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Will Rain Clear the Air? A Simple, Data-Backed Brief Using WW Stations

Executive Summary

Light, brief rain or just rising humidity often makes smog worse before it gets better: fine particles absorb moisture and more particles form in calm, moist air, so $PM_{2.5}$ (and AQI) can climb in the hour or two leading up to showers. That is the pattern seen in our station charts: a pre-rain build-up under weak winds, a sharp drop when sustained showers and gusts arrive, and then a mild evening rebound if winds ease and emissions continue. When rain is city-wide and lasts at least 30–60 minutes with some breeze, raindrops wash particles out and improved mixing keeps AQI low; drizzle or patchy cells provide limited benefit and the improvement is short-lived.

Key Takeaway

In simple terms, smog can rise before it falls. As clouds build, humidity increases and winds are weak; particles swell and new fine particles form, so AQI climbs. Once proper rain arrives—preferably widespread and lasting—and winds pick up, raindrops remove pollution and the air mixes, so AQI drops quickly. This sequence is well documented in peer-reviewed studies and is produced by our two station charts in this report.



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1) The simple science (why rain can raise or reduce PM_{2.5})

Before/with only drizzle:

- High humidity → particles absorb water and look “bigger.”
- Stagnant air → more secondary particles form.
- Result: AQI can rise even though clouds are building.

During steady rain:

- Raindrops “wash out” particles (wet scavenging).
- Gusty outflows / mixing help dilute what’s left.
- Result: AQI falls, often fast.

After rain:

- If winds stay light and emissions stay high (traffic, burning), AQI can bounce back in hours.

2) What our two stations show

A) I-8 (AQI line)

- **Before the rain (12–2 PM):** Humidity rises quickly while winds remain weak. In this moist, stagnant air, fine particles absorb water and secondary PM_{2.5} forms, so AQI climbs. This is the classic pre-rain build-up.
- **When rain and gusts arrive (~4:15–6 PM):** Wind speeds spike and showers or outflow pass through. Raindrops remove particles (wet scavenging) and winds mix the boundary layer, so AQI falls sharply within a short time.
- **After the event (6–9 PM):** Winds stay moderate at times and humidity is lower than the afternoon peak. With continued ventilation, the AQI stays near its lowest values.
- **Late evening (9 PM–12 AM):** Winds ease and humidity edges upward. A gentle rebound begins and the AQI creeps up, though it remains well below the afternoon maximum.

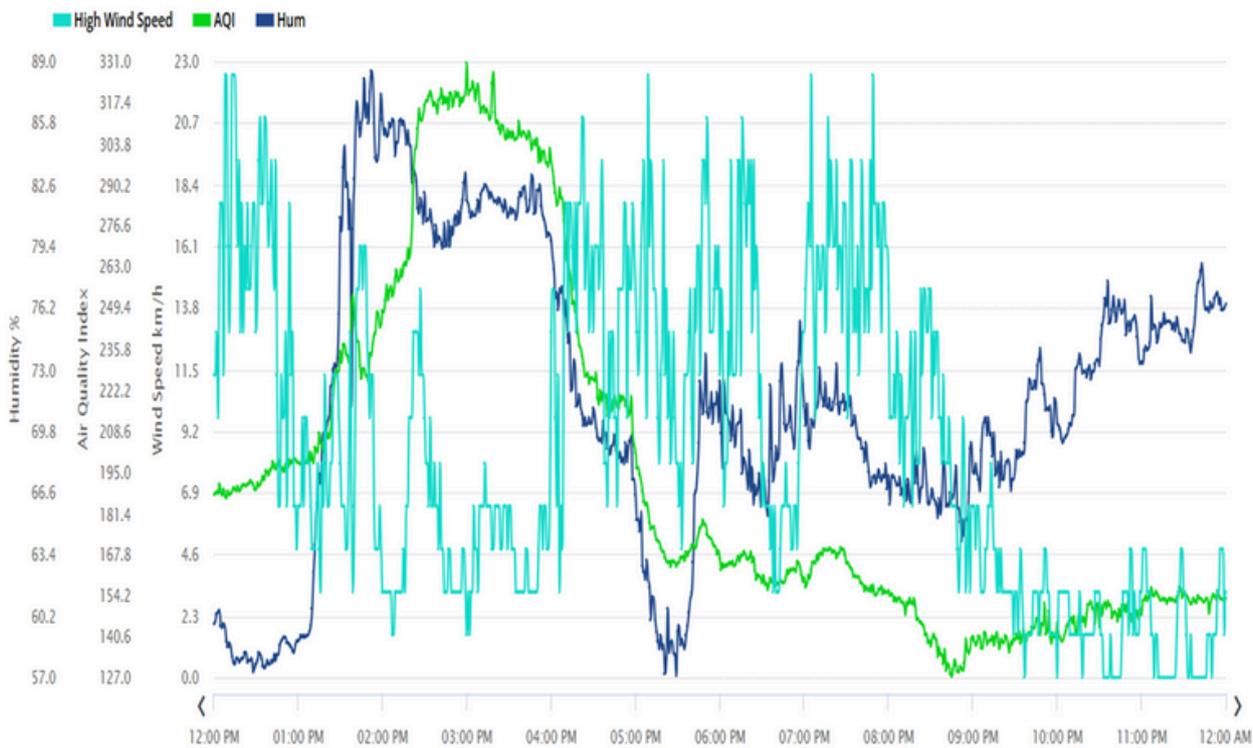


Figure A: AQI (green), Humidity (navy), and High Wind Speed (teal).

B) G-8/2 (AQI line)

- **Before the rain (12:00–1:30 PM):** Humidity begins to rise while winds ease toward calm. In moistening but stagnant air, particles swell and secondary PM_{2.5} forms; AQI holds at moderate-high levels and then starts to climb.
- **Pre-rain build-up (1:30–3:30 PM):** Humidity surges into the 70s with very light winds. AQI rises steadily to the day's peak—no washout yet.
- **When rain and gusts arrive (~3:30–5:30 PM):** Wind speed spikes and humidity drops. AQI turns down and falls quickly through late afternoon as wet scavenging and mixing clear the air.
- **After the event (5:30–7:00 PM):** Winds remain intermittently brisk and humidity stays lower. AQI stabilizes near the day's minimum.
- **Early night drift (7:00–8:00 PM):** Humidity edges up and winds fluctuate at lower levels. AQI shows small bumps but stays much lower than the afternoon peak.

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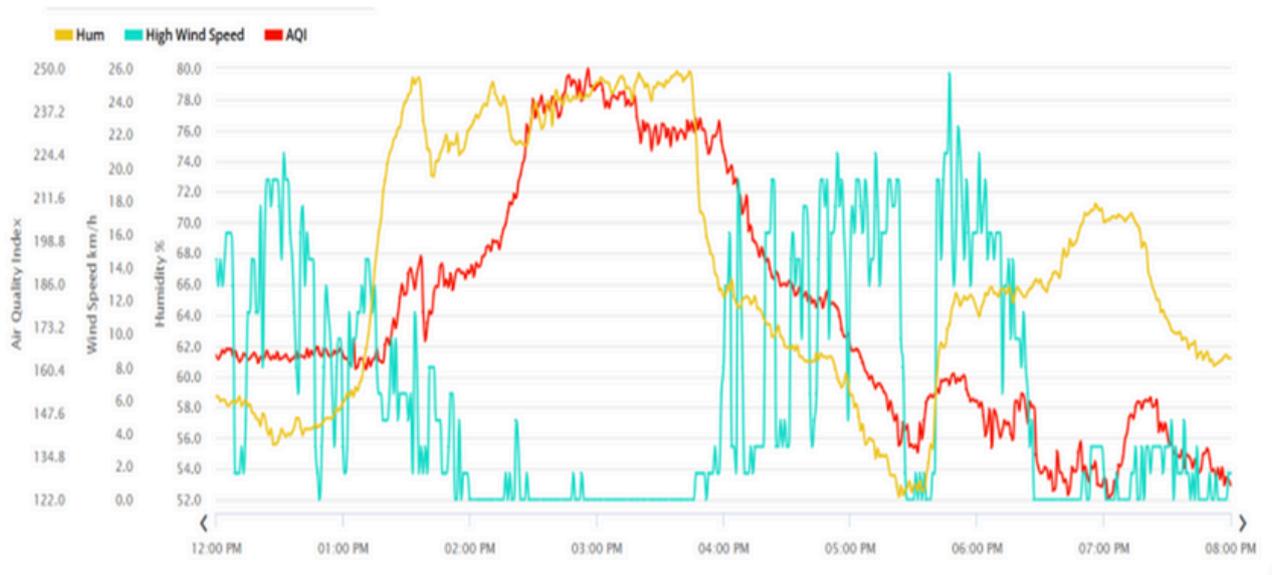


Figure B: AQI (red), Humidity (gold), and High Wind Speed (teal).

3) What happens if rain starts soon?

- **If it's only sprinkles/drizzle ($\leq 10-15$ min, very light):** AQI may barely change or drop a little, and could climb again if humidity stays high.
- **If moderate city-wide showers last $\geq 30-60$ min with some breeze:** Expect a clear, step-down in both series within 30–120 min of onset. Typical drops after a decent shower can be 50–150 AQI points, depending on how intense and widespread the rain is.
- **Post-rain rebound:** If winds die and emissions resume, AQI can rise again the same evening or next morning (especially in valleys/low mixing heights).

Conclusion

Smog can rise before it falls. In today's record, as clouds built and humidity increased under light winds, $PM_{2.5}$ —and thus AQI—climbed at both I-8 and G-8/2 through the early to mid-afternoon. When showers and gusty outflow arrived later in the afternoon (about 3:30–6:00 PM), the AQI at both sites dropped quickly, reflecting raindrop washout and better mixing. Through the early evening, continued bursts of wind kept AQI low, with only a mild rebound once winds eased. This matches the research pattern: light or brief drizzle with weak winds can coincide with higher $PM_{2.5}$, whereas sustained, city-wide rain with some breeze reliably cleans the air. Hence, expect a pre-rain uptick, a sharp rain-time decline when showers are meaningful, and a small post-rain drift if the atmosphere calms again.

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Reference

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3. Rain + wind effects on $PM_{2.5}$ — wet scavenging confirmed; stronger effect on coarse particles but meaningful for $PM_{2.5}$ too.

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