Architecture overview

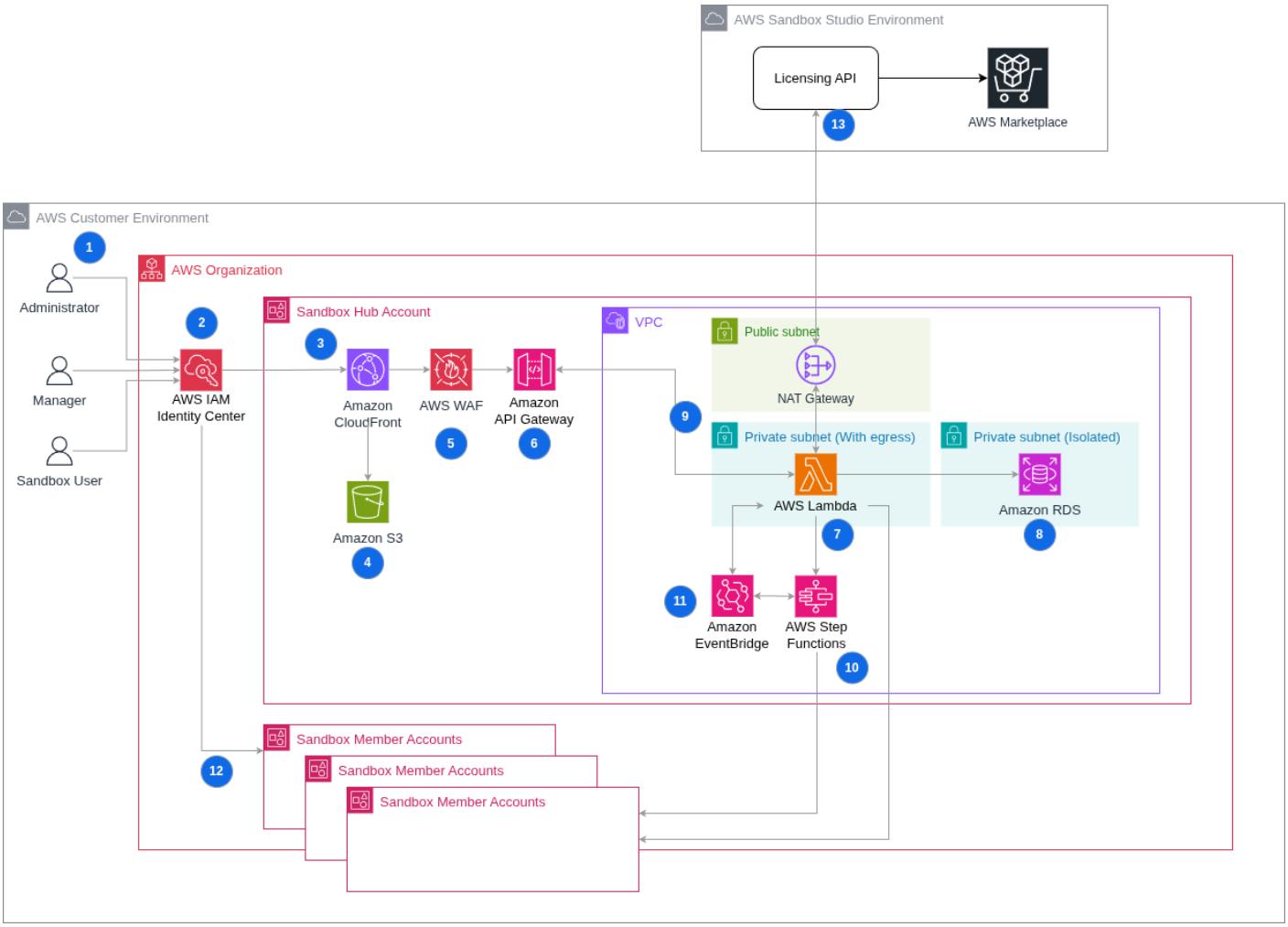
The architecture of Sandbox Studio brings together multiple AWS services to deliver secure, temporary sandbox environments. At a high level, the solution uses a combination of managed services that each play a specific role — from provisioning accounts and handling authentication, to monitoring usage and cleaning up resources. These services work together through event-driven automation and serverless functions to ensure scale, reliability, and efficiency. Security and compliance are built into the design, with controls such as least-privilege access, encryption, service control policies (SCPs), and network isolation.

The following sections provide more detail on the overall solution design, the AWS services used, and the security model that underpins it.

Solution Architecture

Sandbox Studio solution is built entirely on AWS services, with each component playing a specific role in delivering, securing, and managing sandbox environments. The architecture uses managed services to ensure scalability, security, and automation.

The diagram below shows the main components and how they interact. Follow the numbered sections in this guide to understand the purpose and function of each component in the solution.



1. User Roles & Responsibilities

Sandbox Studio supports **three types of users**, each with distinct responsibilities:

1. Administrators

Responsible for configuring and maintaining Sandbox Studio for their organisation.
Key responsibilities include:

- Setting **global policies** such as maximum budget thresholds and cleanup rules.

- Managing **AWS integration**, including permissions and guardrails.
- Provisioning new sandbox accounts when needed.
- Overseeing **security and governance** settings.

2. Managers

Oversee day-to-day sandbox usage within a team or department.
Key responsibilities include:

- Approving or rejecting sandbox requests.
- Assigning account templates to users.
- Tracking **spending** and **activity** for accounts under their supervision.

3. Sandbox Users

Request and use sandbox accounts for **development, testing, training, or experimentation**.
They must operate within:

- Guardrails
- Permissions
- Budget limits

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2. Authentication and Access

- All users access Sandbox Studio via a **SAML 2.0 application** using **AWS IAM Identity Center**.
- IAM Identity Center can:
  - Use its **own internal user store**, or
  - Integrate with **external identity providers** (e.g., Okta, Microsoft Entra ID).
- Most organisations with an existing **AWS Organisation** use an external provider for centralised identity management.

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3. Application Entry Point

- The **web UI** is accessed through **Amazon CloudFront**, which serves as a single entry point for:
  - The static web UI (hosted in Amazon S3).
  - API endpoints (via Amazon API Gateway).

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4. UI Hosting

- **Amazon S3** hosts static assets such as **HTML, CSS, and JavaScript** files.

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5. API Protection

- **AWS WAF** protects API Gateway from common exploits, bots, and resource abuse.

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6. API Gateway

- The web UI communicates with **Amazon API Gateway REST APIs** to:
  - Fetch data
  - Update configuration and status information
- **AWS Lambda functions** authorize requests using **role-based access control** based on IAM Identity Center groups.

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7. Backend

AWS Lambda is used throughout Sandbox Studio to run backend logic, including:

- **Authorizing API requests** based on group memberships.
- **Reading and writing data** to a database.
- **Monitoring account leases** for budget or duration threshold breaches.
- **Invoking lifecycle actions** such as account cleanup, OU movement, and permission updates.

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8. Database

- **AWS Lambda** functions read and write configuration and status data to a **PostgreSQL** database deployed using **Amazon Relational Database Service (RDS)**.
- The RDS database runs **inside a VPC** in the **sandbox hub account**.

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9. Networking

The Amazon **Virtual Private Cloud (VPC)** hosts the PostgreSQL RDS database used by Sandbox Studio.
Key characteristics include:

- **Private subnets** for hosting the RDS database securely.
- **VPC-enabled Lambda functions** to allow direct database access.
- **Network isolation** from other AWS resources to protect sensitive configuration and status data.

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10. Account Lifecycle Management

- AWS Step Functions coordinate the lifecycle of sandbox accounts, including:
  - Onboarding new accounts
  - Terminating leases
  - Cleaning up accounts for reuse

- Step Functions move accounts between **Organizational Units (OUs)** based on their current status.
- Onboarding or termination events trigger dedicated cleanup workflows. These workflows can invoke other AWS services, such as **AWS CodeBuild**, to run resource deletion tools like **AWS Nuke**, ensuring all user-created resources are removed before the account is returned to the available pool.

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11. Event-Driven Automation

- **Amazon EventBridge** routes lifecycle events such as
  - **Lease budget breaches**
  - **Lease duration breaches**

- When triggered, these events can:
  - Send email notifications
  - Invoke Lambda functions and Step Functions to manage lifecycle actions

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12. Sandbox Account Access

- Users can access assigned AWS sandbox accounts via:
  - **AWS IAM Identity Center Access Portal** (console access)
  - **Programmatic access** using generated credentials
- The Sandbox Studio web UI provides **SSO links** for direct AWS console login.

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13. Licensing Server

- Sandbox Studio regularly queries the Sandbox Studio Software Licensing Service to confirm the customer's entitlement. That service will also query the AWS Marketplace.

Note: a number of other supporting AWS services are used by Sandbox Studio. Please see AWS services in this solution for the full list.

AWS services in this solution

Sandbox Studio uses a combination of **AWS managed services** to securely deliver, manage, and clean up sandbox environments. The table below describes the core AWS services used in the solution.

AWS Service	Description
Amazon CloudFront	Acts as the **entry point** into the application. It fronts both the static website (hosted in Amazon S3) and the API Gateway, ensuring secure and efficient content delivery.
AWS IAM Identity Center	Manages **all user access** to the solution. Every user has an account in IAM Identity Center, where access permissions and group memberships are defined.
AWS AppConfig	Stores **global limits and application settings**, allowing configuration updates without code changes. Used across multiple parts of the solution.
AWS Organisations	Hosts all **organisational units (OUs)** used to manage sandbox accounts. The solution places accounts in different OUs depending on their state in the sandbox lifecycle.
Amazon RDS	Provides a **PostgreSQL database** for storing structured data such as account templates and lease records.
AWS Secrets Manager	Securely stores **private keys for authentication** and database credentials used by the application.
AWS Lambda	Runs **all backend compute** for the application using a serverless architecture, avoiding the need for containers or virtual machines.
AWS CodeBuild	Runs **pre-launch tasks** (such as deploying resources into new accounts) and **cleanup tasks** (such as deleting resources after a sandbox lease expires).
Amazon S3	Hosts the **main static website** for the application.
AWS Key Management Service (AWS KMS)	Uses **customer-managed keys** to encrypt various elements of the solution.
Amazon Simple Queue Service (Amazon SQS)	Handles **asynchronous events** such as bulk account setup or cleanup operations.
AWS Systems Manager	Uses AWS Systems Manager **Parameter Store** to store **installation-time configuration variables** that need to be shared across different CloudFormation stacks in the solution.

AWS Service	Description
Amazon CloudWatch	Captures **all application logs and system metrics**, allowing administrators to monitor system health and troubleshoot issues.

Security & Compliance

This page provides an overview of the security model used by **Sandbox Studio**. It explains how the solution is deployed, the controls in place, and how it aligns with enterprise security, compliance, and governance requirements.

Deployment Model

- **Customer-owned deployment** – Sandbox Studio is deployed into your own **AWS Organisation or Landing Zone**. It is not SaaS.
- **Full control** – You retain complete ownership of AWS accounts, configurations, and network boundaries.
- **Account isolation** – Sandbox accounts are provisioned into dedicated **Organisational Units (OUs)** with **Service Control Policies (SCPs)** applied to enforce guardrails.

Data Protection

- **No production data ingestion** – Sandbox Studio does not ingest, store, or process production workloads unless specifically configured to do so.
- **Local metadata** – Configuration data, logs, and monitoring outputs remain within your AWS accounts unless explicitly shared.
- **Encryption standards**:
  - **In transit** – All communication uses TLS 1.2 or higher.
  - **At rest** – All persistent data is encrypted with AWS KMS (customer-managed where appropriate).
- **Credential handling** – No AWS credentials are stored outside your environment.

Identity & Access Management

IAM Roles

- Multiple **IAM roles** are deployed to run Sandbox Studio and discover resources within AWS accounts.
- Roles follow **least privilege principles**, granting only the minimal permissions required for each function.
- Separation of duties is enforced across deployment, lifecycle automation, and monitoring components.

IAM Identity Center & SAML

- **AWS IAM Identity Center** (formerly AWS SSO) provides **centralised authentication**.

- Sandbox Studio integrates with **SAML 2.0 identity providers** (e.g., Okta, Microsoft Entra ID) for seamless single sign-on.
- Users sign into the Sandbox Studio web UI with **existing corporate credentials**, eliminating the need for local passwords.

Role-based Access

- Access levels are defined by **permission sets**:
  - **End users** – Request and operate sandbox accounts.
  - **Managers** – Approve requests, define templates, and oversee usage.
  - **Administrators** – Configure global settings, guardrails, and integrations.
- **SCP enforcement** prevents privilege escalation, service misuse, or bypassing of governance controls.

Network Security

Sandbox Studio backend services run inside a **dedicated VPC** with a layered subnet model to enforce isolation.

- **Three subnet tiers**:
  - **Public subnet** – Only for CloudFront distribution and API Gateway.
  - **Private application subnets** – Run AWS Lambda functions with **controlled outbound-only egress** for required API calls.
  - **Private database subnets** – Host PostgreSQL RDS, with **no inbound or outbound internet access**.
- **No direct internet exposure** – Backend compute and storage remain fully private.
- **AWS WAF protection** – A **regional WAF ACL** secures API Gateway endpoints using four AWS managed rule groups and two custom rules.
- **Separation of duties** – Network boundaries ensure web entry points, compute, and data tiers are isolated.

Core Security Services

AWS Key Management Service (KMS)

- Sandbox Studio creates **four Customer Managed Keys (CMKs)**, one per stack (AccountPool, IDC, Data, Compute).
- Each CMK encrypts AWS resources such as:
  - CloudWatch Logs
  - Amazon SQS queues
  - EventBridge event buses
  - AWS Secrets Manager secrets
  - AWS CodeBuild projects
  - Amazon RDS database
- CMKs follow **separation of concerns**, limiting key scope and permissions per stack.

AWS WAF

- Web Application Firewall (WAF) protects **API Gateway endpoints**.
- Rules include managed protections (e.g., SQLi, XSS, bot control) and two custom allowlists.
- Default behaviour blocks any request failing rule evaluation.

Amazon CloudFront

- Serves the Sandbox Studio web UI hosted in **Amazon S3**.
- Configured with **TLS 1.2+** for all sessions.
- Adds **HTTP security headers** to viewer responses.
- For stricter TLS enforcement, a custom certificate can be applied to require TLS 1.2 or TLS 1.3.

Amazon RDS

- All user data stored in **Amazon RDS** (Relational Database Service) is encrypted at rest with **AWS KMS CMKs**.

AWS Lambda

- All backend logic runs on **serverless Lambda functions**.
- Each function uses the **most recent stable runtime**.
- **No secrets are logged**, and IAM roles are isolated per function.
- Functions operate with **least-privilege permissions** and scoped network access.

Lifecycle Management

- **Pre-configured templates** – Sandboxes are provisioned with security guardrails and governance baked in.
- **Automated teardown** – On expiry, AWS Nuke ensures accounts are cleaned and reset before reuse.
- **Flexible expiry options** – Accounts may expire based on **time** or **budget thresholds**. Logs are retained for audit purposes.

Logging, Monitoring & Governance

- **AWS-native monitoring** is fully supported. Customers are able to use the following native AWS services and are encouraged to do so to increase their security posture:
  - **AWS CloudTrail** – Comprehensive audit logging.
  - **AWS Config** – Compliance and drift detection.
  - **Amazon GuardDuty** – Continuous threat detection.
  - **Amazon CloudWatch** – Metrics, alarms, and application insights.
- **Governance enforcement** – SCPs and automation to prevent insecure patterns (e.g. public S3 buckets).

Compliance Alignment

While Sandbox Studio itself is not independently certified, it is **built entirely on AWS services that hold stringent compliance certifications**. This means Sandbox Studio inherits the **trusted compliance foundation** of AWS.

Key AWS Certifications in Scope

AWS services underpinning Sandbox Studio have been audited against major frameworks, including:

- **SOC 1, SOC 2, SOC 3**
- **PCI DSS**
- **HIPAA / HITECH**
- **ISO 27001, ISO 27017, ISO 27018**
- **FedRAMP**
- **GDPR**
- **FIPS 140-3** (for AWS KMS)

Compliance Certifications for Core Services

Service	Certifications
Amazon CloudFront	SOC 1, SOC 2, SOC 3, PCI DSS, HIPAA, ISO 27001/17/18, FedRAMP
AWS IAM Identity Center	SOC 1, SOC 2, SOC 3, PCI DSS, HIPAA, IRAP, ISO 27001/17/18
AWS AppConfig	SOC 1, SOC 2, SOC 3, PCI DSS, HIPAA, ISO 27001/17/18, FedRAMP
AWS Organizations	SOC 1, SOC 2, SOC 3, PCI DSS, HIPAA, ISO 27001/17/18
Amazon RDS	SOC 1, SOC 2, SOC 3, PCI DSS, HIPAA/HITECH, ISO 27001/17/18, FedRAMP, GDPR
AWS Secrets Manager	SOC 1, SOC 2, SOC 3, PCI DSS, HIPAA, ISO 27001/17/18, ISO 9001
AWS Lambda	SOC 1, SOC 2, SOC 3, PCI DSS, HIPAA, FedRAMP, ISO 27001/17/18
AWS CodeBuild	SOC 1, SOC 2, SOC 3, PCI DSS, HIPAA, FedRAMP, ISO 27001/17/18
Amazon S3	SOC 1, SOC 2, SOC 3, PCI DSS, HIPAA/HITECH, ISO 27001/17/18, FedRAMP, GDPR
AWS Key Management Service (KMS)	SOC 1, SOC 2, SOC 3, PCI DSS, HIPAA, FedRAMP, ISO 27001/17/18, FIPS 140-3
Amazon Simple Queue Service (SQS)	SOC 1, SOC 2, SOC 3, PCI DSS, HIPAA, ISO 27001/17/18, FedRAMP

Service	Certifications
AWS Systems Manager	SOC 1, SOC 2, SOC 3, PCI DSS, HIPAA, FedRAMP, ISO 27001/17/18
Amazon CloudWatch	SOC 1, SOC 2, SOC 3, PCI DSS, HIPAA, FedRAMP, ISO 27001/17/18

For official audit reports and current scope, use **AWS Artifact** or consult the **AWS Services in Scope by Compliance Program** documentation.

Summary

Sandbox Studio is designed with **security-first principles** and built on **compliant AWS services** . Key assurances include:

- Complete customer control of data, identity, and network boundaries.
- End-to-end encryption, least-privilege IAM roles, and enforced SCP guardrails.
- Defence-in-depth VPC design with layered subnets and strict egress rules.
- Strong network protection via AWS WAF and CloudFront TLS enforcement.
- Automated account lifecycle management with auditable teardown.
- Monitoring and governance integrated with AWS-native services.
- Foundation aligned with **ISO 27001, SOC 2, PCI DSS, HIPAA, and FedRAMP-certified AWS services**.

This model provides **security officers and auditors confidence** that sandbox environments are **isolated, compliant, and tightly governed** — enabling safe innovation in AWS without introducing enterprise risk.

Roles deployed by the solution

Sandbox Studio installs multiple roles in your environment, each serving different purposes

Role name	Account created in	Purpose	Can be assumed by
OrgMgtRole - *SandboxStudio-{Namespace}-OrgMgtRole*	Management Account	For operations on the org management account (Move accounts between OUs, etc.)	IntermediateRole in Hub Account
IntermediateRole - *SandboxStudio-{Namespace}-IntermediateRole*	Hub Account	For functions, step functions, etc to assume to then be able to assume the Org Management Role	Roles starting with SandboxStudio-Compute-* and SandboxStudio-API-*
IdcRole - *SandboxStudio-{Namespace}-IdcRole*	Management Account	For operations in Identity Center	IntermediateRole in Hub Account
SandboxAccountRole - *SandboxStudio-{Namespace}-SandboxAccountRole*	Member accounts	For Hub Accounts to control member accounts	IntermediateRole in Hub Account
CodeBuildDeployRole	Member accounts	To allow launch templates in member accounts	Step function to create launch templates
LaunchTemplateExternalAccessRole	Hub Account	Allows access to S3 buckets in external accounts	CodeBuildDeployRole

More info on LaunchTemplateExternalAccessRole

This role is a bit particular in the sense that it is created with the following policy:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Condition": {
                "StringNotEquals": {
                    "aws:ResourceAccount": "<HUB ACCOUNT ID>"
                }
            },
```

```
            "Action": [
                "s3:GetObject",
                "s3:ListBucket"
            ],
            "Resource": "*",
            "Effect": "Allow"
        }
    ]
}
```

This gives the role permissions to list buckets and get objects in every buckets that are NOT the Hub Account (The account where the role is created).

The purpose of this is to allow you to grant this role access to your own bucket should you have resources in other accounts.

For example, let's say you want to launch a template in a Sandbox Account with resources coming from an external S3 bucket (resources, CloudFormation templates, ...). You can grant access to your external bucket to this role through **Bucket policy**.

The codebuild task running your launch template will assume this role which in turn can access your resources in a secure manner.

Secrets & Encryption keys

Secrets

Sandbox Studio creates 4 secrets in AWS Secrets Manager:

Secret name	Description	Rotated?
/SandboxStudio/Sandbox/Auth/IdpCert	IAM Identity Center Certificate of the Sandbox Studio SAML 2.0 custom app	No
/SandboxStudio/Sandbox/Auth/JwtSecret	The secret for JWT used by Sandbox Studio	Automatically, every 30 days
/SandboxStudio/Sandbox/RDS/Credentials	Credentials for RDS PostgreSQL instance for SandboxStudio	Not automatically - *Planned for next Sandbox Studio releases*
/SandboxStudio/Sandbox/SMTP/Credentials	SMTP Credentials for Sandbox Studio (Only use if Sandbox Studio is configured to send notifications using SMTP)	No

> Sandbox Studio uses JWT Token for authentication mechanism. As part of the solution, and to ensure higher standards of security, the JWT Secret is rotated every 30 days.

Encryption keys

Sandbox Studio creates the following KMS keys:

Aliases	Key type	Key spec	Key usage
-	Symmetric	SYMMETRIC_DEFAULT	Encrypt and decrypt
SandboxStudio/Sandbox/Sandbox-SandboxStudio-Data	Symmetric	SYMMETRIC_DEFAULT	Encrypt and decrypt
-	Symmetric	SYMMETRIC_DEFAULT	Encrypt and decrypt

Aliases	Key type	Key spec	Key usage
SandboxStudio/Sandbox/Sandbox-SandboxStudio-Compute	Symmetric	SYMMETRIC_DEFAULT	Encrypt and decrypt
SandboxStudio/Sandbox/Sandbox-SandboxStudio-API	Symmetric	SYMMETRIC_DEFAULT	Encrypt and decrypt

> Sandbox Studio S3 Buckets use Amazon-Managed server-side encryption.

Data stored (and where)

Overview

Sandbox Studio provisions a single-AZ database by default (db.t4g.micro). You can modify the database size according to your requirements.

Data Storage

The database stores the following types of data:

- User display names and internal Identity Center identifier
- Email addresses
- Cost information

This information comes from the first user login from AWS Identity Center user.

Security

Network Isolation: The database resides in a private subnet with:

- No egress access
- No external ingress access

Personal Information: The only personally identifiable information (PII) stored consists of user display names and email addresses. This data remains isolated within the secured private subnet.