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Water Quality Index as a Tool in Assessing Ground Water Pollution due to Sewage Disposal – A Study in Vallakkadavu-Beemappally Stretch of Thiruvananthapuram District, Kerala

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Abstract: ***Groundwater is considered as the most important natural resources in our earth. It is one of the major sources of fresh water in both the rural and urban areas. Groundwater quality in the two administrative wards of Thiruvananthapuram Corporation has special significance and needs great attention because the groundwater in this area facing threats due to sewage disposal. The present work aimed to assess the groundwater quality of study area for knowing the suitability of drinking purpose by calculating the WQI .This was carried out by subjecting ten groundwater samples, collected from selected site in two different season pre monsoon and post monsoon to comprehensive physico-chemical and biological analysis. Ten parameters have been considered for calculating the WQI such as: pH, total hardness, calcium, magnesium, chloride, nitrate, sulphate, phosphate, EC and total dissolved solids. Computed water quality index shows that 80% and 60% of water sample fall under poor category during pre monsoon and monsoon respectively. The high value of WQI at this site has been found to be mainly due to the higher values of nitrate, chloride, phosphate, sulphate, total hardness due to the mixing of sewage with the ground water. WQI is a very useful and an efficient tool to analyse and understand the ground water quality status of a region to the decision makers. Finally the study concludes that the groundwater resource in this area not suitable for drinking purposes under normal condition and further action for control of sewage pollution is solicited.***
Keywords: WQI, Ground water pollution, Sewage contamination

I.INTRODUCTION

For the past few decades there has been a serious demand for water resources. Industrialisation, Urbanisation, various developmental activities have resulted not only in a high demand for water, but also in the degradation of water quality which leads the water crisis. In today's world sewage groundwater pollution is one of the major problems faced by most cities, this kind of pollution leads to health related and environmental issues. Due to this fact, it becomes essential for periodic monitoring of quality of groundwater. With proper treatment of water it is possible to reduce the groundwater pollution. There are different ways for assessing water quality, one of which is the water quality index (WQI). WQI provides a single number that expresses the overall water quality at certain location, based on several water quality parameters is one of the most effective tools to communicate information on overall quality status of water, to concerned user community and policy makers. The purpose of the present study is to assess the utility of Water Quality Index as a tool to estimate the impact of sewage disposal on groundwater in two wards of Thiruvananthapuram Corporation, Vallakadavu and Beemappally.

II. STUDY AREA

The two adjacent administrative wards, Beemappally and Vallakkadavu, Thiruvananthapuram district, Kerala state, India has been chosen for conducting the study (Figure2.1). It is belongs to South Kerala Division, near to Arabian Sea. The study area covers the 1.19km2 of Thiruvananthapuram Corporation located between the latitude 8.495945°N and longitude 76.954381°E.The study area is near to the sewage treatment plant, Muttathara. Climatically the area belongs to tropical savanna and tropical The annual variation of mean air temperature at this area is from 21º C to 34º C. The humidity is high and rises about 90% during the monsoon season. The average annual rainfall of the study area is 2035mm. It is significant that the district gets be ne fits of both monsoon - southwest monsoon and northeast monsoon . The landforms can be categorised into three units viz lowlands, midlands

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and highlands. Red loams, coastal alluvium, riverine alluvium are the major types of soil found in Thiruvananthapuram district mainly in the midland (CGWB, 2013)

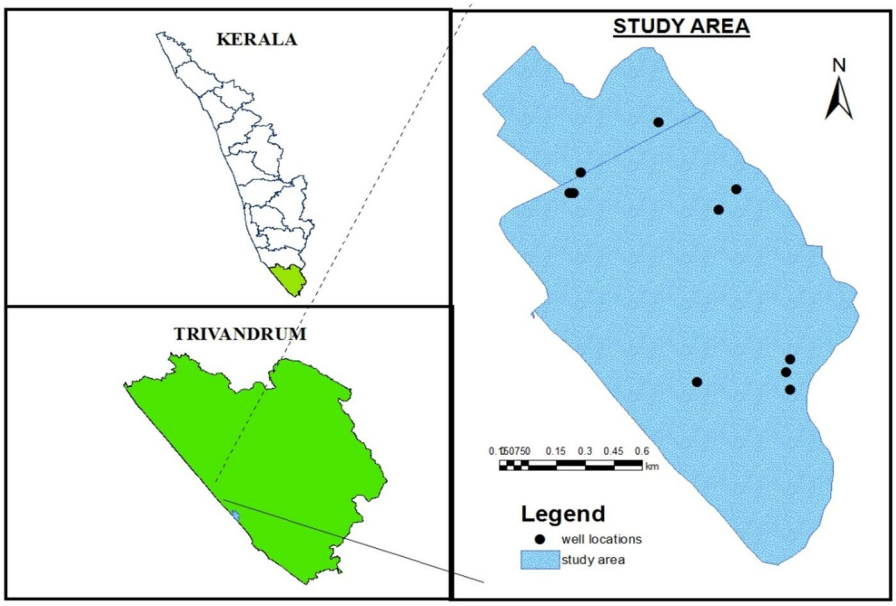


Fig.1: Location map of study area

III. METHODOLOGY

A. Data Used

Hydrochemical and geospatial data were used for this present investigation. The water sample were collected by using the field kit and the water quality parameters such as pH ,electrical conductivity, total hardness ,TDS, calcium, magnesium, chloride, sulphate, nitrate, and phosphate are used for the WQI calculation. The study area delineation has been done using the administrative division map, then the dug wells in the study area were selected and GPS is used to locate all sampling points.

B. Collection And Analysis Of Sample

In order to assess the quality of groundwater sources a total 10 representative dug well samples were collected from two wards of Thiruvananthapuram Corporation during pre monsoon and monsoon period 2018. General procedures for groundwater sampling and chemical analysis were carried out according to standard procedure .pH, electrical conductivity, and total dissolved solids were determined in the field. Other chemical constituent were done in the laboratory as per the standard methods for the Examination of Water and Wastewater (APHA 2012).

C. Water Quality Index (Wqi) Calculation

Water quality index is the ranking method that provides the composite power of individual Water quality parameter on the overall quality of water. It is predetermined from the point of view of human utilisation. Potability of groundwater and its quality status can be examined by using WQI. It used as a tool to get a comprehensive picture of overall quality of groundwater. The Indian standard specified for drinking Water (BIS, 2003) was used for the calculation of WQI. The WQI was computed through three steps.

In the first step each of 9 parameters (EC, pH, TDS, Nitrate TH, Calcium, magnesium, chloride, sulphate) was assigned a weight (wi) according to its relative importance in the overall quality of water for drinking purpose the maximum weight 5 was assigned to nitrate because of its major importance in water quality assessment; the minimum weight 2 was assigned to calcium and magnesium because of less significance. Other parameters such as pH, TDS, EC, TH, Chloride, Sulphate were assigned weights between 1 and 5 based on their relative significance in water quality evaluation.

In the second step the relative weight (Wi) of chemical parameter was computed using Eq.1 (Table.1)

$$Wi = wi/\sum^{n} wi \qquad \rightarrow (1)$$

Table .1 groundwater quality parameter with their Relative weight

Chemical Parameter	Indian Standard	Weight(wi)	Relative weight
pH	6.5-8.5	4	0.0114
Total Hardness	300-600	3	0.7142
Calcium	75-200	2	0.047
Magnesium	30-100	2	0.047
Chloride	250-1000	4	0.0952
TDS	500-2000	4	0.095
Nitrate	45-100	5	0.1109
Sulphate	200-400	4	0.952
EC	500	3	0.7142
Total	52	34	1

Wi denotes the relative weight, wi denotes the weight of each parameter and n is the number of parameter chosen. The Tabe.2 shows the relative weight of chemical parameters which are used to assess water quality index.

In the third step, a quality rating scale (qi) for each parameter is assigned by dividing concentration in each water sample by its respective standard according to the guidelines laid down in the BIS and the result multiplied by 100 using Eq.2

$$qi= (Ci/Si)*100 \quad \rightarrow (2)$$

Where, qi is the quality rating, Ci is the Concentration of each chemical parameter in the each water sample in mg/L.

In the fourth step, the sub index (SI) is first determined for each chemical parameter as given below Eq.3

$$SI=WI*qi \quad \rightarrow (3)$$

Where, SI is the sub index, Wi is the relative weight of each chemical parameter, and qi is quality rating. For computing water quality index of each sample calculate the sum of sub index value of each parameter using Eq.4

$$SI=\sum SIi. \quad \rightarrow (4)$$

IV. RESULTS AND DISCUSSION

A. Water Quality Index Analysis (Wqi) Analysis

The computed WQI value for well samples around the sewage treatment plant ranges from 97.36-251.37 for pre monsoon and 65.-174.216 for monsoon as shown in Table.2, also the graphical representation of seasonal variation of WQI shown in the Fig.2. Therefore, the water quality can be categorize into five types ‘excellent water’ to ‘water unfit for use’.Table.3 shows the percentage of groundwater sample that falls under different catogory. It was observed from the results that the minimum and maximum values of WQI has been found to be 65.35 during monsoon and 251.37 during pre monsoon depicted as per the Table.2. Accordingly, in pre monsoon and monsoon 80% and 60% of water samples fall under the poor category respectively, indicating groundwater not fit for drinking purpose. In pre monsoon and monsoon seasons only about 10%, 40% groundwater samples are in good quality respectively. In the current study, it was observed that most of the water quality parameters are crossing their permissible limit as per BIS and WHO standard. The analysis report gives the changes between the water quality parameter values with respect to their well location in different seasons. According to the result of this study it was clear that most of the well water samples are subjected to sewage contamination, mainly in the case of well water samples which are nearer to the sewage treatment plant (S6) and also with the seasonal variation in the groundwater quality parameters. It was observed that nutrients like nitrate, phosphate and sulphates which are specifically pointing to sewage contamination, are exhibiting seasonal fluctuation which may affect the groundwater quality of the entire region. In normal groundwater bodies, the nitrate concentration is typically below 2mg/L. In this study, the highest concentration of nitrate content (13.53mg/L) was reported during monsoon at S5 which is adjacent to the sewage treatment plant, Muttathara. But in pre monsoon, the nitrate level in this site gets decreased when compared to monsoon. From this observation it is clear that the seepage rate is undoubtedly influencing the nitrate content in groundwater during monsoon. It was also revealed that sewage content from sewage treatment plant and septic tank contain large amount of decaying organic matter.

Phosphate content in the groundwater bodies of study area varied in both seasons. The permissible limits of phosphate in drinking water are 0.3mg/L as per BIS standard. In the present study, 60% of water samples showed high phosphate content above the permissible limit, during pre monsoon season. Highest value of phosphate concentration was reported at S6 during pre monsoon it

may be due to the biotic sources like human waste, laundry detergents from houses etc.The sulphate content varied between the sampling locations during monsoon and pre monsoon. The highest value was noticed at sample location, S5 during pre monsoon which is very near to the sewage treatment plant. This may be due to the contamination of domestic effluent and mixing of untreated wastes from the sewage treatment plant to groundwater bodies.

The similar study was conducted in the groundwater bodies near Valiyathura sewage farm in Thiruvananthapuram by Jainy and Jaya in the year 2010. It was observed that majority of groundwater sample showed high concentration of nutrient mineral such as phosphate, calcium, magnesium and potassium. From Their study it revealed that higher concentration of mineral content was due to the leaching of waste water from sewage farm, septic tanks and polluted parvathy puthanar canal.

In the year 2011 a study was conducted by Sridhar in Sangli city on the impact of sewage disposal in groundwater, the result of the study revealed that groundwater bodies around the city was contaminated mainly by the untreated sewage disposal into the groundwater bodies that affect the quality of groundwater.

Table. 2 Water quality index values for selected sample location

Sample	Water quality index(WQ I)	
	Pre monsoon	Monsoon
S1	97.36	65.535
S2	173	108.14
S3	145.18	107
S4	155.4	174.216
S5	251.37	167
S6	107	81.13
S7	125.98	86.99
S8	114	93.67
S9	152	127.4
S10	135	105.42

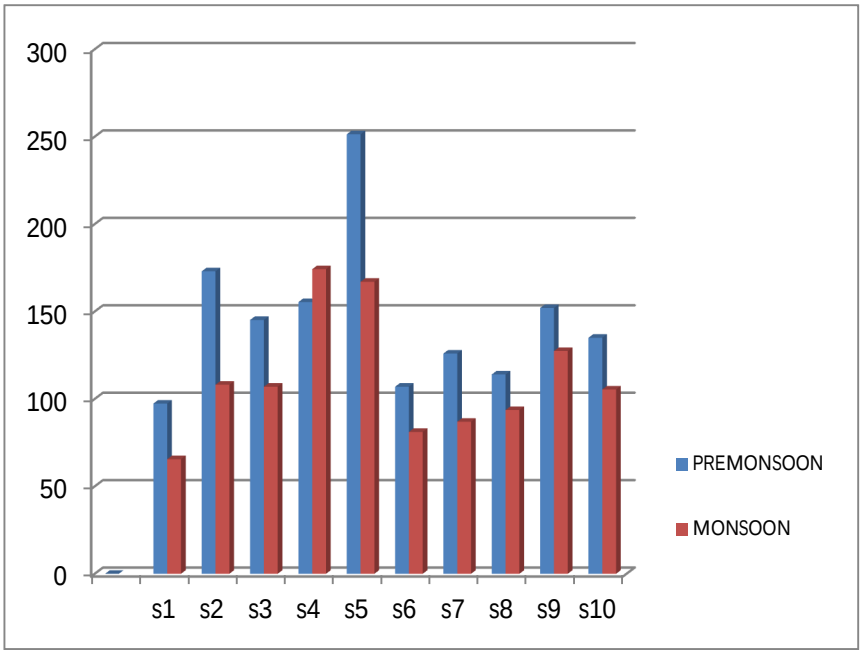


Fig.3 seasonal variation of WQI with respect to sample locations

Table.3 water quality classification based on WQI values of the study area

Water quality	WQI values	% of water sample (pre monsoon)	% of water sample (monsoon)
Excellent	< 50	0	0
Good	50-100	10%	40%
Poor	100-200	80%	60%
Very poor	200-300	10%	-
Unfit for use	>300	-	-

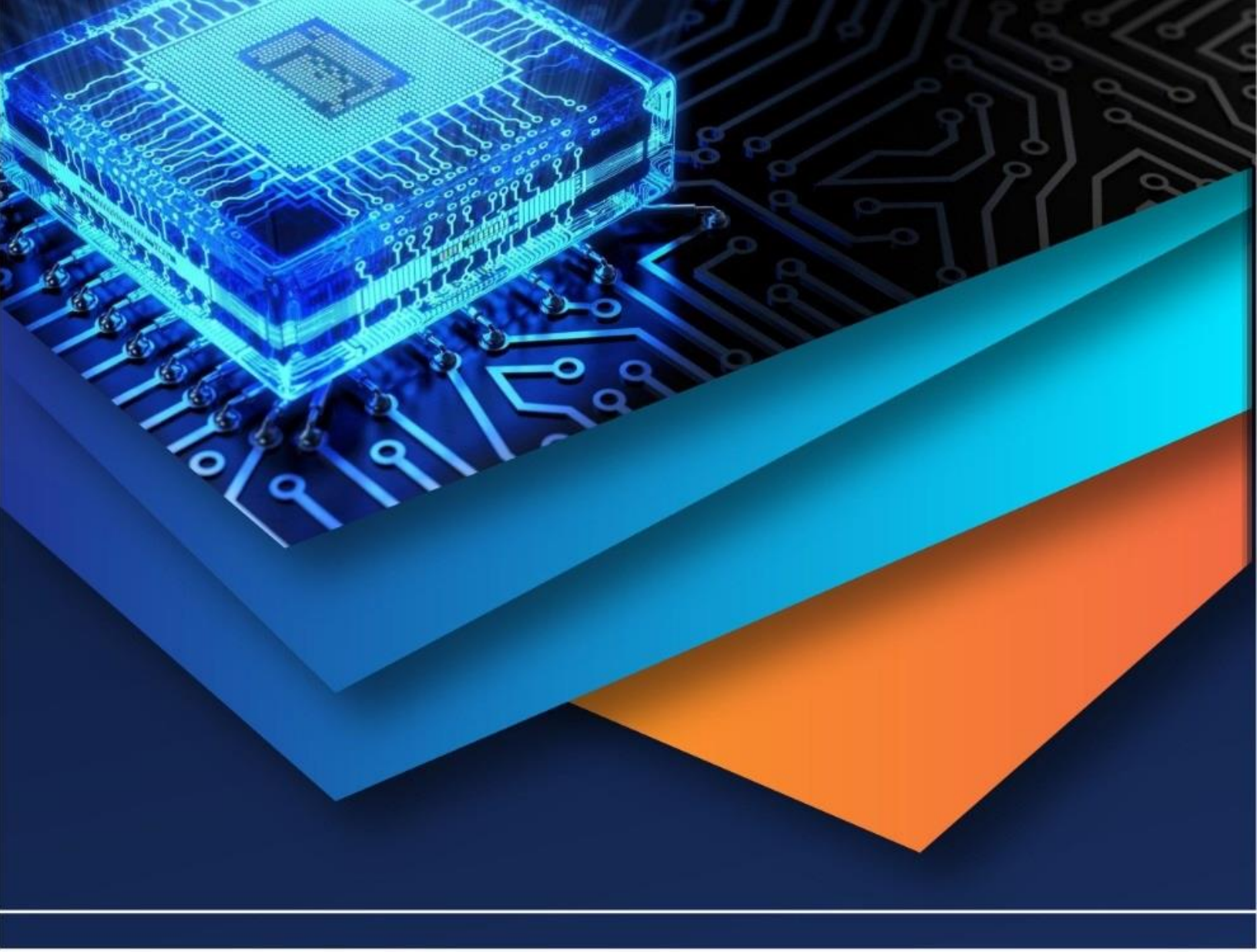
V. CONCLUSION

In the present investigation an attempt was made to study the quality of groundwater in two seasons in the sampling locations of Vallakkadavu and Beemappally in Thiruvananthapuram Corporation which are adjacent to the sewage treatment plant, Muttathara. The main goal of this study was to evaluate the groundwater quality of this area by using WQI as a tool. A total of 10 groundwater samples were collected and analysed for various physicochemical parameter in both monsoon and pre monsoon. According to the analysis report it was revealed that most of the groundwater resources in the study area are subjected to sewage contamination with respect well location and the seasonal variation of water quality parameters. During the study most of the water samples showed higher level of phosphate, sulphate, and nitrate. This is may be due to the seepage of waste water from sewage treatment plant, septic tank and also from the biotic sources to the groundwater bodies. The estimated water quality index demonstrate that groundwater quality in most of samples from the study area are not very satisfactory for drinking purposes without some level of treatment.

The estimated water quality index (WQI) provides an easy way of understanding the overall potability of water quality. From the result of WQI calculation wide variation were reported among the samples Accordingly in pre monsoon and monsoon 80% and 60% of water samples fall under the poor' category respectively , indicating groundwater not fit for drinking purpose. The result indicates that study area is currently suffering from groundwater pollution .the higher values of water quality index are mainly due to the higher values of Calcium, nitrate, phosphate, sulphate, chloride, and total hardness in groundwater which may be due to the mixing of sewage with groundwater bodies. There is a need of urgent attention on the requirement of various treatments in the groundwater bodies of the study area before usage of human consumption.

REFERENCES

[1] APHA, Standard methods for the examination of water and wastewater, American Public Health Association, Washington D.C., 2005
[2] Asadi, S.S., Padmaja Vuppala and Anji Reddy. M, 'Remote Sensing and GIS Techniques for Evaluation of Groundwater Quality in Municipal Corporation of Hyderabad (Zone-V), India', Int. J. Environ. Res. Public Health, vol 4(1), pp 45-52, 2007.
[3] BIS-Indian standard for drinking water specification – 10500. Bureau of Indian Standards, New Delhi, 2003.
[4] Dhanaji Kanase, G., 'Physico-Chemical Analysis of Drinking Water Samples of Different Places in Malegaon Tahsil, Maharashtra, India', Pelgia Research Library, Advances in Applied Science Research, vol 7(6), pp 41-44, 2016.
[5] Horton, R. K., 'An index number system for rating water quality' J–Water Pollution Control Federation, pp 300–305, 1965.
[6] Jainy Varghese, and Jaya, D.S., 'Assessment of Nutrient Minerals Status in the Ground Water Sources around the Valiyathura Sewage Farm in Tiruvananthapuram, Kerala', International Quarterly Journal of Environmental Sciences, vol.1, pp.394-376, 2011.
[7] Jena, V., 'Physico Chemical Analysis of Groundwater of Selected Areas of Raipur City', Indian Journal Science Research, vol.13 (1), pp.61-65, 2017.
[8] Kolekar, S.S., 'Physico-Chemical Analysis of Ground Water Quality Parameters- A Review', Journal of Chemical and Pharmaceutical Sciences (JCPS), vol. (10), 2017.
[9] Mazhar Nazeeb Khan, S.M., and Ravi Kumar, 'Geogenic assessment of water quality Index for the groundwater in Tiruchengode taluk, Namkkal district, Tamil Nadu, India', Chemical Science Transactions, vol.2 (3), pp 1021-1027, 2013.
[10] Nagmani, C., 'Physico Chemical Analysis of Water Samples', International Journal of Scientific & Engineering Research, Vol. 6, 2015.
[11] Palanisamy, P. N., Geetha, A., Sujatha. M., Sivakumar, P. and Karunakaran.K. 'Assessment of Ground Water Quality in and around Gobichettipalayam Town Erode District, Tamil Nadu', E-Journal of Chemistry, vol. 4(3), pp. 434-439, 2007.
[12] Suresh Konkey, Chitranshi, U.B., Rahul Dev Garg., 'Ground water quality analysis and mapping using GIS Techniques', International Journal of Engineering Science and Technology,vol.6,2014



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