

Winter Weather Operations Documentation (Version 1.0)

Introduction to Winter Weather Operations

Winter Weather Operations can be used to develop winter weather response plans, monitor winter weather operations in real-time, share near real-time road status updates, and track vehicle locations and materials used during winter weather events.

Adverse weather conditions have a major impact on the safety of roadways and communities depend on efficient winter weather operations to keep roads safe and traffic flowing. As a result, state and local agencies spend more than 2.3 billion dollars on snow and ice control operations annually. Unfortunately, the increasing frequency and severity of winter storms is consuming a larger percentage of operations and maintenance budgets each year. Winter Weather Operations is typically implemented by public works departments, road commissions, and departments of transportation that want to understand where snowplows have traveled during a winter storm, optimize response activities, and clearly communicate what roads have been serviced.

The Winter Weather Operations solution delivers a set of capabilities that help you develop winter weather response plans, centralize snowplow vehicle feeds, monitor winter weather operations in real-time, share near real-time road status updates, and track vehicle locations and materials used during winter weather events (and the entire winter season).

Requirements

Winter Weather Operations requires the following:

- ArcGIS Online
- ArcGIS Velocity (Advanced)
- ArcGIS Pro 2.8 or later (Standard or Advanced)
- ArcGIS Survey123 Connect
- ArcGIS Tracker (optional)
- ArcGIS QuickCapture (optional)

Information products

Winter Weather Operations includes the following information products:

Item	Description	Minimum user type
Winter Operations Center	An ArcGIS Experience Builder app used by operations managers to plan operations, manage authoritative content, and track operations activity throughout the entire winter season.	Editor
Active Winter Event Dashboard	An ArcGIS Dashboards app used by operations managers and directors to monitor snow response activities during operational periods.	Viewer

Winter Season Dashboard	An ArcGIS Dashboards app used by operations managers and directors to review response activities for any event throughout the winter season.	Viewer
Material Reporter	An ArcGIS Survey123 form used by operations managers and yard supervisors to report materials used by each vehicle during winter weather operations.	Editor
Status Reporter	An ArcGIS QuickCapture project used by drivers to record current vehicle location and service status during winter weather operations.	Field Worker
Winter Weather Operations Notebook	An ArcGIS Notebooks app used by operations managers to automate data management and ArcGIS Velocity tasks.	Creator
Vehicles	A Microsoft Excel document used by operations managers to inventory vehicle information.	Not required
Winter Weather Data Management	An ArcGIS Pro project used by mapping technicians to manage an authoritative inventory of snow routes, parking restrictions and service areas.	GIS Professional Standard

When you deploy this solution in your ArcGIS organization, you also get an ArcGIS Solution item that organizes the key information products and summarizes all the ArcGIS items (applications, forms, projects, maps, feature layers, feature layer views, and so on) included with the solution. The ArcGIS Solution item also illustrates any dependencies items have on each other.

Configure Winter Weather Operations

Winter Weather Operations can be used to develop winter weather response plans, monitor winter weather operations in real-time, share near real-time road status updates, and track vehicle locations and materials used during winter weather events.

In this topic, you'll learn how to configure the Winter Weather Operations solution to meet specific needs in your organization.

Manage snow routes and service areas data

Before using the solution, you must create and load your organization's snow routes, service districts, and parking restrictions (if applicable) into the feature layers deployed with the solution. The Winter Weather Data Management ArcGIS Pro Project includes a series of tasks to help you prepare, create, and load these foundational layers in the solution.

- Sign in to your ArcGIS organization and browse to the Winter Weather Data Management Desktop Application Template.
- Open the item page and click **Download**.
- Unzip and open the Winter Weather Data Management project.
- On the **View** tab, in the **Window** group, click **Catalog Pane**.
- In the **Catalog** pane, expand the **Tasks** folder, and double-click the **Winter Weather Data Management** task.
- In the **Tasks** pane, click the **Prepare existing data**, **Process snow routes**, and **Append to feature layers** task groups to expand the collection of tasks.

Prepare existing data

Your organization may have existing snow routes or street centerline data, features depicting parking restrictions, and service district boundaries. This data can be loaded into the target feature classes in the file geodatabase provided in the Winter Weather Data Management project.

Service Districts may represent boundaries within your jurisdiction your agency uses for driver assignments or other boundary such as neighborhoods that directors and operations management would like to use to compare progress. The service district id's will later be associated with Snow Routes, enabling the Winter Weather solutions to measure operations progress and last serviced information based on Service Districts. Follow the instructions in the **Service districts** task to load existing data, add new features if necessary, and define service district ids.

Snow Routes are used to represent street segments your agency is responsible for servicing during winter weather events. Follow the instructions in the **Snow routes** task to load existing snow route features and attributes such as road name, route priority, snow route id, and road class. Additional steps are provided to guide you through populating required fields used by the solution apps and ArcGIS Velocity analytics.

Note:

Valid values are required in the **T_AUTOMOBILES**, and **F_AUTOMOBILES** fields. These fields are used by the ArcGIS Velocity Snap to Network tool as a part of an analytic model delivered with the Winter Weather Operations solution. If you are only using the Winter Weather Outreach solution,

or do not have these attributes for your snow routes, these values will be populated for you to indicate all snow route features represent two-way travel.

Parking Restrictions data can be loaded from an existing data source or created from the snow route features uploaded in the Snow Routes task. Follow the instructions in the **Parking restrictions** task to load existing data, create new features if necessary, and define parking restriction attributes.

Process snow routes

Once snow routes, parking restrictions and service district information is prepared and loaded into the solution schema, additional refinement is needed to process new snow route attributes and features used by solution applications and ArcGIS Velocity analytics. Follow the steps in the **Process snow routes** task to intersect snow routes with service district information, edit snow route features, create unique snow route identifiers, and calculate snow route segment length.

Note:

Not all steps in the **Process snow routes** task need to be completed if you are only using the Winter Weather Outreach Solution. When applicable, these steps will indicate if it is an optional step when using only the Winter Weather Outreach solution.

Append to feature layers

After preparing and processing existing data into the solutions schema using the Winter Weather Data Management geodatabase, snow routes, parking restrictions and service districts data are now ready to be loaded into feature layers deployed with the solution. Follow the steps in **Append to feature layers** task to complete the data management workflows required by the solution.

Inventory vehicles

Create and manage an authoritative inventory of winter fleet vehicle information so you can bring together disparate sources of information and create a common operating picture of vehicles supporting your winter weather operations. Completing the vehicle inventory helps you understand the current state of automated vehicle location (AVL) technology used by your fleet, identify the needs of vehicles without AVL, and helps you document important information for each vehicle required by the solution.

For each vehicle in your fleet, including those you contract with, you will document required vehicle information such as a unique vehicle or asset ID, indicate if the vehicle is a part of your dedicated fleet or a contracted vehicle, solid material capacity, and what technology will be used to report vehicle location and winter-related telemetry for plow up/down status and solid material spreading sensors.

There are two options for completing the vehicle inventory, using the Vehicle Manager in Winter Operations Center, or using the Vehicles Excel Spreadsheet. Inventorying vehicle information using the Vehicles Excel Spreadsheet enables you to batch upload vehicle information, while the Vehicle Manager form enables you to add one vehicle at a time and enables you to modify existing vehicle information once added to the solution's Vehicles table.

Follow the steps below to inventory vehicles using the Vehicle Manager in the Winter Operations Center.

- Sign in to your ArcGIS organization and browse to the Winter Operations Center app.
- Open the item page and click **View**.

The Winter Operation Center Home page is opened by default.

- Click **Vehicles** on the navigation menu.
- Click **Add New Vehicle**.

The Add New Vehicle window appears.

- Type in a **Vehicle ID**.

Note:

This form will prevent you from entering a Vehicle ID already entered into the system. Ensure Vehicle ID's entered here are unique and that they match the same unique asset ID or vehicle ID used by your vendor AVL system. If the vehicle you are adding will require drivers to use ArcGIS Tracker, use a unique ID to identify this vehicle such as an equipment asset number, VIN or license plate number.

- The **Vehicle Name** question is optional and used to provide an alternate name for the vehicle.
- The **Fleet or Contractor** question is **required** and is used to indicate if this vehicle is part of your dedicated fleet or a contracted resource.
- The **Automated Vehicle Location Reporting** question is **required** is used to document the existing technology, or technology needed on this vehicle, that will report vehicle location and service status during winter weather operations.

Vendor AVL Only	Select this option to indicate the vehicle is supported by an AVL system or device where both location and sensors for plow up/down and spreaders are present. This option should also be selected if an AVL system or device reports location but has limited or no sensors for the plow or spreaders, but that you chose to always indicate an in-service status when the vehicle is in operations.
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ArcGIS Only	Select this option to indicate drivers of this vehicle will use the Status Reporter QuickCapture project to report vehicle location and service status during operations. This vehicle has no AVL system or device on board.
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Vendor AVL Location with ArcGIS Field Operations	Select this option to indicate drivers of this vehicle will use the Status Reporter QuickCapture project to augment sensor information to indicate their service status during operations. This vehicle has an AVL system or device that only reports vehicle location, but has limited or no sensor information for the plow or spreaders that would otherwise indicate service status.
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- The **Plow Function** question is optional and is used to document the primary role, assignment, route or road class this plow will be used on.
- The **Salt / Solid Material Capacity** question is **required** and is used to document in US tons, the solid material capacity of the vehicle.
- The **Brine Capacity** question is optional and is used to document in gallons, the brine/wet mix capacity of the vehicle.

- The **Make and Model** question is optional and is used to document the make and model of the vehicle.
- The **Plow Type** question is optional and is used to document the type of snowplow blade attached to the vehicle.
- The **Vehicle Status** question is optional and is used to document if the vehicle is available for operations.
- Click **Submit**.

Follow the steps below to complete the vehicle inventory using the Vehicles Microsoft Excel document.

- Verify that you are signed in to your ArcGIS organization and browse to the Vehicles Microsoft Excel item.
- Open the item page and click **Download**.
- Open and edit the `Vehicles.xlsx` file and provide the vehicle information. Required vehicle fields are noted in the spreadsheet, and valid values, where applicable, are provided in column drop downs.

Once complete, save and close the file.

- In your ArcGIS organization, browse to the OperationsManagement feature layer.
- Open the item page and click **Update Data > Append Data to Layer**.
- Click **Choose File**, browse to the spreadsheet, and click **OK**.
- Click **Upload and Continue**.
- Ensure the **Choose the layer to update:** is set to **Vehicles**.
Uncheck **Update existing features**.
- Click **Apply Updates**.

After completing the vehicle inventory, reference the `Location Source` field in the Vehicles table. If all vehicles are identified as **Vendor AVL Only**, you can proceed to the next topic, **Configure feeds**.

If you have identified any vehicles `Location Source` as **ArcGIS Only** or **Vendor AVL Locations with ArcGIS Field Operations**, complete the remaining sections starting with **Provision Users** to support drivers of these vehicles with ArcGIS location tracking and field operations capabilities.

Provision users

Included with the Winter Weather Operations solution is a group designed to help organize drivers, provide access to the Status Reporter QuickCapture project, and add drivers to an ArcGIS Tracker view.

Note:

The following steps require users accounts to have already been created for drivers.

To add drivers to the Winter Operations Drivers group, complete the following steps:

- In a browser, sign in to your ArcGIS organization.
Verify that you have privileges to manage member groups before continuing.


- Click **Groups** at the top of the site.
- Click the **Winter Operations Drivers** group to open the group details page.
- Click the **Overview** tab and click **Invite users**.
- Select the members you want to add and click **Add to group**.
- Repeat steps 3 through 6 for each group where you need to add members.

Drivers added to this group need a minimum user type of **Field Worker** in order to the Status Reporter QuickCapture project and ArcGIS Tracker.

Update the Status Reporter project

When completing the vehicle inventory, you may have identified vehicles that either did not have an existing AVL technology on board or had limited AVL technology (no telemetry or sensor information for plow up/down and solid material spreader information). In the inventory you identified these vehicles as either **ArcGIS Only** (no existing AVL technology), or **Vendor AVL Locations with ArcGIS Field Operations**.

Referencing the Vehicle information created in the previous steps, you will add the Vehicle IDs to the Status Reporter QuickCapture project and share the project with drivers.

- In a browser, go to the ArcGIS QuickCapture website and sign in to your ArcGIS organization.
- Click the **Status Reporter** project to open it.
- Click the **Vehicle ID** button to Manage project user input.
- Click the **Edit** button  for **Vehicle ID** under Project User Input.

The Edit user input window appears.

- Click **Batch edit**.
- Delete the example entries, and provide the **Vehicle ID** for any vehicle in your inventory where Location Source is **ArcGIS Only** or **Vendor AVL Locations with ArcGIS Field Operations**.
- Click **Save**.
- Click **Done**.
- Click **Save**.

Create a track view

When completing the vehicle inventory, you may have identified vehicles in your fleet with no AVL technology on board. The drivers of these vehicles will use devices in the vehicle to report vehicle location using ArcGIS location tracking technology.

Referencing the vehicle information created in the previous steps, you will use ArcGIS Tracker Track Viewer to create a track view of drivers Track Viewer.

- In a browser, sign in to your organization and open Track Viewer.
By default, Track Viewer is in the app launcher if it's installed and you have the view location tracks privilege. Installation is often done as part of enabling location tracking.
- Click **Create View**.
- Type the name **ArcGIS Snowplow Drivers**, or provide a different name and click **Create View**.

Tip:

Make note of the name used for the view, as this will create a hosted feature layer view and will be referenced later steps when creating Vehicle feeds in ArcGIS Velocity.

When you create the view, a group in ArcGIS Online that controls access to the view is also created.

- On the **Mobile Users** tab, add drivers whose last known locations and tracks should be seen in the track view.
 - Click the drop-down for **Select to add mobile users**
 - Scroll the list to **Groups (import members)**, select the **Winter Operations Drivers** group.
 - Click **Add**.

Note:

While you can add any user as a mobile user, that user won't have a last known location or track until they are tracked with the ArcGIS Tracker mobile app or tracked with the Field Maps mobile app.

You have created a track view of drivers supporting your winter weather operations using ArcGIS Tracker to report their vehicle location. You are now ready to configure a feeds in ArcGIS Velocity connect to this track view.

Configure feeds

A feed is a real-time stream of data coming into ArcGIS Velocity. Feeds typically connect to external sources of observational data such as Internet of Things (IoT) platforms, message brokers, or third-party API's. Feeds parse incoming tabular, point, polyline, or polygon data and expose it for analysis and visualization.

The two feeds deployed with the solution, SnowRoutesVelocity Feed and Vehicle_servicestatus Feed, connect to feature layers used by the solution and require additional steps to configure and start. You will also use feeds to connect to and ingest location data generated by your vehicles, whether from a vendor AVL system, drivers using ArcGIS location tracking on their devices, or a mix of both, depending on the needs identified during the vehicle inventory. The steps to configure vehicle feeds will vary depending on the needs of your organization.

Note:

Follow the steps in the order they are presented below when configuring feeds and analytics.

Start the Vehicles_servicestatus Feed

The Vehicles_servicestatus Feed ingests records from the Vehicles_servicestatus feature layer view. This join view contains all vehicles records stored in the Vehicles table (OperationsManagement feature layer), and if present, is joined with the latest records created in the Service Status layer (FieldOperations feature layer). Creating a feed from this join view enables the Winter Weather Operations solution to create a common operating picture from multiple vehicle feed sources.

This feed is already configured and executable, follow the steps below to start the feed.


- Verify that you are signed in to your ArcGIS organization and browse to the ArcGIS Velocity application.
- Using the site menu, click **Feeds**.
- Click the **Vehicle_servicestatus Feed** to launch the feed Details page.
- Click **Start** to start the feed.

Update the SnowRoutesVelocity Feed

The SnowRoutesVelocity Feed ingests data from the SnowRoutesVelocity feature layer. This feed is used by the Share Route Status real-time analytic, which transfers route status updates from ArcGIS Velocity to ArcGIS Online so route status information can be shared publicly.

Before the SnowRoutesVelocity Feed can be configured, the feature layer must first be created. To create the feature layer, the Reset Snow Routes big data analytic needs to be run for the first time. After its first execution, the SnowRoutesVelocity feature layer is created in the spatiotemporal datastore, and features from the SnowRoutes hosted feature layer are copied and loaded into the SnowRoutesVelocity feature layer.


Follow the steps below to run the Reset Snow Routes big data analytic for the first time.

- In the ArcGIS Velocity application, use the site menu and click **Big Data**.
- Click the **Edit** button  for the **Reset Snow Routes** big data analytic.
- Click **Start** to run the big data analytic.

Wait for the analytic status to update to **Completed** before proceeding to the next step.

The SnowRoutesVelocity feature layer is used as referenced output in the scheduled big data analytic, Snow Route Status. The Snow Route Status analytic is used to push near real-time route status updates into the SnowRouteVelocity feature layer during active winter weather operations. When the winter weather event ends, the Reset Route Status big data analytic can be run to clear the route status information in the SnowRoutesVelocity feature layer.

Follow the steps below to configure the SnowRoutesVelocity Feed.

- In the ArcGIS Velocity application, use the site menu and click **Feeds**.
- Click the **Edit** button  for the **SnowRoutesVelocity Feed**.
- Change the search context from ArcGIS to **My Content**, then search for and select the **SnowRoutesVelocity_UniqueID** Feature Service
Ensure Feature Service is selected, not the Map Service of the same name.
- Click **Next**.
- The parameter values are pre-configured for all remaining steps and should not be modified.
Select **Next** for the **Filter Data**, **Confirm Schema**, **Timestamp Field**, **Identify Key Fields**, and **Feed Polling Interval** steps.
- Leave the feed name and optionally provide a summary. Select **Complete** to finish configuring the feed.

The feed will validate, and the **Executable** status will update to **Yes**.

- Click **Start** to start the feed.

Configure vehicle feeds

Configure vehicle feeds to connect to an automated vehicle location system through a supported third-party API or message broker using supported feed types in ArcGIS Velocity. If drivers are using ArcGIS location tracking on devices in their vehicles, you can also configure vehicle feeds to consume the track view of drivers supporting winter operations created in previous steps.

Follow the steps below to configure a vehicle feed from a track view created in ArcGIS Track Viewer:

- Open the ArcGIS Velocity application.
- Click **Create feed** to create a new feed.
- Click **See all** in the ArcGIS feed type.
- Click **Feature Layer**
- From the Configure Feature Layer page, if not already set, change the search context to **My Content**, then search for and select the **ArcGIS Snowplow Drivers** Feature Service
- Under Select a sublayer, click to select **Last Known Locations (1)**.
- Leave the default parameters for the Filter Data step and select **Next**.
- Leave the default parameters for the Confirm Schema step and select **Next**.
- Modify the Date field for latest features to **location_timestamp** and select **Next**.
- Leave the default parameters for the Identify Key Fields step and select **Next**.
- Modify the Feed Polling Interval to **Runs periodically every 10 seconds Every day** then select **Next**.
- Name the feed **ArcGIS Snowplow Drivers Feed** and optionally provide a summary.

An alternate can be used for your vehicle feed, but vehicle feed name above will be referenced in subsequent steps.

- Select **Complete** to finish configuring the feed

You have just configured a feed to ingest vehicle locations reported by drivers with ArcGIS location tracking technology on their devices. Follow the steps below to configure a vehicle feed to connect to a third-party API, data provider, cloud or message broker, otherwise proceed to **Update analytics**.

When configuring feeds to connect to a third-party API, data provider, cloud or message broker, consider the information gathered during the vehicle inventory. If the vehicle inventory indicates all vehicles are supported by your vendor AVL (Location Source is "Vendor AVL Only" for all vehicles), you will only need to create a single vehicle feed. If you identified any vehicles with AVL that do not have additional telemetry to indicate an in-service status during operations such as plow up/down and active material spreading (Location Source is "Vendor AVL Location with ArcGIS Field Operations"), you will need to create a feed for these vehicles as well so drivers can report their service status using the Status Reporter QuickCapture project.

Follow the steps below for configuring a vehicle to connect to your vendor AVL provider.

- Open the ArcGIS Velocity application.
- Click **Create feed** to create a new feed.

- Choose the feed type you want to create by browsing the groups of feeds or by searching using a keyword. The feed types needed to connect to your vendor AVL are grouped into three different categories:
 - Cloud
 - Web and Messaging
 - Data Providers
- Select the feed type you want to create.
- Enter the feed configuration details. Note that the configuration parameters will vary depending upon the feed type selected.
- Click **Next** to continue with the remaining steps including confirming the schema, identifying the key fields, and defining the polling interval (if applicable). Pause on the last step, **Save**, to name your feed according to the choices below.
 - Name your vehicle feed **AVL Snowplows Feed** for a feed supporting vehicles with whose Location Source field is **Vendor AVL Only**.
 - Name your vehicle feed **AVL Location Only Snowplows Feed** for a feed supporting vehicles with whose Location Source field is **Vendor AVL Location and ArcGIS Field Operations**.

Note:

Alternate names can be used for your vehicle feeds, but the above vehicle feed names will be referenced in subsequent steps.

- Select **Complete** to finish configuring the feed

Note:

For more information, see Configure input data and the Create a feed quick lesson.

Update analytics

Four ArcGIS Velocity analytics, two real-time analytics and two big data analytics, are deployed with the solution and need to be updated once all feeds have been configured and are successfully running.

Real-time analytics perform processing on data ingested from feeds, analyzing each individual message as it is received. Real-time analytics are used especially for transforming data, geofencing, and incident detection. The real-time analytics delivered with this solution are configured to transform one or more vehicle feeds into a common operating picture and for sharing route status updates with the public.

Big data analytics perform batch analysis and processing on stored data such as data in a feature layer or cloud big data stores like Amazon S3 and Azure Blob Storage. Big data analytics are typically used for summarizing observations, performing pattern analysis, and incident detection. The big data analytics delivered with this solution are configured to provide near real-time route status updates, store vehicle location history, summarize material usage and distance traveled, and reset route status information when a winter weather event or operational period ends.

Note:


All feature layer outputs generated by the analytics have specific data retention settings, and where applicable, archiving settings, already configured. Any modifications to data retention and archiving settings should be made before the analytics run for the first time, and after reading guidance in the **Modify the Winter Fleet Tracking real-time analytic** and **Update the Snow Route Status big data analytic** topics. Read more about data retention in ArcGIS Velocity.

The Reset Route Status big data analytic has already been configured in previous steps. Follow the steps in the order presented below when configuring the remaining analytics.

Validate and start the Share Snow Route Status real-time analytic

The Share Snow Route Status real-time analytic connects to snow route status output generated by the Snow Route Status big data analytic, and loads this information into a hosted feature layer that can be shared with the public. Follow the steps below to validate and start the Share Snow Route Status real-time analytic.

Follow the steps below to validate and start the Share Snow Route Status Real-Time Analytic.

- In the ArcGIS Velocity application, use the site menu and click **Real-Time**.
- On the Real-Time Analytics page click the **Edit** button  for the **Share Snow Route Status** real-time analytic.
- The SnowRouteVelocity Feed is running and connected directly to SnowRoutes hosted feature layer.

Note:

If the analytic does not show a successful validation status, try reloading the page to force another validation of the analytic.

- Click **Start** to start the feed.

Modify the Winter Fleet Tracking Real-Time Analytic


The Winter Fleet Tracking real-time analytic connects to and merges vehicle and service status information with one or more vehicle feeds, and generates two outputs, VehicleStream and VehicleTracks.

- VehicleStream is used to visualize last known vehicle locations for the entire fleet. Vehicle Stream consists of a stream layer and a feature layer storing only the latest records for each vehicle.
- The VehicleTracks feature layer is used as an input for multiple tools in the Snow Route Status big data analytic. A short data retention window and no archiving is configured for this output, as vehicle location history with archiving is already configured for this data on a different output generated by the Snow Route Status big data analytic.

The Winter Fleet Tracking analytic has been designed to support three different configurations of vehicle feeds consistent with the needs identified in the vehicle inventory and the vehicles feed(s) you configured in the previous step. The Winter Fleet Tracking analytic will need to be modified to fit the needs of your organization by locating the correct vehicle feed pipeline in the analytic, and replacing the broken, place-holder feeds(s) with your vehicle feed(s). A series of steps below outline various tasks for

updating the Winter Fleet Tracking real-time analytic to fit the needs of your organization. Follow the order in which the steps are presented below.

Follow the steps below to update the analytic with your vehicle feed and delete unused vehicle feed pipelines.

- In the ArcGIS Velocity application, use the site menu and click **Real-Time**.
- Click the **Edit** button  for the **Winter Fleet Tracking** real-time analytic.
- Add your vehicle feed(s) to the analytic by clicking **Feeds** from the tools menu, then **Select existing feed**.
- Click on your vehicle feed in the list and then click **Confirm**.
- If you configured more than one vehicle feed, repeat the steps above for each vehicle feed.
- Review the broken, place-holder feeds list below and their pipelines in the model. You will replace your vehicle feed with the corresponding pipeline.
 - If you configured an **ArcGIS Snowplow Drivers Feed**, delete the placeholder **ArcGIS Location Tracking Feed** and connect your feed as the **Target** in the **Dynamic Attribute Join on Username** tool.
 - If you configured an **AVL Location Only Snowplow Feed**, delete the placeholder **AVL Location Only Feed** and connect your feed as the **Target** in the **Dynamic Attribute Join on VehicleID** tool.
 - If you configured a **AVL Snowplow Feed**, delete the placeholder **AVL Feed** and connect your feed as the **Target** in the **Dynamic Attribute Join on VehicleID-1** tool.

Note:

Do not delete the **Vehicles_servicestatus Feed**, regardless of what vehicle feed pipeline is used.

- Click **Save** to commit your changes and validate the analytic.
- Once vehicle feeds are connected to the correct pipeline, unused vehicle feed pipelines need to be deleted from the model. See Figure 1 below for the Winter Fleet Tracking analytic configured to support the **ArcGIS Snowplow Drivers Feed** and the **AVL Snowplow Feed**.
 - If only one vehicle feed is used **delete** all other vehicle feed pipelines, from the placeholder vehicle feed, to the Merge tool. **Reconnect** your vehicle feed's pipeline from the **Map Fields** tool to the **Calculate Processed Datetime** tool.
 - If two of the three vehicle feeds are used, ensure pipelines **Merge** after the **Map Fields** tool, and connect directly from the Merge tool to the **Calculate Processed Datetime** tool.

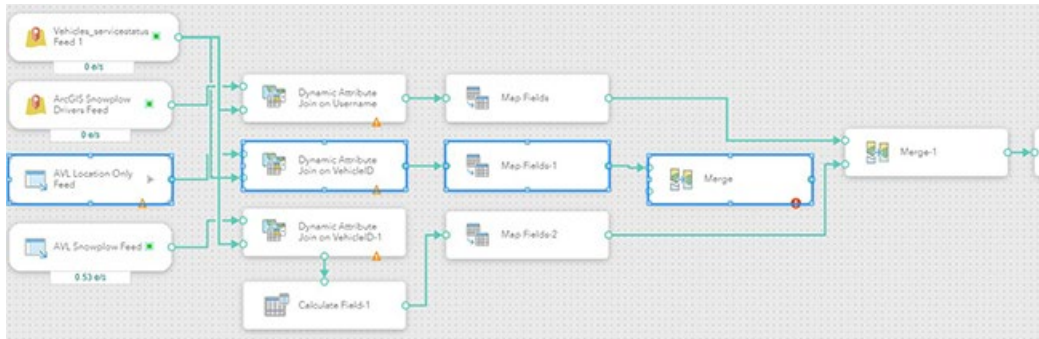
Note:

Multiple nodes in the model can be selected by holding the **Ctrl** button on your keyboard and selecting each node, then click **Delete** on your keyboard to remove the

selected nodes from the model. If a mistake is made when deleting nodes, keyboard shortcuts **Ctrl-Z** and **Ctrl-Y** will undo and redo edits.

- Click **Save** to commit your changes and validate the analytic.
 - If **ArcGIS Snowplow Drivers** is the only vehicle feed pipeline in your analytic, click **Start** to turn on the **Winter Fleet Tracking** real-time analytic. No additional configuration is needed since the schema was already known by the pipeline tools connecting to the feed.
 - If you have additional vehicle feeds in your model, continue configuring your vehicle feed pipelines following the steps below.


Figure 1



The selected nodes are deleted from the Winter Fleet Tracking real-time analytic, and the ArcGIS Snowplow Drivers Feed and the AVL Snowplows Feed are connected as inputs to the Merge 1 tool.

No additional configuration is needed if you are only using the **ArcGIS Snowplow Drivers Feed** pipeline since the schema was already known by the tools connecting to the feed. Additional configuration is required if you are using a vendor AVL for your vehicle feeds (**AVL Snowplow Feed** and/or the **AVL Location Only Snowplow Feed**), since the schemas for these feeds will vary for different AVL vendors.

Follow the steps below to finish configuring the **AVL Snowplow Feed** in the Winter Fleet Tracking real-time analytic.

- Double-click the **Dynamic Attribute Join on VehicleID** to open tool properties.
- Click the drop-down for the **Target field** and select the asset or vehicle id from your feed.
This is the same Vehicle ID value recorded in the vehicle inventory.
- Click **Apply**.
- Click **Save** to commit recent changes and validate the analytic.
- Double-click the Calculate Field-1 to open tool properties.
- Click the **Edit** button  for **servicetype**.

The **servicetype** field will be used to transform raw values from your vehicle feed that indicate plow up/down and material spreading rates, open gates, or other relevant values from your vehicle feed, to values used by the solution to indicate if the vehicle is actively servicing a road and what type of service being performed.

- Click the **Edit** button  again to **Configure Arcade expression**. Use Arcade to classify raw values from the feed a valid value below:

- In-transit
- Plowing and deicing
- Plowing
- Deicing
- Anti-icing

```
//Example Arcade expression to classify values from the feed to values
used by the solution plowstatus = $feature.yourplowfield //example values
are text, include "up", "down" materialstatus =
$feature.yourmaterialfield // example values are numeric if (plowstatus
== "up" && materialstatus = 0) { return 'In-transit' } if (plowstatus ==
"down" && materialstatus > 0) { return 'Plowing and deicing' } if
(plowstatus == "down" && materialstatus = 0) { return 'Plowing' } if
(plowstatus == "up" && materialstatus > 0) { return 'Deicing' } ...
```

- Double-click on the **Map Fields-2** tool to open field properties.
- Reference the table below for a list of output fields that need mapped with your vehicle feed's input.

<feed field name>	speedmph
<feed field name>	heading
<feed field name>	vehicleid
<feed field name>	location_timestamp

Some fields may require you transform existing values into the data or value type defined by the Output field. For example, if your feed contains speed expressed as meters per second, use the following Arcade expression to calculate miles per hour:

```
//Example Arcade expression Floor($feature["yourspeedfield"]*2.237.
```

- Click **Apply**.
- Click **Save** to commit your changes and validate the analytic.

Follow the steps below to finish configuring the **AVL Location Only Snowplow Feed** in the Winter Fleet Tracking real-time analytic.

- Double-click the **Dynamic Attribute Join on VehicleID** to open tool properties.
- Click the drop-down for the **Target field** and select the asset or vehicle id from your feed.
This is the same Vehicle ID value recorded in the vehicle inventory.
- Click **Apply**.
- Double-click on the **Map Fields-1** tool to open field properties.
- Reference the table below for a list of output fields that need mapped with your vehicle feed's input.

<feed field name> speedmph
<feed field name> heading
<feed field name> vehicleid
<feed field name> location_timestamp

Some fields may require you transform existing values into the data or value type defined by the Output field. For example, if your feed contains speed expressed as meters per second, use the following Arcade expression to calculate miles per hour:

```
//Example Arcade expression Floor($feature["yourspeedfield"]*2.237.
```

The remaining fields are already configured. Since drivers of these vehicles are using the Status Reporter QuickCapture project, the Service Status is being sourced from the Vehicles_servicestatus feed.

- Click **Apply**.
- Click **Save** to save and validate the analytic.
- Click **Start** to start the real-time analytic.

Update the Snow Route Status big data analytic

Snow Route Status is a scheduled big data analytic and is configured with four different analytic pipelines and feature layer outputs to support near real-time route status updates, summarize material used (US tons) and distance traveled (miles) by each vehicle, and store vehicle location history during active winter events.

- The first analytic pipeline derives an output feature layer that displays the last time an in-service snowplow visited a given snow route segment. As a referenced feature layer output, data retention and archiving properties are set by the Reset Snow Routes big data analytic that originally created this output feature layer. A shorter retention period without archiving is defined for this output, as route features are designed to be updated regularly during active winter weather operations.


Note:

By default, the only records from the VehicleTracks feature layer that will not be processed by the analytic and shown as last serviced is the "In Transit" value in the servicestatus field. All other values in the servicestatus field, including *null* or empty values, will be processed and treated as an in-service status. This can be modified by updating the Arcade expression in the Join Features tool.

- The second analytic pipeline summarizes the distance traveled (miles) by each vehicle during an event and associates the event start date with each record generated. This feature layer output is configured to retain data for one year before it is archived, meaning Velocity will maintain up to two years of your data.
- The third analytic pipeline stores vehicle location history and associates the event start date with each record generated. This feature layer output is configured to retain data for one year before it is archived, meaning Velocity will maintain up to two years of your data.

- The fourth analytic pipeline summarizes the material used (US tons) by each vehicle during an event and associates the event start date with each record generated. This feature layer output is configured to retain data for one year before it is archived, meaning Velocity will maintain up to two years of your data

Follow the steps below to update and start the Snow Route Status big data analytic.

- In the ArcGIS Velocity application, use the site menu and click **Big Data Analytic**.
- On the Big Data Analytics page click the **Edit** button  for the **Snow Route Status** big data analytic.
- Note the broken nodes in the analytic, **Vehicle Tracks** and **SnowRoutesVelocity**. When the solution was initially deployed, these feature services did not yet exist.
Double-click the **VehicleTracks** node to open the source data properties.
- Click **Edit**.
- Change the search context from ArcGIS to **My Content**, then search for and select the **VehicleTracks_UniqueID** Feature Service
Ensure Feature Service is selected, not the Map Service of the same name.
- Click **Next**.
- The parameter values are pre-configured for all remaining steps and should not be modified.
Select **Next** for the **Filter Data**, **Confirm Schema**, and **Timestamp Field** steps.
- Leave the pre-configured values in the **Identify Key Fields** step and click **Complete**.
- Double-click the broken output node **SnowRoutesVelocity**.
- Click **Edit**.
The Configure Feature Layer (existing) page appears.
- Search for and select **SnowRoutesVelocity_UniqueID** then click **Next**.
- Leave the default value **Keep latest feature** for **Data storage method** and click **Complete**.
The analytic will validate, indicated by a green check mark at the top of the page.
- Click **Save** to commit recent updates to the analytic.
- Click **Start** to run the scheduled big data analytic.

Note:

The Snow Route Status big data analytic is configured to run every three minutes. Change this interval to meet the needs of your organization.

You have completed the steps for updating the ArcGIS Velocity analytics delivered with the solution.

Schedule the Winter Weather Operations Notebook

The Winter Weather Operations Notebook can be used by mapping technicians and operations managers to automate data management and ArcGIS Velocity tasks when scheduled to run as a task in ArcGIS Online.

When a new Winter Event is created in the Winter Operations Center, at its next scheduled run-time, the notebook will start all feeds and analytics associated with the solution.

When operations managers end the Winter Event, at its next scheduled run-time, the notebook will stop all feeds and analytics associated with the solution, reset route status information, and truncate records stored in the Service Status layer of the FieldOperations feature layer.

Follow the steps below to schedule the Winter Weather Operations Notebook to run as a scheduled task in ArcGIS Online:

Note:

You must be assigned a role of Administrator or custom role which includes the privilege to Create, edit and schedule notebooks in order to run and schedule ArcGIS Notebooks and complete the following steps.

- Verify that you are signed in to your ArcGIS organization and browse to the Winter Weather Operations Notebook item.
- Open the item page and click **Open Notebook**.
- Click **Tasks**.
- Click **Create Task**.
- For **Title**, type Winter Event Task and click **Next**.
- Leave the default values to schedule the notebook to run every 15 minutes.
Click **Create Task** to finish scheduling the notebook.

Configure the Material Reporter form

The Material Reporter form can be used by operations managers and yard supervisors to record material used for any vehicle during an active operation. Material used can be reported from the Winter Operations Center > Vehicles page and with additional configuration, can also be used as a standalone survey.

Follow the steps below to configure the Material Reporter form to be used as a standalone survey

- Install ArcGIS Survey123 Connect.
- Start ArcGIS Survey123 Connect and sign in to your ArcGIS organization.
- Click **Material Reporter** to download the survey.
- In the **Download** window, click **Download** and click **OK**.
- Click **Material Reporter** to open the survey.
- On the side toolbar, click the **XLSForm** button.

- In the Microsoft Excel spreadsheet, click the **survey** tab if not already active.
- Insert the below text into cell F4 of the spreadsheet, replacing the text *placeholder* with the feature service URL of the Vehicles table in the OperationsManagement table (hosted) deployed with the solution.

autocomplete search("vehicles?url=*placeholder*")

- Save and close the Microsoft Excel spreadsheet and preview your changes in ArcGIS Survey123 Connect.
- Click **Publish survey** to publish your changes and click **OK**.

Use Winter Weather Operations

The Winter Weather Operations solution delivers a set of capabilities that help you develop winter weather response plans, centralize snowplow vehicle feeds, monitor winter weather operations in real-time, share near real-time road status updates, and track vehicle locations and materials used during winter weather events (and the entire winter season).

In this topic, you'll learn how to use the solution by assuming the role of a user and performing the workflows below.

Manage vehicle inventory

Before the winter season begins, agencies responsible for keeping roads safe during the winter prepare and plan for winter weather operations by readying vehicles, material, and personnel for the upcoming season. Workforce reductions, changes in technology, and an increased use of contracted resources can make planning and response information difficult to manage and access. The result can lead to missed assignments, budget overruns, and a frustrated community. Completing a vehicle inventory can help agencies identify needs by documenting all vehicles supporting their winter weather operations, both fleet and contracted.

The Winter Operations Center can be used operations managers of public works and transportation agencies to manage an authoritative source of information for all vehicle supporting winter weather operations.

In these workflows, you will assume the role of an operations manager of a public works agency responsible for maintaining information on vehicles supporting winter weather operations.

Add a new vehicle

In this workflow, you will add a new contractor vehicle to the vehicle inventory.

- Sign in to your ArcGIS organization and browse to the Winter Operations Center app.
- Open the item page and click **View**.

The Winter Operations Center Home page is opened by default.

- Click **Vehicles** on the navigation menu.
- Click **Add New Vehicles**.

The Add New Vehicle window appears.

- Enter the following vehicle inventory details:

Questions	Answers
Vehicle ID	Type Contractor 1
Vehicle Name	Leave the pre-populated value.
Fleet or Contract	Choose Contractor
Automated Vehicle Location Reporting	Choose ArcGIS Only
Plow Function	Type <code>District 1 cul-de-sacs</code>
Salt / Solid Material Capacity	Enter <code>1</code>
Brine Capacity	Enter <code>0</code>

Make and Model	Type Ford F-250
Plow Type	Type Straight
Vehicle Status	Choose Operational


- Click **Save**.
- The driver of this vehicle will use the Status Reporter QuickCapture project to report their vehicle location, service status and material used during operations. The following tasks need to be completed to finish adding the vehicle and driver to your winter weather operations:
 - Add the driver to the **Winter Operations Drivers** group. See the configure topic Provision users for more information.
 - Add the contractor's **Vehicle ID** to the Status Reporter QuickCapture project. See the configure topic Update the Status Reporter project for more information.
 - Add the driver to the ArcGIS Tracker track view **ArcGIS Snow Plow Drivers** created in the configure topic Create a track view.

Update vehicle information

Snow removal and ice control can take a toll on vehicles and equipment during winter weather operations. On occasion, equipment fails. In this workflow you will update the status of a vehicle in your inventory.

- Verify that you are signed in to your ArcGIS organization and browse to the Winter Operations Center app.
- Open the item page and click **View**.

The Winter Operations Center Home page is opened by default.

- Click **Vehicles** on the navigation menu.
- Click the **Edit** button  for a vehicle in the list.

The Edit Vehicle Info window appears.

- Update the **Vehicle Status** to **Out for repair**.
- Click **Submit**.

Create a new winter event

The ability to record snow removal and ice control activity by each operational period is important for operation managers who want to track key performance metrics, compare response activities over the course of the season, and justify budget needs for the next season. The Winter Operations Center can be used to define winter weather events so you can track key performance metrics during operational periods.

In this workflow, you will assume the role of an operations manager in a public works or transportation agency responsible for defining the start of an operational period for a winter weather event.

- Verify that you are signed in to your ArcGIS organization and browse to the Winter Operations Center app.
- Open the item page and click **View**.

The Winter Operations Center Home page is opened by default.

- Click **Events** on the navigation menu.
- Click **New Event**.

The Create a New Event window appears.

- Complete all the required questions in the survey.
- Click **Submit**.

Note:

When a new event is created and the Winter Weather Operations Notebook is configured to run on a schedule, at its next scheduled run-time, the notebook will start all feeds and analytics associated with the solution. See the configure topic [Schedule the Winter Weather Operations Notebook](#) for more information.

[Report service status and material used during operations](#)

Public works and transportation agencies can use ArcGIS to extend their ability to track and monitor winter weather operations by including vehicles with limited or no existing AVL technology on board. Drivers equipped ArcGIS location tracking technology and field operations apps can be tracked alongside vehicles supported by an AVL system, and yard supervisors and operations managers can help record material used for any vehicle during operations.

[Use the Status Reporter ArcGIS QuickCapture project](#)

The Status Reporter ArcGIS QuickCapture project can be used by drivers to record current vehicle location, service status and material used during winter weather operations.

In this workflow, you will assume the role of a snowplow driver for a public works agency who needs to report his in-service status during operations, and material used when he returns to the yard.

- Download **ArcGIS Tracker** onto your mobile device.
- Open ArcGIS Tracker and sign in to your ArcGIS Organization.
- Tap the **profile icon** then tap **Last known location**.
- Tap **30 secs**.

Note:

The above steps only need to be completed on initial install. Each time you open the Status Reporter QuickCapture project, you will be able to launch ArcGIS Tracker from the project to start location tracking.

- Download ArcGIS QuickCapture onto your mobile device.
- Open QuickCapture and sign in to your ArcGIS organization.
- Select the add project button.
- Select **Browse Projects** and select the **Status Reporter** project card to download.

- Tap the **Status Reporter** project in the gallery to open it.
- Tap the **Vehicle ID** you will use for winter weather operations then tap **DONE**.
- Tap **Location Tracking**.
The ArcGIS Tracker app will appear.
- Tap **Track my location**, then tap your device **back button**.
The Status Reporter QuickCapture project will appear.
- Tap the button **In-Transit** in the Service Status button group before leaving the maintenance yard.
- Tap the button **Plowing & Deicing** in the Service Status button group when you begin to service your snow route.
- When you return to the maintenance yard for more material, tap the button in the **Report Material Used** group that most accurately describes how much material was used during your last round-trip.

Use the Material Reporter

Agencies have the flexibility to decide how material is reported and by whom. Some vehicles may have existing sensors that track this information as a part of their AVL system, while other vehicles do not. The Material Reporter app can be used by operations managers and yard supervisors to help record material used for any vehicle during operations, giving operations managers another data point to validate other material-use reporting for their fleet.

In this workflow, you will assume the role of a yard supervisor responsible for recording material used for each round trip a vehicle returns to the yard.

- Verify that you are signed in to your ArcGIS organization and browse to the Material Reporter form.

Note:

The Material Reporter form can also be accessed from the Winter Operations Center's Vehicle page.

- Open the item page and click **Open in Survey123 > Open in browser**.
- Click the drop-down in the **Select a Vehicle** question and select a vehicle from your inventory.
- Choose **Single load** for the **Report material used for a single load or multiple loads?** question.
- Choose **Full Load** for the **Select load size** question.
- Click **Submit**.

Monitor operations

Real-time information and transparency are critical during winter weather response activities. Maintaining a road network is complex and quickly communicating progress to travelers is a challenge for government agencies. Understanding where snowplows have traveled and are currently located during a winter storm optimizes response activity and helps clearly communicate what roads have been serviced.

The Active Events and Winter Season Dashboards can be used by public works and transportation agency directors and operations managers to monitor winter weather operations in real-time and track vehicle movement and materials used during operational periods and throughout the entire winter season.

Track progress and vehicles during active operations

The Active Events Dashboard helps you monitor snow response activities during operational periods so you can ensure service agreements and key performance metrics are being met.

In this workflow, you will assume the role of a transportation director who is looking to monitor progress during an active operation. You will use the Active Events Dashboard to review key metrics and to monitor operations progress for servicing priority routes during an active winter weather event.

- Verify that you are signed in to your ArcGIS organization and browse to the Active Events Dashboard app.

Note:

The Active Events Dashboards app can also be accessed from the Winter Operations Center's Active Event page.

- Open the item page and click **View Dashboard**.

The Active Events Dashboard allows directors and operations managers to monitor active operations including last known vehicle locations, open service requests, distance traveled, material used, and progress made towards servicing your road network.

- In the map panel, click on the Legend.

Snow Routes are symbolized into four categories based on when they were last serviced: Within the last 10 minutes, Between 10 and 30 minutes, Over 30 minutes, and Service pending.

- Click the arrow located on the left of the application to display the filter panel. The filter panel can be pinned to the dashboard by clicking the pin in the upper right corner.

The filter panel allows you to filter the Roadway Serviced and Percent Serviced metrics by District, Route Priority, Snow Route, Road and Last Serviced information. The Vehicles, Fleet or Contractor, and Service Status filters will filter the vehicles list and the Distance Traveled and Material Used metrics. The vehicles list can be used to select, pan and zoom the map to a vehicle in active operations.

- Select the highest priority route from the **Route Priority** filter.
- Select **Within the last hour** in the **Last Serviced** filter.

Roadway Serviced and Percent Serviced metrics are updated to reflect how much of the highest priority routes have been serviced within the last hour.

Review performance throughout the winter season

The Winter Season Dashboard helps you review response activities for any winter weather event so you can adapt future response plans and address performance challenges.

In this workflow, you will assume the role of an operations manager who needs to review vehicle location history to validate a community report of a damaged mailbox.

- Verify that you are signed in to your ArcGIS organization and browse to the Winter Season Dashboard app.

Note:

The Winter Season Dashboard app can also be accessed from the Winter Operations Center's Current Season page.

- Open the item page and click **View Dashboard**.

The Winter Season Dashboard allows directors and operations managers to review key performance metrics for any operational period throughout the winter season including vehicle history, distance traveled, material used, and service requests.

- In the map panel, click on the Legend.

Vehicle locations are summarized as hexagon bins with the number of records displayed as the label.

- Click the arrow located on the left of the application to display the filter panel. Pin the panel using the pin button in the upper right corner.

The filter panel allows you to select any winter event from the current season to see key performance metrics and vehicle locations associated with the operational period of the event.

- The Requests and Request Type bar charts are linked to service requests features on the map.

Select **Mailbox Damage** using the Request Type bar chart.

- Zoom and pan the map to the location of one of the service requests.

The extent of the map will filter vehicle location history.

- Click on the service request and note the date submitted.

Use the **Vehicle and Request Date** filter to investigate vehicle activity in the area during the reported mailbox damage.

End a winter event

Measuring effectiveness and improving winter operations begins with proper tracking of response activities during operational periods. When a winter event ends and the operational period comes to a close, operations managers need to be able to summarize their response activity associated with the conditions observed during their operations. The Winter Operations Center can be used to end an active operational period and summarize key performance metrics and weather observations.


In this workflow you will assume the role of an operations manager in a transportation agency responsible for ending the active operational period and providing key performance metrics and observations associated with the past winter weather event.

- Verify that you are signed in to your ArcGIS organization and browse to the Winter Operations Center app.

- Open the item page and click View.

The Winter Operations Center Home page is opened by default.

- Click **Events** on the navigation menu.

- Click the **Edit** button  for the **Active Event** in the list.
- Enter the **Snowfall Total (inches)** observed during the operational period.
- Enter the **Total Material Used (tons)** tracked during the observational period.

Note:

To provide this value, reference the Active Events Dashboard **Material Used** indicator.

- Enter the **Total Distance Traveled (miles)** tracked during the observation period.

Note:

To provide this value, reference the Active Events Dashboard **Distance Traveled** indicator.

- Click **Submit**.

Note:

When the active event ends and the Winter Weather Operations Notebook is configured to run on a schedule, at its next scheduled run-time, the notebook will stop all feeds and analytics associated with the solution. See the configure topic [Schedule the Winter Weather Operations Notebook](#) for more information.