WATER QUALITY ANALYSIS REPORT

August 2025

Prepared for: District Health Officers and Policymakers

Executive Summary

This report presents a comprehensive analysis of water quality across 222 monitoring stations in 23 districts of Maharashtra, based on data collected in August 2025 by the Maharashtra Pollution Control Board (MPCB) under the National Water Monitoring Programme (NWMP).

The findings reveal a critical gap between water classification labels and actual regulatory compliance. While 63.5% of monitored water bodies carry a Class A designation — implying suitability as a drinking water source — the data shows that the vast majority of these stations are failing one or more safety standards. This is not a monitoring problem. This is a pollution control and enforcement problem.

222	23	5.50	38.3%	79.3%
Stations Monitored	Districts Covered	Avg. dissolve O2	High Risk Stations	Fail BOD Limit

Key findings at a glance:

- **79.3%** of stations exceed the safe BOD limit of 3 mg/L, indicating widespread organic pollution.
- **79.1%** of stations fail the Total Coliform limit of 50 MPN/100mL, posing a direct public health risk.
- **Nashik, Mumbai, Pune, and Nagpur** are the highest risk districts, requiring immediate intervention.
- **Kolhapur, Sangli, and Beed** are the only districts with zero violations — serving as benchmarks for good practice.

Q1. Water Quality Distribution

What percentage of monitored water bodies meet Class A/B standards?

Of the 222 monitored stations:

- 141 stations (**63.5%**) are classified as Class A — designated as drinking water sources requiring only disinfection.
- 5 stations (**2.3%**) are classified as Class B — designated for outdoor bathing.
- Combined, **65.8%** of stations carry a Class A or B designation.
- 51 stations (**23%**) are unclassified — listed as 'No Information' in the dataset.

However, when tested against BIS regulatory safety thresholds:

- Only 55 stations (**24.8%**) are truly safe — they have zero violations across all parameters.
- 55 out of 141 Class A stations (**39%**) are classified as High Risk — meaning they carry a drinking water label but are actively failing safety standards.
- 108 out of 141 Class A stations (**77%**) exceed at least one safety limit.

This 41-percentage-point gap between labelled compliance (65.8%) and actual compliance (24.8%) is the single most important finding of this analysis. Current water classifications are not a reliable guide to water safety

Q2. Geographic Hotspots

Which districts have the poorest water quality? Which need urgent intervention?

District-level risk scoring — calculated as the average proportion of safety parameters violated per station — reveals a clear geographic pattern: pollution is concentrated in urban and industrial districts, not randomly distributed.

Tier 1 — Immediate Intervention Required

District	Risk Score	High Risk Stations	Avg BOD (mg/L)	Avg DO (mg/L)	Stations
Nashik	0.72	13 / 16 (81%)	5.1	4.8	16
Mumbai	0.65	11 / 12 (92%)	15.7	4.1	12
Pune	0.63	14 / 28 (50%)	11.0	4.3	28
Nagpur	0.60	6 / 13 (46%)	9.0	4.7	13

Tier 2 — Priority Monitoring Required

District	Risk Score	High Risk Stations	Avg BOD (mg/L)	Avg DO (mg/L)	Stations
Bhandara	0.58	3 / 4 (75%)	4.1	6.0	4
Dhule	0.57	5 / 7 (71%)	5.1	4.7	7
Solapur	0.57	2 / 7 (29%)	7.1	5.2	7
Akola	0.53	3 / 5 (60%)	10.6	6.2	5
Thane	0.52	19 / 39 (49%)	20.3	4.8	39

Tier 3 — Safe Districts (Benchmarks)

- **Kolhapur**: Risk Score 0.00 — 8 stations, all Safe. Avg BOD = 2.85 mg/L (below the 3 mg/L limit). The only district where every station meets every standard.
- **Sangli**: Risk Score 0.00 — 5 stations, all Safe. Avg BOD = 2.92 mg/L.
- **Beed**: Risk Score 0.00 — 1 station, Safe. Avg BOD = 3.00 mg/L.

These three districts demonstrate that regulatory compliance is achievable. Their water management practices should be studied and replicated in high-risk areas.

Q3. Parameter Violations

Which parameters most frequently exceed safe limits?

Six parameters were tested against BIS regulatory thresholds. The results reveal that biological contamination and organic pollution are the dominant threats to Maharashtra's water quality — not physical or mineral parameters.

Parameter	Safe Limit	Stations Failing	% Failing	Severity
Organic Pollution (BOD)	< 3 mg/L	176 / 222	79.3%	CRITICAL
Bacterial Contamination (Total Coliform)	< 50 MPN/100mL	170 / 215	79.1%	CRITICAL
Fecal Contamination (Fecal Coliform)	< 10 MPN/100mL	152 / 215	68.5%	CRITICAL
Low Oxygen Levels (DO)	> 5 mg/L	68 / 215	30.6%	HIGH
High Turbidity	< 5 NTU	54 / 215	24.3%	MODERATE
Suspended Solids (TSS)	< 100 mg/L	6 / 215	2.7%	LOW

Key interpretation:

- BOD and Total Coliform are failing at almost identical rates (79.3% vs 79.1%), suggesting a **common cause:** untreated sewage discharge is simultaneously raising organic load and bacterial counts.
- Fecal Coliform at **68.5%** confirms the contamination is largely of human and animal origin — a direct sewage and waste disposal problem.
- Low DO at 30.6% is a **consequence of high BOD**: as bacteria decompose organic matter, they consume dissolved oxygen, suffocating aquatic life.
- Turbidity and TSS are lower concern — likely reflecting **natural sediment** during the August monsoon season rather than pollution.

Q4. Correlations

Is there a relationship between BOD and DO? Between industrial districts and pollution?

BOD vs Dissolved Oxygen

Pearson correlation analysis confirms a strong, statistically significant negative relationship between BOD and Dissolved Oxygen:

- Correlation coefficient **r = -0.623** (strong negative)
- P-value = 1.65 x 10^-24 — **statistically significant** beyond any reasonable doubt
- Plain interpretation: **as organic pollution (BOD) increases, oxygen levels fall**. Every unit increase in BOD is associated with a measurable drop in DO.

This is not coincidental — it is a direct environmental mechanism. Microorganisms consuming organic waste deplete dissolved oxygen in the process. The implication is clear: reducing BOD through sewage treatment will directly improve oxygen levels and restore aquatic ecosystem health.

Industrial Districts vs Rural Districts

Category	Avg BOD (mg/L)	Safe Limit	Exceeds by
Industrial Districts (Mumbai, Thane, Pune, Nashik, Nagpur)	13.75	3.0	4.6x
Rural Districts (Kolhapur, Sangli, Beed, Ratnagiri, Parbhani)	4.08	3.0	1.4x

Industrial districts show BOD levels 4.6 times the safe limit on average — more than 3 times worse than rural districts. Industrial discharge, MIDC effluents, and concentrated urban sewage are the primary drivers. The Chi-Square test further confirms this geographic pattern is statistically significant (chi-square = 527.22, p = 8.19 x 10^-64).

Q5. Class Characteristics

Do Class A waters have significantly different DO levels than Class C/E?

Statistical testing (one-way ANOVA) was used to determine whether water classification predicts actual dissolved oxygen levels.

Water Class	Stations	Avg DO (mg/L)	Avg BOD (mg/L)	DO Safe? (>5)
A (Drinking Water)	141	5.52	9.73	Borderline
B (Bathing)	5	6.14	10.60	Yes
C (Drinking + Treatment)	6	5.98	5.50	Yes
E (Irrigation / Industrial)	19	5.25	7.35	Borderline

ANOVA Test Result: F-statistic = 0.4705, p-value = 0.703

The p-value of 0.703 is far above the significance threshold of 0.05. We fail to reject the null hypothesis. There is no statistically significant difference in Dissolved Oxygen levels across water classes.

What this means for stakeholders:

- A Class A designation provides **no guarantee** of higher oxygen levels or better water quality.
- Class A stations have an average BOD of **9.73 mg/L** — more than 3 times the safe limit of 3 mg/L. The label 'drinking water source' does not reflect actual water safety.
- Water classification appears to reflect historical or intended use rather than current measured quality. A comprehensive **re-classification exercise** is urgently needed.

Q6. Outlier Stations

Are there any stations with anomalous readings that require investigation?

Five monitoring stations showed the most severe regulatory violations — failing 5 or 6 out of 6 safety parameters simultaneously. These represent the most contaminated water bodies in the state and require immediate investigation and remediation.

Station / Water Body	District	Violations	BOD	DO (mg/L)	Total Coliform	Status
Chikhali Nallah meets Godavari	Nashik	6/6	8.8	3.0	920	CRITICAL
Godavari at Kapila-Godavari confluence	Nashik	6/6	8.6	4.8	920	CRITICAL
BPT Navapur (MIDC industrial drain)	Thane	5/6	54.0	0.15	280	CRITICAL
Colour Chem Nalla, Majiwada	Thane	5/6	30.0	1.0	540	CRITICAL
Uttan Sea at Bhayander	Thane	5/6	16.0	4.4	920	CRITICAL

Notable observations:

- BPT Navapur shows a BOD of 54 mg/L — **18 times the safe limit** — and a DO of just 0.15 mg/L. This water body is effectively biologically dead. The station is directly adjacent to Tarapur MIDC industrial zone.
- Colour Chem Nalla in Thane (BOD = 30 mg/L, DO = 1.0 mg/L) is a direct industrial discharge nala and represents **uncontrolled effluent release**.
- Both Nashik Godavari stations with 6/6 violations are in the urban stretch of the river, downstream of city discharge points, indicating **inadequate sewage treatment** infrastructure.

Q7. Seasonal Patterns

How does water quality vary across months?

This dataset covers only August 2025 — a single month during the monsoon season. Multi-month seasonal comparison is therefore not possible from this dataset alone.

However, the following seasonal context is relevant:

- August falls in the **peak monsoon period** for Maharashtra. Elevated turbidity readings (24.3% of stations exceeding 5 NTU) are consistent with monsoon runoff carrying sediment into water bodies.
- Monsoon conditions can dilute some pollutants while simultaneously washing agricultural and urban runoff into rivers — the net effect on BOD and coliform is **typically an increase**.
- The August data should be considered a monsoon baseline. A **complete seasonal analysis** would require data from at least one pre-monsoon month (March-May) and one post-monsoon month (November-January).

Recommendation: MPCB should prioritize collecting and publishing multi-month NWMP data to enable seasonal trend analysis. The data.gov.in NWMP repository contains additional months that could be integrated.

Q8. Resource Allocation

Which districts should receive priority for monitoring and treatment infrastructure?

Based on Risk Score, High Risk station count, average BOD levels, and total coliform failures, the following prioritization framework is recommended for MPCB resource allocation:

Priority	District	Risk Score	High Risk Stns	Avg BOD	Coliform Fail	Recommended Action
1	**Nashik**	0.72	13 / 16	5.1 mg/L	15 / 16	Immediate STP upgrade
2	**Mumbai**	0.65	11 / 12	15.7 mg/L	12 / 12	Industrial discharge audit
3	**Pune**	0.63	14 / 28	11.0 mg/L	28 / 28	Sewage infrastructure
4	**Nagpur**	0.60	6 / 13	9.0 mg/L	13 / 13	Industrial + urban audit
5	**Bhandara**	0.58	3 / 4	4.1 mg/L	3 / 4	Increased monitoring
6	**Dhule**	0.57	5 / 7	5.1 mg/L	5 / 7	Effluent controls
7	**Thane**	0.52	19 / 39	20.3 mg/L	39 / 39	MIDC discharge enforcement

Note on Thane: Although Thane ranks 9th by Risk Score, it has the highest absolute count of High Risk stations (19) and the highest average BOD (20.3 mg/L) of any district. Its large station count (39) dilutes its average risk score, but the severity of contamination at its worst stations — particularly MIDC industrial drains — makes it a high-priority target for enforcement action.

Specific Recommendations

- Nashik, Mumbai, Pune — **Immediate investment** in Sewage Treatment Plant (STP) capacity and real-time monitoring of BOD and coliform at Class A stations downstream of urban areas.
- Thane MIDC zone — **Enforcement action** against BPT Navapur and Colour Chem Nalla discharge points. These stations show BOD levels 18x and 10x the safe limit respectively — indicating uncontrolled industrial effluent.
- Kolhapur, Sangli, Beed — **Study and document** water management practices for replication. These districts demonstrate that compliance is achievable under similar geographic and demographic conditions.
- All 23 Districts — Water quality **classification audit required**. Stations carrying Class A labels while failing safety standards must be re-evaluated and reclassified to avoid misleading the public.

Final Conclusion

Maharashtra does not have a water monitoring problem. The NWMP programme successfully collected data from 222 stations across 23 districts. The data is clear, consistent, and actionable.

Maharashtra has a pollution control and enforcement problem — and this data has now made it measurable.

The three priorities that would have the greatest impact on public health outcomes are:

- Reduce BOD through sewage treatment: **79.3%** of stations failing the BOD limit is not a natural phenomenon. It is the result of inadequate sewage treatment infrastructure. Every rupee invested in STP capacity in Nashik, Mumbai, and Pune will reduce BOD, raise DO, and lower bacterial contamination simultaneously.
- Enforce industrial discharge limits: The MIDC-adjacent stations in Thane show BOD levels that are biologically incompatible with aquatic life. These are not borderline violations — they are **catastrophic failures** that require immediate enforcement.
- Re-classify water bodies honestly: Labelling a water body as Class A while it fails 5 out of 6 safety standards creates false confidence among the public and policymakers. **Accurate classification** is the foundation of effective water governance.