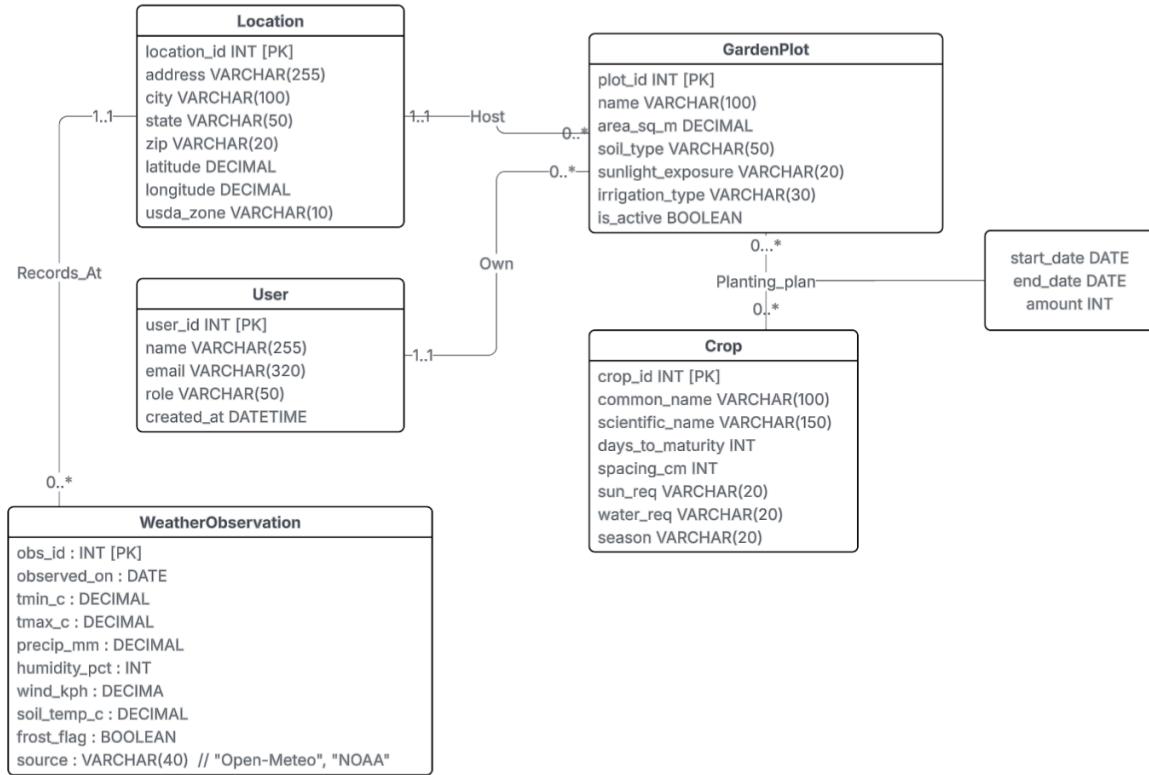


Conceptual and Logical Database Design

UML Diagram



Entities: Assumptions and Explanations

User: One account manages gardens. We expect one owner per plot and possible future roles/permissions. Keep as an entity so one user can own many plots.

Location: A physical site (address, lat/long, USDA zone). Multiple plots can share one site and all weather attaches to the site. Keep as an entity to keep geo/zone data in one place.

GardenPlot: A distinct bed/area with stable traits (area, soil, sun, irrigation, active flag). It belongs to exactly one owner and one location.

Crop: Catalog of plant types with specific crop facts (days to maturity, spacing, sun/water needs). Kept as an entity so these facts are defined once and reused across many plantings.

WeatherObservation: Daily weather measured at a location (observed_on date, tmin/tmax, precip, humidity, wind, optional soil temp, frost flag, source). Stored as its own entity for recommendations and trend analysis across time.

Relationships: Cardinality and Explanations

User \leftarrow owns \rightarrow GardenPlot:

1 \leftrightarrow many.

Each plot has exactly one accountable owner, while a user may own zero or many plots.

Location \leftarrow hosts \rightarrow GardenPlot:

1 \leftrightarrow many.

A site can have many plots, each plot sits at exactly one site.

GardenPlot \leftarrow grows \rightarrow Crop (relationship with attributes – Planting):

many \leftrightarrow many, with relationship attributes

Location \leftarrow records_at \rightarrow WeatherObservation:

1 \leftrightarrow many.

Many daily observations over time per site. Each weather row belongs to one location.

Normalization / 3NF

Functional Dependencies (FDs)

- location_id \rightarrow (address, city, state, zip, latitude, longitude, usda_zone)
- plot_id \rightarrow (name, area_sq_m, soil_type, sunlight_exposure, irrigation_type, is_active, owner_user_id, location_id)
- user_id \rightarrow (name, email, role, created_at)
- crop_id \rightarrow (common_name, scientific_name, days_to_maturity, spacing_cm, sun_req, water_req, season)
- obs_id \rightarrow (observed_on, tmin_c, tmax_c, precip_mm, humidity_pct, wind_kph, soil_temp_c, frost_flag, source, location_id)

Normalization check:

- Location:
 - location_id \rightarrow (address, city, state, zip, latitude, longitude, usda_zone)
 - zip \rightarrow (city, state)
 - latitude, longitude \rightarrow (usda_zone)
 - latitude, longitude \rightarrow (city, state)
 - \Rightarrow Location is not in 3NF because of transitive rule
 - Decompose into:
 - Location(location_id [PK], address, zip, latitude, longitude)
 - PostalCode(zip [PK], city, state, usda_zone)
- Garden Plot:
 - plot_id \rightarrow (name, area_sq_m, soil_type, sunlight_exposure, irrigation_type, is_active, owner_user_id, location_id)
 - \Rightarrow plot_id is in 3NF
- User:

- $\text{user_id} \rightarrow (\text{name}, \text{email}, \text{role}, \text{created_at})$
 - $\text{email} \rightarrow (\text{user_id})$
 - $\Rightarrow \text{user_id}$ is in 3NF by Trivial Rule (determines itself)
- Crop:
 - $\text{crop_id} \rightarrow (\text{common_name}, \text{scientific_name}, \text{days_to_maturity}, \text{spacing_cm}, \text{sun_req}, \text{water_req}, \text{season})$
 - $\Rightarrow \text{crop_id}$ is in 3NF
- Weather Observation:
 - $\text{obs_id} \rightarrow (\text{observed_on}, \text{tmin_c}, \text{tmax_c}, \text{precip_mm}, \text{humidity_pct}, \text{wind_kph}, \text{soil_temp_c}, \text{frost_flag}, \text{source}, \text{location_id})$
 - $\Rightarrow \text{obs_id}$ is in 3NF

Final 3NF:

- Location(location_id [PK], address, zip, latitude, longitude)
- PostalCode(zip [PK], city, state, usda_zone)
- GardenPlot(plot_id [PK], name, area_sq_m, soil_type, sunlight_exposure, irrigation_type, is_active, owner_user_id [FK→User.user_id], location_id [FK→Location.location_id])
- User(user_id [PK], name, email UNIQUE, role, created_at)
- Crop(crop_id [PK], common_name, scientific_name, days_to_maturity, spacing_cm, sun_req, water_req, season)
- WeatherObservation(obs_id [PK], location_id [FK→Location.location_id], observed_on DATE, tmin_c, tmax_c, precip_mm, humidity_pct, wind_kph, soil_temp_c, frost_flag, source)

Relational Schema

Location(location_id: INT [PK], address: VARCHAR(255), city: VARCHAR(100), state: VARCHAR(50), zip: VARCHAR(20), latitude: DECIMAL, longitude: DECIMAL, usda_zone: VARCHAR(10))

User(user_id: INT [PK], name: VARCHAR(255), email: VARCHAR(320), role: VARCHAR(50), created_at: DATETIME)

GardenPlot(plot_id: INT [PK], user_id: INT [FK to User.user_id], location_id: INT [FK to Location.location_id], name: VARCHAR(100), area_sq_m: DECIMAL, soil_type: VARCHAR(50), sunlight_exposure: VARCHAR(20), irrigation_type: VARCHAR(30), is_active: BOOLEAN)

Crop(crop_id: INT [PK], common_name: VARCHAR(100), scientific_name: VARCHAR(150), days_to_maturity: INT, spacing_cm: INT, sun_req: VARCHAR(20), water_req: VARCHAR(20), season: VARCHAR(20))

Planting_Plan(plot_id: INT [FK to GardenPlot.plot_id], crop_id: INT [FK to Crop.crop_id], start_date: DATE, end_date: DATE, amount INT)

```
WeatherObservation(obs_id: INT [PK], location_id: INT [FK to Location.location_id],  
observed_on: DATE, tmin_c: DECIMAL, tmax_c: DECIMAL, precip_mm: DECIMAL,  
humidity_pct: INT, wind_kph: DECIMAL, soil_temp_c: DECIMAL, frost_flag: BOOLEAN, source:  
VARCHAR(40))
```