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AN IN-DEPTH INVESTIGATION INTO WATER QUALITY ISSUES OF THE MULA RIVER IN PUNE DISTRICT

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Abstract:

The mismanagement of urban water resources presents a serious challenge, particularly in densely populated cities with high individual water consumption and substantial waste production. Urban water sources—such as rivers, lakes, tanks, and groundwater—are frequently depleted, polluted, or damaged. Rapid urbanisation and industrial development have intensified this problem, resulting in a significant decline in the water resources of Pune city. The growing urban population, along with increased demand for domestic and industrial water use, has led to reduced water availability and deteriorating water quality. One of the key water bodies, the Mula River, which flows through Pune, is severely polluted with untreated sewage and industrial waste. This study aims to evaluate the level of organic pollution in the Mula River. Over a six-month period, water samples were collected and analysed for various parameters, including dissolved oxygen, total hardness, biochemical oxygen demand (BOD), and chemical oxygen demand (COD). Additional factors such as pH, temperature, and electrical conductivity (EC) were also examined.

The results reveal high concentrations of organic pollutants in the river, with notably elevated BOD and COD levels at four of the five sampling locations. Moreover, increased values of dissolved oxygen, total hardness, and EC were also recorded at these sites.

Keywords: *Water pollution, BOD, COD, Mula River, Pune.*

Introduction:

A river undergoes significant transformations along its course—from its rocky, fast-flowing mountain source to a slow-moving, deep stream in the lowlands—shaped largely by the surrounding terrain and geological features (Bellos & Sawidis). As it flows, it transports both natural substances and human-made pollutants, undergoing various chemical and microbiological changes along the way (Goltermann, 1985; Admiraal & van Zanten, 1988). The chemical composition of river water at any given point is influenced by factors such as local geology, climate, and human activities (Bricker & Jones, 1995). Understanding these influences is vital for the sustainable management of land and water resources (Petts et al., 1996).

Throughout history, human civilizations have thrived along rivers, but in modern times, increasing urbanization, industrial development, and agricultural

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practices have led to significant river degradation (UNEP, 2001). Although India is home to many perennial rivers originating in the Himalayas, growing demands for irrigation, domestic use, and industrial processes have placed immense pressure on these water sources. Widespread pollution from untreated sewage, industrial discharge, and agricultural runoff continues to impact both surface and groundwater quality.

In Pune, rapid urban growth and industrial expansion have significantly worsened river pollution, particularly in the Mula River. Originating in the Western Ghats, the Mula River is dammed at Panshet and Temghar to supply water to the city. Evaluating the pollution levels in the Mula River is critical for effectively managing Pune's current and future water demands.

Study Area Overview:

Study Area:

Pune, situated in western Maharashtra on the Deccan Plateau (18º31'22.45'' N, 73º52'32.69'' E), lies at the heart of the Mula and Mutha river basins—both key tributaries of the Bhima River. The metropolitan area covers approximately 7,250 square kilometres and is drained by the Mula, Mutha, and Pavana rivers. Pune experiences a moderate climate with three distinct seasons: summer (March to May, with temperatures ranging from 30°C to 38°C), monsoon (June to September, receiving an average annual rainfall of around 722 mm, peaking in July), and winter (November to February, with daytime temperatures around 28°C and nighttime temperatures often falling below 10°C).

The Mula and Mutha river basins cover areas of 2,703 sq km and 897 sq km, respectively, both originating in the Sahyadri ranges and flowing through the city. With a population exceeding 3 million, Pune's semi-arid climate and rapid urbanisation have a direct impact on local water quality. Understanding the city's geographical and climatic context is crucial for addressing river pollution and implementing sustainable water management strategies.

Pune follows the Asia/Kolkata time zone (UTC+05:30), which is standard across India.

Material and Methods:

To evaluate the water quality of the Mula River, five sampling locations were selected:

1. Downstream of Mulshi Dam,
2. Balewadi,
3. MES,
4. Vishrantwadi, and
5. Sangamwadi Bridge (the confluence point of the Mula and Mutha Rivers).

Monthly water samples were collected from June to November 2023 using clean, clearly labelled plastic bottles.

The collected samples were analysed for seven key physico-chemical parameters in accordance with the standard procedures outlined by Trivedi & Goel (1986) and APHA (1995). These parameters included temperature, pH, electrical conductivity (EC), biochemical oxygen demand (BOD), chemical oxygen demand (COD), dissolved oxygen (DO), and total hardness.

Temperature was measured on-site using a mercury thermometer. Electrical conductivity was tested using a Systronics digital conductometer calibrated with 0.1 N KCl. pH was determined using a digital pH meter and standard buffer solutions. BOD was calculated based on the difference in DO after a 5-day incubation at 20°C. COD was measured through titration using ferrous ammonium sulphate and ferroin as an indicator. DO was determined using Winkler's method, and total hardness was assessed through EDTA titration.

All results were compiled and presented in the form of tables and graphical charts for clear interpretation.

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Results and Discussion:

The study recorded water temperatures ranging from 23.0°C to 26.8°C, with an average of 25°C. The lowest pH value (6.2) was observed at Sangamwadi Bridge in April, while the highest (7.8) was recorded at Vishrantwadi, also in April. Electrical Conductivity (EC) varied significantly across sites and seasons, with the lowest value of 40 µmhos/cm observed at Mulshi Dam downstream in January, and the highest—580 µmhos/cm—recorded at Sangamwadi Bridge in April.

Overall, temperature, pH, and EC values showed increasing trends over time. Mulshi Dam downstream consistently recorded lower EC values (around 61 µmhos/cm) compared to other locations. These findings are consistent with earlier research, such as Sunita Nandes' study of the Godavari River, which reported temperatures between 21–23.6°C, pH between 7.7–8.4, and comparable EC levels. Similar pH ranges were reported for rivers like the Penganga (7.56–8.13), Krishna (7.4–8.1), and Bhima (7.0–7.9) in Maharashtra Pollution Control Board (MPCB) data from 2003. The MPCB had also examined the Mula and Mutha Rivers at similar locations, yielding comparable results.

Water temperature plays a crucial role in influencing other physicochemical parameters. Higher temperatures reduce the solubility of gases—especially dissolved oxygen (DO)—while increasing the solubility of some chemicals. In the summer, elevated temperatures and low river inflow can lead to higher evaporation rates and organic residue buildup, further depleting DO (Justic et al., 1997). Although pH showed seasonal variations, it remained within ranges conducive to sustaining aquatic life.

Biochemical Oxygen Demand (BOD) levels were lowest at Mulshi Dam downstream (21.5 mg/L), while the other four sites exhibited significantly higher BOD values—averaging 122.5, 172.33, 192.17, and 241 mg/L, respectively. In June, the minimum BOD was 18 mg/L at Mulshi, whereas the maximum was 272 mg/L in April at Sangamwadi Bridge. These levels are comparable to findings from the Central Pollution Control Board's (CPCB) 2005 National Water Quality Monitoring Programme, which reported BOD levels of 204 mg/L in the Sabarmati River, 136 mg/L in Kali East, 59 mg/L in the Yamuna, and over 600 mg/L in rivers like Amlakhedi and Ghaggar.

Chemical Oxygen Demand (COD) ranged from 52 to 690 mg/L. The lowest was observed in March at Mulshi Dam downstream, and the highest at Sangamwadi Bridge in the same month. Khadakwasla recorded the lowest average COD (61.5 mg/L), while the other sites had significantly higher values. CPCB's 2005 data on 21 Indian rivers showed similarly wide COD variations—e.g., 1–180 mg/L in Yamuna and 4–803 mg/L in Sabarmati. High COD values are typically linked to industrial and municipal effluent contamination, indicating severe organic pollution. Such pollution often leads to freshwater eutrophication, resulting in oxygen depletion and harm to aquatic life.

Dissolved oxygen levels reflected the extent of pollution. Extremely low DO values—averaging 0.03–0.05 mg/L—were found at several sites, indicating near-anaerobic conditions due to heavy organic load. Mulshi Dam downstream, however, recorded a significantly higher DO level of 6.57 mg/L, pointing to better water quality. According to a 2005 CAPCB report, rivers like the Narmada and Mahanadi maintained DO levels above 4 mg/L, while heavily polluted rivers such as the Sabarmati (0.3 mg/L) and Godavari (0.8 mg/L) reported critically low values.

Total hardness in water samples ranged from 30 mg/L to 180 mg/L, with Mulshi Dam downstream having the lowest values. Hardness, while problematic for domestic and industrial use due to scaling, can have a minor benefit in reducing the mobility of heavy metals by forming protective scales in pipes.

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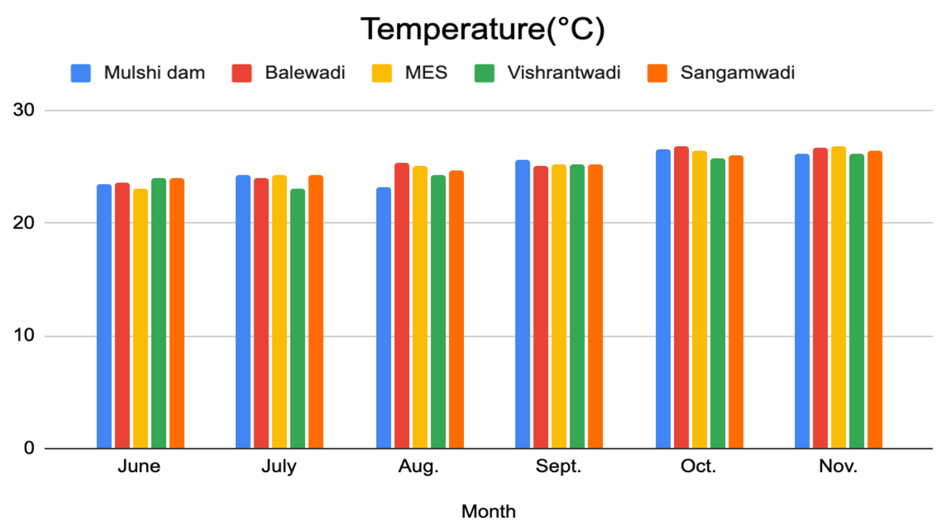
Among all sampling sites, only Mulshi Dam downstream exhibited relatively low levels of BOD, COD, and other pollutants, indicating cleaner water. In contrast, Sangamwadi Bridge emerged as the most polluted location, with extremely high BOD and COD levels, pointing to significant organic contamination and poor water quality.

Table 1 : Parameters studied and methods used with Indian Standards

Sr No	Parameters	Method Applied	Indian Standard
1	pH	Electrometric Method	6.5-8.5
2	DO (mg/L)	Azide modification	7.6-7.0
3	BOD (mg/L)	Azide modification	30
4	COD (mg/L)	Dichromate reflux	250
5	Chlorides (mg/L)	Argentometric Titrimetric method	250
6	Sulphates (mg/L)	Colorimetric Turbidimetric method	200
7	Nitrates (mg/L)	Colorimetric Turbidimetric method	45
8	Calcium (mg/L)	EDTA Titration Method	75
9	Magnesium (mg/L)	EDTA Titration Method	30
10	Hardness (mg/L)	EDTA Titration Method	300

Figure 1: Concentration of physicochemical parameters in the water of the Mula River



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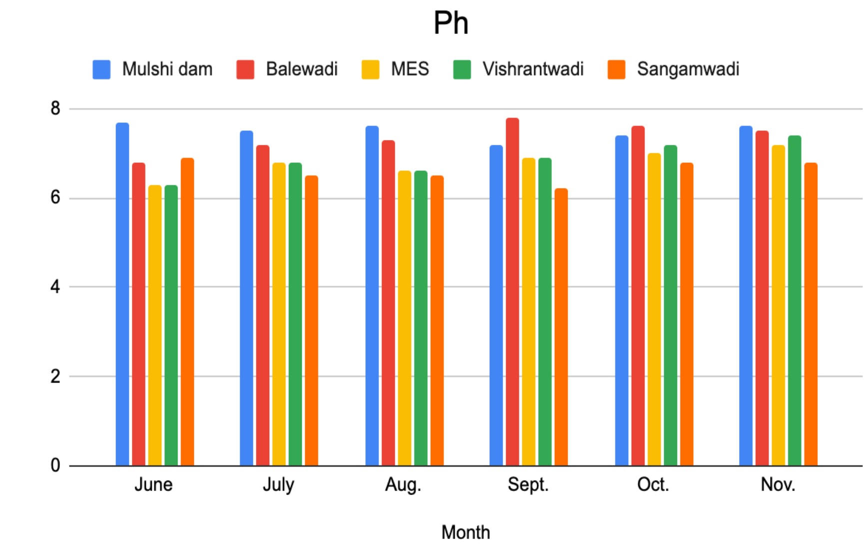
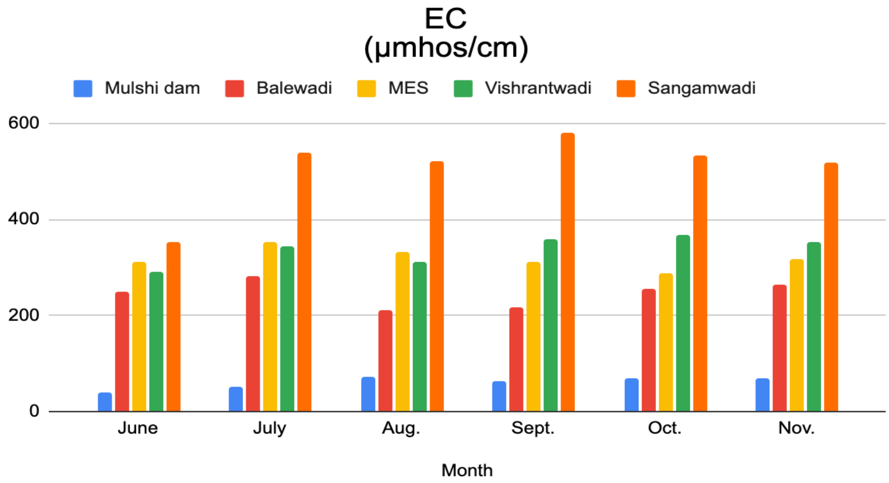
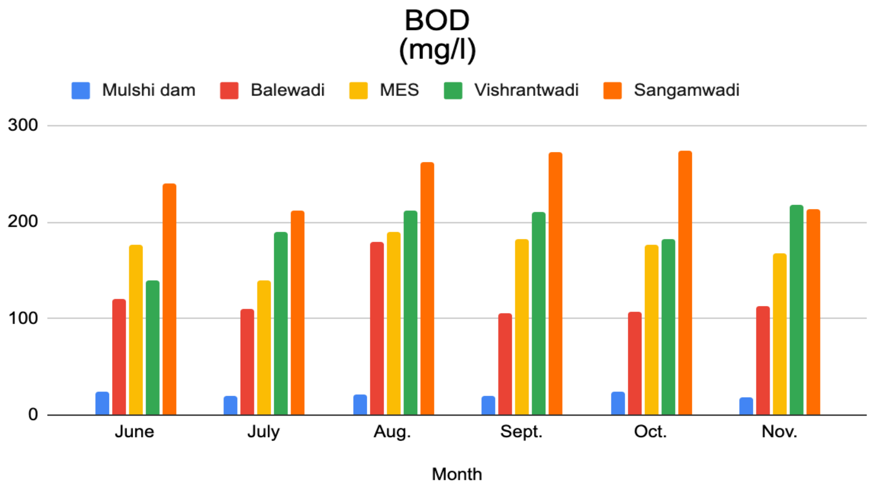
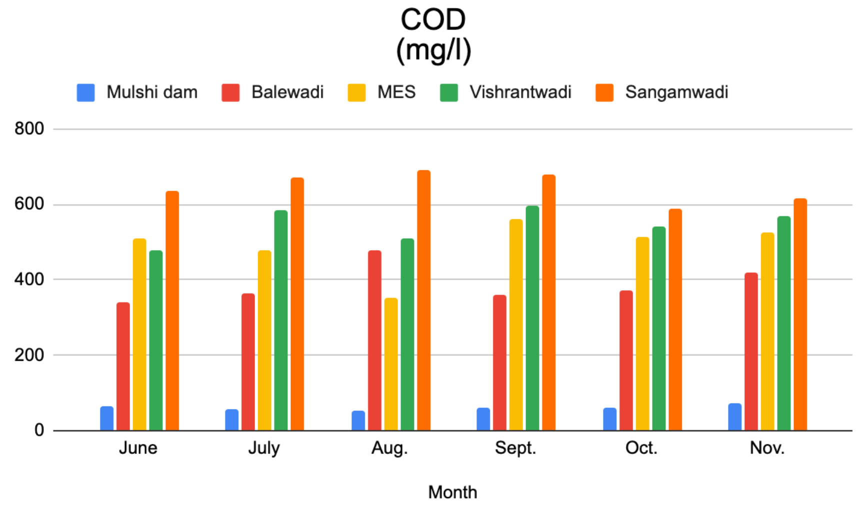
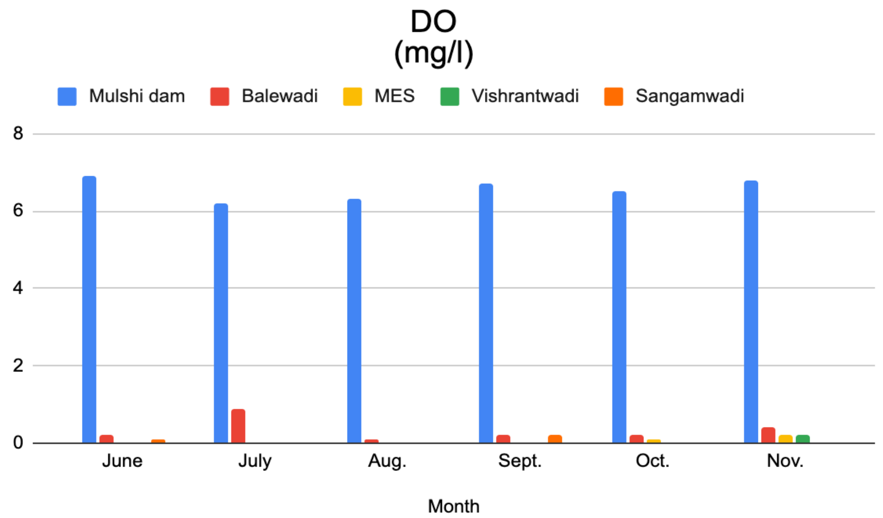
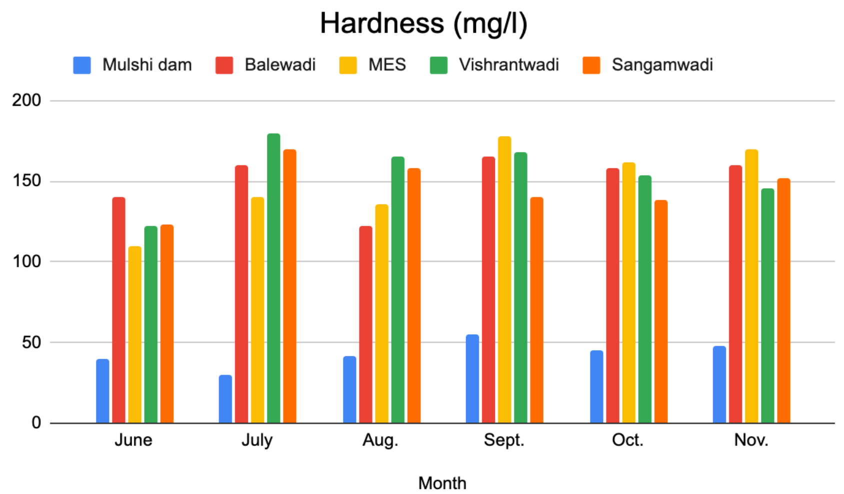







COD
(mg/l)
Mulshi dam
Balewadi
MES
Vishrantwadi
Sangamwadi
800
600
400
200
0
June
July
Aug.
Sept.
Oct.
Nov.
Month


DO
(mg/l)
Mulshi dam
Balewadi
MES
Vishrantwadi
Sangamwadi
8
6
4
2
0
June
July
Aug.
Sept.
Oct.
Nov.
Month


Hardness (mg/l)
Mulshi dam
Balewadi
MES
Vishrantwadi
Sangamwadi
200
150
100
50
0
June
July
Aug.
Sept.
Oct.
Nov.
Month

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Conclusion:

The findings from the study of the Mula River in Pune reveal serious degradation in water quality, primarily due to human activities. Variations in water quality across different sampling sites highlight the need for an integrated and comprehensive approach to water management. Key conclusions include:

1. **Changes in Temperature, pH, and Electrical Conductivity:**
   Rising temperatures, pH levels, and EC values over time suggest both seasonal influences and human impact. Temperature plays a key role by affecting chemical solubility and reducing dissolved oxygen levels.
2. **Elevated BOD and COD Levels:**
   Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were alarmingly high, particularly at Sangamwadi Bridge, indicating significant organic pollution from domestic sewage, industrial effluents, and agricultural runoff.
3. **Dissolved Oxygen Depletion:**
   Low levels of dissolved oxygen, especially in areas with high BOD and COD, threaten aquatic life. The oxygen is consumed during the breakdown of organic pollutants, leading to ecological stress.
4. **Geographical and Climatic Influence:**
   Pune's topography and climate, particularly the monsoon season, intensify water quality problems by increasing runoff and pollutant concentration.
5. **Human-Induced Pollution:**
   Urbanisation, industrialisation, excessive use of fertilisers, and untreated sewage discharge are major contributors to river contamination.
6. **Threats to Groundwater:**
   The deterioration of surface water quality raises concerns about potential groundwater contamination, highlighting the need for preventive action to safeguard all water sources.
7. **Need for Integrated Policies:**
   Sustainable water resource management requires coordinated policies involving multiple stakeholders, including industries, local governments, and communities.
8. **Impact of Dams:**
   Structures like Mulshi and Temghar dams influence river flow and water quality. Understanding their ecological impact is essential for balanced water management.
9. **Sangamwadi Bridge as a Critical Zone:**
   With the highest recorded pollutant levels, Sangamwadi Bridge emerges as a priority location for monitoring and targeted remediation.

References :

1. *American Public Health Association (1995): Standard Methods, 18th edition; for the estimation of water and waste. APHA, Washington D.C., 6-187.*
2. *Trivedi, R. K., & Goel, P. K. (1986): This is an article published in the year 1969 by Rene Dubos. This book mainly focuses on studying water pollution through biological and chemical methods. Environmental Publications, Karad, 8-17, 35-153.*
3. *Goltermann, H. L. (1985): The Rhine and the Rhone: Geochemistry Part 5: Synthesis and Conclusions. Annales de Limnologie, 21, 191-201.*
4. *Maharashtra Pollution Control Board (2003): Water Quality Report, 4-48.*
5. *Bellos, D., & Sawidis, T. (2005): Chemical Pollution from the River Pinios (Thessalia-Greece) Journal of Environmental Management.*
6. *Central Pollution Control Board (2005): I'm sorry, but this topic seems to be irrelevant. Please provide the right question or try to give some other question. This appears to be a journal entry into a national water monitoring program.*
7. *Petts, G., & Calow, P. (Eds.) (1996): River Restoration. Blackwell Science, Oxford.*

8. *Sunita Nande (2000): Both physically and chemically, the waters from Kandwa river and Godavari have been compared.*
9. *Sahasrabuddhe, K., Mahabaleshwarkar, M., Joshi, J., Kanade, R., Goturkar, S., Oswal, P., & Patwardhan, A. (2003): Status altering of urban ponds and issues related to health in Pune, India. The 3rd International Conference on Environment and Health was held at Chennai, India, from 15th December to 17th December 2003. Chennai: The Faculty of Environmental Studies from York University mentioned by the authors is indeed a very famous and highly regarded college.*
10. *UNEP (2001): Environmental situation analysis showcasing a chapter spotlighting India. United Nations Environment Programme Publications.*
11. *Admiraal, W., & Van Zanten, B. (1988): This study shows if biological activities have any effect on how detritus are transported within the Lower River Rhine. It's a way of evaluating how one action can impact the movement of waste products. Freshwater Biology, 20, 215–225.*

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