

# Green Irrigation Management System (GIMS)

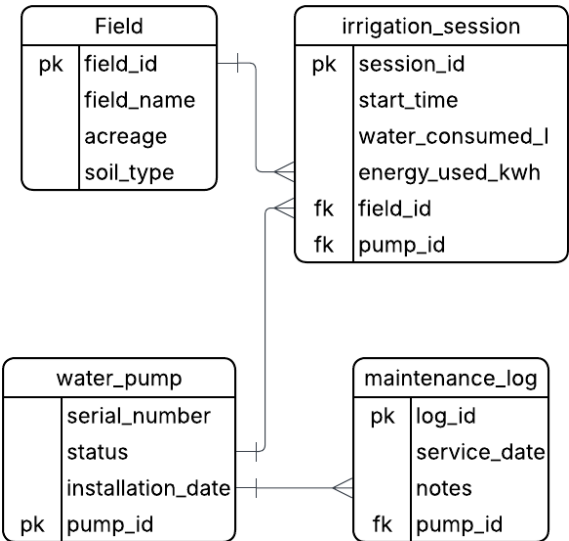
## Phase III: Logical Model Design

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### 1 Entity-Relationship Diagram (ERD)

The following Entity-Relationship Diagram (ERD) illustrates the four core entities and their One-to-Many (1:M) relationships, forming a dimensional model (Star Schema) that supports both transactional integrity and Business Intelligence (BI) analysis.



### 2 Data Dictionary and Schema Definition

The schema consists of two Dimension Tables (**FIELD**, **WATER\_PUMP**), one Fact Table (**IRRIGATION\_SESSION**), and one Audit Table (**MAINTENANCE\_LOG**).

Table 1: GIMS Data Dictionary (3NF)

Table	Column	Data Type	Constraints / Keys
<b>FIELD</b>  (Dimension)	FIELD_ID	NUMBER(10)	<b>PK</b> , NOT NULL, IDENTITY
	FIELD_NAME	VARCHAR2(50)	NOT NULL, UNIQUE
	ACREAGE	NUMBER(8,2)	NOT NULL, CHECK > 0
	SOIL_TYPE	VARCHAR2(50)	CHECK ('Clay', 'Loam', 'Sandy')
<b>WATER_PUMP</b>  (Dimension)	PUMP_ID	NUMBER(10)	<b>PK</b> , NOT NULL, IDENTITY
	SERIAL_NUMBER	VARCHAR2(50)	NOT NULL, UNIQUE
	MODEL_NAME	VARCHAR2(100)	NOT NULL
	STATUS	VARCHAR2(20)	NOT NULL, CHECK ('ON', 'OFF', 'MAINTENANCE')
<b>MAINTENANCE_LOG</b>  (Audit)	LOG_ID	NUMBER(10)	<b>PK</b> , NOT NULL, IDENTITY
	PUMP_ID	NUMBER(10)	<b>FK</b> (WATER_PUMP)
	SERVICE_DATE	DATE	NOT NULL
	NOTES	VARCHAR2(500)	
<b>IRRIGATION_SESSION</b>  (Fact)	SESSION_ID	NUMBER(15)	<b>PK</b> , NOT NULL, IDENTITY
	FIELD_ID	NUMBER(10)	<b>FK</b> (FIELD), NOT NULL
	PUMP_ID	NUMBER(10)	<b>FK</b> (WATER_PUMP), NOT NULL
	START_TIME	TIMESTAMP	NOT NULL
	WATER_CONSUMED_L	NUMBER(10,2)	NOT NULL, CHECK $\geq 0$
	ENERGY_USED_KWH	NUMBER(6,2)	NOT NULL, CHECK $\geq 0$

### 3 Design Justification and Principles

#### 3.1 Normalization (Third Normal Form - 3NF)

The logical model is designed to adhere to the Third Normal Form (3NF) to minimize data redundancy and ensure transactional integrity.

- **Adherence:** The schema satisfies 3NF as all non-key attributes are dependent solely on the entire primary key and not on any other non-key attribute.

### 3.2 Business Intelligence (BI) Structure

The model utilizes a Star Schema pattern, optimizing the database for efficient analytical querying necessary for the BI phase.

- **Fact Table:** IRRIGATION\_SESSION is the central fact table containing the measures (metrics) that will be aggregated and analyzed.
- **Dimension Tables:** FIELD and WATER\_PUMP are dimension tables providing context and descriptive attributes for grouping and filtering the fact data.

### 3.3 Auditing and PL/SQL Integration

The structure supports required PL/SQL operations for automation and auditing.

- **Auditing:** The MAINTENANCE\_LOG table provides a structured location for auditing equipment service history, supporting alerts for overdue maintenance.
- **PL/SQL Support:** The STATUS column in the WATER\_PUMP table is critical for the validation function IS\_PUMP\_AVAILABLE.