IBM SOAR

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**Data Feed Integration Guide v2.2.2**

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IBM SOAR Incident Response Platform Data Feed Integration Guide

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| --- | --- | --- |
| Version | Publication | Notes |
| 1.0 | June 2019 | Initial release. |
| 1.1 | July 2019 | Kafka support |
| 1.2 | September 2019 | Added file-feed template to app.config |
| 2.0 | November 2019 | Break out different datasource solutions to a plugin capability |
| 2.1.0 | March 2021 | Support for attachment content |
| 2.2.0 | January 2022 | Support workspaces  Reload types during reload operation Remove warnings on field types text and Boolean |
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| 2.2.2 | October, 2022 | Fix for rare case when event.message is corrupt |

Table of Contents

[1. Overview 5](#_Toc90999076)

[1.1. Architecture 5](#_Toc90999077)

[1.2. Initial Population 6](#_Toc90999078)

[1.3. Useful Tools 6](#_Toc90999079)

[2. Prerequisites 7](#_Toc90999080)

[2.1. App Host Installation 7](#_Toc90999081)

[2.2. Integration Server Installation 8](#_Toc90999082)

[2.2.1. Install the Python components 8](#_Toc90999083)

[2.2.2. Configure the Python components 9](#_Toc90999084)

[2.2.3. Deploy customizations to the IBM SOAR platform 9](#_Toc90999085)

[2.2.4. Run the integration framework 10](#_Toc90999086)

[2.2.5. Configure Resilient Circuits for restart 10](#_Toc90999087)

[2.3. Confirm deployment 11](#_Toc90999088)

[2.4. Configuration of Rules for data tables 11](#_Toc90999089)

[3. Configuration 12](#_Toc90999090)

[3.1. Resilient Circuits config file 12](#_Toc90999091)

[3.2. Upgrading to rc\_data\_feed 2.2.0 13](#_Toc90999092)

[4. Test 13](#_Toc90999093)

[5. Preparation Checklist 14](#_Toc90999094)

[6. Configuration and Known Issues 14](#_Toc90999095)

[6.1. All Feeds 14](#_Toc90999096)

[6.2. Datetime Fields and Timezones 15](#_Toc90999097)

[7. Functions 15](#_Toc90999098)

[8. Troubleshoot 16](#_Toc90999099)

[8.1. reload=True issues 16](#_Toc90999100)

[9. Support 17](#_Toc90999101)

[10. Modifications 17](#_Toc90999102)

[11. Appendix: Schemas 18](#_Toc90999103)

# Overview

This guide describes the IBM SOAR Data Feed capability. This functionality allows an IBM SOAR customer to maintain "replica" data from an IBM SOAR platform for access by other tools, such as Business Intelligence solutions. The replications and updates are performed in near real-time. The data written represents the current state of incident data, notes, artifacts, data tables, and so on.

## Architecture

This extension allows you to perform queries on IBM SOAR data without having to access the IBM SOAR database directly. You can then run business intelligence queries from other tools.

The data can be written to any or all of the following destinations. A plugin framework is available with plugins available for:

* ODBC databases:
  + PostgreSQL
  + MySQL (MariaDB)
  + Microsoft SQLServer
  + Oracle
* SQLite file/database
* ElasticSearch
* Splunk ES using the HTTP Event Collector
* Local directory (one file per object)
* Kafka
* IBM SOAR

The content is consistent with the IBM SOAR type/field semantic model and includes custom fields. For SQL destinations, the table name is the same as the type name (such as incident, task, and artifact) and the column names are the same as the field "programmatic name".

Data tables are supported (the programmatic name will be the same as the DB table name).

Newly added fields and data tables are dynamically added to the existing destination database.

The architecture allows other destinations to be created with relative ease. The following diagram shows the overall data flow from the IBM SOAR platform to the existing feeds.

A screenshot of a computer

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## Initial Population

When you run the Data Feed extension against an IBM SOAR platform that has pre-existing data, it can optionally read all that platform’s data and populate your feeds. After the initial data population, the extension performs all updates by listening on a message destination (queue) from which integration logic is called to update the data source.

## Useful Tools

Most "business intelligence" tools allow you to query data from SQL databases. Here are some tools that you can use to run queries and reports against this data:

* Tableau
* Microsoft Power BI
* IBM Cognos
* Grafana
* Interactive SQL, for example:

-- Number of artifacts for each incident

select i.id, i.name, count(\*) num\_artifacts

from incident i join artifact a on i.id = a.inc\_id

group by i.id, i.name;

# Prerequisites

Before installing, verify that your environment meets the following prerequisites:

* IBM SOAR platform is version 31 or later.
* You have access to an IBM SOAR integration server. An *integration server* is the system that you use to deploy integration packages to the IBM SOAR platform. See the [Resilient Integration Server Guide (PDF)](https://github.com/ibmresilient/resilient-reference/blob/master/developer_guides/Integration%20Server%20Guide.pdf) for more information.
* The following plugin environments have been tested and are recommended. These datasources are available as separate python packages which can be installed and made available to the data feed integration through references in your app.config file.
  + PostgreSQL 9.6 or higher
  + MySQL 5.7 (MariaDB 10.3) or higher
  + Microsoft SQL Server 2017
  + Oracle 12c (Python 3.6 or greater required)
  + Splunk ES 7.1
  + ElasticSearch 7.0
  + Kafka
  + IBM SOAR

## App Host Installation

Each plugin is a separate app on the AppExchange. To install two plugins (ex. SplunkFeed and ODBCFeed), each app on the app exchange will be installed and configured separately.

Be aware that installing two or more apps will not install multiple sets of Rules for synchronizing incidents, artifacts, notes. etc. The steps needed to configure more than one Data Feeder app are:

1. When installing the second (or third) app, create a new message destination (ex. odbc\_feed for the ODBCFeed app.
2. Configure the app’s app.config file setting queue=odbc\_feed.
3. Navigate to the existing Data Feed rule and add the second message destination to the Destinations field.
4. Repeat the process for each rule required for the ODBCFeed app.

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## Integration Server Installation

The integration package contains Python components that are called by the IBM SOAR platform. These components run in the Resilient Circuits integration framework. The package also includes IBM SOAR customizations that will be imported into the platform later.

You perform these installation procedures at the IBM SOAR integration server.

### Install the Python components

Complete the following steps to install the Python components:

1. Ensure that the environment is up-to-date, as follows:

sudo pip install --upgrade pip

sudo pip install --upgrade setuptools

sudo pip install --upgrade resilient-circuits

1. Run the following commands to install the package:

unzip rc\_data\_feed-<version>.zip

[sudo] pip install --upgrade rc\_data\_feed-<version>.tar.gz

1. Plugins will have their own procedures for installation and library requirements. Refer to each plugin’s README file for any special considerations to support.

### Configure the Python components

The Resilient Circuits process runs as an unprivileged user, typically named integration. If you do not already have an integration user configured on your appliance, create it now.

Complete the following steps to configure and run the integration:

1. Using sudo, switch to the integration user, as follows:

sudo su - integration

1. Use one of the following commands to create or update the resilient-circuits configuration file. Use –c for new environments or –u for existing environments.

resilient-circuits config -c

or

resilient-circuits config –u [-l rc-data-feed]

1. Edit the resilient-circuits configuration file, as follows:
   1. In the [resilient] section, ensure that you provide all the information required to connect to the IBM SOAR platform.
   2. In the [feeds] section, define the feeds you intend to use and create separate sections for each feed. For example:

[feeds]

feed\_names=my\_postgresql\_feed,my\_file\_feed,my\_sqlite\_feed

reload=True

# feed\_data is the default queue that will be listened to

queue=feed\_data

# set to true if attachment data should be part of payload send to plugins

include\_attachment\_data = false

[my\_postgresql\_feed]

class=ODBCFeed

odbc\_connect=Driver={PostgreSQL};Server=localhost;Port=5432;Database=feed

sql\_dialect=PostgreSQL96Dialect

uid=mypguser

pwd=mypassword

[my\_file\_feed]

class=FileFeed

directory=/var/resilient/feed\_data

[my\_sqlite\_feed]

class=SQLiteFeed

file\_name=/var/resilient/feed.sqlite3

In this example, two separate plugins have also been installed for sql databases (rc-data-feed-plugin-odbcfeed) and file system storage (rc-data-feed-plugin-filefeed).

### Deploy customizations to the IBM SOAR platform

The package contains rules required for the flow of incident data changes to the data feeds.

1. Use the following command to deploy these customizations to the IBM SOAR platform:

resilient-circuits customize [-l rc-data-feed]

1. Respond to the prompts to deploy the message destination and rules.

### Run the integration framework

To test the integration package before running it in a production environment, you must run the integration manually with the following command:

resilient-circuits run

The resilient-circuits command starts, loads its components, and continues to run until interrupted. If it stops immediately with an error message, check your configuration values and retry.

### Configure Resilient Circuits for restart

For normal operation, Resilient Circuits must run continuously. The recommend way to do this is to configure it to automatically run at startup. On a Red Hat appliance, this is done using a systemd unit file such as the one below. You may need to change the paths to your working directory and the app.config file.

1. The unit file must be named resilient\_circuits.service To create the file, enter the following command:

sudo vi /etc/systemd/system/resilient\_circuits.service

1. Add the following contents to the file and change as necessary:

[Unit]  
Description=Resilient-Circuits Service  
After=resilient.service  
Requires=resilient.service

[Service]  
Type=simple  
User=integration  
WorkingDirectory=/home/integration  
ExecStart=/usr/local/bin/resilient-circuits run  
Restart=always  
TimeoutSec=10  
Environment=APP\_CONFIG\_FILE=/home/integration/.resilient/app.config  
Environment=APP\_LOCK\_FILE=/home/integration/.resilient/resilient\_circuits.lock

[Install]  
WantedBy=multi-user.target

1. Ensure that the service unit file is correctly permissioned, as follows:

sudo chmod 664 /etc/systemd/system/resilient\_circuits.service

1. Use the systemctl command to manually start, stop, restart and return status on the service:

sudo systemctl resilient\_circuits [start|stop|restart|status]

You can view log files for systemd and the resilient-circuits service using the journalctl command, as follows:

sudo journalctl -u resilient\_circuits --since "2 hours ago"

## Confirm deployment

Once the package deployment is complete, you can view them in the IBM SOAR platform Rules tab, as shown below.



## Configuration of Rules for data tables

Data tables are also supported by the Data Feeder. Because rules are written to specific data tables, they require a IBM SOAR administrator to create them manually. The following screenshot shows a rule which references a data table and it triggers for any row change (insert, update, delete). Follow this procedure for all the data tables you need to include in the Data Feeder.



# Configuration

There are two aspects to configuration of the Data Feed extension: IBM SOAR Server configuration and app.config configuration.

## Resilient Circuits config file

The configuration goes in the standard app.config file. There is a "feeds" section that contains a "feed\_names" key, which is a comma separated list of feeds that you want to enable. The names you use represent the names of the subsequent sections that contain the actual feed configurations. Each name must be unique. For example:

[feeds]

feed\_names=**my\_postgresql\_feed**,my\_file\_feed,my\_sqlite\_feed

reload=True

# use reload\_types to limit the types of objects when reload=true.

# Ex: incident,task,note,artifact,attachment,<data\_table\_api\_name>

reload\_types=

# set to true if ElasticSearch errors occur during reload=true

reload\_query\_api\_method=false

# feed\_data is the default queue that will be listened to

queue=feed\_data

# set to true if attachment data should be part of payload send to plugins

include\_attachment\_data = false

# if necessary, specify the supported workspaces and the list of feeds associated with each workspace

# ex: workspaces=“Default Workspace”:[“sqlserver\_feed”], “workspace A”:[“kafka\_feed”,”resilient\_feed”]

workspaces=

[**my\_postgresql\_feed**]

class=ODBCFeed

odbc\_connect=Driver={PostgreSQL};Server=localhost;Port=5432;Database=feed

sql\_dialect=PostgreSQL96Dialect

uid=mypguser

pwd=mypassword

[my\_file\_feed]

class=FileFeed

directory=/var/resilient/feed\_data

[my\_sqlite\_feed]

class=SQLiteFeed

file\_name=/var/resilient/feed.sqlite3

In this example feed\_names references three feeds. The comma separated names refer to additional sections of configuration settings. Two plugins have also been installed for sql databases (rc-data-feed-plugin-odbcfeed) and file system storage (rc-data-feed-plugin-filefeed).

This structure allows you to create as many feeds as you need, regardless of the "class". For example, you can have three different ODBC feeds as long as they all have unique section names.

You can perform an initial data population by setting reload=True in the app.config [feeds] section and then restarting Resilient Circuits. Be aware that every time Resilient Circuits starts with reload=True, the entire set of IBM SOAR incidents, notes, artifacts, and so on are refreshed in your feeds.

New in version 2.2

When reload=True is set, use reload\_types= to limit the types of objects to reload. This is useful if your synchronization requirements does not include all data types. reload\_types is also referenced when using the manual Sync Incidents action.

Synchronization of objects can now be partitioned by workspace. See the workspaces parameter to specify which workspaces refer to list of installed data feeder plugins.   
Note: once the workspaces parameter is used, include a definition for the ‘Default Workspace’ if plugin use is intended for that workspace.

For example, if you use both the odbcfeed and the elasticfeed plugins, you can configure incidents in ‘workspace A’ to send data to the odbcfeed feed and incidents in ‘workspace B’ to send data to both odbcfeed and elasticfeed.

Two methods exist for synchronizing incidents and related data when reload=True is set. The default method uses a search API call which is the most efficient method. For very large incident lists, this method may fail with ElasticSearch errors. When this occurs, use reload\_query\_api\_method=True to use an alternative (and slower method) of performing the initial synchronization.

## Upgrading to rc\_data\_feed 2.2.0

When upgrading to version 2.2.0, new app.config settings are not automatically added. Add the following settings to the [feeds] section if you’d like to use them:

# use reload\_types to limit the types of objects when configuring reload=true.

# Ex: incident,task,note,artifact,attachment,<data\_table\_api\_name>

reload\_types=

# if necessary, specify the supported workspaces (by label, case sensitive) and the list of feeds associated with each workspace

# ex: workspaces=“Default Workspace”:[“sqlserver\_feed”], “workspace A”:[“kafka\_feed”,”resilient\_feed”]

workspaces=

# Test

A simple test can be performed by setting up a data feed with the feed\_names=file\_feed plugin and datastore and the parameter reload=False. Once configured and resilient-circuits is running, perform an update to an incident and confirm that the resilient-circuits logs contain an update

2019-04-04 21:16:02,165 INFO [file\_feed] Inserting/updating incident; id = 2783460

The resulting file (incident\_2783460.json) will contain a json formatted representation of the incident data similar to the following

{

"addr": null,

"alberta\_health\_risk\_assessment": null,

"hard\_liability": 0,

"city": null,

"country": "United States",

"creator\_id": "able baker (a@example.com)",

"crimestatus\_id": "Unknown",

"data\_encrypted": null,

"data\_format": null,

"end\_date": "2019-03-14T13:06:48.550000",

"create\_date": "2019-02-13T18:38:55",

"discovered\_date": "2019-02-13T18:38:40",

"start\_date": null,

"exposure\_dept\_id": null,

"description": "<div class=\"rte\"><div>new description new again -- updated</div></div>",

"employee\_involved": null,

…

}

Now repeat the same test with your production datastore plugin(s). Data is not synchronized until new IBM SOAR objects are created or existing ones are updated.

# Preparation Checklist

In order to successfully use this extension, ensure you have built out your environments outlined in the sections above, and reviewed the requirements below:

1. Identified all the objects you will perform analytics on, including data tables. Data tables will require additional rules added for synchronization to your datastore.
2. Install the necessary plugins and configured all aspects of your datastore
   1. For odbc datastores, install and test the appropriate drivers and configuration settings.
   2. Build out the database to use and the account has the correct permissions for data access.
3. Add the datastore configuration data to your app.config file, including the feed(s) to use.
4. Confirmed that your BI tool has access to the datastore environment.
5. Reviewed your use of the reload app.config setting as this will have potential performance consequences when resilient-circuits is restarted.
6. Completed the tests defined in section 5.

# Configuration and Known Issues

There are a number of issues to be aware of when using the Data Feed

## All Feeds

* When deleting a IBM SOAR incident, that record will be deleted from the replica datastore. However, all the incident’s associated tasks, notes, artifacts, datatables, etc. are not removed.
* For sizing purposes, here are some guidelines for the size of each object type. Use this information for estimation of your file system and database requirements.

|  |  |
| --- | --- |
| Incident | ~ 4000 characters |
| Tasks | 2000-5000 characters |
| Notes | 1000-3000 characters |
| Artifacts | < 500 characters |
| Attachments[[1]](#footnote-1) | Up to 20mb |
| Data tables | 200-2000 characters per row |

* Incident HIPAA fields when directly edited are not synchronized in near-time. Any additional change to an incident will then also update the HIPAA fields.
* Due to the structure of the internal IBM SOAR database, some fields written to a data feeder datastore will always be blank or zero. Below is a short list of those fields:
  + Task - attachment\_count, notes\_count, at\_id
* Moving an attachment from a task to the Incident will remove that attachment from the datastore. There is no workaround at present.

## Datetime Fields and Timezones

All IBM SOAR datetime fields retain their data in the UTC timezone. When persisting this data to a datastore, the ISO date format is used such as: 2019-04-18T19:07:42+00:00.

See the README document for rc\_data\_feed\_plugin\_odbcfeed for specific database considerations

# Functions

The Data Feed solution also includes a rule, workflow and function which can be run within the IBM SOAR UI to synchronize Incidents and their associated Tasks, Notes, Artifacts, etc. From the Actions menu within an incident, the Data Feeder: Sync Incidents rule allows one to specify a range of incidents to synchronize and which method of synchronization to use. It’s suggested to initially use Query API Method: No for performance optimization.

This function is intended for the synchronization of a small number of incidents and is not intended to replace the reload=True app.config setting. Continue to use reload=True to initially load all existing incidents and their data.

Note: Using reload=true may represent 1000s of synchronization events. This can cause measurable performance impact on your IBM SOAR platform or datasource solution (ex. Postgres datatable). Scheduling this activity for after hour periods should be considered.

**Note:** Only versions of Resilient >= 31 support this capability.

A screenshot of a cell phone

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Figure Rule Activity Fields Example

# Troubleshoot

There are several ways to verify the successful operation of a IBM SOAR extension.

* IBM SOAR Action Status

When viewing an incident, use the Actions menu to view Action Status. By default, pending and errors are displayed. Modify the filter for actions to also show Completed actions. Clicking on an action displays additional information on the progress made or what error occurred.

* IBM SOAR Scripting Log

A separate log file is available to review scripting errors. This is useful when issues occur in the pre-processing or post-processing scripts. The default location for this log file is: /var/log/resilient-scripting/resilient-scripting.log.

* IBM SOAR Logs

By default, IBM SOAR logs are retained at /usr/share/co3/logs. The client.log may contain additional information regarding the execution of functions.

* Resilient-Circuits

The log is controlled in the .resilient/app.config file under the section [resilient] and the property logdir. The default file name is app.log. Each function will create progress information. Failures will show up as errors and may contain python trace statements.

## reload=True issues

This app.config setting will synchronize all IBM SOAR incidents and their related tasks, notes, incidents when resilient-circuits is started. Depending on the number of incidents, this process can take up to several hours.

It’s possible to run into errors associated with an API call used (search\_ex) when synchronizing incident tasks, notes, artifacts, etc. When this situation occurs, an error in the ElasticSearch log where appear as:

22:22:06.801 [http-bio-443-exec-16757] INFO c.c.web.rest.Co3ExceptionMapperBase - Mapping exception to REST

com.co3.domain.exceptions.Co3IllegalArgumentException: There are one or more invalid characters in the search query.

at com.co3.search.ElasticSearchClient$ClientHelper.execute (ElasticSearchClient.java:215)

If this should occur, edit the app.config file and change the reload\_query\_api\_method parameter to True.  
reload\_query\_api\_method=True

This change will use an alternative method to synchronize all data. It should be noted that this method will take longer to complete the reload process.

# Support

For additional support, visit <https://ibm.com/mysupport>.

Including relevant information from the log files will help us resolve your issue.

# Modifications

Each datastore is defined as its own python library using a common namespace data-feeder-plugins. This common namespace allows for the dispatching of multiple plugins without conflicting with the other installed plugins. This diagram identifies key aspects of a plugin namespace:

A screenshot of a cell phone

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Plugin logic based on given class: i.e FeedDestinationBase

App.config section for plugin

Unique Package name

See below for contents

Common Namespace

For the namespace \_\_init\_\_.py file, the contents need to be:

**from** pkgutil **import** extend\_path  
  
\_\_path\_\_ = extend\_path(\_\_path\_\_, \_\_name\_\_)

The FeedDestinationBase class can be extended to accommodate for different data structures. rc-data-feed-plugin-odbcfeed is one example of how to extend this class.

# Appendix: Schemas

This sample represents the schema for a Postgres DB built-in objects (incident, artifact, attachment, note, milestone and task). Your schema will vary when custom fields are added as well as datatables added. This schema presents a complete representation of the fields stored within IBM SOAR.

This list was generated via the following sql command

SELECT columns.table\_name, column\_name, data\_type FROM information\_schema.tables   
inner join INFORMATION\_SCHEMA.COLUMNS  
on columns.table\_name = tables.table\_name  
where tables.table\_catalog='res\_test' and tables.table\_schema='public'  
and tables.table\_name in ('incident', 'artifact', 'note', 'task', 'milestone', 'attachment')  
order by columns.table\_name, column\_name;

|  |  |  |
| --- | --- | --- |
| Table Name | Column Name | Data Type |
| artifact | description | text |
| artifact | hits | text |
| artifact | id | integer |
| artifact | inc\_id | integer |
| artifact | relating | boolean |
| artifact | type | text |
| artifact | value | text |

|  |  |  |
| --- | --- | --- |
| Table Name | Column Name | Data Type |
| attachment | content\_type | text |
| attachment | created | timestamp without time zone |
| attachment | creator\_id | text |
| attachment | id | integer |
| attachment | inc\_id | integer |
| attachment | name | text |
| attachment | size | Bigint |
| attachment | task\_id | Number |
| Attachment | content | blob[[2]](#footnote-2) |

|  |  |  |
| --- | --- | --- |
| Table Name | Column Name | Data Type |
| incident | addr | text |
| incident | alberta\_health\_risk\_assessment | boolean |
| incident | city | text |
| incident | confirmed | boolean |
| incident | country | text |
| incident | create\_date | timestamp without time zone |
| incident | creator\_id | text |
| incident | crimestatus\_id | text |
| incident | data\_compromised | boolean |
| incident | data\_contained | boolean |
| incident | data\_encrypted | boolean |
| incident | data\_format | text |
| incident | data\_source\_ids | text |
| incident | description | text |
| incident | discovered\_date | timestamp without time zone |
| incident | due\_date | timestamp without time zone |
| incident | employee\_involved | boolean |
| incident | end\_date | timestamp without time zone |
| incident | exposure\_dept\_id | text |
| incident | exposure\_individual\_name | text |
| incident | exposure\_type\_id | text |
| incident | exposure\_vendor\_id | text |
| incident | gdpr\_breach\_circumstances | text |
| incident | gdpr\_breach\_type | text |
| incident | gdpr\_breach\_type\_comment | text |
| incident | gdpr\_consequences | text |
| incident | gdpr\_consequences\_comment | text |
| incident | gdpr\_final\_assessment | text |
| incident | gdpr\_final\_assessment\_comment | text |
| incident | gdpr\_harm\_risk | text |
| incident | gdpr\_identification | text |
| incident | gdpr\_identification\_comment | text |
| incident | gdpr\_lawful\_data\_processing\_categories | text |
| incident | gdpr\_personal\_data | text |
| incident | gdpr\_personal\_data\_comment | text |
| incident | gdpr\_subsequent\_notification | boolean |
| incident | hard\_liability | bigint |
| incident | harmstatus\_id | text |
| incident | hipaa\_acquired\_comment | text |
| incident | hipaa\_additional\_misuse\_comment | text |
| incident | hipaa\_additional\_misuse | boolean |
| incident | hipaa\_adverse\_comment | text |
| incident | hipaa\_breach\_comment | text |
| incident | hipaa\_breach | boolean |
| incident | hipaa\_adverse | boolean |
| incident | hipaa\_acquired | boolean |
| incident | hipaa\_misused\_comment | text |
| incident | hipaa\_misused | boolean |
| incident | id | integer |
| incident | impact\_likely | boolean |
| incident | inc\_id | integer |
| incident | inc\_training | boolean |
| incident | incident\_type\_ids | text |
| incident | jurisdiction\_name | text |
| incident | members | text |
| incident | name | text |
| incident | negative\_pr\_likely | boolean |
| incident | nist\_attack\_vectors | text |
| incident | owner\_id | text |
| incident | org\_id | number |
| incident | phase\_id | text |
| incident | plan\_status | text |
| incident | reporter | text |
| incident | resolution\_id | text |
| incident | resolution\_summary | text |
| incident | severity\_code | text |
| incident | start\_date | timestamp without time zone |
| incident | state | text |
| incident | workspace | text |
| incident | zip | text |

|  |  |  |
| --- | --- | --- |
| Table Name | Column Name | Data Type |
| milestone | date | timestamp without time zone |
| milestone | description | text |
| milestone | id | integer |
| milestone | inc\_id | integer |
| milestone | title | text |

|  |  |  |
| --- | --- | --- |
| Table Name | Column Name | Data Type |
| note | create\_date | timestamp without time zone |
| note | id | integer |
| note | inc\_id | integer |
| note | mentioned\_users | text |
| Note | task\_id | number |
| note | text | text |
| note | user\_id | text |

|  |  |  |
| --- | --- | --- |
| Table Name | Column Name | Data Type |
| task | active | boolean |
| task | at\_id | bigint |
| task | attachments\_count | bigint |
| task | cat\_name | text |
| task | category\_id | text |
| task | closed\_date | timestamp without time zone |
| task | custom | boolean |
| task | description | text |
| task | due\_date | timestamp without time zone |
| task | id | integer |
| task | inc\_id | integer |
| task | inc\_name | text |
| task | init\_date | timestamp without time zone |
| task | instr\_text | text |
| task | instructions | text |
| task | members | text |
| task | name | text |
| task | notes\_count | bigint |
| task | owner\_id | text |
| task | phase\_id | text |
| task | private | boolean |
| task | required | boolean |
| task | status | text |

1. Size based on including file content (see app.config setting: include\_attachment\_data) [↑](#footnote-ref-1)
2. Only available when app.config setting: include\_attachment\_data=true [↑](#footnote-ref-2)