commencement of the work by Forest Department.
ii. For 1st year maintenance an amount of Rs. 63,55,244/- + GST 12% will be paid immediately after completion of raising of plantation.
iii. For 2nd year maintenance an amount of Rs. 27,63,769/- + GST 12% will be paid immediately after completion of 1st year maintenance.

iv. For 3rd year maintenance an amount of Rs. 4,05,600/- + GST 12% will be paid immediately after completion of 2nd year maintenance.

The levelling of site and Approach roads as per the site conditions will be done by the Executive Engineer, PIPHW, Division No 3, Polavaram. The site will be handed over immediately after receiving the letter of acceptance.

Yours faithfully,

Superintending Engineer,
PIPHW Circle, Dowlaiswaram.

Annex - 'D'

Interim report

COMPLIANCE MONITORING AND ASSESSMENT OF AMBIENT AIR QUALITY, NOISE LEVELS AND WATER QUALITY AT POLAVARAM, W.G.DIST., ANDHRA PRADESH

Sponsor

Executive Engineer (FAC), P.I.P.H.W. Divn. No. III
Polavaram – 534315

CSIR-National Environmental Engineering Research Institute
Hyderabad Zonal Centre
Uppal Road, Hyderabad-500007

December 2020

Project Personnel

CSIR-NEERI, Hyderabad Zonal Centre

Mrs. Morami Kalita
Dr. Meganathan. P. R
Mr. S. Harirama Kumar
Mr. Shaik Fareed
Ms. P. Priyanka
Mr. Madhu
Ms. Akanksha
Mr. A. Suresh
Mr. Sangamesh
Mr. Rahul Shete
Ms. A. Bhavana
Mr. J. Eshwar

Dr. Tanvir Arfin
Mrs. M. Sumathi
Mr. M. Paresh Kumar
Mr. K. Yadagiri
Mr. P. Ramulu
Ms. Yashaswitha
Ms. Yeshwitha
Mr. Nagaraju
Ms. Poulami
Mr. K.Chandrakant
Ms. Vincy
Mr. Sprudhar

Project Leader(s)

Dr, T.V.B.P.S.Rama Krishna

Ms. Ramya Sanam

Dr. Shaik Basha

Project Coordinator

Dr. Rakesh Kumar
Director, CSIR-NEERI, Nagpur

Chapter 1

Introduction

1.0 Preamble

The Polavaram Irrigation Project is a multipurpose terminal Project across river Godavari near Polavaram Village about 42 km on upstream of Godavari Barrage, Dowlaiswaram. The Project envisages Irrigation benefits to an extent of 7.20 Lakh acres for the up land areas of East Godavari & Visakhapatnam Districts under left main canal (181.5 km) and West Godavari & Krishna Districts under right main canal (174 km) and generating of 960 MW of Power. In addition to irrigation benefits 80 TMC of Godavari water is proposed to be diverted to Krishna River and supply 23.44 TMC of drinking water to habitations and industries in and around Visakhapatnam city including Vizag steel plant. Water saved in Krishna River will be used for drought prone areas of Rayalseema region.

The construction Polavaram Project is taken up after obtaining all the statutory clearances from the various ministries of Government of India. The environmental concerns during the construction forms the part of the Environmental Impact Assessment report and only after considering all such impact and its mitigation measures, the Ministry of Environment & Forest has granted clearance to the project on 25.10.2005.

The dumping yards are common features of any construction project which itself is a standard practice of minimizing pollution. The status of compliance with the conditions specified in the clearances i.e., Air Quality Monitoring Test Reports, Noise Level and Water Quality Tests Reports have to be submitted to the Ministry of Environment and Forests, Government of India and APPCB, Vijayawada (NGT OA No. 857 of 2018-Tribunal order dated 01.11.2018).

In this regard, Executive Engineer (FAC), P.I.P.H.W. Divn. No. III, Polavaram approached CSIR-NEERI, Hyderabad Zonal Centre to take up the Environmental Quality Assessment in and around Polavaram Irrigation project including dumping site to know the environmental impacts and to suggest any mitigative measures, if required.

Based on the technical discussions and site visit by CSIR-NEERI HZC scientists and the information provided by Executive Engineer (FAC), P.I.P.H.W. Divn. No. III, Polavaram, an environmental monitoring and assessment study with reference to ambient air quality, noise levels and water quality is proposed with the following objectives and scope of work.

1.1 Objectives

- To identify the monitoring locations for air, water and soil quality based on local meteorology, land cover/topography and other available information/charts
- To monitor ambient air quality (AAQ), noise levels and water quality, soil quality at identified locations in and around project site.
- To assess the AAQ levels, noise levels and water quality, soil quality in and near Polavaram dumping site and suggest suitable mitigation measures, if required.

1.2 Scope of Work and Methodology

The environmental quality data will be generated in the project site on monthly basis in the year excluding monsoon season (June-August). The environmental assessment includes generation of data on the air, noise and water environments of the study area. The data collection will be done for

Terrestrial Environment

a. Air Environment
b. Noise Environment
c. Groundwater and surface water Environment
d. Soil Environment

Terrestrial Environment

Air Environment

- Selection of sampling stations: About three AAQ stations will be selected based on the local meteorology, dumping site area, accessibility, availability of electricity and local people's support.
- The ambient air quality (AAQ) monitoring stations will be established and 24 h sample collection will be done for following parameters: Particulate Matter (size less than 10 µm or PM_{10}), Particulate Matter (size less than 2.5 µm or $PM_{2.5}$), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2), Ozone (O_3), Carbon monoxide (CO), Ammonia (NH_3), Benzene (C_6H_6), Particulate metals like lead

(Pb), Arsenic (As) and Nickel (Ni) and particulate associated Benzo-alpha-pyrene (BaP), as per National Ambient Air Quality Standards (NAAQS) Criteria by Central Pollution Control Board (CPCB), New Delhi.

- The samples will be collected each station for every month except monsoon season (June-August) as per CPCB guidelines.
- Collection of hourly meteorological data comprising wind speed, wind direction, temperature, relative humidity, cloud cover, solar insolation and rainfall (from secondary data sources or from nearest IMD station).
- Total samples for AAQ in a year= 3 (stations) X 8 (twice in a week for one month) X 9 (months excluding June-August) = 216
- Delineation of mitigation measures after assessing the AAQ levels

Noise environment

- Day Time and Night time noise levels will be monitored at each station, twice a week for one month, preferably at the ambient air quality monitoring sites and selected locations.
- Total samples for noise levels in a year= 10 (stations) X 4 (once in a week for one month) X 2 (day and night) X 9 (months excluding June-August) = 720
- Delineation of mitigation measures after assessing the noise levels

Groundwater environment

- Groundwater will be collected at the representative locations and will be analyzed for the following parameters: pH, TSS, TDS, Fluoride, salinity, total alkalinity, Total hardness, sulphates, nitrate, phosphate, Chloride, total coliforms, DO, BOD, heavy metals like Fe, B, Ni, Zn, Pb, Cr, Cr, Cu, As, Mn, Hg.
- Measurement of groundwater levels in bore wells once in a month in identified quarter
- Total samples for Groundwater quality in a year= 10 (stations) X 9 (months excluding June-August) = 90
- Recommendations on water conservation measures
- Delineation of mitigation measures after assessing the water quality.

Soil environment

- Assessment of Soil quality in the study area will be carried out at selected stations for physico-chemical parameters like pH, Conductivity, Organic Carbon, Texture, Bulk Density, Particle Density, Porosity, water holding capacity, Soluble Cations (Calcium, Magnesium, Sodium, and Potassium), Sulphates, Chlorides, Available N, P & K, Sodium Absorption Ratio (SAR).
- Total samples for soil quality in a year= 5 (stations) X 2 (pre- and post-monsoon seasons in a year) = 10

Surface water Environment

- Surface water will be collected at the available locations and will be analyzed for the following parameters: pH, TDS, Fluoride, salinity, total alkalinity, Total hardness, sulphates, nitrate, phosphate, Chloride, total coliforms, DO, BOD, heavy metals like Fe, B, Ni, Zn, Pb, Cr, Cr, Cu, As, Mn, Hg.
- Sediment samples will be characterized for Texture, Total Organic Carbon and heavy metals (Al, As, Cr, Mn, Fe, Co, Cd, Pb, Ni, Cu, Zn)
- Biological Environment:
    - Phytoplankton count, major genera and generic diversity
    - Zooplankton count, major genera and group diversity
    - Numerical and biomass density per unit area, identification of species and species diversity of benthic fauna in sediments.
- Total samples for surface water and sediments = 5 (stations) X 2 (surface water and sediment) X 3 (pre- and post-monsoon seasons and winter season in a year) = 30

1.3 Layout of the report

The report is presented in the following structure:

Chapter 1: Introduction (this chapter)

Chapter 2: Description of Study Area

Chapter 3: Prevailing Environmental Quality Status

Chapter 4: Conclusions and Future Work

Chapter 2

Description of Study Area

(Source: CGWB Report, W.G. District)

3.0 INTRODUCTION

The project site lies in between the latitudes N 17° 12' 30" to N 17° 19' 00" and longitudes E 81° 36' 00" to E 81° 42' 00". A 5 km radius buffer has been prepared around the project site.

31. CLIMATE AND RAINFALL

The climate is tropical in nature and is influenced by the topographical variations and maritime influence. The Deccan Plateau has more of a temperate climate than the coastal belt. The Eastern Ghats in Vishakhapatnam and its neighbourhood play a significant role, which acts as a barrier to easterly winds in association with depression from Bay of Bengal during the southwestern monsoon.

3.2 SOILS

The different soils in the area are red loams, sandy loams, sandy soils and black cotton soils. Red loamy soils are predominate and occupy about 70% in the District. Sandy loamy soils are largely confined to the coastal areas and to certain stretches in the interior mandals. Black cotton soils occur in some parts of the area.

3.3 DRAINAGE

Godavari rivers and its tributaries drain the northern and central part and Pennar river drains in southern part of state before joining Bay of Bengal. There are 3 major basins and 11 medium river basins in the state. The drainage pattern is generally dendritic with wide valleys in western peniplain. The drainage in Eastern Ghat is coarse and dendritic with steep and narrow valleys. Youthful streams and valleys mark the eastern coastal tract intersected by innumerable feeder and distributary canal system. The delta of river are very extensive and characterized by considerable thickness of alluvial material.

Chapter 3

Prevailing Baseline Environmental Status

3.0 FIELD WORK

Field work of the Polavaram project was undertaken by CSIR-NEERI, HZC Team during the months February, March and November 2020 except for the months April to October due to the COVID pandemic. A 5 km buffer around the Polavaram project site was prepared. The locations were plotted in the study area for various environments. The monitoring for various environments like air, noise, water, land etc. was carried out in the whole study area.

3.1 Air Environment

Ambient Air Quality Study

The ambient air quality status in the study area is carried out during February, March and November 2020 at 5 locations selected based on local topography and meteorological conditions using network design criteria and monitoring was carried out as per CPCB guidelines. The sampling locations were presented in Table 3.1.1. The locations of air quality monitoring in the study area are shown in Fig. 3.1.1.

Micrometeorology

Meteorological data of wind speed, wind direction, temperature and relative humidity were collected from nearest Meteorological Station (Nidadavolu, WG Dist., A.P) from Climatological Tables of India Meteorological Department.

The windrose diagram for February (**Fig. 3.1.2a**) shows that the predominant winds are from S, E, N, NE, SE and SW directions. The wind speed has been observed in the range of 0.5 - 4.5m/s. Ambient temperature varied between 19.7 - 31.9^{o}C during February, while the relative humidity was observed in the range of 54-79%

The windrose diagram for March (**Fig. 3.1.2b**) shows that the predominant winds are from S, SW, E, NE N, and SE directions. The wind speed has been observed in the range of 0.5 - 4.8m/s. Ambient temperature varied between 22.2 - 34.1^{o}C during March, while the relative humidity was observed in the range of 54-79%.

The windrose diagram for November (**Fig. 3.1.2c**) shows that the predominant winds are from E, NE, N and SE directions. The wind speed has been observed in

the range of 0.5 - 3.2m/s. Ambient temperature varied between 20.9 - 30.6^{o}C during November, while the relative humidity varied in the range of 66-80%.

Ambient Air Quality Status

Ambient air quality sampling for Particulate Matter (size less than 10 µm or PM_{10}), Particulate Matter (size less than 2.5 µm or $PM_{2.5}$), Sulphur dioxide (SO_2), Oxides of Nitrogen (NO_X) and Ammonia (NH_3) on 24 hrly basis was made Ozone (O_3) and Carbon Monoxide (CO) on 1 hrly basis & Benzene as spot concentrations were monitored. The techniques/methods used for monitoring and analysis of air quality parameters are given in Table 3.1.2. The data collected was subjected to statistical analysis like minimum, maximum, average and standard deviation. The Particulate metals like lead (Pb), Arsenic (As) and Nickel (Ni) along with Benzo(α)pyrene (BaP) in the particulate matter were analysed. The observed ambient air quality data within the study area for February, March and November 2020 are given in Tables 3.1.3, 3.1.4 and 3.1.5, respectively. The parameters were analyzed following standard methods and concentration levels were compared with National Ambient Air Quality Standards (NAAQS) prescribed by Central Pollution Control Board (Annexure I).

Particulate Matter

The 24hourly minimum-maximum values and average PM_{10} and $PM_{2.5}$ concentrations at all the sampling locations during February, March and November 2020 are given in Tables 3.1.3, 3.1.4 and 3.1.5, respectively. It is observed that the average PM_{10} concentrations varied between 58 - 94 µg/m^3, 59 - 83 µg/m^3 and 45 - 75 µg/m^3, respectively, during February, March and November 2020 within the study area and found that the average PM_{10} concentrations are within the NAAQS (PM_{10} - 100 µg/m^3) at all locations. It is observed that the average $PM_{2.5}$ concentrations varied between 37 - 50 µg/m^3, 20 - 34 µg/m^3 and 29 - 40 µg/m^3, respectively, during February, March and November 2020 within the study area and found that the average $PM_{2.5}$ concentrations are within the NAAQS ($PM_{2.5}$ - 60 µg/m^3). The higher values of particulate matter (PM_{10} and $PM_{2.5}$) in terms of maximum concentrations in the study area may be due to the vehicular movement and unpaved roads.

Gaseous Pollutants

Sulfur dioxide and Oxides of Nitrogen

The 24hourly minimum-maximum values and average SO_2 and NO_X concentrations at all the sampling locations during February, March and November 2020 are given in Tables 3.1.3, 3.1.4 and 3.1.5, respectively. The average concentrations of SO_2 are found to be varying within the range of 2 - 4 µg/m^3, 4 - 5 µg/m^3 and 2 - 4 µg/m^3, respectively, during February, March and November 2020. The average concentrations of NO_X are found to be varying within the range of 5 - 6µg/m^3, 6 - 6µg/m^3 and 5 - 7µg/m^3 in the study area during February, March and November 2020, respectively. The levels of SO_2 and NO_x were observed well below NAAQS (80 µg/m^3).

Ammonia

Atmospheric ammonia (NH_3) is a pollutant which is highly soluble in water, its major sink in the atmosphere is by wet deposition. The residence time of ammonia in the lower level of the atmosphere is a few hours, though in the calm environment it may exist for weeks. Ammonia is the major base present in the atmosphere and is therefore important in neutralizing acidic species such as SO_2, H_2SO_4, HNO_3 and HCl. To assess the levels of ammonia in air, samples were collected by passing air through absorbing media and analyze by wet chemical method. The average concentrations of NH_3 are found to be varying within the range of 22 - 39µg/m^3 (Table 3.1.3), 22 - 41µg/m^3 (Table 3.1.4) and 9 - 17µg/m^3 (Table 3.1.5), respectively, during February, March and November 2020 within the study area and these values are well within the NAAQS (400 µg/m^3).

Ozone

Ozone (O_3) is a secondary air pollutant formed by photochemical reactions involving NOx and VOCs, mainly hydrocarbons. In the presence of solar radiation, nitrogen dioxide (NO_2) dissociates to form nitric oxide (NO) and an oxygen atom (O). O_3 is then formed by O_2 reacting with the oxygen atom (O). However, when hydrocarbons are present, NO is converted to NO_2, thus leaving little NOx to react with O_3. This reaction leads to a build-up of O_3 in the atmosphere. Sources of NO_2

and VOCs are primarily anthropogenic, generally produced during combustion processes from automobile emissions and industrial activities.

To assess the levels of ozone in air, samples were collected by passing air through absorbing media during day time (1000-1800 h) assuming ozone production occurs in the presence of solar radiation, NOx and VOCs. The samples were analyzed by wet chemical method. The average concentrations of O_3 are found to be varying within the range of 9 - 39 µg/m^3 (Table 3.1.3), 11 - 26µg/m^3 (Table 3.1.4) and 8 - 15 µg/m^3 (Table 3.1.5) during February, March and November 2020, respectively, within the study area which were below the NAAQS (1 h avg. 180 µg/m^3).

Carbon Monoxide (CO)

Carbon monoxide is a colourless and odourless gas. It is formed when substances containing carbon are burned with an insufficient supply of air. The combustion of fuels such as petrol, gas, coal and wood generate carbon monoxide. Gas and wood used for cooking and heating in appliances like stoves and barbecues add to such emissions. Apart from it, motor vehicles are also one of the main sources of carbon monoxide pollution in urban and sub-urban environment.

The concentrations of CO measured as 1 hrly averages are found to be ranging from 0.15 to 0.19mg/m^3 (Table 3.1.3), 0.15 to 0.18mg/m^3 (Table 3.1.4) and 0.12 - 0.16µg/m^3 (Table 3.1.5) during February, March and November 2020, respectively, in the study area and the values are found to be less than NAAQS (1 hr. avg. 4 mg/m^3).

Benzene

The spot concentrations of Benzene are observed to be below detectable limit (BDL) during February, March and November 2020 within the study area and are well within NAAQS (Tables 3.1.3, 3.1.4 and 3.1.5).

Particulate Associated Toxic Pollutants

Airborne particles are important carriers of metals, some of which possess toxic properties. The concentrations and size distributions of trace metals are governed by the nature of emissions to the atmosphere as well as rates of wet and dry deposition, cloud processing, and exchange of air between the boundary layer

and the free troposphere, and chemical transformations. The elevated metal concentrations can pose a serious risk to human health. Fossil fuel utilization, such as liquid fuel for vehicular exhaust and lubricant residues, are considered as important contributors. Heavy metals like lead, arsenic and nickel associated with particulate matter were determined.

Lead (Pb)

Lead (Pb) is a metal found naturally in the environment as well as in manufactured products. The major sources of lead emissions have been motor vehicles (such as cars and trucks) and industrial sources includes near lead smelters, waste incinerators, utilities, and lead-acid battery manufacturers. Depending on the level of exposure, lead can adversely affect the nervous system, kidney function, immune system, reproductive and developmental systems and the cardiovascular system. Lead exposure also affects the oxygen carrying capacity of the blood. Lead is persistent in the environment and accumulates in soils and sediments through deposition from air sources, direct discharge of waste streams to water bodies, mining, and erosion. Ecosystems near point sources of lead demonstrate a wide range of adverse effects including losses in biodiversity, changes in community composition, decreased growth and reproductive rates in plants and animals, and neurological effects in vertebrates. The observed Pb concentrations at all the locations ranged from BDL - 0.05 $\mu g/m^3$ (Table 3.1.3), BDL - 0.08 $\mu g/m^3$ (Table 3.1.4) and BDL - 0.07 $\mu g/m^3$ (Table 3.1.5) in the study area during February, March and November 2020, respectively, and are well below the NAAQS (1 $\mu g/m^3$).

Arsenic (As)

Arsenic (As) is a naturally occurring element widely distributed in the earth's crust. Inorganic forms of arsenic are found throughout the environment. It is released into the air by volcanoes, weathering of arsenic-containing minerals and ores, and commercial or industrial processes. Metal smelters release elevated inorganic arsenic into the air. Other air sources of inorganic arsenic exposure include burning of plywood treated with an arsenic wood preservative. Acute (short-term) high-level inhalation exposure to arsenic dust or fumes can cause gastrointestinal effects

(nausea, diarrhea, abdominal pain) and nervous system disorders. Chronic (long-term) inhalation exposure to inorganic arsenic can cause irritation of the skin and mucous membranes and lung cancer. Arsenic concentrations are found be ranging from BDL - 1.22ng/m^3 (Table 3.1.3), BDL - 0.64ng/m^3 (Table 3.1.4), and BDL (Table 3.1.5) during February, March and November 2020, respectively, in the study area and are well below prescribed standards (NAAQS for As - 6 ng/m^3).

Nickel (Ni)

Nickel is a naturally occurring element and can be combined with other metals, such as iron, copper, chromium and zinc, to form alloys. These alloys are used to make coins, jewelry, and items such as valves and heat exchangers. Most nickel is used to make stainless steel. Nickel can be released into ambient air from oil and coal combustion, nickel metal refining, sewage sludge incineration, and other sources. Respiratory effects are associated with chronic exposure to nickel in the air, which can cause chronic bronchitis, lung and nasal sinus cancers. The observed Ni concentrations at all the locations are found to be ranged from BDL - 2.34ng/m^3 (Table 3.1.3), BDL - 1.26ng/m^3 (Table 3.1.4) and BDL - 1.84µg/m^3 (Table 3.1.5) in the study area during February, March and November 2020, respectively, which were below the NAAQS (20 ng/m^3).

Benzo (α) pyrene (BaP)

BaP is the most well-known polycyclic aromatic hydrocarbon (PAH) in a large group of organic compounds with two or more fused aromatic rings. PAHs are formed mainly as a result of incomplete combustion of organic materials during industrial and other anthropogenic activities including processing of coal and crude oil, combustion of natural gas, combustion of refuse, vehicular traffic, cooking and tobacco smoking, as well as natural episodes such as forest fires. Motor vehicle exhaust and their re-suspension are major contributors of PAHs, including benzo[α]pyrene. BaP will tend to be adsorbed onto particulates during cooling and condensation in the atmosphere and generally exist in the particle phase at normal ambient temperatures in the atmosphere. Particle sizes will be mostly <2.5 µm (aerodynamic diameter). Processes governing the fate of BaP in the atmosphere are the same processes that govern transport and removal of these small particles from the atmosphere.

The BaP concentrations are not detected at all locations in the study area during February, March and November 2020, respectively, (Tables 3.1.3, 3.1.4 and 3.1.5) and NAAQS for BaP is 1 ng/m^3.

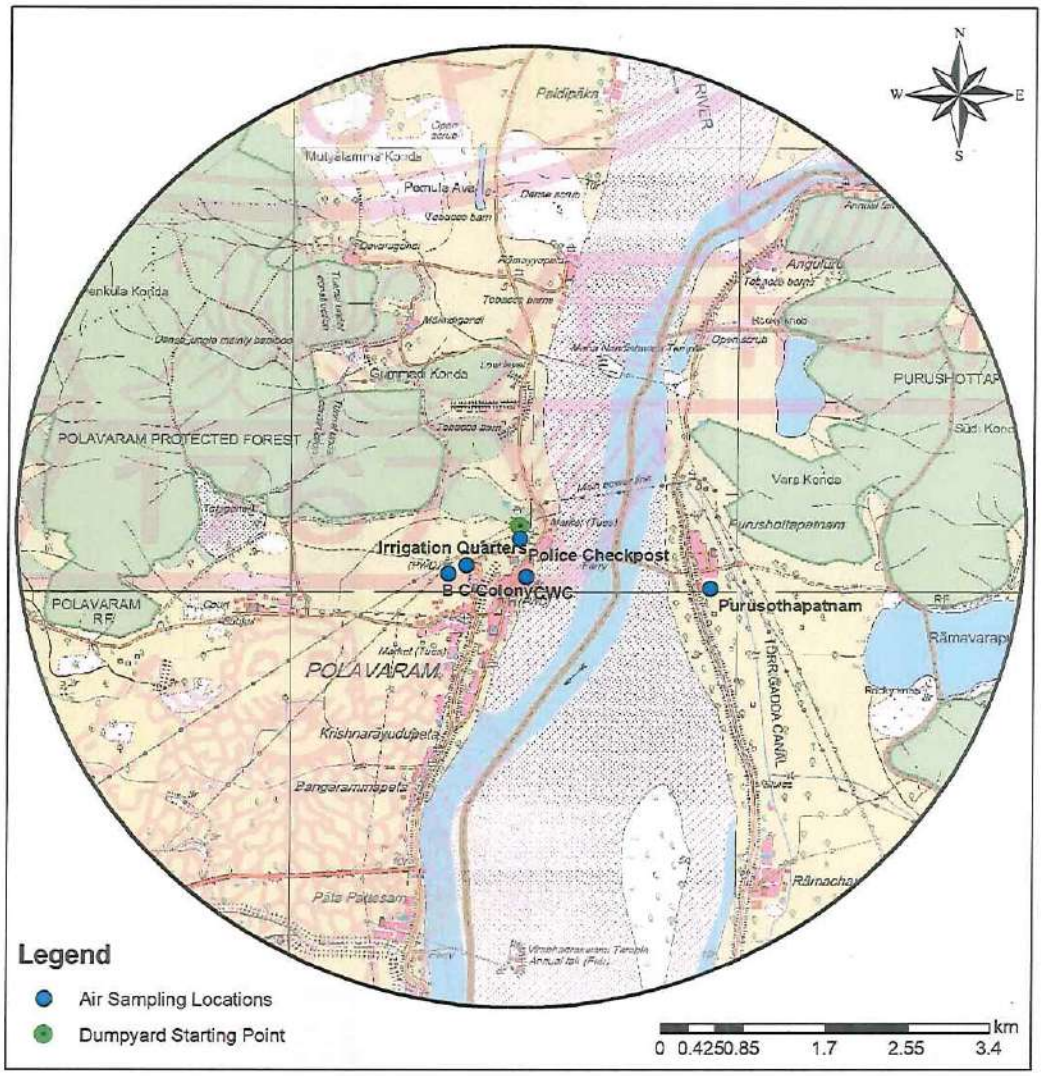
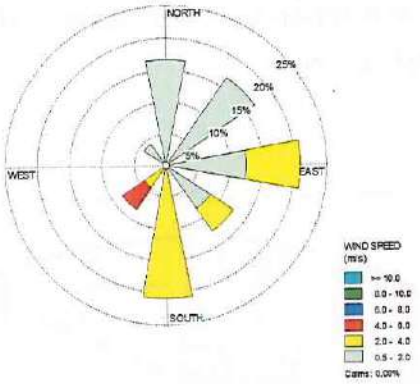
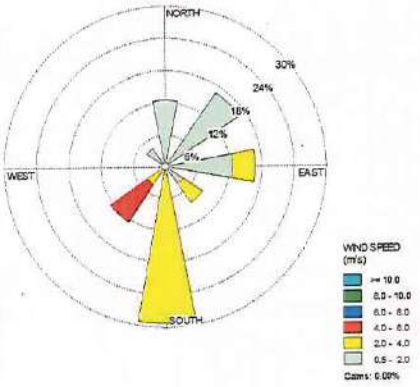


Fig. 3.1.1 Air quality monitoring locations within the study area

(a)



(b)



(c)

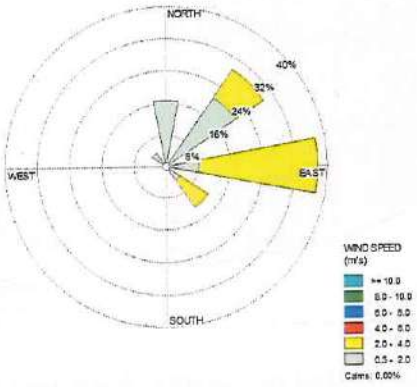


Fig. 3.1.2 Windrose for (a) February, (b) March and (c) November - Polavaram

Table 3.1.1: Air Quality Sampling Locations

Sr. No	Sampling Location	Latitude	Longitude
1.	Irrigation Quarter	N 17° 15' 09"	E 81° 38' 29"
2.	BC Colony	N 17° 15' 06"	E 81° 38' 23"
3.	Police Check Post	N 17° 15' 18"	E 81° 38' 47"
4.	Purusothapatnam	N 17° 15' 01"	E 81° 39' 51"
5.	CWC	N 17° 15' 05"	E 81° 38' 49"

Table 3.1.2: Techniques Used for Ambient Air Quality Monitoring

Sr. No.	Parameter	Monitoring Technique
1.	Particulate Matter size < 10 microns or PM_{10}	Gravimetric
2.	Particulate Matter size less than 2.5 microns or $PM_{2.5}$	Gravimetric
3.	Sulphur Dioxide (SO_2)	EPA Improved West and Geake Method
4.	Oxides of Nitrogen (NO_X)	Modified Jacobs-Hoechheiser Method
5.	Ammonia (NH_3)	Nesslers Method
6.	Ozone (O_3)	UV Photometric method
7.	Carbon monoxide (CO)	Quest CO monitor
8.	Lead (Pb)	AAS/ICP method for sampling on EPM 2000
9.	Benzene	Benzene Analyzer
10.	Arsenic(As),	AAS/ICP method for sampling on EPM 2000 or equivalent filter paper
11.	Nickel (Ni)	AAS/ICP method for sampling on EPM 2000 or equivalent filter paper
12.	Benzo(alpha)pyrene (BaP)	Solvent extraction analysis on GC-MS

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Table 3.1.3: Ambient Air Quality during February 2020

S. No.	Location Name	PM_{10}	$PM_{2.5}$	SO_2	NO_X	NH_3	O_3	As	Pb	Ni	CO	Benzene	B(a)P
		µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	ng/m³	µg/m³	ng/m³	mg/m³	µg/m³	ng/m³
		24 hr	24 hr	24 hr	24 hr	24 hr	1 hr	24 hr	24 hr	24 hr	1 hr	Spot	24 hr
1.	Irrigation Quarter	92±36 (54-126)	50±24 (23-86)	4±3 (2-7)	5±1 (5-6)	22±9 (13-31)	28±15 (19-45)	1.22	0.02	0.36	0.16	BDL	BDL
2.	BC Colony	58±18 (32-73)	37±17 (17-57)	2±1 (2-4)	6±1 (5-7)	26±24 (5-54)	26±9 (20-37)	BDL	BDL	2.34	0.15	BDL	BDL
3.	Police Check Post	94±32 (69-129)	50±18 (32-77)	4±3 (2-8)	6±1 (5-7)	39 ±14 (23-48)	39±17 (26-58)	1.13	0.05	1.17	0.19	BDL	BDL
4.	Purusothapatnam	86±34 (51-137)	48±30 (25-96)	3±2 (2-6)	6±1 (5-7)	29±14 (12-46)	21±7 (12-28)	0.84	BDL	0.89	0.15	BDL	BDL
5.	CWC	66±33 (34-118)	46±17 (27-72)	3±2 (2-6)	5±1 (5-7)	37±15 (12-50)	9±2 (7-11)	BDL	BDL	BDL	0.18	BDL	BDL
NAAQS		**100**	**60**	**80**	**80**	**400**	**180**	**6**	**1**	**20**	**4**	**5**	**1**

Note: The 24 hrly average concentrations of particulate matter and gaseous pollutants are reported as **Avg. ± S.D (Minimum - Maximum).**
BDL - Below Detectable Limit

Table 3.1.4: Ambient Air Quality during March 2020

S. No.	Location Name	PM_{10}	$PM_{2.5}$	SO_2	NO_X	NH_3	O_3	As	Pb	Ni	CO	Benzene	B(a)P
		µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	ng/m³	µg/m³	ng/m³	mg/m³	µg/m³	ng/m³
		24 hr	24 hr	24 hr	24 hr	24 hr	1 hr	24 hr	24 hr	24 hr	1 hr	Spot	24 hr
1.	Irrigation Quarter	59±15 (45-80)	32±17 (15-60)	4±2 (2-6)	6±3 (3-9)	38±18 (16-60)	26±18 (18-37)	0.32	BDL	BDL	0.15	BDL	BDL
2.	BC Colony	61±18 (42-87)	20±18 (13-30)	4±3 (2-8)	6±1 (5-7)	22±17 (5-50)	20±4 (15-26)	BDL	0.01	1.26	0.18	BDL	BDL
3.	Police Check Post	83±47 (40-129)	34±19 (21-56)	5±3 (2-8)	6±2 (5-8)	26±4 (23-31)	14±5 (7-18)	0.64	BDL	1.12	0.16	BDL	BDL
4.	Purusothapatnam	70±18 (45-93)	29±13 (15-55)	4±3 (2-8)	6±1 (5-8)	41±18 (17-70)	24±8 (16-38)	BDL	0.02	BDL	0.15	BDL	BDL
5.	CWC	83±25 (57-109)	31±12 (17-44)	4±2 (2-6)	6±2 (5-8)	24±18 (13-50)	11±2 (9-13)	BDL	0.08	1.16	0.17	BDL	BDL
NAAQS		**100**	**60**	**80**	**80**	**400**	**180**	**6**	**1**	**20**	**4**	**5**	**1**

Note: The 24 hrly average concentrations of particulate matter and gaseous pollutants are reported as **Avg. ± S.D (Minimum - Maximum).**
BDL - Below Detectable Limit

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Table 3.1.5: Ambient Air Quality during November 2020

S. No.	Location Name	PM_{10}	$PM_{2.5}$	SO_2	NO_X	NH_3	O_3	As	Pb	Ni	CO	Benzene	B(a)P
		µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	ng/m³	µg/m³	ng/m³	mg/m³	µg/m³	ng/m³
		24 hr	24 hr	24 hr	24 hr	24 hr	1 hr	24 hr	24 hr	24 hr	1 hr	Spot	24 hr
1.	Irrigation Quarter	65±23 (45-95)	38±11 (23-50)	2±0 (2-2)	5±0 (5-5)	11±7 (5-20)	10±6 (5-18)	BDL	0.04	BDL	0.12	BDL	BDL
2.	BC Colony	61±12 (46-85)	40±14 (19-64)	3±2 (2-9)	5±0 (5-5)	17±20 (5-58)	14±8 (5-28)	BDL	0.03	1.84	0.14	BDL	BDL
3.	Police Check Post	51±11 (39-62)	31±6 (26-41)	4±4 (2-11)	7±5 (5-15)	17±14 (6-36)	15±9 (7-27)	BDL	0.01	1.29	0.16	BDL	BDL
4.	Purusothapatnam	45±27 (14-80)	29±6 (22-33)	2±0 (2-3)	5±0 (5-5)	9±3 (6-12)	8±3 (6-12)	BDL	BDL	0.63	0.12	BDL	BDL
5.	CWC	75±30 (34-104)	37±3 (34-41)	4±3 (2-9)	5±0 (5-5)	13±1 (12-13)	12±2 (10-15)	BDL	0.07	1.41	0.15	BDL	BDL
NAAQS		**100**	**60**	**80**	**80**	**400**	**180**	**6**	**1**	**20**	**4**	**5**	**1**

Note: The 24 hrly average concentrations of particulate matter and gaseous pollutants are reported as **Avg. ± S.D (Minimum - Maximum).**
BDL - Below Detectable Limit

3.2 Noise Environment

Noise often defined as an unwanted sound which interferes with speech communication, causes annoyance, distracts from work, and disturbs sleep, deteriorating quality of life. Elevated noise levels have been associated with adverse impact on human health, ranging from minor annoyance to physiological damage. Noise pollution survey is required to be carried out in the study area to evaluate the impact of noise on the surrounding environment. According to the World Health Organization (WHO), noise pollution is the third most hazardous type of environmental pollution after that air and water pollution.

Methodology

The objective of the survey of noise pollution is to assess the impacts during construction of Polavaram project. Noise levels were measured as 'A' weighted average in the identified locations within the 5 km study area with dumping yard as centre. The sound pressure levels were monitored using a precision integrated sound level meter (Larson Davis Model 831), which has capability to measure (online) sound pressure level on continuous basis. The day time noise levels were monitored between 6 am to 10 pm and the night time noise levels between 10 pm to 6 am. The noise monitoring locations are depicted in Figure 3.2.1 and listed in Table 3.2.1.

Baseline Noise Levels in the study area

The observed noise (Leq) levels were monitored during February, March and November 2020 within the study area are presented in the Table 3.2.2. In the villages and residential colonies surrounding the Polavaram project, it is observed that the daytime noise levels vary between 50.2-52.9 dB(A), 50.1-54.5 dB(A) & 51.6-53.8 dB(A) and night time noise levels vary between 43.1-45.0 dB(A), 42.8-44.8 dB(A) & 40.8-44.0 dB(A) during February, March and November 2020, respectively. The noise levels are compared with CPCB limits for residential areas. The noise levels are observed to be within the CPCB standards for residential areas (Annexure II) during day and night time.

The noise levels at locations near the construction activities of Polavaram project are compared with CPCB limits for commercial areas as the activities may fall in mixed category. The observed Leq values of day time noise levels during February, March and November 2020 respectively are varying between 64.2-70.2 dB(A), 62.6-66.6 dB(A) and 59.4-68.6 dB(A). The night time noise levels are within the range of 52.2-67.9 dB(A), 53.6-60.9 dB(A) and 50.7-60.7 dB(A), respectively during February, March and November 2020 near the construction activities of Polavaram project. It is observed that daytime and night time noise levels are exceeding the CPCB limits for commercial zone at most of the sites. These higher noise levels are attributed to operation of DG sets, Excavators, Cranes, Crushers, movement of trucks, vehicles, and concrete mixers etc. in connection with ongoing construction activities of Polavaram.

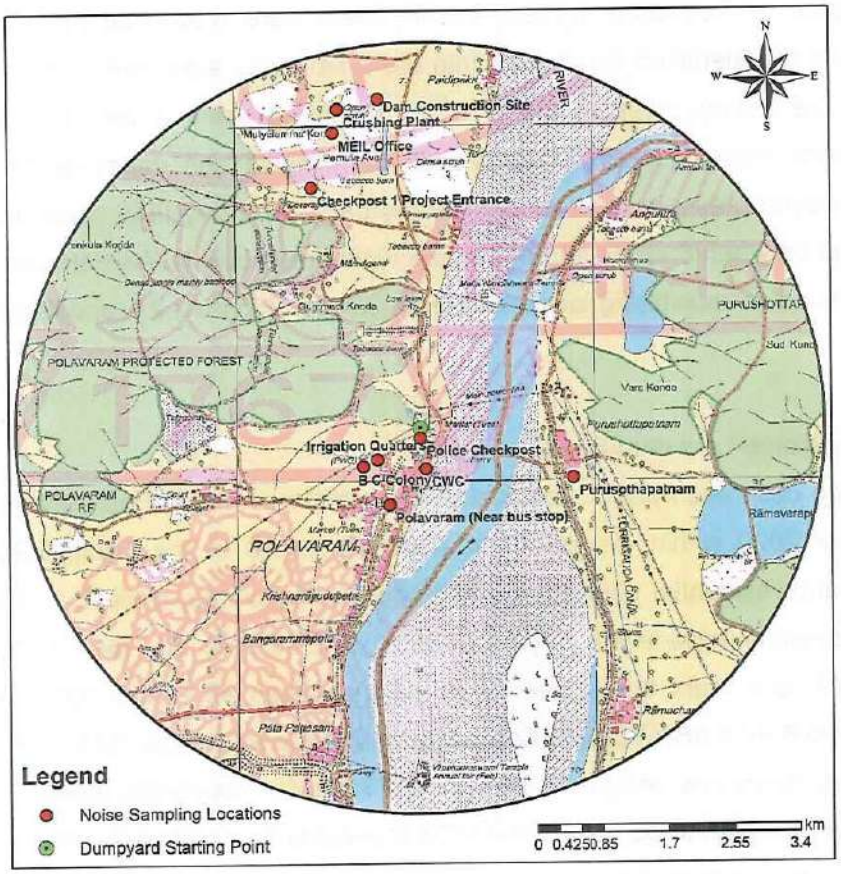

Fig. 3.2.1 Noise monitoring locations in the study area

Table 3.2.1: Details of Noise Sampling Locations

S. No.	Noise Monitoring Locations	Latitude	Longitude
1	Irrigation Quarters	N 17° 15' 09"	E 81° 38' 29"
2	B C Colony	N 17° 15' 06"	E 81° 38' 23"
3	Police Checkpost	N 17° 15' 18"	E 81° 38' 47"
4	Purusothapatnam	N 17° 15' 01"	E 81° 39' 51"
5	CWC	N 17° 15' 05"	E 81° 38' 49"
6	Checkpost 1 project entrance	N 17° 17' 04"	E 81° 38' 02"
7	MEIL office	N 17° 17' 27"	E 81° 38' 11"
8	Crushing Plant	N 17° 17' 37"	E 81° 38' 13"
9	Dam construction site	N 17° 17' 41"	E 81° 38' 30"
10	Polavaram (near bus stop)	N 17° 14' 50"	E 81° 38' 34"

Table 3.2.2: Noise Levels [dB(A)] at Sampling Locations

S. No.	Noise Monitoring Locations	February 2020		March 2020		November 2020	
		Day Time (Leq)	Night Time (Leq)	Day Time (Leq)	Night Time (Leq)	Day Time (Leq)	Night Time (Leq)
Locations in Residential area							
1	Irrigation Quarters	52.2	43.5	54.5	43.2	53.8	43.8
2	B C Colony	50.2	45.0	51.4	44.8	51.6	44.0
3	Police Check post	50.8	45.0	50.1	44.5	52.5	43.8
4	Purusothapatnam	52.7	43.1	52.8	42.8	51.8	40.8
5	CWC	52.9	43.9	53.5	44.1	53.0	43.1
CPCB Standards for Residential Area		**55**	**45**	**55**	**45**	**55**	**45**
Locations in Commercial area							
6	Check post 1 project entrance	64.2	61.1	66.3	57.6	65.9	54.8
7	MEIL office	65.0	52.2	62.6	53.9	59.4	50.7
8	Crushing Plant	70.2	67.9	66.6	60.9	64.0	60.7
9	Dam construction site	65.6	62.5	65.6	58.4	68.6	55.2
10	Polavaram (near bus stop)	67.6	56.3	65.2	53.6	65.5	54.6
CPCB Standards for Commercial Area		**65**	**55**	**65**	**55**	**65**	**55**

3.3 Water Environment

Groundwater Quality

Water is the most crucial element of life, the rapid urbanization and expansion of infrastructure creates stress on water environment in many ways: depletion of water sources, Increase in demand and pollution in water sources by the discharge of domestic sewage and solid waste.

To address the issues raised it is necessary to analyze the quality of the existing water resources to represent the prevailing status of water quality and to delineate the measures for improving the quality of water environment.

In order to assess quality of water, Physico-Chemical, Nutrient, Oxygen Demand and Bacteriological parameters having relevance to public health and aesthetic significance are selected and accordingly samples are collected and analyzed as per the standard methods (APHA AWWA 22nd Edition 2012) prescribed for surface and Groundwater.

According to the existing activities related to water environment occurring in the study area, depending on topography, surface runoff as well as natural/manmade drainage for irrigation and canal systems the water quality survey has been planned and appropriate sampling locations for both Surface and Groundwater were identified within the study area of 5 km radial distance around project site.

Groundwater Quality

The 11 Groundwater samples were collected from dug (open) wells as well as from bore wells / hand pumps on monthly basis in and around the Polavaram project site within the study area (Fig. 3.3.1). The water quality analysis data was assessed for various parameters and Presented in the Tables:

Physical parameters

- In general, pH in groundwater reflects the suitability of groundwater for drinking purpose. The water samples collected from all the sites has pH ranging from 6.8 – 7.5, 7.0 – 7.5 and 6.7 – 7.3, respectively, during February, March and

November 2020. The observed pH values were within the normal range as per the BIS norms.

- The Turbidity values in the study area ranged from 0.1 – 0.6 mg/l, 0.1 – 0.5 mg/l, and 0.1 – 0.8 mg/l, respectively, during February, March and November 2020. The observed Turbidity values are found in the limits of BIS for all the samples.
- TDS is a measure of dissolved elements present in water. TDS values in ground water ranged from 337 - 1552 mg/l, 351 – 1427 mg/l and 365 - 178 mg/l, respectively, February, March and November 2020. The observed values are within the Permissible limits of BIS Standards.

Inorganic Parameters

- The Total Hardness values in the study area ranged from 232 – 880mg/l, 252 – 884mg/l and 140 – 780mg/l, respectively, during February, March and November 2020. Expect at some locations most of samples showed total hardness values within the permissible limit of BIS.
- Ca hardness values (as $CaCO_3$) in the study area ranged from 133 – 463mg/l, 150 – 421mg/l and 108 – 448mg/l, respectively, during February, March and November 2020. The locations where Higher Ca hardness values observed may be due to dominant rocks.
- The observed chloride concentration varied from 25 - 364mg/l, 26 – 402mg/l and 23 - 462mg/l, respectively, during February, March and November 2020. The observed Chloride values are normal with respect to permissible limit of BIS.
- Sulphate content in the groundwater varied from 11 – 171 mg/l, 6 – 190 mg/l and 7 - 99 mg/l, respectively, during February, March and November 2020. The sulphate values for all groundwater samples were within the permissible limits of BIS.
- The sodium levels in the groundwater varied from 16 – 187 mg/l, 26 – 168 mg/l, and 44 - 303 mg/l, respectively, during February, March and November 2020.
- The Fluoride levels in the groundwater varied from 0.24 – 1.0 mg/l, 0.11 – 1.3 mg/l, and 0.1 – 0.51 mg/l, respectively, during February, March and November 2020. The observed values are within the permissible limit of BIS.

Nutrient Demand Parameters

- The nitrate content in the groundwater varied in the range of 3.5 – 172 mg/l, 3.0 – 16.3 mg/l, and 0.2 – 1.39mg/l, respectively, during February, March and November 2020. The observed vales are normal, but the highest value of Nitrate was observed at Pattiseema during February 2020 may due to the Irrigation Practices.
- BOD observations are normal and ranging from 1 – 2.5 mg/l, 0.9 – 2.2mg/l and <0.5 – 6.3 mg/l, respectively, during February, March and November 2020.

Bacteriological Parameters

- Portability of groundwater with respect to microbiological analysis was checked using MPN Index. The MPN values ranged between 33 - >1600, 350 - >1600 and <1.8 - >1600 during February, March and November 2020, respectively.

Heavy Metals

- Heavy Metals like As, B, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn were analyzed and observed that most of the element concentrations were below the BIS during the study Period
- Iron and Manganese concentrations at some locations were observed to be more than permissible limit of the BIS, which may be attributed to the dominant Rocks

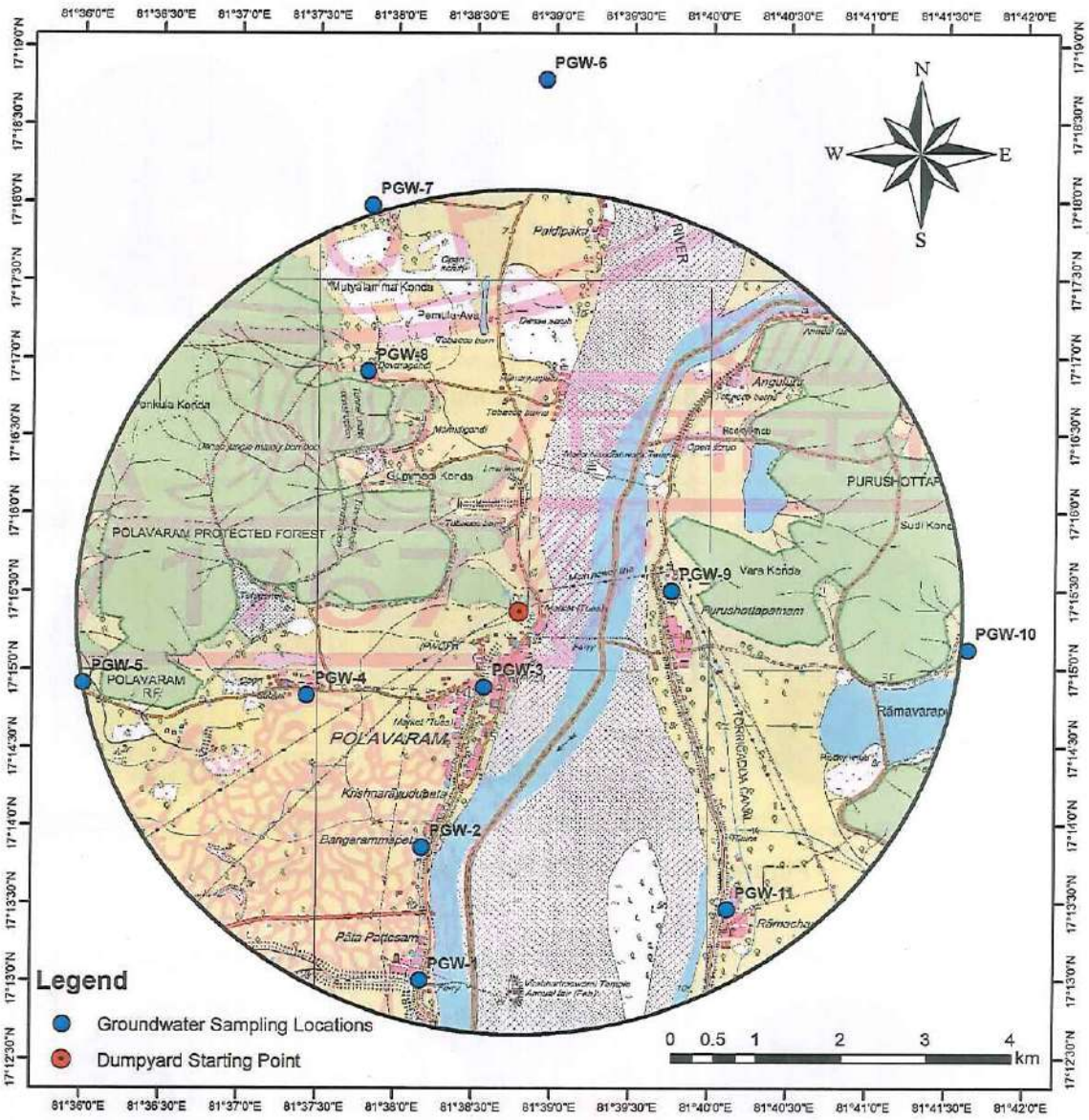

Figure 3.3.1: Groundwater sampling locations in the study area

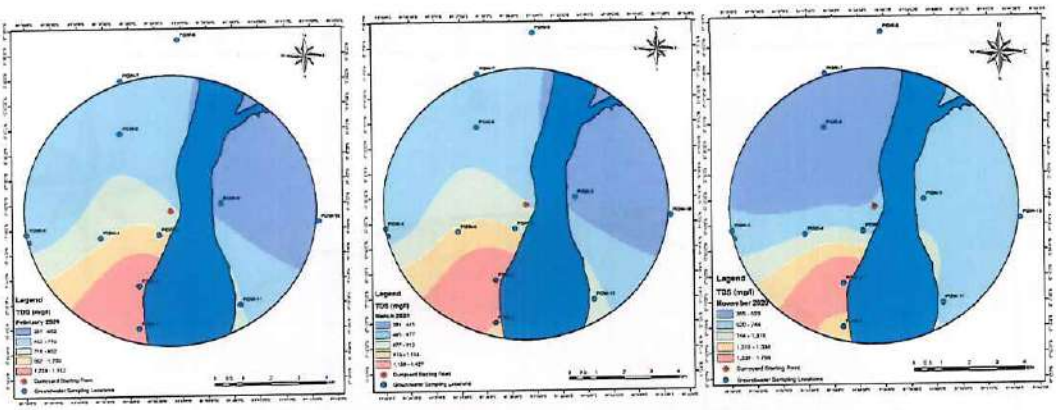

Figure 3.3.2A,B,C: TDS map of the study area

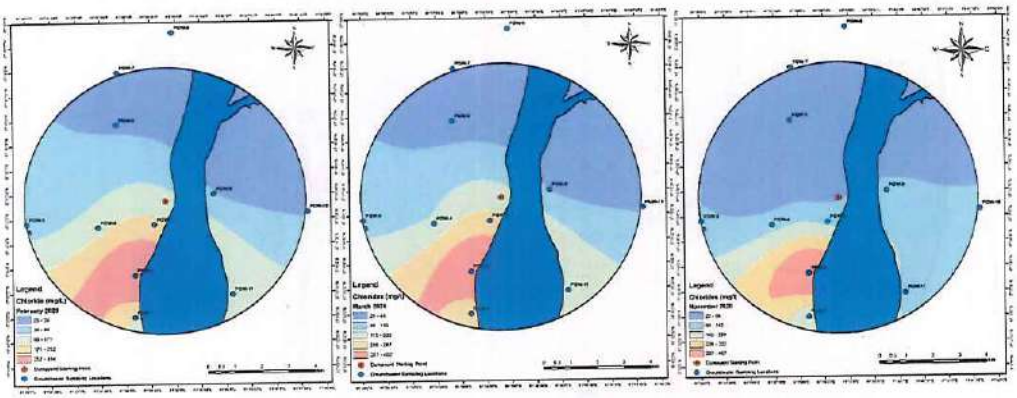

Figure 3.3.3A,B,C: Chloride map of the study area

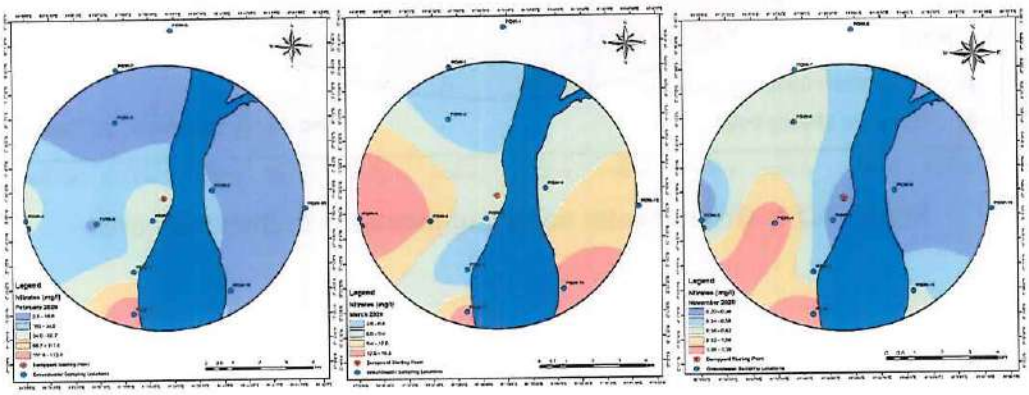

Figure 3.3.4A,B,C: Nitrate map of the study area

Table 3.3.1: Details of Groundwater Sampling Locations (2020)

S. No	Location Name	Sample Code	Latitude	Longitude	Type	Water level (m)		
						February	March	November
1	Pattisema	PGW-1	17°13'00.05"	81°38'10.08"	HP	5.3	-	0.3
2	Bangaramapeta	PGW-2	17°13'51.55"	81°38'10.38"	DW	3.0	3.0	1.7
3	Polavaram	PGW-3	17°14'53.29"	81°38'33.91"	DW	3.2	4.0	1.4
4	New Devaragondi	PGW-4	17°14'50.18"	81°37'26.05"	HP	3.5	-	1.6
5	Itukalakota	PGW-5	17°14'54.66"	81°36'00.46"	HP	2.5	2.4	2.8
6	Singanapalli	PGW-6	17°18'47.25"	81°38'56.16"	HP	2.5	-	0.6
7	Chegondapalli	PGW-7	17°17'58.57"	81°37'50.09"	DW	3.0	4.5	1.5
8	Old devaragondi	PGW-8	17°16'54.89"	81°37'48.82"	DW	1.5	1.5	0.7
9	Purushohapatnam	PGW-9	17°15'30.16"	81°39'45.48"	HP	2.0	-	1.7
10	Nelakota	PGW-10	17°15'07.42"	81°41'38.57"	HP	2.0	-	0.7
11	Ramachandrapuram	PGW-11	17°13'27.65"	81°40'07.26"	HP	3.5	-	1.7

Due to COVID-19 Pandemic condition Environmental monitoring from April to October 2020 was suspended

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Table 3.3.2: Groundwater Quality Physical Parameters (2020)

S. No	Sample Code	pH			Turbidity (NTU)			TSS (mg/l)			EC (µs/cm)			TDS (mg/l)		
		Feb	March	Nov	Feb	March	Nov	Feb	March	Nov	Feb	March	Nov	Feb	March	Nov
1	PGW-1	7.1	7.0	6.7	0.4	0.5	0.1	4.1	5.8	1.1	2110	1920	1972	1358	1164	1136
2	PGW-2	6.8	7.0	6.7	0.1	0.1	0.1	2.3	2.2	1.2	2660	2540	3070	1552	1427	1786
3	PGW-3	7.2	7.5	6.9	0.1	0.1	0.1	0.5	2.6	0.4	1692	1639	1246	1010	897	681
4	PGW-4	7.2	7.2	6.8	0.3	0.2	0.5	1.1	2.0	0.8	1570	1644	1268	889	954	723
5	PGW-5	7.2	7.2	6.8	0.1	0.1	0.1	6.0	2.2	0.1	1038	983	1066	599	537	605
6	PGW-6	7.1	7.1	6.8	0.6	0.1	0.8	1.7	0.6	45.7	1128	1121	1256	720	666	681
7	PGW-7	7.2	7.1	6.9	0.1	0.1	0.1	0.3	1.2	1.9	1190	1194	1221	750	737	714
8	PGW-8	7.1	7.1	7.2	0.2	0.1	0.1	1.2	2.2	4.5	1029	979	665	674	626	365
9	PGW-9	7.5	7.4	7.0	0.1	0.1	0.2	0.3	2.4	1.1	560	571	938	337	351	656
10	PGW-10	6.9	7.1	7.0	0.5	0.1	0.1	1.6	2.4	0.3	992	958	1059	614	563	640
11	PGW-11	7.4	7.5	7.3	0.2	0.4	0.2	1.0	3.4	0.9	1229	1291	1212	715	726	667
IS: 10500-2012 (Desirable-Permissible Limits)		**6.5 - 8.5**			**1 - 5**			**-**			**-**			**500 - 2000**		

Table 3.3.3: Groundwater Quality-Inorganic Parameters (2020)

S.No	Sample Code	Total Hardness (as $CaCO_3$) mg/l			Ca Hardness (as $CaCO_3$) mg/l			Mg Hardness (as $CaCO_3$) mg/l			Sodium as Na mg/l			Potassium as K mg/l		
		Feb	March	Nov	Feb	March	Nov	Feb	March	Nov	Feb	March	Nov	Feb	March	Nov
1	PGW-1	836	808	524	463	380	368	373	428	156	108	112	174	5	4	8
2	PGW-2	880	884	780	447	421	448	433	463	332	139	145	303	39	45	61
3	PGW-3	560	496	288	259	199	192	301	297	96	119	121	140	6	7	21
4	PGW-4	364	380	336	184	173	236	180	207	100	187	168	155	8	3	2
5	PGW-5	392	376	140	235	229	108	157	147	32	48	54	167	1	2	7
6	PGW-6	640	620	524	290	263	320	350	357	204	16	29	44	1	1	2
7	PGW-7	428	410	408	227	214	192	201	196	216	69	76	95	35	50	45
8	PGW-8	428	417	160	192	180	112	236	237	48	70	61	69	19	27	14
9	PGW-9	232	252	328	161	150	220	71	102	108	23	26	48	1	1	3
10	PGW-10	396	361	288	133	158	188	263	203	100	56	65	118	6	8	7
11	PGW-11	404	399	196	200	203	136	204	196	60	83	103	161	1	1	3
IS: 10500-2012 (Desirable-Permissible Limits)		**200 - 600**			-			-			-			-		

Table 3.3.4: Groundwater Quality-Inorganic Parameters (2020)

S. No	Sample Code	Total Alkalinity as CaCO3 mg/l			Sulphate as SO_4^{2-} mg/l			Chloride as Cl^- mg/l			Salinity ‰			Fluoride as F mg/l			Silica as SiO_2 mg/l		
		Feb	March	Nov	Feb	March	Nov	Feb	March	Nov	Feb	March	Nov	Feb	March	Nov	Feb	March	Nov
1	PGW-1	644	432	524	109	190	97	179	225	178	0.41	0.37	0.32	0.98	0.21	0.10	40	57	28
2	PGW-2	616	516	632	171	84	99	364	402	462	0.65	0.73	0.83	0.62	0.31	0.18	37	44	29
3	PGW-3	488	356	348	80	60	65	189	229	111	0.34	0.41	0.20	0.85	0.46	0.27	38	38	18
4	PGW-4	388	516	392	106	91	77	141	136	102	0.25	0.25	0.18	1.00	1.30	0.38	51	53	23
5	PGW-5	376	268	328	28	27	30	71	102	82	0.12	0.18	0.15	0.90	0.51	0.37	34	33	37
6	PGW-6	664	392	472	11	6	16	25	48	56	0.04	0.08	0.10	0.28	0.11	0.15	44	41	38
7	PGW-7	508	504	452	62	41	61	48	52	66	0.08	0.09	0.12	0.73	0.43	0.40	28	36	44
8	PGW-8	544	484	276	29	29	7	32	28	23	0.06	0.05	0.04	0.60	0.28	0.29	23	40	26
9	PGW-9	204	208	292	26	32	46	36	42	74	0.06	0.08	0.13	0.24	0.23	0.10	15	23	34
10	PGW-10	460	448	392	27	24	37	33	26	52	0.06	0.05	0.09	0.80	0.74	0.51	20	38	47
11	PGW-11	304	264	328	99	80	63	148	175	120	0.27	0.32	0.22	0.32	0.20	0.40	15	16	26
IS: 10500-2012 (Desirable-Permissible Limits)		**200-600**			**200-400**			**250-1000**			**-**			**1-1.5**			**-**		

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Table 3.3.5: Groundwater Quality-Nutrient and Demand Parameters (2020)

S. No	Sample Code	Nitrate as NO_3^- mg/l			Total Phosphorus mg/l			DO mg/l			BOD mg/l		
		Feb	March	Nov	Feb	March	Nov	Feb	March	Nov	Feb	March	Nov
1	PGW-1	172	14	1.39	0.010	0.014	0.014	1.5	2.0	1.5	1.5	0.9	<0.5
2	PGW-2	46	2.7	0.53	0.042	BDL	0.161	1.5	2.7	0.4	1.1	1.3	3.0
3	PGW-3	50	7.4	0.22	0.029	0.014	0.167	3.0	6.4	2.7	1.4	1.9	2.5
4	PGW-4	16.4	12.1	1.35	0.041	0.014	0.034	3.5	2.4	1.9	2.2	1.1	0.6
5	PGW-5	39.9	16.3	0.26	0.063	0.005	0.056	3.2	3.5	1.3	1.1	1.0	1.0
6	PGW-6	3.5	3.8	0.24	0.048	BDL	0.017	2.5	3.6	1.9	1.6	1.2	0.7
7	PGW-7	24.3	16.3	0.48	0.065	BDL	0.069	2.8	1.9	0.5	2.3	1.6	6.3
8	PGW-8	7.1	5.5	0.71	0.032	0.023	0.028	2.8	2.0	1.5	2.0	1.5	<0.5
9	PGW-9	16.8	8.6	0.20	0.047	0.022	0.026	3.4	4.0	1.1	2.5	2.2	0.8
10	PGW-10	44.3	8.3	0.20	0.122	0.017	0.425	2.4	4.0	1.0	1.0	0.9	<0.5
11	PGW-11	7.9	15.1	0.60	0.059	0.023	0.041	4.0	4.3	1.0	2.5	2.1	0.7
IS: 10500-2012 (Desirable-Permissible Limits)		**45**			-			-			-		

Table 3.3.6: Groundwater Quality- Microbial Parameters (2020)

S NO	Sample Code	MPN		
		1ml	10ml	INDEX
		Feb	March	Nov
1	PGW-1	1600	350	>1600
2	PGW-2	>1600	>1600	240
3	PGW-3	140	>1600	220
4	PGW-4	920	>1600	130
5	PGW-5	220	350	2.0
6	PGW-6	1600	350	<1.8
7	PGW-7	>1600	>1600	220
8	PGW-8	47	>1600	79
9	PGW-9	48	>1600	130
10	PGW-10	33	>1600	240
11	PGW-11	350	>1600	<1.8

Table 3.3.7A: Groundwater Quality- Heavy Metals (2020)

S NO	Sample Code	As			B			Cd			Co			Cr			Cu		
		mg/l																	
		Feb	Mar	Nov	Feb	Mar	Nov	Feb	Mar	Nov	Feb	Mar	Nov	Feb	Mar	Nov	Feb	Mar	Nov
1	PGW-1	0.004	BDL	BDL	0.083	BDL	0.161	BDL	BDL	BDL	BDL	BDL	0.001	BDL	BDL	0.007	BDL	BDL	BDL
2	PGW-2	0.004	BDL	BDL	0.112	BDL	0.036	BDL	BDL	0.003	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
3	PGW-3	BDL	BDL	BDL	0.023	BDL	BDL	BDL	BDL	0.002	BDL	BDL	BDL	BDL	BDL	0.001	BDL	BDL	BDL
4	PGW-4	0.003	BDL	BDL	0.104	BDL	0.218	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.005	0.003	BDL	0.006
5	PGW-5	0.002	BDL	BDL	0.026	BDL	0.020	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.001	BDL	BDL
6	PGW-6	0.001	BDL	BDL	0.027	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.001	0.028	BDL	0.006	BDL	BDL	0.002
7	PGW-7	0.001	BDL	BDL	0.079	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.014	BDL	BDL	BDL	BDL	BDL
8	PGW-8	0.002	BDL	BDL	0.075	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.010	BDL	BDL	BDL	BDL	BDL
9	PGW-9	0.001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.002	BDL	BDL	BDL	BDL	BDL
10	PGW-10	BDL	BDL	BDL	0.027	BDL	0.064	BDL	BDL	BDL	BDL	BDL	BDL	0.006	BDL	0.002	BDL	BDL	BDL
11	PGW-11	0.002	BDL	BDL	0.046	BDL	0.033	BDL	BDL	BDL	BDL	BDL	BDL	0.010	BDL	0.004	BDL	BDL	0.002
IS: 10500-2012 (Desirable-Permissible Limits)		0.01-0.05			0.5-1.0			0.003-NR			-			0.05-NR			0.05-1.5		

Table 3.3.7B: Groundwater Quality- Heavy Metals (2020)

S.No	Sample Code	Fe			Mn			Ni			Pb			Zn			Hg		
		mg/l																	
		Feb	Mar	Nov	Feb	Mar	Nov	Feb	Mar	Nov	Feb	Mar	Nov	Feb	Mar	Nov	Feb	Mar	Nov
1	PGW-1	0.875	1.27	0.892	0.134	0.130	0.236	BDL	BDL	BDL	BDL	BDL	0.004	BDL	BDL	0.091	BDL	BDL	BDL
2	PGW-2	BDL	0.020	BDL	0.021	0.040	0.051	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.031	BDL	BDL	BDL
3	PGW-3	BDL	0.110	0.121	BDL	0.070	0.075	BDL	BDL	BDL	BDL	BDL	0.001	BDL	BDL	0.092	BDL	BDL	BDL
4	PGW-4	1.718	0.170	2.103	0.036	0.020	0.216	BDL	BDL	BDL	0.014	BDL	0.005	0.035	BDL	0.405	BDL	BDL	BDL
5	PGW-5	0.072	0.280	0.245	0.030	0.050	0.052	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.019	BDL	BDL	BDL
6	PGW-6	3.907	0.240	3.076	0.305	0.190	0.435	BDL	BDL	BDL	0.005	BDL	0.017	0.157	BDL	0.303	BDL	BDL	BDL
7	PGW-7	0.440	0.040	BDL	0.089	0.030	0.107	0.002	BDL	BDL	0.003	BDL	0.001	0.050	BDL	0.006	BDL	BDL	BDL
8	PGW-8	0.088	BDL	0.044	0.565	BDL	0.130	BDL	BDL	0.001	BDL	BDL	0.001	BDL	BDL	0.008	BDL	BDL	BDL
9	PGW-9	BDL	0.033	0.242	0.012	BDL	0.013	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.090	BDL	BDL	BDL
10	PGW-10	0.779	0.200	0.023	0.025	0.050	BDL	BDL	BDL	BDL	0.002	BDL	0.001	0.313	BDL	0.010	BDL	BDL	BDL
11	PGW-11	1.172	0.320	0.646	0.308	0.030	0.279	0.001	BDL	BDL	0.002	BDL	0.004	0.495	BDL	0.523	BDL	BDL	BDL
IS: 10500-2012 (Desirable-Permissible Limits)		0.3-NR			0.1-0.3			0.02-NR			0.01-NR			5-15			0.01-NR		

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3.4 SURFACE WATER ENVIRONMENT

The Surface water sampling point's selection was done based on the Polavaram project activity. In total 5 surface water samples along the Godavari River were collected during February 2020 from Top Surface and Bottom level. Among the 5 Samples collected, 2 samples were located in Upstream and 3 Samples were located in downstream region of Study Area (Fig. 3.4.1). The river water sampling locations are listed in Table 3.4.1.

Physico-chemical parameters along with biological indicators of pollution have been identified for assessing the prevailing status of river water environment and identification of impacts due to proposed developmental activities in and around project site. Water quality data various parameters were presented in the following tables and discussed as follows:

- The parameters pH varied from 7.1 – 7.4, Turbidity varied from 0.1- 0.3 TSS varied from 0.2-5.9 during February 2020 in the study area.
- TDS values in river water at all locations during February 2020 ranged from 82 - 113mg/l, all samples showed normal TDS values with respect to river water Quality.
- Inorganic Parameters i.e. Total Alkalinity, Total Hardness, Chloride, Sulphate and Fluoride are observed to be normal and in optimum level during February 2020
- The N-Nitrate content in the river water samples varied from 0.17 – 0.28 mg/l during February 2020 and the observed values are normal.
- Phosphate as phosphorus concentrations in the river water samples ranged from BDL – 0.010 mg/l during February 2020 which indicates low level.
- The dissolved oxygen in the river water samples are fairly good and ranged from 6.6 – 7.8 mg/l during February 2020 .
- The biological oxygen demand are normal in the river water samples and varied from 1.1 – 3.5 mg/l, during February 2020 indic.
- Total coliforms and Fecal Coliforms in river water varied from 1800 – TNC and ND-1080 CFU/100ml during February 2020.

- Heavy Metals like As, B, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn were observed to normal in concentrations during February 2020.

Phytoplankton:

Phytoplankton are known as the primary producers which is essential for the survival and sustainability of other aquatic organisms. The diversity of phytoplankton could be disturbed by environmental changes and thus they are one of the indicators to monitor the effect of environmental imbalance in the water body.

- Analyses of water samples illustrated good abundance of phytoplankton community in surface water (Table 3.4.7).
- The diversity of phytoplankton varied across samples. The number of phytoplankton genera ranged from 15 to 30.
- The abundance of phytoplankton in the samples was in the range between 202×10^3 to $478 \times 10^3 L^{-1}$.
- Most abundant phytoplankton in the samples were *Navicula* sp. (10.75%), *Closterium* sp. (8.93%), *Oscillatoria* sp. (6.47%), *Nodularia* sp. (5.85%) and *Stauroneis* sp. (5.78%).
- The Shannon-Wiener Diversity Index (SWDI) was found to be varied from 2.308 to 3.025 indicating good water quality with respect to phytoplankton.

Zooplankton:

The group zooplankton is known as primary consumer or secondary producers. The diversity of zooplankton is important for the productivity of water environment.

- The analyses of zooplankton assemblage suggested moderate to fair level of diversity in the study environment (Table 3.4.8).
- The most abundant zooplankton in the samples were *Keratella* sp. (73.33%), *Notholca* sp. (8.58%), *Mayorella* sp. (7.02%) and *Leptodora* sp. (4.68%).
- The diversity was observed to be different across sampling sites. The number of zooplankton per sample varied from five to eleven.

- The abundance of zooplankton was found to be varied from 897 to 8165 per m^3.
- The SWDI ranged from 0.060 to 1.235 which suggests that the zooplankton is under moderate level of stress. The low SWDI in some samples was attributed to the highest abundance of *Keratella* sp. in the samples.

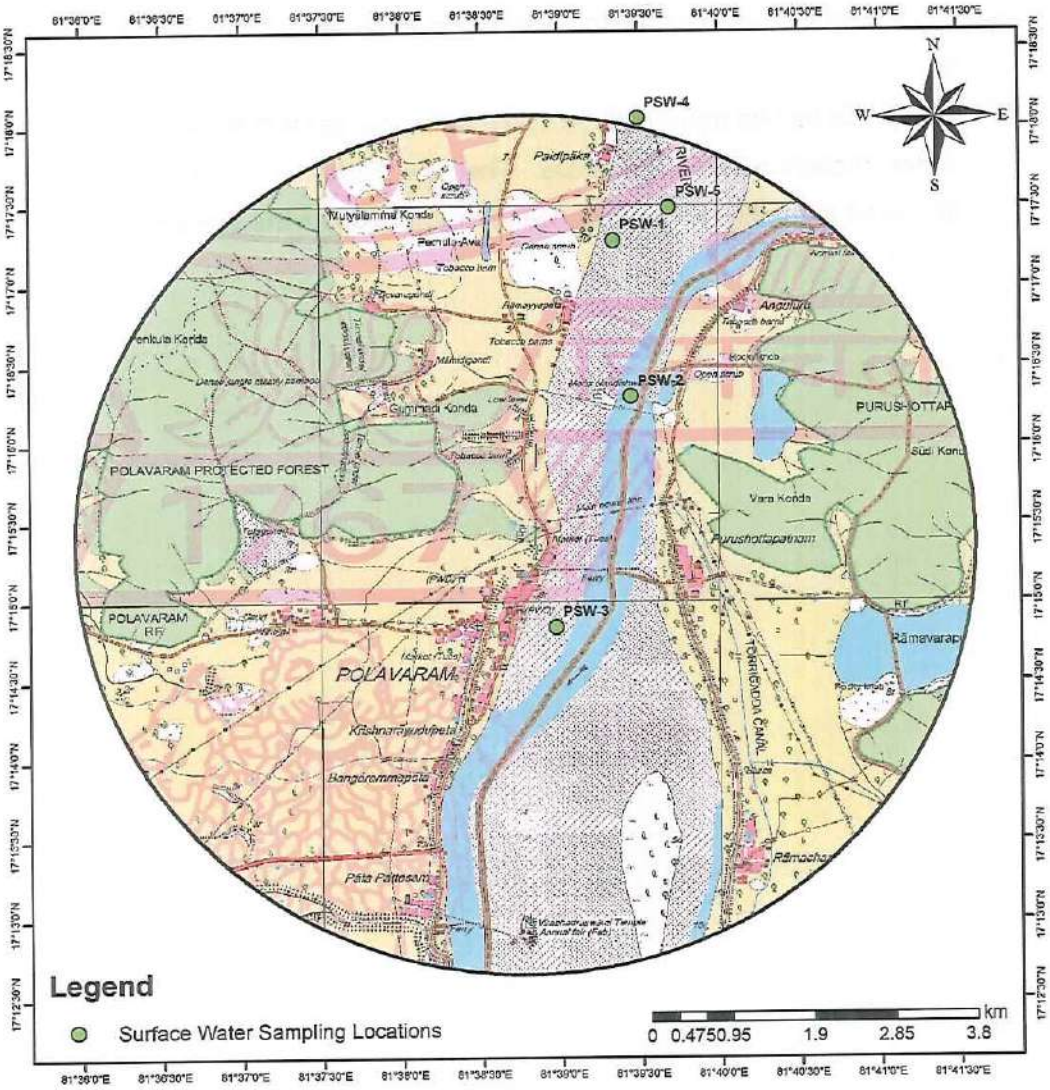

Figure 3.4.1: River sampling locations in the study area

Table 3.4.1: Surface Water Quality- Details of the Sampling Points (February 2020)

S No.	Location	Sample Code	Latitude	Longitude	Depth (m)	Transparency (m)
1.	Godavari River	PSW-1S PSW-1B	17°17'16.67"	81°39'20.42"	6.0	2.0
2.	Godavari River	PSW-2S PSW-2B	17°16'17.88"	81°39'26.89"	9.0	2.0
3.	Godavari River	PSW-3S PSW-3B	17°14'50.26"	81°38'58.19"	3.0	1.5
4.	Godavari River	PSW-4S PSW-4B	17°18'03.22"	81°39'29.91"	3.0	2.0
5.	Godavari River	PSW-5S PSW-5B	17°17'24.01"	81°39'41.50"	2.8	2.0

Table 3.4.2: Surface Water Quality- Physical Parameters (February 2020)

S No.	Sample Code	pH	Turbidity	TSS	EC	TDS
			NTU	mg/l	µs/cm	mg/l
1	PSW-1S	7.3	0.1	0.3	134	82
2	PSW-1B	7.2	0.2	1.6	175	112
3	PSW-2S	7.4	0.1	0.3	164	108
4	PSW-2B	7.1	0.3	5.9	178	113
5	PSW-3S	7.1	0.2	0.3	172	109
6	PSW-3B	7.3	0.3	5.0	169	108
7	PSW-4S	7.1	0.2	0.2	162	101
8	PSW-4B	7.1	0.3	4.3	178	113
9	PSW-5S	7.2	0.1	0.6	173	110
10	PSW-5B	7.1	0.2	1.3	173	112

Table 3.4.3: Surface Water Quality-Inorganic Parameters (February-2020)

S NO	Sample Code	Total Alkalinity	Total Hardness	Ca Hardness	Mg Hardness	Cl^-	Salinity	SO^{-2}_4	F
		mg/l	mg/l	mg/l	mg/l	mg/l	‰	mg/l	mg/l
1	PSW-1S	48	44	24	20	16	0.02	4	0.13
2	PSW-1B	60	48	24	24	25	0.04	4	0.18
3	PSW-2S	52	48	39	9	25	0.04	3	0.51
4	PSW-2B	60	52	27	25	25	0.04	3	0.12
5	PSW-3S	56	44	27	17	25	0.04	4	0.27
6	PSW-3B	60	44	27	17	22	0.04	5	0.14
7	PSW-4S	56	52	31	21	16	0.02	7	0.28
8	PSW-4B	64	48	31	17	21	0.04	5	0.16
9	PSW-5S	60	44	39	5	21	0.04	5	0.32
10	PSW-5B	60	48	31	17	25	0.04	3	0.11

Table 3.4.4: Surface water Quality – Demand and Nutrient Parameters (February 2020)

S.No	Sample Code	DO	BOD	$N\text{-}NO_3$	$P\text{-}PO_4$
		mg/l	mg/l	mg/l	mg/l
1	PSW-1S	6.8	2.3	0.22	BDL
2	PSW-1B	6.6	1.8	0.28	BDL
3	PSW-2S	7.2	3.0	0.22	BDL
4	PSW-2B	7.0	1.1	0.24	BDL
5	PSW-3S	7.3	2.3	0.20	BDL
6	PSW-3B	7.4	1.5	0.20	BDL
7	PSW-4S	7.7	3.2	0.23	BDL
8	PSW-4B	7.4	3.5	0.23	BDL
9	PSW-5S	7.8	3.3	0.19	BDL
10	PSW-5B	7.3	3.5	0.17	0.010

Table 3.4.5: Surface Water Quality- Microbial Parameters (February 2020)

S. No	Sample Code	Total Viable count		T.C	F.C
		CFU/0.1ml	CFU/1ml	CFU/100ml	CFU/100ml
1	PSW-1S	179	$1790X10^5$	1800	ND
2	PSW-2S	131	$1310X10^5$	TNC	1080
3	PSW-3S	195	$1950X10^5$	1840	120
4	PSW-4S	133	$1330X10^5$	2600	300
5	PSW-5S	143	$1430X10^5$	2120	80

Table 3.4.6: Surface Water Quality - Heavy Metals (February 2020)

S No	Sample Code	As	B	Cd	Co	Cr	Cu	Fe	Mn	Ni	Pb	Zn
		mg/l										
1.	PSW-1S	BDL	0.007	BDL	BDL	0.008	BDL	0.182	0.024	0.004	BDL	0.061
2.	PSW-2S	0.002	0.031	BDL	BDL	0.011	BDL	0.094	0.028	0.005	BDL	0.135
3.	PSW-3S	BDL	BDL	BDL	BDL	0.008	BDL	0.211	0.016	BDL	BDL	0.004
4.	PSW-4S	BDL	BDL	BDL	BDL	0.005	BDL	0.012	0.080	BDL	BDL	BDL
5.	PSW-5S	BDL	BDL	BDL	BDL	0.014	BDL	0.005	0.078	0.003	BDL	BDL

Table 3.4.7: Diversity of phytoplankton community in surface water samples

Phytoplankton Genera (No'sx10^3/L)	PSW-1		PSW-2		PSW-3		PSW-4		PSW-5	
	No's	%	No's	%	No's	%	No's	%	No's	%
Amphora sp.	13	3.79	16	4.82	--	--	--	--	--	--
Anabaena sp.	7	2.04	--	--	--	--	--	--	16	7.92
Ankistrodesmus sp.	17	4.96	8	2.41	4	0.84	14	5.93	--	--
Bacillaria sp.	7	2.04	--	--	--	--	--	--	5	2.48
Blue Green Algae	--	--	--	--	30	6.28	--	--	--	--
Chodatella sp.	3	0.87	--	--	--	--	--	--	--	--
Cladophora sp.	--	--	3	0.90	--	--	--	--	--	--
Closterium sp.	36	10.50	47	14.16	31	6.49	20	8.47	--	--
Coscinodiscus sp.	3	0.87	4	1.20	1	0.21	--	--	--	--
Cyclotella sp.	13	3.79	1	0.30	21	4.39	--	--	--	--
Cymbella sp.	10	2.92	--	--	8	1.67	--	--	--	--
Diatoms	16	4.66	10	3.01	36	7.53	20	8.47	36	17.82
Fragilaria sp.	--	--	5	1.51	8	1.67	19	8.05	--	--
Golenkinia sp.	--	--	6	1.81	--	--	--	--	--	--
Grammotophora sp.	--	--	--	--	1	0.21	--	--	--	--
Gyrosigma sp.	--	--	--	--	12	2.51	--	--	3	1.49
Merismopedia sp.	8	2.33	9	2.71	27	5.65	17	7.20	3	1.49
Microspora sp.	--	--	4	1.20	--	--	2	0.85	--	--
Mougeotia sp.	--	--	12	3.61	--	--	--	--	--	--
Navicula sp.	48	13.99	26	7.83	47	9.83	34	14.41	35	17.33
Nitzschia sp.	24	7.00	14	4.22	22	4.60	19	8.05	--	--
Nodularia sp.	17	4.96	44	13.25	30	6.28	--	--	28	13.86
Nostoc sp.	12	3.50	23	6.93	22	4.60	--	--	8	3.96
Oedogonium sp.	5	1.46	--	--	22	4.60	8	3.39	--	--
Oocystis	--	--	6	1.81	5	1.05	--	--	--	--
Oscillatoria sp.	8	2.33	39	11.75	44	9.21	12	5.08	--	--
Pediastrum sp.	--	--	--	--	2	0.42	--	--	1	0.50
Phacus sp.	--	--	16	4.82	14	2.93	--	--	--	--
Pinnularia sp.	21	6.12	10	3.01	10	2.09	8	3.39	--	--
Pleurosigma sp.	--	--	14	4.22	--	--	--	--	--	--
Prorocentrum sp.	--	--	--	--	6	1.26	--	--	6	2.97
Red Algae	4	1.17	--	--	3	0.63	--	--	1	0.50
Scenedesmus sp.	10	2.92	9	2.71	--	--	--	--	4	1.98
Skeletonema sp.	--	--	--	--	28	5.86	10	4.24	5	2.48
Sphaerocysts	--	--	--	--	5	1.05	--	--	--	--
Staurastrum sp.	14	4.08	--	--	4	0.84	--	--	2	0.99
Stauroneis sp.	30	8.75	--	--	28	5.86	34	14.41	30	14.85
Synedra sp.	--	--	--	--	2	0.42	17	7.20	19	9.41
Tetraedron sp.	17	4.96	--	--	--	--	--	--	--	--
Tribonema sp.	--	--	--	--	1	0.21	2	0.85	--	--
Trichodesmium sp.	--	--	--	--	4	0.84	--	--	--	--
Volvox sp.	--	--	6	1.81	--	--	--	--	--	--
SWDI	**2.904**		**2.804**		**3.025**		**2.525**		**2.308**	
Diversity	**23**		**23**		**30**		**15**		**16**	
Total (No'sx10^3/L)	**343**		**332**		**478**		**236**		**202**	

Table 3.4.8: Diversity of zooplankton in surface water samples

Zooplankton Genera (No's/M^3)	PSW-1		PSW-2		PSW-3		PSW-4		PSW-5	
	No's	%	No's	%	No's	%	No's	%	No's	%
Ceratium sp.	250	3.06	--	--	--	--	--	--	--	--
Cypridopsis sp.	--	--	11	0.39	--	--	10	1.11	1	0.08
Daphnia sp.	--	--	--	--	--	--	--	--	10	0.78
Diaphanosoma sp.	250	3.06	--	--	--	--	--	--	--	--
Diaptomus sp.	14	0.17	10	0.36	7	--	--	--	10	0.78
Doliolum sp.	--	--	12	0.43	8	0.24	--	--	4	0.31
Eubranchipus sp.	--	--	--	--	5	0.28	12	1.34	--	--
Eurecyrus sp.	9	0.11	--	--	--	0.17	--	--	--	--
Keratella sp.	5000	61.24	2125	76.25	2875	--	500	55.74	1250	98.04
Lathonura sp.	--	--	4	0.14	--	99.17	--	--	--	--
Leptodora sp.	375	4.59	250	8.97	--	--	125	13.94	--	--
Limnocalanus sp.	4	0.05	--	--	3	--	--	--	--	--
Macrothrix sp.	4	0.05	--	--	1	0.10	--	--	--	--
Mayorella sp.	1125	13.78	--	--	--	0.03	--	--	--	--
Notholca sp.	1125	13.78	--	--	--	--	250	27.87	--	--
Simocephalus sp.	--	--	125	4.49	--	--	--	--	--	--
Fish Eggs	--	--	250	8.97	--	--	--	--	--	--
Foraminifera	9	0.11	--	--	--	--	--	--	--	--
SWDI	**1.235**		**0.854**		**0.060**		**1.064**		**0.119**	
Diversity	**11**		**8**		**6**		**5**		**5**	
Abundance	**8165**		**2787**		**2899**		**897**		**1275**	

3.5 Sediment Quality

Sediment Characterization

Suspended matter may be divided into different categories that generally are divided as organic and inorganic suspended matter. Organic suspended matter contains mainly phytoplankton. Inorganic part contains mainly sediments that are suspended by currents and waves, or taken to the water column by human activities like dredging and dumping.

Five river sediment samples were collected as per the standard procedure using Van Veen Grab Sampler to evaluate the existing status of sediment quality. Sediments samples were collected from Godavari River during February 2020. The locations identified within project area are given in Table 3.5.1 and Fig. 3.5.1.

Representative sediment samples were collected from the project site for evaluation of the physico-chemical characteristics of sediment. Standard methods have been followed for the analysis of sediment samples. Sediment quality delineated through specific parameters, viz Particle Size Distribution, Texture, Total Organic carbon and Heavy Metals. Heavy metals in sediment samples were determined by extracting sediment by Hydrochloric acid and Nitric acid mixture digestion and analysed on ICP-OES (SW-846-6010-B / EPA).

The sediment texture is observed to be predominantly sandy as Fine sand is dominant with a range from 63.97 to 94.61% in all the sediment samples. TOC content in sediments varied from 0.069 to 0.440 %. Sediment Quality is furnished in Table 3.5.2.

Heavy Metals

Selected Sediment samples from study area were analyzed for heavy metals such as Boron (1.05 to 4.00 mg/kg), Chromium (2.21 to 7.37 mg/kg), Zinc (BDL to 3.84 mg/kg), Lead (0.50 to 1.12 mg/kg), Nickel (1.54 to 4.21 mg/kg), Cadmium (0.11 to 0.35 mg/kg), Iron (1083 to 3204 mg/kg) , Manganese (24.76 to 43.76 mg/kg), Copper (0.80 to 3.22 mg/kg) ,Cobalt (0.91 to 2.27 mg/kg) , Mercury (0.01 to 0.02 mg/kg), Arsenic (BDL) (Table 3.5.3). The heavy metals occur in the sediment as cations and are adsorbed by the negatively charged sediment particle. They are held strongly as complex on the surface of clay alumino silicates hydrated oxide and humus. The heavy metal concentrations in the sediments

samples of the study area below USEPA, Indian river system and World river system standards.

Benthic fauna:

Benthic fauna is one of the indicators of productivity in water environment. The environmental stress or factors such as climate, pH, season, water flow, etc could affect the diversity of benthic fauna and thus studying the diversity of Benthos could help to understand the environmental stress in the water environment.

- Analyses of sediment samples indicate moderate level of diversity of benthic organisms (Table 3.5.4).
- The organisms such as *Sphaerium* sp. (34.92%), *Gonibasis* sp. (11.11%), *Pisidium* sp. (10.17%) and Copepods (9.52%) were found to be abundant in the sediments samples collected from the surface water.
- The diversity of organisms in the sediment samples varied from four to six which suggests that the diversity of benthic organisms do not vary drastically.
- The abundance of benthic organisms ranged from 180 to 900 per m^2.
- The ecological index (SWDI) was noticed to range between 0.790 and 1.631 and the values suggest moderate level of stress on the organisms in the River sediment.

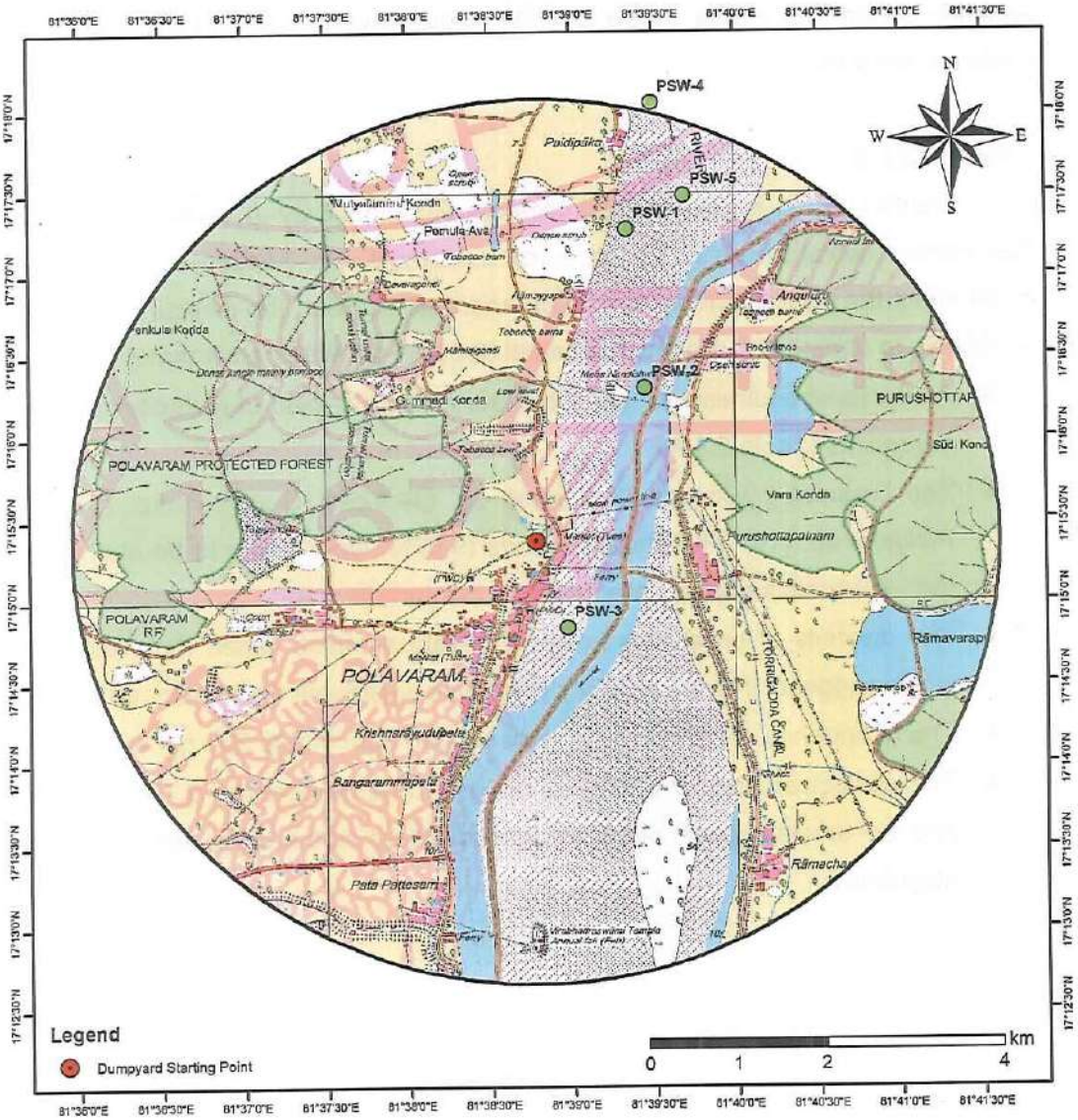

Fig. 3.5.1: Sediment sampling locations

Table 3.5.1: Sediment sampling locations and GPS co-ordinates

Sr. No.	Sample Code	Village	Latitude	Longitude
1.	SW-1	Coffer Dam	17°17'16.67"	81°39' 20.42"
2.	SW-2	Beside Janakiramudu Temple	17°16'17.88"	81°39' 26.89"
3.	SW-3	Polavaram Reva	17°14'50.26"	81°38' 58.19"
4.	SW-4	Paidipaka opp	17°18'03.22"	81°39' 29.91"
5.	SW-5	Auguluru	17°17' 29.01"	81°39' 41.50"

Table 3.5.2: Particle Size Distribution and TOC

S. No	Sample Code	Particle Size Distribution (%)				Texture	TOC
		Coarse Sand	Fine Sand	Silt	Clay		
1.	PSW-1	27.42	64.81	0.89	6.88	Sand (S)	0.304
2.	PSW-2	8.34	79.82	3.83	8.01	Loamy Sand (LS)	0.227
3.	PSW-3	8.46	66.02	7.86	17.66	Sandy Loam (SL)	0.440
4.	PSW-4	28.47	63.97	0.05	7.51	Sand (S)	0.136
5.	PSW-5	0.21	94.61	1.37	3.81	Sand (S)	0.069

Table 3.5.3: Heavy Metals in Sediment Samples

Sr. No.	Sample Code	As	B	Cd	Cr	Co	Cu	Fe	Hg	Mn	Ni	Pb	Zn
		--------mg/kg--------											
1.	PSW-1	BDL	1.80	0.17	2.36	1.14	0.80	1487	0.01	26.42	2.02	0.50	BDL
2.	PSW-2	BDL	4.00	0.35	7.15	2.27	3.22	3204	0.01	77.08	4.21	1.11	2.45
3.	PSW-3	BDL	2.33	0.21	2.89	1.72	1.30	1900	0.01	43.76	2.70	0.53	1.28
4.	PSW-4	BDL	1.05	0.11	2.21	0.91	0.39	1083	0.01	24.76	1.54	0.18	BDL
5.	PSW-5	BDL	3.65	0.30	7.37	1.76	2.15	2708	0.02	32.47	3.03	1.12	3.84

Table 3.5.4: Diversity of benthic organisms in the sediment samples

Benthos organisms (No's/M^2)	PSW-1		PSW-2		PSW-3		PSW-4		PSW-5	
	No's	%	No's	%	No's	%	No's	%	No's	%
Pleuroceridae										
Gonibasis sp.	225	35.71	--	--	90	25.00	--	--	--	--
Sphaeriidae	--	--	--	--	--	--	--	--	--	--
Sphaerium sp.	--	--	45	25.0	--	--	360	40.00	585	76.47
Pisidium sp.	135	21.43	--	--	--	--	135	15.00	--	--
Unionidae	--	--	--	--	--	--	--	--	--	--
Margaritifera sp.	--	--	45	25.0	135	37.50	--	--	45	5.88
Unio sp.	--	--	--	--	--	--	180	20.00	--	--
Lymnaeidae	--	--	--	--	--	--	--	--	--	--
Lymnaea sp.	--	--	--	--	--	--	--	--	45	5.88
Copepods	90	14.29	45	25.0	45	12.50	90	10.00	--	--
Crustaceans	45	7.14	--	--	45	12.50	--	--	--	--
Amphipoda	90	14.29	45	25.0	--	--	45	5.00	--	--
Polychaete	--	--	--	--	45	12.50	--	--	90	11.76
Fish Larvae	45	7.14	--	--	--	--	90	10.00	--	--
SWDI	1.631		1.347		1.494		1.583		0.790	
Diversity	6		4		5		6		4	
Abundance	630		180		360		900		765	

3.6 Land Environment

The proposed project site is situated at Polavaram, West Godavari Distyrict, A.P. Physiographically the district is divided into two natural regions. viz., Alluvial plain and upland areas. The alluvial plain covers 30% of the area in southern part of the Eluru – Kovuru railway line while uplands which include agency area constitutes 70% of the total district area. The important landforms in the district include Structural hills, Pediplain, Pediment inselberg complex, Coastal landforms and Valley fills.

The project location falls in Krishna – Godavari Zone of agro climatic zones. The zonescover East Godavari Part, West Godavari, Krishna, Guntur, and contiguous areas of Khammam, Nalgonda and Prakasam. Rainfall of this zone is 800-1100mm. Soil type is deltaic alluvium, red soils with clay, red loams, coastal sands and saline soils. Paddy, Groundnut, Jowar, Bajra, Tobacco, cotton, chillies, Sugarcane and Horticultural Crops are the important crops grown.

The different type of soils encountered in the west Godavari district are red soils, black cotton soils, deltaic alluvial soils and coastal sands,the red soils are seen mostly around Chintalapudi, Koyyalagudem, Nallajerla and southeast Polavaram villages They are permeable and well drained to moderately well drained. The black cotton soils are encountered in around Eluru, Nidamarru places in the district. Deltaic alluvial soils are very deep and highly fertile. These are seen mostly in around Polavaram, Kovvuru, Nidadavolu and Tanuku places.The coastal sands are seen occurring as patches in the south west and southern most parts of the district.

Paddy is the major crop in this District in both of the Seasons. During Kharif Season, Sugarcane is the 2nd major crop. Both Paddy and Sugarcane together contributes around 95% of total cropped area. During Rabi Season Crops namely Maize, Tobacco, Groundnut, Pulses and Sunflower are other major sown areas. Mango, Coconut, Oil palm, Cashew, Citrus, Banana, Turmeric, Sapota, Papaya, Cucumber, Gourds, Bhendi, Brinjal, Tomato, Cabbage, Cauliflower and Leafy vegetables which are treated as other important Horticulture Crops grown in the District.

Soil Characteristics

Twelve locations were identified for soil quality assessment at different

villages within the study area including project site. The locations and names of villages are given in Table 3.6.1 and their relative locations are as depicted in Fig. 3.6.1. Representative soil samples were collected from 15-30 cm depth at identified locations/villages and project site for the analysis of physico-chemical characteristics to represent existing soil quality (baseline) status.

The standard methods have been followed for the analysis of soil samples. The international pipette method (Black, 1965 and Piper 1966) was adopted for determination of particle size analysis. The textural diagram was derived using "SEE soil class 2.0 version based on the United States Department of Agriculture (USDA) classification of soils. Physical parameters such as bulk density, porosity and water holding capacity were determined by KR Box method (Keen and Raczkowski, 1921).

The chemical characteristics of soil were determined by preparing soil extract in distilled water in ratio 1:2 (Jackson, 1967). Organic carbon was determined by Walkey and Black method (1979). Fertility status of soil in terms of available nitrogen was determined by Kjeldhal method and available phosphorus was determined by chlorostannous reduced molybdophosphorous blue colour method (Olsen method, 1954). Potassium was determined by flame photometric method (Jackson ML 1967). Heavy metals in soil were determined by extracting soil with conc. H_2SO_4 and conc. HNO_3 followed by analysis on Inductively Coupled Plasma Spectrometer (ICP) (APHA, 1995).

Physical Characteristics

Physical characteristics of soil samples are delineated through specific parameters, viz., particle size distribution, texture, bulk density, porosity and water holding capacity. The particle size distribution in terms of percentage of total sand, silt and clay is furnished in Table 3.6.2.

Particle size distribution, also known as gradation, refers to the proportions by dry mass of a soil distributed over specified particle-size ranges. Soil particles vary greatly in size, and soil scientists classify soil particles into sand, silt, and clay. Starting with the finest, clay particles are smaller than 0.002 mm in diameter. Particle size distribution is a major factor as it influences water holding capacity, bulk density, Soil moisture availability, and nutrient content. The size of soil particles is important. The amount of open space between the particles influences how easily water moves

through a soil and how much water the soil will hold. Too much clay, in proportion to silt and sand, causes a soil to take in water very slowly. Such a soil gives up its water to plants slowly. Fine sand content (33.72 to 76.86%) of the soil samples collected from the study area are found to be higher as compared to silt and clay content. Texture indicates the relative content of particles of various sizes, such as sand, silt and clay in the soil. Texture influences the ease with which soil can be worked, the amount of water and air it holds, and the rate at which water can enter and move through soil. Soil texture is a classification of soil based on its physical texture and characteristics, particularly the size of the particles that make up the soil. The predominant texture of soil in study area is sandy clay loam and sandy loam followed by sand (Fig.3.6.2).

Soil bulk density is the mass of dry soil per unit of bulk volume, including the air space. Soil bulk density can vary substantially among different soil types and is affected by management practices. Particle density is volumetric mass of solid soil. It differs from bulk density because the volume used does not include pore spaces. The bulk density and particle density of soils in the region are in the range of 0.96 to 1.26 g/cm^3 and 2.00 to 2.63 g/cm^3 (Table 3.6.3).

Soil porosity is a measure of air-filled pore spaces and gives information about movement of gases, inherent moisture, and development of root system and strength of soil. Soil Water Holding Capacity is controlled primarily by the soil texture and the soil organic matter content. The porosity and water holding capacity of soil samples in study area are found in the ranges: 40.81-59.71% and 33.96 – 62.07% (Table 3.6.3), as the soils of the study area are mostly sandy loam in texture.

Chemical Characteristics

The collected soil samples were analysed for various chemical parameters, viz. pH, electrical conductivity, soluble cations and anions, Sodium Adsorption Ration (SAR), nutrients and organic carbon content in the soil samples are presented in Tables 3.6.4 - 3.6.5.

pH is an important parameter to indicate of the alkaline or acidic nature of the soil. It also affects the microbial population as well as the solubility of metal ions and regulates nutrient availability. Variation in pH of soil within the study area is presented in Table 3.6.4 and it was observed that the majority of the soil samples

are moderately acidic to moderately alkaline in nature with pH variation from 6.25 to 7.33.

The soluble salts were determined from soil saturated extract (1:2). The soluble salts in soil samples are expressed in terms of electrical conductivity (EC) and have been observed in the range: 0.067 to 0.312 mS/cm (Table 3.6.4), which fall in the normal category (<1 mS/cm). Amongst the soluble cations, Ca^{2+} and Mg^{2+} are observed in the range of 0.002 to 0.025 and 0.01 to 0.62 meq/100g and Na^{+}, and K^{+} are in the ranges of 0.12 to 0.62 and 0.07 to 0.65 meq/100g of soil extract respectively (Table 3.6.4).

Sodium adsorption ratio (SAR), along with pH, characterizes salt-affected soils. It is an easily measured property that gives information on the comparative concentrations of Na+, Ca2+, and Mg2+ in soil solutions. SAR of soil samples of the study area ranged from 0.77 to 5.55 except in the the samples from Ramachandra puram (13.44). The SAR of a soil extract takes into consideration that the adverse effect of sodium is moderated by the presence of calcium and magnesium ions. When the SAR rises above 12 to 15, serious physical soil problems arise and plants have difficulty in absorbing water. The most important anions present in soluble state in the soil are chlorides and sulphates. Chlorides ranged from 0.52 to 0.96 meq/100gm and sulphates content ranged from 0.014 to 0.033 meq/100 gm. Most of the samples from the study area are found to be in Non-Salinized range with respect to Chloride.

Organic matter present in soil influences its physical and chemical properties. It commonly accounts for as much as one third or more of the cation exchange capacity of the surface soil and is responsible for stability of soil aggregates. Organic carbon in soil samples vary in the range 0.24 to 1.38 % which is low to very high and available potassium levels are from medium to high, varies from 69.10 to 1133 and phosphorus levels ranged from 308 to 726kg/ha, respectively. However, available nitrogen showed low to medium range value i.e. in the range 75.26 to 326 kg/ha. Soil fertility ratings are rated as per ICAR. The results show that the soil in study area is poor in nutrient level. The fertility status of soil is presented in Table 3.6.5.

Heavy Metals

The heavy metals occur in the solution as cations and are adsorbed by the negatively charged soil particle. They are held strongly as complex on the surface of clay alumino silicates hydrated oxide and humus. In general, adsorption increases with pH. Although the trace metals in soil are very important for the quality of soil and environment, excessive level of trace elements can cause water pollution, toxicity in plants, foods and ultimately in animals and humans that feed upon them. The heavy metals also create problems in the nutrient utilization by plant and also marked reduction in chlorophyll content. As a result, the limits of metal deposition rates to soils should take into account the general ecotoxicity, phytotoxicity, transfer to animals and risk to the human health. The trace metal concentrations in soils may be affected by the deposition of wastes released from various industries and other related establishments.

All soils naturally contain trace levels of metals. The presence of metals in soil is, therefore, not indicative of contamination. The concentration of metals in uncontaminated soil is primarily related to the geology of the parent material from which the soil was formed. Depending on the local geology, the concentration of metals in a soil may exceed the ranges (from literature).

Soil samples were also analyzed for heavy metals such as Arsenic (BDL), Boron (7.81 to 17.16 mg/kg)) Cadmium (0.65 to 1.96 mg/kg), Chromium (11.87 to 27.81 mg/kg), Cobalt (3.07 to 9.69 mg/kg), Copper (5.98 to 32.01 mg/kg), Iron (5789 to 11486 mg/kg), Mercury (0.01 to 0.03 mg/kg), Manganese (110 to 437 mg/kg), Nickel (7.34 to 23.84 mg/kg), Lead (1.42 to 4.49 mg/kg) and Zinc (7.98 to 29.44 mg/kg). The observed concentrations are presented in Table 3.6.6. The heavy metal concentrations in the study area are below Screening and response levels as per MoEF&CC Guidance Document for assessment and remediation of contaminated site in India.

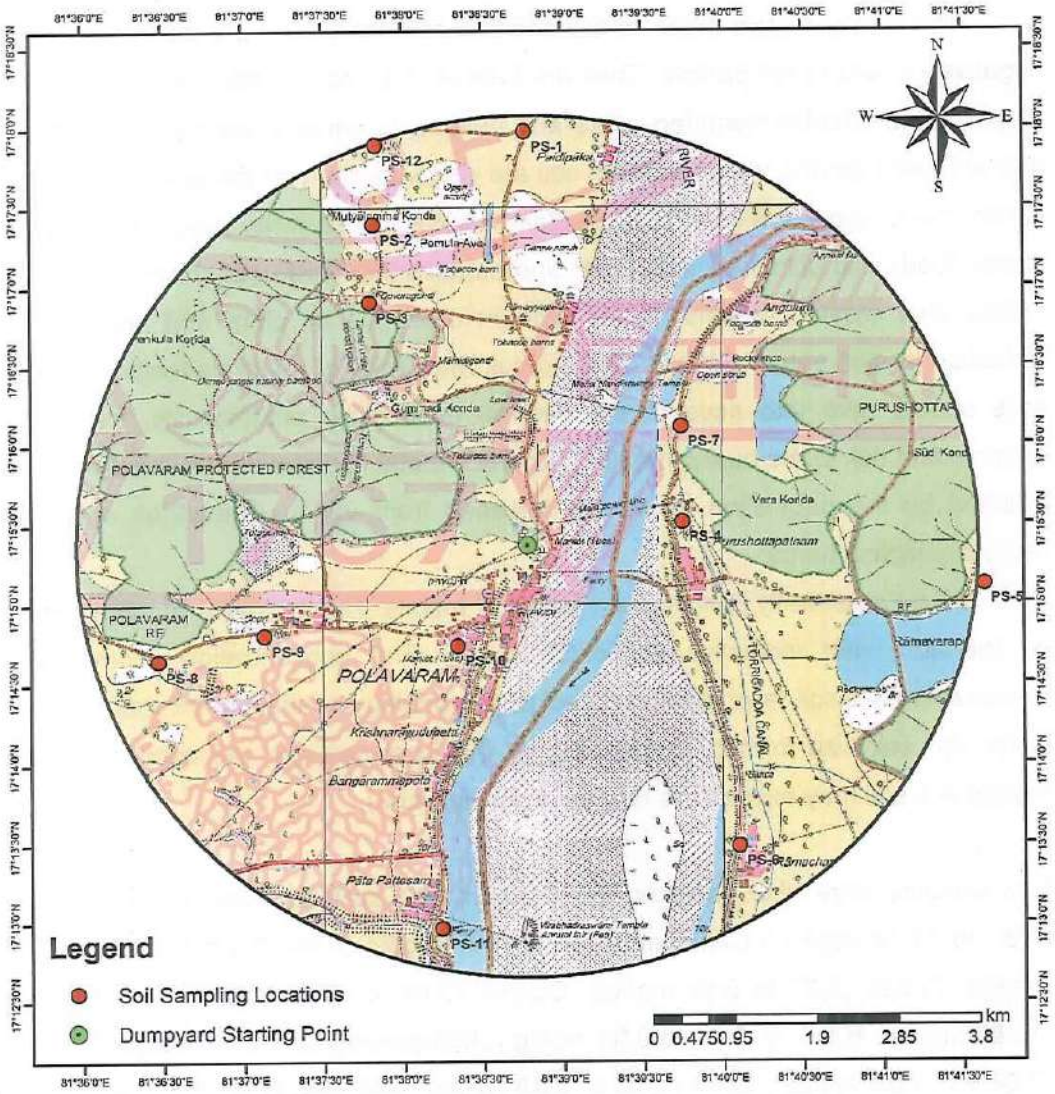

Fig. 3.6.1: Soil sampling locations

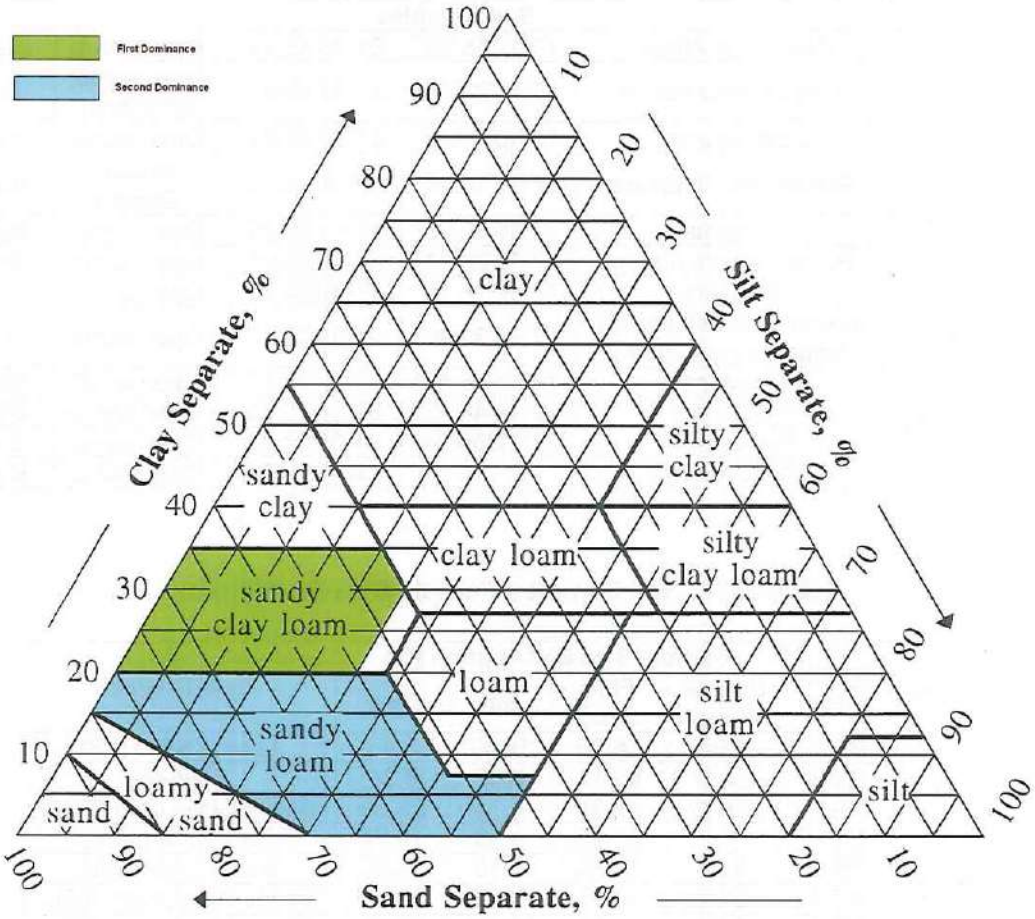

Figure 3.6.2 : Predominant Soil Texture

Table 3.6.1: Soil Sampling Locations and GPS co-ordinates

Sr. No.	Sample Code	Village	Latitude	Longitude	Source	Soil Color
Soil Samples						
1.	PS-1	Paidipaka Village	17°17'58.66"	81°38'46.29"	Open scrub	Black
2.	PS-2	Mutyalamma Konda	17°17'23.78"	81°37'49.41"	Open scrub, Bare area	Red
3.	PS-3	Devaragonda	17°16'54.25"	81°37'47.81"	Open scrub	Black
4.	PS-4	Purushotha Patanam	17°15'30.78"	81°39' 44.92"	House Garden	Black
5.	PS-5	Nelakota	17°15'06.91"	81°41'38.40"	Open scrub	Black
6.	PS-6	Ramachandra puram	17°13'28.74"	81°40'05.97"	Open scrub	Black
7.	PS-7	Auguluru	17°16'06.77"	81°39'44.70"	Open scrub	Red
8.	PS-8	Itukala kota(Pattiseema Attipothala patanam)	17°14'38.90"	81°36'28.17"	Open scrub	Red
9.	PS-9	Ramaithpeta	17°14'48.48"	81°37'07.91"	Open scrub	Black
10.	PS-10	Polavaram	17°14'44.47"	81°38'20.53"	Open scrub	Black
11.	PS-11	Pattiseema	17°12'58.04"	81°38'14.33"	Open scrub	Black
12.	PS-12	Chegondapalli	17°17'57"	81°37'47"	Open scrub	Black

Table 3.6.2: Soil Samples Particle Size Distribution

S.No.	Sample Code	Particle Size Distribution (%)				Soil Texture
		Coarse Sand	Fine Sand	Silt	Clay	
1.	PS-1	2.66	76.86	14.49	5.98	Loamy Sand (LS)
2.	PS-2	28.97	61.11	3.68	6.24	Sand (S)
3.	PS-3	23.43	49.37	4.14	23.06	Sandy Clay Loam (SCL)
4.	PS-4	11.71	67.95	3.55	16.79	Sandy loam (SL)
5.	PS-5	9.29	71.35	4.10	15.26	Sandy Loam (SL)
6.	PS-6	5.31	62.13	12.16	20.40	Sandy Clay Loam (SCL)
7.	PS-7	8.77	48.13	22.29	20.81	Sandy Clay Loam (SCL)
8.	PS-8	16.07	66.74	4.29	12.91	Sandy Loam (SL)
9.	PS-9	5.15	33.72	6.49	54.65	Clay (C)
10.	PS-10	2.04	65.75	4.30	27.91	Sandy Clay Loam (SCL)
11.	PS-11	1.20	65.50	20.56	12.75	Sandy Loam (SL)
12.	PS-12	38.35	57.45	1.59	2.60	Sand (S)

Table 3.6.3: Soil Physical Properties

S.No.	Sample Code	Density (g/cc)		Porosity Percent (%)	Water Holding Capacity (%)
		Bulk	Particle		
1.	PS-1	1.10	2.00	44.90	47.90
2.	PS-2	1.26	2.50	49.58	33.96
3.	PS-3	1.21	2.04	40.81	41.49
4.	PS-4	1.06	2.63	59.71	46.65
5.	PS-5	1.15	2.63	56.26	43.88
6.	PS-6	0.96	2.04	52.82	62.07
7.	PS-7	1.01	2.00	49.39	50.00
8.	PS-8	1.21	2.38	49.38	41.39
9.	PS-9	1.19	2.04	41.67	60.56
10.	PS-10	1.18	2.33	49.37	44.91
11.	PS-11	1.10	2.56	57.10	54.14
12.	PS-12	1.15	2.50	53.80	40.18

Table 3.6.4: Chemical Properties of Soil Extract (water soluble)

S.No.	Sample Code	pH	EC	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	SO_4^{-}	Cl^{-}	SAR
			mS/cm	---------(meq/100gm)---------						
1.	PS-1	6.74	0.177	0.004	0.62	0.14	0.07	0.015	0.96	0.77
2.	PS-2	6.25	0.067	0.004	0.01	0.13	0.07	0.014	0.88	4.46
3.	PS-3	7.21	0.224	0.006	0.03	0.17	0.12	0.020	0.72	3.71
4.	PS-4	6.86	0.200	0.006	0.03	0.14	0.16	0.025	0.52	3.46
5.	PS-5	7.09	0.312	0.008	0.04	0.12	0.21	0.024	0.76	2.49
6.	PS-6	7.14	0.206	0.004	0.03	0.62	0.65	0.033	0.68	13.44
7.	PS-7	6.71	0.145	0.005	0.03	0.15	0.10	0.022	0.80	3.29
8.	PS-8	6.89	0.181	0.025	0.13	0.16	0.07	0.014	0.84	1.83
9.	PS-9	7.33	0.208	0.002	0.03	0.15	0.07	0.020	0.76	3.60
10.	PS-10	6.29	0.150	0.003	0.09	0.16	0.07	0.017	0.76	2.40
11.	PS-11	7.13	0.177	0.016	0.03	0.16	0.07	0.016	0.92	3.34
12.	PS-12	6.75	0.142	0.004	0.01	0.17	0.20	0.026	0.72	5.55

Table 3.6.5: Soil Fertility Status

S.No.	Sample Code	Organic Carbon (%)	Available		
			N	P	K
			kg/ha		
1.	PS-1	0.90	176	388	231
2.	PS-2	0.42	75.26	340	68.10
3.	PS-3	0.75	163	487	1133
4.	PS-4	1.34	251	603	203
5.	PS-5	1.31	238	726	1117
6.	PS-6	1.40	213	623	1305
7.	PS-7	1.38	326	438	603
8.	PS-8	0.24	87.80	308	103
9.	PS-9	0.84	138	412	477
10.	PS-10	0.65	201	417	268
11.	PS-11	0.59	188	362	391
12.	PS-12	1.02	188	652	168
Poor soil		**< 0.5**	**< 280**	**<10**	**<108**
Medium soil		**0.5-0.75**	**280-560**	**10-24.6**	**108-280**
Fertile soil		**>0.75**	**> 560.0**	**> 24.6**	**>280**

Nutrient status Classification: Source: Soil Testing in India, Dept. of Agri. And Cooperation, Ministry of Agriculture, Govt. of India, 2011

Table 3.6.6: Heavy Metals in Soil Samples

Sr. No.	Sample Code	As	B	Cd	Cr	Co	Cu	Fe	Hg	Mn	Ni	Pb	Zn
		--------mg/kg--------											
1.	PS-1	BDL	15.44	1.29	19.83	7.67	17.25	10468	0.01	252	14.88	3.16	19.55
2.	PS-2	BDL	11.76	0.98	20.07	3.26	18.52	8254	0.01	112	12.54	1.92	11.02
3.	PS-3	BDL	7.81	0.65	12.47	3.07	8.42	5944	0.02	110	7.34	1.79	7.98
4.	PS-4	BDL	11.55	3.24	20.92	6.75	21.66	8266	0.03	270	14.57	3.59	27.07
5.	PS-5	BDL	7.93	0.67	12.74	3.79	5.98	5789	0.02	211	8.01	1.54	11.90
6.	PS-6	BDL	8.00	0.69	11.87	4.82	8.77	6100	0.03	218	8.46	1.73	14.61
7.	PS-7	BDL	14.84	1.23	21.17	7.81	16.91	10191	0.02	318	17.57	2.04	17.73
8.	PS-8	BDL	13.59	1.13	12.75	5.43	7.31	9496	0.03	168	10.48	1.42	11.46
9.	PS-9	BDL	14.02	1.32	23.62	6.74	32.01	9933	0.01	146	23.84	4.49	29.44
10.	PS-10	BDL	11.23	1.05	20.29	7.23	15.16	8858	0.03	302	13.74	3.47	21.86
11.	PS-11	BDL	17.16	1.42	27.81	9.69	22.91	11456	0.02	437	22.93	3.85	26.52
12.	PS-12	BDL	13.48	1.12	14.55	5.02	11.73	9379	0.03	236	9.58	3.06	18.21

Chapter 4

Conclusions & Future Work

4.1 CONCLUSIONS

The present study aimed to assess the periodical environmental quality status within 5 km radius of the Polavaram Project. The field work for various components viz., air, groundwater, river water, soil and river sediments was carried out in the study area during 2020 during February, March and November except for April to October due to COVID pandemic for assessing the prevailing environmental quality. Based on the primary data collected during the study period, following conclusions are drawn:

- ✓ The ambient air quality at all locations in the study area are found to be within National Ambient Air Quality Standards (NAAQS) w.r.to gaseous pollutants (SO_2, NO_2, O_3, CO, NH_3 and C_6H_6), PM_{10} and $PM_{2.5}$. The higher values of particulate matter (PM_{10} and $PM_{2.5}$) in terms of maximum concentrations in the study area may be due to the vehicular movement and unpaved roads.
- ✓ In the villages and residential colonies surrounding the Polavaram project, it is observed that the daytime noise levels vary between 50.2-52.9 dB(A), 50.1-54.5 dB(A) & 51.6-53.8 dB(A) and night time noise levels vary between 43.1-45.0 dB(A), 42.8-44.8 dB(A) & 40.8-44.0 dB(A) during February, March and November 2020, respectively. The noise levels are compared with CPCB limits for residential areas. The noise levels are observed to be within the CPCB standards for residential areas
- ✓ The observed Leq values of day time noise levels during February, March and November 2020 respectively are varying between 64.2-70.2 dB(A), 62.6-66.6 dB(A) and 59.4-68.6 dB(A). The night time noise levels are within the range of 52.2-67.9 dB(A), 53.6-60.9 dB(A) and 50.7-60.7 dB(A), respectively, during February, March and November 2020 near the construction activities of Polavaram project. It is observed that daytime and night time noise levels are exceeding the CPCB limits for commercial zone at most of the sites. These higher noise levels are attributed to operation of DG sets, Excavators, Cranes, Crushers, movement of Trucks, vehicles, and concrete mixers etc. in connection with ongoing construction activities of Polavaram.

- ✓ The groundwater quality at most of the sampling locations for various parameters was well within the permissible limit of BIS except for TDS, calcium hardness, nitrate
- ✓ Iron and Manganese concentrations at some locations in groundwater were observed to be more than permissible limit of the BIS which may be attributed to the dominant Rocks
- ✓ The river water quality showed values within the range. Phytoplankton and zooplankton showed significant diversity in the study area.
- ✓ Soil texture in the study area varies from loamy sand, sandy clay loam, clay and sand, whereas, loamy sand and sandy clay loam are the prominent textural class

4.2 FUTURE WORK

- The sampling work for all the components are per the schedule will be carried out
- Analysis of the samples for various environmental components will be continued.

References

APHA (2012). Standard methods for analysis of the water and waste water analysis, 22nd editions.

BIS (2012). Indian standard specification for drinking water. IS: 10500.

Annexure - I

Annexures

National Ambient Air Quality Standards – 2009

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1.	Sulphur Dioxide (SO_2), $\mu g/m^3$	Annual * 24 Hours **	50 80	20 80	-Improved west and Gaeke -Ultraviolet fluorescence
2.	Nitrogen Dioxide (NO_x), $\mu g/m^3$	Annual * 24 Hours **	40 80	30 80	-Modified Jacob & Hochheiser (Na-Arsenite) -Chemiluminescence
3.	Particulate Matter (Size less than 10 µm) or PM_{10} $\mu g/m^3$	Annual * 24 Hours **	60 100	60 100	-Gravimetric -TOEM -Beta attenuation
4.	Particulate Matter (Size less than 2.5 µm) or $PM_{2.5}$ $\mu g/m^3$	Annual * 24 Hours **	40 60	40 60	-Gravimetric -TOEM -Beta attenuation
5.	Ozone (O_3) $\mu g/m^3$	8 hours ** 1 hour**	100 180	100 180	-UV photometric -Chemiluminescence - Chemical method
6.	Lead (Pb) $\mu g/m^3$	Annual * 24 Hours **	0.50 1.00	0.50 1.00	-AAS/ICP method after sampling on EPM 2000 or equivalent filter paper -ED-XRF using Teflon filter
7.	Carbon Monoxide (CO) mg/m^3	8 hours ** 1 hour *	02 04	02 04	-Non Dispersive Infrared Spectroscopy
8.	Ammonia (NH_3) $\mu g/m^3$	Annual * 24 Hours **	100 400	100 400	-Chemiluminescence -Indophenol blue method
9.	Benzene (C_4H_4) $\mu g/m^3$	Annual *	05	05	-Gas chromatography based continuous analyzer - Adsorption and Desorption followed by GC analysis
10.	Benzo Pyrene (BaP) - particulate phase only ng/m^3	Annual *	01	01	-Solvent extraction followed by HPLC/GC analysis
11.	Arsenic(As) ng/m^3	Annual *	06	06	-AAS/ICP method after sampling on EPM 2000 or equivalent filter paper
12.	Nickel(Ni) ng/m^3	Annual *	20	20	-AAS/ICP method after sampling on EPM 2000 or equivalent filter paper

* Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform intervals

** 24 hourly or 8 hourly or 01 hourly monitored values as applicable shall be compiled with 98% of the time in a year. 2% of the time they may exceed the limits but not on two consecutive days of monitoring

Annexure-II

Ambient Air Quality Standards in Respect of Noise

(as recommended by CPCB)

Area Code	Category of Area/Zone	Limits in dB(A) Leq*	
		Day Time	Night Time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

Notes:

1. Day time shall mean from 6.00 a.m. to 10.00 p.m.
2. Night time shall mean from 10.00 p.m. to 6.00 a.m.
3. Silence zone is defined as an area comprising not less than 100 meters around hospitals, Educational Institutions and courts. The silence zones are zones which are declared as such by the competent authority.
4. Mixed categories of areas may be declared as one of the four abovementioned categories by the competent authority.

* dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is related to human hearing

"A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of human ear

Leq : It is an energy mean of the noise level over a specified period

[The Gazette of India Extraordinary
MoEF Notification, 14 February, 2000]

Annexure-III

Specifications for Drinking Water - (IS 10500: 2012)

S. No.	Substance or characteristic	Requirement (Acceptable limit)	Permissible limit in the absence of alternate source	Remarks
Essential Characteristics				
1.	Colour Hazen Units, max	5	15	Extended to 15 only if toxic substances are not suspected in absence of alternate sources
2.	Odour	Agreeable	Agreeable	a. test cold and when heated b. test after several dilutions
3.	Taste	Agreeable	Agreeable	Test to be conducted only after safety has been established
4.	Turbidity (NTU) Max	1	5	-
5.	pH value	6.5 to 8.5	No relaxation	-
6.	Total hardness (mg/l, $CaCO_3$) Max.	200	600	-
7.	Iron (mg/l, Fe) Max	0.3	No relaxation	Total concentration of manganese (as Mn) and iron (as Fe) shall not exceed 0.3 mg/l
8.	Chlorides (as Cl) mg/l Max	250	1000	-
9.	Free residual chlorine (mg/l), Min	0.2	1	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be minimum 0.5 mg/L
Desirable Characteristics				
10.	Total dissolved solids, mg/l, max	500	2000	-
11.	Calcium (mg/l, Ca) Max.	75	200	-
12.	Magnesium (mg/l, Mg) Max.	30	100	-
13.	Copper (mg/l, Cu) Max.	0.05	1.5	-
14.	Manganese (mg/l, Mn) Max.	0.1	0.3	Total concentration of manganese (as Mn) and iron(as Fe) shall not exceed 0.3 mg/l
15.	Sulphate (mg/l, SO_4) Max.	200	400	May be extended upto 400 provided Magnesium (as Mg) does not exceed 30
16.	Nitrate(mg/l, NO_3) Max.	45	No relaxation	-
17.	Fluoride(mg/l, F) Max.	1.0	1.5	-
18.	Phenolic compounds (mg/l C_6H_5OH) Max.	0.001	0.002	-
19.	Mercury (mg/l, Hg) Max	0.001	No Relaxation	-
20.	Cadium (mg/l, Cd) Max.	0.003	No Relaxation	-

S. No.	Substance or characteristic	Requirement (Acceptable limit)	Permissible limit in the absence of alternate source	Remarks
21.	Selenium (mg/l, Se) Max.	0.01	No Relaxation	-
22.	Total Arsenic (mg/l, As) Max.	0.01	0.05	-
23.	Cyanide(mg/l, CN) Max.	0.05	No Relaxation	-
24.	Lead (mg/l, Pb) Max.	0.01	No Relaxation	-
25.	Zinc(mg/l, Zn) Max.	5	15	-
26.	Anionic detergents (mg/l, MBAS) Max	0.2	1.0	-
27.	Total Chromium(mg/l),Max.	0.05	No relaxation	-
28.	Polynuclear aromatic hydrocarbons (mg/l, PAH) Max.	0.0001	No relaxation	-
29.	Mineral oil (mg/l) Max.	0.05	No relaxation	-
30.	Pesticides (mg/l) Max.	-	No relaxation	-
	Radioactive materials			
31.	Alpha emitters (Bq/l) Max.	0.1	No relaxation	-
32.	Beta emitters (pci/l) Max.	1.0	No relaxation	-
33.	Alkalinity (mg/l) Max.	200	600	-
34.	Aluminium (mg/l, Al) Max.	0.03	0.2	-
35.	Boron(mg/l) Max.	0.5	1.0	-

Annexure-IV

Methods for Preservation and Analysis of Water Samples

S. No.	Parameter	Units of Expression	Preservative and Storage Condition	Reference: APHA 21st Edition Methods
			Physical Parameters	
1.	Temperature	^0C	Analyze immediately	2550 – B: (Thermometer)
2.	pH	--	Analyze immediately	4500-H^+ - B: (Electrode)
3.	Conductivity	µs/ms	Refrigeration at 4^oC	2510 – B: (Conductivity meter)
4.	Total dissolved solids	mg/l	Refrigeration at 4^oC	2540 – C: (dried at 180^oC & gravimetric)
5.	Total suspended solids	mg/l	Refrigeration at 4^oC	2540 – D: (dried at 103^oC-105^oC & gravimetric)
6.	Turbidity	NTU	Refrigerate and Analyze immediately	2130 – B: (Nephelometric)
			Inorganic Parameters	
7.	Total alkalinity	as $CaCO_3$ mg/l	Refrigerate and Analyze immediately	2320 – B: (Titration)
8.	Hardness	as $CaCO_3$ mg/l	Add HNO_3 to pH < 2 and refrigerate	2340 – C: (EDTA Titrimetric)
9.	Chloride	mg/l	Not Required	4500-Cl^- - B: (Argentometric)
10.	Sulphate	mg/l	Refrigeration at 4^oC	4500-SO_4^{--} - E: (Turbidimetric)
11.	Fluoride	mg/l	Not Required	4500-F^- - D: (SPADNS)
12.	Sodium and potassium	mg/l	Not Required	3500- K, Na-B: (Flame Photometric)
			Nutrient and Demand Parameter	
13.	Nitrate	as NO_3^- - N mg/l	Refrigerate and analyze immediately	4500-NO_3^- B: (UV spectrophotometric)
14.	Total Phosphate	mg/l	Refrigeration at 4^oC	4500-P-D: (Stannous Chloride)
15.	Dissolved Oxygen [DO]	mg/l	Analyze immediately	4500-O-C: (Azide modification)
16.	COD	mg/l	Add H_2SO_4 at pH <2 refrigerate & analyze immediately	5220-B: (Open Reflux)
17.	BOD	mg/l	Refrigeration at 4^oC & analyze immediately	5210-B: (BOD Test at 27 ^oC)
18.	Total Kjeldhal Nitrogen	mg/l	Refrigerate and Add H_2SO_4 to pH<2	4500- N_{ORG}-B: (Macro-kjeldhal)
19.	Oil and grease	mg/l	Add H_2SO_4 at pH <2 refrigerate	5220 –B: (Liquid-Liquid Partition Gravimetric)
			Heavy Metals	
20.	Heavy metals	mg/l	Add HNO_3 to pH <2	3030 –E, 3125 - B: (ICP- MS)

Annexure-V

Soil Fertility Ratings

S.No	Soil Nutrients	Soil Fertility Ratings		
		Low	Medium	High
1	Organic carbon as a measure of available Nitrogen (%)	< 0.5	0.5 - 0.75	> 0.75
2	Available N as per alkaline permanganate method (kg/ha)	< 280	280 - 560	> 560
3	Available P by Olsen's method (kg/ha) in Alkaline soil	< 10	10 - 24.6	> 24.6
4	Available K by Neutral N, ammonia acetate method (kg/ha)	< 108	108 - 280	> 280

pH Range	Soil Reaction Rating
<4.6	Extremely acid
4.6-5.5	Strongly acid
5.6-6.5	Moderately acid
6.6-6.9	Slightly acid
7.0	Neutral
7.1-8.5	Moderately alkaline
>8.5	Strongly alkaline

General interpretation of EC values

S.No.	Soil	EC (mS/cm)	Total salt content (%)	Crop reaction
1.	Salt free	0-2	<0.15	Salinity effect negligible, except for more sensitive crops
2.	Slightly saline	4-8	0.15-0.35	Yield of many crops restricted
3.	Moderately saline	8-15	0.35-0.65	Only tolerant crops yield satisfactorily
4.	Highly saline	>15	>0.65	Only very tolerant crops yield satisfactorily

(Source: Methods Manual, Soil Testing in India, Dept. of Agri. And Cooperation, Ministry of Agriculture, Govt. of India, 2011)

Annexure-VI

Metals Concentrations Typically Found in Unpolluted Soil and Soil Clean Up Standards

Metal (Symbol)	Typical Concentrations in Natural Soils (mg/kg)
Aluminium (Al)	10000 - 300000*
Antimony (Sb)	< 1 - 8.8
Arsenic (As)	< 0.1 - 73
Barium (Ba)	10-1500
Beryllium (Be)	<1 - 7
Cadmium (Cd)	<0.010 - 2
Chromium (Cr)	1-1000
Cobalt (Co)	< 0.3 - 70
Copper (Cu)	< 0.6-495
Iron (Fe)	7000 - >550000*
Lead (Pb)	2 - 200*
Magnesium (Mg)	50 - 50000
Manganese (Mn)	< 2 -7000
Mercury (Hg)	3.40
Molybdenum (Mo)	0.2 - 5*
Nickel (Ni)	5 - 500*
Potassium (K)	50 - 37000
Selenium (Se)	< 0.1 - 3.9
Silver (Ag)	0.01 - 8
Strontium (Sr)	50 - 1000*
Thallium (Tl)	0.1 - 0.8
Tin (Sn)	2 - 200*
Titanium (Ti)	1000 - 10000
Zinc (Zn)	< 3.0 - 264
Zirconium (Zr)	60 - 2000 *

(Source: Frink, Charles R., 1996. "A Perspective of Metals in Soils", Journal of Soil Contamination, 5(4):329- 359. Table A8: Most Likely Concentrations of EPA Target Analytes in Uncontaminated Soils of the Northeast (mg/kg [ppm] dry weight. www.newhallinfo.org)* Lindsay, W. 1979. Chemical Equilibrium in Soils. New York: John Wiley and Sons. (in: US EPA, 1987. A Compendium of Superfund Field Operations Methods. Exhibit 16-2. "The Content of Various Elements in Soils." www.epa.gov,

 # Criteria are 100 mg/kg for hexavalent chromium and 3900 mg/kg for trivalent chromium

Annexure-VII

Soil (Screening and Response levels)							
S.No	Chemical Name	Chemical Group	Response levels	Screening Levels			
				Agricultural	Residential/ parkland	Commercial	Industrial
			mg/kg				
1.	Arsenic	Metal	50	12	12	12	12
2.	Boron	Inorganic	-	2	-	-	-
3.	Cadmium	Metal	13	1.4	10	22	22
4.	Chromium	Metal	-	64	64	87	87
5.	Cobalt	Inorganic	190	40	50	300	300
6.	Copper	Metal	190	63	63	91	91
7.	Iron	Inorganic	-	-	-	-	-
8.	Mercury	Metal	36	6.6	6.6	24	50
9.	Manganese	Inorganic	-	-	-	-	-
10.	Nickel	Metal	-	-	-	-	-
11.	Lead	Metal	530	70	140	260	600
12.	Zinc	Metal	720	200	200	360	360

Guidance document for assessment and remediation of contaminated sites in India: volume II-2.1-b Screening and Response levels, 1st Edition, December 2015, by MoEF&CC, GoI https://cpcb.nic.in/uploads/hwmd/MoEFCC_guidelines_contaminatedsites.pdf

Annexure VIII

Heavy metals	USEPA Sediment Standards [a]	Average Shale Values [b]	Toxicity Reference Values [c]	Indian River System [d]	World River System [e]
Co	50	19	-	-	20
Cu	31.6	45	16	28	100
Cr	43.4	90	26	87	100
Ni	22.7	68	16	27	90
Cd	0.99	0.30	0.60	-	-
Zn	121	95	110	16	350
Pb	35.8	20	31	-	-

Heavy metal ion concentration in Sediment

References

[a,c] USEPA (1999) National recommended water quality criteria-correction-United State Environmental Protection Agency EPA 822-Z-99-001, http://www.epa.gov./ostwater/pci/revcom), pp 25

[b] Turekian KK, Wedepohl DH (1961) Distribution of the element in some major units of the earth's crust. Bull Geol Soc Am 72:175–192

[d] Subramanian V, Sitaswad R, Abbas N, Jha PK (1987) Environmental geology of the Ganga River basin. J Geol Soc India 30:335–355

[e] Martin J, Meybeck M (1979) Elemental mass-balance of material carried by major world rivers. Mar Chem 7(3):178–206. doi: 10.1016/0304-4203(79)90039-2

Harendra Singh et.al (2017),Assessment of heavy metal contamination in the sediment of the River Ghaghara, a major tributary of the River Ganga in Northern India Applied Water Science, Volume 7, Issue 7, pp 4133–4149