COMP2001 – Coursework1

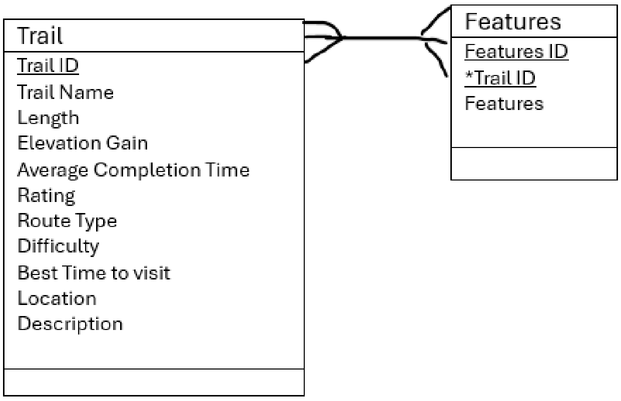
Exercise 1: Normalization

0NF	1NF	2NF	3NF
			Trail
Trail ID	Trail ID	Trail ID	Trail ID
Trail Name	Trail Name	Trail Name	Trail Name
Length	Length	Length	Length
Elevation Gain	Elevation Gain	Elevation Gain	Elevation Gain
Average Completion Time	Average Completion Time	Average Completion Time	Average Completion Time
Rating	Rating	Rating	Rating
Route Type	Route Type	Route Type	Route Type
Difficulty	Difficulty	Difficulty	Difficulty
Best Time to Visit	Best Time to Visit	Best Time to Visit	Best Time to Visit
Location	Location	Location	Location
Description	Description	Description	Description
(Features ID			
Features)			**Trail Features**
	Features ID	*Features ID	*Features ID
	*Trail ID	*Trail ID	*Trail ID
	Features		
		Features ID	**Features**
		Features	Features ID
			Features

Difficulty and Route type could be assumed as repeating groups due to trails usually being "easy, medium or hard" and "loop, out and back, point to point". However, this could change on occasion so its easier to keep these attributes within the trail table. Features is a repeating group however, so had to be split into a separate group. This created a many – many relationship so a junction table had to be added.

Exercise 2: Entity Relationship Diagram

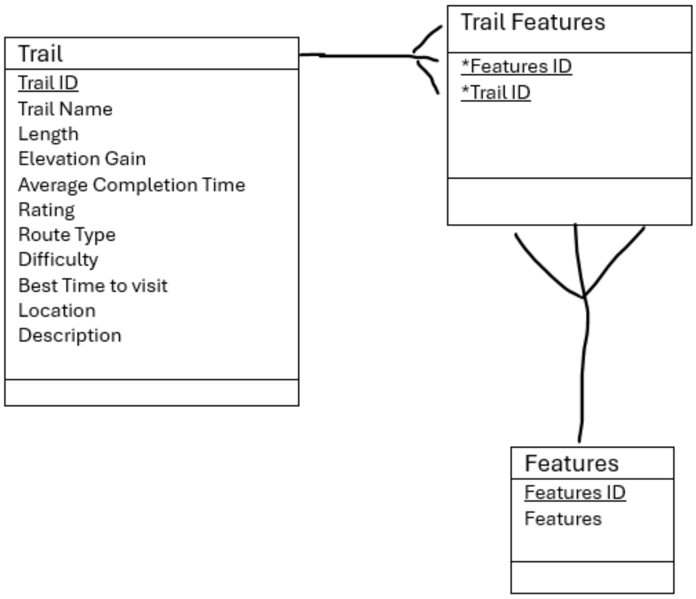
Partial ERD Diagram



The users included in the initial ERD has been removed as that data is going to be pulled through an API. Meaning that the data does not need to be stored in the database. However, the users will have specific access to view a trail (user) or create a trail (admin) which will be decided through roles on the trail microservice.

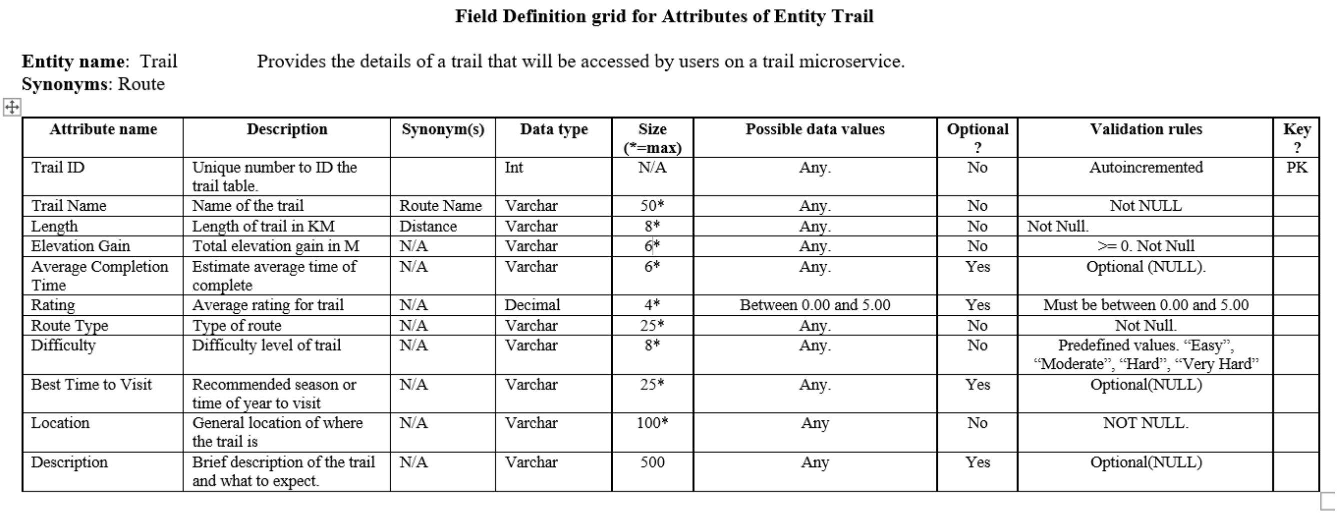
The partial ERD shows the many to many relationship between the Trail and Features.

Final ERD



The final ERD shows the many – many relationship has been resolved by creating a junction table called “Trail features”. This ERD will be implemented into the database.

Exercise 3: Database Design



Field Definition grid for Attributes of Entity Trail

Entity name: Trail Provides the details of a trail that will be accessed by users on a trail microservice.
Synonyms: Route

Attribute name	Description	Synonym(s)	Data type	Size (*=max)	Possible data values	Optional ?	Validation rules	Key ?
Trail ID	Unique number to ID the trail table.		Int	N/A	Any.	No	Autoincremented	PK
Trail Name	Name of the trail	Route Name	Varchar	50*	Any.	No	Not NULL	
Length	Length of trail in KM	Distance	Varchar	8*	Any.	No	Not Null.	
Elevation Gain	Total elevation gain in M	N/A	Varchar	6*	Any.	No	>= 0. Not Null	
Average Completion Time	Estimate average time of complete	N/A	Varchar	6*	Any.	Yes	Optional (NULL).	
Rating	Average rating for trail	N/A	Decimal	4*	Between 0.00 and 5.00	Yes	Must be between 0.00 and 5.00	
Route Type	Type of route	N/A	Varchar	25*	Any.	No	Not Null.	
Difficulty	Difficulty level of trail	N/A	Varchar	8*	Any.	No	Predefined values. “Easy”, “Moderate”, “Hard”, “Very Hard”	
Best Time to Visit	Recommended season or time of year to visit	N/A	Varchar	25*	Any.	Yes	Optional(NULL)	
Location	General location of where the trail is	N/A	Varchar	100*	Any	No	NOT NULL.	
Description	Brief description of the trail and what to expect.	N/A	Varchar	500	Any	Yes	Optional(NULL)	

Field Definition grid for Attributes of Entity Trail Features

Entity name: Trail Features Linking each route to the different features that it may contain
Synonyms: N/A Junction table between Trail and Features

Attribute name	Description	Synonym(s)	Data type	Size (*=max)	Possible data values	Optional ?	Validation rules	Key ?
Trail ID	Unique ID Foreign key identifying the trail table		Int	N/A	Any	No	N/A	FK
Features ID	Unique ID Foreign key identifying the features table		Int	N/A	Any	No	N/A	FK

Field Definition grid for Attributes of Entity Features

Entity name: Features Provides the features that a route may contain
Synonyms: N/A

Attribute name	Description	Synonym(s)	Data type	Size (*=max)	Possible data values	Optional ?	Validation rules	Key ?
Features ID	Unique ID Foreign key identifying each feature of the features table		Int	N/A	Any	No	Autoincremented	FK
Feature	A feature of the trail		Varchar	20*	Any.	No	Not Null	

Exercise 4: SQL

Feature Table

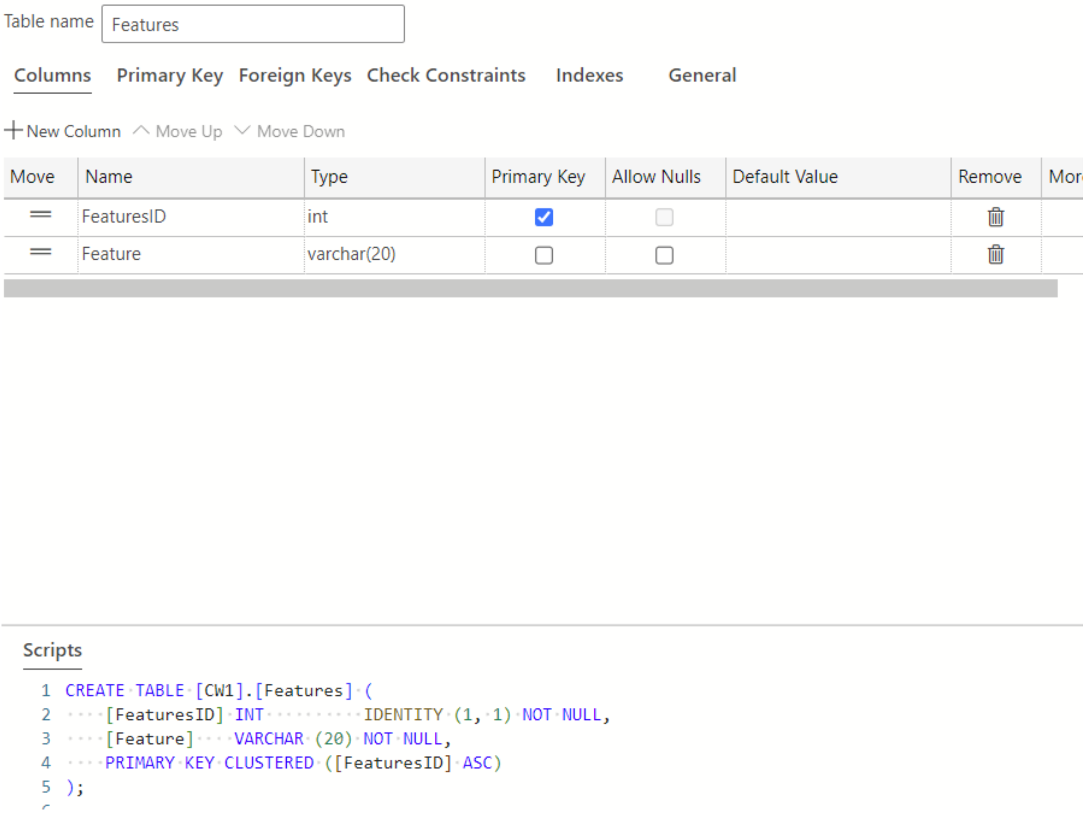


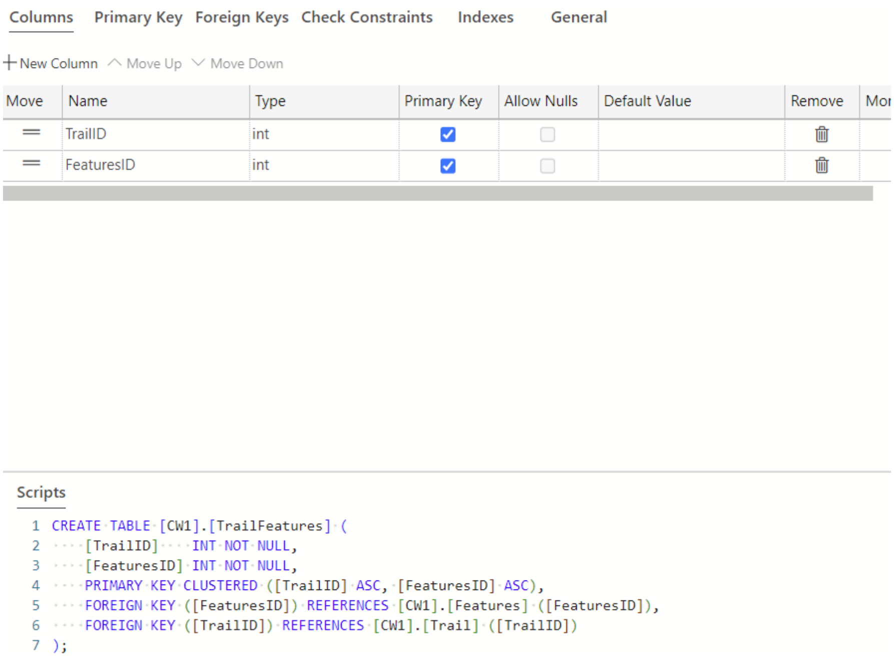
Table name: Features

Move	Name	Type	Primary Key	Allow Nulls	Default Value	Remove	Mor
═	FeaturesID	int	☑	□		🗑	
═	Feature	varchar(20)	□	□		🗑	

Scripts

```
CREATE TABLE [CW1].[Features] (
    [FeaturesID] INT          IDENTITY (1, 1) NOT NULL,
    [Feature]    VARCHAR (20) NOT NULL,
    PRIMARY KEY CLUSTERED ([FeaturesID] ASC)
);
```

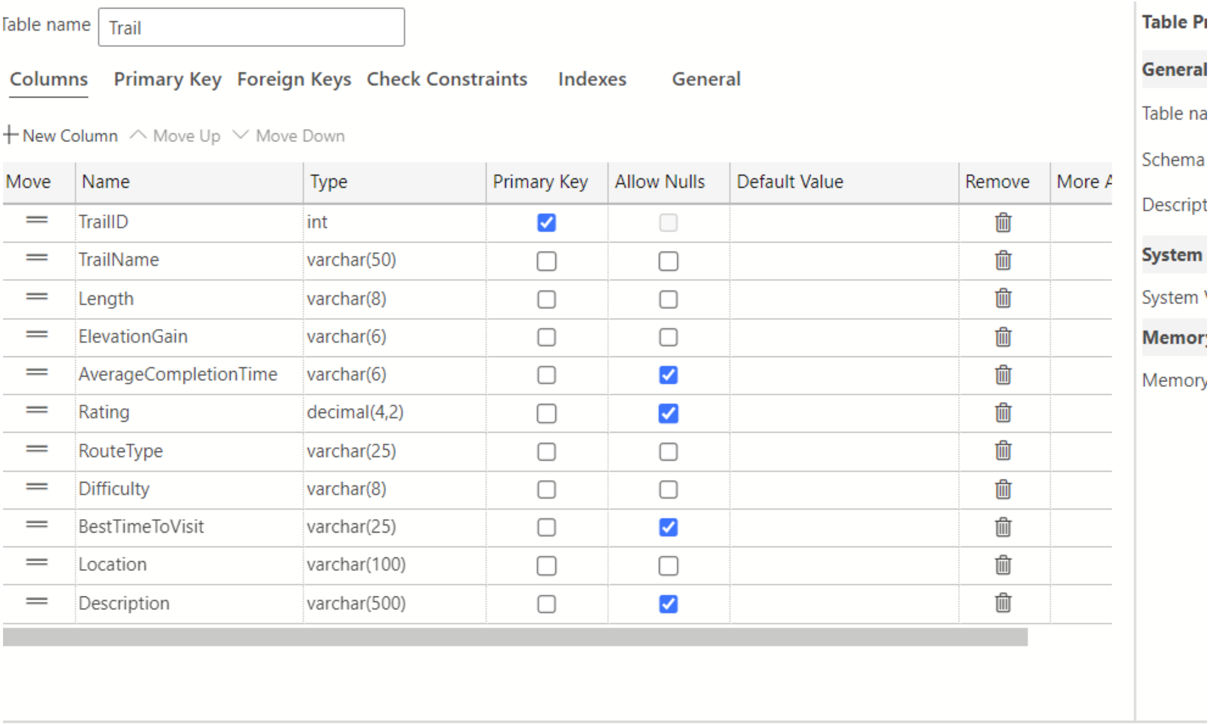
Trail Feature table



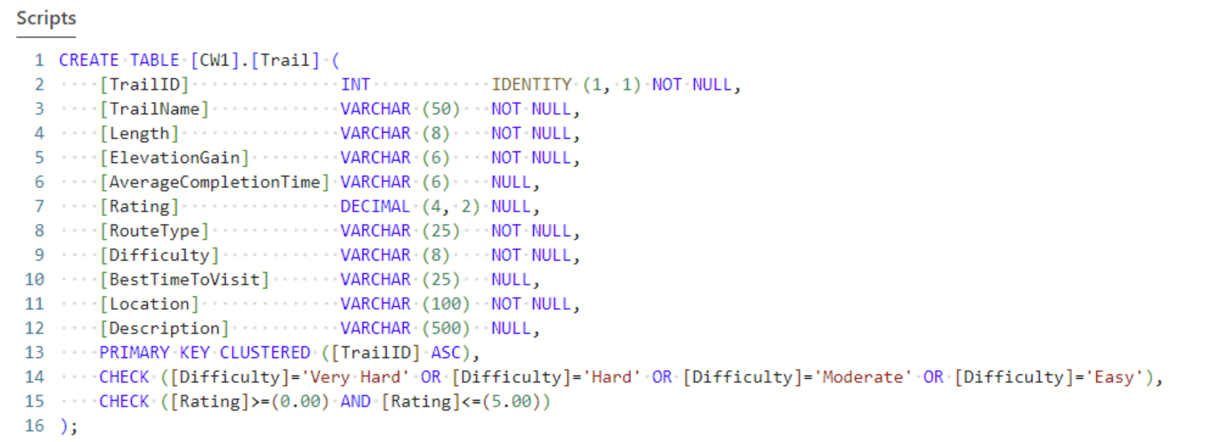
Move	Name	Type	Primary Key	Allow Nulls	Default Value	Remove	Mor
═	TrailID	int	☑	□		🗑	
═	FeaturesID	int	☑	□		🗑	

```sql
CREATE TABLE [CW1].[TrailFeatures] (
    [TrailID]    INT NOT NULL,
    [FeaturesID] INT NOT NULL,
    PRIMARY KEY CLUSTERED ([TrailID] ASC, [FeaturesID] ASC),
    FOREIGN KEY ([FeaturesID]) REFERENCES [CW1].[Features] ([FeaturesID]),
    FOREIGN KEY ([TrailID]) REFERENCES [CW1].[Trail] ([TrailID])
);
```

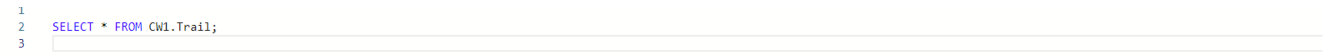
Trail Table



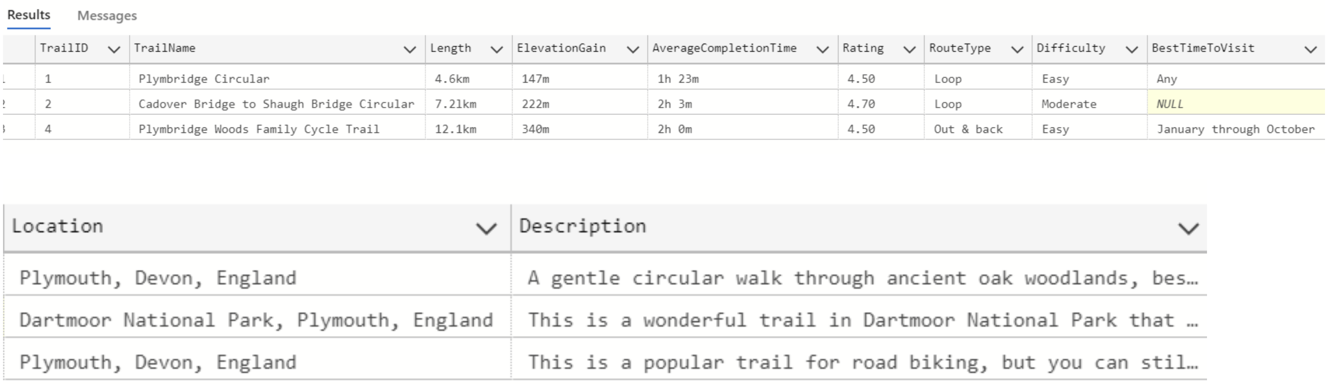
Move	Name	Type	Primary Key	Allow Nulls	Default Value	Remove	More A
═	TrailID	int	☑	□		🗑	
═	TrailName	varchar(50)	□	□		🗑	
═	Length	varchar(8)	□	□		🗑	
═	ElevationGain	varchar(6)	□	□		🗑	
═	AverageCompletionTime	varchar(6)	□	☑		🗑	
═	Rating	decimal(4,2)	□	☑		🗑	
═	RouteType	varchar(25)	□	□		🗑	
═	Difficulty	varchar(8)	□	□		🗑	
═	BestTimeToVisit	varchar(25)	□	☑		🗑	
═	Location	varchar(100)	□	□		🗑	
═	Description	varchar(500)	□	☑		🗑	



```sql
CREATE TABLE [CW1].[Trail] (
    [TrailID]               INT            IDENTITY (1, 1) NOT NULL,
    [TrailName]             VARCHAR (50)   NOT NULL,
    [Length]                VARCHAR (8)    NOT NULL,
    [ElevationGain]         VARCHAR (6)    NOT NULL,
    [AverageCompletionTime] VARCHAR (6)    NULL,
    [Rating]                DECIMAL (4, 2) NULL,
    [RouteType]             VARCHAR (25)   NOT NULL,
    [Difficulty]            VARCHAR (8)    NOT NULL,
    [BestTimeToVisit]       VARCHAR (25)   NULL,
    [Location]              VARCHAR (100)  NOT NULL,
    [Description]           VARCHAR (500)  NULL,
    PRIMARY KEY CLUSTERED ([TrailID] ASC),
    CHECK ([Difficulty]='Very Hard' OR [Difficulty]='Hard' OR [Difficulty]='Moderate' OR [Difficulty]='Easy'),
    CHECK ([Rating]>=(0.00) AND [Rating]<=(5.00))
);
```

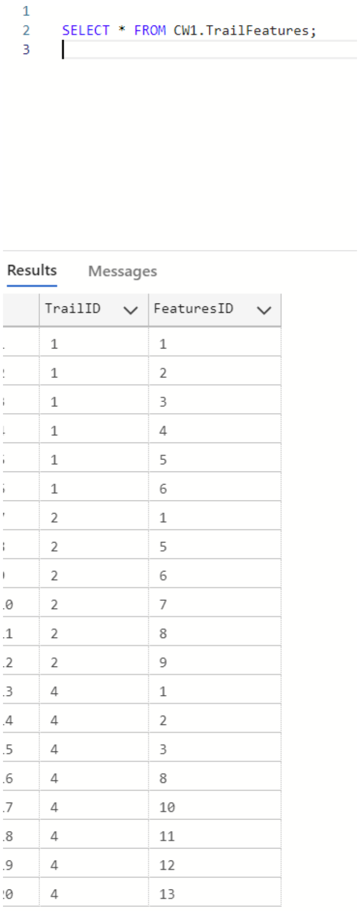


```sql

SELECT * FROM CW1.Trail;

```



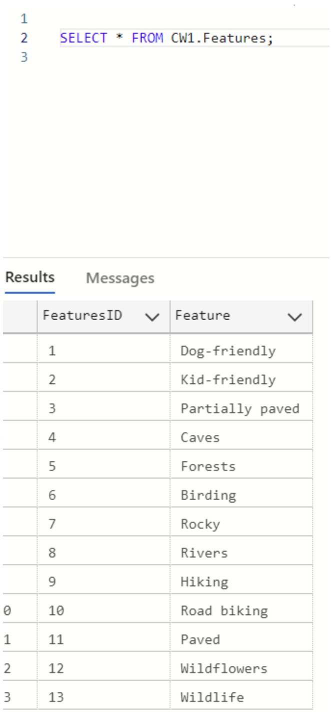
	TrailID	TrailName	Length	ElevationGain	AverageCompletionTime	Rating	RouteType	Difficulty	BestTimeToVisit
1	1	Plymbridge Circular	4.6km	147m	1h 23m	4.50	Loop	Easy	Any
2	2	Cadover Bridge to Shaugh Bridge Circular	7.21km	222m	2h 3m	4.70	Loop	Moderate	*NULL*
3	4	Plymbridge Woods Family Cycle Trail	12.1km	340m	2h 0m	4.50	Out & back	Easy	January through October

Location	Description
Plymouth, Devon, England	A gentle circular walk through ancient oak woodlands, bes…
Dartmoor National Park, Plymouth, England	This is a wonderful trail in Dartmoor National Park that …
Plymouth, Devon, England	This is a popular trail for road biking, but you can stil…



```sql
SELECT * FROM CW1.TrailFeatures;
```

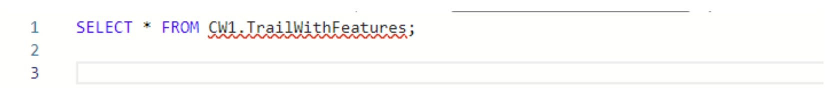
TrailID	FeaturesID
1	1
1	2
1	3
1	4
1	5
1	6
2	1
2	5
2	6
2	7
2	8
2	9
4	1
4	2
4	3
4	8
4	10
4	11
4	12
4	13



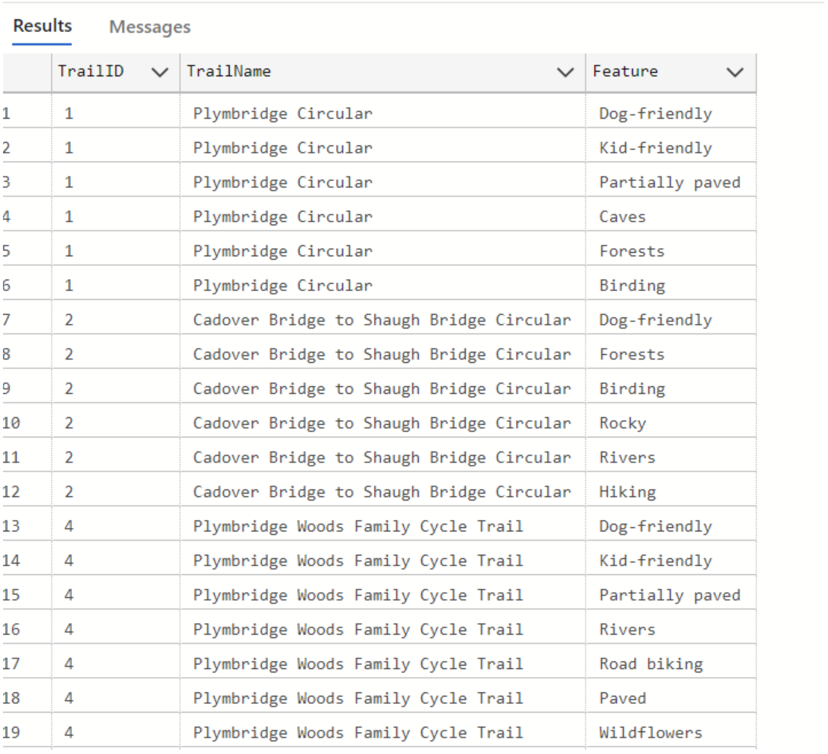
```sql
SELECT * FROM CW1.Features;
```

FeaturesID	Feature
1	Dog-friendly
2	Kid-friendly
3	Partially paved
4	Caves
5	Forests
6	Birding
7	Rocky
8	Rivers
9	Hiking
10	Road biking
11	Paved
12	Wildflowers
13	Wildlife

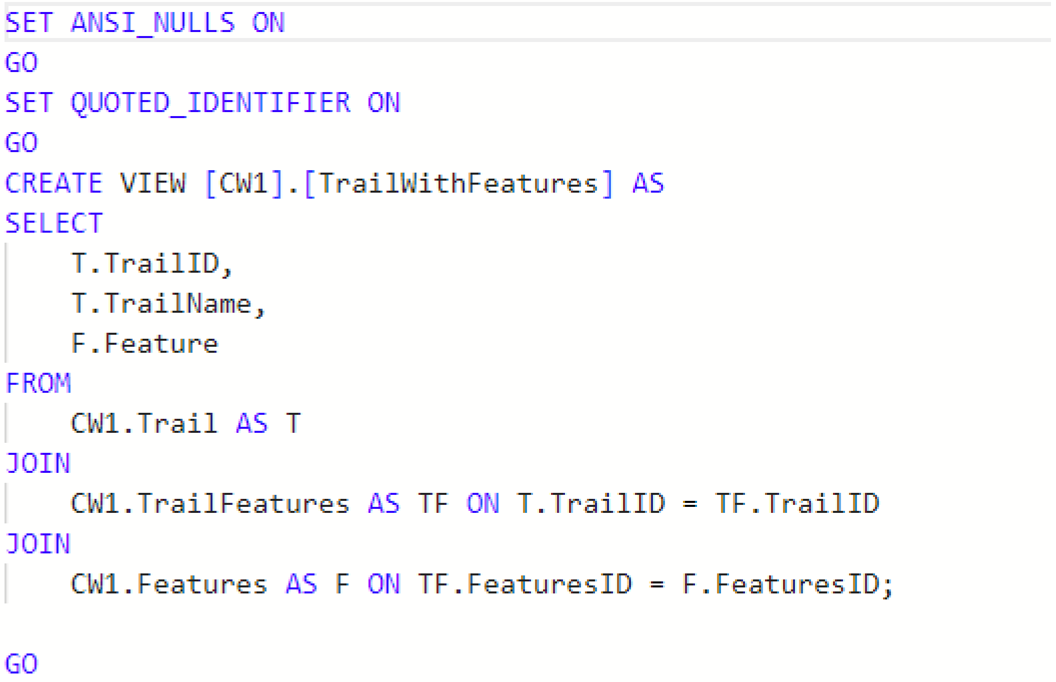
Exercise 5: View



```sql
SELECT * FROM CW1.TrailWithFeatures;
```



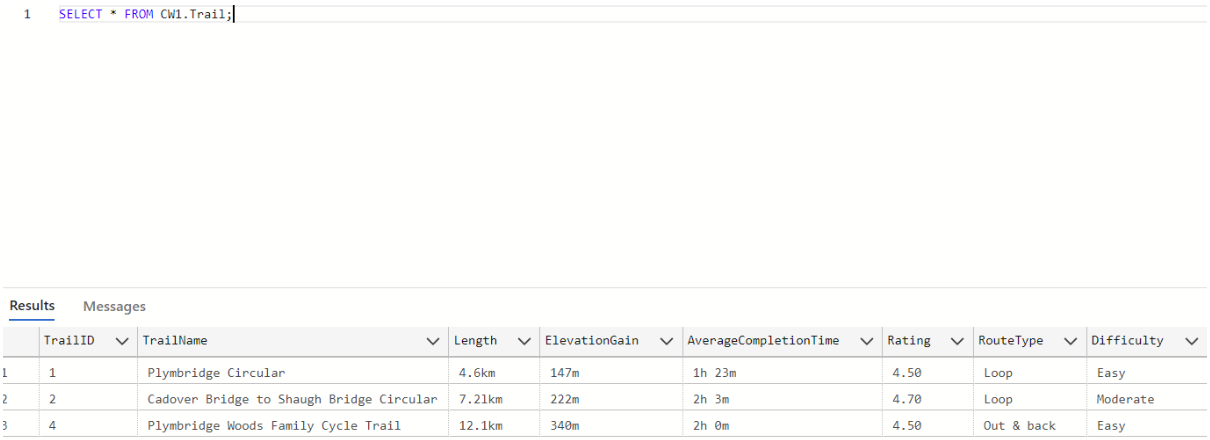
	TrailID	TrailName	Feature
1	1	Plymbridge Circular	Dog-friendly
2	1	Plymbridge Circular	Kid-friendly
3	1	Plymbridge Circular	Partially paved
4	1	Plymbridge Circular	Caves
5	1	Plymbridge Circular	Forests
6	1	Plymbridge Circular	Birding
7	2	Cadover Bridge to Shaugh Bridge Circular	Dog-friendly
8	2	Cadover Bridge to Shaugh Bridge Circular	Forests
9	2	Cadover Bridge to Shaugh Bridge Circular	Birding
10	2	Cadover Bridge to Shaugh Bridge Circular	Rocky
11	2	Cadover Bridge to Shaugh Bridge Circular	Rivers
12	2	Cadover Bridge to Shaugh Bridge Circular	Hiking
13	4	Plymbridge Woods Family Cycle Trail	Dog-friendly
14	4	Plymbridge Woods Family Cycle Trail	Kid-friendly
15	4	Plymbridge Woods Family Cycle Trail	Partially paved
16	4	Plymbridge Woods Family Cycle Trail	Rivers
17	4	Plymbridge Woods Family Cycle Trail	Road biking
18	4	Plymbridge Woods Family Cycle Trail	Paved
19	4	Plymbridge Woods Family Cycle Trail	Wildflowers



```sql
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE VIEW [CW1].[TrailWithFeatures] AS
SELECT
    T.TrailID,
    T.TrailName,
    F.Feature
FROM
    CW1.Trail AS T
JOIN
    CW1.TrailFeatures AS TF ON T.TrailID = TF.TrailID
JOIN
    CW1.Features AS F ON TF.FeaturesID = F.FeaturesID;

GO
```

Exercise 6: Stored Procedures

Before

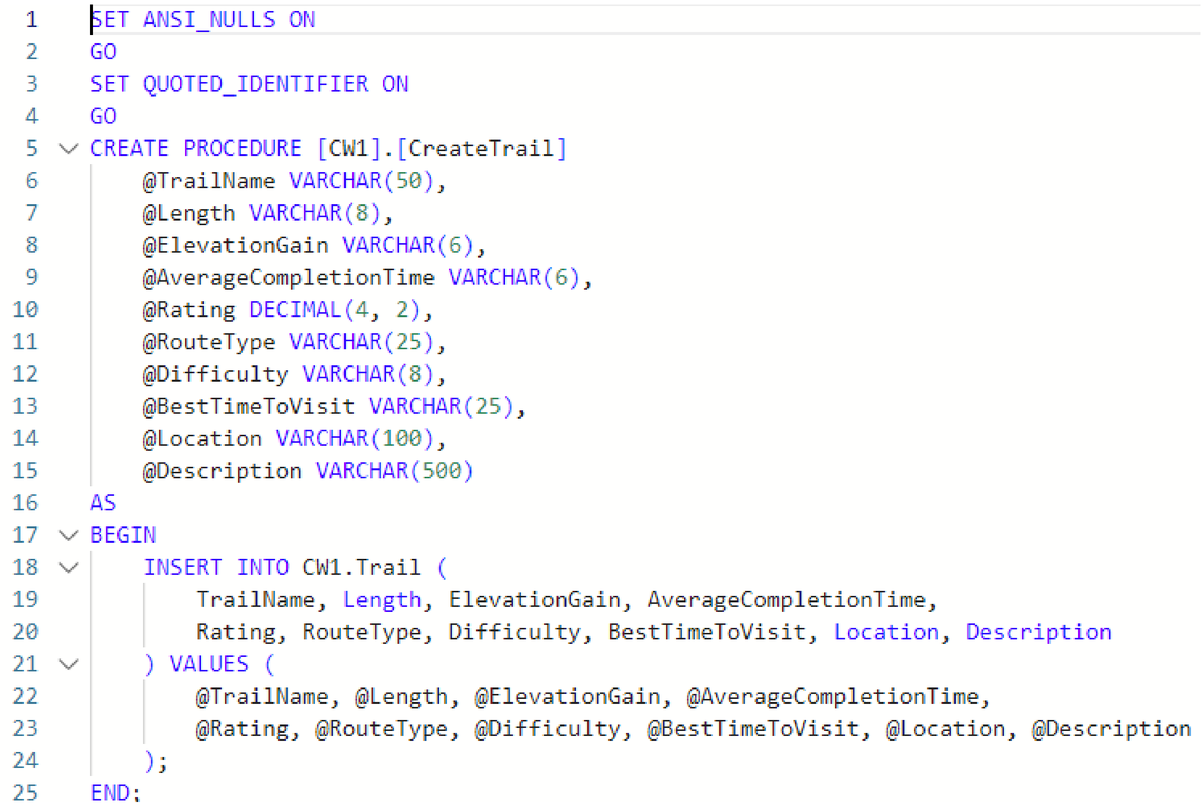


```
SELECT * FROM CW1.Trail;
```

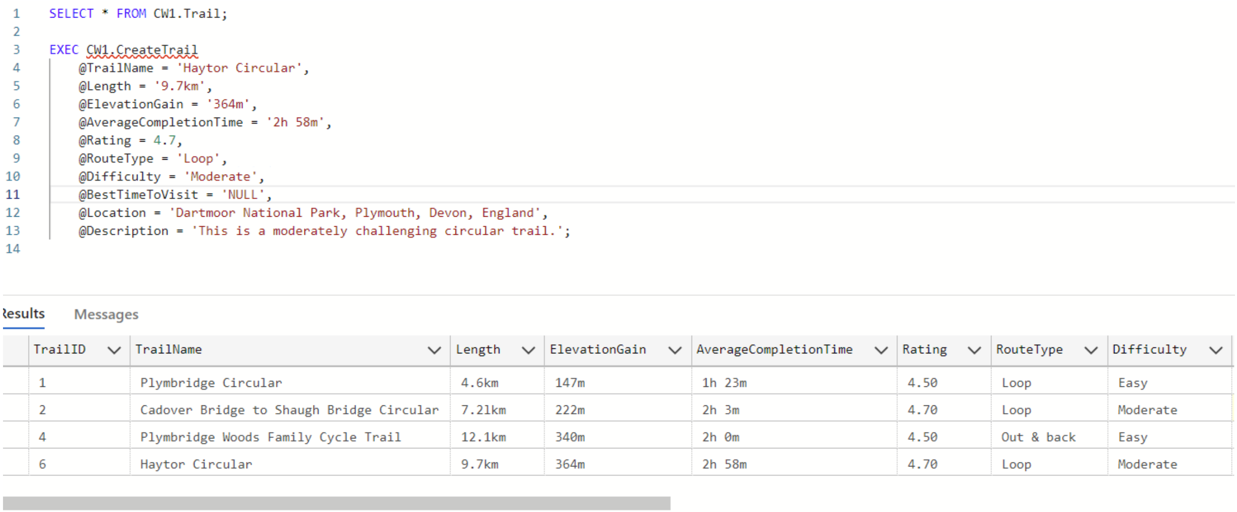
Results Messages

	TrailID	TrailName	Length	ElevationGain	AverageCompletionTime	Rating	RouteType	Difficulty
1	1	Plymbridge Circular	4.6km	147m	1h 23m	4.50	Loop	Easy
2	2	Cadover Bridge to Shaugh Bridge Circular	7.21km	222m	2h 3m	4.70	Loop	Moderate
3	4	Plymbridge Woods Family Cycle Trail	12.1km	340m	2h 0m	4.50	Out & back	Easy

Create



```
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE PROCEDURE [CW1].[CreateTrail]
    @TrailName VARCHAR(50),
    @Length VARCHAR(8),
    @ElevationGain VARCHAR(6),
    @AverageCompletionTime VARCHAR(6),
    @Rating DECIMAL(4, 2),
    @RouteType VARCHAR(25),
    @Difficulty VARCHAR(8),
    @BestTimeToVisit VARCHAR(25),
    @Location VARCHAR(100),
    @Description VARCHAR(500)
AS
BEGIN
    INSERT INTO CW1.Trail (
        TrailName, Length, ElevationGain, AverageCompletionTime,
        Rating, RouteType, Difficulty, BestTimeToVisit, Location, Description
    ) VALUES (
        @TrailName, @Length, @ElevationGain, @AverageCompletionTime,
        @Rating, @RouteType, @Difficulty, @BestTimeToVisit, @Location, @Description
    );
END;
```



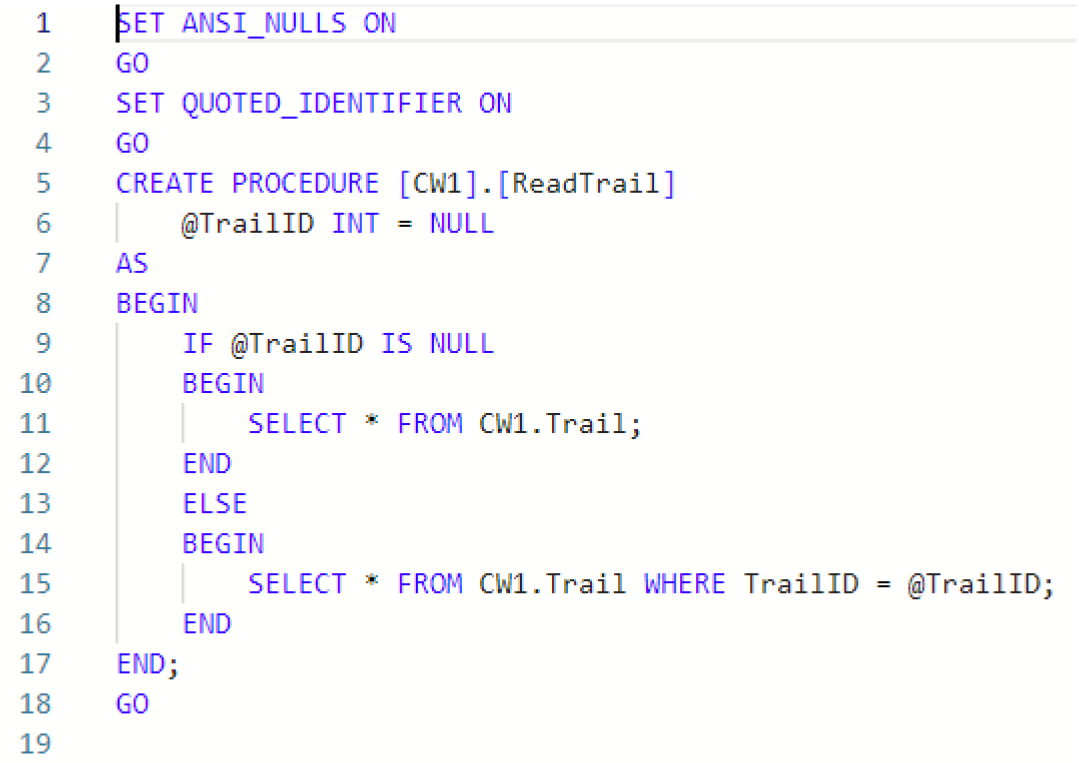
```
SELECT * FROM CW1.Trail;

EXEC CW1.CreateTrail
    @TrailName = 'Haytor Circular',
    @Length = '9.7km',
    @ElevationGain = '364m',
    @AverageCompletionTime = '2h 58m',
    @Rating = 4.7,
    @RouteType = 'Loop',
    @Difficulty = 'Moderate',
    @BestTimeToVisit = 'NULL',
    @Location = 'Dartmoor National Park, Plymouth, Devon, England',
    @Description = 'This is a moderately challenging circular trail.';
```

esults   Messages

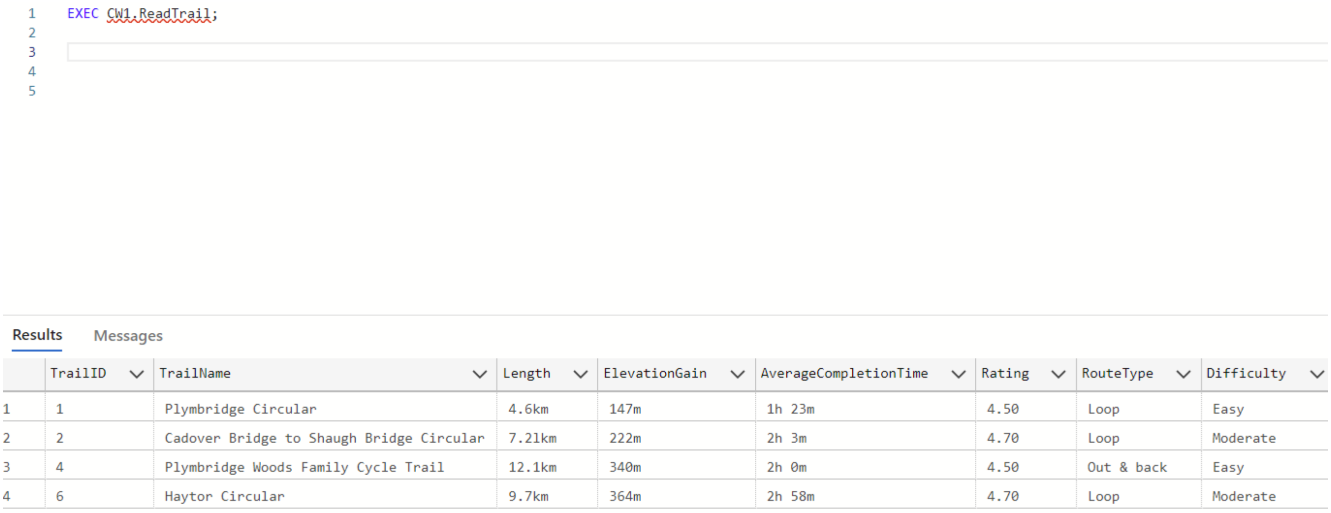
TrailID	TrailName	Length	ElevationGain	AverageCompletionTime	Rating	RouteType	Difficulty
1	Plymbridge Circular	4.6km	147m	1h 23m	4.50	Loop	Easy
2	Cadover Bridge to Shaugh Bridge Circular	7.21km	222m	2h 3m	4.70	Loop	Moderate
4	Plymbridge Woods Family Cycle Trail	12.1km	340m	2h 0m	4.50	Out & back	Easy
6	Haytor Circular	9.7km	364m	2h 58m	4.70	Loop	Moderate

Read

It can read the whole trail table, or just one trail within the table.

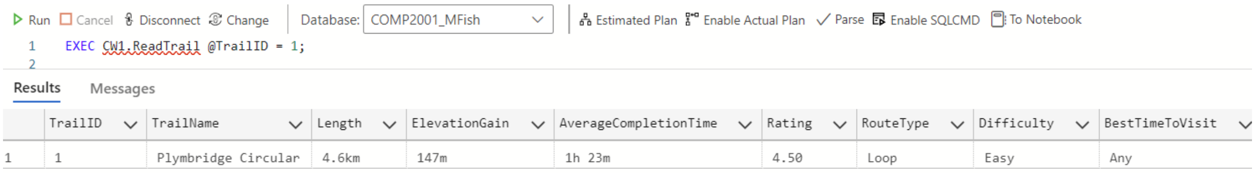


```
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE PROCEDURE [CW1].[ReadTrail]
    @TrailID INT = NULL
AS
BEGIN
    IF @TrailID IS NULL
    BEGIN
        SELECT * FROM CW1.Trail;
    END
    ELSE
    BEGIN
        SELECT * FROM CW1.Trail WHERE TrailID = @TrailID;
    END
END;
GO
```



```sql
EXEC CW1.ReadTrail;
```

	TrailID	TrailName	Length	ElevationGain	AverageCompletionTime	Rating	RouteType	Difficulty
1	1	Plymbridge Circular	4.6km	147m	1h 23m	4.50	Loop	Easy
2	2	Cadover Bridge to Shaugh Bridge Circular	7.21km	222m	2h 3m	4.70	Loop	Moderate
3	4	Plymbridge Woods Family Cycle Trail	12.1km	340m	2h 0m	4.50	Out & back	Easy
4	6	Haytor Circular	9.7km	364m	2h 58m	4.70	Loop	Moderate

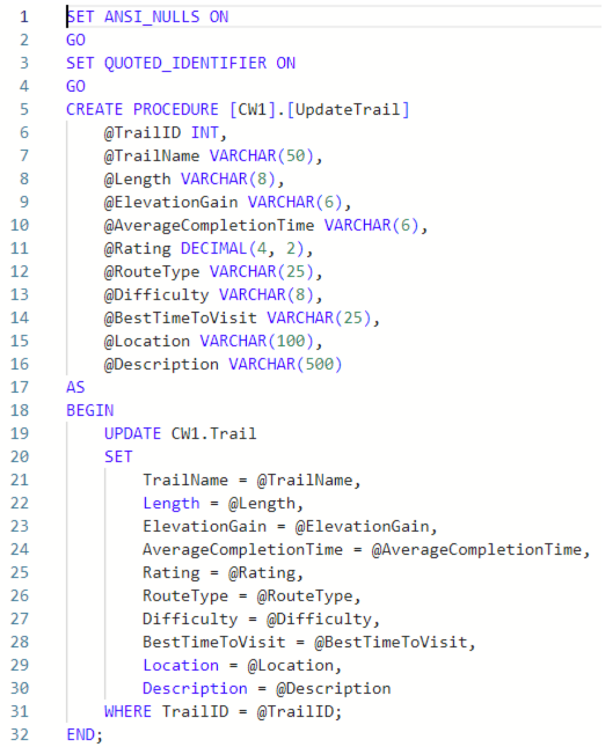


Database: COMP2001_MFish

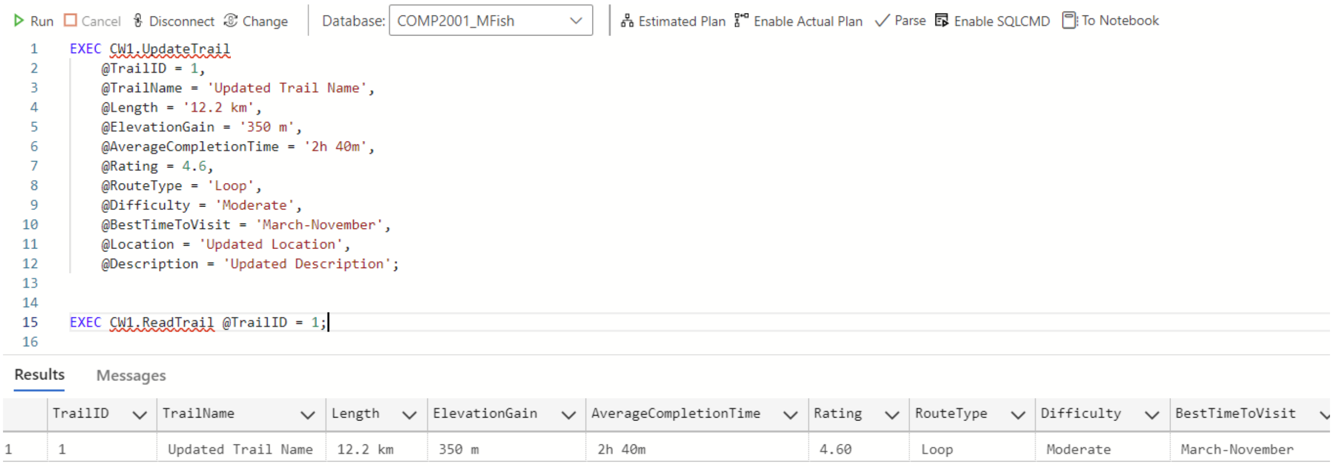
```sql
EXEC CW1.ReadTrail @TrailID = 1;
```

	TrailID	TrailName	Length	ElevationGain	AverageCompletionTime	Rating	RouteType	Difficulty	BestTimeToVisit
1	1	Plymbridge Circular	4.6km	147m	1h 23m	4.50	Loop	Easy	Any

Update



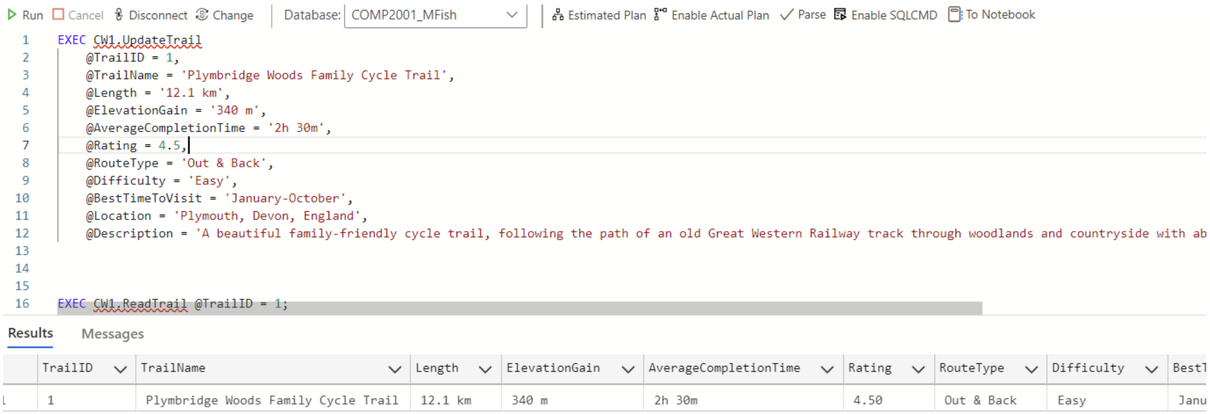
```sql
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE PROCEDURE [CW1].[UpdateTrail]
    @TrailID INT,
    @TrailName VARCHAR(50),
    @Length VARCHAR(8),
    @ElevationGain VARCHAR(6),
    @AverageCompletionTime VARCHAR(6),
    @Rating DECIMAL(4, 2),
    @RouteType VARCHAR(25),
    @Difficulty VARCHAR(8),
    @BestTimeToVisit VARCHAR(25),
    @Location VARCHAR(100),
    @Description VARCHAR(500)
AS
BEGIN
    UPDATE CW1.Trail
    SET
        TrailName = @TrailName,
        Length = @Length,
        ElevationGain = @ElevationGain,
        AverageCompletionTime = @AverageCompletionTime,
        Rating = @Rating,
        RouteType = @RouteType,
        Difficulty = @Difficulty,
        BestTimeToVisit = @BestTimeToVisit,
        Location = @Location,
        Description = @Description
    WHERE TrailID = @TrailID;
END;
```



```sql
EXEC CW1.UpdateTrail
    @TrailID = 1,
    @TrailName = 'Updated Trail Name',
    @Length = '12.2 km',
    @ElevationGain = '350 m',
    @AverageCompletionTime = '2h 40m',
    @Rating = 4.6,
    @RouteType = 'Loop',
    @Difficulty = 'Moderate',
    @BestTimeToVisit = 'March-November',
    @Location = 'Updated Location',
    @Description = 'Updated Description';


EXEC CW1.ReadTrail @TrailID = 1;
```

	TrailID	TrailName	Length	ElevationGain	AverageCompletionTime	Rating	RouteType	Difficulty	BestTimeToVisit
1	1	Updated Trail Name	12.2 km	350 m	2h 40m	4.60	Loop	Moderate	March-November

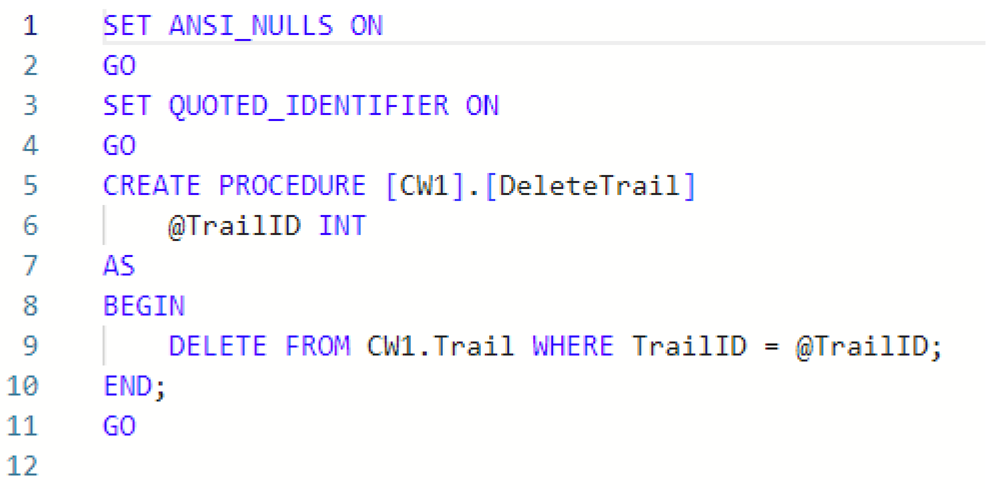
Update back to original



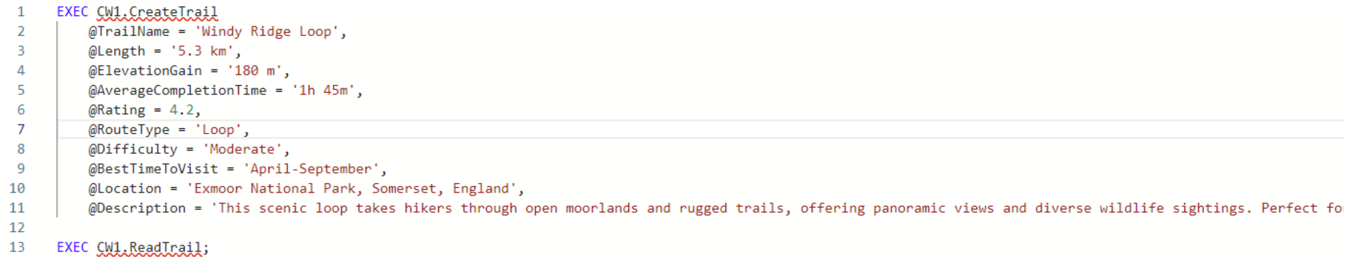
```sql
EXEC CW1.UpdateTrail
    @TrailID = 1,
    @TrailName = 'Plymbridge Woods Family Cycle Trail',
    @Length = '12.1 km',
    @ElevationGain = '340 m',
    @AverageCompletionTime = '2h 30m',
    @Rating = 4.5,
    @RouteType = 'Out & Back',
    @Difficulty = 'Easy',
    @BestTimeToVisit = 'January-October',
    @Location = 'Plymouth, Devon, England',
    @Description = 'A beautiful family-friendly cycle trail, following the path of an old Great Western Railway track through woodlands and countryside with ab



EXEC CW1.ReadTrail @TrailID = 1;
```

	TrailID	TrailName	Length	ElevationGain	AverageCompletionTime	Rating	RouteType	Difficulty	BestT
l	1	Plymbridge Woods Family Cycle Trail	12.1 km	340 m	2h 30m	4.50	Out & Back	Easy	Janu

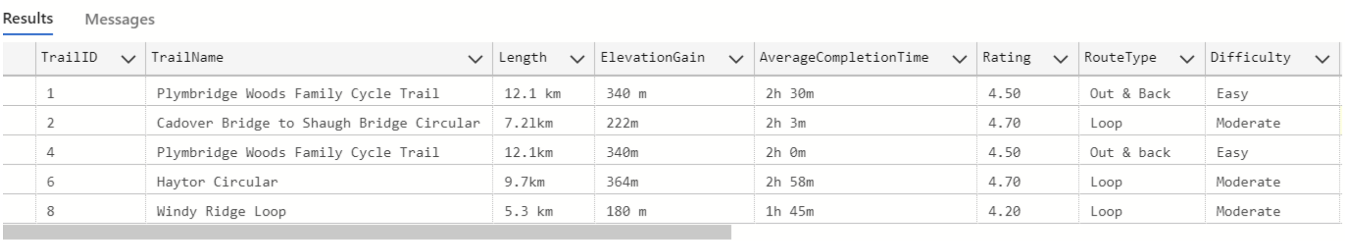
Delete



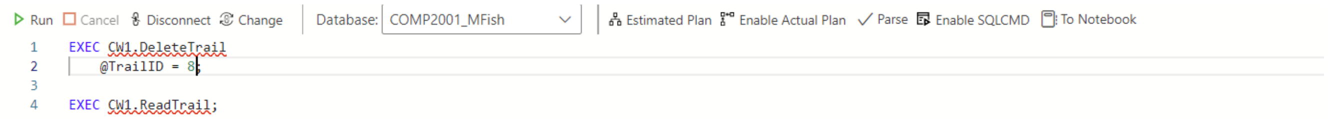
```sql
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE PROCEDURE [CW1].[DeleteTrail]
    @TrailID INT
AS
BEGIN
    DELETE FROM CW1.Trail WHERE TrailID = @TrailID;
END;
GO
```



```
EXEC CW1.CreateTrail
    @TrailName = 'Windy Ridge Loop',
    @Length = '5.3 km',
    @ElevationGain = '180 m',
    @AverageCompletionTime = '1h 45m',
    @Rating = 4.2,
    @RouteType = 'Loop',
    @Difficulty = 'Moderate',
    @BestTimeToVisit = 'April-September',
    @Location = 'Exmoor National Park, Somerset, England',
    @Description = 'This scenic loop takes hikers through open moorlands and rugged trails, offering panoramic views and diverse wildlife sightings. Perfect fo

EXEC CW1.ReadTrail;
```

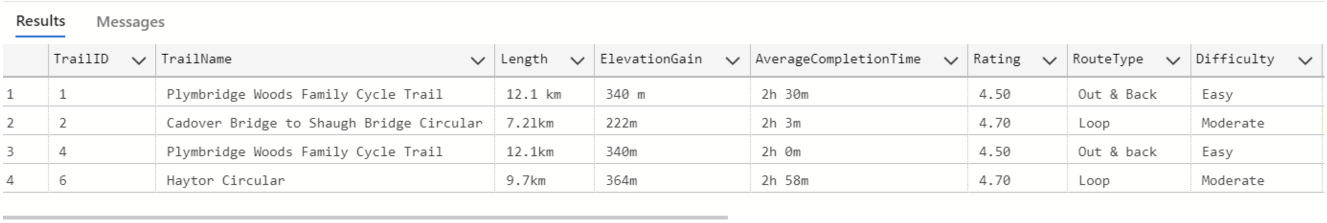


	TrailID	TrailName	Length	ElevationGain	AverageCompletionTime	Rating	RouteType	Difficulty
	1	Plymbridge Woods Family Cycle Trail	12.1 km	340 m	2h 30m	4.50	Out & Back	Easy
	2	Cadover Bridge to Shaugh Bridge Circular	7.21km	222m	2h 3m	4.70	Loop	Moderate
	4	Plymbridge Woods Family Cycle Trail	12.1km	340m	2h 0m	4.50	Out & back	Easy
	6	Haytor Circular	9.7km	364m	2h 58m	4.70	Loop	Moderate
	8	Windy Ridge Loop	5.3 km	180 m	1h 45m	4.20	Loop	Moderate



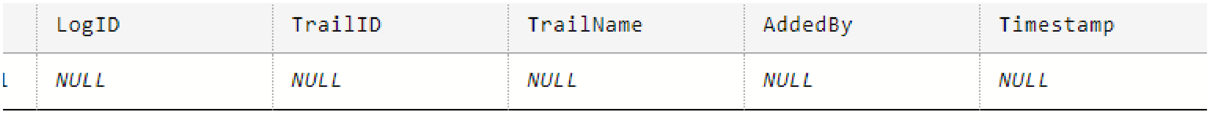
Database: COMP2001_MFish

```
EXEC CW1.DeleteTrail
    @TrailID = 8;

EXEC CW1.ReadTrail;
```

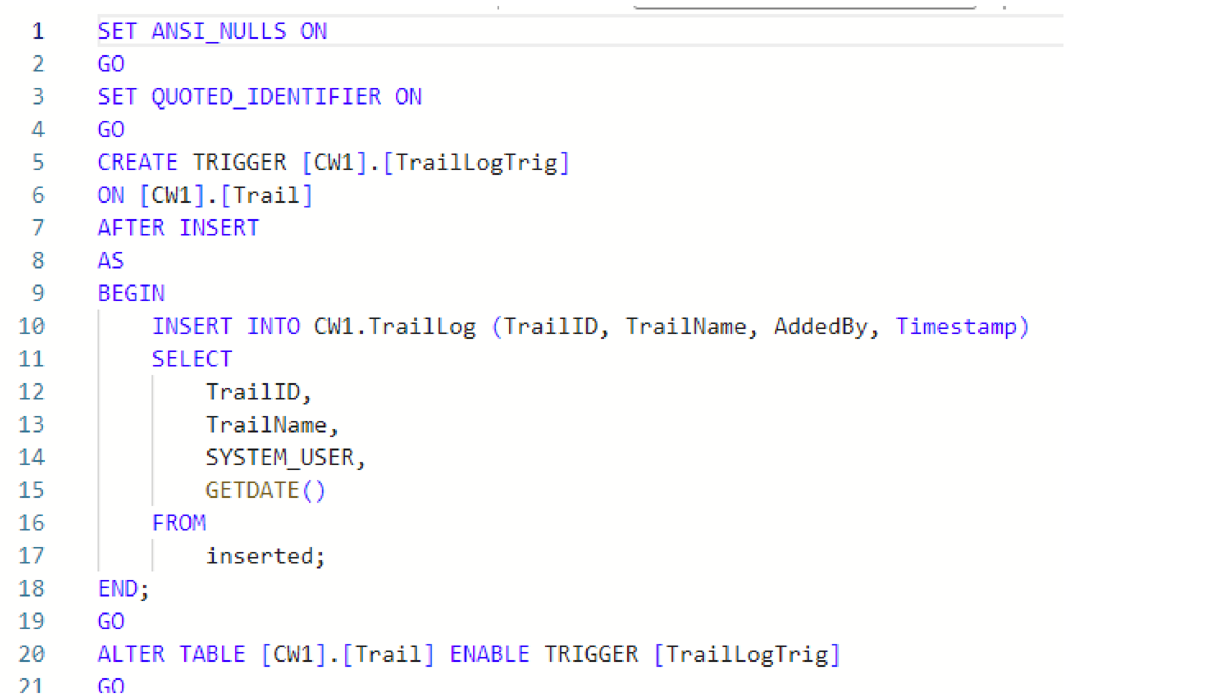


	TrailID	TrailName	Length	ElevationGain	AverageCompletionTime	Rating	RouteType	Difficulty
1	1	Plymbridge Woods Family Cycle Trail	12.1 km	340 m	2h 30m	4.50	Out & Back	Easy
2	2	Cadover Bridge to Shaugh Bridge Circular	7.21km	222m	2h 3m	4.70	Loop	Moderate
3	4	Plymbridge Woods Family Cycle Trail	12.1km	340m	2h 0m	4.50	Out & back	Easy
4	6	Haytor Circular	9.7km	364m	2h 58m	4.70	Loop	Moderate

Exercise 7: Triggers



	LogID	TrailID	TrailName	AddedBy	Timestamp
1	NULL	NULL	NULL	NULL	NULL



```sql
SET ANSI_NULLS ON
GO
SET QUOTED_IDENTIFIER ON
GO
CREATE TRIGGER [CW1].[TrailLogTrig]
ON [CW1].[Trail]
AFTER INSERT
AS
BEGIN
    INSERT INTO CW1.TrailLog (TrailID, TrailName, AddedBy, Timestamp)
    SELECT
        TrailID,
        TrailName,
        SYSTEM_USER,
        GETDATE()
    FROM
        inserted;
END;
GO
ALTER TABLE [CW1].[Trail] ENABLE TRIGGER [TrailLogTrig]
GO
```

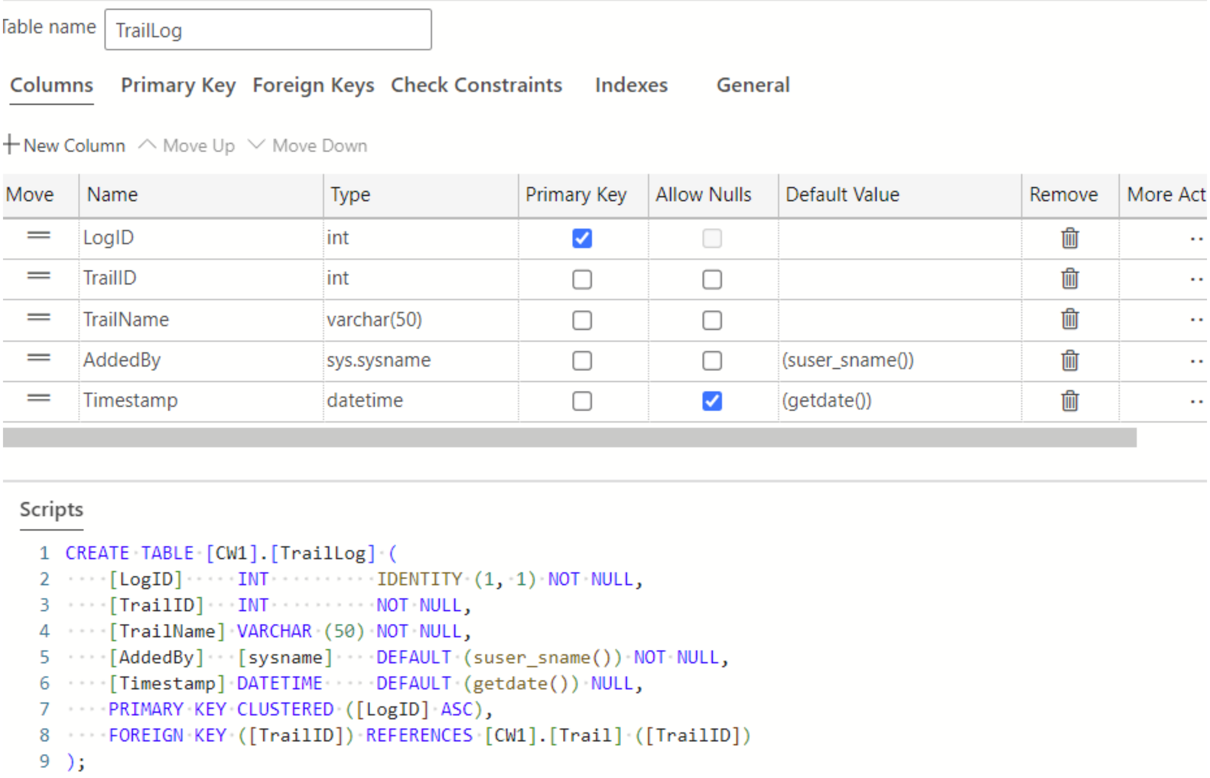


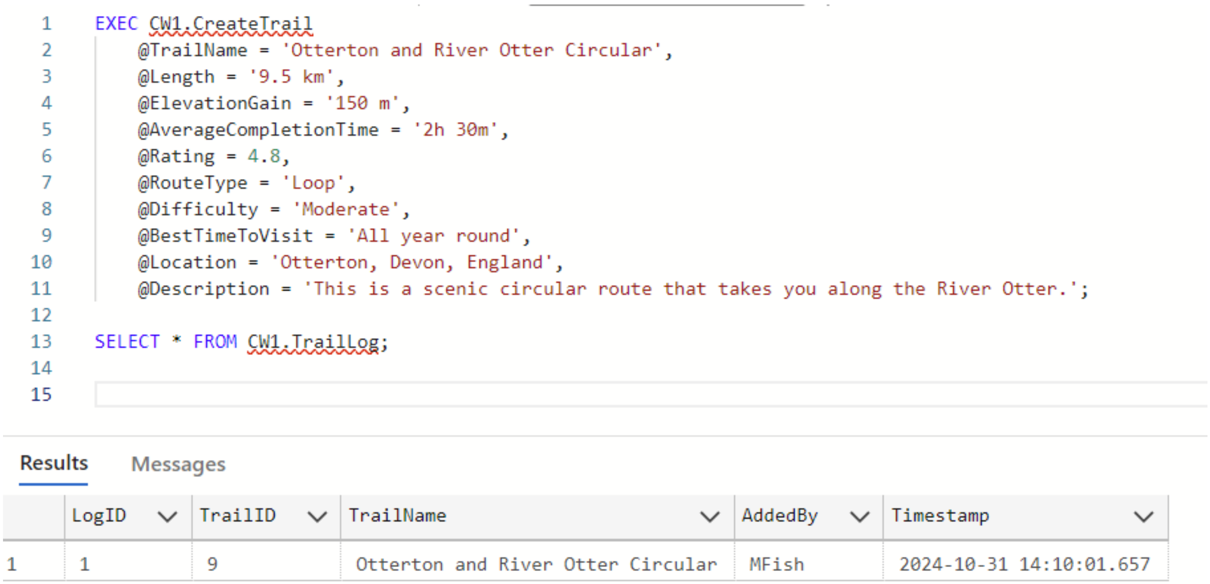
Table name: TrailLog

Move	Name	Type	Primary Key	Allow Nulls	Default Value	Remove	More Act
═	LogID	int	☑	☐		🗑	··
═	TrailID	int	☐	☐		🗑	··
═	TrailName	varchar(50)	☐	☐		🗑	··
═	AddedBy	sys.sysname	☐	☐	(suser_sname())	🗑	··
═	Timestamp	datetime	☐	☑	(getdate())	🗑	··

Scripts

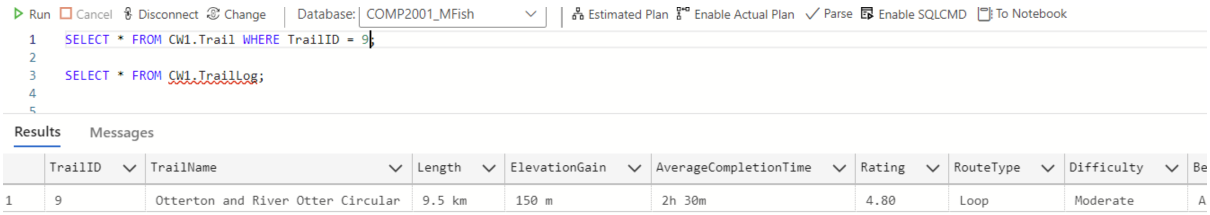
```sql
CREATE TABLE [CW1].[TrailLog] (
    [LogID]     INT          IDENTITY (1, 1) NOT NULL,
    [TrailID]   INT          NOT NULL,
    [TrailName] VARCHAR (50) NOT NULL,
    [AddedBy]   [sysname]    DEFAULT (suser_sname()) NOT NULL,
    [Timestamp] DATETIME     DEFAULT (getdate()) NULL,
    PRIMARY KEY CLUSTERED ([LogID] ASC),
    FOREIGN KEY ([TrailID]) REFERENCES [CW1].[Trail] ([TrailID])
);
```

Create new trail to view in log:



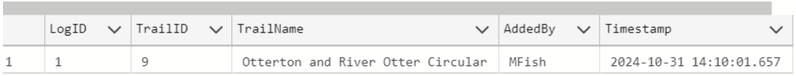
```
EXEC CW1.CreateTrail
    @TrailName = 'Otterton and River Otter Circular',
    @Length = '9.5 km',
    @ElevationGain = '150 m',
    @AverageCompletionTime = '2h 30m',
    @Rating = 4.8,
    @RouteType = 'Loop',
    @Difficulty = 'Moderate',
    @BestTimeToVisit = 'All year round',
    @Location = 'Otterton, Devon, England',
    @Description = 'This is a scenic circular route that takes you along the River Otter.';

SELECT * FROM CW1.TrailLog;
```

	LogID	TrailID	TrailName	AddedBy	Timestamp
1	1	9	Otterton and River Otter Circular	MFish	2024-10-31 14:10:01.657



```
SELECT * FROM CW1.Trail WHERE TrailID = 9;

SELECT * FROM CW1.TrailLog;
```

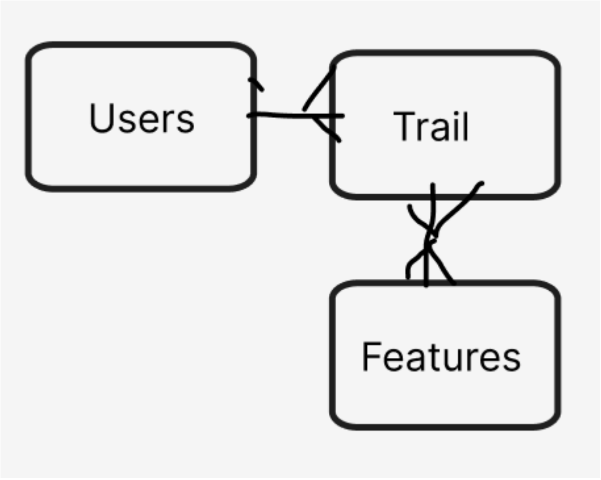
	TrailID	TrailName	Length	ElevationGain	AverageCompletionTime	Rating	RouteType	Difficulty	Be
1	9	Otterton and River Otter Circular	9.5 km	150 m	2h 30m	4.80	Loop	Moderate	A



	LogID	TrailID	TrailName	AddedBy	Timestamp
1	1	9	Otterton and River Otter Circular	MFish	2024-10-31 14:10:01.657

Appendix

Initial ERD Diagram



Users
Trail
Features