

Groundwater ML Platform - Library Analysis

1. Backend (Python/FastAPI)

The backend is built with FastAPI and handles data processing, API endpoints, and background tasks.

Library	Category	Usage Description
fastapi	Framework	Core API framework handling endpoints and requests.
uvicorn	Server	ASGI server for running the application.
pandas	Data Science	Data loading, cleaning, and WQI attribute calculation.
numpy	Data Science	Numerical operations and array handling.
pydantic	Validation	Data validation for request/response models.
apscheduler	Scheduling	Background background tasks (e.g. daily alerts).
supabase	Database	Client connection for user and subscription data.
resend	Email	Service for delivering email alerts.
python-dotenv	Config	Environment variable management.

2. Frontend (Next.js)

The frontend is a React-based web application using Next.js for routing and rendering.

Library	Category	Usage Description
next	Framework	React framework for SSR and routing.
react	UI Library	Core component-based UI library.
@mui/material	UI Components	Pre-styled visual components (Material Design).
tailwindcss	Styling	Utility-first CSS for custom layouts.
leaflet	Maps	Interactive map engine.
react-leaflet	Maps	React wrapper for Leaflet integration.
recharts	Charts	Data visualization graphs and charts.

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		React hooks for data fetching and caching.
axios	HTTP Client	Making API requests to the backend.
zod	Validation	Schema validation for forms.
framer-motion	Animation	UI transitions and animations.
swr	Data Fetching	