

The Texas Department of Transportation (TxDOT) recently published information about a statewide operation to replace a certain type of guardrail end treatment that has caused multiple deaths. In this lesson, you'll manage multiple stages of this operation, including data collection, guardrail inspections, and recording the replacements.

First, you'll create a feature layer in ArcGIS Online to contain the data. Then, you'll use ArcGIS QuickCapture, Collector for ArcGIS, and Survey123 for ArcGIS to complete the operation. Last, you'll display the results in Operations Dashboard for ArcGIS.

Prepare a feature layer

Before you begin the operation, you'll prepare a feature layer to be used during all stages of the operation. Field workers will use this layer to mark the location of guardrail end treatments and add more detailed information about their type and replacement status.

Create a feature layer

First, you'll create the layer in ArcGIS Online (or ArcGIS Enterprise) and provide basic metadata.

1. Sign in to your [ArcGIS organizational account](#) or into ArcGIS Enterprise using a named user account.

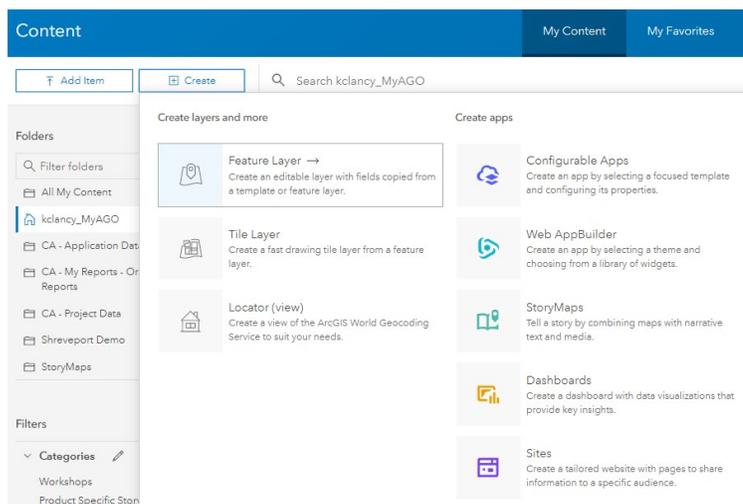
Note:

If you don't have an organizational account, you can sign up for an [ArcGIS free trial](#).

2. On the ribbon, click **Content**.

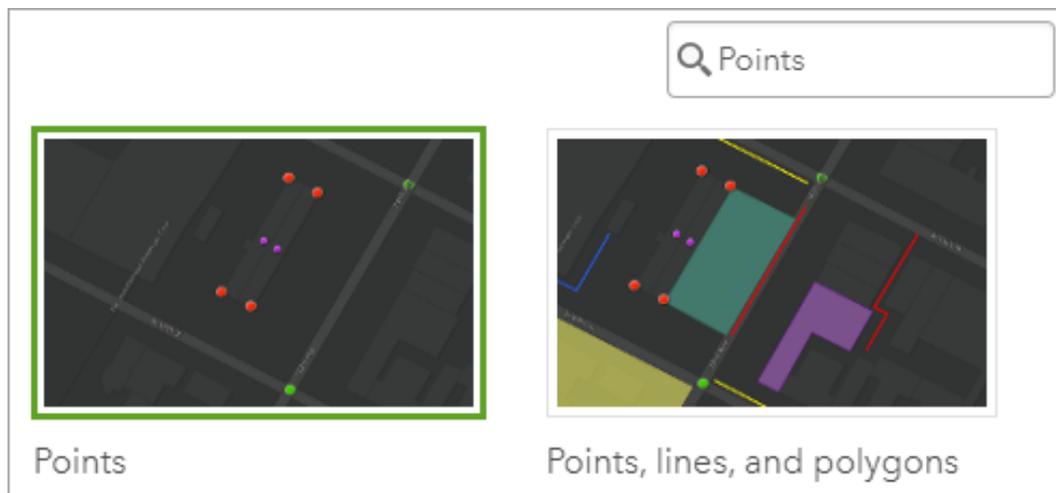


3. On the **Content** page, click **Create** and choose **Feature Layer**.



The **Create a feature layer** window appears. It contains many feature layer templates, including one for guardrails. However, your operation requires custom fields to track replacement status and other specific information. You'll use the basic **Points** template and add the custom fields later.

4. In the search bar, type **Points**. Click the **Points** feature layer template.



A pane appears with more information about the template.

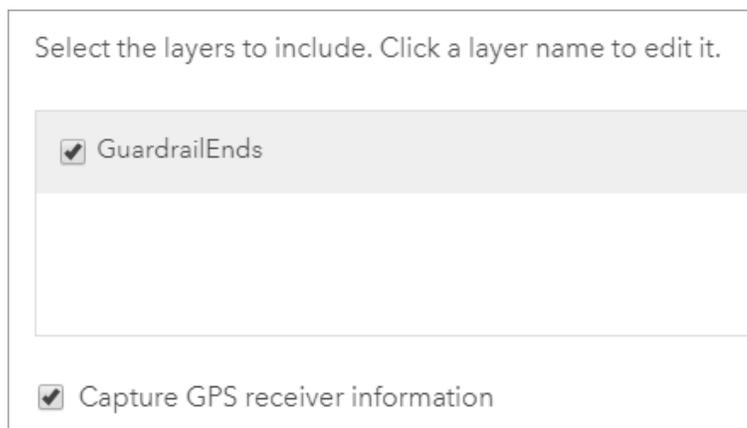
5. Click **Create**.

The default name of the new layer is **Point layer**. You'll change the layer name to be more meaningful and ensure that it is formatted correctly. For a layer to be used in Survey123 for ArcGIS, its name must have no spaces.

6. Click the layer name (**Point layer**) to edit the name. Replace the existing text with **GuardrailEnds** and press Enter.

You'll also enable the layer to receive GPS information from Collector.

7. Check **Capture GPS receiver information**.



8. Click **Next**.

Next, you'll choose the layer's default extent.

9. Zoom to Dallas, Texas. (Your extent does not need to match the example image exactly.)



10. Click **Next**.

11. Enter the following parameters:

- For **Title**, type Guardrail End Treatments (and add your name or initials).
- For **Tags**, add the tags Survey123, Collector, QuickCapture, Texas, and Department of Transportation.
- For **Summary**, type A layer used to collect data regarding the end treatments of guardrails throughout Texas. This data will originally be collected in QuickCapture, modified in Collector, and finalized in Survey123.

Note:

Layers must have unique names within your organization. Adding your name or initials ensures that the layer name is unique.

12. Optionally, for **Save in folder**, choose a folder.

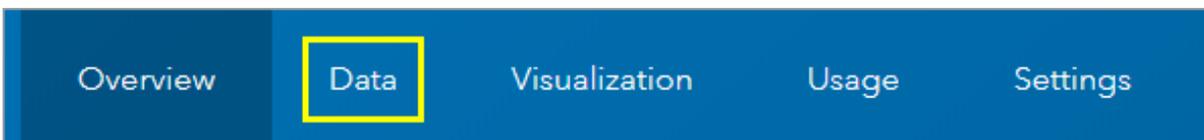
13. Click **Done**.

After a few moments, the layer is created and its details page appears.

Add a custom field

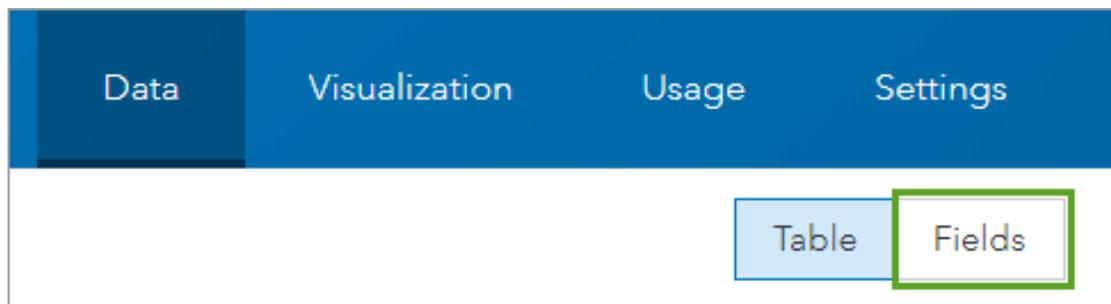
You've created the feature layer that your field workers will use during all three stages of the operation. Next, you'll add a custom field specific to the guardrail end treatment data you want to collect.

1. On the details page, click the **Data** tab.



The layer currently has no data because your field workers haven't started collecting it yet.

2. Click the **Fields** button.



The layer's fields are listed. By default, the layer has several fields, many of which you won't need. You'll delete the unneeded fields.

3. Check the box next to the following fields:

- **HDOP**
- **VDOP**
- **Fix Type**
- **Correction Age**
- **Station ID**
- **Number of Satellites**
- **Fix Time**
- **Compass Reading**
- **Speed (km/h)**
- **Average Horizontal Accuracy (m)**
- **Average Vertical Accuracy (m)**
- **Averaged Positions**
- **Standard Deviation (m)**

4. Click the **Delete** button.



5. In the **Delete** window, click **Delete**.

The fields are deleted. Next, you'll add several new fields. The first field will be for the guardrail end treatment type.

6. Click the **Add** button.

7. In the **Add Field** window, enter the following parameters:
 - For **Field Name**, type GuardrailEndType (with no spaces).
 - For **Display Name**, type Guardrail End Type.
 - Uncheck **Allow Null Values**.

By unchecking **Allow Null Values**, you ensure that field workers must provide the guardrail end treatment type when collecting information.

8. Click **Add New Field**.

The field is added to the end of the list of fields. Currently, field workers will be able to type the guardrail end treatment type when filling in this field. However, there are only a few types. To reduce the time spent filling in the field and minimize the chance of errors, you'll create a list of the types from which workers can choose.

9. Scroll to the bottom of the list of fields and click the **Guardrail End Type** field.
10. Click **Create List**.

Create List

Delete

Details

Type: String
Name: GuardrailEndType

Each item in the list must have a label (the displayed value) and a code (the stored value). Codes cannot have spaces or special characters. Both labels and codes are case sensitive.

11. Add the following list items (click **Add** to create a list item):

Label	Code
X-Lite	X-Lite
ET Plus	ETPlus
ET 2000	ET2000
SoftStop	SoftStop
Other	Other

Label	Code	
<input type="text" value="X-Lite"/>	<input type="text" value="X-Lite"/>	
<input type="text" value="ET Plus"/>	<input type="text" value="ETPlus"/>	
<input type="text" value="ET 2000"/>	<input type="text" value="ET2000"/>	
<input type="text" value="SoftStop"/>	<input type="text" value="SoftStop"/>	
<input type="text" value="Other"/>	<input type="text" value="Other"/>	

+ Add

12.

13. Click **Save**. In the upper right corner of the **Guardrail End Type** field, click the X.

You return to the list of fields.

Add more fields

You'll add several more fields to the feature layer. Some of these fields have lists and some do not.

1. Click **Add**. Add a field with the following parameters:
 - For **Field Name**, type Roadside.
 - For **Display Name**, type Roadside.
 - Uncheck **Allow Null Values**.
2. For the **Roadside** field, create a list with the following list items:

Label	Code
Left	Left
Right	Right

3. Add a field with the following parameters:
 - For **Field Name**, type RouteName.
 - For **Display Name**, type Route Name.
4. Add a field with the following parameters:
 - For **Field Name**, type Priority.
 - For **Display Name**, type Priority.
5. For the **Priority** field, create a list with the following list items:

Label	Code
High	High
Moderate	Moderate
Low	Low

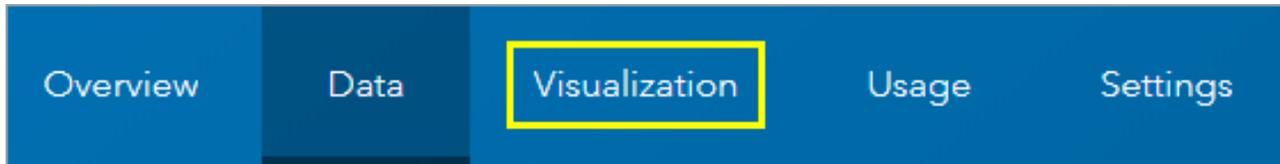
6. Add a field with the following parameters:
 - For **Field Name**, type ReplacementDate.
 - For **Display Name**, type Date of Replacement.
 - For **Type**, choose **Date**.
7. Add a field with the following parameters:
 - For **Field Name**, type ReplacementStatus.
 - For **Display Name**, type Status of Replacement.
 - For **Default Value**, type Not Started.
8. For the **Status of Replacement** field, create a list with the following list items:

Label	Code
Not Started	NotStarted
In Progress	InProgress
Successful Completion	Completed

9. Create a field with the following parameters:
 - For **Field Name**, type AdditionalComments.
 - For **Display Name**, type Additional Comments.

You've added all the fields necessary for the guardrail end treatment replacement project. Before you continue, you'll also configure the layer's default symbology so that it has a different symbol for each guardrail end treatment type.

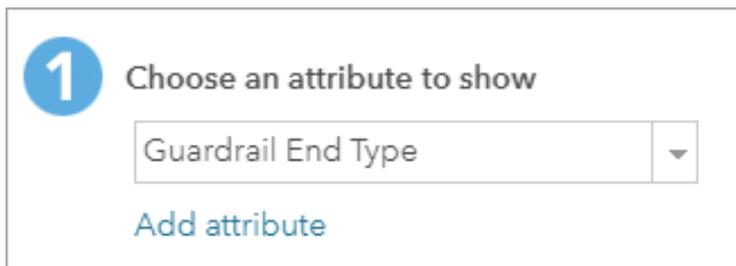
10. Click the **Visualization** tab.



11. Click the **Change Style** button.

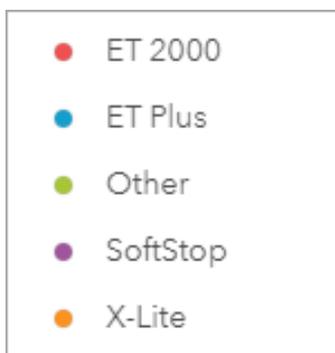


12. For **Choose an attribute to show**, choose **Guardrail End Type**.



13. Click **Done**.

The legend lists the five types of guardrail end treatments, each with a unique symbol.



14. Click **Save Layer**.

You've created a feature layer to contain information about guardrail end treatments collected by your field workers. You also configured custom fields specific to your operation. This layer will be used in each stage of your operation.

Manage the reconnaissance phase

The operation to replace guardrail end treatments throughout Texas will have three phases: reconnaissance, review, and replacement. The reconnaissance phase is a broad review of all guardrail end treatments in the state. Field workers will drive every road in the state and quickly collect data without leaving their vehicles. Then, a TxDOT district manager will examine the data and determine which maintenance areas to prioritize.

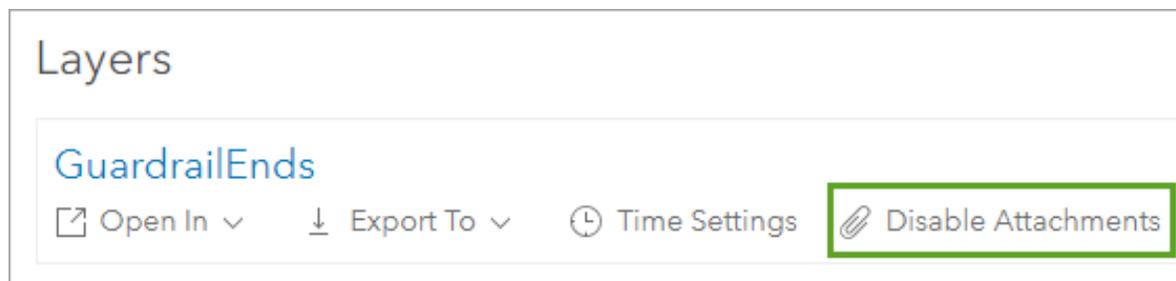
For this stage, you'll create an [ArcGIS QuickCapture](#) project. QuickCapture is an app that allows users to quickly record observations in the field. Your project will help field workers add data for each guardrail end treatment they see while on the road.

Prepare feature templates

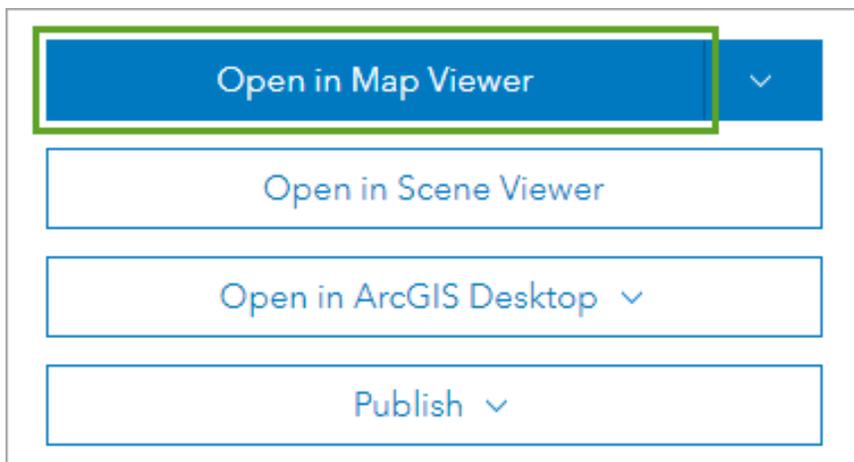
Before you create the QuickCapture project, you'll create feature templates for your guardrail end treatments layer. Feature templates define information about features added to a layer. By defining certain information ahead of time, you'll save your field workers time when they create features. These feature templates will also be used to automatically generate buttons in QuickCapture.

1. If necessary, open the details page of your guardrail end treatments layer.
2. If necessary, click the **Overview** tab.

For feature templates to be added to a layer, attachments must be enabled. Under **Layers**, for the **GuardrailEnds** layer, the **Disable Attachments** option indicates that attachments are enabled. If attachments were not enabled, the option would read **Enable Attachments**. If you see the **Disable Attachments** option, you do not need to do anything.



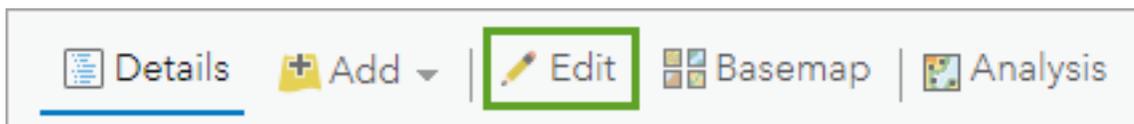
3. Click **Open in Map Viewer**.



The layer is added to a new web map. The layer has no data, but the map extent changes to the extent you set when you created the layer.

You'll design feature templates so that there is a unique template for each guardrail end treatment type for each side of the road.

4. On the ribbon, click the **Edit** button.

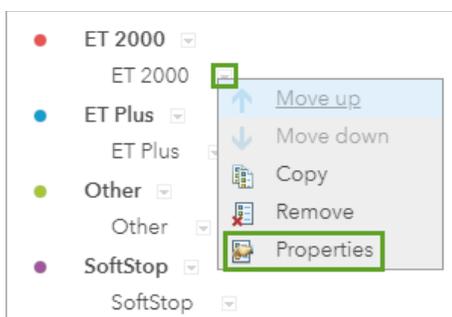


The **Add Features** pane appears. It lists the five guardrail end treatment types with their symbols, as you set when you configured the layer's default symbology.

5. At the bottom of the **Add Features** pane, click **Manage**.

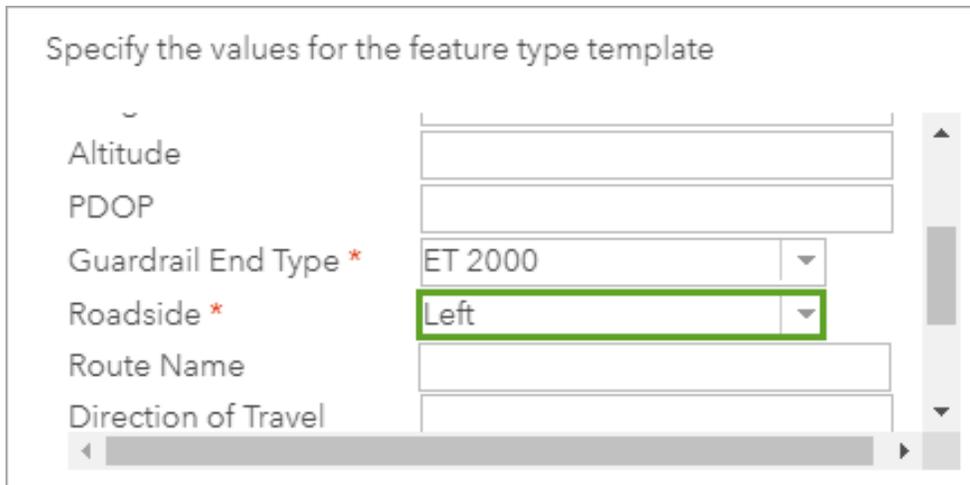
The feature templates for each guardrail end treatment type are listed. By default, each type has only one feature template.

6. For the **ET 2000** feature template (not the type), click the arrow and choose **Properties**.



7. In the **Properties** window, for **Name**, delete the existing text and type **Left**.

8. Under **Specify the values for the feature type template**, scroll to the **Roadside** field and choose **Left**.



Specify the values for the feature type template

Altitude

PDOP

Guardrail End Type * ET 2000

Roadside * **Left**

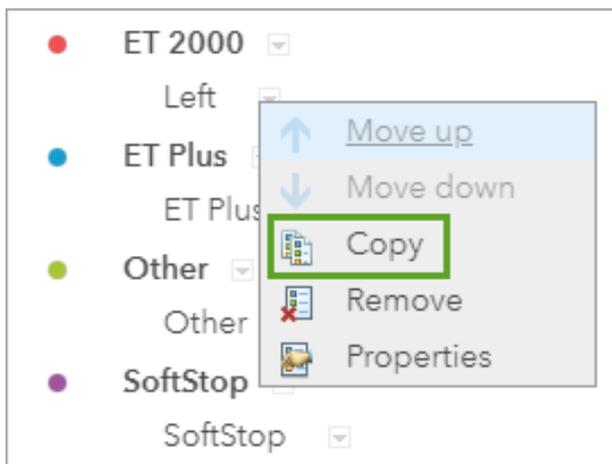
Route Name

Direction of Travel

9. Click **Done**.

Next, you'll create a feature template for guardrail end treatments on the right side of the road.

10. For the **Left** template, click the arrow and choose **Copy**.



11. In the **Properties** window, change **Name** to Right. Under **Specify the values for the feature type template**, scroll to the **Roadside** field and choose **Right**.

12. Click **Done**.

13. Create **Left** and **Right** feature templates for the remaining four guardrail end treatment types.



14. At the bottom of the **Manage New Features** pane, click **Save Changes**.

You've now created feature templates for each guardrail end treatment type for each side of the street.

15. Close the web map (you do not need to save).

Create a QuickCapture project

Next, you'll create a QuickCapture project using the feature layer. In the project, the guardrail end treatment types (ET 2000, ET Plus, SoftStop, X-Lite, and Other) will appear as groups and the feature templates (Left and Right) will appear as buttons.

1. Go to the [ArcGIS QuickCapture site](#) (also called QuickCapture Designer). If necessary, sign in with your ArcGIS or Enterprise account.

Once you sign in, you are directed to the **My projects** page. This page lists your QuickCapture projects.

2. Click the **New Project** button.

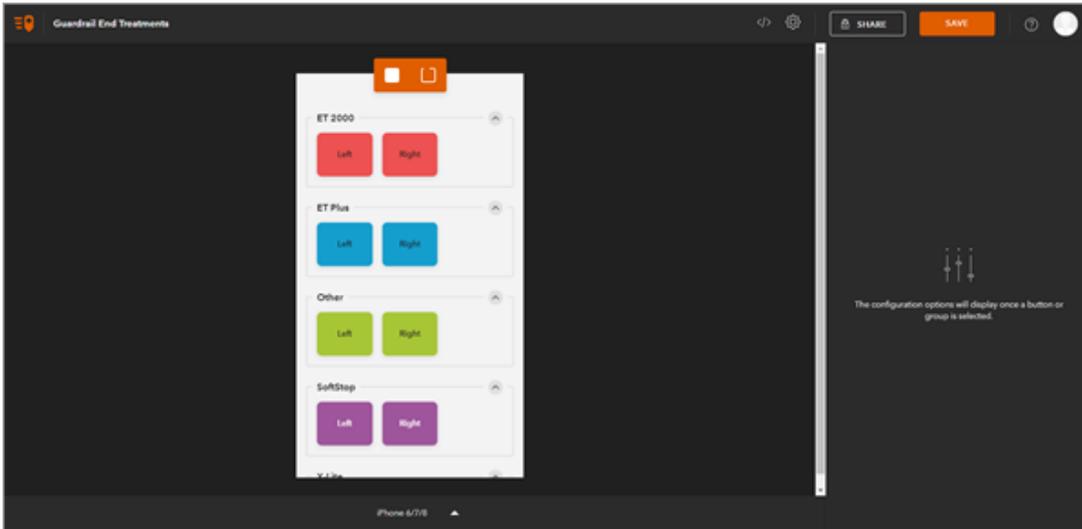
You're prompted to choose the feature layers you want to use in the project.

3. Locate and click your **Guardrail End Treatments** feature layer to select it. At the bottom of the screen, click **Next**.

Next, you'll confirm the project's basic information, such as its title.

- For **Title**, type `Guardrail End Treatments` and add your name or initials. Confirm that **Data recovery email** is set to a valid email address.
- Click **Create**.

The QuickCapture project is created. It displays a preview of the app that your field workers will access using their mobile devices. The app lists each guardrail end treatment type with buttons for the **Left** and **Right** feature templates.

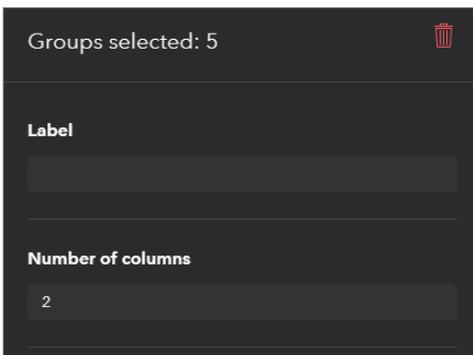


Currently, the app has empty space next to each set of buttons. You'll change the number columns to match the number of buttons so that the empty space is removed.

- Hold the Shift key. In the preview, click each **group** name (**ET 2000**, **ET Plus**, and so on) to select them all.

Once the **group names** are selected, options appear for configuration.

- For **Number of columns**, type 2.



The preview automatically updates.



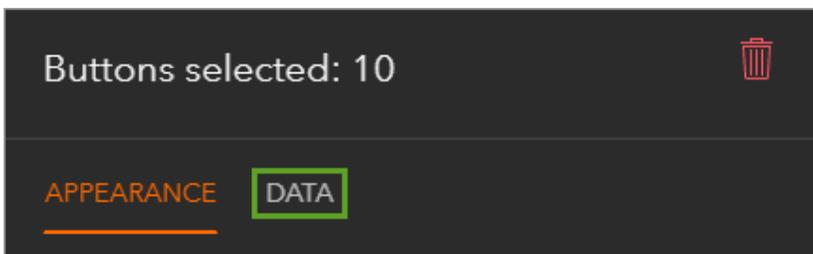
Because the buttons are so large, the fifth guardrail end treatment type, X-Lite, is only displayed if the user scrolls down. You'll reduce the size of the buttons so all five types are displayed at once.

8. In the preview, in the **ET 2000** group, click the **Left** button. Hold the Shift key and click all of the other buttons so that all 10 buttons are selected (you may need to resize your screen to select all of the buttons).
9. In the properties pane, for **Size**, click the smallest button size.



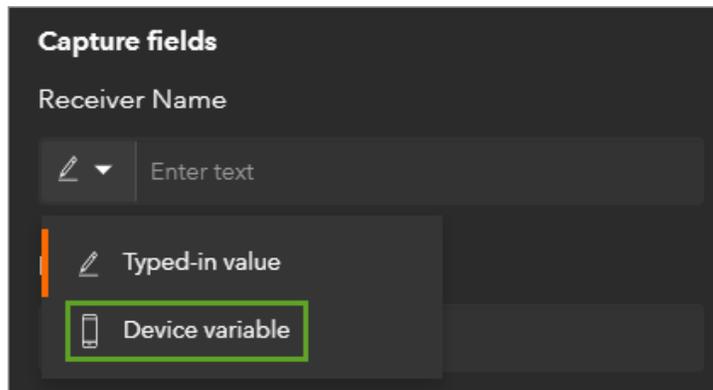
The preview updates with the smaller button size. Next, you'll set variables so that the user's location data is automatically captured when they add a feature.

10. Click the **Data** tab. (Keep the buttons selected)



This tab lists all of the attribute fields you configured for the feature layer. By default, all fields must be manually entered by the field worker when they add a feature. You'll change some of the fields so that they automatically use the location information of the field worker's device.

11. For **Receiver Name**, click the pencil drop-down menu and choose **Device variable**.



A list of possible variables that can be taken from the device appears. Your field workers will be using external GNSS receivers connected to their devices, so you'll choose a variable for external sensors.

12. Check the following device variables:
 - For **Horizontal Accuracy (m)**, choose **Device variable** and choose **Horizontal accuracy (m)**.
 - For **Vertical Accuracy (m)**, choose **Device variable** and choose **Vertical accuracy (m)**.
 - For **Latitude**, choose **Device variable** and choose **Latitude (DD)**.
 - For **Longitude**, choose **Device variable** and choose **Longitude (DD)**.
 - For **Altitude**, choose **Device variable** and choose **Altitude (m)**.
 - For **PDOP**, choose **Device variable** and choose **PDOP**.
 - For **Direction of Travel**, choose **Device variable** and choose **Direction of travel (°)**.

When field workers add guardrail end treatment features, all of these fields will be automatically populated with information from their devices.

Tip:

To confirm that the buttons in your project correspond to the correct guardrail end type and roadside, click a single button to select it. On the **Data** tab, scroll to the **Guardrail End Type** and **Roadside** capture fields. The values in these fields should match the selected button's group and name, respectively.

13. On the ribbon, click **Save**.



A message appears, confirming that your project is saved and can be downloaded in the QuickCapture mobile app.

14. Close the QuickCapture project.

Capture a record

For the purposes of this exercise, you don't need to drive the roads of Texas to collect guardrail end treatment data. However, to test your project, you'll open it in the QuickCapture mobile app and capture an example record.

1. Open ArcGIS QuickCapture on your mobile device.

Note:

If you don't have the ArcGIS QuickCapture mobile app, you can install it from the [App Store](#) or [Google Play](#), depending on your device.

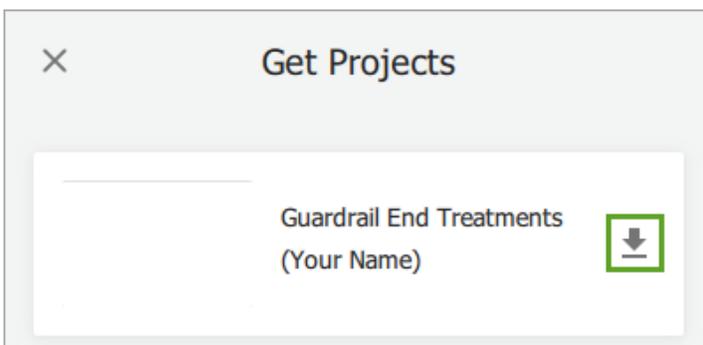
2. Click **Sign in with ArcGIS Online** or **Sign in with ArcGIS Enterprise**. Sign in with the appropriate credentials.

The **My workspace** page appears. This page lists all the projects downloaded to your device.

3. Click **Get Projects**.

All QuickCapture projects available to you are listed. These include projects you've created and projects shared with your organization.

4. Locate your **Guardrail End Treatments** project and click the download button.

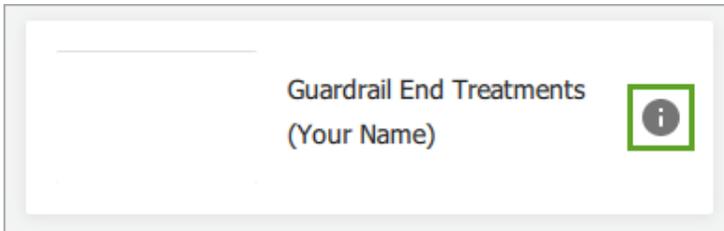


Note:

Depending on your device, your interface may differ from the example images.

Once downloaded, the download button becomes an information button. You can click the information button to see the project metadata, whether a project update is available, and if there are records that have failed to send.

5. Click the information button.

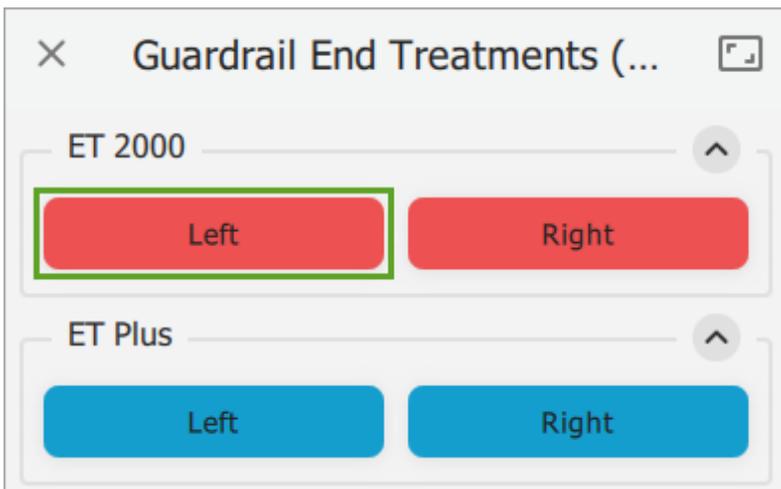


Currently, your project doesn't have much metadata.

6. Click **Capture**.

The project opens. It contains grouped buttons similar to the preview you saw when you configured the app.

7. In the **ET 2000** group, click the **Left** button.



Note:

To capture a feature, your device's GPS must meet an accuracy threshold. If your GPS does not meet the threshold, you'll receive an error message. If you cannot capture a feature, walk outside to get a signal or continue to the next section.

The feature is captured at your current location (which is may not be in Texas). The feature has attribute information that indicates it is an ET 2000 guardrail end treatment on the left side of the road. Other attribute information, such as altitude and direction of travel, is captured automatically from your device's sensor.

Note:

The **Direction of Travel** attribute will only be collected if you are moving at the time of capture.

8. Click other buttons to collect more features.

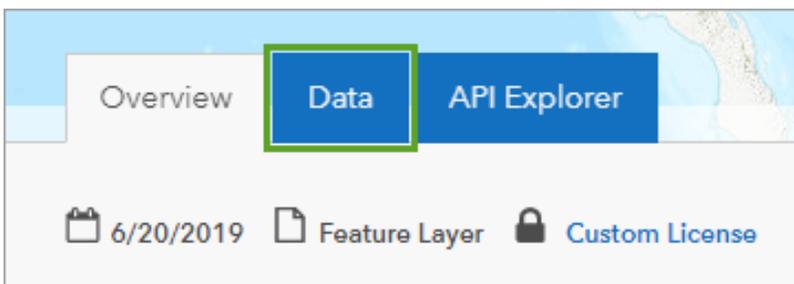
If your device is connected to the internet, your captured points are automatically sent to the feature service. If points have not been sent, a number appears in the upper right corner of the project.

9. Once satisfied, close the ArcGIS QuickCapture mobile app.

Append sample data

Next, you'll analyze the captured data in ArcGIS Online. Because you only captured a few sample points, you'll use guardrail end treatment data collected by TxDOT officials when they performed the replacement operation. You'll append this data to the guardrail maintenance layer you created.

1. Go to the [TxDOT Guardrail End Treatments page](#) on the TxDOT open data portal.
2. Click the **Data** tab.



The full dataset has 137,181 records. For the purposes of this exercise, you'll filter the results to display only X-Lite guardrail end treatment types in the Dallas area. The X-Lite type is the type that needs to be replaced.

3. For the **ET_TYPE** column, click the filter button.



Showing 1 to 10 of 137,181

OBJECTID	ET_TYPE	RB_DIRECTION
1	ET 2000	Right

The **ET_TYPE** filter appears next to the number of records.

4. Click the filter name and choose **X-Lite**.

Showing 1 to 10 of 137,181

OBJECTID	ET_TYPE
1	ET 2000
2	ET Plus
3	ET 2000
4	ET 2000
5	SKT 350
6	SKT 350

ET_TYPE

- SKT 350 (37488)
- ET Plus (31533)
- Turndown Down (26453)
- Turndown Up (15356)
- ET 2000 (8322)
- DAT (7254)
- Other (4122)
- X-Lite (3606)
- MSKT (2503)

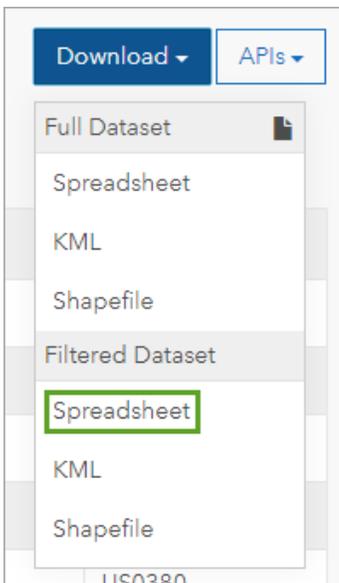
5. For the **DIST_NM** column, click the filter button. Click the filter name and choose **Dallas**.

You'll also limit the results to those found on major United States highways.

6. For the **RTE_NM** column, click the filter button. Click the filter name, type **US**, and press Enter.

The filter is applied. Only 218 records remain.

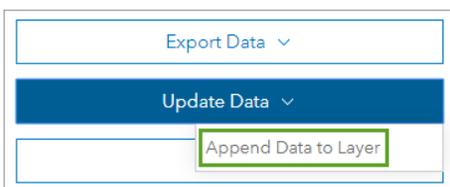
7. Click **Download**. Under **Filtered Dataset**, choose **Spreadsheet**.



The data is downloaded as a spreadsheet to your computer. Next, you'll append it to your feature layer.

8. Go to your ArcGIS organization. (If necessary, sign in.) On the ribbon, click the **Content** tab and click the name of your **Guardrail End Treatments** feature layer (not the QuickCapture project).

9. Click **Update Data** and choose **Append Data to Layer**.



The **Append Data** window appears.

10. Click **Choose File**. Browse to and double-click the **TxDOT_Guardrail_End_Treatments** spreadsheet that you downloaded.
11. Click **Upload and Continue**.

To properly append the data, you'll need to match fields from the downloaded spreadsheet to the feature layer.

12. Click **Show field matching**. For the **GuardrailEndType** field, choose **ET_TYPE**.

Append Data ?	
esrignss_pdop	<None>
esrignss_receiver	<None>
esrignss_v_rms	<None>
GuardrailEndType	ET_TYPE
Latitude	<None>

13. Match the following fields:
 - For **Latitude**, choose **Y**.
 - For **Longitude**, choose **X**.
 - For **Roadside**, choose **RB_DIRECTION**.
 - For **RouteName**, choose **RTE_NM**.

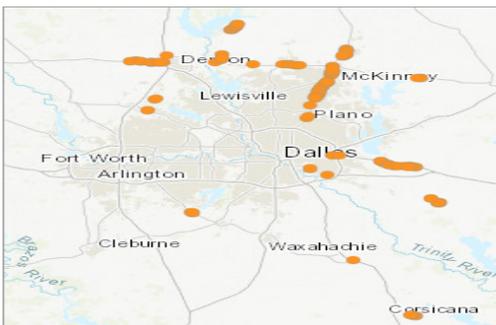
14. Click **Apply Updates**.

The data is appended.

15. On the details page, click **Open in Map Viewer**.

Your data is added to the map. It includes the appended data and the sample records you collected, but you only want to focus on the appended data.

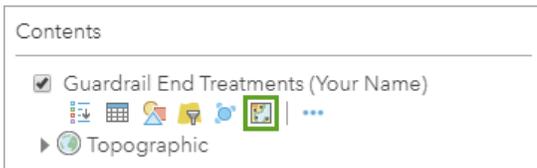
16. Navigate to Dallas, Texas.



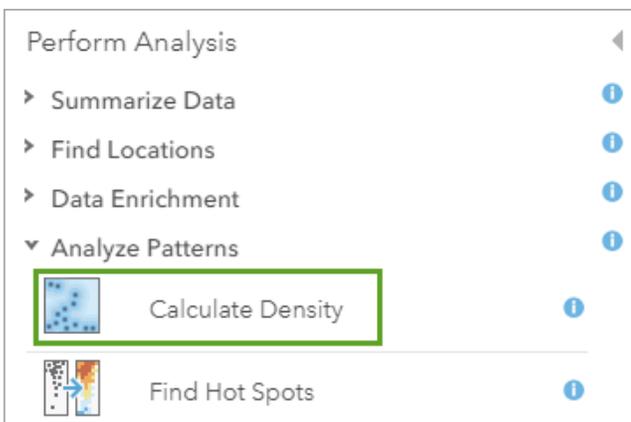
Analyze the data (Optional because it uses 0.22 credits)

Your map shows the location of X-Lite guardrail end treatments in the Dallas area. You'll analyze the density of the points to determine the locations where replacement efforts should be focused.

1. In the **Contents** pane, point to the **Guardrail End Treatments** layer and click the **Perform Analysis** button.



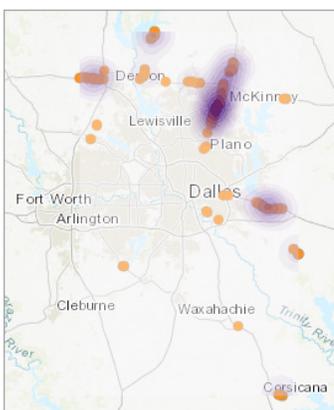
2. Expand **Analyze Patterns** and click **Calculate Density**.



The **Calculate Density** tool opens. This tool will show you where the points are most densely concentrated. You don't need to change any of the default parameters.

3. Click **Run Analysis**.

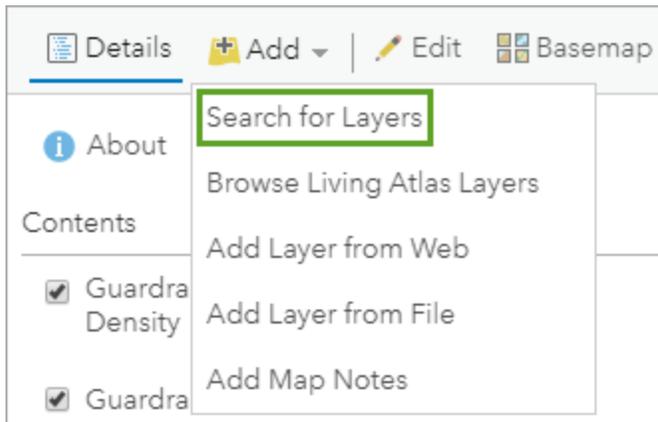
The tool runs and the **Guardrail End Treatments Density** layer is added to the map.



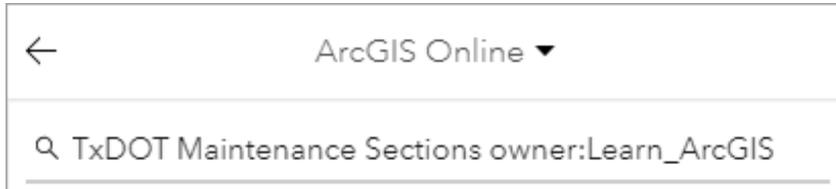
The densest locations are the darkest purple. According to your analysis, the most guardrail end treatments are located in the northeast corner of the Dallas-Fort Worth metropolitan area, near Plano and McKinney.

To determine which maintenance teams will need to be deployed for the next stage of the operation, you'll add the TxDOT maintenance sections to the map.

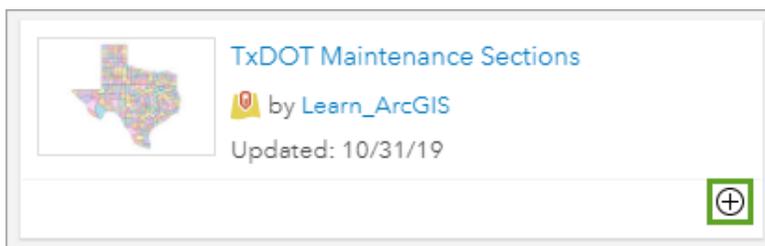
4. On the ribbon, click **Add** and choose **Search for Layers**.



5. Click **My Content** and choose **ArcGIS Online**. In the search bar, type TxDOT Maintenance Sections owner:Learn_ArcGIS and press Enter.

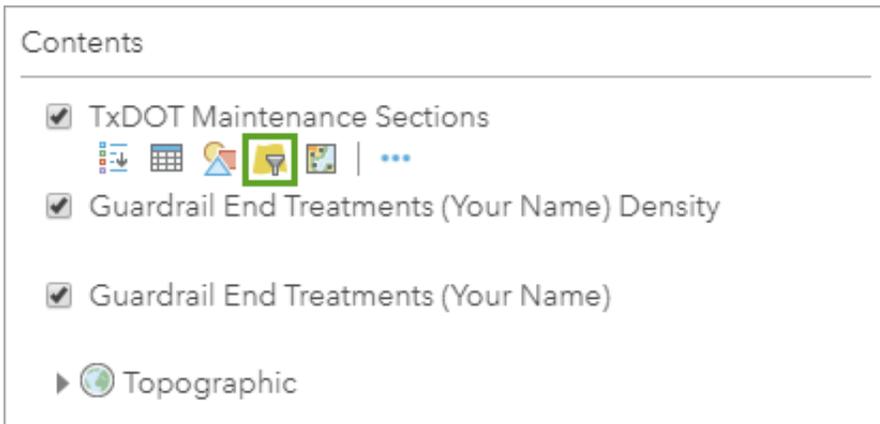


6. In the list of results, for **TxDOT Maintenance Sections**, click the **Add** button.



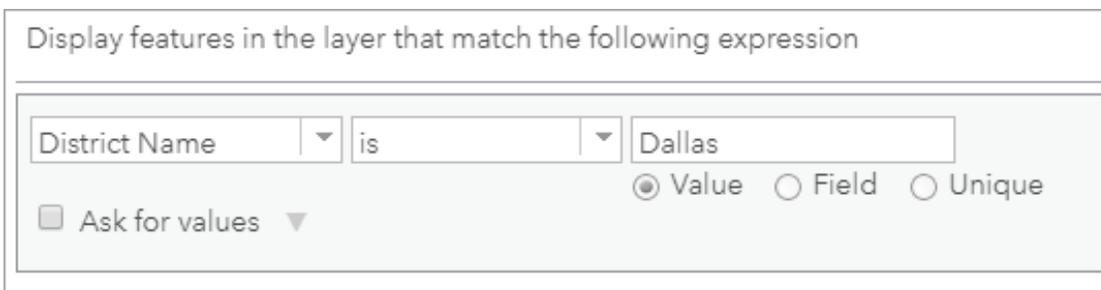
The maintenance sections are added to the map as polygons. They cover all of Texas. You'll filter the layer to only show maintenance sections in the Dallas area.

7. At the top of the pane, click the **Back** button. In the **Contents** pane, point to the **TxDOT Maintenance Sections** layer and click the **Filter** button.



The **Filter** window appears.

8. Create the expression **District Name is Dallas**.



9. Click **Apply Filter**.

Only maintenance sections in the Dallas district are displayed. According to your map, X-Lite guardrail end treatments are most densely clustered in the Collin maintenance section (the northeast section). With this information, the district manager can assign teams for further inspection.

You won't need the density layer for the rest of the workflow, but it might be useful to have in case you need to refer to it again.

10. In the **Contents** pane, uncheck the **Guardrail End Treatments Density** layer to turn it off.

11. On the ribbon, click **Save** and choose **Save As**. Save the map with the following parameters:

- For **Title**, type Guardrail End Treatments.
- For **Tags**, add the tags Texas, Dallas, and Collector.
- For **Summary**, type Information about guardrail end treatments collected by field workers.

You've created a QuickCapture project to capture guardrail end treatments in Texas. After capturing a few sample points, you created a web map using sample data and used it to determine the areas to prioritize. You've completed the reconnaissance phase. Next, you'll move to the review phase.

Manage the review phase

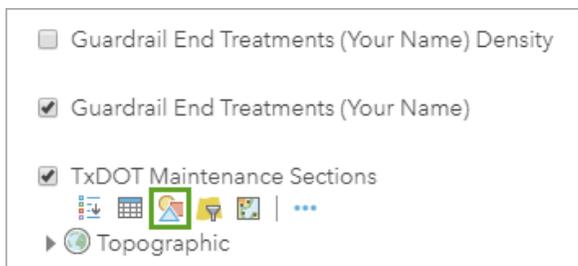
During the review phase, the TxDOT district manager requests local maintenance teams to review the results obtained during the reconnaissance stage. These maintenance teams leave their vehicles to make standing inspections of each guardrail end treatment. They validate the information collected during the reconnaissance phase and add more detailed attribute information to the point features. Ultimately, they recommend whether a guardrail end treatment should be replaced.

Configure the map

Your web map will be used in Collector to review information about each end treatment. To ensure your map is legible for your field workers, you'll configure the map.

The maintenance sections are displayed above the other data, making the map difficult to read. You'll also adjust layer symbology and add labels so the map is more readable. Then, you'll configure the layer pop-up.

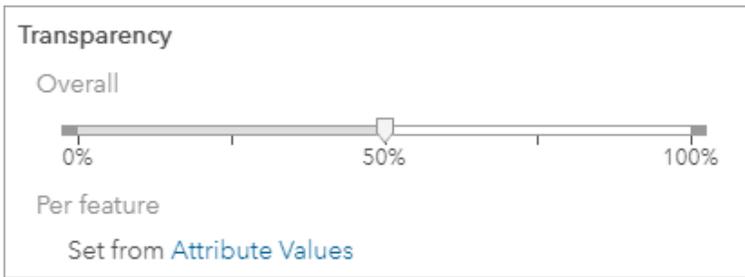
1. If necessary, open your Guardrail End Treatments web map in ArcGIS Online or ArcGIS Enterprise.
2. In the **Contents** pane, drag the **TxDOT Maintenance Sections** layer below the **Guardrail End Treatments** layer.
3. Point to the **TxDOT Maintenance Sections** layer and click the **Change Style** button.



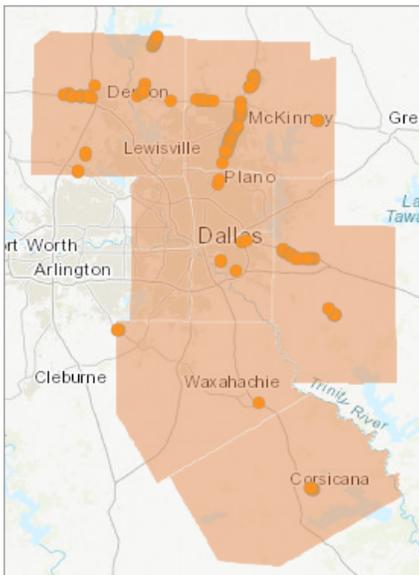
4. For **Choose an attribute to show**, choose **Office Name**. Under **Select a drawing style**, for **Location (Single symbol)**, click **Select**.

You'll add symbol transparency so the points are easier to see.

5. For **Location (Single symbol)**, click **Options**. For **Transparency**, drag the slider to about 50 percent.

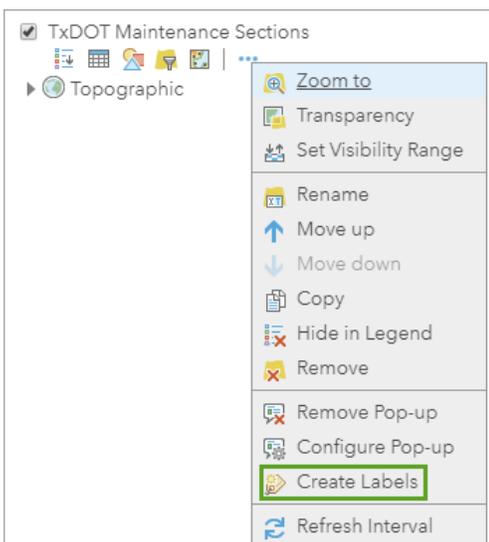


6. Click **OK**. Click **Done**.



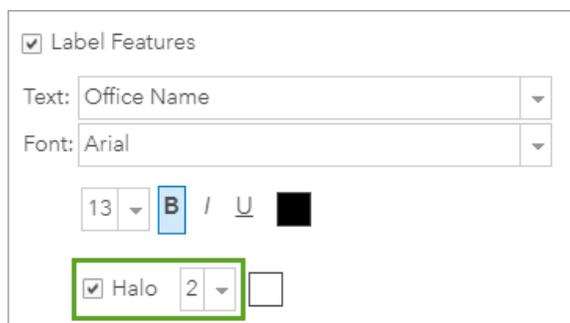
Next, you'll add labels to the maintenance sections so that the name of each office appears on the map.

7. In the **Contents** pane, point to the **TxDOT Maintenance Sections** layer. Click the **More Options** button and choose **Create Labels**.



The default labels have black text, which can be difficult to read in some areas.

- In the **Label Features** pane, check the **Halo** box. For the halo size, choose **2**.



Label Features

Text: Office Name

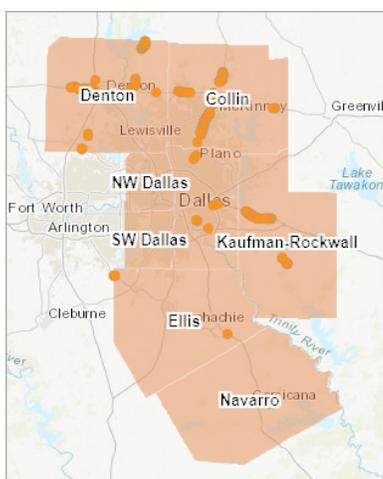
Font: Arial

13 B I

Halo 2

- Click **OK**.

The labels are applied.



The last part of your map that you'll configure is the pop-up for the **Guardrail End Treatments** layer. The pop-up determines which fields are editable in Collector for ArcGIS, which your field workers will use in the next stage of the operation (review). You'll remove fields from the pop-up that will only be used during the third stage of the operation (replacement).

- In the **Contents** pane, point to your **Guardrail End Treatments** layer. Click the **More Options** button and choose **Configure Pop-up**.
- In the **Configure Pop-up** pane, for **Pop-up Contents**, click **Configure Attributes**.

Pop-up Contents

Display:

These field attributes will display:

- Receiver Name {esrignss_receiver}
- Horizontal Accuracy (m) {esrignss_h_rms}
- Vertical Accuracy (m) {esrignss_v_rms}
- Latitude {esrignss_latitude}

Configure Attributes

Show feature attachments as links

Show when last edited

The **Configure Attributes** window appears. This window lists all of the layer's attribute fields and indicates which are displayed in the pop-up and which can be edited.

12. In both the **Display** and **Edit** columns, uncheck the following fields:

- o **Date of Replacement**
- o **Status of Replacement**
- o **Additional Comments**

<input type="checkbox"/> Display	<input type="checkbox"/> Edit	Field Name	Field Alias
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	{Direction}	Direction of Travel
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	{Priority}	Priority
<input type="checkbox"/>	<input type="checkbox"/>	{ReplacementDate}	Date of Replacement
<input type="checkbox"/>	<input type="checkbox"/>	{ReplacementStatus}	Status of Replacement
<input type="checkbox"/>	<input type="checkbox"/>	{AdditionalComments}	Additional Comments

13. Click **OK**. In the **Configure Pop-up** pane, click **OK**.

14. Save the map.

Edit features in Collector

The maintenance teams will use Collector for ArcGIS to validate and edit attribute information for each feature. Collector is a mobile data collection app that provides more detailed collection than QuickCapture. As such, it's useful for the local maintenance teams who will perform in-depth inspections of the guardrail end treatments.

You'll open your web map in Collector and perform an inspection of one of the previously captured points.

1. Open Collector for ArcGIS on your Android, iOS, or Windows 10 device.

Note:

If you don't have Collector for ArcGIS, it is available for free on [Google Play](#) or [Amazon](#) for Android devices, the [App Store](#) for iPad and iPhone, and [Microsoft](#) for Windows 10 devices.

2. Sign in with your ArcGIS or ArcGIS Enterprise account.

After you sign in, a list of web maps appears. These are all the maps to which you have access that have editable data.

Note:

Depending on the device you use to access Collector, your interface may differ from the example images.

3. Click your **Guardrail End Treatments** map.
4. If you receive a notification asking you to allow Collector for ArcGIS to access your location, click **Allow**.

The map opens to your current location. This location is probably not Dallas, Texas.

5. On the toolbar, click the search button. (It may look different than the example image.)



6. Search for Dallas and navigate to Dallas, Texas.

Next, you'll perform an inspection.

7. On the map, tap any point (zoom in if necessary).

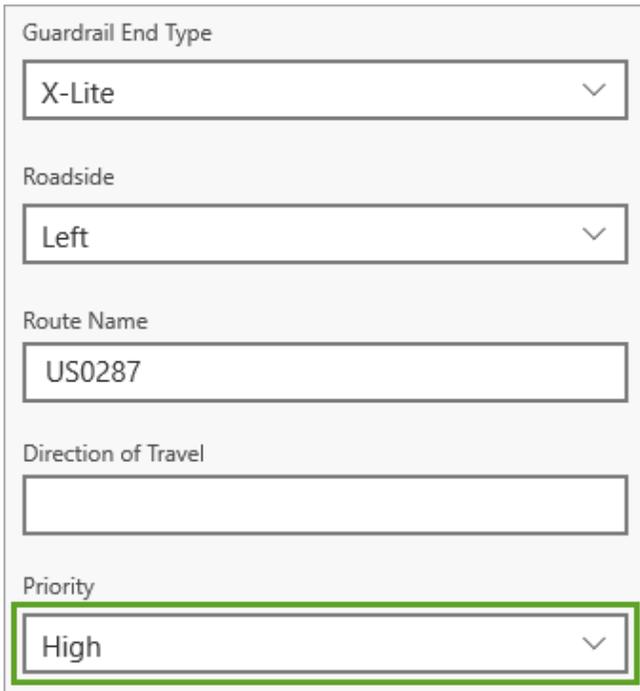
A form appears. Your maintenance teams will edit the **Priority** entry. In this operation, all X-Lite guardrail end treatments must be replaced. They will all have a high priority.

8. Click the edit button.



The fields become editable.

9. For **Priority**, choose **High**.



Guardrail End Type

X-Lite

Roadside

Left

Route Name

US0287

Direction of Travel

Priority

High

10. On the ribbon, click **Submit**.



The changes to the feature are saved. Next, your field workers inspect a guardrail end treatment and discover that it was identified on the wrong side of the road. They'll edit the attributes accordingly.

11. On the map, click any point. Click the edit button.
12. For **Roadside**, change the value either from **Right** to **Left** or **Left** to **Right**. For **Priority**, choose **High**.
13. Click **Submit**. (Edit at least two points to show)

Changes can also be made to the **Guardrail End Type**, **Route Name**, or **Direction of Travel** attributes.

14. Close Collector.

You've conducted a review of the QuickCapture points using Collector. After the review phase is completed, the replacement phase of the operation can begin.

Break Time 10 min

This next part of the exercise will be done together by instructor

Manage the replacement phase

Once the teams assigned to review each guardrail end treatment have made their recommendations, the replacement phase begins. In this phase, end treatments are assigned in batches to contractors for replacement. Once contractors have replaced an end treatment, they'll complete a form in Survey123 for ArcGIS to record when the replacement was completed and what type of end treatment was used in the replacement.

Unlike Collector, which is primarily map-based, Survey123 uses digital forms. It's useful for field workers who may not have GIS expertise, such as the independent contractors who will manage the replacements. You'll create the Survey123 form that the contractors will use.

Create a survey

Your survey will consist of questions that will inform TxDOT when replacements took place and what type of guardrail end treatment was installed. You'll create the survey using the Survey123 Connect desktop app. The survey will then be used in the Survey123 field app.

1. Open the Survey123 Connect desktop app.

Note:

If you don't have Survey123 Connect, you can download it from the [Survey123 for ArcGIS resources page](#). Under **Get Survey123**, under **Survey123 Connect**, click the download link for your desktop operating system. Run the downloaded installer and follow the instructions in the setup wizard.

2. Click **Sign In**. Sign in using your ArcGIS or Enterprise account.
3. Click **New Survey**.

The **New Survey** window appears.

4. For **Title**, type Guardrail End Treatments.

Title
Guardrail End Treatments
Table name will be: Guardrail_End_Treatments

While you can base the survey on a template, you'll base your survey on your **Guardrail End Treatments** feature layer.

5. For **Select an initial XLSForm design**, choose **Feature Service**. Search for and choose your **Guardrail End Treatments** layer.

Select an initial XLSForm design

- Templates
- Samples
- Community
- My Surveys
- My Organization
- Feature Service
- File

Guardrail End Treatments

Guardrail End Treatments (Your Name)

Modified: Wednesday, October 30, 2019 11:50:17 AM

Type: Feature Service

Owner:

Access: private

6. Click **Create Survey**.

The survey is created. In Survey123 Connect, a preview of the survey form appears. Also, a spreadsheet opens. Spreadsheets are the editing environment for Survey123 Connect surveys, with each survey question listed in a spreadsheet row.

By default, the survey contains all the fields in the feature layer. You'll edit the form to remove fields that the contractors don't need, such as fields that were used in other stages of the operation.

7. In the spreadsheet, delete the rows with the following labels:
 - **Receiver Name**
 - **Horizontal Accuracy (m)**
 - **Vertical Accuracy (m)**
 - **Latitude**
 - **Longitude**
 - **Altitude**
 - **PDOP**
 - **Roadside**
 - **Direction of Travel**
 - **Priority**
 - **Position Source Type**
 - **Image**

The survey now has only six fields: **Point**, **Guardrail End Type**, **Route Name**, **Date of Replacement**, **Status of Replacement**, and **Additional Comments**.

	A	B	C
1	type	name	label
2			
3	geopoint	GuardrailEnds_point	Point
4	select_one GuardrailEr	GuardrailEndType	Guardrail End Type
5	text	RouteName	Route Name
6	dateTime	ReplacementDate	Date of Replacement
7	select_one GuardrailEr	ReplacementStatus	Status of Replacement
8	text	AdditionalComments	Additional Comments
9			

The **Point** and **Route Name** fields provide the geographic location of the guardrail end treatments. While contractors need to be able to see this information, they should not be able to change it, because you already confirmed the location during the review phase. You'll make these fields read-only.

- For the **Point** and **Route Name** rows (rows 3 and 5), in the **readonly** column (column K), choose **yes**.

	C	K
1	label	readonly
2		
3	Point	yes
4	Guardrail End Type	
5	Route Name	yes
6	Date of Replacement	

To make best use of screen width, you'll format the **Guardrail End Type** question so that the five types are displayed horizontally.

- For the **Guardrail End Type** row (row 4), in the **appearance** column (column I), choose **horizontal**.

	C	I
1	label	appearance
2		
3	Point	
4	Guardrail End Type	horizontal
5	Route Name	

- Save the spreadsheet.

When you save the spreadsheet, the Survey123 Connect preview automatically updates to reflect the changes.

Guardrail End Treatments (Your Name)

Point
 34°3'N 117°11'W ± 22312 m



Guardrail End Type *
 X-Lite ET Plus ET 2000 SoftStop Other

Route Name

Date of Replacement
 Date Time

Status of Replacement
 Not Started
 In Progress
 Successful Completion

Additional Comments

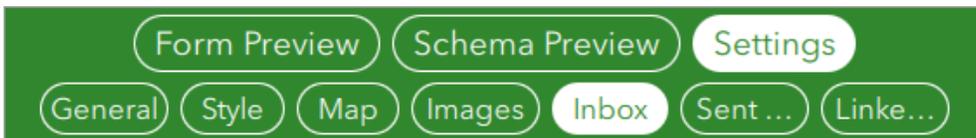
✓

Note:

The location of the point in your survey preview may differ from the example image.

By default, Survey123 is designed for capturing new records. In your operation, contractors will be editing existing records. You'll enable the inbox for editing existing survey data.

11. On the ribbon, click **Settings**. Click **Inbox**.



12. For **Inbox mode**, choose **Enabled**.

The Inbox settings are used to configure editing of existing survey data retrieved from the server.

Inbox mode

Enabled - The Inbox folder will be available for this survey ▼

You can set a query so that contractors only receive certain records as surveys. Your query will ensure that they only receive records with a high priority for replacement.

13. For **Query expression**, type `Priority='High'`.

Query expression (where clause)

Priority='High' ✕

Your survey is ready to be published.

14. Click **Publish**.



15. In the **Publish Survey** window, click **Publish Survey**. After the survey is published, click **Ok**.

16. Close Survey123 Connect and the spreadsheet.

Record replacement information

Next, you'll use the Survey123 field app to record a sample replacement.

1. Open the Survey123 field app on either your Android or iOS mobile device or on your Windows 10 operating system.

Note:

If you don't have the Survey123 field app, you can download it for free as a mobile app from the [App Store](#), [Google Play](#), or [Amazon](#). Alternatively, you can download it for free as a desktop app from the [Survey123 for ArcGIS resources page](#).

2. Click **Sign In**. Sign in using your ArcGIS or Enterprise account.

Once you sign in, a list of your downloaded surveys appears.

3. Click **Get Surveys**.
4. Search for Guardrail End Treatments. For your **Guardrail End Treatments** survey, click the download button.

Note:

Depending on the device you use to access Survey123, your interface may differ from the example images. The example images were captured using the desktop app.

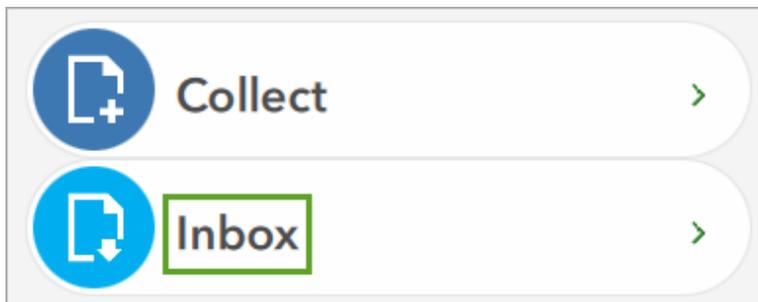


A message appears, informing you that the download is completed.

5. Click **Ok**. On the ribbon, click the back arrow.

You return to your list of surveys.

6. Click the **Guardrail End Treatments** survey.
7. Click **Inbox**.



A message appears, informing you that the inbox is empty.

8. Click **Refresh**.

The inbox is refreshed. All records that were assigned high priority in Collector are listed.

9. Click the first record.

Your contractors will record the new guardrail end type and the date and time of replacement.

10. For **Guardrail End Type**, choose **ET Plus**. For **Date of Replacement**, choose the current date and time.

Guardrail End Type *

X-Lite
 ET Plus
 ET 2000

SoftStop
 Other

Route Name

US0287

Date of Replacement

11. For **Status of Replacement**, choose **Successful Completion**. Optionally, for **Additional Comments**, write a comment.
12. At the bottom of the survey, click the submit button (the check mark).



13. Click **Send Now**. (If your device is offline, you'll only have the option to send later, when your device is online.)

The record is sent and you return to the inbox. You can follow the same process to complete the remaining high priority records, if there are any.

14. Close Survey123.

You've created a survey for your contractors to use to record guardrail end treatment replacements. With this survey, you've completed all three stages of the operation. Next, you'll display the results.

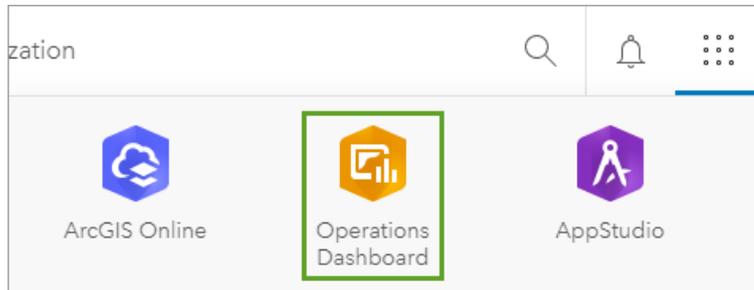
Display the results

Now that the operation is complete, you'll display the results using Operations Dashboard for ArcGIS. A dashboard can include a map, charts, and other data, even when that data is updated in real time. Your dashboard will display an overview of the entire operation, including the locations of X-Lite guardrail end treatments in the Dallas area, the number of end treatments that have been replaced, and the total number of end treatments.

Add a map

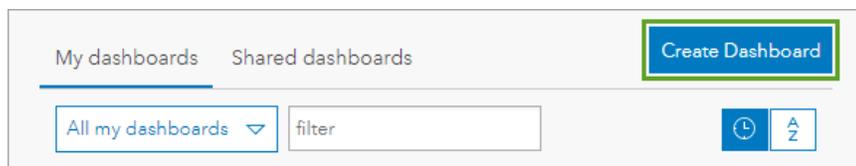
First, you'll open Operations Dashboard and begin a new dashboard. Then, you'll add your web map.

1. Sign in to your [ArcGIS organizational account](#) or into ArcGIS Enterprise using a named user account.
2. On the ribbon, click the **App Launcher** button and choose **Operations Dashboard**.



Your Operations Dashboard home page appears. It contains a list of all of your dashboards.

3. Click **Create Dashboard**.

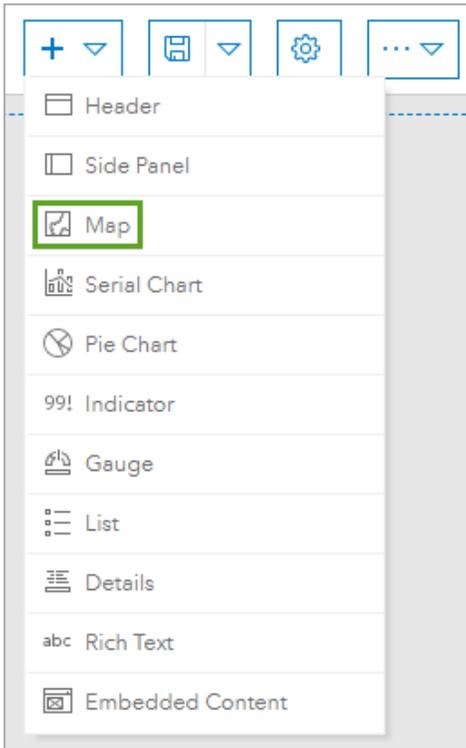


The **Create new dashboard** page appears.

4. Enter the following information:
 - o For **Title**, type Guardrail End Treatments.
 - o For **Tags**, add the tags Survey123, Collector, QuickCapture, Texas, and Department of Transportation.
 - o For **Summary**, type This dashboard displays the results of the guardrail end treatment replacement project. It displays a map showing the guardrail end treatments, their type, and replacement status.
5. Click **Create Dashboard**.

The dashboard is created. It is currently empty. First, you'll add the web map you created that shows the locations of X-Lite guardrail end treatments in the Dallas area.

6. On the ribbon, click the add button and choose **Map**.

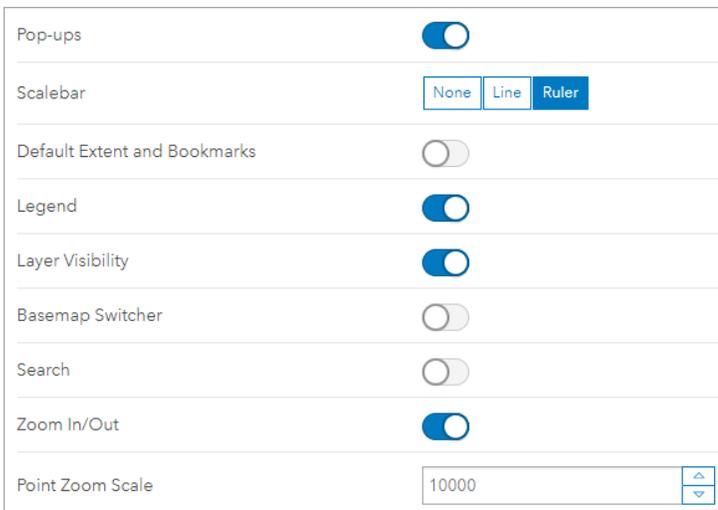


A list of your maps appears. (You can also add a map that is shared with you, even if you did not create it.)

7. Click the thumbnail of your **Guardrail End Treatments** web map.

Options for the map's settings appear. You'll add a scale bar and other basic map functionality.

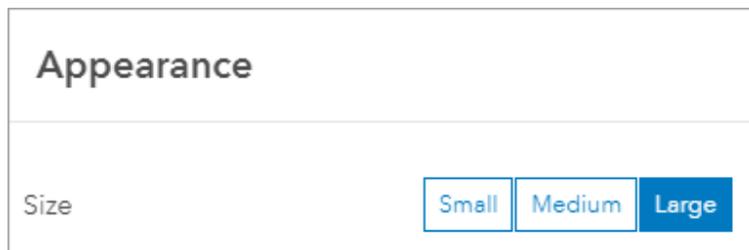
8. For **Scalebar**, choose **Ruler**. Turn on the **Legend**, **Layer Visibility**, and **Zoom In/Out** options.



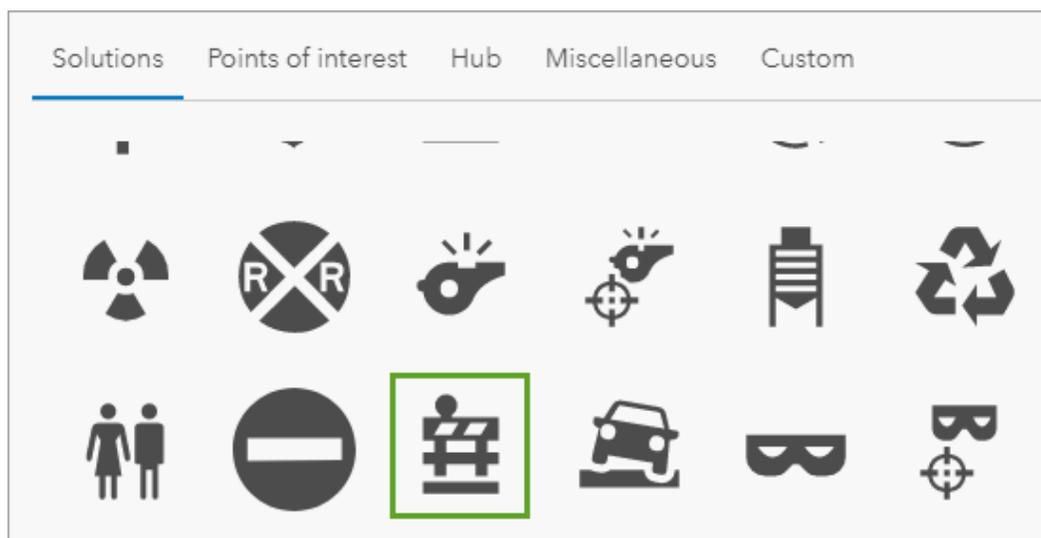
9. Click **Done**.

You return to your dashboard. Your map has been added. Before you continue, you'll add a header with the title of your dashboard.

10. Click the add button and choose **Header**.
11. Under **Appearance**, for **Size**, choose **Large**.

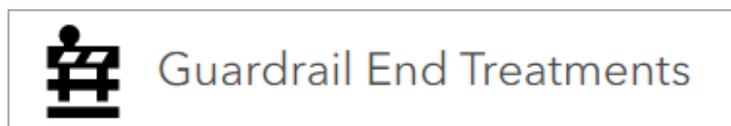


12. For **Logo Type**, choose **Icon**. In the list of icons, scroll down and choose the guardrail icon (or any icon you think is appropriate.)



13. Click **Done**.

The header is added to the dashboard.



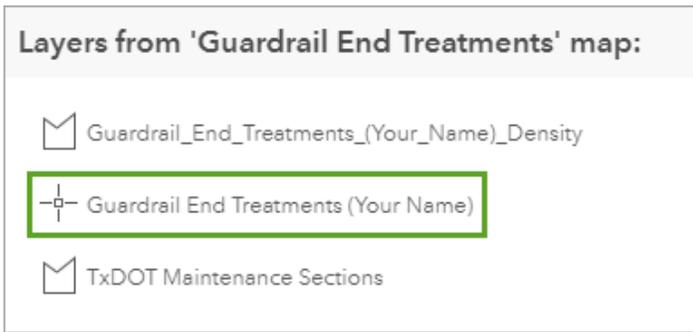
Add an indicator

Next, you'll add an indicator. An indicator displays the total number of features in a layer you choose. Your indicator will show the total number of guardrails recorded by your feature layer.

1. Click the add button and choose **Indicator**.

You're prompted to choose a layer.

2. Click the **Guardrail End Treatments** layer.



Options for configuring the indicator appear, alongside a preview of the indicator. Currently, the indicator only contains the number of features in the layer. You'll add explanatory text.

3. Click the **Indicator** tab.



4. For **Top Text**, type Total Number of Guardrail End Treatments. For **Bottom Text**, type in Dallas.

The preview automatically updates with the text. (Your feature layer may have a different number than the example image.)



5. Click **Done**.

The indicator is added to the dashboard. By default, it takes up half the screen and is much larger than it needs to be. You'll leave its size unchanged for now. Once you add all the elements of your dashboard, you'll resize them appropriately.

Add a gauge

Next, you'll add a gauge. This gauge will show the total number of X-Lite guardrail end treatments replaced in the area.

1. Click the add button and choose **Gauge**.

As with the indicator, you're prompted to choose a layer on which the gauge will be based.

2. Click the **Guardrail End Treatments** layer.

Next, you'll configure the gauge. You'll create a filter so that the gauge shows features that have had their replacement status set to **Successful Completion**.

3. Under **Data Options**, for **Filter**, click the **Filter** button.

Data Options Show data table

Value

Layer: Guardrail End Treatments (Your Name) Change

Filter + Filter

Value Type Statistic Feature

4. For **Field for the condition**, choose **Status of Replacement**. For **Select a value**, choose **Successful Completion**.

Filter

Status of Replacement coded string ▼ 🗑️

equal ▼

Value Field

Successful Completion ▼

AND OR

Currently, the maximum value displayed in the gauge is a fixed value of 100. You'll change the maximum value to show the total count of guardrail end treatments.

5. Under **Data Options**, under **Maximum Value**, for **Value Type**, click **Statistic**.

Maximum Value

Value Type

Layer: Guardrail End Treatments (Your Name)

You'll also display the number of end treatments that have been replaced as a percentage.

6. Click the **Gauge** tab.

Data

Gauge

General

7. Under **Value**, turn on **As Percentage**.

Value

As Percentage

Percentage Pattern

8. Click the **General** tab. For **Title**, click **Edit**.

Data

General Options

Gauge

General

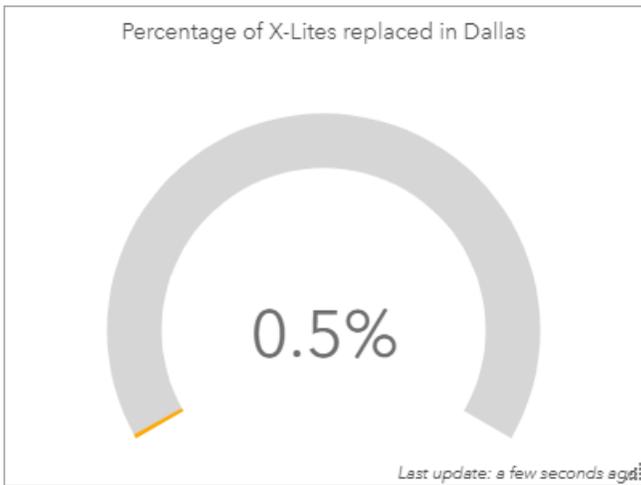
Name

Title

Description

9. Type Percentage of X-Lite end treatments replaced in Dallas. Center the text.

The preview updates to show the configured gauge. (Your percentage may differ from the example image.)



10. Click **Done**.

The gauge is added to the dashboard. As with the indicator, it is much larger than it needs to be, but you'll resize it later.

Add a chart

The final element you'll add to the dashboard is a pie chart. This pie chart will show the percentage of guardrail end treatments per route.

1. Click the add button and choose **Pie Chart**. In the list of layers, click the **Guardrail End Treatments** layer.
2. Under **Data Options**, for **Category Field**, choose **Route Name**.

Data Options		Show data table
Layer: Guardrail End Treatments (Your Name)		Change
Filter	+ Filter	
Categories From	Grouped Values Features Fields	
Category Field	Route Name	
Statistic	Count	
Sort By	+ Sort	

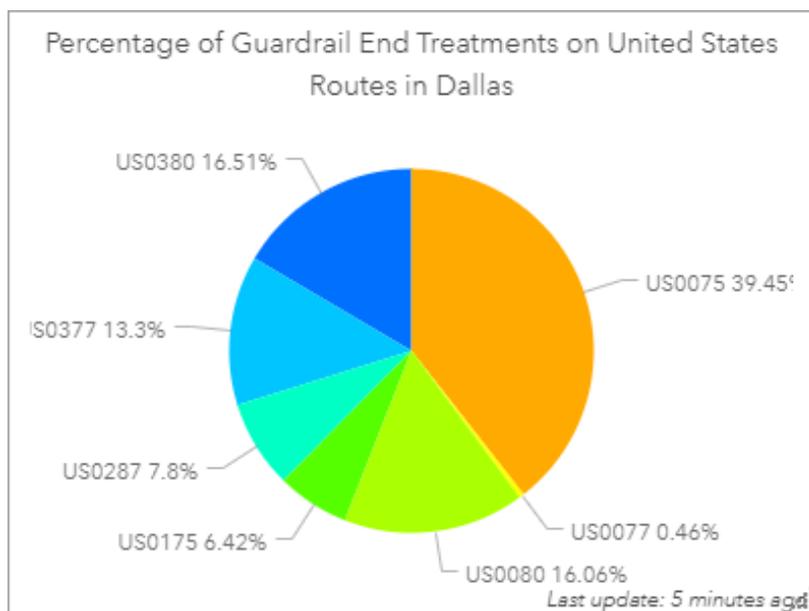
The preview updates to include a pie chart with the percentage of guardrail end treatments per route. Next, you'll add explanatory text.

3. Click the **General** tab. For **Title**, click **Edit**.
4. Type **Percentage of Guardrail End Treatments on United States Routes in Dallas**. Center the text.

Tip:

Optionally, you can change the colors of the slices in the pie chart. Click the **Slices** tab. For each slice, click the color and change it to the color you want.

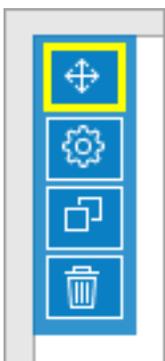
The preview displays the completed pie chart. (Your numbers may differ from the example image.)



5. Click **Done**.

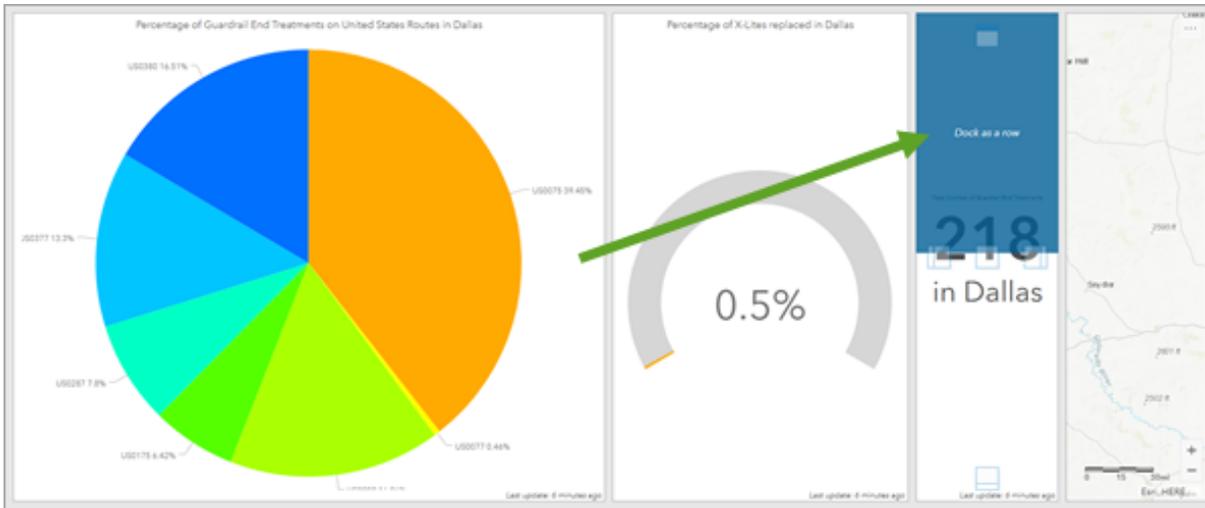
The pie chart is added to the dashboard. Next, you'll rearrange and resize dashboard elements.

6. Point to the upper left corner of the pie chart element. Drag the **Drag item** button.



The element moves.

7. Dock the pie chart element above the indicator element.

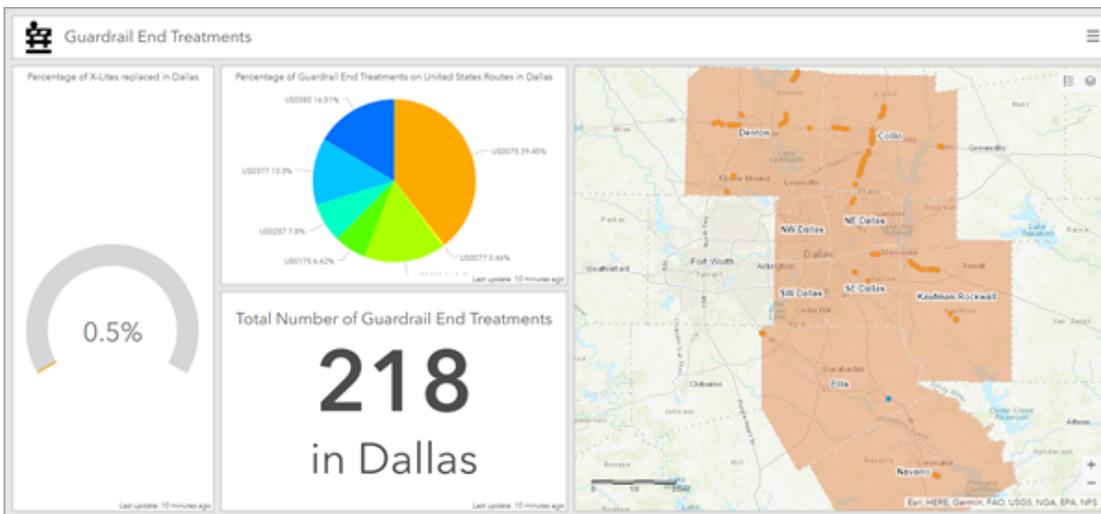


8. Point to the vertical bar between the gauge element and the pie chart and indicator elements. Drag the bar to the left to decrease the size of the gauge element.

9. Drag the vertical bar between the map element and the pie chart and indicator elements to increase the size of the map.

10. Pan and zoom the map so that the data is in the center of the map element.

Your dashboard is reorganized to better display all the elements.



11. On the ribbon, click the save button.



You've created a dashboard that shows a summary of the guardrail end treatments that have been assessed and replaced. This dashboard will update in real time as field workers capture points, complete reviews, and track replacements using QuickCapture, Collector, or Survey123.

In this lesson, you undertook a massive operation to replace guardrail end treatments in Texas. You created a feature layer to contain the end treatment data and used it in conjunction with several field apps to manage all stages of the operation. The three mobile apps you used (QuickCapture, Collector, and Survey123) can work concurrently or separately to produce accurate results. The data captured by these apps can be summarized and shared in apps such as Operations Dashboard to keep managers and stakeholders informed. Overall, this lesson provided you a broad view of the capabilities of several ArcGIS apps.

You can find more lessons in the [Learn ArcGIS Lesson Gallery](#).