Excellent. This document is the exact scientific blueprint required for the core logic of your application. You've found the "source of truth."

My role here is to translate this dense, technical government document into a clear, actionable guide for your developers. Here is the breakdown of the exact formulas and the step-by-step implementation plan.

Guide to Implementing the US EPA Air Quality Index (AQI)

This is the scientific and mathematical guide for converting raw pollutant concentrations (from TEMPO or other sources) into the official US Air Quality Index (AQI). The primary audience for this guide is **Omar (AI/ML)**, who will implement the core calculation, and **Ebrima/Hawa (Content)**, who will extract the corresponding health messages.

I. The Core Formula (Equation 1, Page 18)

The entire AQI calculation is based on a single linear interpolation formula.

$$I_p = \frac{I_{Hi} - I_{Lo}}{BP_{Hi} - BP_{Lo}}(C_p - BP_{Lo}) + I_{Lo}$$

Where:

- I_p = The Air Quality Index for the pollutant (p).
- C_p = The truncated concentration of the pollutant.
- BP_{Hi} = The concentration breakpoint that is **greater than or equal to** C_p.
- BP_{Lo} = The concentration breakpoint that is **less than or equal to** C_p.
- I_{Hi} = The AQI value corresponding to BP_{Hi}.
- I_{Lo} = The AQI value corresponding to BP_{Lo}.

II. The Breakpoint Lookup Table (Table 6, Page 19)

This table is the most critical piece of data. It provides the values for BPHi, BPLo, IHi , and ILo that you will plug into the formula above.

Here are the relevant rows for your primary TEMPO pollutants, **Ozone (O_3)** and **Nitrogen Dioxide (NO_2) **, extracted for clarity:

AQI Category	AQI Range (I_{Lo} - I_{Hi})	O_3 (8-hour) Breakpoints (ppm) (BP_{Lo} - BP_{Hi})	NO_2 (1-hour) Breakpoints (ppb) (BP_{Lo} - BP_{Hi})
Good	0 - 50	0.000 - 0.054	0 - 53
Moderate	51 - 100	0.055 - 0.070	54 - 100
Unhealthy for Sensitive Groups	101 - 150	0.071 - 0.085	101 - 360
Unhealthy	151 - 200	0.086 - 0.105	361 - 649
Very Unhealthy	201 - 300	0.106 - 0.200	650 - 1249
Hazardous	301 - 500	(Calculated with 1-hour O_3)	1250 - 2049

III. Step-by-Step Implementation Guide for Developers (Omar's Task)

Here is the algorithm to implement in a Python function, for example: calculate_aqi(pollutant_type, concentration_value)

Step 1: Unit Conversion (Critical Prerequisite)

- The EPA table uses specific units: **ppm** for Ozone and **ppb** for Nitrogen Dioxide.
- Your TEMPO data will be in scientific units (likely mol/cm² or similar).
- **You MUST convert the raw TEMPO concentration into the correct units (ppm or ppb) before using the formula.** This will require finding a standard atmospheric conversion formula which typically involves Avogadro's number, molar mass, and standard temperature/pressure assumptions. **This is a critical research task.**

Step 2: Truncate Concentration (
CpC_pCp

)

- As per page 18, truncate the converted concentration value.
  - **Ozone (ppm):** Truncate to 3 decimal places (e.g., 0.0785333 becomes 0.078).
  - **NO_2 (ppb):** Truncate to an integer (e.g., 60.7 becomes 60).

Step 3: Find Breakpoints (Table Lookup)

- Using the truncated concentration (C_p), find the row in the Breakpoint Table where your value fits.
- From that row, extract the four key values: BP_{Hi}, BP_{Lo}, I_{Hi}, and I_{Lo}.
- **Example from Page 20:** If your truncated O_3 concentration is **0.078 ppm**:
  - It falls in the "Unhealthy for Sensitive Groups" range (0.071 - 0.085).
  - Therefore:
    - BP_{Lo} = 0.071
    - BP_{Hi} = 0.085
    - I_{Lo} = 101
    - I_{Hi} = 150

Step 4: Calculate the Index (I_p)

- Plug the values from Step 3 into **Equation 1**.
- **Example (cont.):**
  - $I_p = \frac{150-101}{0.085-0.071}(0.078 - 0.071) + 101$
  - $I_p = \frac{49}{0.014}(0.007) + 101$
  - $I_p = 3500 * 0.007 + 101$
  - $I_p = 24.5 + 101 = 125.5$

Step 5: Round the Final Value

- As per page 18, "Round the index to the nearest integer."
- **Example (cont.):** 125.5 rounds to **126**.

IV. Action Items for the Team

For Omar (AI/ML Engineer):

1. **Implement the Algorithm:** Create a Python function calculate_aqi(pollutant, concentration) that performs steps 1-5 above. Use the Breakpoint Table as a hardcoded dictionary or configuration file.
2. **Research Unit Conversion:** Find the correct scientific formula to convert TEMPO's native mol/cm² (or other unit) to ppm (for O_3) and ppb (for NO_2). **This is your highest priority scientific task.**
3. **Create a Unit Test:** Use the exact example from the document (O_3 concentration of 0.078 ppm should return an AQI of 126) to validate that your function is correct.

For Ebrima & Hawa (Content & Support):

1. **Extract Health Advice:** Your primary source is **Table 5: Pollutant-Specific Sub-indices and Cautionary Statements** (pages 13-17).
2. **Create a "Health Advice Map":** For each pollutant (Ozone, NO_2) and each AQI category (Good, Moderate, etc.), extract the exact text from the table.
   - **Example:** For Ozone, in the "Unhealthy for Sensitive Groups" category (AQI 101-150), the advice is: "Sensitive groups: Make outdoor activities shorter and less intense... People with asthma: Follow your asthma action plan..."
3.
4. **Deliver this Map:** Provide this structured text to **Sawaneh** so he can build the logic into the backend API. When the API calculates an AQI of 126 for Ozone, it should automatically return this specific health advice.

This document provides everything your team needs to build a scientifically accurate and trustworthy AQI application.