MariaDB

MIGRATE RDS MYSQL TO SKYSQL MARIADB USING AMAZON DATA MIGRATION SERVICE

WHITEPAPER

HOW TO MIGRATE FROM RDS TO SKYSQL WITH LITTLE/NO DOWNTIME?

This is probably the most often asked question to date. Fortunately, AWS makes this quite easy. By following the steps detailed here, migrating data and cutting over to SkySQL can be painless. This document is intended for existing AWS RDS customers looking to migrate to MariaDB SkySQL.

ASSUMPTIONS / PREREQUISITES

Amazon Web Services Database Migration Service will hereon be called AWS DMS.

This demonstration assumes an AWS MariaDB or MySQL RDS instance already exists and has a read replica. For more information:
https://docs.aws.amazon.com/AmazonRDS/latest/UserGuide/USER_ReadRepl.html#USER_ReadRepl.Create.

AWS DMS requires an AWS IAM user. The AWS documentation states the user must have the "AdministratorAccess" role. However, this link gives an alternative without giving admin: https://github.com/awsdocs/aws-dms-user-guide/blob/master/doc_source/CHAP_Security.IAMPermissions.md. In addition to those roles outlined, it was also necessary to add the "ListAttachedRolePolicies" role for this demonstration.

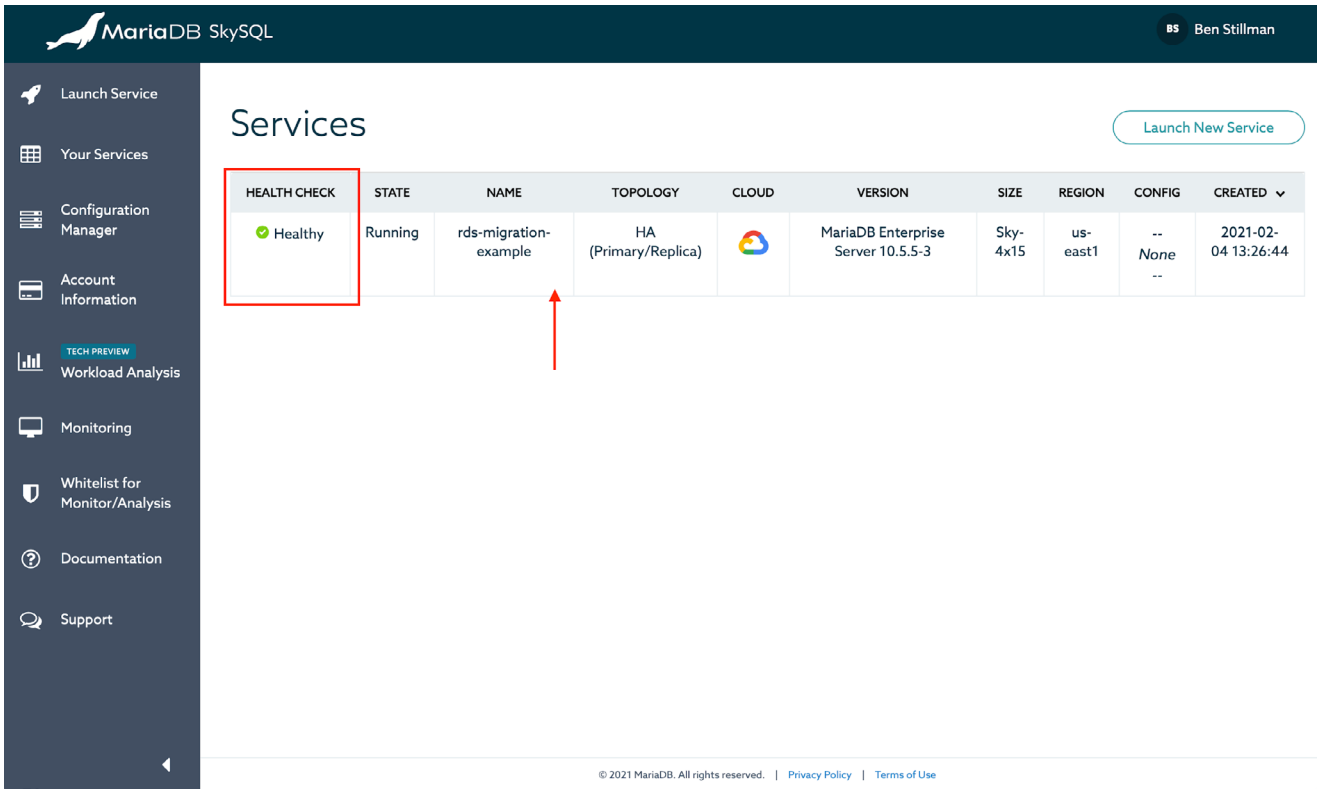
This demonstration assumes a MariaDB SkySQL service has already been started. For more information, see https://mariadb.com/products/skysql/docs/get-started/.

Lastly, it is assumed that the SkySQL service's default password has been changed as recommended.

Let's get started!

GATHER INFORMATION FROM DESTINATION SKYSQL SERVICE

Assuming the SkySQL service is created and the "Health Check" column reports the service as "Healthy", click anywhere on the service's row to open the service details. For this demonstration, a "Transactions" topology "HA (Primary/Replica)" service was created within the Google Cloud Platform using "Sky-4x15" instance sizes.

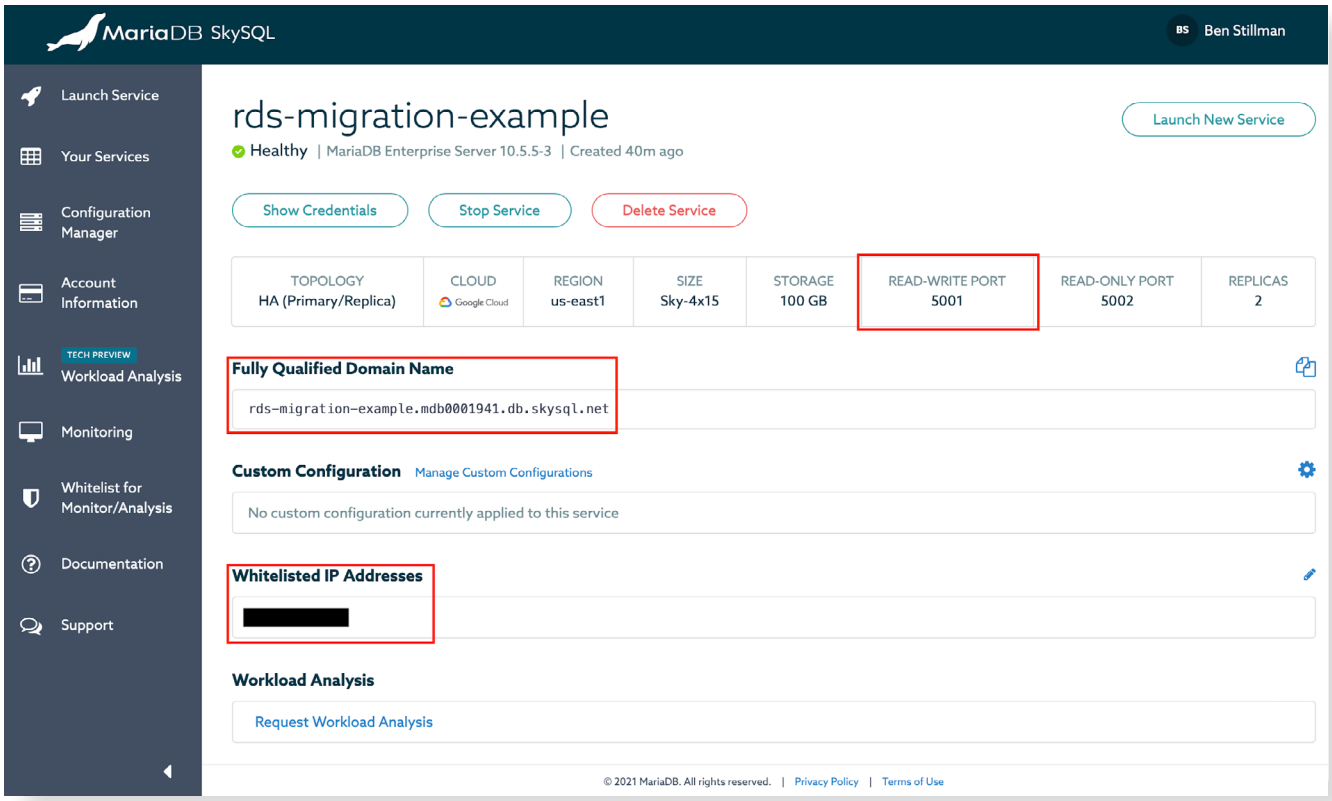


From the service details page, some information needs to be gathered and noted for later use. This includes the service's "Fully Qualified Domain Name" and "Read-Write Port".

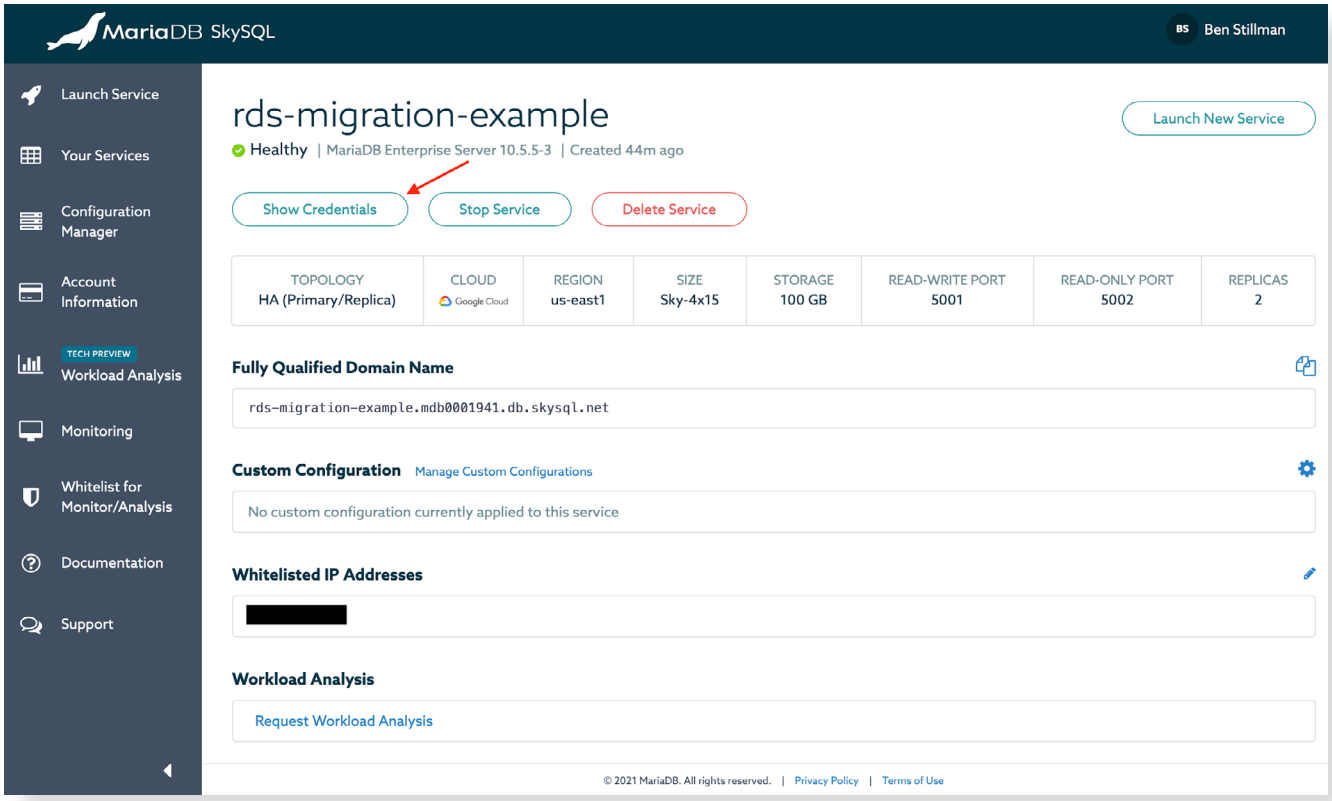
For this demonstration, these are:

Fully Qualified Domain Name: rds-migration-example.mdb0001941.db.skysql.netRead-Write Port: 5001

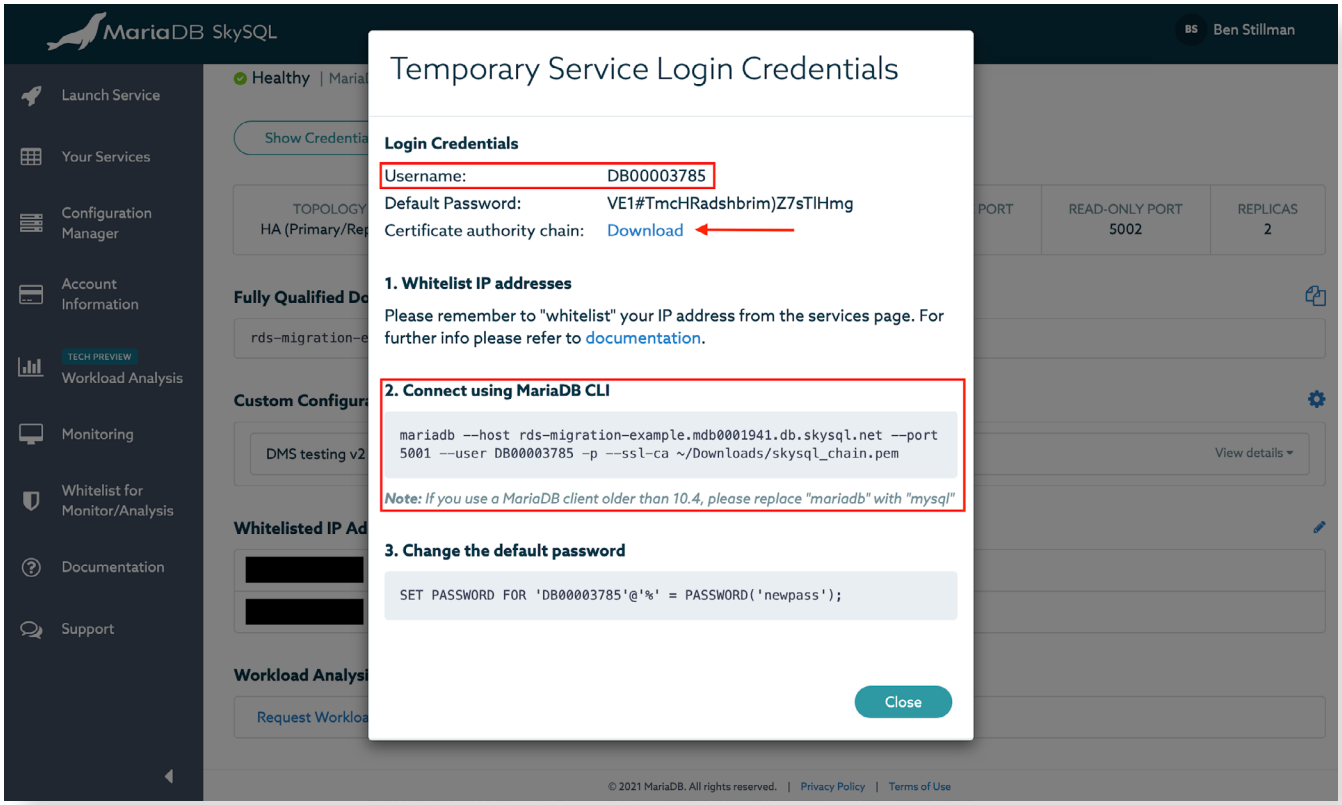
In addition, verify the IP which this service will be accessed from has been whitelisted.



Next, click on “Show Credentials”.



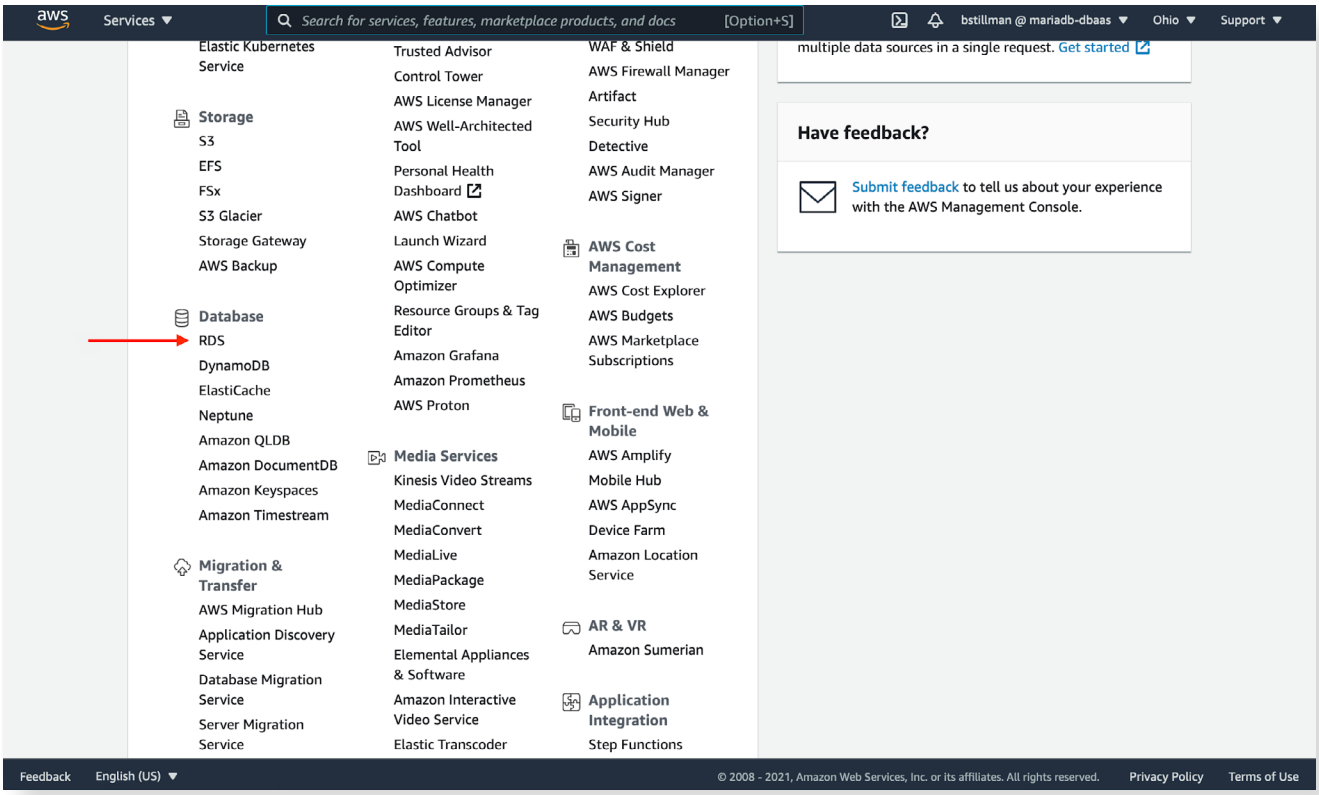
Note the “Username” and connection string (“Connect using MariaDB CLI”). This demonstration assumes the “Default Password” has been changed, so it does not need to be noted. Also download the “Certificate authority chain” by clicking “Download”.



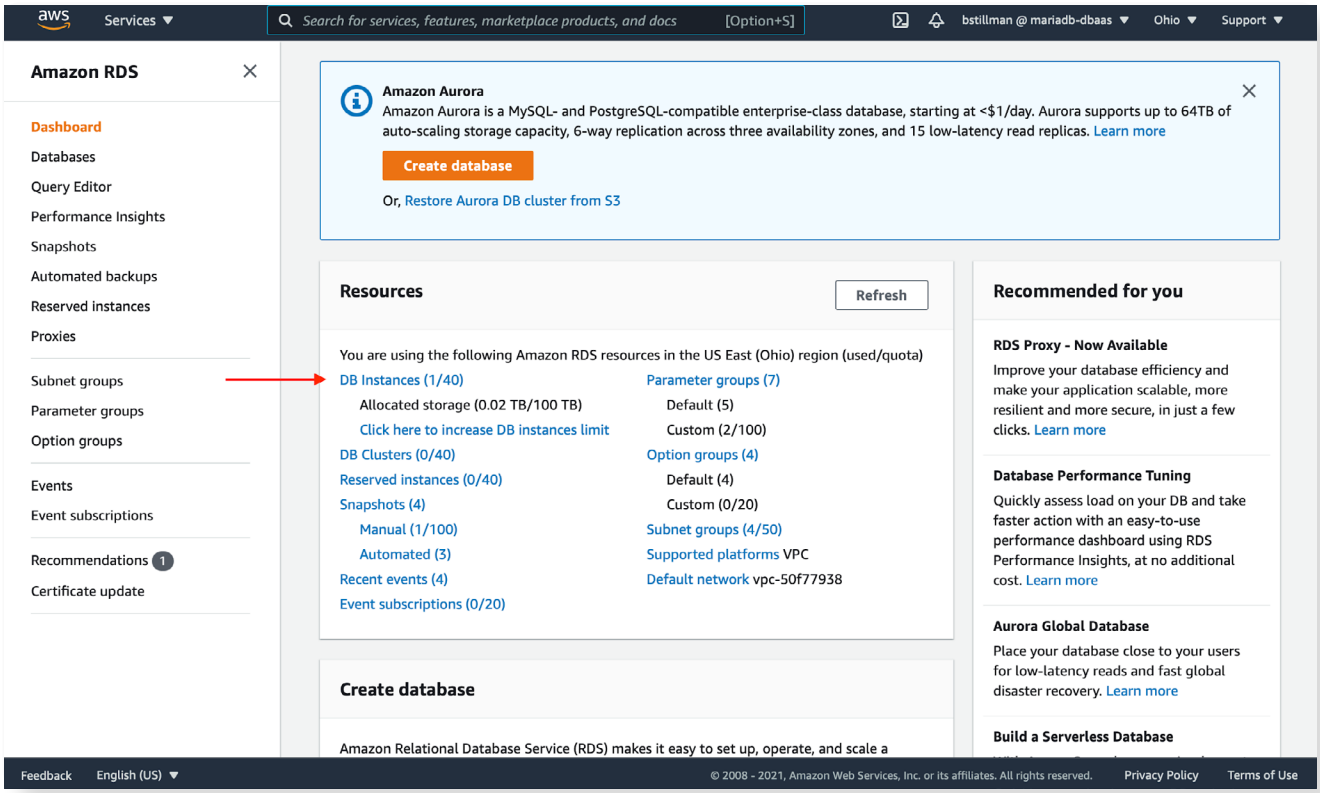
GATHER INFORMATION FROM SOURCE RDS INSTANCE

Next, gather the necessary information from the RDS instance which is to be migrated.

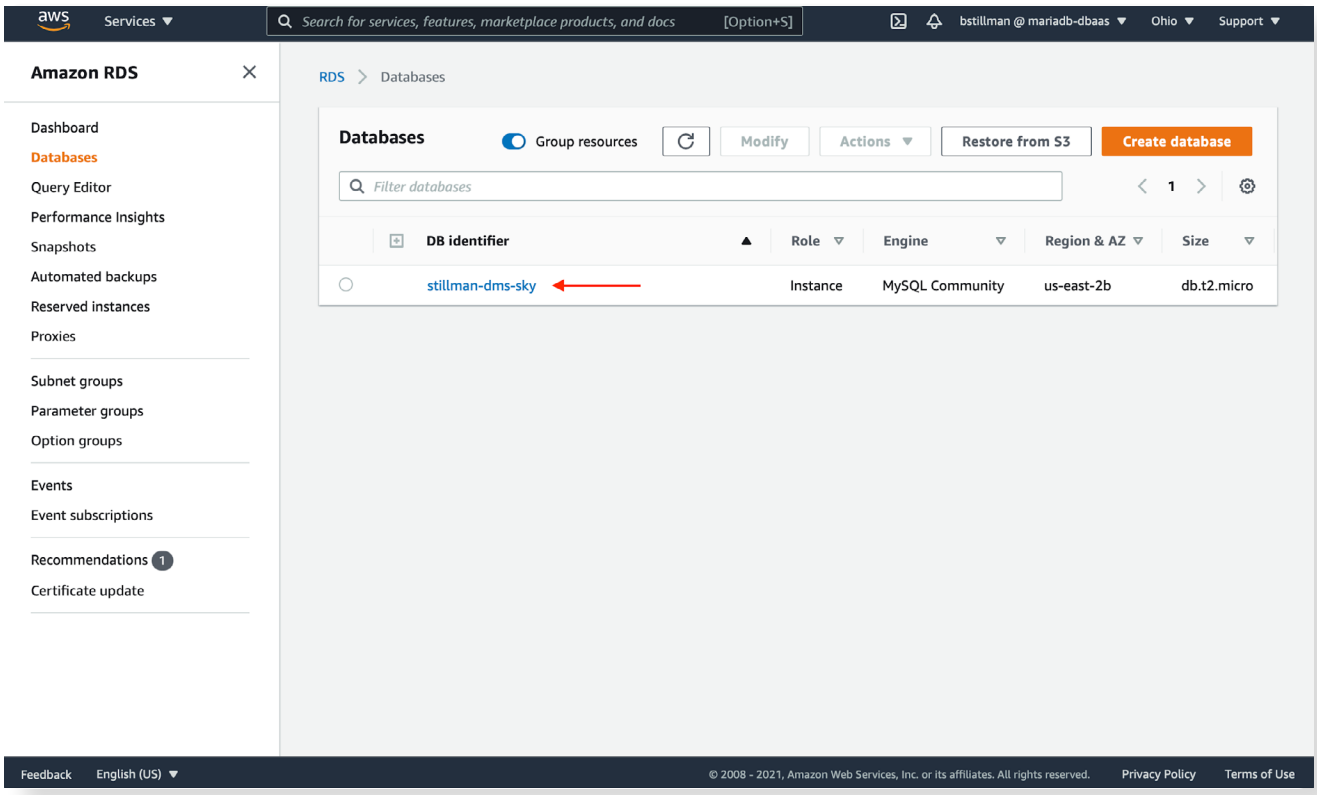
From the AWS Portal, under "Databases", click "RDS".



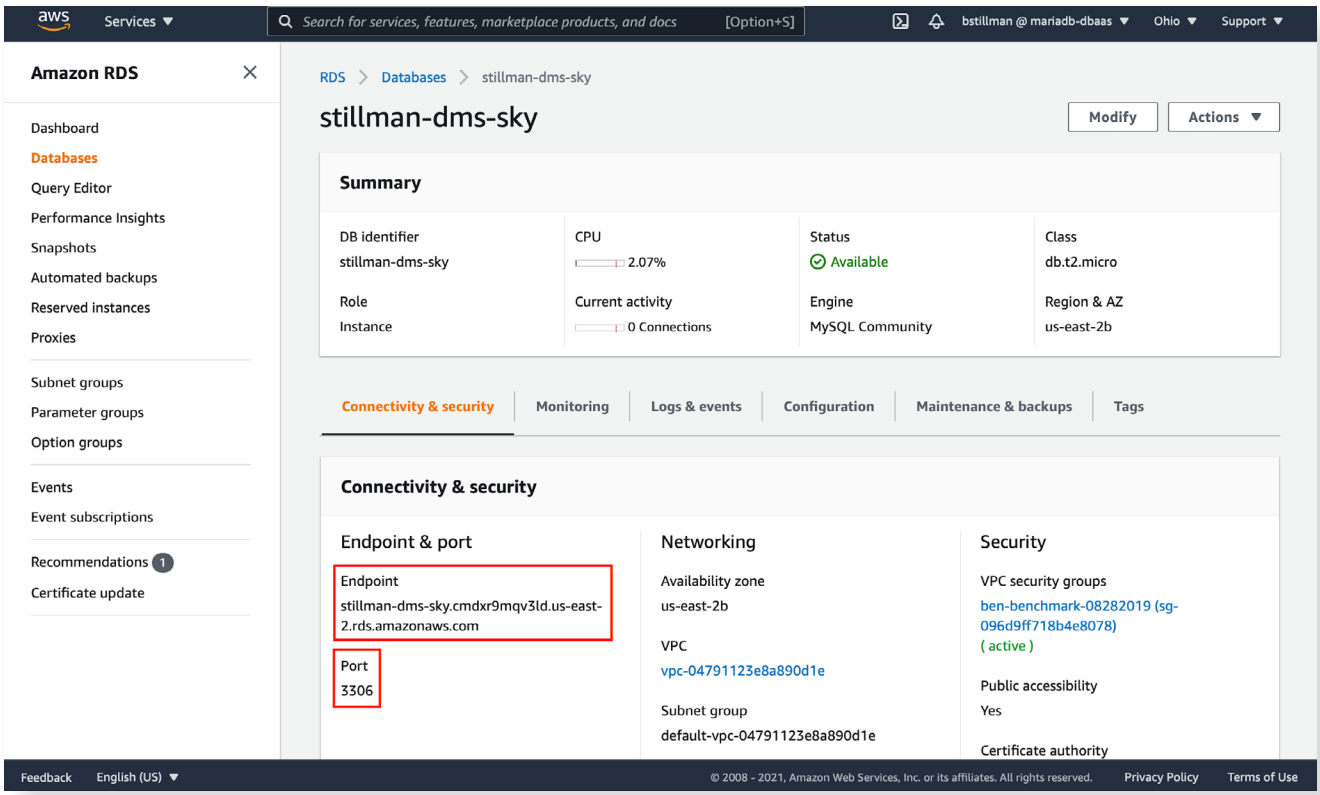
Next, click “DB Instances”.



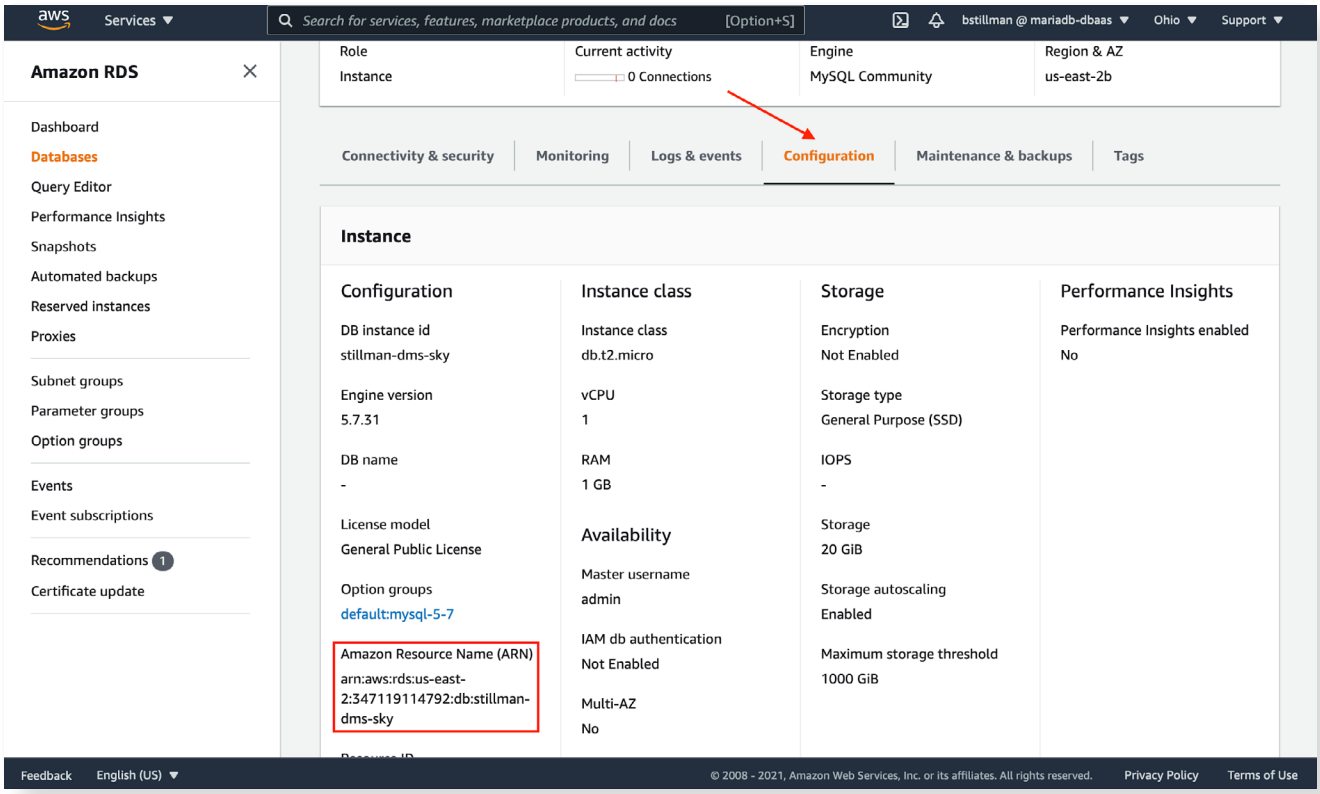
From here, click on the “DB identifier” of the instance to be migrated. For this demonstration, it’s “stillman-dms-sky”.



From this page, note the “Endpoint” and “Port”.



Click on “Configuration”. Find and note the Amazon Resource Name (ARN).

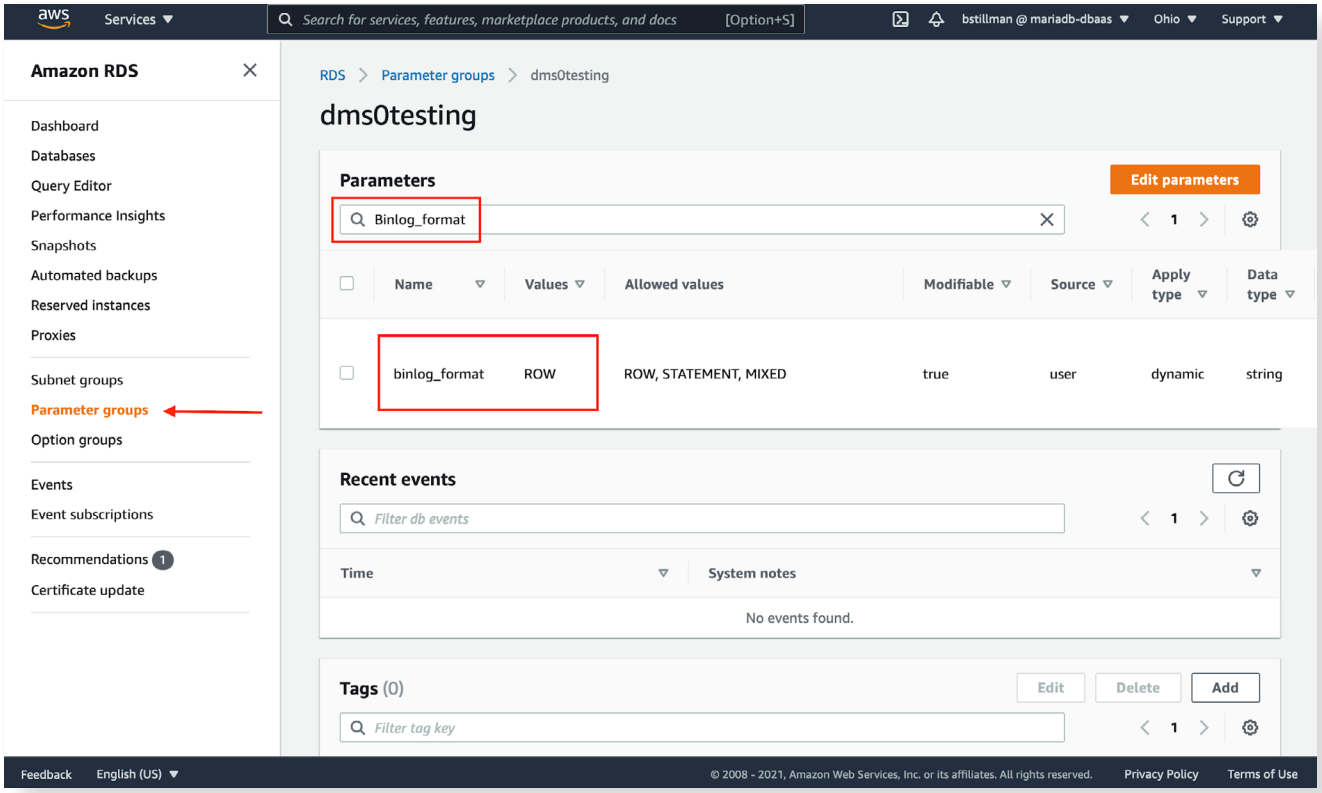


Now that the necessary information has been gathered, next is to configure the RDS instance and SkySQL service.

CONFIGURE THE RDS INSTANCE

In order for AWS DMS to function properly, a few things need to be configured on the RDS instance to be migrated.

First, change the binary logging format from MIXED to ROW. For this demonstration, a new "Parameter Group" was created named "dms0testing" because this demonstration instance did not have a pre-existing "Parameter Group". The only change made was setting "binlog_format" to "ROW". (Unfortunately, although "binlog_format" is a dynamic variable, it cannot be set dynamically in RDS.)



Modify the RDS instance to use the new "Parameter Group". Note this change must take effect before starting the AWS DMS "Database Migration Task" later.

Connect to the AWS RDS instance.

```
mysql --host stillman-dms-sky.cmdxr9mqv3ld.us-east-2.rds.amazonaws.com --Port 3306
--user admin -p
Enter password:
```

Verify the variable “binlog_format” has been correctly applied.

```
SHOW GLOBAL VARIABLES LIKE ‘binlog_format’;
```

Next, configure the binary logs to not expire for at least 24 hours. This is done via the command-line interface.

Use rds_set_configuration to set the binlog retention.

```
CALL mysql.rds_set_configuration(‘binlog retention hours’, 24);
```

CONFIGURE THE SKYSQL SERVICE

AWS DMS uses `LOAD DATA LOCAL INFILE` for the initial data load process. By default, the variable `LOCAL_INFILE` is disabled in SkySQL. For this demonstration, a new configuration was created in SkySQL using the "Configuration Manager" named "DMS Testing". Only `LOCAL_INFILE` was modified. If the SkySQL target instance already has a custom configuration, that configuration can be edited instead of creating a new custom configuration.

For more information about "Configuration Manager" and applying custom configurations to SkySQL services, see https://mariadb.com/products/skysql/docs/instructions/configuration-manager/.

This change must take effect before starting the AWS DMS "Database Migration Task" later.

Connect to the SkySQL service via the command-line interface.

```
mariadb --host rds-migration-example.mdb0001941.db.skysql.net --port 5001 --user
DB00003785 -p --ssl
Enter password:
```

Verify the variable “local_infile” has been correctly applied.

```
SHOW GLOBAL VARIABLES LIKE ‘local_infile’;
```

CREATE USER FOR AWS DMS CONNECTION ON SKYSQL SERVICE

It is best practice to have separate users for each application or action. For this demonstration, create a user to be used exclusively for AWS DMS to connect to the SkySQL service.

Create the AWS DMS user.

```
CREATE USER 'dmsuser'@'%'
IDENTIFIED BY '6Hvmw@GQERbRygNx#j3dMwN!rrH2t2v&WH';
```

Grant the appropriate privileges to the AWS DMS user for the database to be migrated. For this demonstration, the database which will be migrated is named "dmstestdb". This database does not yet exist within the SkySQL service.

```
GRANT ALTER, CREATE, DROP, INDEX, INSERT, UPDATE, DELETE, SELECT
ON dmstestdb.*
TO 'dmsuser'@'%';
```

Grant the appropriate privileges to the AWS DMS user for the "awsdms_control" database used by AWS DMS to keep track of the replication status.

```
GRANT SELECT, INSERT, UPDATE, DELETE, CREATE, DROP, INDEX, ALTER, CREATE TEMPORARY TABLES,
LOCK TABLES, EXECUTE, CREATE VIEW, SHOW VIEW, CREATE ROUTINE, ALTER ROUTINE, EVENT,
TRIGGER,
DELETE HISTORY
ON awsdms_control.*
TO 'dmsuser'@'%';
```

CREATE DATABASE SCHEMA ON SKYSQL

While connected to the SkySQL service, create the database and table(s) that will be migrated from RDS. This is done directly on the SkySQL service rather than allowing AWS DMS to create them because AWS DMS only creates the most basic structure to migrate the data. Thus things like auto-increments are left out.

```
CREATE DATABASE testing;
CREATE TABLE TableA (
  id int(11) NOT NULL AUTO_INCREMENT,
  uuid_junk varchar(50) NOT NULL,
  create_ts timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP,
  PRIMARY KEY (`id`)
;
```

CREATE USER FOR AWS DMS CONNECTION ON RDS INSTANCE

Following best practice, create an AWS DMS specific user on the RDS instance to be migrated. This user will be used by AWS DMS to connect to the RDS instance.

Connect to the AWS RDS instance.

```
mysql --host stillman-dms-sky.cmdxr9mqv3ld.us-east-2.rds.amazonaws.com --Port 3306
--user admin -p
Enter password:
```

Create the AWS DMS user.

```
CREATE USER 'dmsuser'@'%'
IDENTIFIED BY 'kfjR67HEWFklg98FGE#hyghdfp7@!';
```

Grant the necessary privileges to the AWS DMS user.

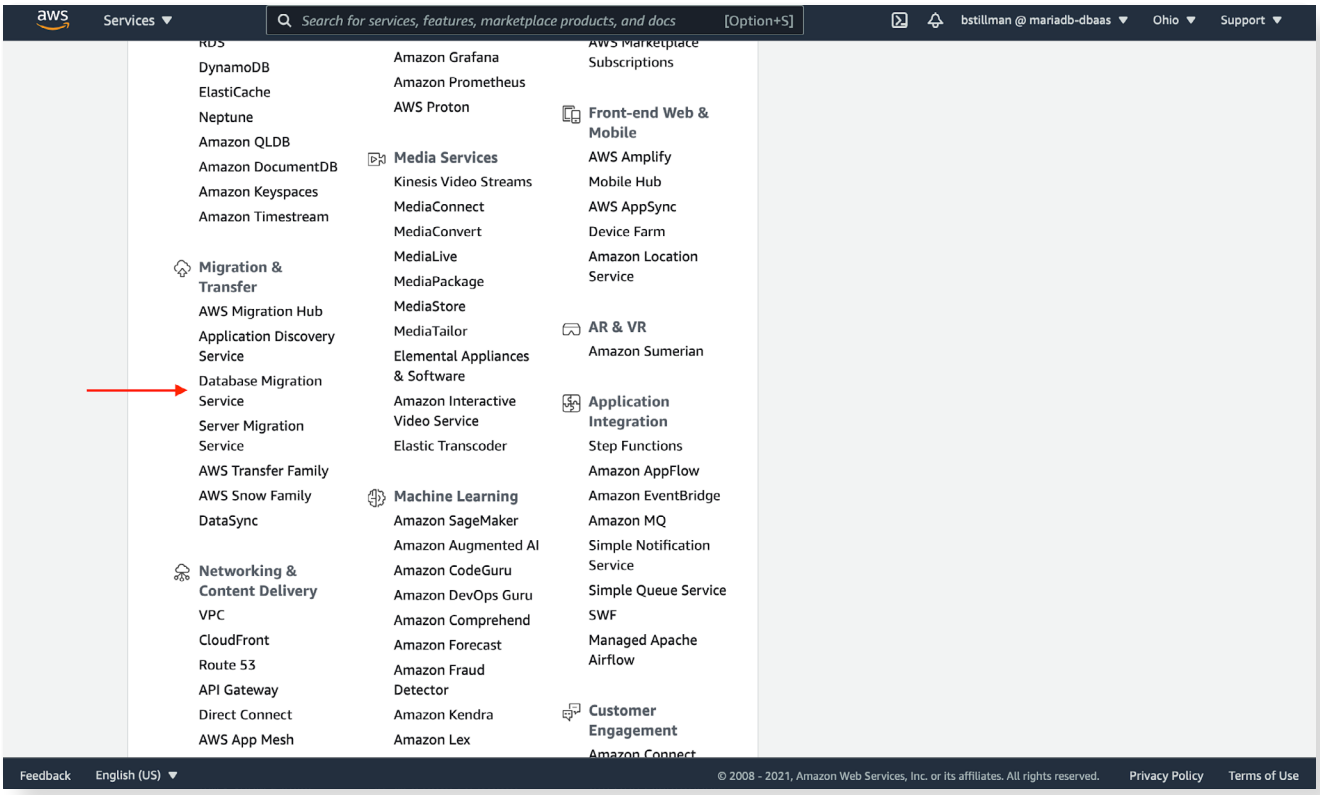
```
GRANT REPLICATION CLIENT, REPLICATION SLAVE
ON *.* TO 'dmsuser'@'%';
```

At this point, the AWS DMS user is created on both the source (AWS RDS instance) and the target (SkySQL service).

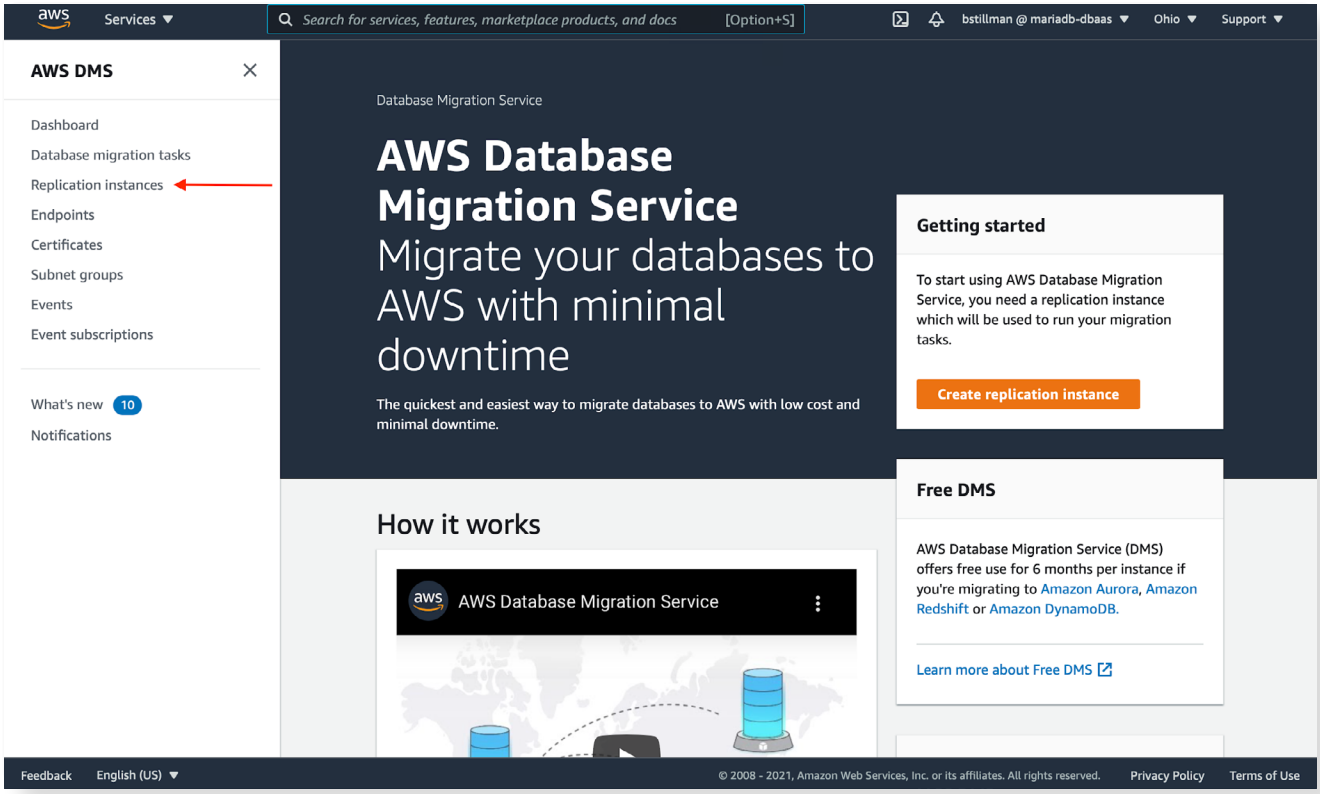
CREATE AWS DMS REPLICATION INSTANCE

In order to begin setting up AWS DMS to migrate the RDS database to SkySQL, a “Replication instance” needs to be created.

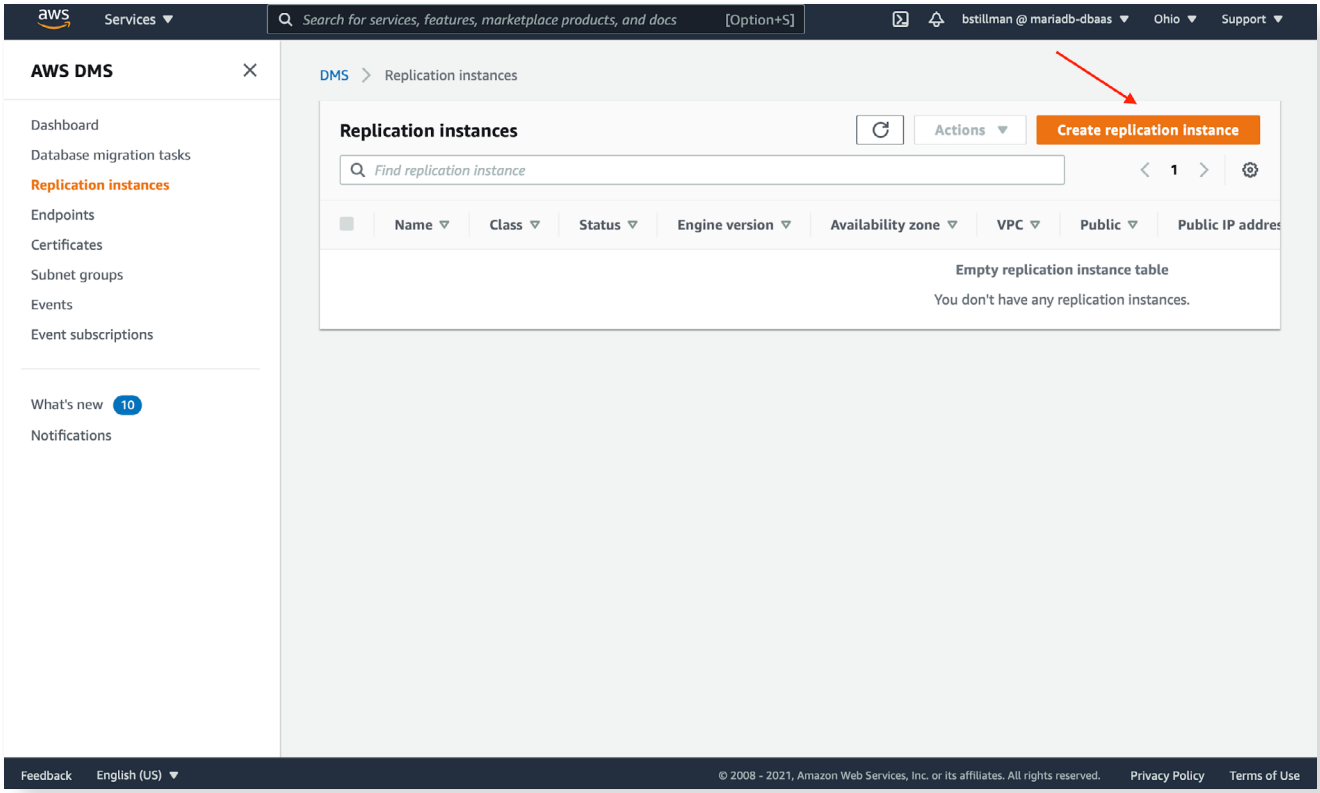
From the AWS Console, click on “Database Migration Service” under “Migration & Transfer”.



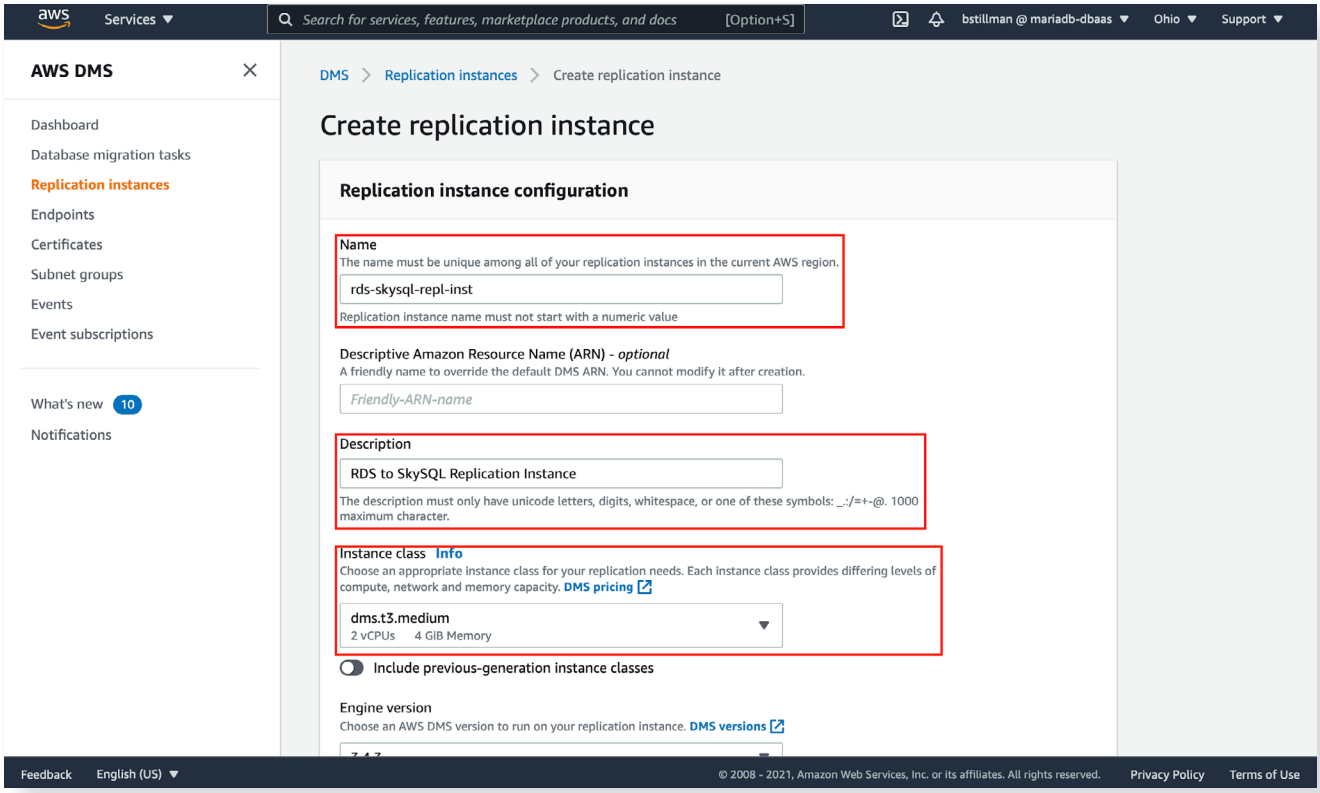
Click on “Replication instances”.



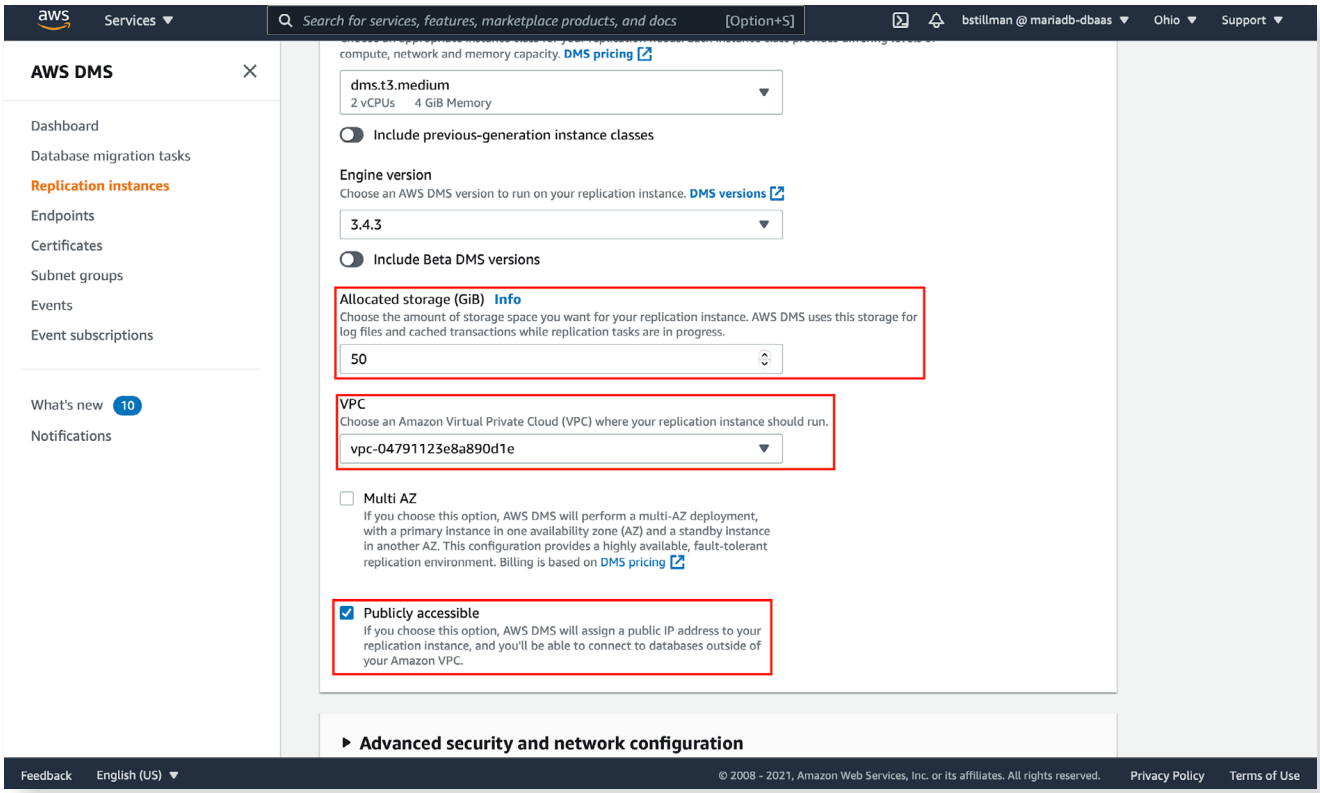
Click on the “Create replication instance” button.



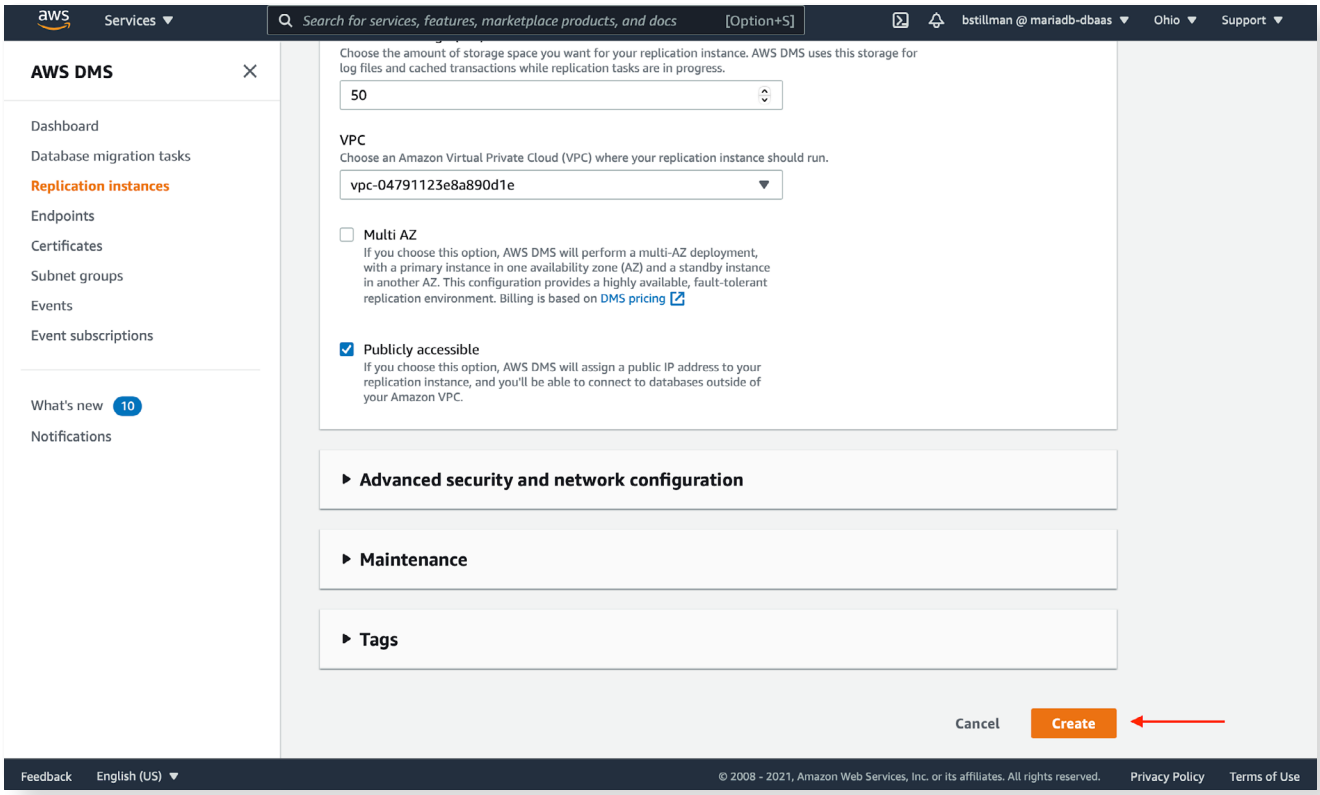
Now configure the “Replication instance”. Enter a “Name” and “Description” for this “replication instance”. Then select an “Instance class”.



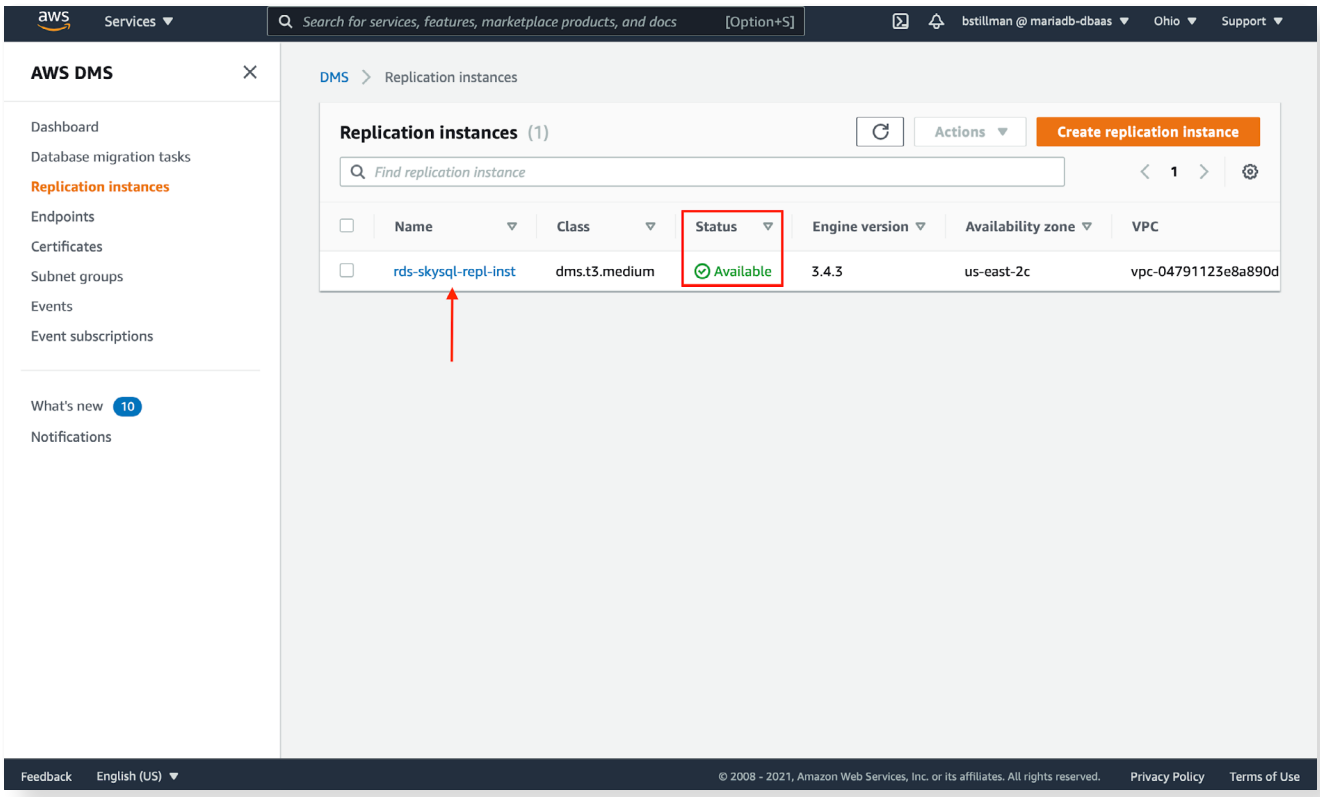
Scroll down to continue the configuration. “Allocated storage” defaults to 50 GB. For this demonstration, this is sufficient. Select the “VPC” which this “replication instance” should run. For this demonstration, the VPC where the RDS instance to be migrated runs was selected. Next, “Publicly accessible” should be checked by default. Verify that it is checked.



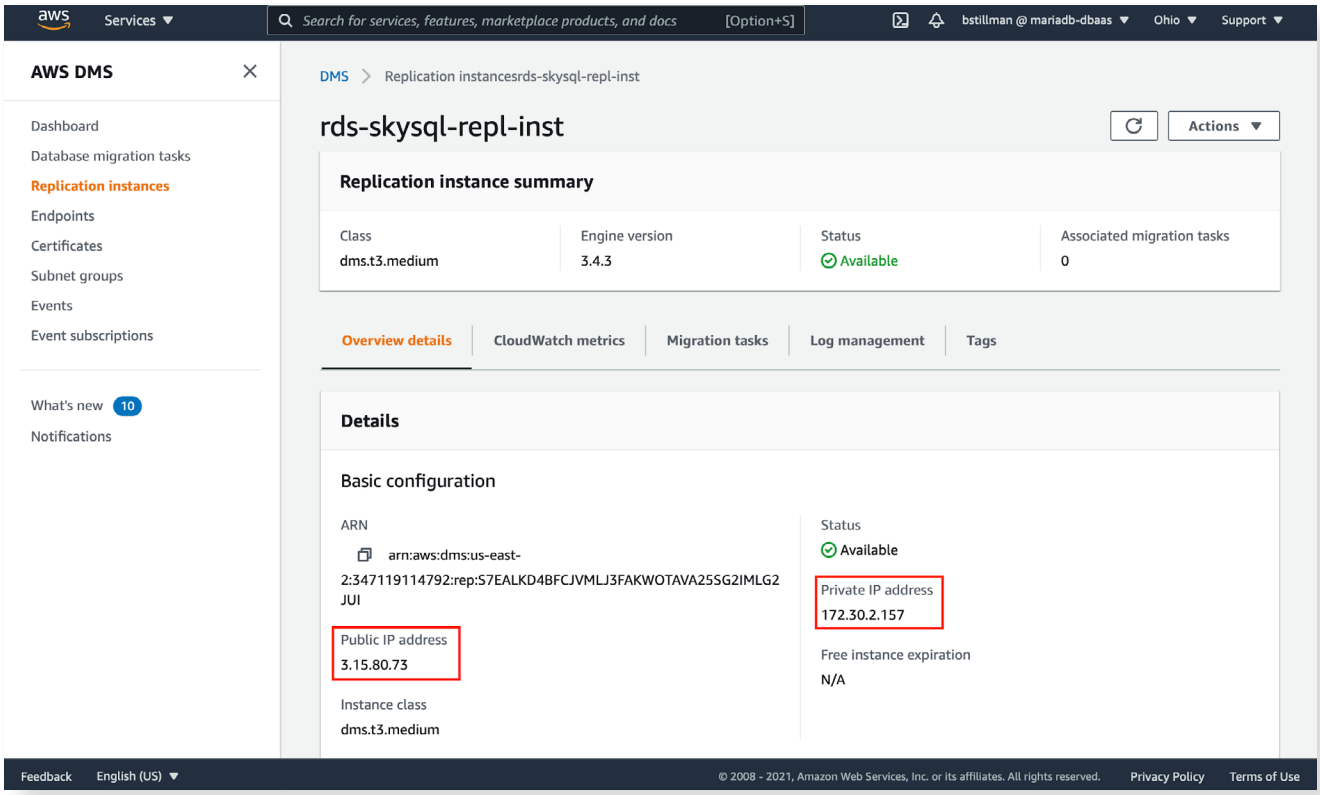
Scroll to the bottom of the page. For this demonstration, no other configuration is needed. Click the "Create" button.



Once the newly created "replication instances" has a "Status" of "Available", click on the instance's "Name" to see more details.



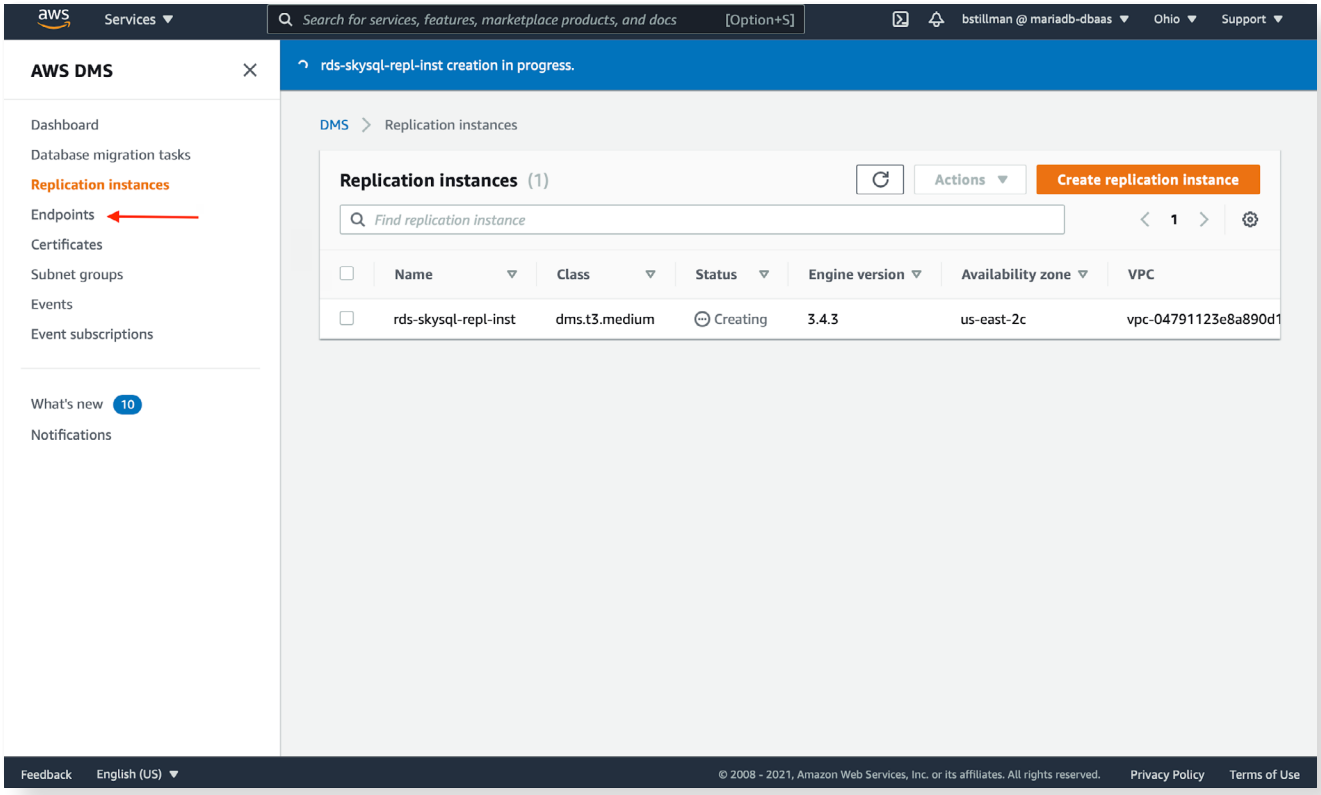
From here, note the “Public IP address” and “Private IP address”.



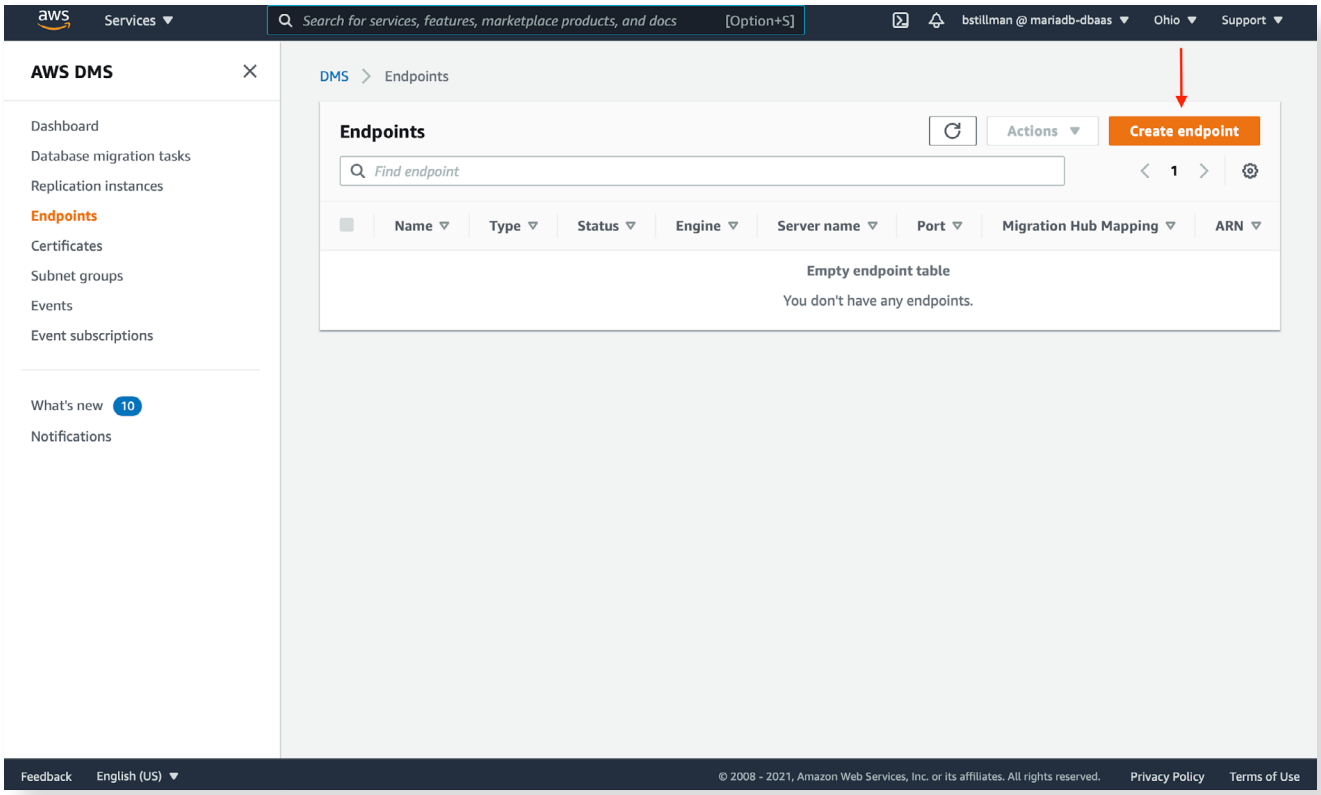
CREATE AWS DMS SOURCE ENDPOINT

Next, the Source Endpoint needs to be created.

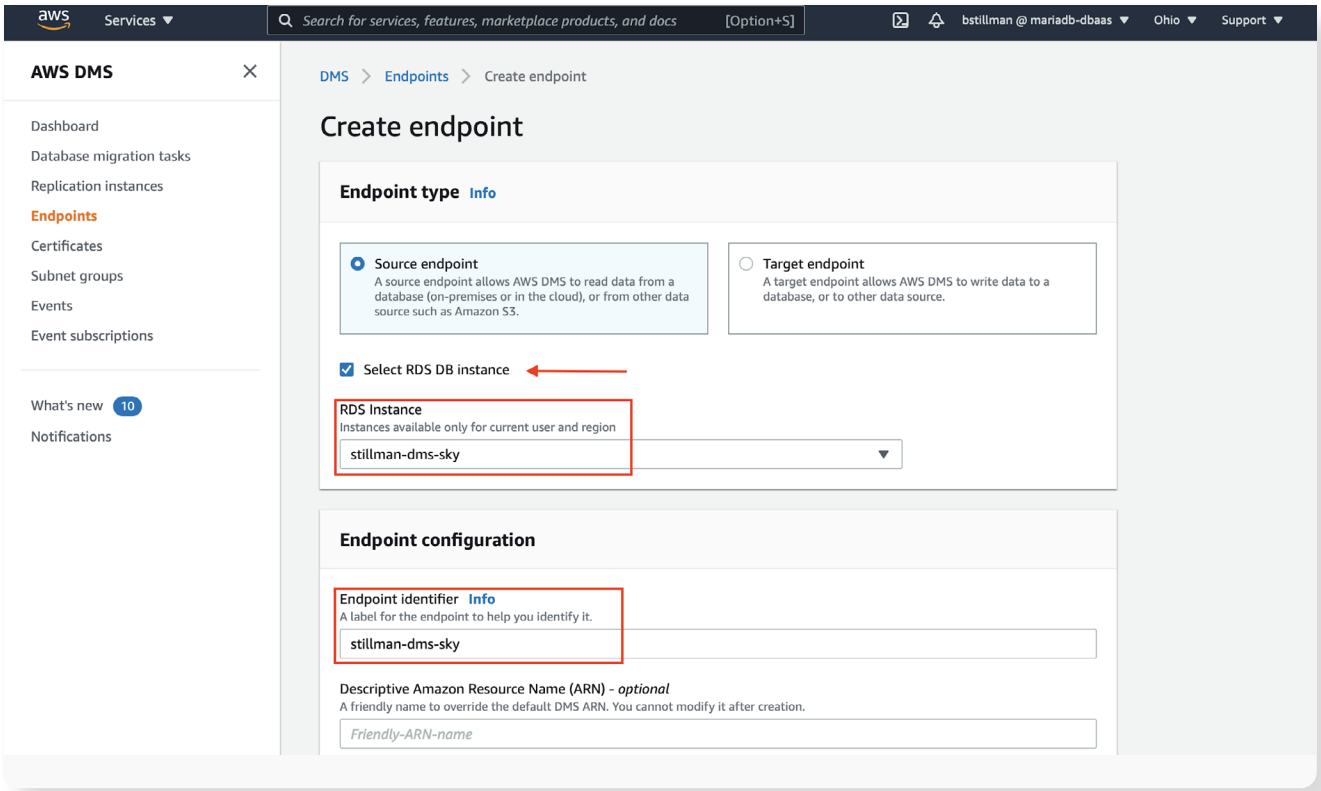
Click on "Endpoints" in the navigation menu on the left side.



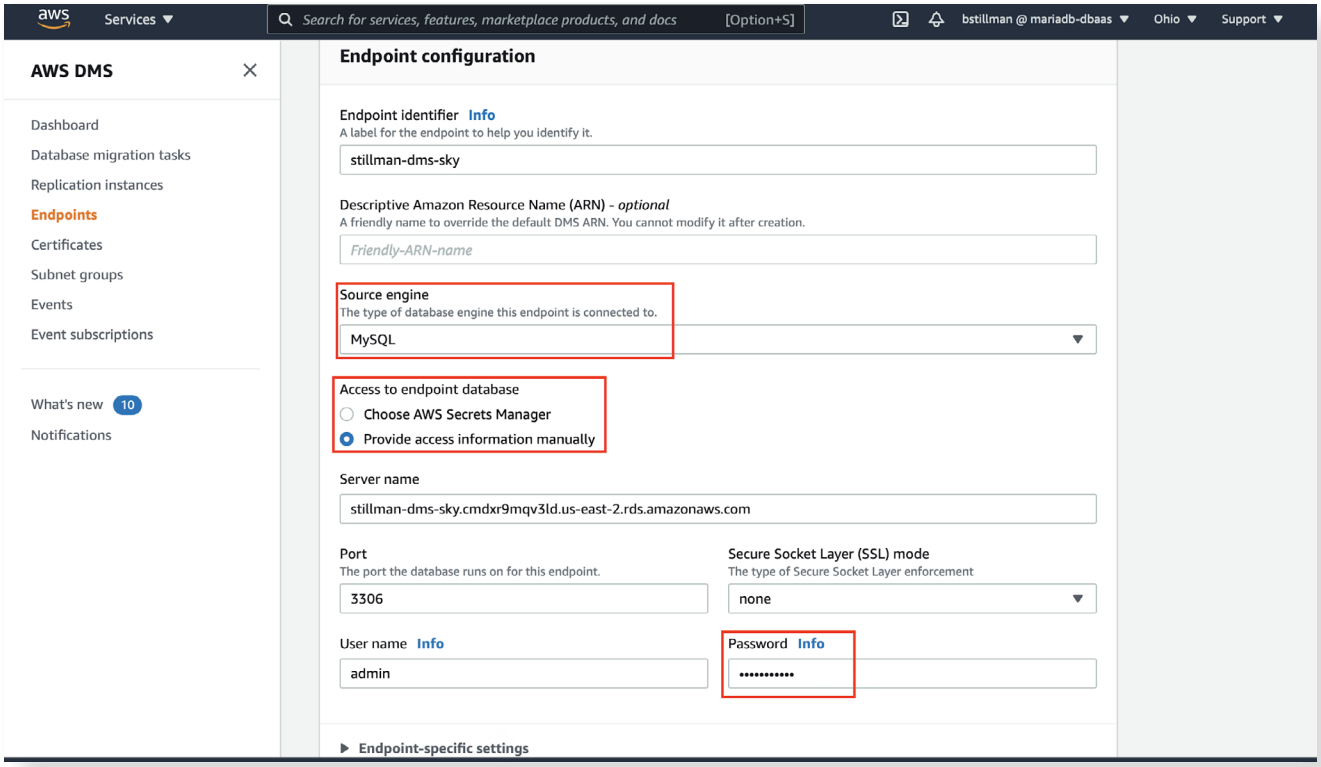
Click on the "Create endpoint" button.



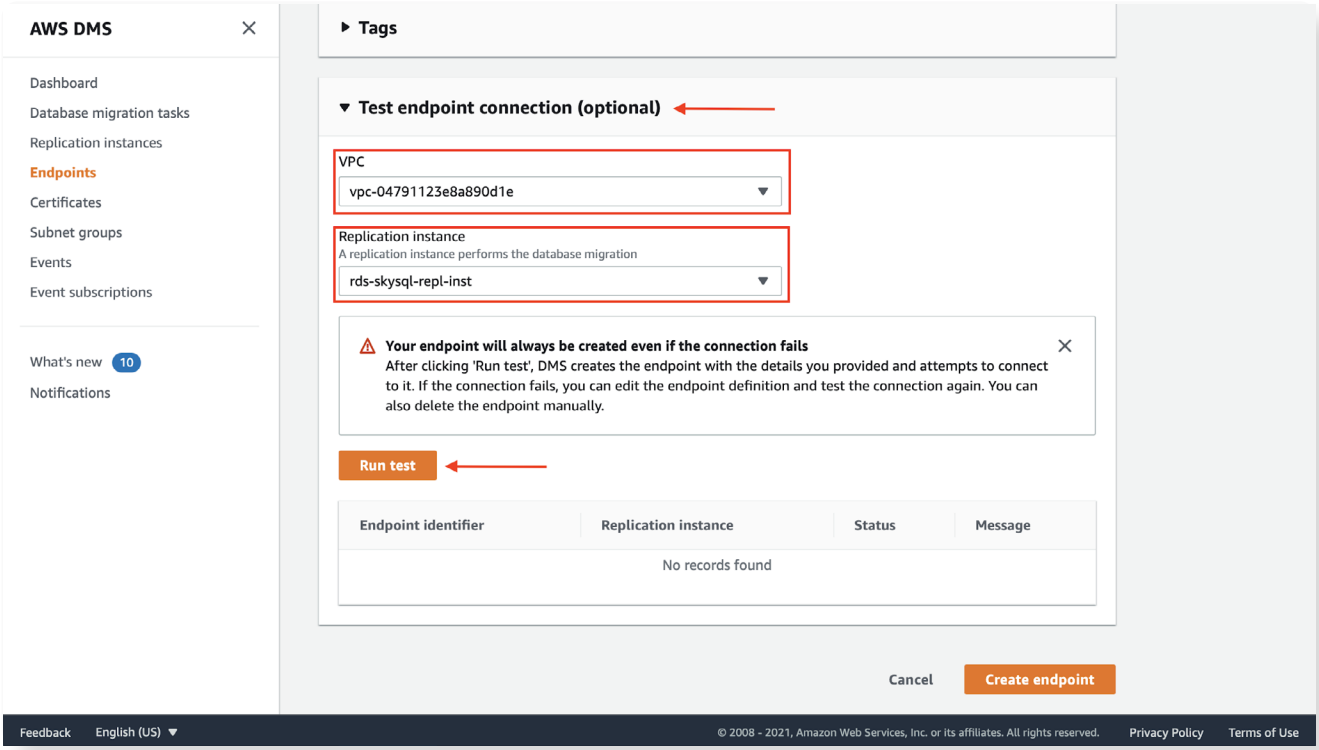
"Source endpoint" should already be selected by default. Click the checkbox next to "Select RDS DB instance". Then under "RDS Instance", select the RDS instance to be migrated. In this example, it's the instance named "stillman-dms-sky" mentioned earlier. Notice the "Endpoint identifier" field under "Endpoint configuration" is auto-populated.



Scroll down and complete the "Endpoint configuration". Under "Source engine", select "MySQL" (or whatever engine the source endpoint is) if it isn't already. Under "Access to endpoint database", select the correct option. For this demonstration, "Provide access information manually" was selected. Since an RDS instance was chosen as the source, "Server name", "Port", and "User name" were auto-populated. Enter the password at "Password".



Configuration is complete and the endpoint can be tested. Continue scrolling down. At the bottom of the endpoints page, click on "Test endpoint connection (optional)" to open the endpoint testing configuration. Select the "VPC" and "Replication instance" to test. Next, click "Run test". This will create the endpoint and test. If the test is successful, continue. If the test is unsuccessful, it is most likely that the replication instance's "Private IP address" noted earlier needs to be granted access in the RDS instance's security group. More information can be found here: https://docs.aws.amazon.com/AmazonRDS/latest/UserGuide/Overview.RDSSecurityGroups.html.


AWS DMS
Dashboard
Database migration tasks
Replication instances
Endpoints
Certificates
Subnet groups
Events
Event subscriptions
What's new 10
Notifications
Tags
Test endpoint connection (optional)
VPC
vpc-04791123e8a890d1e
Replication instance
A replication instance performs the database migration
rds-skysql-repl-inst
Your endpoint will always be created even if the connection fails
After clicking 'Run test', DMS creates the endpoint with the details you provided and attempts to connect to it. If the connection fails, you can edit the endpoint definition and test the connection again. You can also delete the endpoint manually.
Run test
Endpoint identifier
Replication instance
Status
Message
No records found
Cancel
Create endpoint
Feedback
English (US)
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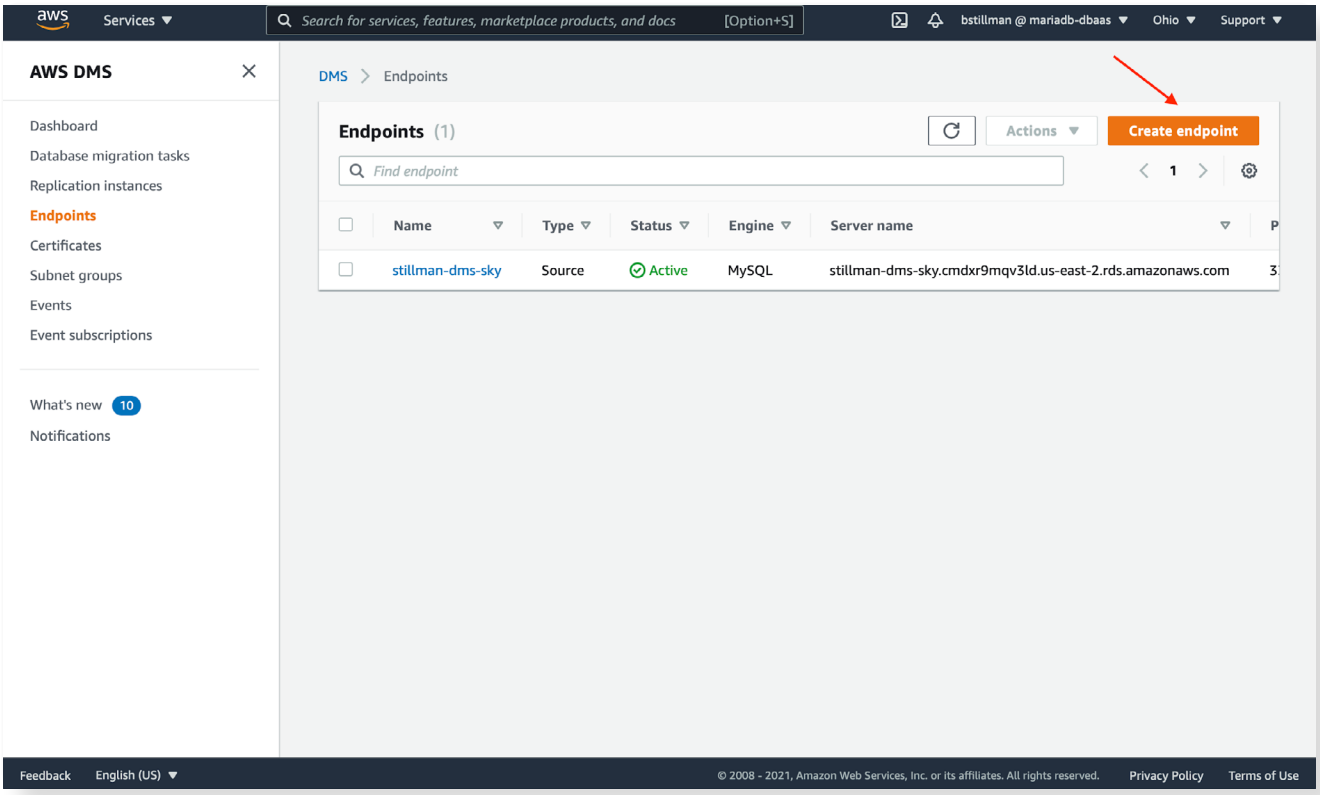
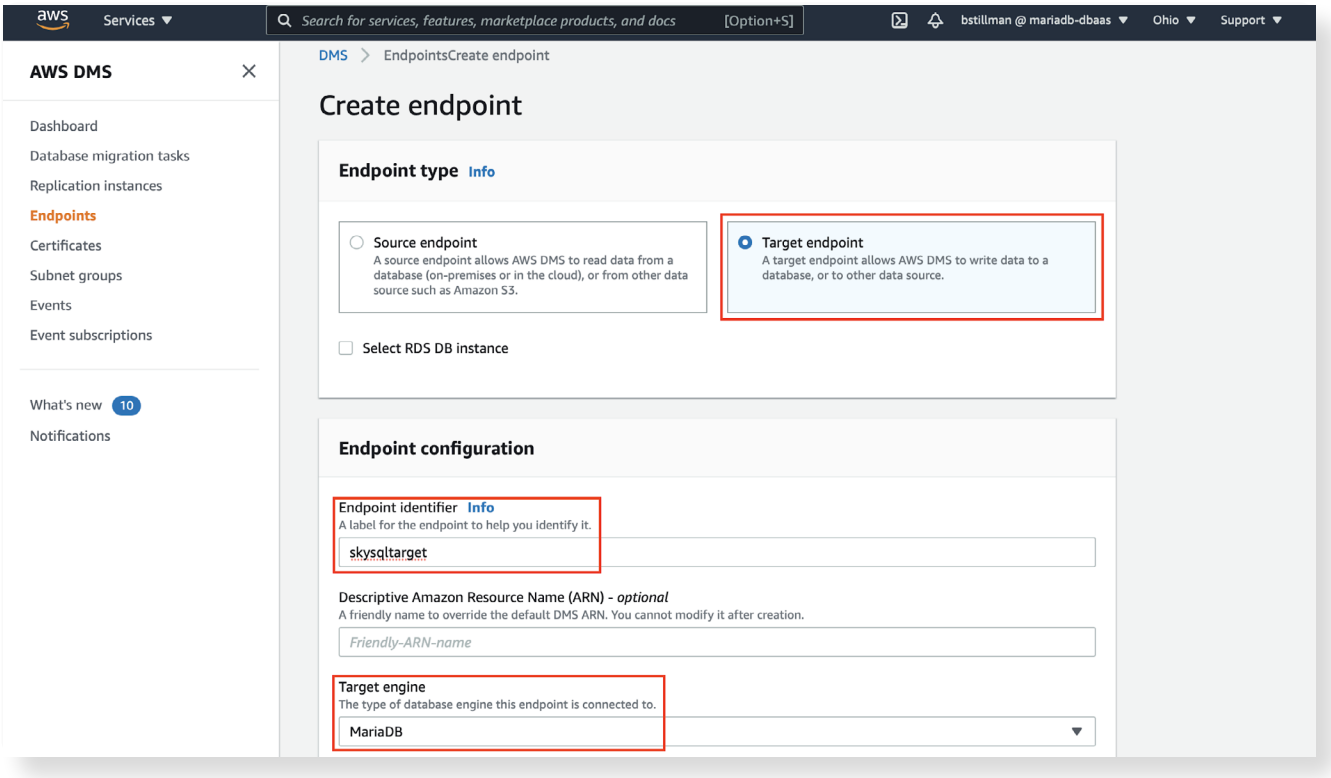
CREATE SKYSQL TARGET ENDPOINT

Next, the Target Endpoint needs to be created.

Click the "Create endpoint" button.

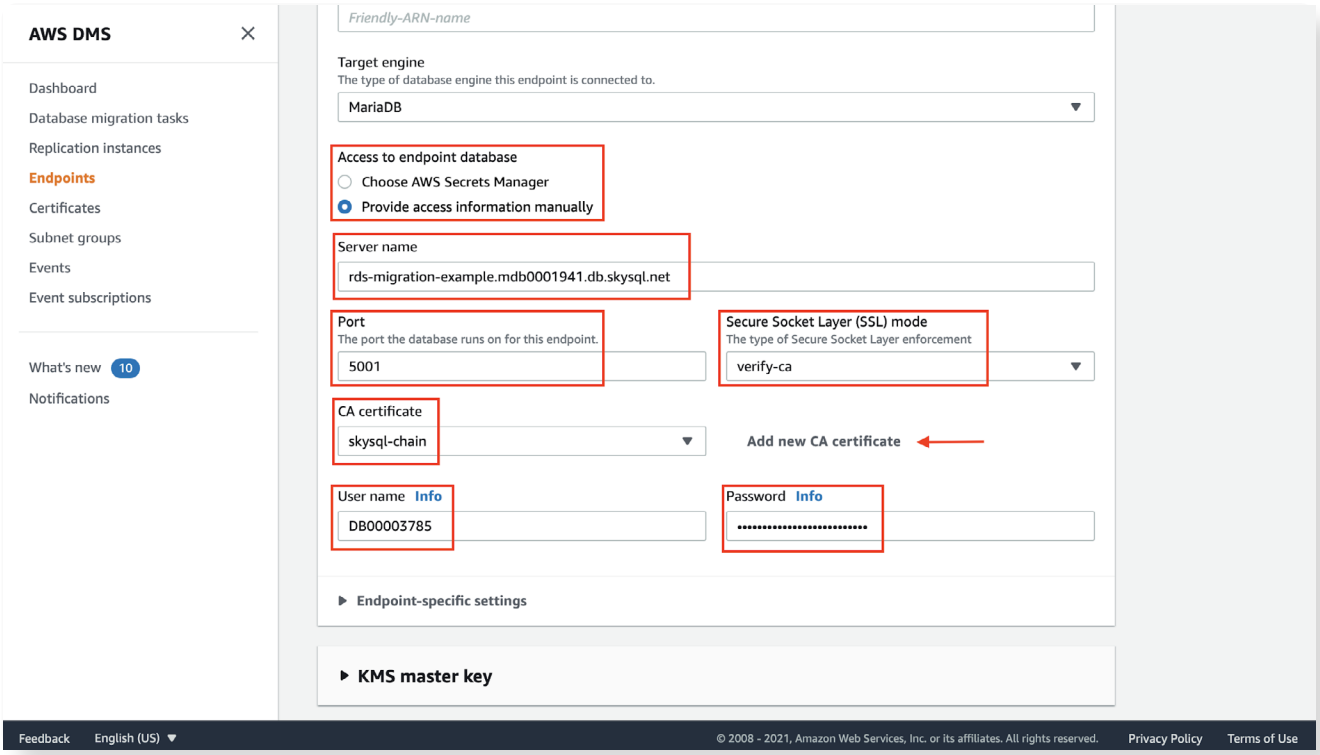


Select “Target endpoint”. Enter a descriptive “Endpoint identifier”. Choose “MariaDB” as the “Target engine”.

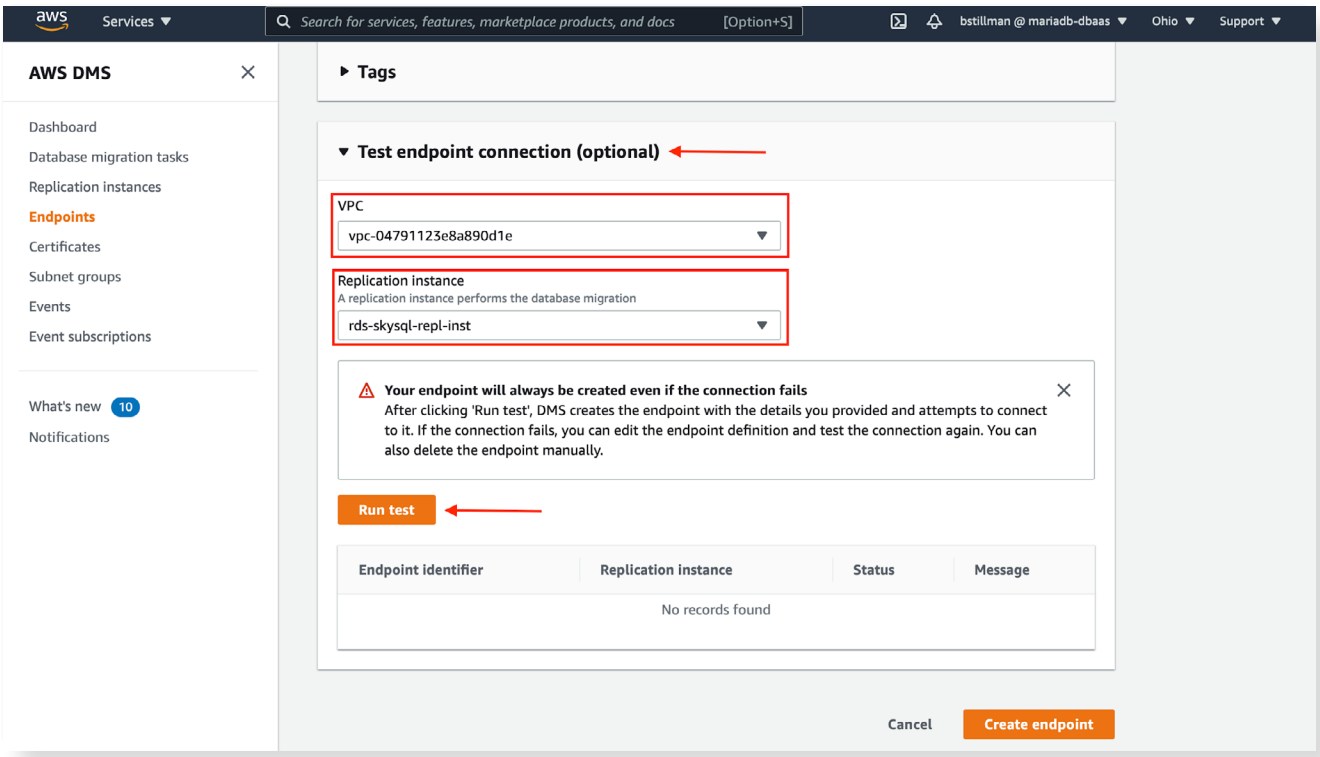


Scroll down to complete the configuration.

- Under “Access to endpoint database”, select “Provide access information manually”.
- For “Server name”, enter the “Fully Qualified Domain Name” from the SkySQL service.
- “Port” is the “Read-Write Port” from the SkySQL service.
- Select “verify-ca” under “Secure Socket Layer (SSL) mode”.
- Click “Add new CA certificate”.
- Upload the “Certificate authority chain” from SkySQL.
- Now “skysql-chain” should be available to select in the “CA certificate” drop-down.
- Lastly, enter the “User name” and “Password” for the SkySQL service.



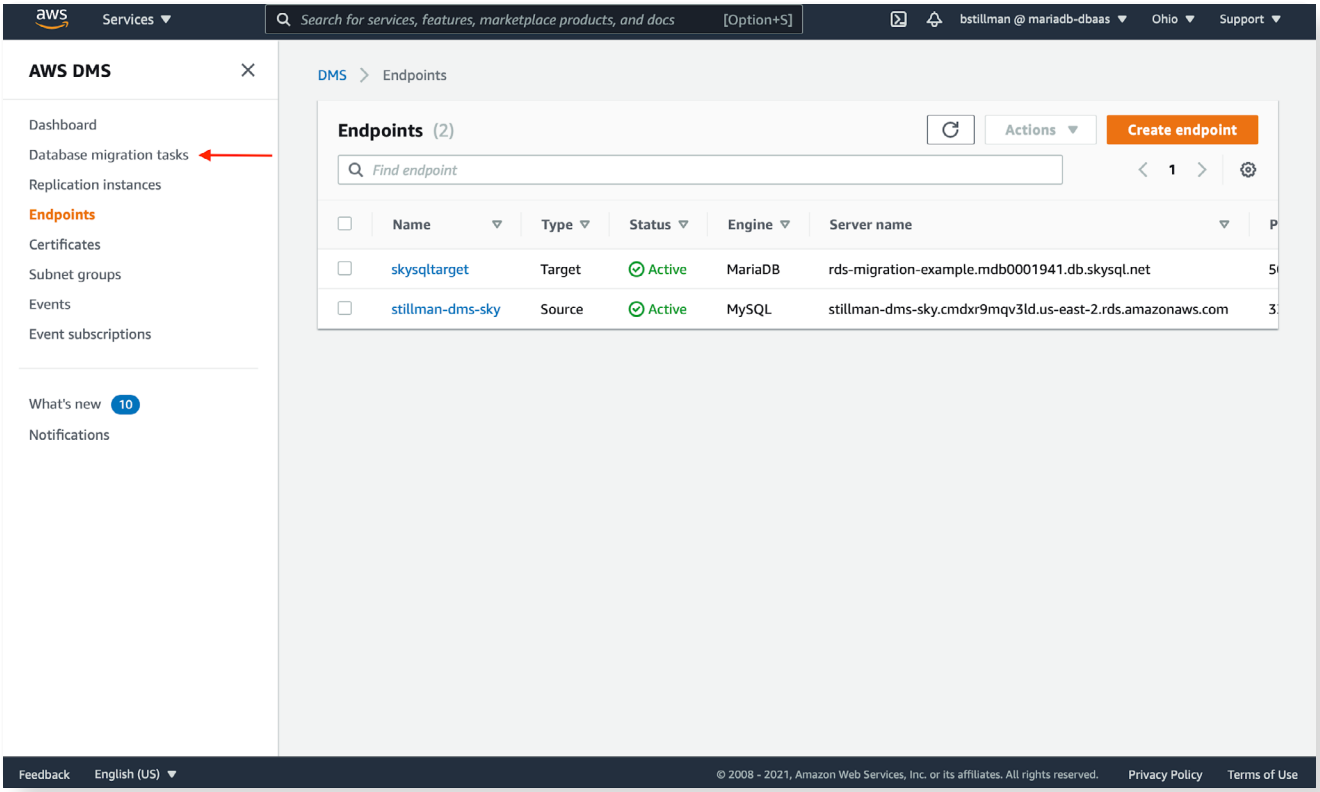
Configuration is complete and the endpoint can be tested. Continue scrolling down. At the bottom of the "Endpoints" page, click on "Test endpoint connection (optional)" to expand the testing configuration. Select the correct "VPC" and "Replication instance". Then click the "Run test" button. This will create the endpoint and test. If the test is successful, continue. If the test is unsuccessful, it is most likely that the replication instance's "Public IP address" noted earlier needs to be whitelisted in the SkySQL service. More information can be found here: https://mariadb.com/products/skysql/docs/instructions/ip-whitelist-services/.



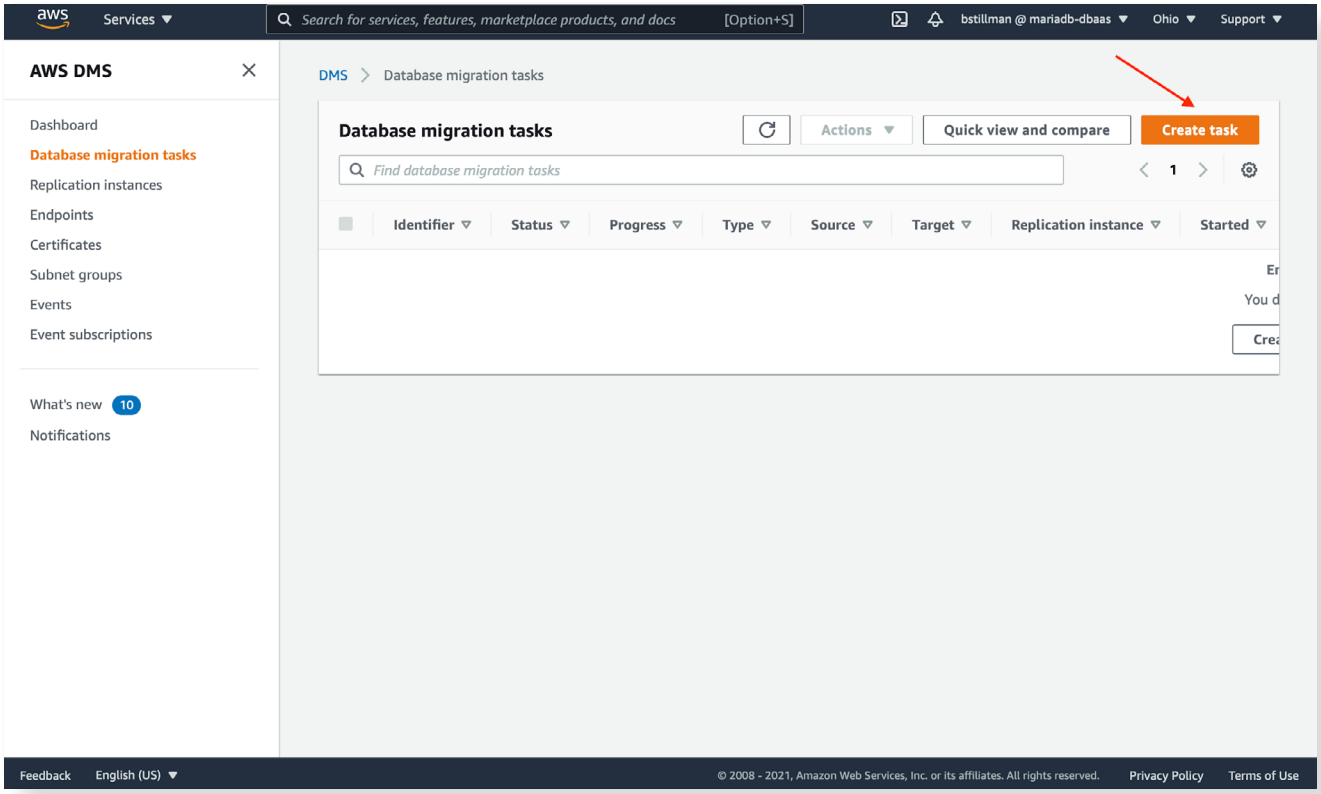
CREATE AWS DMS DATABASE REPLICATION TASK

Next, create the “Database replication task”.

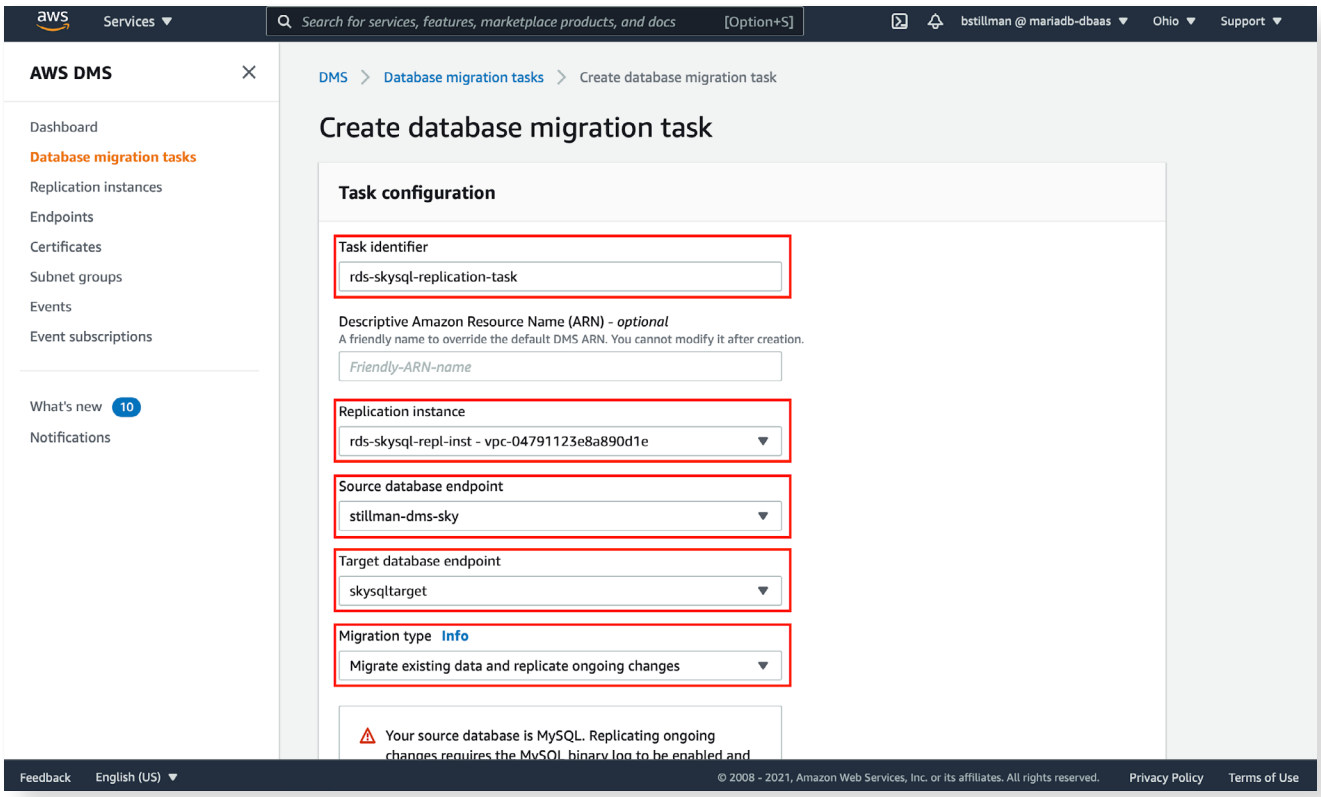
Click on “Database replication tasks” in the navigation menu on the left side.



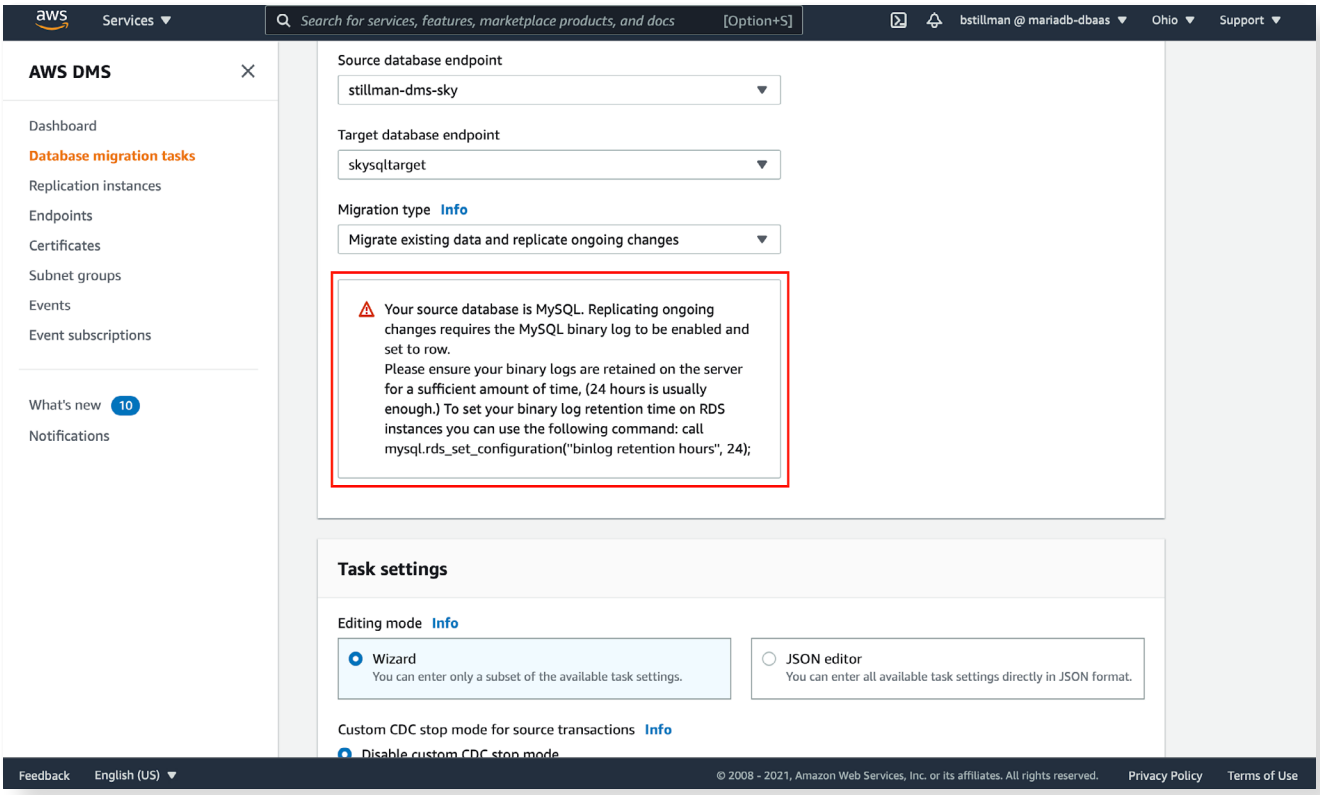
Click the "Create task" button.



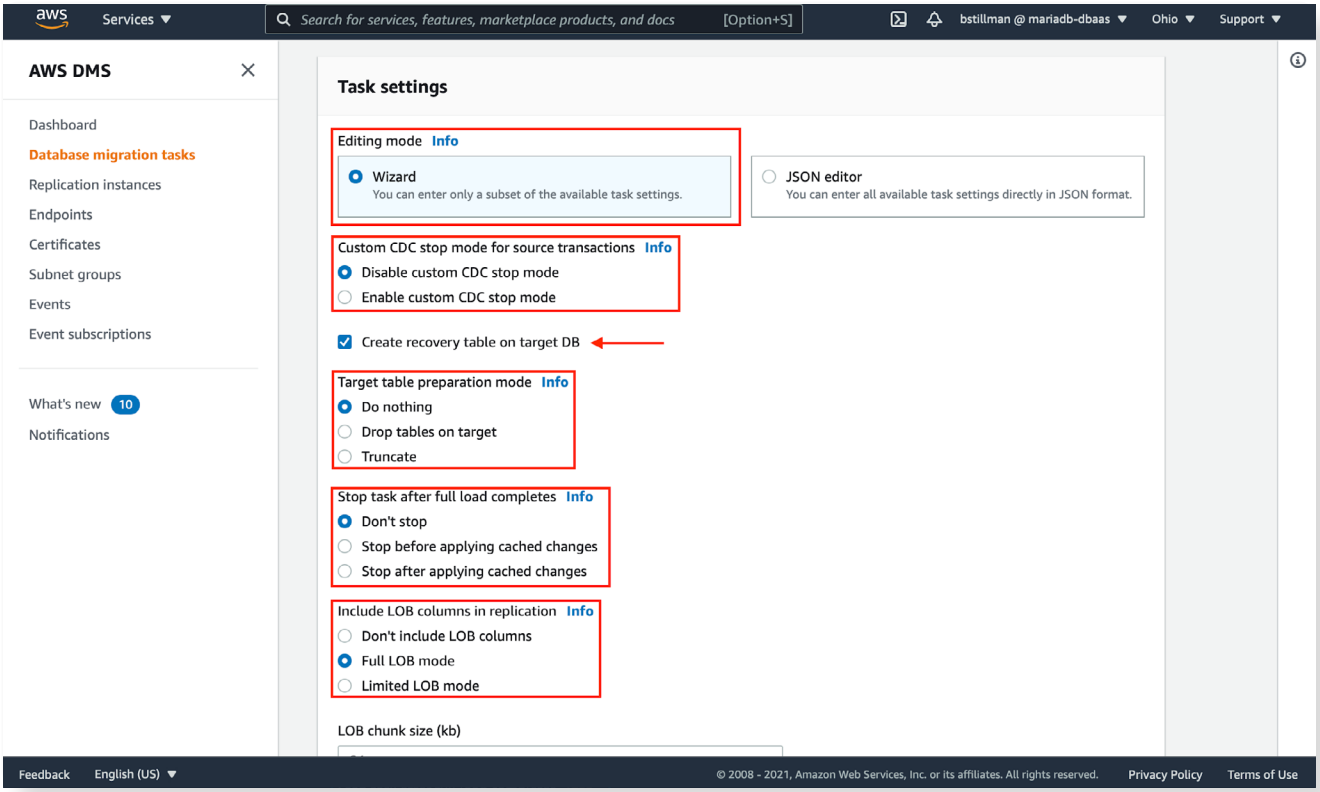
Enter a descriptive "Task identifier". Select the correct "Replication instance", "Source database endpoint", "Target database endpoint", and "Migration type". For this demonstration, this migration will be "Migrate existing data and replicate ongoing changes". This does a bulk load of existing data and replicates any further changes to the SkySQL service.



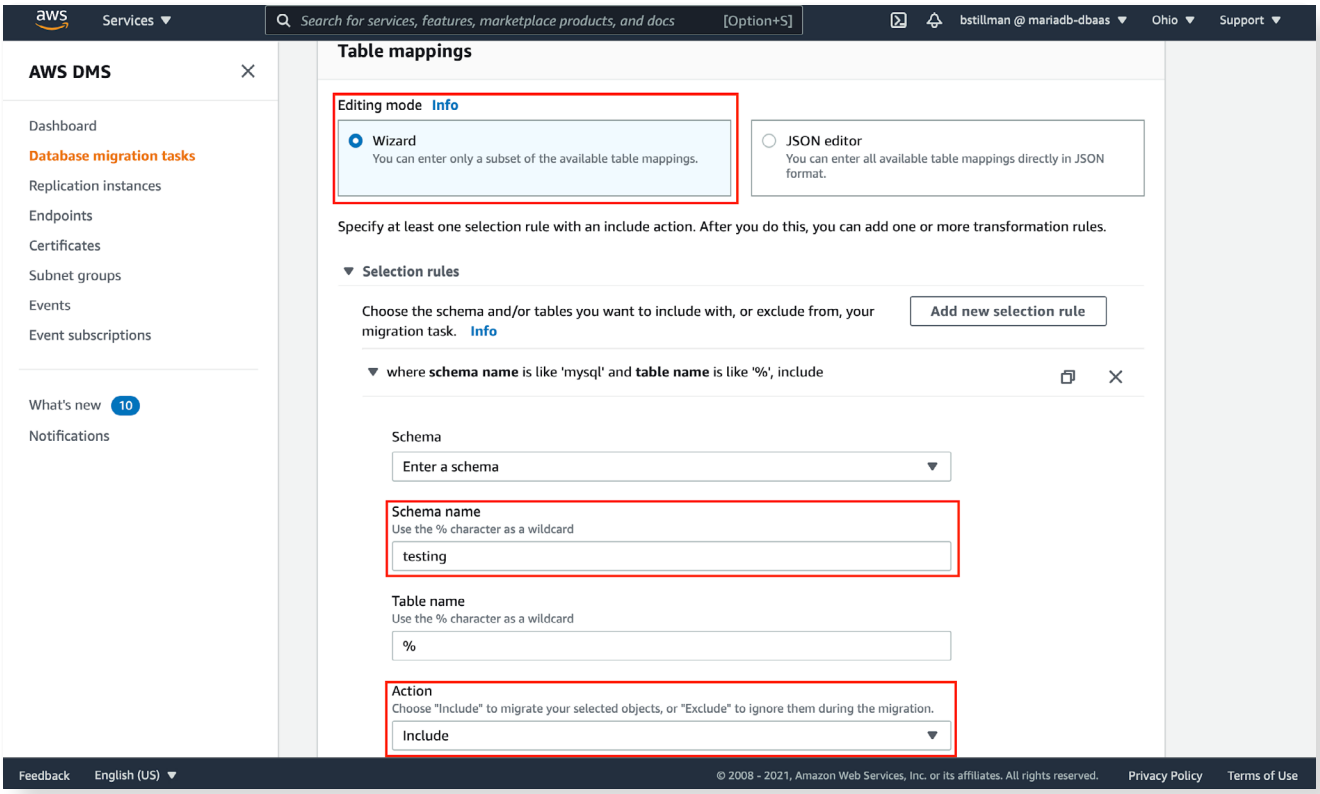
Note the warning presented. This should have already been completed during the "Configure the RDS Instance" step, thus safe to ignore.



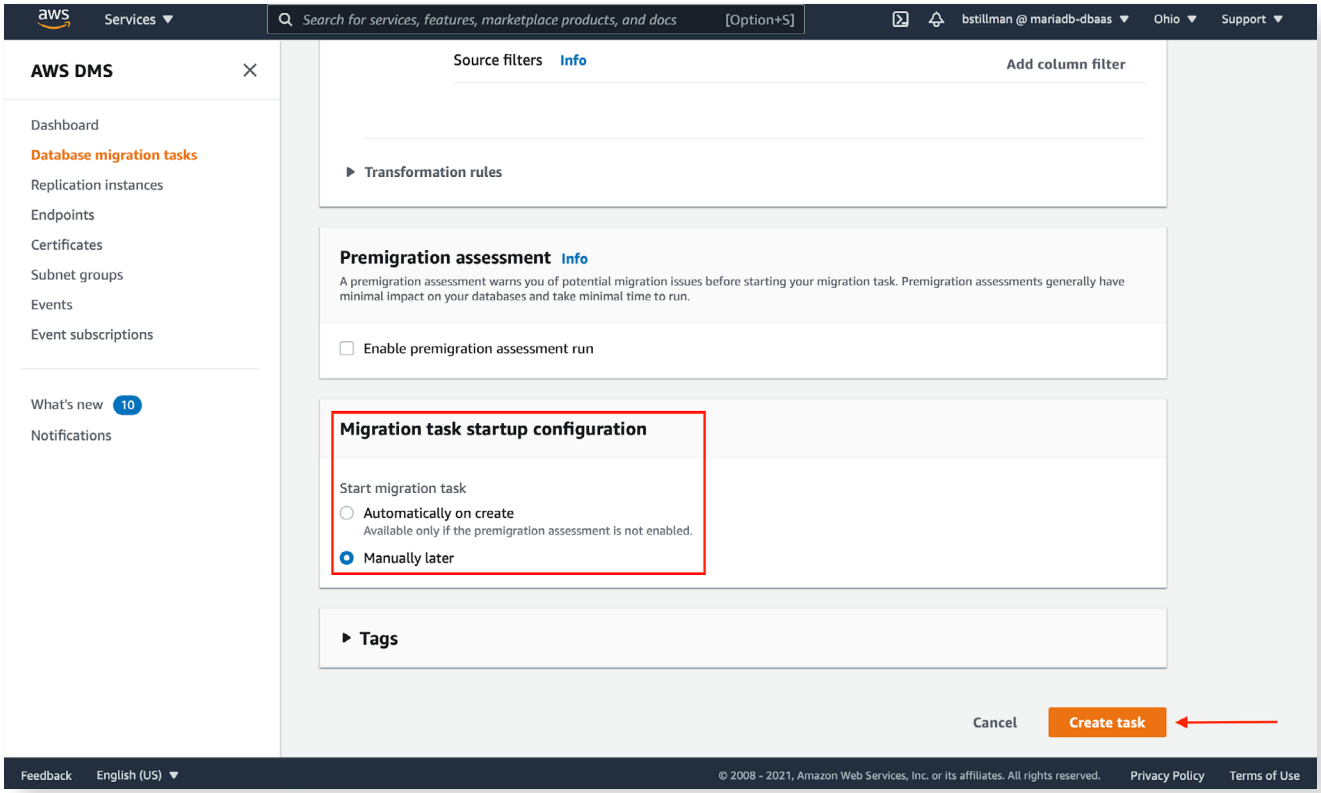
Continue scrolling down to continue configuring. Select "Wizard" for "Editing mode". Select "Disable custom CDC stop mode". Click the checkbox for "Create recovery table on target DB". For "Target table preparation mode", select the best option. For this demonstration, "Do nothing" was selected as the database to be migrated does not contain any data in the SkySQL service. Under "Stop task after full load completes", select "Don't stop". Under "Include LOB columns in replication", select the best option. For this demonstration, "Full LOB mode" was chosen although no LOBs are in the database to be migrated.



Scroll down to the "Table mappings" section. Select "Wizard" for "Editing mode". Now create a "Selection rule". For this demonstration, a database or schema named "testing" and all tables within will be included for migration.



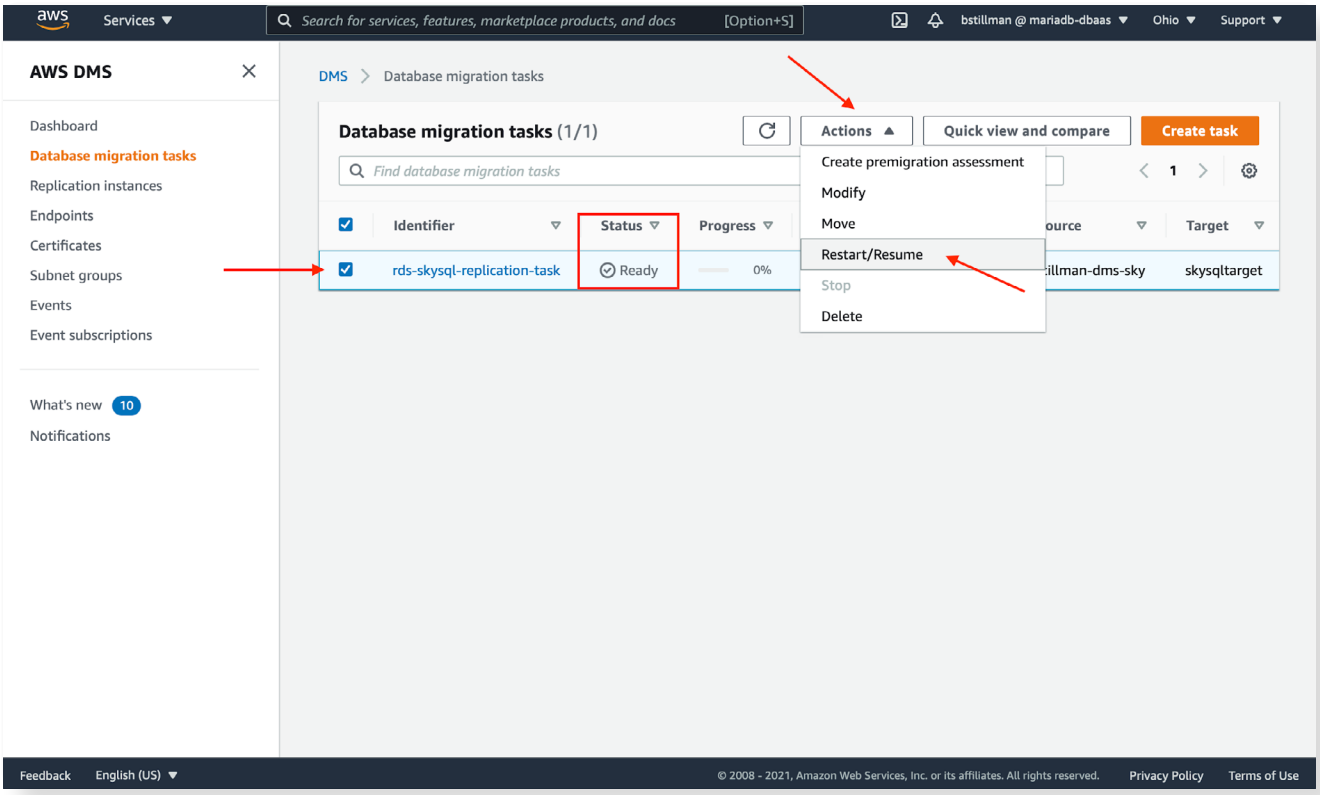
Scroll down to the bottom of the page. Under “Migration task startup configuration”, select “Manually later”. Then click the “Create task” button.



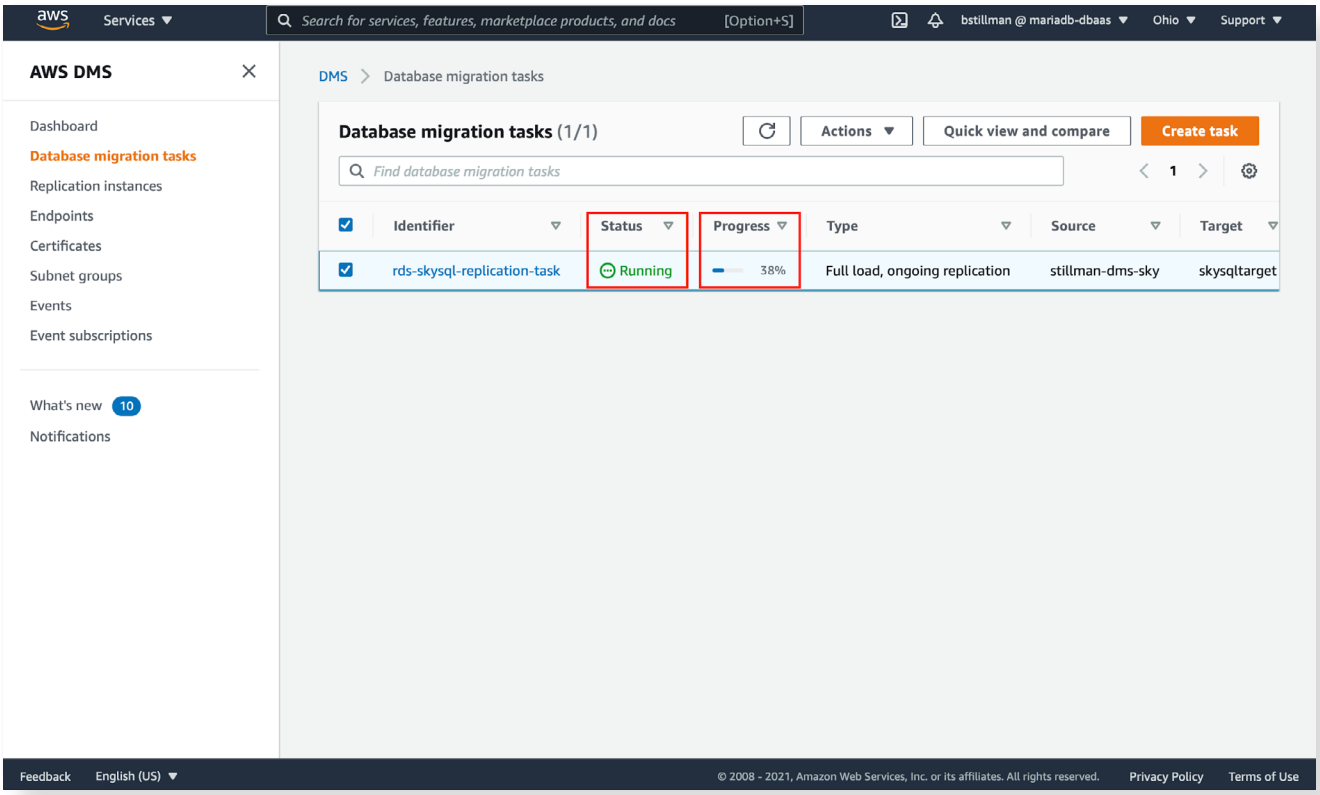
While the “replication task” is being created, verify the data within the RDS database to be migrated. For this demonstration, there is one table named “TableA” in the database named “testing”.

```
SELECT COUNT(*) FROM testing.TableA;
+----------+
| COUNT(*) |
+----------+
| 14017096 |
+----------+
```

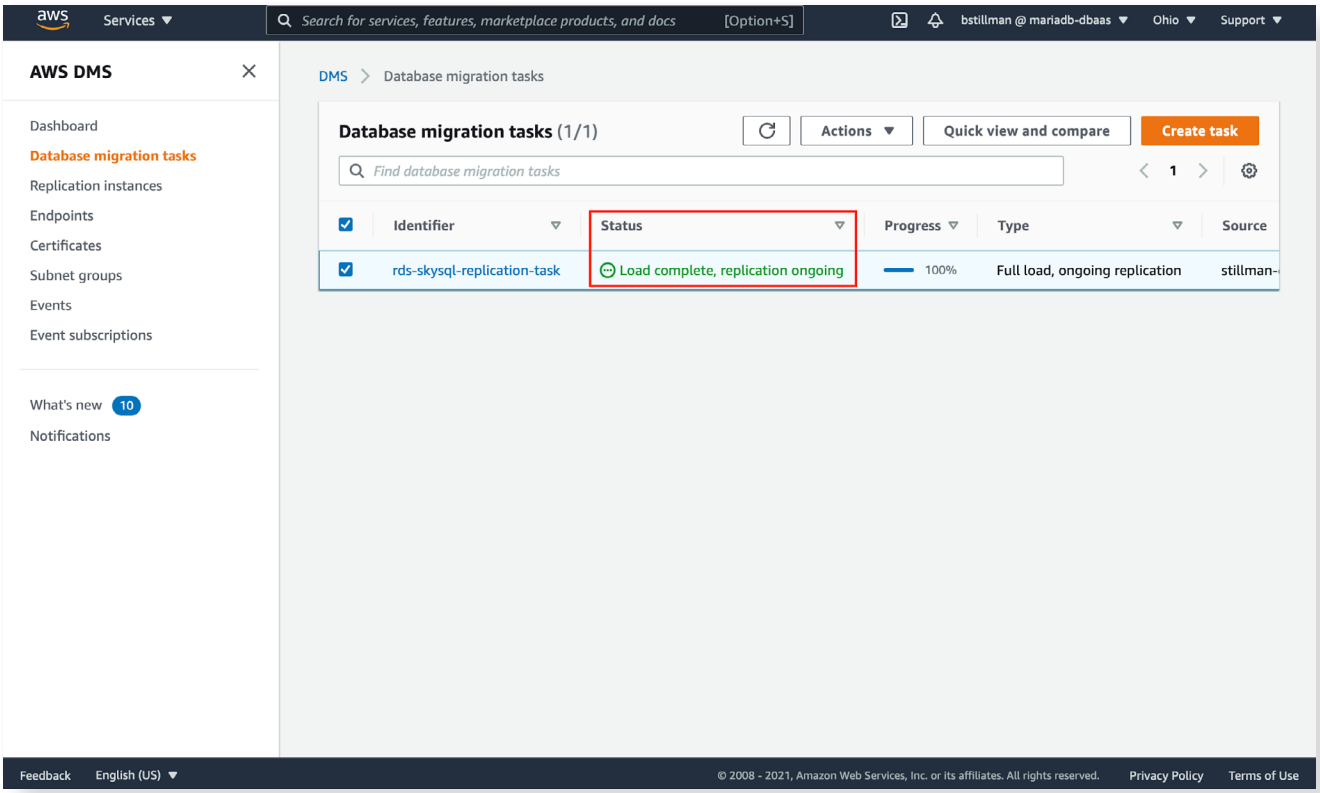
Once the replication task’s “Status” reports “Ready”, check the checkbox next to the service. Then click “Actions”, and then “Restart/Resume” to start the task.



The replication task's "Status" should now report "Running", and the "Progress" should be reporting. This can take a considerable amount of time depending on the size of the data to be migrated.



Once the initial bulk data load is complete, the “Status” should change to “Load complete, replication ongoing”.



Verify on the SkySQL service that the database and table has been migrated successfully.

```
SELECT COUNT(*) FROM testing.TableA;
+----------+
| COUNT(*) |
+----------+
| 14017096 |
+----------+
```

This matches the results from the RDS instance.

Now verify additional changes on the RDS instance are migrated to the SkySQL service by inserting a record into the table.

```
INSERT INTO testing.TableA (uuid_junk) VALUES ('ccaae845-6c9e-11eb-bf8d-06676091bc04');
```

Verify that record now exists in the SkySQL service.

```
SELECT uuid_junk FROM testing.TableA
WHERE uuid_junk = 'ccaae845-6c9e-11eb-bf8d-06676091bc04';
```

```
+--------------------------------------+
| uuid_junk
| +--------------------------------------+
| ccaae845-6c9e-11eb-bf8d-06676091bc04 |
+--------------------------------------+
```

AWS DMS has been successfully set up and is migrating any changes to the RDS instance to the SkySQL service. At this point, the application using the RDS instance can now be tested against real, live data on the SkySQL instance and cutover can be scheduled.

TESTING AND VALIDATION

Through the successful completion of this migration process, a second copy of the data in AWS RDS has been established on MariaDB SkySQL. This process is repeatable, which enables teams to perform a range of data validation and application testing before performing application migration.