**i)Normalization**

**1NF:**

**Rangers table**

| ranger\_id | name | contact\_number | rank | assigned\_area |
| --- | --- | --- | --- | --- |
| 102 | James | 725376275 | NULL | Garland |
| 101 | Daniel | 726476485 | NULL | Johnstones |
| 104 | Alex | 722759769 | NULL | Western |
| 103 | Francis | 724683912 | NULL | Eastland |

**Patrol table**

| patrol\_id | start\_time | end\_time | area\_covered | ranger\_id |
| --- | --- | --- | --- | --- |
| 1 | 28/03/2025 | 17:00:00 | Savannah zone | 101 |
| 2 | 28/03/2025 | 18:00:00 | Savannah zone | 102 |
| 3 | 29/03/2025 | 17:00:00 | Ol-dunya edge | 103 |
| 4 | 30/03/2025 | 15:00:00 | Viunah Forest | 104 |

**Report table**

| report\_id | incident\_id | details | date |
| --- | --- | --- | --- |
| 1 | 3 | Several wildlife products have been transported illegally | 29/03/2025 |
| 2 | 2 | A team rescued an injured antelope and transferred it to the sanctuary | 27/03/2025 |
| 3 | 1 | Seven elephants have been killed by poachers | 28/03/2025 |
| 4 | 4 | Rangers discovered illegal logging in Viuhan Forest | 30/03/2025 |

**Incident table**

| incident\_id | date | time | location | type | severity | description | ranger\_id |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 28/03/2025 | 11:00:00 | Savannah zone | Poaching | High | Illegal hunting reported | 103 |
| 2 | 28/03/2025 | 11:00:00 | Ol-dunya edge | Animal rescue | Low | Injured antelope found | 102 |
| 3 | 29/03/2025 | 12:00:00 | Savannah zone | Smuggling | Medium | Illegal transport spotted | 101 |
| 4 | 30/03/2025 | 08:00:00 | Viunah Forest | Habitat destruction | High | Damaged habitat reported | 103 |

**Protected\_Area table**

| protected\_area\_id | name | location |
| --- | --- | --- |
| 1 | Savannah zone | Eastern region |
| 2 | Viunah Forest | Western region |
| 3 | Ol-dunya edge | Southern region |

**Wildlife table**

| wildlife\_id | species | population | area\_id |
| --- | --- | --- | --- |
| 1 | Elephant | 50 | 2 |
| 2 | Giraffe | 62 | 3 |
| 3 | Lion | 98 | 1 |

**2NF**

**Ranger table:**

| ranger\_id | name | contact\_number | rank | assigned\_area |
| --- | --- | --- | --- | --- |
| 102 | James | 725376275 | NULL | Garland |
| 101 | Daniel | 726476485 | NULL | Johnstones |
| 104 | Alex | 722759769 | NULL | Western |
| 103 | Francis | 724683912 | NULL | Eastland |

**Protected\_Area**

| ranger\_name | area\_name | location |
| --- | --- | --- |
| James | Savannah zone | Eastern region |
| Daniel | Viunah Forest | Western region |
| Alex | Ol-dunya edge | Southern region |
| Francis | Eastland | Northern |

**3NF:**

**Protected\_Area table**

| Protected\_Area\_ID | Name | Region\_ID |
| --- | --- | --- |
| 1 | Savannah zone | 1 |
| 2 | Viunah Forest | 2 |
| 3 | Ol-dunya edge | 3 |
| 4 | Eastland | 4 |

**Region table**

| Region\_ID | Location |
| --- | --- |
| 1 | Eastern region |
| 2 | Western region |
| 3 | Southern region |
| 4 | Northern |

**Tables and fields**

**Rangers**

CREATE TABLE Ranger (

Ranger\_ID INT PRIMARY KEY,

Name VARCHAR(50),

Contact\_Number INT,

Rank VARCHAR(20),

Assigned\_Area VARCHAR(50)

);

INSERT INTO Ranger(Ranger\_ID,Name,Contact\_Number,Assigned\_Area) VALUES

(102,'James',0725376275,'Garland'),

(101,'Daniel',0726476485,'Johnstone'),

(104,'Alex',0722759769,'Western'),

(103,'Francis',0724683912,'Eastland');

**Patrol**

CREATE TABLE Patrol (

Patrol\_ID INT PRIMARY KEY,

Start\_Time TIMESTAMP,

End\_Time TIMESTAMP,

Area\_Covered VARCHAR(50),

Ranger\_ID INT,

FOREIGN KEY (Ranger\_ID) REFERENCES Ranger(Ranger\_ID)

);

INSERT INTO Patrol(Patrol\_ID,Start\_Time,End\_Time,Area\_Covered,Ranger\_ID) VALUES

(1,'2025-03-28 08:00:00','2025-03-28 17:00:00','Savannah zone',101),

(2,'2025-03-28 07:00:00','2025-03-28 18:00:00','Savannah zone',102),

(3,'2025-03-29 09:00:00','2025-03-29 17:00:00','Ol-dunya edge',103),

(4,'2025-03-30 06:00:00','2025-03-30 15:00:00','Viunah Forest',104);

**Incident**

CREATE TABLE Incident (

Incident\_ID INT PRIMARY KEY,

Date DATE,

Time TIME,

Location VARCHAR(100),

Type VARCHAR(50),

Severity VARCHAR(20),

Description TEXT,

Ranger\_ID INT,

FOREIGN KEY (Ranger\_ID) REFERENCES Ranger(Ranger\_ID)

);

INSERT INTO Incident(Incident\_ID,Date,Time,Location,Type,Severity,Description,Ranger\_ID) VALUES

(1,'2025-03-28','11:00:00','Savannah zone','Poaching','High','Illegal hunting reported','103'),

(2,'2025-03-28','11:00:00','Ol-dunya edge','Animal rescue','Low','Injured antelope found','102'),

(3,'2025-03-29','12:00:00','Savannah zone','Smuggling','Medium','Illegal transport spotted','101'),

(4,'2025-03-30','08:00:00','Viunah Forest','Habitat destruction','High','Damaged habitat reported','103');

**Report**

CREATE TABLE Report (

Report\_ID INT PRIMARY KEY,

Incident\_ID INT NOT NULL,

Details TEXT NOT NULL,

Date DATE NOT NULL,

FOREIGN KEY (Incident\_ID) REFERENCES Incident(Incident\_ID)

);

INSERT INTO Report (Report\_ID, Incident\_ID, Details, Date)

VALUES

(1, 3, 'Several wildlife products have been transported illegally', '2025-03-29'),

(2, 2, 'A team rescued an injured antelope and transferred it to the sanctuary', '2025-03-27'),

(3, 1, 'Seven elephants have been killed by poachers', '2025-03-28'),

(4, 4, 'Rangers discovered illegal logging in Viuhan Forest', '2025-03-30');

**Protected\_Area**

CREATE TABLE Protected\_Area (

Protected\_Area\_ID INT PRIMARY KEY,

Name VARCHAR(50) NOT NULL,

Location VARCHAR(100) NOT NULL

);

INSERT INTO Protected\_Area(Protected\_Area\_ID,Name,Location)VALUES

(1,'Savannah zone','Eastern region'),

(2,'Viunah Forest','Western region'),

(3,'Ol-dunya edge','Southern region');

**Wildlife**

CREATE TABLE Wildlife (

Wildlife\_ID INT PRIMARY KEY,

Species VARCHAR(50) NOT NULL,

Population INT NOT NULL,

Area\_ID INT,

FOREIGN KEY (Area\_ID) REFERENCES Protected\_Area(Protected\_Area\_ID)

);

INSERT INTO Wildlife(Wildlife\_ID,Species,Population,Area\_ID)VALUES

(1,'Elephant',50,2),

(2,'Giraffe',62,3),

(3,'Lion',98,1);

**iii)Indexes**

**Clustered index** - Improves lookup performance and ensures efficient row retrieval.

CREATE INDEX idx\_ranger\_id ON Ranger(ranger\_id);

CREATE INDEX idx\_patrol\_id ON Patrol(patrol\_id);

CREATE INDEX idx\_incident\_id ON Incident(incident\_id);

CREATE INDEX idx\_report\_id ON Report(report\_id);

CREATE INDEX idx\_protected\_area\_id ON Protected\_Area(protected\_area\_id);

CREATE INDEX idx\_wildlife\_id ON Wildlife(wildlife\_id);

**Foreign key indexing -** Speeds up JOIN operations between tables.

CREATE INDEX idx\_ranger\_protected\_area ON Ranger(protected\_area\_id);

CREATE INDEX idx\_patrol\_ranger ON Patrol(ranger\_id);

CREATE INDEX idx\_incident\_patrol ON Incident(patrol\_id);

CREATE INDEX idx\_report\_incident ON Report(incident\_id);

CREATE INDEX idx\_wildlife\_protected\_area ON Wildlife(area\_id);

**Full-text indexing -** Improves searches for descriptive reports and incident logs.

CREATE FULLTEXT INDEX idx\_report\_text ON Report(details);

CREATE FULLTEXT INDEX idx\_incident\_description ON Incident(description);