Table of Contents

Introduction

1.1. Purpose of the test plan document

This test plan defines the complete QA strategy to verify the Airscape system, a Laravel-based air quality monitoring dashboard. The platform simulates real-time AQI data for Colombo and offers features for Public Users, Admins, and Web Masters. This document is aligned with both QA practices and university coursework standards

1.2. Scope

The scope of this test plan includes all features and modules of the Airscape Real-Time Air Quality Monitoring Dashboard, developed as part of the NSBM PUSL2020 coursework. Testing will cover both functional and non-functional aspects across three major user roles:
In Scope

- Role-based access testing (Web Master, Admin)
- Sensor Management (CRUD operations with map integration)
- Data simulation validation (AQI baseline, variation, frequency)
- Alert Configuration (thresholds, rules, log display)
- Admin User Management (add/edit/delete admin accounts)
- Public dashboard features (AQI map, marker popups, chart)
- Historical data visualization
- UI/UX consistency and browser compatibility
- Exploratory and regression testing on major features

1.3. Overview

This plan is designed to ensure that the system meets its functional goals, provides reliable experience for each user role, and is ready for potential future automation using Playwright.

- The scope of testing and target functionality
- The overall QA strategy, including test techniques and tools
- A detailed breakdown of test types (functional, regression, UI, etc.)
- Test design standards, data requirements, and execution plans
- Defect management and reporting procedures
- Environments, deliverables, schedules, and risk mitigation.

1.3. Definition

Term	Description
QA	Quality Assurance
AQI	Air Quality Index
CRUD	Create, Read, Update, Delete
E2E	End-to-End Testing
UAT	User Acceptance Testing
UI/UX	User Interface / User Experience
ETP	Exploratory Testing Process
RTM	Requirement Traceability Matrix

Test strategy

2.1.1 – Product Overview

Airscape is a web-based real-time air quality monitoring system built with Laravel for the backend and (Leaflet.js) for map visualization. It allows city administrators and the public to view AQI (Air Quality Index) levels across various locations in Colombo.

- Sensor Management : Admins can add, edit, and deactivate AQI sensors positioned on an interactive map.
- Data Simulation Engine : Automatically simulates AQI values based on baseline and variation rules for each sensor.
- Alert Configuration : Admins can define pollutant thresholds to trigger system alerts when AQI exceeds safe levels.
- Web Master : Manages admin users and high-level system access.
- Admin : Manages sensors, alerts, and monitors data.
- Public User : Views the AQI map without logging in.
- Visualization : AQI values are displayed using location markers and popups, along with data charts for historical insights.

2.1.2 Product Risks

Module	Risk Description	Severity	Priority	Mitigation
DA - 01	Realtime Sensor Overview cards not displaying	High	Critical	Verify dashboard query logic and card visibility CSS
DA -02	Realtime sensor card AQI status and level is not displaying	High	High	Validate AQI simulation binding and conditional labels
DA-03	Realtime sensor card Location is not displaying	Medium	Medium	Ensure location field from DB is rendered per card
DA-04	When admin updates the sensor but Realtime sensor status displaying wrong update time	High	High	Sync update timestamp with latest sensor update trigger
DA-05	Webmaster or Admin log to the system but which user logs into the system is not displaying	Critical	Critical	Display current session's authenticated username
DA-06	Webmaster log into the system but show the admin log into the system	Critical	Critical	Ensure correct role type is rendered based on role_id
DA-07	Admin log into the system but displaying webmaster in logging status	Critical	Critical	Cross-check role detection and dashboard label logic
DA-08	`Manage Sensor` button is not working or navigate to wrong page.	Medium	Medium	Check route definition and button `href`/`onclick` handler
SM-01	`Leaflet Map` not displaying after page load	High	Critical	Check map initialization in JS; confirm container is mounted properly
SM-02	Clicking `Add Sensor` button doesn't open the form popup	High	Critical	Validate modal trigger logic and JS event binding
SM-03	Form allows submission without mandatory fields (Sensor ID, Location)	High	Critical	Add required field validation for all inputs
SM-04	Duplicate Sensor IDs accepted, leading to data overwrite	High	Critical	Implement unique constraint on Sensor ID
SM-05	Latitude or Longitude missing or invalid, causing map display errors	Medium	Heigh	Validate coordinate range and require both values
SM-06	Simulation frequency allows invalid values (e.g., negative or zero)	Medium	High	Add range validation (e.g., min 1 minute) |
SM-07	Variation (%) accepts values above 500 or below 0	Medium	High	Limit variation to 0–500 using input constraints
SM-08	Clicking 'Add' with blank fields does not display helpful error messages	Medium	High	Display inline error messages near fields
SM-09	Status dropdown fails to save proper selection (e.g., "Active" reverts to default)	Medium	High	Bind selected value properly during form submission |
SM-10	Sensor added successfully, but doesn't appear on map	High	Critical	Verify DB insert + Leaflet map reload integration
SM-11	Form reset doesn't clear all fields	Low	Medium	Ensure all inputs are reset properly
SM-12	Add Sensor form is closed without warning, losing unsaved input	Low	Low	Add confirmation popup before modal close
SM-13	AQI value does not update on map popup after simulation	High	High	Ensure Leaflet popup content is re-rendered after DB update
SM-14	AQI color badge not matching correct level (e.g., AQI 72 should be yellow/Moderate)	High	High	Validate AQI-to-color mapping function in popup logic
SM-15	"Last Updated" timestamp shows old data or incorrect time zone	Medium	Medium	Set timezone in backend (`Asia/Colombo`); update after cron run
SM-16	"Recommendation" or "Risk Level" logic not aligning with AQI value	Medium	Medium	Verify AQI range mapping to health advice (WHO table logic)

SM-17	Markers not repositioning on map when sensor coordinates change	High	Critical	Remove and re-add marker layer dynamically after sensor update
SM-18	Sensor popup overlaps other map UI elements or misaligned on mobile	Medium	Medium	Add z-index or responsive styles for map layer container
DM-01	Location dropdown not filtering data correctly	High	Critical	Verify backend query filters by location ID
DM-02	Date range filter returns no data or breaks the chart	Medium	High	Ensure from/to date format is consistent with backend
DM-03	AQI chart line not updating after filter change	High	Critical	Ensure chart is re-rendered on every refresh trigger
DM-04	AQI chart misaligned or showing wrong timestamps	Medium	Medium	Validate timestamp format; use proper x-axis scale
DM-05	"Export CSV" button not working or exporting wrong data	High	Critical	Test file structure + column values after export
DM-06	Summary cards (Total Records, Average AQI, etc.) not updating after filter	High	Critical	Recalculate summary values on each filter event
DM-07	Color-coded AQI cells do not match actual AQI values (e.g., wrong risk level)	Medium	Medium	Match AQI with defined color thresholds in UI logic
DM-08	Table rows show incorrect location or Sensor ID	High	Critical	Cross-check table values with actual DB query result
DM-09	Empty table with no "no records found" message	Low	Medium	Display user-friendly empty state message
DM-10	Inactive sensors count always zero even if there are inactive sensors	Medium	High	Count sensors by active/inactive status from live data
AUM-01	Admin creation form allows submission with blank fields	High	Critical	Add field-level validations (required + format check)
AUM-02	Email field allows invalid formats or duplicates	High	High	Apply email regex + unique DB constraint
AUM-03	Password field accepts weak passwords or short input	Medium	High	Add min-length + strength validation (8+ chars)
AUM-04	Status dropdown fails to reflect or save selected value	Medium	Medium	Bind dropdown properly and test default values
AUM-05	New admin saved but not shown in table immediately	Medium	Medium	Re-fetch or append new admin after save
AUM-06	Deactivated admin can still log in or perform actions	High	Critical	Block access if status is inactive
AUM-07	Admin deletes another admin accidentally (no confirmation prompt)	High	High	Add confirmation dialog before deletion
AUM-08	Editing admin does not update email or role correctly	Medium	Medium	Validate data binding + API PUT/PATCH endpoint logic
AUM-09	Incorrect role label shown in table (e.g., Admin shown as Web Master)	Medium	Medium	Cross-check role_id values and render labels properly
AUM-10	Action buttons (Edit/Delete) unresponsive or menu doesn't close on outside click	Low	Low	Use event propagation control and fallback close logic
AC-01	Threshold field accepts non-numeric or blank values	High	Critical	Add input type validation and required check
AC-02	Pollutant type dropdown does not enforce selection before saving	High	Critical	Set default to null + validate selection before POST
AC-03	Duplicate rules for the same pollutant and frequency allowed	Medium	Medium	Prevent same pollutant + frequency combo from saving twice
AC-04	Frequency dropdown allows unrealistic values (e.g., 1 sec or no limit)	Medium	Medium	Restrict options to predefined intervals (e.g., 5m–60m)
AC-05	Email or System alert toggle not saved or not reflected correctly	Medium	Medium	Ensure toggle states are stored and reflected in DB

AC-06	Alerts not triggering even when AQI exceeds threshold	High	High	Use boundary value simulation tests (e.g., AQI = 99 → 100)
AC-07	Alert logs not saving into system_alerts table	High	High	Confirm DB insertion on rule match + log output
AC-08	System/email alerts sent multiple times for same AQI breach	Medium	Medium	Add cooldown/debounce logic to avoid spam alerts
AC-09	Recent System Alerts list not refreshing after rule triggers	Medium	Medium	Re-fetch alert logs after simulation tick or use WebSocket
AC-10	Delete rule button fails or doesn't remove alert rule from DB	Medium	Medium	Verify rule deletion function and soft-delete logic
RBA-01	Web Master login redirects to Admin dashboard (wrong panel)	High	Critical	Verify role check before redirect
RBA-02	Admin login redirects to Web Master panel (elevated access)	High	Critical	Add role guard middleware for route access
RBA-03	Logged-in user role label shows incorrectly in UI header	Medium	Medium	Validate role display using session or DB values
RBA-04	Role selection page allows bypass using URL manipulation	High	Critical	Restrict direct access with session role check
RBA-05	Logging out of one role and logging into another cause's session conflict	Medium	Medium	Clear session data properly on logout
RBA-06	Admin user manually changes URL to Web Master route and gains access	High	Critical	Enforce route-level middleware using `auth: webmaster`
RBA-07	Login error messages are not shown or unclear (wrong email/pass)	Low	Low	Display user-friendly error on failed login
RBA-08	Password field allows short/weak passwords during login	Medium	Medium	Enforce validation + check for basic strength
RBA-09	No indication of currently logged-in role after login	Medium	Medium	Show active role on dashboard header or sidebar
PUB-01	AQI cards show outdated or unsynchronized values	High	Critical	Sync card content with latest AQI from DB
PUB-02	AQI badge colors do not match risk levels (e.g., AQI 72 not yellow)	High	High	Map AQI values to color thresholds (0–50 green, etc.)
PUB-03	Sensor popup values (AQI, recommendation) don't match card view	High	High	Ensure popup data pulls from same source as card
PUB-04	Recommendation text missing or inconsistent in popup	Medium	Medium	Match AQI value range to correct health message
PUB-05	Location Marker do not load or show wrong location	High	High	Validate lat/lng on sensor creation + verify marker rendering
PUB-06	Leaflet map fails to load or load tiles	High	Critical	Ensure Leaflet + OSM API loads; test internet fallback
PUB-07	Page doesn't refresh AQI automatically or on schedule	High	High	Use set Interval or manual Refresh button for live data
PUB-08	Sensor not shown on map even if active	High	Critical	Test map population logic for all active sensors
PUB-09	Clock not synced to system/server timezone	Low	low	Set timezone globally (Asia/Colombo) on frontend using JS

	Word	Meaning
1.	DA	Dashboard
2.	SM	Sensor Management
3.	DM	Data Management
4.	AUM	Admin User Management
5.	AC	Alert Configuration
6.	RBA	Role base Authentication
7.	PUB	Public Dashboard

2.1.3 Test Coverage

	Module	Test Strategy
1.	Dashboard	The Dashboard is the first landing screen for Admins and Web Masters. Testing will focus on verifying the accuracy of real-time AQI sensor cards, logged-in role labels, badge color consistency, and the correct reflection of AQI values. UI and UX aspects such as spacing, responsiveness, and alignment will also be validated. No database writes operations occur here, but the correctness of real-time simulated values fetched from the backend will be a critical test point.
2.	Sensor Management	This module allows Web Masters and Admins to add and deactivate AQI sensors. Functional testing will cover form validation, coordinate validation, map rendering, and ensuring simulation logic is bound to each sensor. Testing will ensure sensors appear correctly on the Leaflet map and are stored in the database with the correct AQI baseline, frequency, and variation logic. Form and modal usability will also be assessed.
3.	Admin User Management	Testing will focus on role-based access control. Admins can only be managed by Web Masters. Add/edit/delete functionality will be validated with positive and negative test cases. Unique email constraints, correct role assignments, and status toggles will be checked. Test scenarios will ensure inactive admins cannot log in and that edits persist across reloads.
4.	Data Management	This module visualizes AQI logs through a chart and summary cards. Tests will ensure location and date filters affect the chart and data table accurately. The average AQI, total records, and CSV export functionalities will be covered. Database verification and UI chart refresh timing will be core testing focus points.
5.	Alert Configuration	Testing will cover creation of rules per pollutant, threshold logic, and alert triggering. Pollutant types (e.g., PM2.5, AQI, CO2) will be tested against simulated AQI values to confirm alert behavior. Email and system alerts toggles will be tested. Testing will ensure that rules do not duplicate and that alerts are logged and displayed in the "Recent Alerts" list.
6.	Role-Based Authentication	This module includes the dual login paths for Web Master and Admin. Testing will validate that the correct role dashboard is shown upon login, role label is displayed correctly, and that unauthorized route access is blocked. Tests will include session cleanup, redirection, and misuse of URLs to access higher-privileged areas.
7.	Public Dashboard	The homepage shows live AQI cards for public users. Testing will validate real-time color-coded badges, recommendations based on AQI range, and popup values on the Leaflet map. AQI level matching between card and map popup will be tested.

		Testing will also focus on UI/UX such as responsive card display and timezone-correct clock.

2.1.4 Functional Requirements

	Module	Functional Requirements
1.	Dashboard	• System display real-time AQI values from active sensors. • Show AQI levels with color-coded status badges (Good, Moderate, Unhealthy, etc.) • System displays the name of the currently logged-in user. • Show location name and AQI card info: time, risk level, recommendation • Navigate to "Manage Sensors" from dashboard card
2.	Sensor Management	• Add new sensors (modal form: name, ID, location, AQI baseline, frequency, variation, coordinates, status) • Validate required fields on sensor add (e.g., Sensor ID format, coords) • Simulate AQI values using baseline, variation %, and frequence • View sensor details in modal popup from map or sidebar • View sensor details in modal popup from map or sidebar • Deactivate/delete sensors using sidebar action
3.	Admin User Management	• .Web Master can add new Admins using modal form • Validate email (unique) and password (min criteria). • View current Admin list with name, email, status, and role • Edit or Delete Admins using three-dot dropdown • Prevent login by inactive Admins (handled in login logic)
4.	Data Management	• Filter AQI data by location dropdown and date range • Render AQI Over Time chart for selected filters • Show AQI summary: total records, average AQI, active/inactive sensor counts • Display AQI table (Sensor ID, Location, AQI, Status, Timestamp) • Export filtered data as CSV
5.	Alert Configuration	• Create new alert rules by pollutant type (AQI, PM2.5, PM10, CO2, NO2, O3) • Set AQI threshold and frequency (e.g., 15 mins) in modal • Toggle alert channels (System Alert, Email Alert) • Display recent system alerts in list view (with timestamp and message) • Delete existing alert rules
6.	Role-Based Login	• Show role selection screen before login (Web Master / Admin cards) • Redirect to correct login form based on selected role • Validate credentials on login • Redirect to correct dashboard after login based on role

		• Restrict access to certain modules based on role
7.	Public Dashboard	• Display AQI cards per public sensor location • Show AQI level, status color, and sensor name • Interactive Leaflet map with AQI marker popups and recommendations • Auto-refresh AQI values at defined intervals (real-time simulation) • Show system title and tagline on top banner

2.1.5 Non-Functional Requirements

	Module	Non-Functional Requirements
1.	Performance	• System shall render sensor cards and map within 2 seconds under normal conditions. • AQI simulation engine shall process and reflect data within 1 minute of execution. • Alerts shall trigger and display within 5 seconds of AQI threshold being breached.
2.	Security	• Web Master routes shall only be accessible with correct role-based authentication. • Inactive admins must be blocked from accessing any dashboard or features. • Passwords shall be encrypted in the database. • Direct URL access to unauthorized routes must redirect to an error or login page.
3.	Usability & UI/UX	• The interface shall be responsive across modern desktop resolutions. • Form fields shall provide clear placeholder hints and validations. • Popups, charts, and modals must not overlap or break layout.
4.	Compatibility	The application shall work consistently on latest versions of: • Google Chrome • Mozilla Firefox • Microsoft Edge
5.	Load and Stress Testing	High concurrency load testing is covered in the current manual phase. Performance testing will be handled later using automation tools (JMeter).

2.1.6 Out of Scope

Mobile Responsiveness

- While the Airscape UI is partially responsive, mobile testing is not prioritized in this test cycle.
- Full mobile viewports and usability will be validated during future UI/UX testing phases.

Third-Party Service Failures

- Failover and downtime handling of Leaflet map APIs or external AQI services are not tested.
- These integrations are assumed to remain functional during test execution.

Email Delivery Validation

- While system/email alerts are toggled in the UI, actual email delivery testing (SMTP config) is excluded.
- Email alerting will be simulated or verified by UI state only (e.g., alert toggle ON).

Network Interruption Scenarios

- Offline behavior, slow network, or retry logic (e.g., sensor post failures) is out of current scope.

Accessibility Testing (WCAG/Screen Readers)

- ARIA roles, contrast ratios, keyboard navigation are not validated as part of this cycle.

Database Migration or Backup Testing

- We assume clean migrations are completed. Backup/recovery or data rollback testing is excluded.

3.1 Test Design

	Module	Functional Requirements
1.	Dashboard	• System display real-time AQI values from active sensors. • Show AQI levels with color-coded status badges (Good, Moderate, Unhealthy, etc.) • System displays the name of the currently logged-in user. • Show location name and AQI card info: time, risk level, recommendation • Navigate to "Manage Sensors" from dashboard card
2.	Sensor Management	• Add new sensors (modal form: name, ID, location, AQI baseline, frequency, variation, coordinates, status) • Validate required fields on sensor add (e.g., Sensor ID format, coords) • Simulate AQI values using baseline, variation %, and frequence • View sensor details in modal popup from map or sidebar • View sensor details in modal popup from map or sidebar • Deactivate/delete sensors using sidebar action
3.	Admin User Management	• .Web Master can add new Admins using modal form • Validate email (unique) and password (min criteria). • View current Admin list with name, email, status, and role • Edit or Delete Admins using three-dot dropdown • Prevent login by inactive Admins (handled in login logic)
4.	Data Management	• Filter AQI data by location dropdown and date range • Render AQI Over Time chart for selected filters • Show AQI summary: total records, average AQI, active/inactive sensor counts • Display AQI table (Sensor ID, Location, AQI, Status, Timestamp) • Export filtered data as CSV
5.	Alert Configuration	• Create new alert rules by pollutant type (AQI, PM2.5, PM10, CO2, NO2, O3) • Set AQI threshold and frequency (e.g., 15 mins) in modal • Toggle alert channels (System Alert, Email Alert) • Display recent system alerts in list view (with timestamp and message) • Delete existing alert rules
6.	Role-Based Login	• Show role selection screen before login (Web Master / Admin cards) • Redirect to correct login form based on selected role • Validate credentials on login • Redirect to correct dashboard after login based on role • Restrict access to certain modules based on role
7.	Public Dashboard	• Displaying AQI cards per public sensor location • Show AQI level, status color, and sensor name • Interactive Leaflet map with AQI marker popups and recommendations

		• Auto-refresh AQI values at defined intervals (real-time simulation) • Show system title and tagline on top banner

1. Test Scenarios

Module	ID	Test Scenario
Dashboard	DA-TC001	Verify real-time AQI cards load on dashboard
	DA-TC002	Validate AQI badge colors match AQI levels (e.g., Green = Good, Yellow = Moderate)
	DA-TC003	Verify card shows correct sensor location and AQI value
	DA-TC004	Verify dashboard card shows correct risk level and recommendation
	DA-TC005	Verify "Last Updated" timestamp updates in real time
	DA-TC006	Validate name of logged-in user is shown in top right corner
	DA-TC007	Click "Manage Sensors" → verify navigation to Sensor Management module
	DA-TC008	Verify that only active sensors are shown on dashboard cards
	DA-TC009	Simulate AQI change → check if card refreshes without reload
	DA-TC010	Role: Admin logs in → verify that dashboard loads with limited access (no Web Master areas)
Sensor Management	SM-TC001	Add sensor with all valid inputs
	SM-TC002	Try to add sensor with missing required fields (Sensor ID, Location, etc.)
	SM-TC003	Add sensor with invalid coordinates (e.g., non-numeric)
	SM-TC004	Add sensor with duplicate Sensor ID
	SM-TC005	Verify sensor appears in sidebar after successful add
	SM-TC006	Verify new sensor appears on Leaflet map with correct marker
	SM-TC007	Click on sensor marker – verify popup shows AQI, location, time, status
	SM-TC008	Edit an existing sensor's details (frequency, location, etc.)
	SM-TC009	Deactivate a sensor – check if it disappears from map and UI
	SM-TC010	Simulate AQI: check if values change as per frequency/variation logic
	SM-TC011	Try adding sensor with 0 frequency – validate system response

Admin User Management	AUM-TC001	Add new Admin with valid full name, email, password, and active status
	AUM-TC002	Try to add Admin with missing required fields (e.g., no password or email)
	AUM-TC003	Try to add Admin with an already registered email
	AUM-TC004	Add Admin with weak password (e.g., less than 6 characters)
	AUM-TC005	Verify newly added Admin appears in Admin list
	AUM-TC006	Click "Edit" on an Admin – modify name, email, status
	AUM-TC007	Deactivate an Admin and verify status badge updates (red "inactive")
	AUM-TC008	Inactive Admin attempts login – verify login is denied with appropriate message
	AUM-TC009	Verify that delete button removes Admin from the list
	AUM-TC010	Validate sorting of Admin list (latest on top by default)
	AUM-TC011	Check role label is always "Admin" (non-editable role display)
Data Management		
	DM-TC001	Filter AQI data by **location** dropdown
	DM-TC002	Filter AQI data by **From - To** date range
	DM-TC003	Apply both date and location filters – verify filtered result set
	DM-TC004	Verify AQI chart updates correctly based on filter
	DM-TC005	Check "Total Records", "Average AQI", "Active/Inactive Sensors" summary tiles
	DM-TC006	Validate sensor-level AQI records display correctly in the data table
	DM-TC007	Apply filters and click "Export CSV" – verify correct file is downloaded
	DM-TC008	Verify table columns: Sensor ID, Location, AQI, Status, Recorded At
	DM-TC009	Check color formatting for AQI value cells (e.g., red for unhealthy, green for good)
	DM-TC010	Try date range with no data – verify proper message shown
	DM-TC011	Ensure map data and chart are consistent with the raw table data
Alert Configuration	AC-TC001	Add a new alert rule with valid pollutant, threshold, and frequency
	AC-TC002	Try to add duplicate rule for same pollutant + frequency
	AC-TC003	Try to add alert rule with missing required fields (e.g., no pollutant type selected)
	AC-TC004	Toggle **System Alert** ON and verify it's saved
	AC-TC005	Toggle **Email Alert** ON and verify it's saved

	AC-TC006	Simulate AQI crossing threshold → verify alert is logged in "Recent System Alerts" section
	AC-TC007	Simulate AQI below threshold → ensure no alert is triggered
	AC-TC008	Verify alert message includes pollutant, threshold, and AQI value
	AC-TC009	Delete an existing alert rule → confirm it is removed from list
	AC-TC010	Add AQI rule at boundary value (e.g., threshold = 100, AQI = 100) → verify alert triggers
	AC-TC001	Add a rule with invalid frequency (e.g., 0 or negative) → verify it is rejected
Role Base Authentication	RBA-TC001	Display role selection screen with both “Web Master” and “Admin” login options
	RBA-TC002	Click “Web Master” → redirect to Web Master login form
	RBA-TC003	Click “Admin” → redirect to Admin login form
	RBA-TC004	Login as valid Web Master → redirect to Web Master dashboard
	RBA-TC005	Login as valid Admin → redirect to Admin dashboard
	RBA-TC006	Enter wrong password for Web Master → verify login is denied with error message
	RBA-TC007	Entering wrong email for Admin → verify login is denied
	RBA-TC008	Admin tries to access Web Master URL directly → verify access is denied (403 or redirect)
	RBA-TC009	Web Master tries to access Admin-only areas → verify allowed or redirected as per rules
	RBA-TC010	Logout from one role → ensure session is cleared and redirection to login page
	RBA-TC011	After login, confirm that dashboard shows correct role label and username
Public Dashboard	PUB-TC001	Load public AQI dashboard page without authentication
	PUB-TC002	Verify AQI cards display per sensor with location and AQI value
	PUB-TC003	Verify AQI status badges (color-coded) match AQI level (e.g., Green = Good, Red = Hazardous)
	PUB-TC004	Verify real-time updates refresh card values at correct intervals
	PUB-TC005	Click on Leaflet map marker → verify popup shows AQI, sensor name, risk level, recommendation
	PUB-TC006	Validate consistency between AQI value in card vs popup for the same sensor
	PUB-TC007	Ensure cards are responsive and properly aligned on different screen sizes
	PUB-TC008	Simulate high AQI → verify popup and badge color change accordingly
	PUB-TC009	Refresh the page → ensure latest AQI values load without error
	PUB-TC010	Check that map loads properly with all active sensors

3.1.1 Test Case Standards

To maintain clarity, consistency, and traceability, all test cases in the Airscape project follow a standardized structure. Each test case is linked to a functional requirement and is clearly documented format. The following standards will be applied:

Naming Convention

- Format: `[Module Code]-TC[Number] (Type of Testing)`
- Example: `SM-TC001 (FC)`

Storage and Documentation

- All test cases will be written in `.md` format
- Stored under: `/manual/test-cases/[module-name].md`

Traceability

- Each test case maps to a functional requirement from Section 2.1.4
- A Requirement Traceability Matrix (RTM) will be maintained separately

Test Design Techniques Used

- Boundary Value Analysis (BVA) – AQI values near threshold
- Equivalence Partitioning – valid vs invalid roles
- Decision Table Testing – alert rule logic
- Exploratory Testing – clicking around map/sensors unscripted

Review and Update Process

- All test cases will be peer-reviewed before execution
- Test cases are version-controlled and updated per feature changes

3.1.2 Test Case

- **All test cases for the Airscape project are written in separate files maintained.**

3.1.3 Test Design Template

- Test Case ID

- Title / Description

- Related Requirement ID

- Preconditions

- Test Steps

- Test Data

- Expected Result

- Actual Result

- Status (Pass/Fail)

- Notes or Defect ID (if failed)

3.1.4 Test Scenario Complexity Categorization

- All identified test scenarios for the Airscape project have been categorized into Low, Medium, and High complexity levels based on the scope, logic, risk, and number of validations required. This helps in better planning of regression suites, risk-based testing, smoke testing, and future automation coverage.

Module	Low	Medium	High
Dashboard	DA-TC001 , DA-TC002 , DA-TC005 , DA-TC006 , DA-TC007	DA-TC003 , DA-TC004 , DA-TC009	DA-TC008 , DA-TC010
Sensor Management	SM-TC005 , SM-TC006 , SM-TC007	SM-TC001 , SM-TC002 , SM-TC003 , SM-TC004 , SM-TC009	SM-TC010 , SM-TC011
Admin Data Management	AUM-TC005 , AUM-TC010 , AUM-TC011	AUM-TC001 , AUM-TC002 , AUM-TC003 , AUM-TC004 , AUM-TC006 , AUM-TC007 , AUM-TC009	AUM-TC008
Data Management	DM-TC001 , DM-TC002 , DM-TC005 , DM-TC008 , DM-TC009 , DM-TC0010	DM-TC003 , DM-TC004 , DM-TC006 , DM-TC007	DM-TC011
Alert Configuration	AC-TC004 , AC-TC005 , AC-TC009	AC-TC001 , AC-TC002 , AC-TC003 , AC-TC008 , AC-TC010 , AC-TC011	AC-TC006, AC-TC007

Role Base Authentication	RBA-TC001, RBA-TC002 , RBA-TC003 , RBA-TC010, RBA-TC011	RBA-TC004 , RBA-TC005 , RBA-TC006 , RBA-TC007	RBA-TC008, RBA-TC009
Public Dashboard	PUB-TC001, PUB-TC002, PUB-TC003, PUB-TC007, PUB-TC009, PUB-TC010	PUB-TC004, PUB-TC005, PUB-TC006	PUB-TC008

3.1.4 Regression Scenarios

	Module	Complexity			
		Low	Medium	Heigh	Total
1.	Dashboard		DA-TC003 , DA-TC004 , DA-TC009	DA-TC008 , DA-TC003 ,	05
2.	Sensor Management		SM-TC001 , SM-TC002 , SM-TC003 , SM-TC004 , SM-TC009	SM-TC010 , SM-TC011	07
3.	Admin User Management		AUM-TC001 , AUM-TC002 , AUM-TC003 , AUM-TC004 , AUM-TC007 , AUM-TC006 , AUM-TC009	AUM-TC008	08
4.	Data Management		DM-TC003 , DM-TC004 , DM-TC006 , DM-TC007	DM-TC011	05
5.	Alert Configuration		AC-TC001 , AC-TC002 , AC-TC003 , AC-TC008 , AC-TC010 , AC-TC011	AC-TC006 , AC-TC007	08
6.	Role Based Authentication		RBA-TC004 , RBA-TC005 , RBA-TC006 , RBA-TC007	RBA-TC008 , RBA-TC009	06
7.	Publish Dashboard		PUB-TC004, PUB-TC005, PUB-TC006	PUB-TC008	04
					43

3.1.5 Risk Based Testing Matrix

	Module	Risk Weight			
		25%	50%	75%	100%
1.	Dashboard	DA-TC001, DA-TC002, DA-TC005,DA-TC006, DA-TC007	DA-TC009	DA-TC003, DA-TC004	DA-TC008, DA-TC010
2.	Sensor Management	SM-TC005, SM-TC006, SM-TC007	SM-TC002, SM-TC003	SM-TC001, SM-TC004 , SM-TC009	SM-TC010 , SM-TC011
3.	Admin User Management	AUM-TC005, AUM-TC010, AUM-TC011	AUM-TC003, AUM-TC004, AUM-TC006, AUM-TC007, AUM-TC009	AUM-TC001, AUM-TC002,	AUM-TC008
4.	Data Management	DM-TC001 , DM-TC002 , DM-TC005 , DM-TC008 , DM-TC009 , DM-TC010	DM-TC003 , DM-TC004 , DM-TC006 , DM-TC007		DM-TC011
5.	Alert Configuration	AC-TC004 , AC-TC005 , AC-TC009	AC-TC002 , AC-TC003 , AC-TC008 , AC-TC011	AC-TC001 , AC-TC010	AC-TC006 , AC-TC007
6.	Role Based Authentication	RBA-TC001 , RBA-TC002 , RBA-TC003 , RBA-TC010, RBA-TC011	RBA-TC006 , RBA-TC007	RBA-TC004 , RBA-TC005	RBA-TC008 , RBA-TC009
7.	Publish Dashboard	PUB-TC001 , PUB-TC002 , PUB-TC003 , PUB-TC007 , PUB-TC009 , PUB-TC010	PUB-TC004 , PUB-TC005, PUB-TC006		PUB-TC008

3.2 Test Execution

- This section outlines the approach for executing various types of testing during the QA phase of the Airscape project. Each test category serves a specific purpose to ensure the system's quality, stability, performance, and usability.

3.2.1 Smoke Testing

These test cases represent the most business-critical functionalities in the Airscape system. They ensure the app is stable and testable before proceeding to detailed test cycles.

Module	Test Case ID	Description
Role-Based Authentication	RBA-TC004	Login as Web Master
Dashboard	DA-TC001	Verify real-time AQI cards load on dashboard
Sensor Management	SM-TC001	Add sensor with valid input
	SM-TC009	Deactivate sensor and verify removal
Alert Configuration	AC-TC006	Simulate AQI above threshold → Trigger alert
Admin User Management	AUM-TC001	Add Admin with valid details
	AUM-TC008	Inactive Admin login should be rejected
Data Management	DM-TC004	Verify AQI chart updates correctly after filter
Public Dashboard	PUB-TC005	Click map marker → verify popup info
Public Dashboard	PUB-TC004	Verify real-time updates on AQI card

3.2.2 Sanity Testing

- Sanity testing is a narrow, focused test cycle executed after minor bug fixes, code merges, or hotfixes. Its goal is to validate that the recently fixed or updated features work as expected, and that the system is still stable around the impacted area.
- This is not a full regression. It acts as a **quick checkpoint** to ensure that new code hasn't introduced critical breakage.

Run	Fix Description	Module Affected	Test Case ID(s)	Status	Remarks
Ex:					
01	Fixed AQI threshold alert bug	Alert Configuration	AC-TC010, AC-TC006	Pass	Alert triggered correctly

Entry Criteria:

- Code changes or fixes are deployed to a test environment
- Only a specific module or flow is affected

Exit Criteria:

- The fixed functionality works correctly
- No critical/high-priority bugs are found
- App remains stable in surrounding areas

3.2.3 Functional Positive Testing

	Module	Functional Positive Test Cases ID			
		Low	Medium	High	Total
1.	Dashboard	DA-TC001 , DA-TC002 , DA-TC005 , DA-TC006 , DA-TC007	DA-TC003 , DA-TC004 , DA-TC009	DA-TC008 , DA-TC010	10
2.	Sensor Management	SM-TC005 , SM-TC006 , SM-TC007	SM-TC001 , SM-TC008 SM-TC009 , SM-TC010		07
3.	Admin User Management	AUM-TC005 , AUM-TC010 , AUM-TC011	AUM-TC001 , AUM-TC006 , AUM-TC007 , AUM-TC009		07
4.	Data Management	DM-TC001 , DM-TC002 , DM-TC005 , DM-TC008 , DM-TC009	DM-TC003 , DM-TC004 , DM-TC006 , DM-TC007	DM-TC011	10
5.	Alert Configurations	AC-TC004 , AC-TC005 , AC-TC009	AC-TC001 , AC-TC008 , AC-TC010	AC-TC006 , AC-TC007	08
6.	Role-Based Authentication	RBA-TC001 , RBA-TC002 , RBA-TC003 , RBA-TC010 , RBA-TC011	RBA-TC004 , RBA-TC005 ,	RBA-TC008 , RBA-TC009	09
7.	Public Dashboard	PUB-TC001 , PUB-TC002 , PUB-TC003 , PUB-TC007 , PUB-TC009 , PUB-TC010	PUB-TC004 , PUB-TC005 , PUB-TC006 ,	PUB-TC008	10

3.2.4 Functional Negative Testing

	Module	Functional Negative Test Cases ID			
		Low	Medium	High	Total
1.	Dashboard	N/A	N/A	N/A	N/A
2.	Sensor Management	N/A	SM-TC002 , SM-TC003 , SM-TC004	SM-TC011	04
3.	Admin User Management	N/A	AUM-TC002 , AUM-TC003 , AUM-TC004	AUM-TC008	04
4.	Data Management	N/A	N/A	N/A	
5.	Alert Configurations	N/A	AC-TC002 , AC-TC003 , AC-TC011	N/A	03
6.	Role-Based Authentication	N/A	RBA-TC006 , RBA-TC007 ,	N/A	02
7.	Public Dashboard	N/A	N/A	N/A	

3.2.5 Functional Alternative Testing

	Module	Functional Alternative Test Cases ID			
		Low	Medium	High	Total
1.	Dashboard	N/A	N/A	DA-TC010	01
2.	Sensor Management	N/A	N/A	N/A	N/A
3.	Admin User Management	N/A	N/A	N/A	N/A
4.	Data Management	N/A	N/A	DM-TC011	01
5.	Alert Configurations	N/A	N/A	N/A	N/A
6.	Role-Based Authentication	N/A	N/A	RBA-TC008 , RBA-TC009	02
7.	Public Dashboard	N/A	N/A	PUB-TC008	01

3.2.6 UI / UX Testing

	Module	UI / UX Test Cases ID			
		Low	Medium	High	Total
1.	Dashboard	DA-TC002 , DA-TC005	N/A	N/A	02
2.	Sensor Management	SM-TC006 , SM-TC007	N/A	N/A	02
3.	Admin User Management	AUM-TC005 , AUM-TC010 , AUM-TC011	N/A	N/A	03
4.	Data Management	DM-TC005 , DM-TC008 , DM-TC009	N/A	N/A	03
5.	Alert Configurations	N/A	N/A	N/A	N/A
6.	Role-Based Authentication	N/A	N/A	N/A	N/A
7.	Public Dashboard	PUB-TC003 , PUB-TC007	PUB-TC003 , PUB-TC003	N/A	04

3.2.6 Performance Testing

	Module	Performance Testing Test Cases ID			
		Low	Medium	High	Total
1.	Dashboard	N/A	DA-TC009 , DA-TC004	N/A	02
2.	Sensor Management	SM-TC006	N/A	SM-TC010	02
3.	Admin User Management	N/A	N/A	N/A	
4.	Data Management	DM-TC001	DM-TC006		02
5.	Alert Configurations	N/A	N/A	AC-TC006	01
6.	Role-Based Authentication	N/A	N/A	N/A	
7.	Public Dashboard	N/A	PUB-TC004 , PUB-TC005	N/A	02

3.2.6 Load/Stress Testing

	Module	Performance Testing Test Cases ID			
		Low	Medium	High	Total
1.	Dashboard	DA-TC001	DA-TC003	N/A	02
2.	Sensor Management	N/A	SM-TC009	SM-TC001 , SM-TC008	03
3.	Admin User Management	N/A	N/A	N/A	N/A
4.	Data Management	N/A	DM-TC007	N/A	01
5.	Alert Configurations	N/A	N/A	AC-TC006	01
6.	Role-Based Authentication	N/A	RBA-TC004 , RBA-TC005	N/A	02
7.	Public Dashboard	N/A	PUB-TC001	N/A	01

3.3 Test Risks

To ensure quality throughout the QA lifecycle, key risks related to system behavior, test environment, and data reliability have been identified and tracked. These are mapped directly to modules and features in the functional test suite.

Please refer to the attached Excel sheet for the complete test risk log:

https://www.notion.so/1e0b285b4c35811cb4aee3c493b9591e?v=1e0b285b4c35819f8acd000c9c39fecd&pvs=4

3.4 Acceptance Criteria

	Acceptance Criteria	Status
01	All smoke and sanity test cases passed	Not Met
02	All P1 and P2 bugs are fixed and verified	Not Met
03	100% of regression test scenarios executed	Not Met
04	All functional positive test cases passed	Not Met
05	UI/UX test cases completed and verified visually	Not Met
06	Role-based access and security scenarios validated	Not Met
07	Final QA report created with metrics and summary	Not Met
08	Automation scripts completed for critical flows	Not Met
09	Test evidence and logs available for all executed test cases	Not Met
10	All exit criteria in Section 3.4 Test Plan reviewed and signed off	Not Met

3.5 Test Metrics Tracker

The complete QA metrics and test execution tracker is maintained in Notion for real-time updates:

Airscape Notion Metrics Tracker :

https://www.notion.so/1e0b285b4c3581acb8b0e9578ac35eda?v=1e0b285b4c35816ba23d000cdf3c26d0&pvs=4

3.6 Test Data Requirements

Module	Data Need	Link	Prepared?
Sensor Management	10+ sensors with AQI, frequency, location	Senor-Management-Data-Link.CSV	Yes
Admin User Management	1 Web Master, 3 Admins	Admin-User-Management-Link.CSV	Yes
Alerts	PM2.5, PM10, AQI threshold-based rules	Alerts-Link.CSV	Yes
Dashboard	Simulated AQI values (3 locations, varying risk)	Dashboard-Link-CSV	Yes
Data Management	50+ AQI records for date-range testing	Data-Management-Link-CSV	Yes

Manually paste the URL in browser you can access Test Data Requirements File also :

- https://www.notion.so/Test_Data_Requirements-1e0b285b4c3580108f19e002c9df985f?pvs=4

4.0 Test Deliverables

	Deliverable	Description
	Test Strategy Document	Defines overall QA strategy, testing types, scope, risks, and approach
	Test Plan Document	This master document
	Test Scenarios & Test Cases	Structured per module, categorized by type (positive, negative, etc.)
	Bug Reports / Defect Log	Contains issue ID, title, severity, status, and resolution notes
	Test Summary Reports	High-level execution stats, defect summary, overall QA readiness
	Automation Scripts (Playwright)	For smoke and regression scripts (login, alert, filter, CRUD)
	Test Metrics Tracker	Dashboard to track test case counts, execution rate, pass %, automation

	Test Risk Tracker	Active risks + mitigations documented and updated
	Test Data Files	Structured mock/test data for sensors, users, AQI logs, alerts

5.0 Environment Setup

- This section describes the environments used for testing, tools, and configurations.

Test Environments

Type	URL / Tool / Setup
Staging URL	http://localhost:8000 (Laravel local server)
Admin Login	/admin/login — Roles: Admin / Web Master
DB	MySQL (localhost) + Laravel Seeder
Sensor Data	Simulated via backend cron/scheduler

Tools Used

Tool	Purpose
VS Code	Editor for code + test scripts
Notion	Test planning, metrics, risks
Postman	API testing (alerts/sensors)
Playwright	Automation framework for E2E tests
Git/GitHub	Version control for test scripts
PhpMyAdmin	Manual DB validation