

Sharing content on the Web

Student Edition

Copyright © 2022 Esri
All rights reserved.

Course version 3.0. Version release date December 2022.

Printed in the United States of America.

The information contained in this document is the exclusive property of Esri. This work is protected under United States copyright law and other international copyright treaties and conventions. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or by any information storage or retrieval system, except as expressly permitted in writing by Esri. All requests should be sent to Attention: Contracts and Legal Services Manager, Esri, 380 New York Street, Redlands, CA 92373-8100 USA.

EXPORT NOTICE: Use of these Materials is subject to U.S. export control laws and regulations including the U.S. Department of Commerce Export Administration Regulations (EAR). Diversion of these Materials contrary to U.S. law is prohibited.

The information contained in this document is subject to change without notice.

US Government Restricted/Limited Rights

Any software, documentation, and/or data delivered hereunder is subject to the terms of the License Agreement. The commercial license rights in the License Agreement strictly govern Licensee's use, reproduction, or disclosure of the software, data, and documentation. In no event shall the US Government acquire greater than RESTRICTED/ LIMITED RIGHTS. At a minimum, use, duplication, or disclosure by the US Government is subject to restrictions as set forth in FAR §52.227-14 Alternates I, II, and III (DEC 2007); FAR §52.227-19(b) (DEC 2007) and/or FAR §12.211/ 12.212 (Commercial Technical Data/Computer Software); and DFARS §252.227-7015 (DEC 2011) (Technical Data - Commercial Items) and/or DFARS §227.7202 (Commercial Computer Software and Commercial Computer Software Documentation), as applicable. Contractor/Manufacturer is Esri, 380 New York Street, Redlands, CA 92373-8100, USA.

@esri.com, 3D Analyst, ACORN, Address Coder, ADF, AML, ArcAtlas, ArcCAD, ArcCatalog, ArcCOGO, ArcData, ArcDoc, ArcEdit, ArcEditor, ArcEurope, ArcExplorer, ArcExpress, ArcGIS, ArcGlobe, ArcGrid, ArcIMS, ARC/INFO, ArcInfo, ArcInfo Librarian, ArcLessons, ArcLocation, ArcLogistics, ArcGIS Pro , ArcNetwork, ArcNews, ArcObjects, ArcOpen, ArcPad, ArcPlot, ArcPress, ArcPy, ArcReader, ArcScan, ArcScene, ArcSchool, ArcScripts, ArcSDE, ArcSdi, ArcSketch, ArcStorm, ArcSurvey, ArcTIN, ArcToolbox, ArcTools, ArcUSA, ArcUser, ArcView, ArcVoyager, ArcWatch, ArcWeb, ArcWorld, ArcXML, Atlas GIS, AtlasWare, Avenue, BAO, Business Analyst, Business Analyst Online, BusinessMAP, CityEngine, CommunityInfo, Database Integrator, DBI Kit, EDN, Esri, Esri—Team GIS, Esri—The GIS Company, Esri—The GIS People, Esri—The GIS Software Leader, FormEdit, GeoCollector, Geographic Design System, Geography Matters, Geography Network, GIS by Esri, GIS Day, GIS for Everyone, GISData Server, JTX, MapIt, Maplex, MapObjects, MapStudio, ModelBuilder, MOLE, MPS—Atlas, PLTS, Rent-a-Tech, SDE, SML, Sourcebook America, SpatialLABS, Spatial Database Engine, StreetMap, Tapestry, the ARC/INFO logo, the ArcGIS logo, the ArcGIS Explorer logo, the ArcPad logo, the Esri globe logo, the Esri Press logo, the GIS Day logo, the MapIt logo, The Geographic Advantage, The Geographic Approach, The World's Leading Desktop GIS, Water Writes, www.arcgis.com, www.esri.com, www.geographynetwork.com, www.gis.com, www.gisday.com, and Your Personal Geographic Information System are trademarks, service marks, or registered marks in the United States, the European Community, or certain other jurisdictions. CityEngine is a registered trademark of Procedural AG and is distributed under license by Esri.

Other companies and products or services mentioned herein may be trademarks, service marks or registered marks of their respective mark owners.

Course introduction

Introduction	i
Course goals	i
Additional resources	i
Installing the course data	i
Icons used in this workbook	iii
Understanding the ArcGIS Platform	iv

1 Sharing GIS resources online

Lesson introduction	1-1
Sharing content	1-3
Facilitating collaboration	1-4
What kinds of content can you share?	1-5
With whom do you want to share?	1-8
Esri-hosted or self-hosted content	1-9
ArcGIS services	1-10
Web maps	1-11
Exploring ArcGIS Online	1-12
How is your data best represented?	1-13
Exercise 1: Create a web map	1-15
Sign in to ArcGIS Online	1-16
Create a web map	1-16
Configure layers	1-19
Save and share map	1-21
Lesson review	1-24

2 Authoring operational content

Lesson introduction	2-1
Preparing operational content	2-2
Feature service vs. map service	2-3
Publishing a feature service to ArcGIS Online	2-5
ArcGIS Pro Sharing tool and Analyzer	2-6
Publishing a feature service to ArcGIS for Server	2-9
Sharing operational content	2-10
Using services	2-11
Authoring and using web map layers	2-12
Exercise 2: Publish and use feature services in a web map	2-14
Prepare an operational layer for sharing	2-15
Publish a hosted feature layer	2-16
Resolve results of analysis	2-17
Prepare another operational layer for sharing	2-19
Publish a map service	2-20
Resolve results of analysis	2-21
Add your published services to web map	2-22

Configure the web map	2-23
Lesson review	2-25

3 Creating web apps

Lesson introduction	3-1
Configuring feature services to support editing.....	3-2
Web maps to web apps	3-5
Sharing editable maps and applications	3-7
Building your own web apps.....	3-8
Other apps	3-9
Creating a custom Web AppBuilder app	3-10
Exercise 3: Create an editable web app.....	3-11
Allow editing for hosted feature service	3-12
Consume web map in web app	3-13
Use web app to perform edits	3-16
Lesson review	3-18

4 Authoring basemap content

Lesson introduction	4-1
Sharing basemap content with ArcGIS for Desktop.....	4-3
Caching workflow: Plan	4-5
Determining scales for caching	4-8
Caching workflow: Design.....	4-9
Preparing basemap layers	4-11
Caching workflow: Test cache	4-12
Publishing a map service	4-14
Caching workflow: Build cache	4-15
Exercise 4: Build a cache for the Esri campus	4-18
Prepare the basemap	4-19
Publish a tile map to ArcGIS Online.....	4-20
Test the tile map	4-24
Generate a tile package to create a tile layer.....	4-25
Examine your tile layer created from tile Package in ArcGIS Online	4-27
Update tiles	4-29
Lesson review	4-30

Appendices

Appendix A: Answers to lesson review questions	A-1
--	-----

Introduction

Welcome to ArcGIS 4: Sharing Content on the Web. In this course, you will learn how to turn your authoritative GIS data, workflows, and maps into ArcGIS services that can be published to ArcGIS Online, ArcGIS for Server, or Portal for ArcGIS.

Course goals

By the end of this course, you will be able to:

- Publish content (such as maps, imagery, and geoprocessing tools) using ArcGIS.
- Create web maps using existing map services.
- Access services and web maps using different clients.

Additional resources

ArcGIS Resources - www.arcgis.com

This site provides unified access to web-based help, online content, and technical support.

Esri GIS Dictionary - <https://esri.acrolinx-iq.com/termbrowser/translationview.html>

This dictionary includes definitions for GIS terms related to geodata, analysis, GIS modeling and web-based GIS, cartography, and Esri software.

Installing the course data

Some exercises in this workbook require data. Depending on the course format, the data is available on a DVD in the back of a printed workbook or as a data download. To install the data, place the DVD in your disc drive or double-click the data download and follow the instructions in the installation wizard. The data will automatically be installed in the C:\Student folder.



DISCLAIMER: Some courses use sample scripts or applications that are supplied either on the DVD or on the Internet. These samples are provided "AS IS," without warranty of any kind, either express or implied, including but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or noninfringement. Esri shall not be liable for any damages under any theory of law related to the licensee's use of these samples, even if Esri is advised of the possibility of such damage.

Icons used in this workbook



Notes point out additional information, exceptions, or special circumstances that apply to a particular topic or procedure.



Tips provide brief help for performing a task or clarifying concepts.



External resources provide optional, special-interest information about course topics.



Best practices offer industry or professional guidelines, help set goals or priorities, and save time.



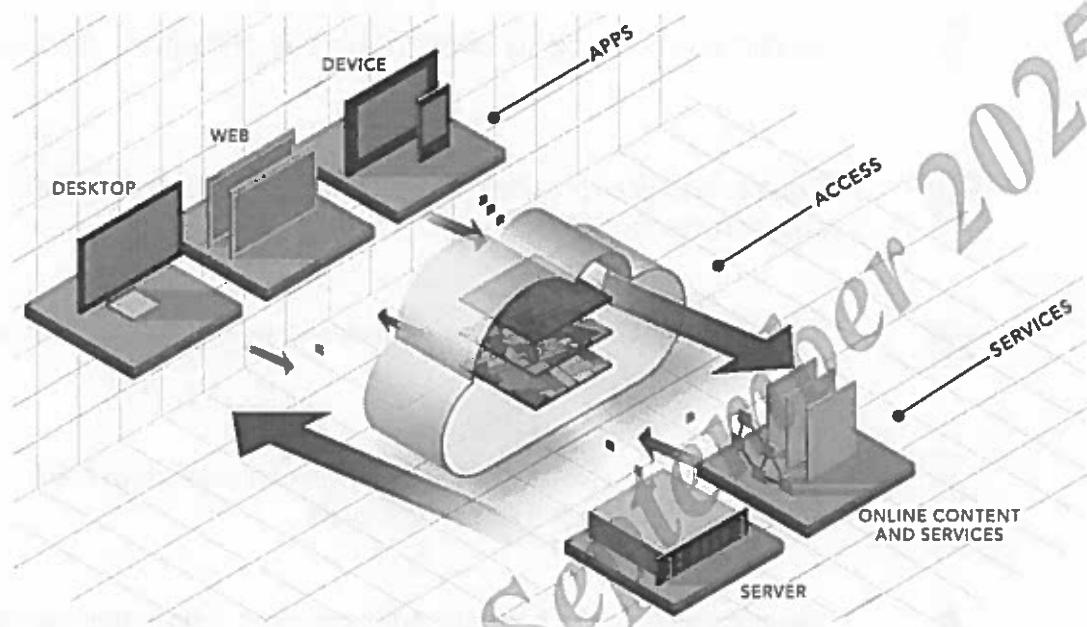
Estimated times provide guidance on approximately how many minutes an exercise will take to complete.



Warnings alert you to potential problems or to actions that should be avoided.

Understanding the ArcGIS Platform

ArcGIS enables employees throughout an organization and the general public to discover, use, make, and share maps—from any device, anywhere, at any time. The platform includes ArcGIS for Desktop, ArcGIS Online, and ArcGIS for Server.



ArcGIS for Desktop

Where GIS professionals work with apps including ArcGIS Pro and ArcGIS Pro to create authoritative geographic data, maps, tools, and analytical models that can be shared as services. The desktop apps provide powerful capabilities for spatial analysis, 3D modeling, image management, and more.

ArcGIS Online

Where knowledge workers, executives, and members of the public collaborate and do self-service mapping using desktops, tablets, or smartphones. ArcGIS Online includes rich content and focused apps that add geographic insight to all types of projects.

ArcGIS for Server

Where IT and GIS professionals manage, secure, and share geographic content as services that can be consumed in desktop, web, and mobile apps. ArcGIS for Server connects with relational database management systems and supports on-premise, cloud, virtual, and hybrid deployments.

50

1

11

1

Sharing GIS resources online

Introduction

Key terms
hosted services
services
web map

Collecting and creating GIS content represents significant effort and expense for you and your organization. Being able to share geographic information with diverse audiences is crucial for dissemination and collaboration efforts. Often, sharing maps and other GIS resources with individuals who may not have the same GIS experience can be a hindrance to effective collaboration. ArcGIS is a platform that provides tools to not only create GIS content, but to effortlessly share your content with broad communities of users in an online framework hosted by Esri. In turn, your rich set of authoritative information is available to a nearly unlimited array of devices and applications, and anyone with access to a web browser.

When sharing a map online, you want users to be able to intuitively navigate and interpret the geographic information that you have provided. Therefore, you will initially focus on basic mapping needs for whoever you are sharing your maps and other GIS resources with. Later, you will learn how to include more sophisticated capabilities in your online maps and applications.

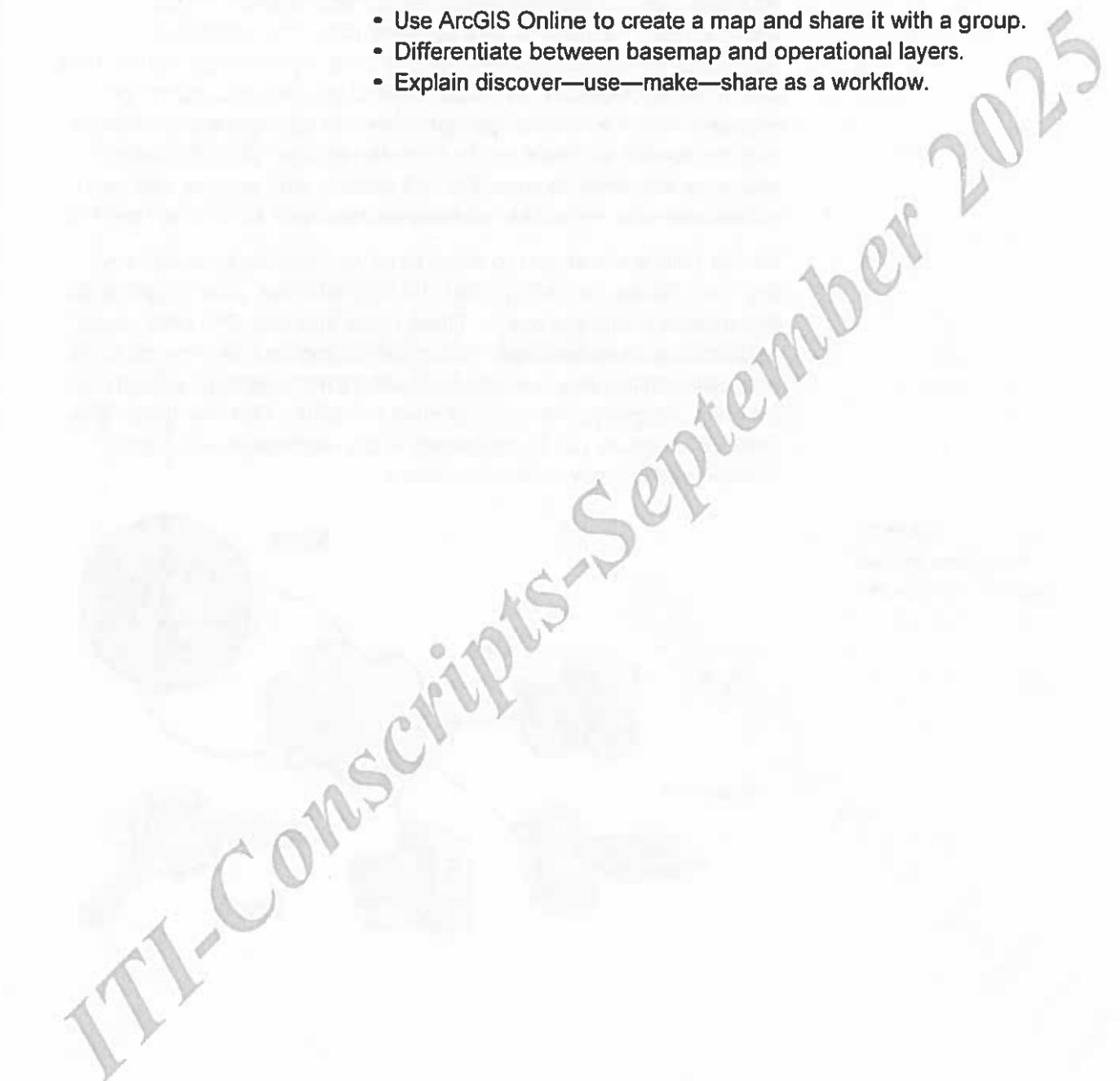
Topics covered

- Sharing GIS content online
- The types of content that can be shared
- Audiences that can use your shared content
- Creating web maps
- Options for hosting content
- ArcGIS services

Learning objectives

After completing this lesson, you will be able to do the following:

- Use ArcGIS Online to create a map and share it with a group.
- Differentiate between basemap and operational layers.
- Explain discover—use—make—share as a workflow.

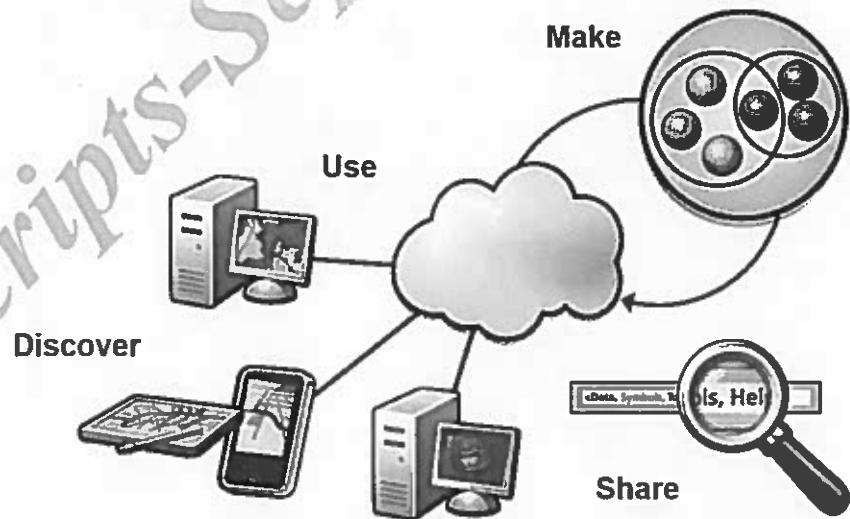


Sharing content

You have likely collected a large quantity and diversity of GIS information in the form of data and resources. This collection represents an enormous investment by your organization, both in time and monetary expense. To utilize much of this GIS information (for example, map documents, geodatabases, or geoprocessing models) requires ArcGIS for Desktop. To make the most of your investment, you need the ability to share this GIS content with anyone who you collaborate with, regardless of whether they have ArcGIS for Desktop.

ArcGIS Online allows you to share all of your GIS content with any user you choose, including other GIS professionals, your organization management, and the public. Those users may rely on a wide range of devices such as desktops, tablets, and smartphones. You can think of ArcGIS Online as a cloud-based content management system that is tightly integrated with your existing ArcGIS for Desktop tools. This integration allows you to seamlessly share searchable web-based content as soon as you have created it.

Figure 1.1
Transparency and easy
access are now expected.

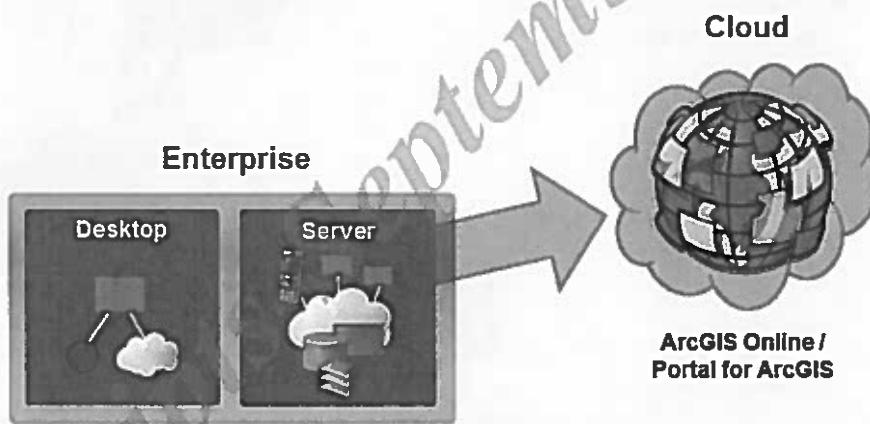


Facilitating collaboration

You may be familiar with the discover—use—make—share model for describing how you can create content, share it with ArcGIS Online, and have it accessed by any target audience you like. In this course, the emphasis is on the role of the content publisher. Although the overall process of using, creating, and sharing is tightly linked, knowing how to share your GIS content and with whom is an important aspect of maximizing collaboration with the widest possible audiences.

In this example, a considerable amount of the GIS content originates from ArcGIS for Desktop.

Figure 1.2
Expanding the ArcGIS enterprise to the cloud facilitates broader collaboration.



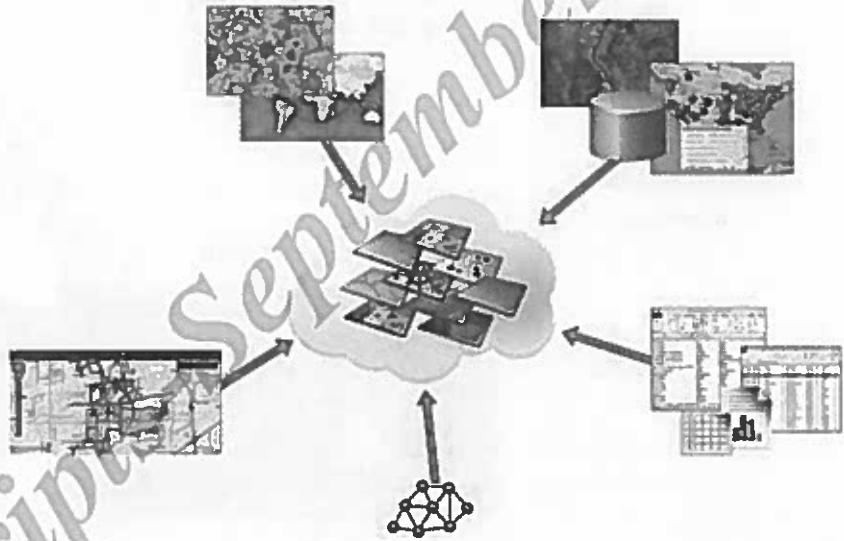
In some cases, content may have been shared within your organizational enterprise to ArcGIS for Server. Another form of sharing involves uploading content from the enterprise to a cloud environment. By doing so, the content becomes searchable and useable from wider audiences, whether the users have access to enterprise tools.

What kinds of content can you share?

The wide variety of GIS content that you can share with ArcGIS Online or Portal for ArcGIS can be divided into five basic categories:

1. Maps: ArcGIS Pro documents and map packages; ArcGIS Online-based web maps
2. Data layers: more dynamic data in the form of services
3. Data files: static data files and packages
4. Tools: geoprocessing packages and services
5. Applications: web and mobile applications

Figure 1.3
The five categories of content that can be shared with ArcGIS Online



Some types of content are fairly static, such as layer packages and map packages. These types are only downloadable and usable by other ArcGIS for Desktop users. But other forms of content are much more dynamic, particularly the services created by sharing data layers from ArcGIS Pro. As the source data in a service changes, the data the

user interacts with is always up-to-date. Services may be used in a wide variety of ways, such as web maps and applications and even by ArcGIS for Desktop users.

Common types of content shared with ArcGIS Online

This table describes some common types of content (also referred to as items) that are shared with ArcGIS Online. You can find a complete list of supported items in the ArcGIS Help.

LESSON 1

Content type	Details
Maps	<p>Although many ArcGIS for Desktop users think maps refer exclusively to ArcGIS Pro documents, ArcGIS Online provides another form of map: a web map.</p> <p>You author a web map directly in ArcGIS Online using a web browser. After you save and share it, others can access the web map. Authoring and using are done in the ArcGIS.com viewer. Web maps are easy to use even by non-GIS professionals. They provide the core method of sharing maps to a much wider audience than you could reach with sharing Desktop maps or map packages. Other supported maps include the following:</p> <ul style="list-style-type: none">• Map packages (.mpk)• CityEngine Web Scene (.3ws)• Tile packages (.tpk)
Data files	<p>Many forms of data files can be shared with ArcGIS Online. Some must be zipped before being shared, such as shapefiles, map templates, and code samples. Many other forms of content may be uploaded in their native formats, such as:</p> <ul style="list-style-type: none">• CSV files• Service definition files (used to create services)• Microsoft Office files• PDF files• Image files• Layer packages

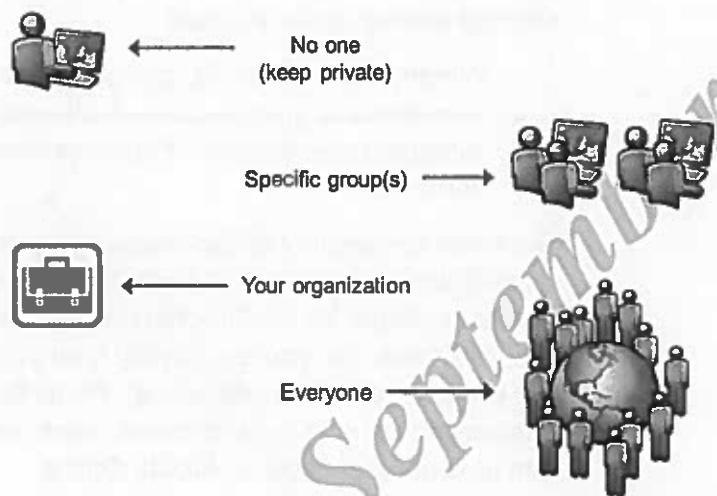
Table 1.2

Content type	Details
Data layers	<p>Data layers are services hosted by ArcGIS Online (referred to as hosted services, or hosted features) or by ArcGIS for Server. Services are GIS data layers that can be accessed using Internet protocols. They can be in the form of map or feature services. In general, feature services allow for manipulation of vector features. However, a whole host of dynamic services may be created in ArcGIS for Server, including the following:</p> <ul style="list-style-type: none"> • Geoprocessing: For geoprocessing/modeling • Geographic data: For accessing geodatabases • Geocoding: For locating an address • Network analysis: For routing • Geometry: Developer uses
Applications	<p>Applications, or apps, are often based on web maps and augmented with custom tools or behavior for a focused use. The two most common forms of applications are web and mobile applications. Web or mobile apps may be hosted in ArcGIS Online or downloaded and hosted in your web server environment.</p>
Tools	<p>Tools perform a function, or set of functions, in ArcGIS for Desktop, on a web map, or in an app. In their static forms, they can be:</p> <ul style="list-style-type: none"> • Geoprocessing samples (.zip) • Geoprocessing package (.gpk) • Locator packages (.gcpk)

With whom do you want to share?

When you first save or upload content to ArcGIS Online, it is considered private and only displays under the My Content link when you are signed in. In order for others to search for, discover, and use your content, share it. You have three options for sharing your content.

Figure 1.4
Options for sharing ArcGIS
Online content.



Share with a group

Groups are a great way to share your content with specific audiences that you want to collaborate with. As a group owner, you can invite others to join the group, as well as decide who can find the group, request membership, and contribute content.

Share within your organization

Similar to sharing with a group, this option allows you to share content with everyone in your organization. Depending on the way your organization is configured, members can share items within the organization only, or with people outside of the organization as well. The organizational account administrator controls these security settings.

Share with everyone

You can choose to share your content with everyone (public). Public sharing may be in addition to sharing it with specific groups and/or within your organization. Again, in an organizational account, the administrator can choose whether to allow public access.

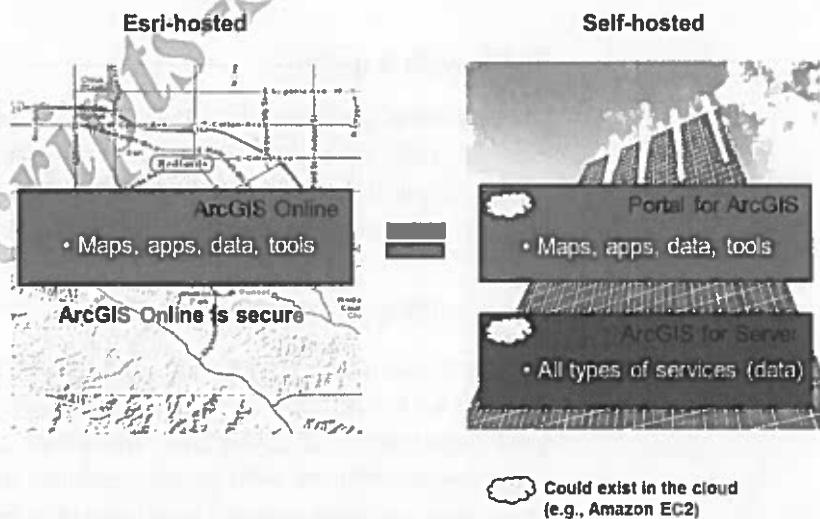
Esri-hosted or self-hosted content

ArcGIS Online offers a secure cloud environment to store your GIS content. By default, when users connect to ArcGIS Online, they authenticate over a secure connection. After authentication, the transfer of information between Esri cloud and clients is not secured. However, the administrator of the account can control three security settings related to the account:

1. Whether to enforce SSL communication for all transactions.
2. Whether anonymous access is allowed.
3. Whether users outside of the organization can share and access content.

Even with the security of Esri-hosted content in ArcGIS Online, your organization may have even higher security requirements. For those situations, Portal for ArcGIS offers nearly identical capabilities as ArcGIS Online, but you can deploy it on your hardware and network (on-premises or in a private cloud). Portal for ArcGIS can be customized to meet organizational needs and offers the same sharing and collaboration tools as ArcGIS Online.

Figure 1.5
Choosing to share content
with ArcGIS Online or with
Portal for ArcGIS is a
decision based on
organizational preference.



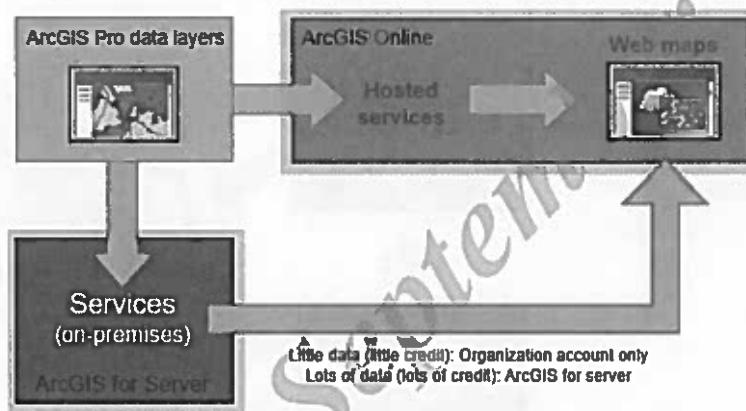
Optionally, you may also decide to deploy ArcGIS for Server within your corporate infrastructure. With ArcGIS Online, using ArcGIS for Server allows you to create and share a multitude of services beyond the services hosted in ArcGIS Online. In Portal for ArcGIS, more instances of ArcGIS for Server can host more types of services that can be linked (or referenced) within Portal, along with other forms of content.

ArcGIS services

You can publish data layers in ArcGIS Pro to create web services. The question for many users is whether data layers should be shared to ArcGIS for Server or ArcGIS Online. In either case, the resulting services are used to build web maps and are accessible to anyone with a web browser. From the perspective of the publisher, the workflow of sharing is identical.

Figure 1.6

In ArcGIS Pro , you can publish data layers as services to ArcGIS Online or ArcGIS for Server.



 Publishing hosted services to ArcGIS Online requires an organizational account.

To make the best choice for your needs, weigh the costs and organizational benefits of each option. In general, users who have not purchased ArcGIS for Server may want to host services in ArcGIS Online, as long as the costs associated with doing so are acceptable. With larger and more numerous data layers, you may find it more cost-effective to purchase ArcGIS for Server for hosting your services on-premises (or in a private cloud).

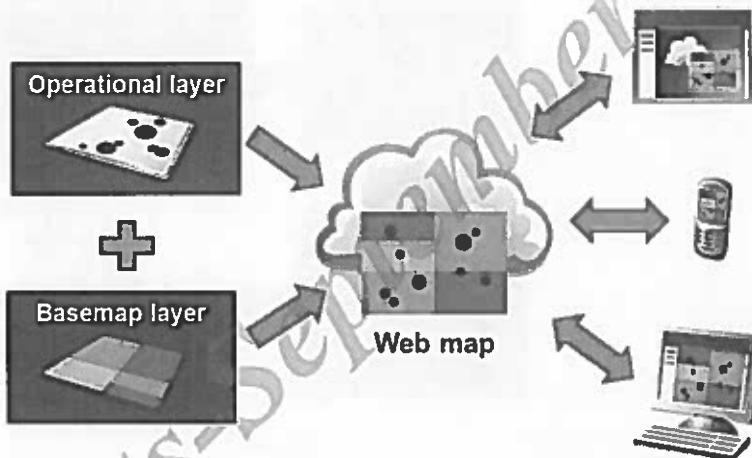
If you have access to both ArcGIS Online and ArcGIS for Server, another strategy is to create services in both, depending on associated costs and how those services will be used. In either case, services derived from either ArcGIS Online or ArcGIS for Server can be combined, or mashed up, to create web maps.

Web maps

Web maps created with the ArcGIS.com map viewer allow you to collaborate with others who lack GIS application skills. Web maps contain data layers and essential navigational capabilities that are easy for anyone to use. The data layers include overlaid data (called operational layers) and basemaps. Basemaps are background reference maps that help orient the user, and operational layers provide the intended focus of the map.

Figure 1.7

Web maps consist of basemaps and operational layers and are accessible by any device with a browser.



As a publisher of the data layers, you must evaluate whether the data should be considered basemap or operational layers.

For example, imagine you work for a state agency that maintains the state park camp sites. You want to create a web map to collaborate with public groups using that information. You use the ArcGIS.com map viewer on ArcGIS Online to create a map, choosing a publicly available basemap or one of your own. You then include an operational layer—typically one that you have previously published from ArcGIS Pro. When you save your web map, you provide metadata for it, including tags. These tags allow others to search for and discover your web map.



Because web maps have simplified navigational capabilities, anyone can interact with them.

In this case, the camp sites are likely the operational layer. However, they may not be. For one project, the camp sites may be the operational layer. In a different project, they might be combined with other data to form a basemap, and another dataset may be the operational layer for the web map. After the web map has been shared, almost any device can access and use it.

Exploring ArcGIS Online

ArcGIS Online provides a web-based GIS content management system, which exists as software as a service (SaaS). To use it, you do not install a program or software. It is intuitive and easy to use for sharing and collaboration. Many users can access the content, with many devices. In this class, you will use an organizational account to share GIS content.

ArcGIS Online allows you to share web maps with the public, specific groups of users, or your organization. A wide variety of data layers (for example, web services, shapefiles, layer and map packages) is freely available on ArcGIS Online. You can search for them and add them to your own web maps. After adding data layers to your web map, as the author, you can configure them extensively.

Figure 1.8
Web map with
configurable layers from
locally added files.



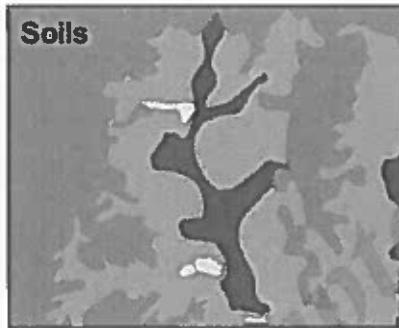
After saving your web map, you can share it with other users through a link to email, built into a web application, or embedded in an existing website.

How is your data best represented?

You can share data layers from ArcGIS Pro to ArcGIS Online or ArcGIS for

Server. These layers can be described as basemap layers or operational layers. Ultimately, the type of layer heavily influences the type of service that you can create. It is important to consider how your data can best be represented because the process for authoring content for basemaps differs from authoring content for operational layers.

Figure 1.9
Organizing data layers as
basemap or operational
content.



Basemap layer



Operational layer

Basemaps

Basemaps are the background maps that provide the spatial context for more focused operational layers that are often displayed on top of them. Basemap layers:

- Tend to be more contiguous data (such as vector polygons).
- Could be imagery.
- Could consist of many layers.
- Are data that never (or infrequently) changes.
- Are data that exhibits complex symbology.

Examples of basemaps include aerial photos, soil polygons, and vegetation index maps.

Operational layers

Operational layers are the main focus of your map, which may represent the central theme for collaboration with a group of users. Operational layers tend to be:

- Vector data with a limited number of features (simpler geometry is more common, such as points or lines).
- The focus of the map; the layer that the web user will interact with.
- The data may change frequently.

Examples of operational layers include bike routes, cell tower locations, or active faults.

You do not need to confine your data layers to either basemap or operational data. The same data may be best represented as a basemap for one project, and as operational layers for another project.

For example, a county GIS department might need to maintain a current trail system. For public access, they may publish only the current trail system as a basemap merged with other reference data like a topographic map. For internal use, they may consider the trail system as operational data with extra features that delineate proposed new trail segments, as well as upgrade plans for existing segments. In this case, they may choose to share the trail system layer twice: Once as a part of a basemap and once as an operational layer.

ITI-Conscript

35 minutes



Exercise 1: Create a web map

Your instructor will assign you a temporary user name and password for ArcGIS Online to use during class. In addition, a group in ArcGIS Online has been pre-created for your class to share items. Record this information for later reference.

User
name: _____

Password: _____

ArcGIS Online group name: _____



User names and passwords are case-sensitive.



ArcGIS Online is a dynamic website, so the interface described in the content may differ from what you see on the screen.

Scenario: You work for the City of Naperville in Illinois. You are responsible for organizing a Bike To Work Day event to ease traffic congestion. The budget allows for only two city-sponsored rest stops. You plan to ask local restaurant owners if they will provide more rest stops at no additional cost to the city. They will supply refreshments and snacks, while simultaneously promoting their establishments. You will create a web map that shows local restaurant locations and the bike routes to share with restaurant owners. They will review your web map and interactively propose locations where they agree to set up rest stops.

In this exercise, you will perform the following tasks:

- Sign in to ArcGIS Online.
- Create a web map and configure layers.
- Save and share the map.

Step 1: Sign in to ArcGIS Online

You will complete this exercise on the organizational site for Esri Training Services. You will log in using the credentials provided by your instructor.

- ❶ Open a web browser, and go to the URL provided by your instructor.

This URL is for the ArcGIS Online organizational site that you will be using for this course.

- ❷ Click Sign In.



If a certificate security warning appears, allow it to install to access the site.

You are taken to a unique page created exclusively for the purposes of this class. This page would not appear on your own ArcGIS Online organizational site.

- ❸ Click the link to log in with Using Your Course Account.
- ❹ Log in by entering the user name and password that your instructor provided.

Step 2: Create a web map

Now you are ready to create a web map.

- ❺ Click Map.

A new map appears with a default basemap.



If another student was previously working on a map, an existing map may open instead. If an existing map opens instead, click the New Map link and proceed as necessary.

The new map shows much more than your area of interest.

- b** In the search box, type Naperville, IL, and press Enter.

The map zooms to Naperville, IL, and a Location pop-up window appears.

- c** Close the Location pop-up window.

You will choose a suitable basemap for this project. You want restaurant owners to determine optimal locations to host a bike rest stop, so you will use the Streets basemap.

- d** Click the Basemap button  and choose the Streets basemap.

Now you will add the bike routes and the restaurant locations. In this case, these layers are already there. Another ArcGIS Online user published the layers and shared them with the Training Services organization.

- e** Click the Add button  and choose Search for Layers.

- f** In the Search for layers to add pane, specify the following, in this order:

- In: ArcGIS Online
- Find: Naperville

- g** Click Go.

- h** Scroll down the results and click Naperville_Bike_Routes.

A window opens, giving you information about this data layer.

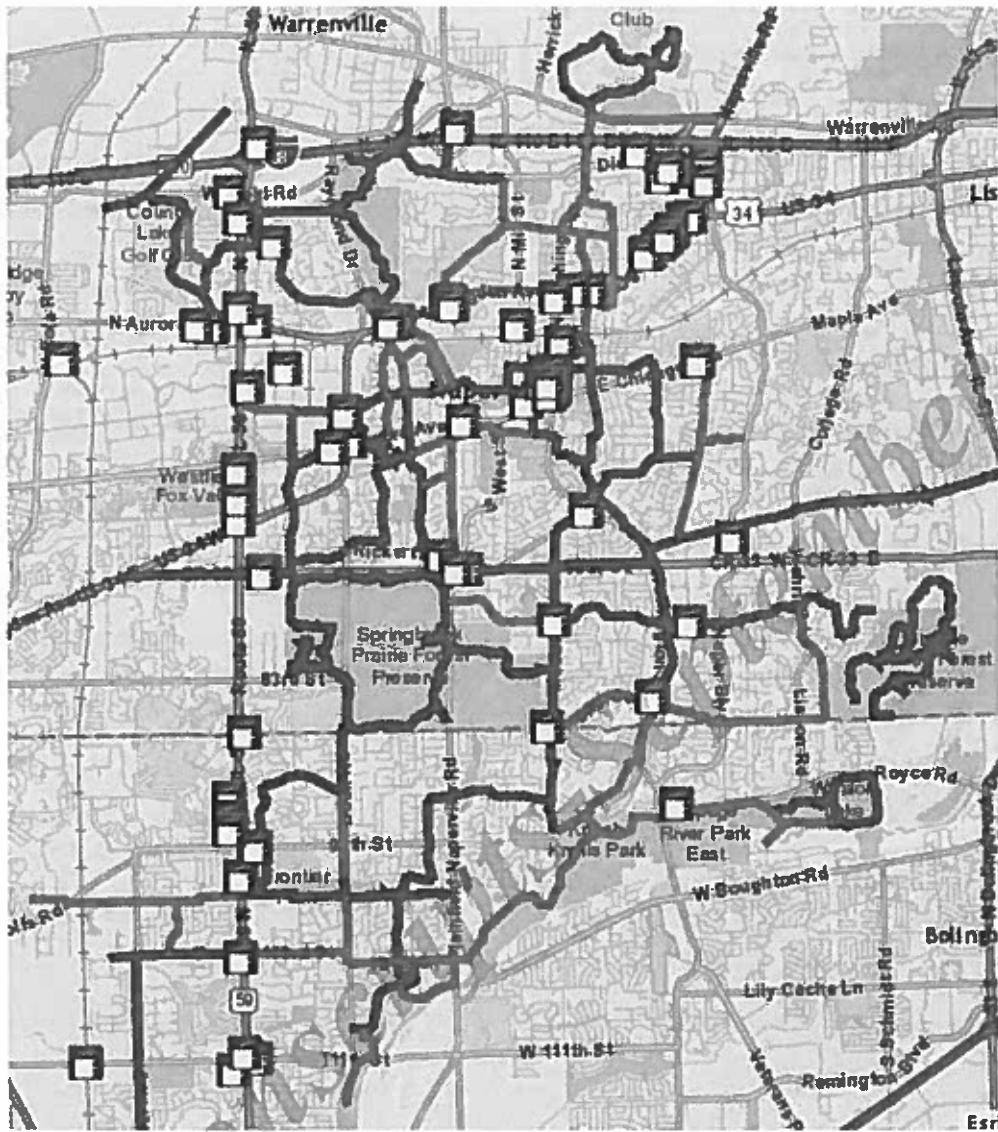
- i** In this window, click Add to map.

The classified bike routes for the city now appear in the map.

Next, you will add the restaurant locations.

LESSON 1

- ① Under the Naperville_Restaurants (Features), click the Add link.



Blue cafe icons representing the restaurants appear on the map.

- ② Click one of the symbols to view the type of information that can appear in pop-up windows.

Notice that some pop-up windows include photos and links to the restaurant websites. You can configure pop-ups with various additional information, including charts, attribute values, images, and attached documents.

- ③ Close the pop-up window.

- ⑮ In the Search for layers pane, click Done Adding Layers.

The Details pane replace the previous pane.

- ⑯ Using the zoom widget in the map, zoom into the map one level.

 Alternatively, you could press the Shift key as you drag your pointer to zoom into (similar to using the Zoom In tool in ArcGIS Pro).

Step 3: Configure layers

Now that you have the essential data for your web map, you will configure the layers and map to make it more useful to the restaurant owners who will use it.

- ⑰ At the top of the Details pane, click the Show Map Legend button .

Notice that the orange bike routes are proposed routes. You want to encourage riders to use established routes for safety's sake. You will filter the layer so that the map only shows existing routes.

- ⑱ Click the Show Contents of Map button .
- ⑲ Click on the name of the Naperville Bike Routes layer.

Contents

-
- Naperville Bike Routes
 - Naperville Restaurants
 - ▶  Streets
 - ...

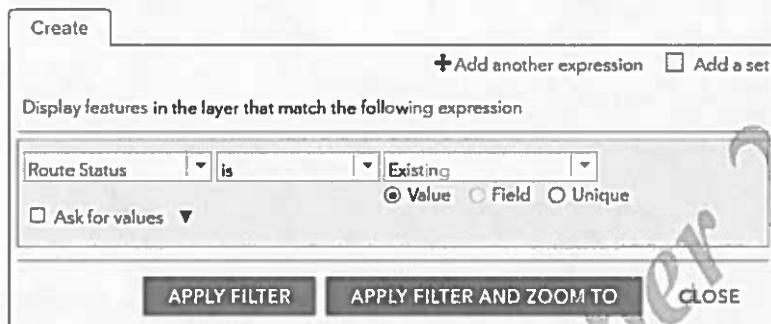
- ⑳ choose filter from the context menu.

LESSON 1

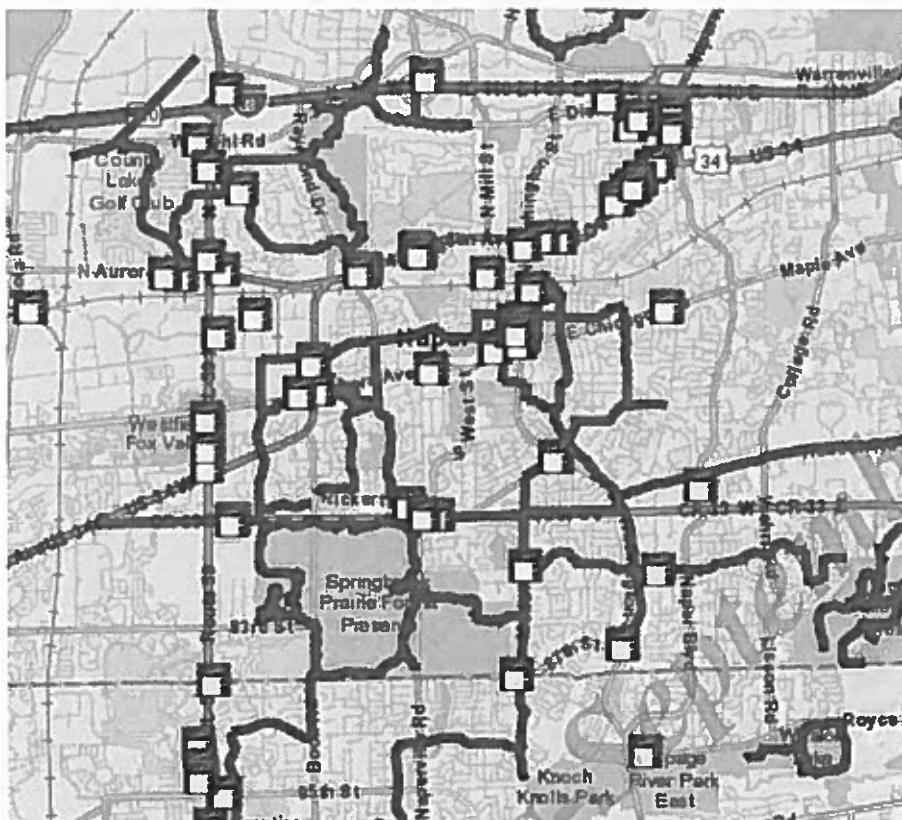
The Route Status field contains integer values of 1 for proposed and 2 for existing.

- e Using the drop-down lists, create the expression Route Status is Existing and then click Apply Filter.

Filter: Naperville_Bike_Routes



- f Zoom out again to show most of the bike routes.



Now your map shows only existing bike routes. You also want the map to show the location of the two city-sponsored rest stops. Because of the limited number of rest stops, you will use map notes to mark up the existing map. If you would like to show many more locations, you might consider using a new data layer to contain them.

- g Click the Add button and choose Add Map Notes.

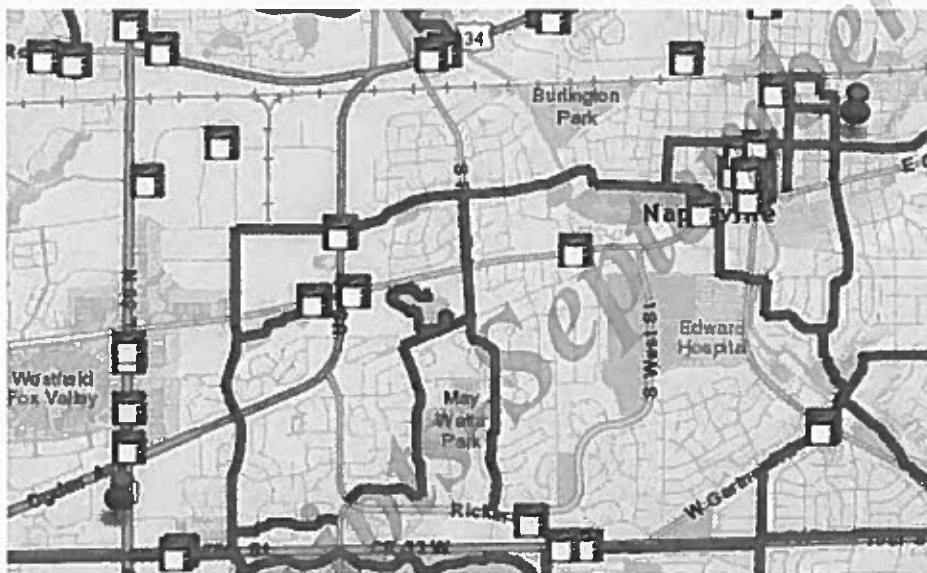
- h In the Add Map Notes dialog box, do the following:

- For Name, type Bike To Work Day Rest Stops
- For Template, leave the default (Map Notes).
- Click Create.

Notice that the Add Features panel replaces the Details panel.

From this panel, you can mark up your map with features (points, lines, and areas). Each one you create can contain text, links, and so on, so that others can understand your notes. Other users of the map can see your map notes, but only the map owner (you) can create them.

- i In the Add Features panel, under Points, click the Pushpin marker .
 - i Click a suitable location on the map along a bike route.
 - k In the Points dialog box, do the following:
 - For Description, type City Rest Stop #1.
 - Click Close.
 - i Use the same process to create another city sponsored rest stop with a description of City Rest Stop #2.



As your map is configured, if users wanted to contribute markups of their own (in other words, to propose their rest stops), they would first need to save their own copy of the map. Saving separate copies would defeat the purpose of facilitating collaboration. However, in an upcoming exercise, you will provide an entire data layer for capturing the rest stops proposed by the restaurant owners.

Step 4: Save and share map

Before you save your map, you want to ensure that users see the full extent of the Naperville bike routes when they first open the map.

- a Click the Details button to view the Contents.

- b** In the Details pane, click on Naperville_Bike_Routes name, choose ... from context menu and choose Zoom to.

Your map is now ready to save and share with your target audience.

- c** Click the Save Map button  and choose Save As.

- d** In the Save Map dialog box, specify the following parameters:

- Title: Naperville Bike To Work Day Map<first name+last initial>
- Tags: Naperville, Bike to Work Day, Restaurants
- Summary: For restaurants to promote their establishments
- Save in folder: Keep the default location.

- e** Click Save Map.

Your next step is to share the web map with others.

- f** Click Share.

Notice you that you can share with:

- Everyone (public)
- Your organization (in this case, Esri Training Services)
- Members of a group: Only appears if you are a member of any groups.

In the current scenario, you might choose to share this map with the public (in other words, for restaurant owners to access). But, for easier resource management in this class, you will share it with a specific group.

- g** Check the box to share with Everyone .

Notice that a shortened URL link to your web map is also included, which you could add to any email list that you would like. Your URL will likely be different from the one pictured.

Link to this map

<http://bit.ly/11hoEjp>



Facebook



Twitter

Embed this map

[EMBED IN WEBSITE](#)

[MAKE A WEB APPLICATION](#)

Note: To embed your map, you must share it with Everyone.

LESSON 1

If you chose to share with Everyone (public), you could embed your map in another website. You could create a wrapper for your map (using the Bike To Work Day theme) and explain how you would like the restaurant owners to use the map.

Finally, notice that you could convert this web map into a web app. Converting to a web app would give you even more options to customize the behavior of the map. If you wanted to, you could even host it directly from your website.

h Click Done.

i After the map is saved, from the Home menu, choose My Content.

Currently, you have only one resource: the web map that you have saved.

j Click the link for your Bike to Work Day Map.

Review the details for your web map. You could edit the information to include a description, as well as access and use constraints for your map. At the bottom of the page, notice that users who you have shared with can post comments about your map.

k Click Open and review the options listed.

Notice that you could open the web map in the map viewer (which you used), or in ArcGIS For Desktop, or you could use the map to create a presentation.

Lesson review

1. After you save a web map in ArcGIS Online, can anyone else access it?

2. If your data includes many layers, changes infrequently, and is made up of contiguous polygons, it should be considered an operational layer.

- a. True
- b. False

3. Explain the role of ArcGIS for Desktop in sharing GIS content online.

2

Authoring operational content

Introduction

Key terms
basemap
feature service
map service
operational content

When you want to share your data as web-accessible services, it becomes important to delineate which layers serve as operational content. In ArcGIS Pro , you follow the same sharing procedures when sharing to ArcGIS Online or ArcGIS for Server, but the specific service options that you choose will vary. This lesson focuses on best practices for sharing operational content, along with how the resulting layers (services) can be used in web maps.

Topics covered

- Sharing ArcGIS Pro layers as web services.
- Feature versus map services.
- The role of Sharing tool and Analyzer when publishing services.
- Clients that can use services.
- Authoring web maps using feature services.

Learning objectives

After completing this lesson, you will be able to do the following:

- Use ArcGIS for Desktop to author and share operational content.
- Apply a published feature service to a web map.

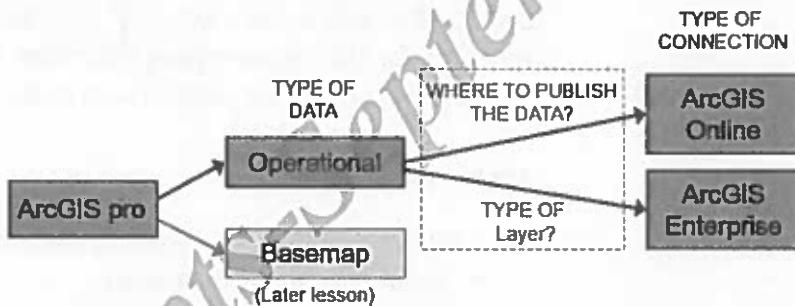
Preparing operational content

You have already learned that before you share data layers as services, you organize your data based on whether it is best suited as basemap or operational content. Organizing your data helps you determine what type of service to create when publishing from ArcGIS Pro.

For example, say you are publishing active fault data (lines) in Colorado and want to use that information in an earthquake risk-assessment map. Your basemap may involve a terrain or topographic map, but the fault data should clearly be an operational layer, or layers. Even with this designation, you still have choices to make about where to publish the data and what type of service to create.

Figure 2.1

Preparing content for sharing involves evaluating the type of data and how it will be used after it has been shared.



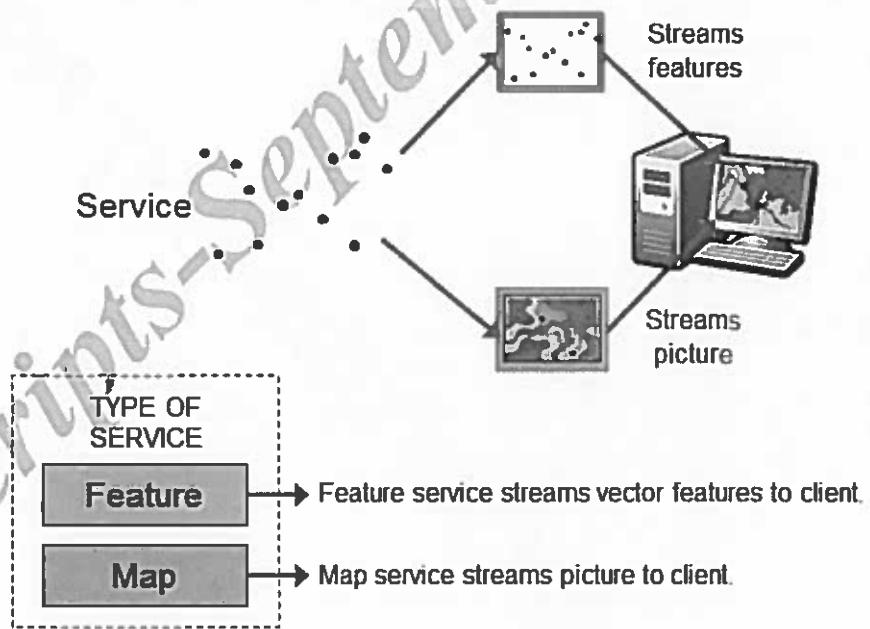
After you have identified which layers in ArcGIS Pro will be shared as operational content, choose where to publish the service. The sharing process is the same whether you publish to ArcGIS for Server or ArcGIS Online. Your decision, however, may affect your answer to the next question: What type of service do you intend to create? The answer to this question is based on how your users will ultimately interact with the service.

Feature service vs. map service

Conceptually, two types of services are common to ArcGIS for Server and ArcGIS Online (although their specific names vary slightly): feature services and map services. In general, **feature services** tend to correspond to operational layers, whereas **map services** correlate to basemap layers. Some overlap exists between the two, so focus your decision making on what your users should be able to accomplish with the service.

In this example, a feature service streams the coordinates of vector features to the client application. This behavior allows the client to do many things with the vector data, like change the symbolization, perform queries, and even edit the data.

Figure 2.2
Comparison of feature and
map services.



Map services create an output image, or picture, of the data, which is sent to the client. Although the client is simply displaying a picture of the data, users can still perform certain actions that make it appear that the data is locally accessible. For example, a pop-up window with attribute values is displayed when a user clicks a feature.

When the number of vector features is large enough, map services provide much better performance than feature services, especially when the map service has been cached. But, feature services allow more end-user control, including the ability to edit the data.



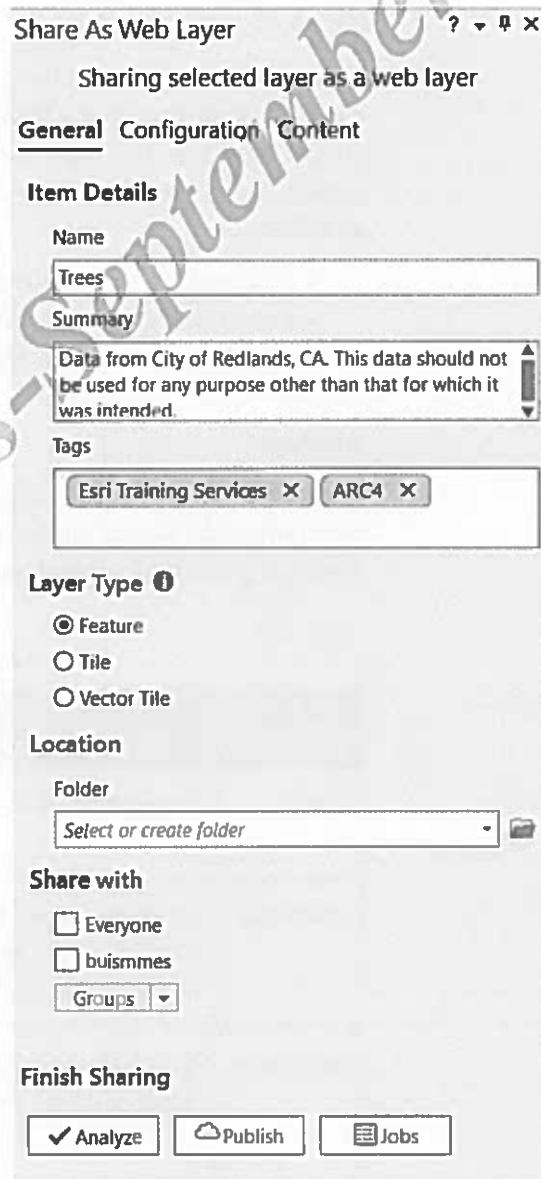
When working with data that, for a given scale of use, has few features and is of a simple geometry type, use feature services. A limited number of point data works best, followed by line data, and so on.

Remember, you can use dual services that would complement each other at appropriate scales. You can create a map service with the target data for all scales smaller than a specified threshold. Then you can create a feature service for use with all scales larger than your threshold (that is, when users are zoomed in far enough to limit the number of features). You can then deploy your "tandem" services in a web maps or web app so that users can seamlessly use them.

Publishing a feature service to ArcGIS Online

There are several best practices to follow when preparing operational layers to be shared with ArcGIS Online. For example, set scale dependencies and create feature templates to set symbology. When you share ArcGIS Pro layers as a service, the sharing tool allows you to set the properties of the service. And, the Analyzer scans your map document and lists any problems that may prohibit you from publishing or decrease service performance. The sharing tool also allows you to share with particular groups to ArcGIS Online during the publishing process.

Figure 2.3
The Sharing tool finds potential problems during the publishing process to ArcGIS Online.



ArcGIS Pro Sharing tool and Analyzer

When you are ready to share your ArcGIS Pro data layers (for example, publish as a service) you simply share the data from ArcGIS Pro as a service. To share successfully, a wizard guides you through choices to make. The Sharing Tool allows you to specify properties and metadata about your service so that users can find your service and access important information about it. The Analyzer in the sharing tool scans your map layers for impediments to publishing and allows you to quickly rectify them if necessary.

Share as web layer tool

With the Share as a web layer tool, you can control many important properties of the service that you are creating. It adjusts the content shown based on the type of service and whether you are publishing to ArcGIS Online or ArcGIS for Server. Some of the essential properties are as follows:

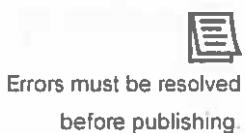
- Capabilities: The type of service and its associated capabilities.
- Item Description: Metadata about your service.
- Sharing: Who to share it with when publishing to ArcGIS Online.

Analyzer

Before publishing the service, you use the Analyzer to discover any problems that would hinder publishing. The Analyzer produces three types of messages, described in the following table.

Table 2.1

Analyzer messages		
Type	Description	What to do
Error	Issues that must be resolved before you can publish.	Resolve issue
Warning	Optional issues that can affect performance, appearance, or data access. Three levels: high, medium, low	Resolve or mark as exception
Message	Suggestions for methods and best practices that can optimize the service.	Resolve or mark as exception



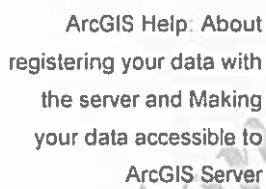
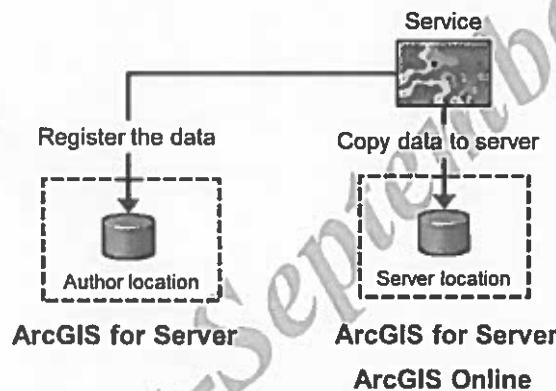
You review the results of the Analyzer in the Prepare window, where you can resolve issues or mark them as exceptions to finalize publishing. Often, the resolution is simply a context menu choice.

How to handle the data

One of the most important choices to make when publishing a feature service involves how the service will access the data. Your two choices are the following:

- Copy the data to the server. Copying the data automatically occurs when publishing to ArcGIS Online.
- Register the data source with the server.

Figure 2.4
Data options for services published to ArcGIS Online and ArcGIS for Server.



When the data is copied to the server, the service has guaranteed access to it. Copying the data is the only option when publishing to ArcGIS Online. If you choose to register the data source, the data remains in the original location (where the map was authored) and the service just references it remotely. Data folders, geodatabases, and ArcSDE connections can be registered with the server. When choosing the register option, make sure that the ArcGIS for Server account has sufficient permissions to access the data.

In general, copying the data to the server is the most certain method for making sure that the service works correctly (in other words, has access to the underlying data). However, in the future, if you decide to update the data, republish the service from the original map document and choose to overwrite the existing service.

Conversely, registering the data source can be advantageous when publishing an authoritative set of data from a central location (for example, using ArcSDE and ArcGIS for Server together in a corporate network). Registering the data source allows the service to have

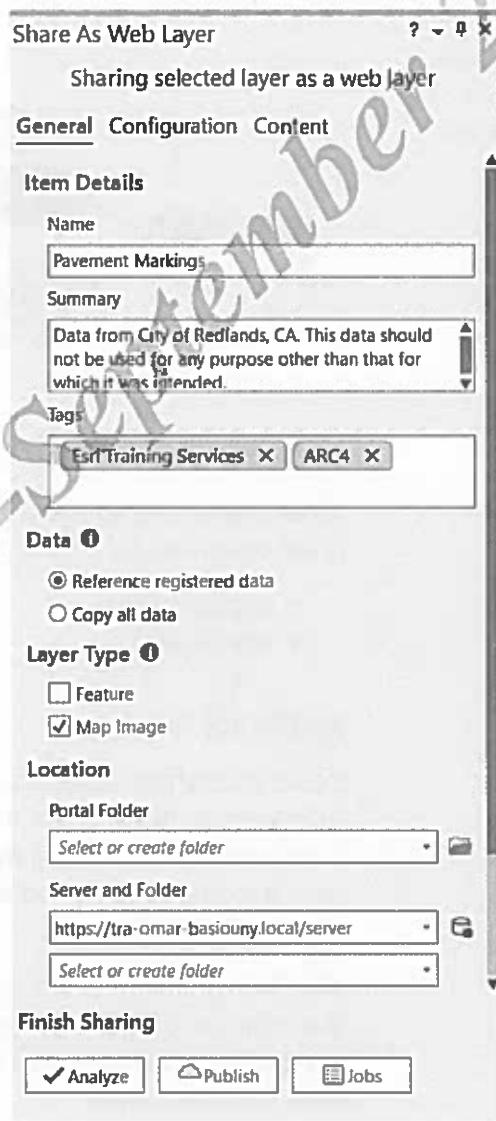
access to the most current data without requiring you to periodically recopy an updated set of data to the server.

ITL-Conscrip...September 2025

Publishing a feature service to ArcGIS for Server

Publishing a similar data layer to ArcGIS for Server presents some differences. ArcGIS for Server allows for many other forms of services than the two types of hosted services in ArcGIS Online. In addition, you can choose to register your data source with the on-premises server or to copy it to the server. Feature services require the data be kept in a multiuser geodatabase registered with ArcGIS for Server.

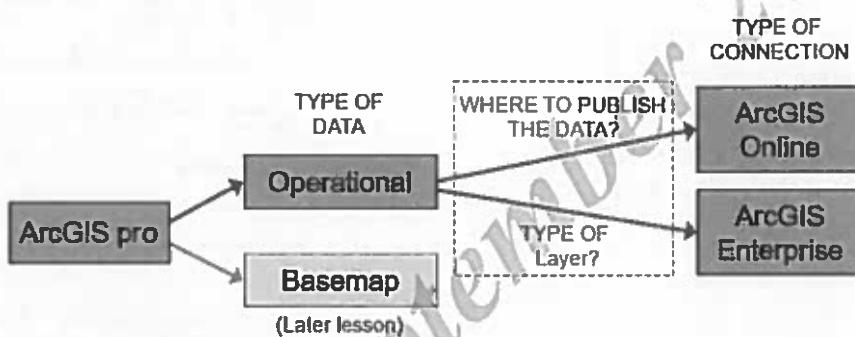
Figure 2.5
When you are publishing to ArcGIS for Server, more capabilities are allowed for map services



Sharing operational content

Another important choice when sharing data layers as a service from ArcGIS Pro is to decide what type of service to create. As mentioned previously, the two services that ArcGIS Online and ArcGIS for Server have in common are map and feature services. But if you choose to publish to one or the other, there are some subtle differences you will need to consider.

Figure 2.6
Types of services available
based on the type of
connection.



ArcGIS Online

When publishing to ArcGIS Online, you are creating a hosted service. It will be either:

- Feature layer
- Map layer

ArcGIS for Server

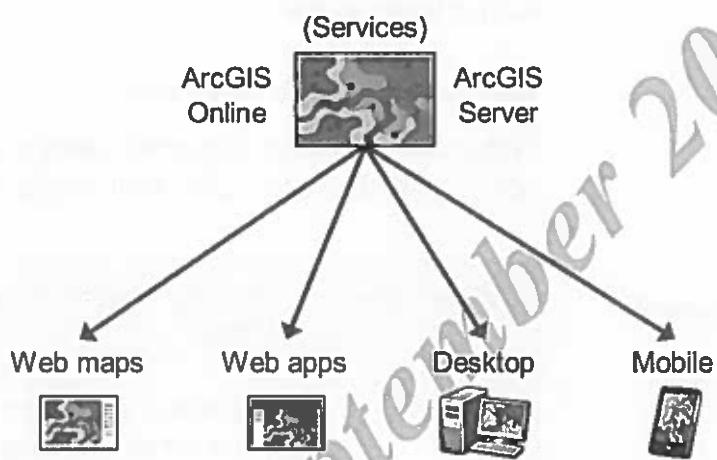
When publishing a map to ArcGIS for Server, you always publish as a map service, but you can optionally enable feature access capabilities. If your goal is to utilize a map service with feature access capabilities, then it would require that the data is stored in ArcSDE and registered with ArcGIS for Server.

Whether you are sharing using ArcGIS Online or ArcGIS for Server, the essential publishing steps are the same. The differences lie in what capabilities you have available to you, which dictate what service type you can create.

Using services

Ultimately, whether you create a service in ArcGIS Online or ArcGIS for Server, the same extensive variety of clients can use it.

Figure 2.7
Services can be used in
many types of clients.



For example, the services can be used in web maps and web apps. Mobile apps can also consume the service for use with mobile devices such as tablets and smartphones. ArcGIS for Desktop users can access the service directly, without any of the extra map-related capabilities inherent to the web maps or apps.

Authoring and using web map layers

Now that you have published the operational data as a feature service, you want users to interact with it in a web map. Many of the following items refer primarily to feature layers, but some may apply to map layers as well.

User access to web map layers

Web maps allow users to perform certain actions on the layers in a service without requiring any prior configuration.

Table 2.2

Display tables	Display an attribute table at the bottom of the map.
Apply filters	Similar to a definition query. Use to display only the features meeting user-defined criteria.
View directions	Get point-to-point directions and the ability to add stops in between.
Measure area, distance, and location	Measure area and distance as well as obtaining coordinates of a location.
Perform analysis	Many publicly available analyses tools.

Configure web map

In addition, you can configure some properties of web map layers in a web map to further encourage collaboration. For example, you can do any of the following:

- Create bookmarks: Save locations so users do not have to manually navigate to an area of interest.
- Enable and configure pop-ups window for each feature service: Display specific attribute fields, images, charts, or attachments when a user clicks a feature.
- Add a notes layer: A web map can have multiple notes layers that users can mark up by drawing points, lines, polygons, and adding text to the map. Only the map owner can download or edit a notes layer.

LESSON 2

For example, imagine you have published a trail system map near your town to share with hikers in the area. You want hikers to use your web map to perform the following:

- Plan day hikes.
- Mark the trail segments they hiked.
- Record birds they see along the way (points).
- Post pictures of scenic locations.

In this example, as the map author, you would create and share a trail web map. You could even create bookmarks to the most popular hiking trails. If you chose a topographic basemap, hikers could gauge how strenuous any given hike would be before attempting it. They might also plan their hikes by using the built-in measure tool, or apply a filter to view only hikes of a specific length. If the trails layer is a feature service, you could configure the pop-up window to show only the attributes that you want, such as length of trail, surface rating, slope, and so on. If you added a notes layer, users could each save their own version of the web map and add notes (for example, points, lines, polygons, text) to it. They could even indicate their favorite hikes, bird sightings, and sample photos to share with their friends.

45 minutes



Exercise 2: Publish and use feature layer in a web map

In this exercise, you will continue to refine your Naperville Bike To Work Day web map. You will use ArcGIS Pro to author and share two operational layers:

- You will publish one layer to ArcGIS Online as a hosted feature layer, which is an empty service that will contain the proposed rest stops for the restaurant owners to edit when using your web map.
- You will publish another layer to ArcGIS Online as a Tile Layer. This web layer will contain data from the Naperville park facilities that both the restaurant owners and the cyclists can use to support their efforts during the event.

By publishing your own layers, you can make your web map a focused collaboration tool to help coordinate the Bike To Work Day rest stop logistics.

In this exercise, you will perform the following tasks:

- Prepare and publish layers to ArcGIS Online.
- Add published layers to a web map.
- Configure a web map.

Step 1: Prepare an operational layer for sharing

- a Start ArcGIS Pro and open a blank Project, rename it SHAR and save it in C:\Student\SHAR
- b In the Catalog pane, right click the Folders button, and create a folder connection To the C:\Student\SHAR folder.
- c Expand the new folder connection and then expand:
 - PublishingFeatureServices > Naperville.gdb > BTWD.

Notice that the BTWD feature dataset contains two feature classes: Restrooms and SecondaryStops. You will publish these two feature classes to extend the capabilities of your Bike To Work Day web map. The feature dataset already has the appropriate spatial reference established.

- d Drag the SecondaryStops feature class onto the map.

You will modify the symbology for this layer to better represent the data.

- e In the contents pane, click the symbol for SecondaryStops.
 - i In the search box, type Store and press Enter.
 - j Choose Grocery Store symbol
 - k Go to Properties tab and Increase the symbol size to 20 and click Apply.
 - l Rename the map to secondarystops and save your project.

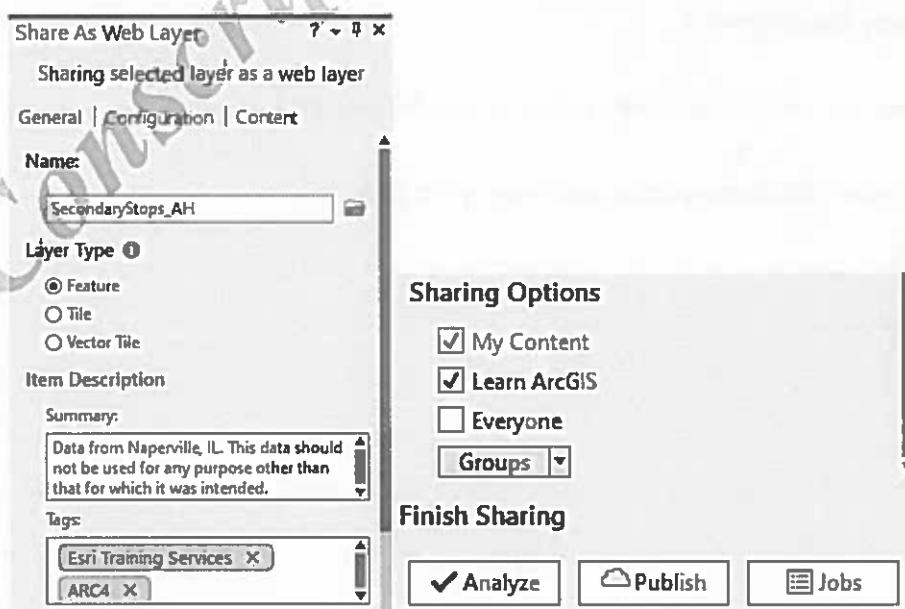
Step 2: Publish a hosted feature layer

Because SecondaryStops layer will be shared as a hosted feature Layer, sign in to ArcGIS Online.

- a In ArcGIS Pro , at the Top Right.
- b Click the link to sign in with Using Your Course Account.
- c Sign in using the user name and password provided by your instructor.
- d In the contents pane Right Click (SecondaryStops) > sharing > Share As Web Layer.
- e Progress though the Share As Web Layer Pane as follows:
 - For name, type **SecondaryStops_<first name+last initial>**
 - For Layer Type, choose **Feature**
 - Notice that the summary and tags are provided automatically

This naming convention will ensure that your layer name is unique among your classmates; ArcGIS Online does not allow duplicate service names.

- f For Sharing Options, check your organization
- g Examine the configuration and Content tab, without changing anything in it.





Be sure you not publish the service with Tile enabled. If you do, the tiles created on the ArcGIS Online servers will consume credits. In a later lesson, you will learn how to upload pre-built tiles from ArcGIS Pro to ArcGIS Online in a way that consumes minimal credits.

Your next step is to analyze the map to look for problems associated with publishing a service.

Step 3: Resolve results of analysis

Now you are ready to analyze the map to discover any potential barriers to publishing the service.

- a At the bottom of the sharing pane, click the Analyze button .

You can now view the analysis results in the message tab.

The message tab can indicate four levels of severity:

- Errors must be resolved before publishing.
- High severity warnings should be addressed.
- Medium severity warnings should be addressed.
- Low severity messages often represent items to consider for a better performing service.

- (b) At the bottom of the sharing pane, click the **Publish** button .

When finished, a message box informs you that the service was published successfully.

- ① In the Catalog pane , Go to Portal tab > My content to view your new Secondary Stops Feature Layer.

 Your web layer name will be appended with your first name and last initial. If necessary, you may need to refresh the connection to see the service.

Step 4: Prepare another operational layer for sharing

Now you will follow the same workflow to publish another web layer for the Naperville parks data that contains restroom information. Although the restrooms data is considered operational data, it is not going to be edited or resymbolized by the end users, so you can publish it as a tile layer.

- a In ArcGIS Pro , open a new map (Insert tab > New map)
- b In the Catalog pane, browse to C:\Student\SHAR\PublishingFeatureServices\Naperville.gdb\BTWD.
- c Drag Restrooms feature class from the BTWD feature dataset onto the map.

You will add a basemap to your map to help orient you as you author the content you want to share.

- d Click the map tab > Basemap  and add the Streets Basemap.
- e In the contents pane, click the symbol for Restrooms to open the Symbol Selector.
- f In the search text box, type rest and press Enter.
- g Click the Restroom symbol and click OK.
- h Rename the map to Restrooms and save your project.

Step 5: Publish a Tile layer

Now you are ready to publish the Restrooms layer as a Tile Layer.

- a In the Contents Pane, Right click (Restrooms) > Sharing > Share As Web Layer.

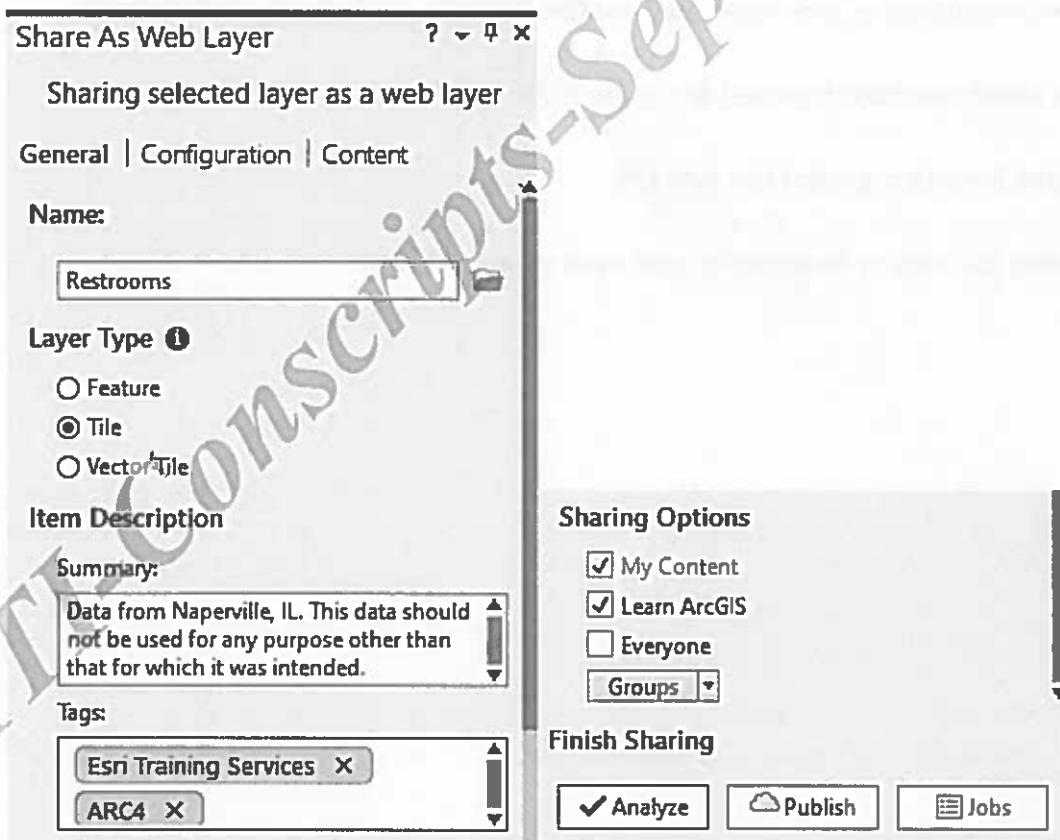
- e Progress though the Share As Web Layer Pane as follows:

- For name, type Restrooms_<first name+last initial>
- For Layer Type, choose Tile
- Notice that the summary and tags are provided automatically

This naming convention will ensure that your layer name is unique among your classmates; ArcGIS Online does not allow duplicate service names.

- f For Sharing Options, check your organization.

- g Examine the configuration and Content tab, without changing anything in it.



Step 6: Resolve results of analysis

Now you are ready to analyze the map to discover any potential barriers to publishing the service.

- a At the bottom of the sharing pane, click the Analyze button .

You can now view the analysis results in the message tab.

The message tab can indicate four levels of severity:

- Errors must be resolved before publishing.
- High severity warnings should be addressed.
- Medium severity warnings should be addressed.
- Low severity messages often represent items to consider for a better performing service.

- b At the bottom of the sharing pane, click the Publish button.

When finished, a message box informs you that the service was published successfully.

- I In the Catalog pane, Go to Portal tab > My content to view your new Restrooms Feature Layer.

 Your web layer name will be appended with your first name and last initial. If necessary, you may need to refresh the connection to see the service.

Step 7: Add your published services to web map

Now you will add your published web layers to your Naperville Bike To Work Day web map.

- a Restore your browser window connected to ArcGIS Online.

 If you closed it, reopen a browser window, go to www.arcgis.com, and sign in with the provided credentials.

- b Go to My Content to view your two new services and your Bike To Work Day map.

<input type="checkbox"/>	<input checked="" type="checkbox"/> Naperville Bike to Work Day Map	<input type="button" value="▼"/>	Web Map
<input type="checkbox"/>	 Restrooms	<input type="button" value="▼"/>	Map Image Layer
<input type="checkbox"/>	 SecondaryStops	<input type="button" value="▼"/>	Feature Layer
<input type="checkbox"/>	 SecondaryStops	<input type="button" value="▼"/>	Service Definition

 Your items will have your first name and last initial appended to them.

- i Click the down arrow next to your Naperville Bike To Work Day Map, then choose Open in map viewer.

- j Click the Add button  and choose Search for Layers.

- k In the Search pane, open the in drop-down list and choose My Content.

Both of your layers appear in the results.

- l Under the Restrooms result, click the Add link.

The restrooms are added to the map.

- m Add the SecondaryStops in the same way.

The single feature in the SecondaryStops service appears in the map.

- n Click Done Adding Layers.

- o If necessary, pan and/or zoom your map so that all data is visible.

- p Click the Save button  and choose Save.

LESSON 2

Step 8: Configure the web map

In this final step, you will ensure that your new layers are configured properly for their intended use in the map.

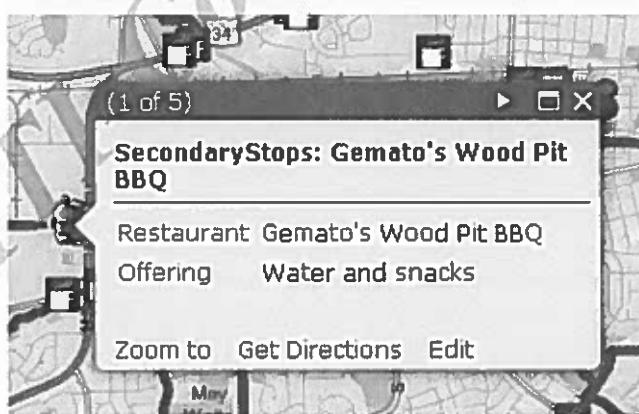
- a Zoom in to the central part of the map until it looks similar to the following graphic.



- b Click a restroom point to attempt to view its pop-up window.

Notice that no pop-up window appears.

- c Pan or zoom to the west central part of the map until you can see the convenience store symbol.
- d Click the convenience store symbol, which represents a sample stop proposed by Gemato's Wood Pit BBQ restaurant.



Notice that the rest stop proposed by Gemato's Wood Pit BBQ restaurant displays two attributes associated with the SecondaryStops service:

1. The restaurant name.
2. The refreshments available for bike riders.

Those attributes are the only details that the city has to capture because the Dine Local Locations service contains lots of other useful information (such as contact info). Bike riders will know where to find a rest stop based on the symbol location. They can also determine if they can obtain water or snacks, based on the Offering attribute. You could also configure the pop-up windows for SecondaryStops to provide extra content, such as restaurant photos or links to websites.

e Close the pop-up window.

You will also create spatial bookmarks so users can quickly navigate to different sections of the map.

f Click the Bookmarks button .

g Click Add Bookmark.

h Type Central Naperville and press Enter.

i Create two more bookmarks as follows:

- Pan north and name the bookmark North Naperville.
- Pan south and name the bookmark South Naperville.

j Test your bookmarks by clicking each one.

Recall that the extent of your web map when you save it is what users will see when they open it.

k In the Contents pane, click the down-arrow next to Naperville Restaurants, and choose Zoom to.

 Zooming to the layer ensures that users will see the entire area of interest when they first open the map. In addition, they can use the bookmarks that you have created for easy navigation.

l Save your map again.

m Keep your browser signed into ArcGIS Online.

n Close ArcGIS Pro without saving the map document.

You have finished this exercise.

LESSON 2

Lesson review

1. Operational content that is shared with ArcGIS Online is typically published as a map service.

- a. True
- b. False

2. When you publish a feature service to ArcGIS Online, what happens to the data?

3. What is a hosted layer?

Answers to Lesson 2 questions

Exercise 2: Publish and use feature services in a web map (page 2-15)

1. Why can you not uncheck the Mapping option?

All service capabilities associated with ArcGIS for Server are actually map services. All the other capabilities build off of the core map service so it is always enabled.

ITI-Conscripts, September 2025

3

Creating web apps

Introduction

Key terms

web app

Now that you know how to use ArcGIS Pro to author a web layer you are ready to use the layer to support editing. To get the most out of your feature layer, you will learn various ways to deploy it.

Editable feature layers can be added to web maps, and used in web and mobile apps. Web apps often provide more functionality. Although you can create a web app from scratch, ArcGIS Online also provides easy-to-use templates that do not require programming. The ArcGIS mobile app extends the use of feature services to tablets and smartphones. If you know how to program, you can also build your own mobile app from scratch.

Topics covered

- Creating editable feature layer
- Creating editable web maps and apps
- Using the templates and Web AppBuilder for ArcGIS
- Developer options for web and mobile apps

Learning objectives

After completing this lesson, you will be able to do the following:

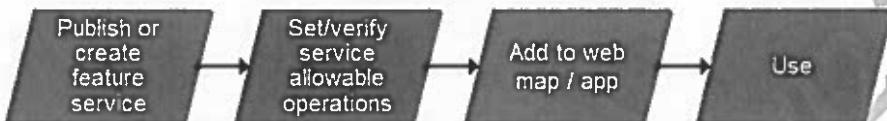
- Identify web application options for using services.
- Use a web application to edit data through a hosted feature service.
- List options for using feature services.

Configuring feature services to support editing

The workflow for an editable feature service is straightforward.

Figure 3.1

Workflow to configure a feature service to support editing.



Step 1: Publish/create the feature service

You could use ArcGIS for Desktop to publish a feature service (hosted in ArcGIS Online or ArcGIS for Server). The resulting feature service can be added to a web map or application. Before publishing a feature service, consider these best practices:

- **Set the appropriate coordinate system**

Set the coordinate system of your published layer to match the coordinate system of the services that you will combine it with. For example, if you plan to use the basemaps available on ArcGIS Online, you would set the coordinate system of the data frame to Web Mercator (Auxiliary Sphere). To mash up multiple services that have different coordinate systems, you would publish using a specific coordinate system for optimal performance.

- **Use domains and subtypes to support editing**

Establishing subtypes or domains can increase the usability of your web map and reinforce data integrity. For example, if restaurant owners manually type attribute values like "water" or "snack," there will likely be misspellings that will require a significant amount of time to correct. Using subtypes and domains can eliminate this problem for you.

- **Create a feature template to support editing**

Inserting new features through a feature service is accomplished through feature templates. Therefore, it is important to create a feature template in ArcGIS Pro before publishing. A template allows you to digitize a new feature and have the default values for the attribute set accordingly. Feature services require that there exists a template for each feature type. When you begin editing in ArcGIS Pro , a feature template is created for each feature type.

The alternative to creating a feature service with ArcGIS Pro is creating an empty one using ArcGIS Online. You can accomplish creating an empty service in ArcGIS Online in two ways:

- If you already have a hosted feature service that has the desired schema, you can create an empty feature service, using it as a template.
- Conversely, you can use one of the publicly available templates on ArcGIS Online to publish an empty feature service.

Another way to create an empty feature service is available to developers at <https://developers.arcgis.com>. Sign in with your ArcGIS Online credentials, and you are able to access your GIS content and create new feature services.

Step 2: Set/verify the allowable operations

The Share as web layer tool allows you to set edit permissions (create, update, delete) on a feature service published to ArcGIS Online or ArcGIS for Server. With ArcGIS Online hosted feature services, as long as you are the owner of the service, you can edit the permissions for the service

to allow users to make any of the following edits:

- Add, update, and delete
- Update attributes only
- Add features only

Step 3: Add to web map/app

You already know how to add a feature service to a new or existing web map. Often, you may not need to change the web map to facilitate its use by editors. However, in some situations, you might configure the pop-up capability of the resulting layer in the web map to display information that helps editors decide where to create data and what attributes to include. In other words, you can choose the specific attributes that you will allow to be edited.

Setting up a web map first can be helpful even if you decide to convert it to a web app. Various web and mobile apps can consume web maps. Any changes made in a web map will be reflected in any apps that consume it. When it is time to share your web map, you can choose to share it as a web app and then select from various pre-built JavaScript templates available on ArcGIS Online. Or, use the Web AppBuilder for ArcGIS to make more custom web apps. Apps from templates or Web AppBuilder require no coding, unless you want to customize them further. They can be embedded in an existing

website, hosted by ArcGIS Online, or downloaded and hosted on your website.

Step 4: Use the web map, web app, or mobile app

When an editor accesses the feature service, they gain the benefits of the work you did before publishing the service.

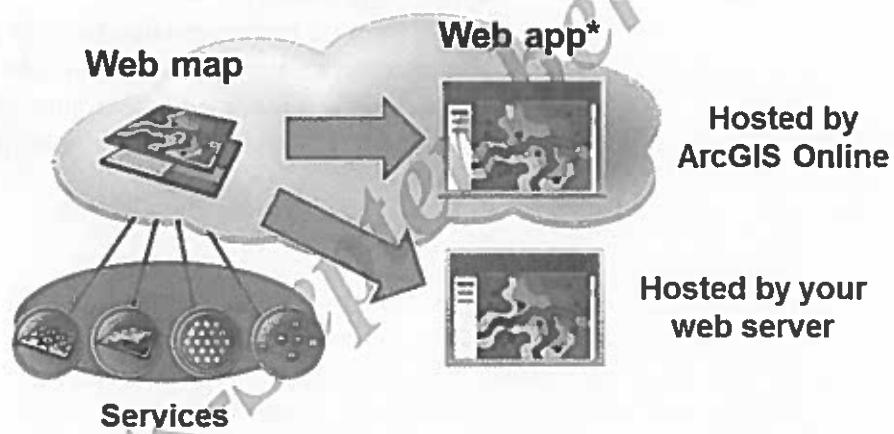
- When an editor creates a feature, the feature template that you established in the authoring phase controls the Edit tool and symbology.
- Because it is a feature service, the editor can change the symbology (locally).
- If you set it up before publishing your service, the attribute entries can use subtypes and domains. The editor can simply set predefined attributes when creating or modifying features, eliminating potential invalid data entries.

Web maps to web apps

Web apps, or applications, can include extra functionality compared with web maps. They can also be shared in more ways, including the following scenarios:

- Hosted in ArcGIS Online
- Hosted in Portal for ArcGIS
- Hosted on your own web server
- Embedded in an existing website

Figure 3.2
Options for hosting web maps as apps.



*Many prebuilt JavaScript app templates

Here are a few examples that you can take advantage of in your web app:

- **Edit:** simple editing functions for editable layers
- **Storytelling Compare:** compare up to three maps in one application
- **Elevation Profile:** create elevation profile for selected feature or measured line
- **Simple Map Viewer:** display map that auto-adjusts to desktop, tablet, phone
- **Storytelling Swipe:** view two overlaid maps using a swipe tool
- **Social media:** embed capabilities to Twitter, Flickr, and so on

Several options can be considered when you use a web app (whether it supports editing).

ArcGIS templates

Figure 3.3

You can build GIS applications using the ArcGIS templates.



If you want more functionality than a web map offers, evaluate the built-in JavaScript templates. ArcGIS templates are publicly available on ArcGIS Online when you share your web map. They are a quick and easy way for anyone to deploy applications and share web map content. Templates are task-specific JavaScript applications that have a focus on specific functionalities, such as parcel location, time aware, social media, or elevation profiles.

More web app options are discussed in upcoming sections.

Sharing editable maps and applications

Operational layers (such as Park Furniture in the following image) can be configured to support editing. Feature services that support editing can control the type of edit operation (add, update, delete). They also support geodatabase behaviors, such as subtypes and domains. In this example, browser users can input new park furniture within a web map.

Figure 3.4
Park facilities data in ArcGIS Pro can be shared and edited as a web map or as an app created from a template.



LESSON 3

Building your own web apps

In addition to the prebuilt ArcGIS templates, there are more tools for creating web apps, with or without requiring coding.

Web AppBuilder for ArcGIS



Figure 3.5

Web AppBuilder offers more functionality than the templates. This application builder still allows you to create web applications without writing a single line of code. You also have a choice of dozens of out-of-the-box widgets to implement into your pure HTML-based application, for extra configuration possibilities. Web AppBuilder for ArcGIS has a graphical user interface (GUI) so you can quickly and easily perform the following:

- Change the look and feel of your web application
- Add functionality with widgets for geoprocessing, printing, navigation, and more
- Apply branding for your organization
- Use your web app wherever you want:
 1. In ArcGIS Online
 2. In Portal for ArcGIS
 3. On your own web server

You can also export your applications as templates, to reuse designs and functionality in future organizational application.

ArcGIS story maps



Figure 3.6

Combine multimedia with maps to tell a story using ArcGIS Story Map.

ArcGIS story map applications are a combination of ArcGIS Online maps and multimedia content (text, photos, video, and audio). You can use them to upload your multimedia content and tell a story about your world. No developer skills are required to create a story map application.

Other apps

You can also use web GIS content in existing native mobile apps, such as Collector for ArcGIS, Operations Dashboard, and the ArcGIS App, all created by Esri using the Native SDKs.

- Collector for ArcGIS is available as an Android or iOS app and allows you to capture data, photos, and video, as well as plan routes and get directions. The app can be configured to fit your organizational workflows. It requires an organizational account to ArcGIS Online.
- Operations Dashboard for ArcGIS allows you to connect services or web maps along with performance indicators such as charts and gauges to provide an up-to-date view of your geographic information. This product also requires an organizational account to ArcGIS Online.
- The ArcGIS App is a free downloadable application for iOS, Android, and Windows Mobile mobile devices. The app allows you to view and navigate maps, collect data, and perform GIS analysis.

Developer options

The ArcGIS Web APIs and native SDKs give developers the ability to create an application from scratch and have full control over its layout and functionality.

The ArcGIS API for JavaScript is a lightweight way to embed maps and tasks in web applications. You can get these maps from ArcGIS Online or your own ArcGIS Server. It uses the latest HTML and CSS standards to increase flexibility and performance in both mobile devices and desktops.

Native SDKs (Runtime) are also for developers, to create custom mobile apps. The SDKs can consume web maps as well as services. These SDKs support smartphones and tablet devices:

- iOS
- Android
- Windows phone

Creating a custom Web AppBuilder app

Even if you are not a programmer, the Web AppBuilder enables you to create customized web applications using a wide variety of prebuilt widgets (tools, buttons, and so on). You can also control the layers used as well as the layout and design of your application. In this scenario, a custom application allows users to create new park furniture features using the ParkFurniture feature service.

Figure 3.7

This web application allows editing using a hosted feature service.



ITI-Conserve

25 minutes



Exercise 3: Create an editable web app

In this exercise, you will continue working on your Bike To Work Day project. You previously created a web map that allows restaurant owners to markup locations of proposed rest stops along the bike routes to provide refreshments and promote their establishments. Now, using that web map and an ArcGIS template, you will create a web application that will allow restaurant owners to add their proposed rest stops to the map.

In this exercise, you will perform the following tasks:

- Set allowable operations for a layer.
- Convert a web map into a web app.
- Use editing inside a web app to add a rest stop.

LESSON 3

Step 1: Allow editing for hosted feature service

- a Restore your browser window for ArcGIS Online. If necessary, sign in with Using Your Course Account.
- b Click Home and then My Content.
- c Look for the two layers you have already created:
 - Restrooms_<your name>, which is an ArcGIS for Server map service.
 - SecondaryStops_<your name>, which is an ArcGIS Online hosted feature service.

In a prior exercise, you added both layers to the Bike To Work Day map. Only SecondaryStops will be editable—on this layer, you want restaurant owners to create secondary rest stops to support the Bike To Work Day event. Therefore, enable editing and allow the restaurant owners to create, delete, and even update attribute information on this layer.

- d Click the link for the SecondaryStops feature layer (not the service definition file).
- e Under Setting, scroll down and notice that editing is disabled.
- f Click Public Data collection.
- g Scroll down again and notice that you can now set the editing permissions for this layer.
- h Set the Editing options to allow editors to add, update, and delete features.

Editing	<input checked="" type="checkbox"/> Enable editing and allow editors to:
	<input checked="" type="radio"/> Add, update, and delete features
	<input type="radio"/> Update feature attributes only
	<input type="radio"/> Add features only

Under the Editing options, you see options for syncing and tracking edits.

- Sync allows users to disconnect from the Internet, but continue to edit data that will be synchronized after the connection is re-established.
- Track Edits allows you to track who performed the edits, and to limit editors so that they can only update and delete the features they added (not features added by others).

- i Click the Save button.

Now, share the layers with the appropriate audience. Although a web map may be shared with a particular group, the layers contained in that web map must also be shared with the same group (unless they are set to public access).

- j Go to My Content.
- k Check the selection check boxes for the following layers:
 - Restrooms_<your name>
 - SecondaryStops_<your name>
- l Click the Share button.

For this scenario, you would likely share the layers and resulting web map with Everyone (public). In this classroom environment, however, you will limit it to just one group.

- m Click the option for your class group (provided by your instructor).
- n Click OK.

On the My Content page, you can see that these two layers are shared with a group.

Step 2: Consume web map in web app

In this step, you will verify that your web map referencing the Restrooms and SecondaryStops layers is ready for restaurant owners to use. Then, you will apply an ArcGIS Template to it that will offer a more editing-focused app for them to use.

- a On the My Content page, click the down arrow for the Naperville Bike To Work Day_<your name> map and choose Open in map viewer.
- b Click the Show Map Legend button .

LESSON 3

- c Compare your legend to the one shown. Add any missing layers, reorder the layers as needed, and resave the map before continuing.

Legend

SecondaryStops_EricR -
SecondaryStops



Naperville_Restaurants -
Restaurants



Naperville_Bike_Routes -
BikeRoutes

- Proposed
- Existing

restrooms_ericr

Restrooms



 To reorder the layers in the Details pane, open the context menu for the layer and move it up or down. Click the Show map legend button  to view the legend.

Now you are ready to create the web application, using your map as the input.

- d Click the Share button .

- e Check the box to share the web map with your class group.



A message may inform you that the Naperville restaurants and bike routes layers will not be visible to others who are not members of the groups they are shared with.

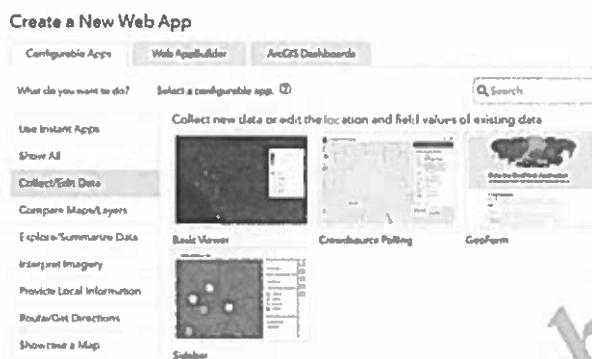
- f If the Update Sharing dialog box appears, click Update Sharing.

Notice that you can copy a link to your map, or embed it in a website. To use embed in a website, you would need to share the map to Everyone (public).

- g Click the Make a Web Application button.

On the Web Application dialog, the Configurable Apps tab lists all the available templates that you can choose from.

- h Locate the Basic viewer template. Click the down arrow next to Publish and select Preview.



A fully functional preview opens in another browser tab. The editable layers are listed in the legend, including in this case the Secondary Stops layer that you own.

- i When you are done previewing the web app, close the browser tab (or window depending upon which browser you are using).
- j In the Web Application dialog, select Basic Viewer template, click on Create Web app.



Basic information about your new web app must be entered before it can be saved and published.

- k For Title, type Bike To Work Day Edit <first name+last initial>.
- l Verify that appropriate Tags and Summary text is entered similar to the text shown in the following graphic.

Share

Fill in the information below to save and publish your web application. View the item details of this web mapping application to see the URL to the application.

Title:	Bike To Work Day Edit Alyson
Tags:	#BikeToWork #BikeToWorkDay #Restaurants #Alyson
Summary:	Includes restaurants and bike routes.

LESSON 3

m Click Save & Publish.

You may see a message reminding you to share the application with others before it can be used, and that you can configure your app as well.

n Do the following:

- Choose a green color scheme.
- Check the box to show the toolbar.
- Check the display editor box in options
- Click Save.

o Click Done to return to the details page of the app.

p Click the Share button. If necessary, check the box to share with your class group (only).

q Under the map thumbnail, click Open > View Application.

Your editing web application opens in a new tab, ready to use. Keep it open for the next step.

Step 3: Use web app to perform edits

In this step, assume that you are a restaurant owner who has received the link to the Bike to Work Day web application. You have been asked to support the event by entering the location that you intend to sponsor.

a In the app, pick any area you think would be good to place a rest stop and zoom in to it.

b In the contents pane, click the Secondary Stops layer to select it.

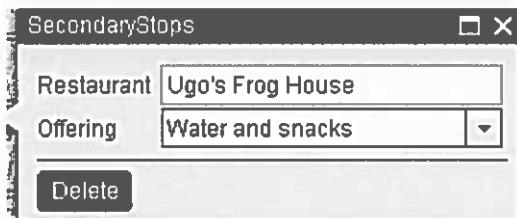
Notice that the Point tool becomes active.

c Create a proposed secondary rest stop by clicking an intersection near the optimal location that you chose.

A pop-up window appears, allowing you to enter the attribute information.

d For Restaurant, type the name of the fictitious restaurant.

- e Next to the Offering attribute, choose Water and Snacks from the drop-down list.



Notice that there is a domain associated with the SecondaryStops feature service, and it has been honored. In addition, the proper symbology has been associated with this new point as defined in the original feature templates.

 You may need to click on the map outside this window for the point to be properly added with symbology.

- f Close the attribute window.
- g Feel free to add more rest stops using the same procedure.
- h When finished adding rest stops, zoom out sufficiently to view most of the Naperville area.
- i Close the browser tab for the Bike To Work Day Edit web app in the map viewer.
- j Go to My Content.
- k Reopen the original web map Naperville Bike to Work Day Map.
- l If necessary, zoom to the part of Naperville where you added the rest stop.

The new rest stop displays. As the city employee, after sending out your invitation to the restaurant owners, you could use this method to monitor the status of their proposed rest stops. If you click the new rest stop, it will display the restaurant name and what is being offered.

LESSON 3

Lesson review

1. Built-in web app templates and custom web apps made with Web AppBuilder must be hosted exclusively in ArcGIS Online.

- a. True
- b. False

2. Feature support editing.

- a. True
- b. False

The following questions are designed to test your understanding of the concepts covered in this lesson. Please answer each question based on the information provided in the lesson and your own knowledge of the subject matter.

1. Which of the following statements is true about built-in web app templates and custom web apps made with Web AppBuilder?

- a. They can be hosted on any web server.
- b. They must be hosted exclusively in ArcGIS Online.

2. Feature support editing is a feature available in which type of application?

- a. Desktop GIS applications
- b. Feature support editing is a feature available in both desktop and web-based applications.

3. What is the primary benefit of using feature support editing in a web-based application?

- a. It allows users to edit features directly from their web browser.
- b. It requires users to download and install specialized software.

4. Which of the following is a requirement for using feature support editing in a web-based application?

- a. A local database connection.
- b. An internet connection and a web browser.

5. Feature support editing is a feature available in which type of application?

- a. Desktop GIS applications
- b. Feature support editing is a feature available in both desktop and web-based applications.

6. What is the primary benefit of using feature support editing in a web-based application?

- a. It allows users to edit features directly from their web browser.
- b. It requires users to download and install specialized software.

7. Which of the following is a requirement for using feature support editing in a web-based application?

- a. A local database connection.
- b. An internet connection and a web browser.

8. Feature support editing is a feature available in which type of application?

- a. Desktop GIS applications
- b. Feature support editing is a feature available in both desktop and web-based applications.

9. What is the primary benefit of using feature support editing in a web-based application?

- a. It allows users to edit features directly from their web browser.
- b. It requires users to download and install specialized software.

10. Which of the following is a requirement for using feature support editing in a web-based application?

- a. A local database connection.
- b. An internet connection and a web browser.

4

Authoring basemap content

Introduction

Key terms

cached map service

test cache

tiled map service

Basemaps are vital reference layers for any map and are easy to share using ArcGIS for Desktop. But before you invest your time in sharing your own basemaps, you may want to investigate all of the basemaps already available at ArcGIS Online, whether provided by Esri or other users.

Basemaps are used as reference layers for web maps, or maps within web applications or mobile apps. They provide a rich set of background data to support your use of authoritative operational layers.

Basemaps are published as map services, either to ArcGIS Online or ArcGIS for Server. In either case, basemap services are almost always cached (tiled) so that display performance is optimized. Caching involves pre-rendering tiles, in the form of images, of the basemap at various scales. If you plan to combine your basemap with another cached service, the scale levels must match in order for both cached maps to be displayed. The authoring process in ArcGIS Pro involves making sure that you have a common tiling scheme and that the symbology of individual layers is appropriate for the scales of display that the server will create.

Topics covered

- How to share basemaps with ArcGIS for Desktop
- The caching workflow
- Existing basemaps available with ArcGIS Online
- How to build a test cache

LESSON 4

Learning objectives

After completing this lesson, you will be able to do the following:

- Evaluate the suitability of data as basemap content.
- Apply sound design decisions to create an optimal cache.
- Create a test cache in ArcGIS Pro as a tile package.

ITI-Conscripts-September 2025

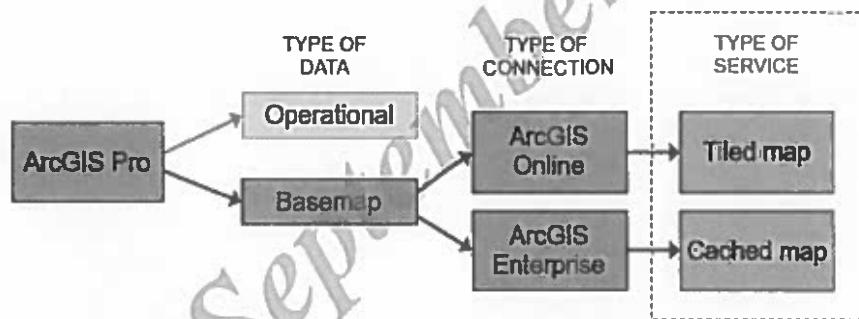
Sharing basemap content with ArcGIS for Desktop

Basemaps have certain common characteristics:

- Layers tend to change infrequently.
- Data is more continuous (often raster or polygon vector data).
- Tends to have many more layers than operational data.
- Typically used as background reference.
- Contain text or annotation.

When you share your basemap layers from ArcGIS for Desktop, you will publish as a map service to ArcGIS Online or to ArcGIS for Server.

Figure 4.1
Publishing a basemap as a map service to ArcGIS Online or ArcGIS for Server.



Map services in ArcGIS for Server

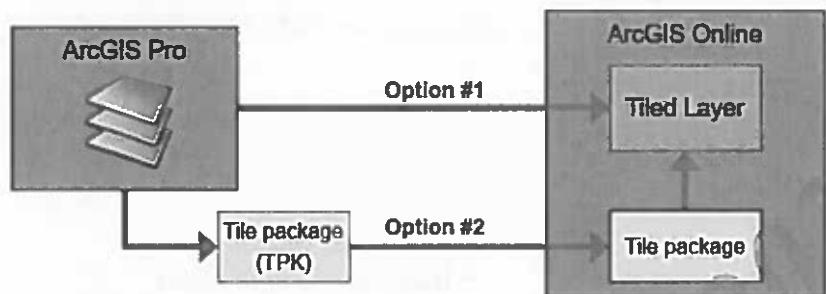
Map services in ArcGIS for Server are either **cached** (tiled) or **dynamic** (not tiled). However, for a basemap, the use of dynamic map services is discouraged; the display performance in most situations is much better with cached map services. However, whenever any of the underlying data changes, cached map services must be updated (the tiles must be re-created).

Map services in ArcGIS Online

Map services in ArcGIS Online are shared as a **tiled** (cached) map service, also referred to as a hosted **tiled map service**. One choice for creating such a service is to publish using your ArcGIS Online connection and allow the tiles to be created after the data has been uploaded to ArcGIS Online. In this situation, ArcGIS Online is providing the computational resources to generate and store the tiles. The alternative is to use ArcGIS for Desktop to create the tiles first and then upload the resulting tile package to ArcGIS Online. Once uploaded, the tile package is published as a tiled map service, referred to as a **tile layer**.

LESSON 4

Figure 4.2
The two options for sharing ArcGIS for Desktop basemap content to ArcGIS Online.



When planning your strategy for sharing basemaps, consider whether you will include many layers in one basemap or fewer layers in multiple basemaps. In other words, basemaps may be combined, or mashed up, with other basemaps in web maps and apps to provide the necessary background reference. In the latter case, you must be aware of the tiling scheme used by the tiled map services you want to combine so that they align properly and use the exact same scales.

Caching workflow: Plan

The workflow for caching a map service involves:

- Planning
- Designing
- Creating a test cache
- Building the final cache

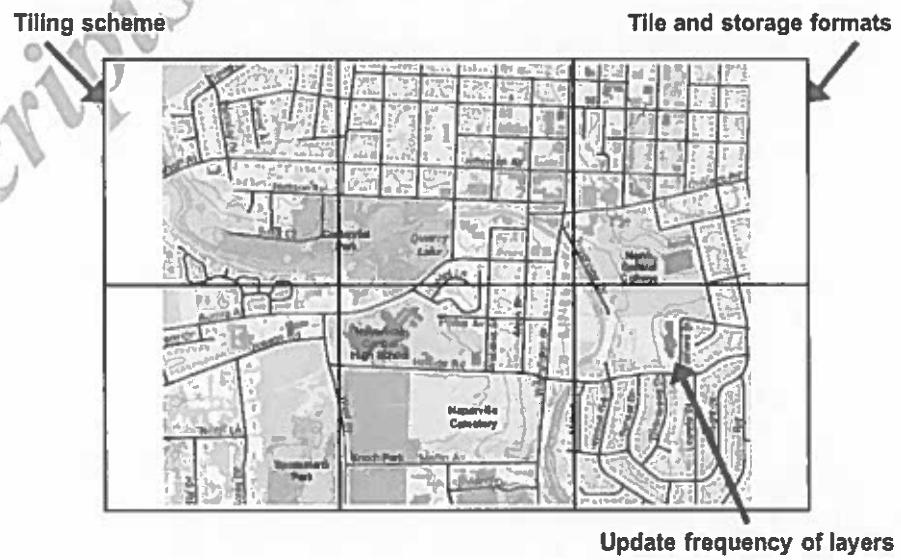
Figure 4.3
Planning is the first step in
the caching workflow.



Planning is important so that you know what parameters to use when building a cache. Some points to consider before building a cache include the following:

- Update frequency
- Tile formats
- Storage formats
- Tiling scheme

Figure 4.4
Planning your map cache.



Update frequency

Consider the expected frequency for updating any of the layers that will constitute the map service. For example, if your basemap layers consist of aerial photos overlain with municipal park boundaries, the park boundaries may change slightly on an annual basis. If so, rebuilding the cache may not be a problem. However, if you have a layer like forest perimeters, then you may need to rebuild the cache on a monthly basis. Building and deploying a cache can be very time intensive, so you may want to separate the layers that may never update from the layers that do and publish separate map services. Map services may be combined in client applications. By organizing your map services by how often recaching has to happen, you can save considerable time in the end.

Tile formats

Although you can set numerous cache properties, your choice of image format is important in terms of storage, performance, and the ability to overlay with other map services.

Table 4.1

PNG	<ul style="list-style-type: none"> Supports transparency (a good choice when needed) The default chooses the appropriate bit depth to support visual quality while minimizing storage
PNG8	<ul style="list-style-type: none"> Limited support for transparency Maximum 256 colors
PNG24	<ul style="list-style-type: none"> Supports transparency Maximum 16 million colors
PNG32	<ul style="list-style-type: none"> Supports transparency Many colors, good if anti-aliasing is used
JPEG	<ul style="list-style-type: none"> Can set compression level Good for raster layers/many colors
MIXED	<ul style="list-style-type: none"> JPEG for central areas PNG32 for peripheral areas for transparency

Storage formats

In ArcGIS for Server, you have a choice of two tile storage formats: compact and exploded.

- Compact: If you plan to create tile packages on a staging server, and then copy them to the production server, consider using the compact format, which bundles the tiles in a more efficient form for copying. When creating tile packages to upload to ArcGIS Online, the compact format is automatically used.
- Exploded: The exploded format is useful for viewing the individual tiles, but they take longer to create and copy.

Tiling scheme

The tiling scheme involves a set of display scales, the tile size, and tile origin. Most web content uses the ArcGIS Online/Bing/Google Maps tiling scheme, so using it is highly recommended. However, some users may need to share GIS content using custom tiling schemes that match their internal organizational standards for existing cached map services. Once again, choosing the appropriate tiling scheme is important when overlaying multiple map services in a web map or application.

Determining scales for caching

When designing a caching scheme, it is important to determine the minimum and maximum scales to use to set the upper and lower limits on the cache. Although you want to allow enough detail (capability to zoom in) for your users, keep in mind that each additional scale level increases the number of tiles by a factor of about four.

Figure 4.5

A suitable scale to use as a maximum scale for a cache for the Bike To Work Day Map.



Caching workflow: Design

Now that you have planned the caching of a map service, it is time to consider how to actually design your tiling scheme in ArcGIS Pro . If you plan on mashing up your service with ArcGIS Online or Google Maps, use the tiling scheme for these commercially available services. However, some organizations may prefer to use a custom tiling scheme to adhere to their own standards.

Figure 4.6
The design step of the
caching workflow.



In order to overlay properly, map services must use the same tiling scheme. Tiling schemes include levels of detail (or scales at which that tiling scheme can be cached). You can choose the levels of detail that are appropriate for your map service; tiles will be cached for each level of detail that is included in your map service. Remember that creating a cache can take a significant amount of time and disk space, so more levels of detail will require more time and space.



Because cache creation can require significant time and disk space, the recommendation is to create tiles on a staging server within your organization. Then, transfer the resulting set of tiles to the production server (whether ArcGIS for Server or ArcGIS Online).

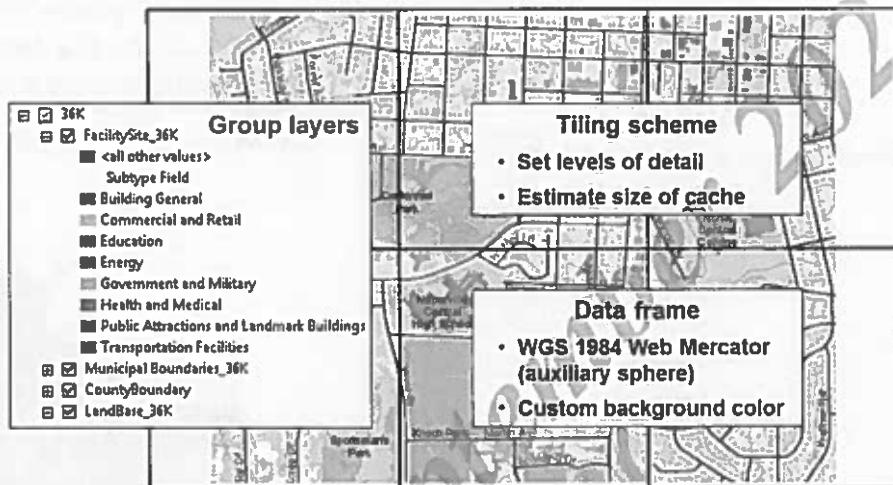
Authoring considerations

ArcGIS Online basemaps use WGS 1984 Web Mercator (auxiliary sphere). If your data uses another coordinate system, you can add the data to ArcGIS Pro and set the data frame properties to use WGS 1984 Web Mercator (auxiliary sphere). When you publish, the data frame properties will define the coordinate system of the resulting service. Using WGS 1984 Web Mercator (auxiliary sphere) is advisable, particularly if you intend to combine or replace with any of the map services available in ArcGIS Online.



Allowing the service to project the data on the fly this way will decrease performance and cause the cache tiling to take more time.

Figure 4.7
Design considerations in ArcGIS Pro for publishing cached map services



If your intent is to combine cached map services in a web map or web app, transparency is vital. Select either a PNG format or a mixed format (JPEG/PNG) to support transparency. In addition, consider how the transparency is determined in ArcGIS Pro . ArcGIS Pro uses the

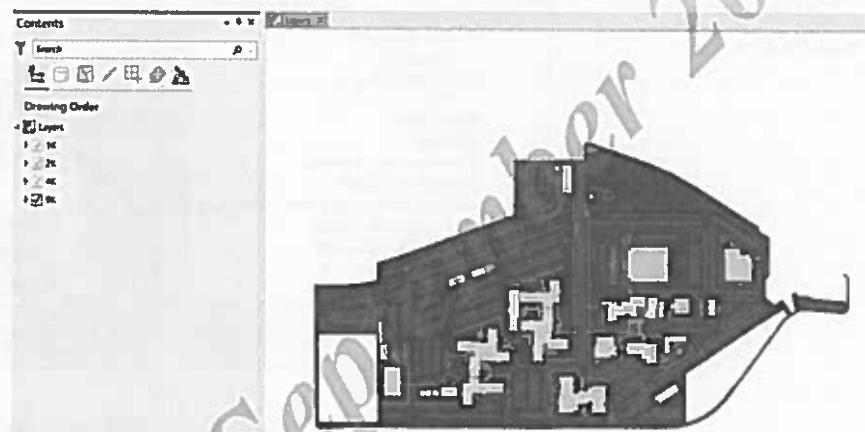
background color to determine transparency% white (RGB = 255, 255, 255) by default. If you have any white features in your map, they will be transparent in the resulting tiles. You could set a custom background color to an RGB value that is not in your map (for example, an off white, RGB = 254, 255, 255; or a bright pink, RGB = 230, 0, 170).

When authoring a map for a cached service, using grouped layers is highly recommended. Grouping layers allows you to specifically control which layers are seen at any given scale in the tiling scheme, as well as how features are drawn (symbology, labeling). You can add or remove layers at scales that are not appropriate to show them. You can set symbology uniquely at different scales. For example, when caching the 1:36,000 scale tiles, facility sites can be classified as unique symbols. However, at 1:72,000, they may be classified as only two symbols, such as government or commercial facilities. Annotation may also be set differently across scales.

Preparing basemap layers

When publishing a cached map service in ArcGIS Pro , consider grouping your layers by the scale levels you know that users will be limited to seeing. That way, you can control the display of features precisely, and minimize the storage requirements and time to create the tiles.

Figure 4.8
Preparing data to publish
as a map service.

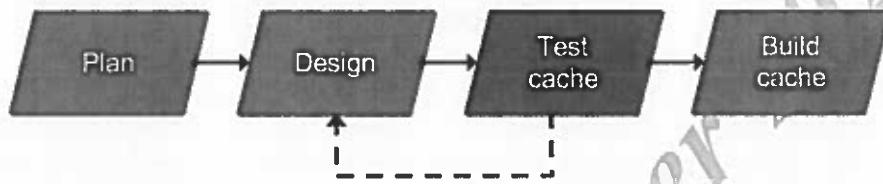


Caching workflow: Test cache

Before committing to creating a potentially large and time-consuming process to create the entire cache for a map service, it is highly recommended that you create a test cache. Here are some benefits of creating a test cache.

Figure 4.9

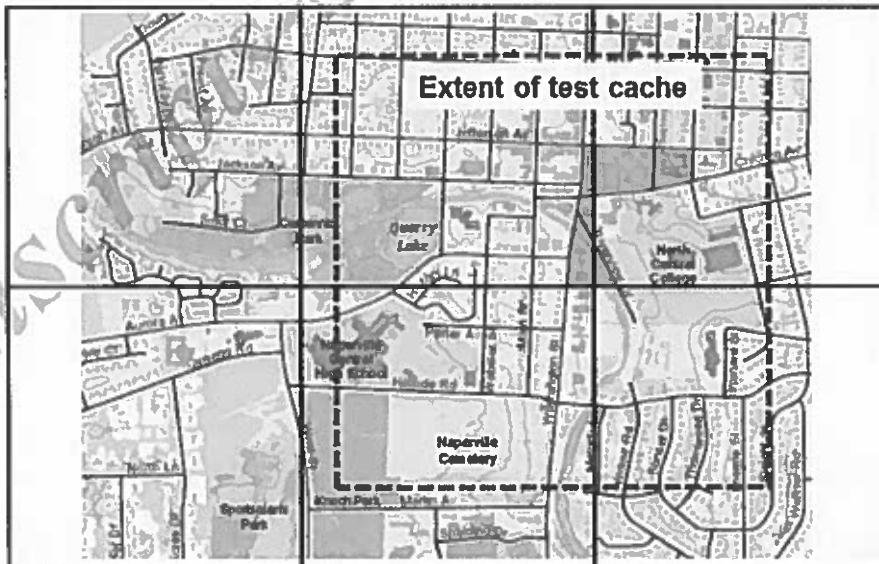
The test cache part of the caching workflow.



First, a **test cache** is of a much smaller area than the entire extent of all the data layers. Thus, it is much quicker to create. Second, a test cache provides an opportunity to use the service with any web maps or apps and see it the way users will see it. If you discover any inconsistencies with how features are displayed at any given scale, you have not invested a lot of time in cache creation. You may also decide to add or remove a scale level to limit or extend the levels of detail for the users of your service.

Figure 4.10

A test cache can provide insight into the optimal caching parameters.



When setting the extent to use to create a cached map service in ArcGIS Pro , you can use one of the following to limit the extent to an area of interest (test cache area):

- Full extent of the map (as defined by data frame properties)
- Current extent of the map
- Import extent from a feature class

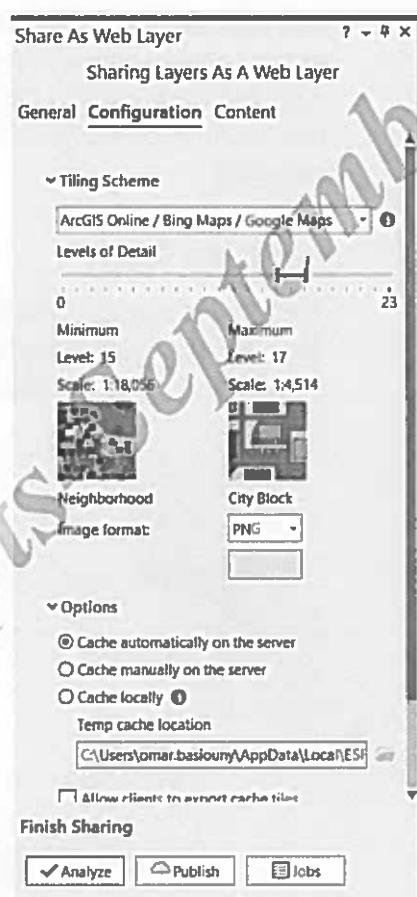
Ultimately, if you learn that you must change your caching strategy, revisit the design phase of the caching workflow and test out your adjustments again.

Publishing a map service

When creating a cache, you have control over specific caching parameters, including the tiling scheme, tile formats, compression level, and levels of detail. And based on the number of levels of detail, you can estimate the size of the cache before generating it.

Figure 4.11

Caching options related to publishing a map service.



Caching workflow: Build cache

After you have a successful test cache, you are ready to create the final cache for the map service.

Figure 4.12
The build cache part of
the caching workflow.

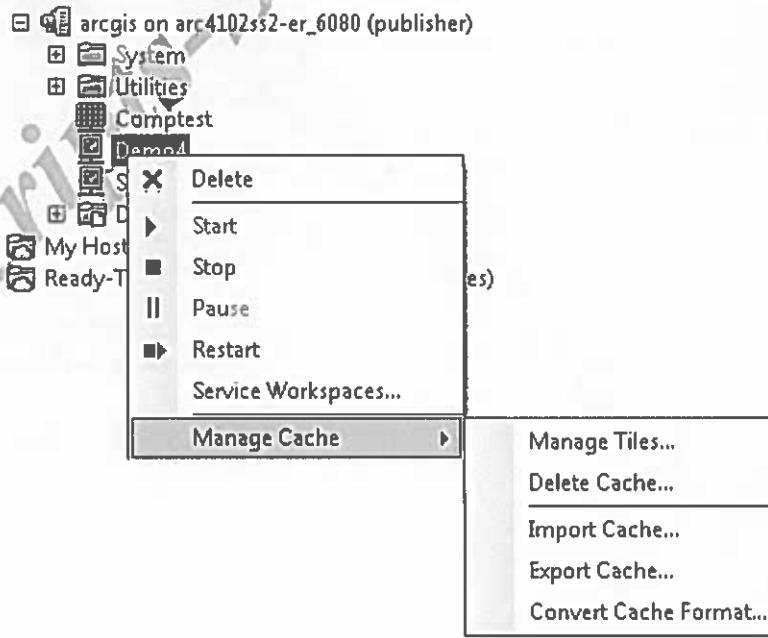


The process of building the cache varies slightly when creating a **cached map service** in ArcGIS for Server compared to creating a tiled map service in ArcGIS Online. Even if you are doing the latter, you still may want to create your test cache in ArcGIS for Server for speed and simplicity.

ArcGIS for Server

The easiest way to build the final cache using ArcGIS for Server is to use your connection to ArcGIS for Server and the set of cache management tools associated with it.

Figure 4.13
The Manage Cache tools
under the connection to
ArcGIS for Server.



The process is as follows:

1. Delete the test cache.
2. Delete the map service used for the test cache.
3. Change the data frame properties to use the full extent of data layers.
4. Republish the map service with the corresponding cache.

To begin, you delete the existing test cache. You will most likely reset the data frame properties in ArcGIS Pro to use the full extent of the data,

so you can also delete the map service. Then simply republish the map using the full extent of the data and use the caching option.

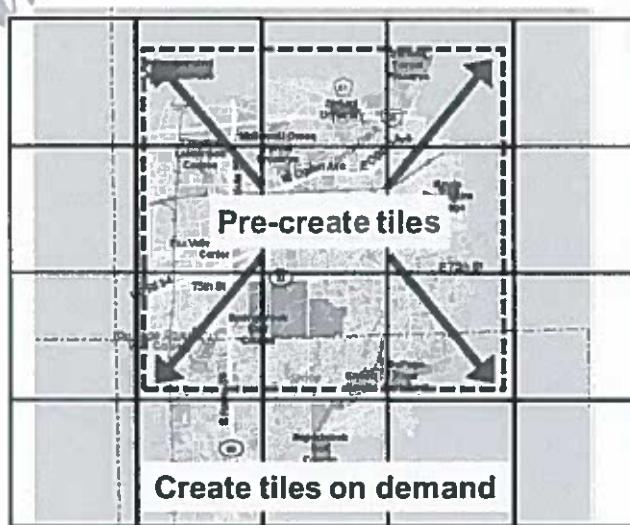
The only other choice to consider is whether to pre-create the tiles or have them created on demand:

- If you choose to pre-create the tiles, the tiles will begin generating when the service is started. You can use the View Cache Status option to see how complete the cache is. View Cache Status is helpful for large cache processes.
- If you choose to have the tiles created upon demand, then when users access your service, each tile will be generated on the fly, delivered to the client application, and added to the server cache. Subsequent requests will return tiles from the cache. Thus, you can avoid a long wait time to create the cache, but users will see improving performance over time as increasing amounts of tiles have been created.
- Another option is to pre-create tiles for areas that will be used more frequently and at higher scale levels. In this way, you minimize the chance that users will encounter uncached areas.

Figure 4.14

Pre-caching tiles for the busiest areas is a nice compromise to make your service available more quickly.

(ArcGIS for Server only)



Invariably, even basemap data may change over time. But updating tiles in a cache is easy to do. There are tools to delete and re-create tiles which can even be scripted to automatically perform updates and can be based on an area of interest.

ArcGIS Online

Note that publishing hosted services requires an organizational account for ArcGIS Online. ArcGIS Online only hosts tiled map services, but you have two methods for creating the service:

- You could publish a tiled map service directly from ArcGIS Pro . With this method, the data is uploaded to ArcGIS Online and tiles are generated in ArcGIS Online.
- You could pre-create a tile package in ArcGIS Pro and then upload it to ArcGIS Online, where it can be used to create a new tiled map service.

Alternatively, another method is to use an existing hosted feature service to create a hosted map service. That way the same set of data could be represented both as a map and feature service.

30 minutes



Exercise 4: Build a cache for the Esri campus

You are tasked with creating a basemap for the Esri headquarters in Redlands, California. Using ArcGIS online, you will publish a test cache to ensure that the properties that you select and the symbolization meet your needs. You will then share a tile package to ArcGIS Online and use it to create a tiled map service.

In this exercise, you will complete the following tasks:

- Build a test cache in ArcGIS online:
 - Prepare the Basemap.
 - Publish a Tile Map to ArcGIS Online.
 - Test the Tile Map.
- Share a tile package to ArcGIS Online.
- Update tiles.

LESSON 4

Step 1: Prepare the Basemap

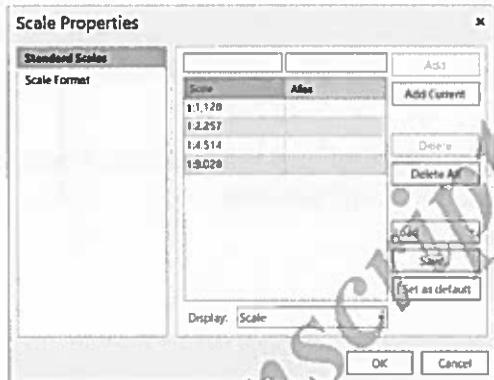
- a Start ArcGIS Pro (SHAR) Project , In Catalog Pane browse to your ..\SHAR\BuildMapCache folder, and open Campus.mxd (Right Click > import & open).

Review the contents pane and notice that the data layers have been organized into groups. Using layer groups helps ensure that layers only display at certain scales and their symbology and labeling is appropriate.

Review the 9K and 4K grouped layers. Notice that there are fewer layers in the 9K grouped layer, which makes sense because showing detailed layers at smaller scales would be confusing for the user and time consuming to cache.

Next, you will ensure that the scales being displayed in ArcGIS Pro as you author the Basemap content reflect what users in most applications would see once it is published.

- b Click the map scale drop-down, then choose Customize.



The scale would be set to use the ArcGIS Online/Bing/Google Maps tiling scheme. However, all of the scales smaller than 1:9,028 would be removed. So, when you are authoring your basemap, you will see exactly what your users of the tiled/cached map will see.

- c Click Load > ArcGIS Online/Bing/Google > delete all scales lower 1:9,028 > click ok
- d Click the Zoom Out button twice.

Notice that the display is blank. Each group layer has scale dependencies set, so each set of layers only display within an appropriate range. Using scale dependencies ensures that what you author in ArcGIS Pro will be reflected in the cache when the tiles are generated.

- e Use the scale window to return to the 1:9,028 scale.

Now you will examine the spatial reference information in the data frame properties. This spatial reference is what the Sharing pane will use by default as the spatial reference for the resulting layer (and cache).

- ❶ in the contents pane, double-click Layers to open the Data Frame Properties dialog box.
- ❷ Click the Coordinate System tab.

1. What is the coordinate system being used?

- ❸ Click Cancel to close the dialog box.
- ❹ Inside any of the grouped layers, double-click any layer to open its layer properties.
- ❺ Click the Source tab > Spatial Reference.

2. What is the projected coordinate system being used?

You see that the individual layers are stored in a state plane system, but that the data frame is set to WGS 1984 Web Mercator (auxiliary sphere)—a standard for web services.

- ❻ Click Cancel to close the Layer Properties dialog box.
- ❼ Collapse any grouped layers that are expanded.

Step 2: Publish a tiled map to ArcGIS online

In this step, you will publish a tiled map to ArcGIS online as a test to ensure the tiles display the information you want them to. You will limit the area of interest for your test cache to speed up the process.

- ❽ From the Map tab > Bookmarks menu, choose Test cache area.
- ❾ in the contents pane, double-click Layers to open the Data Frame Properties.

LESSON 4

- c On the Extent tab, under Extent of data in all layers, click the option for Custom extent.
- d Click choose calculation type, set the option to Current Visible Extent, if necessary.
- e Check Clip Layers to extent, then click OK in the Data Frame Properties dialog box.
- f If you receive a geographic coordinate system warning, click Yes.
- g Save your Project.

Now you are ready to create the Tile Map.

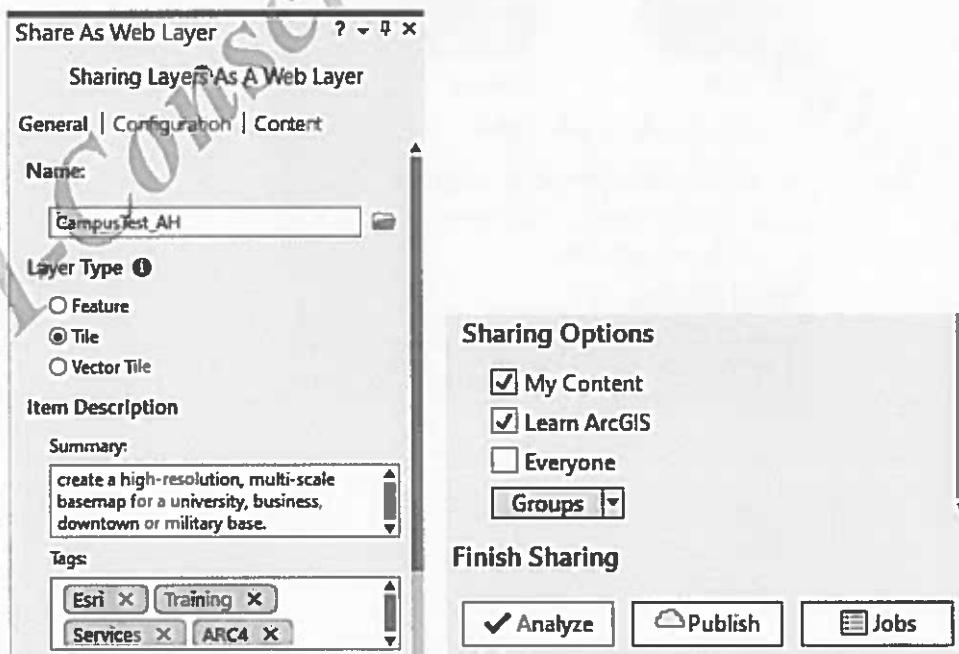
- h From the Contents Pane > select Layers
- i Go to share tab > choose Web Layer.

Progress though the Share as Web Layer Pane as follows:

- For name, type CampusTest_<first name+last initial>
- For Layer Type, choose Tile
- Notice that the summary and tags are provided automatically

This naming convention will ensure that your layer name is unique among your classmates; ArcGIS Online does not allow duplicate service names.

- j For Sharing Options, check your organization.

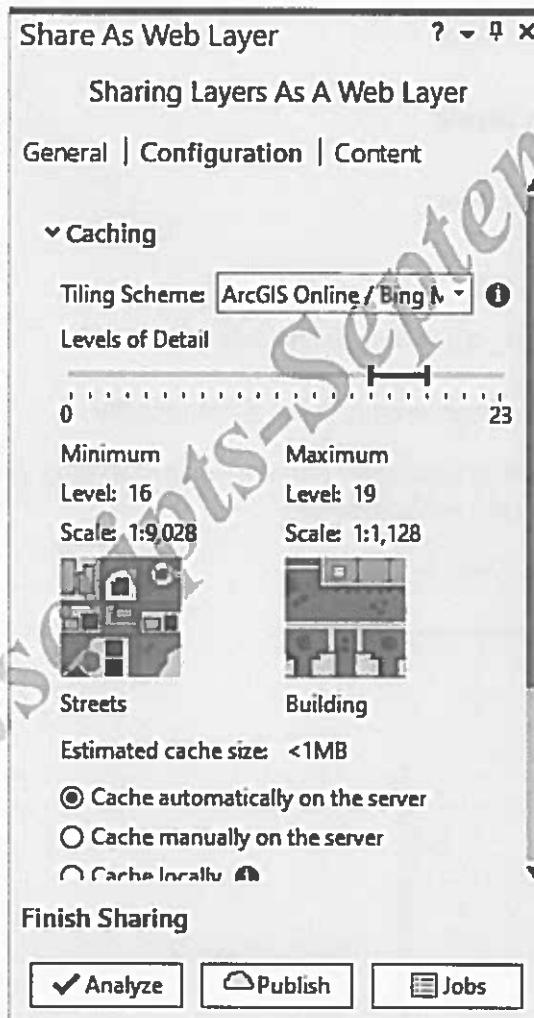


(k) Go to the Configuration tab

Notice that the tiling scheme is already set to ArcGIS Online/Bing/Google Maps, which will allow you to overlay this basemap with others. Also, even though your map document scales were more limited, notice that the level of detail includes the entire scale range inherent to ArcGIS Online/ Bing/Google Maps. Although you can cache other scales than the ones used in your map, for this exercise, you will limit your cache to the scales in your map.

L Using the slider controls, set scale levels as follows:

- Maximum scale level = 1:1,128 (level 19)
- Minimum scale level = 1:9,028 (level 16)



LESSON 4

- (m) Accept the other defaults
- (n) Click the Analyze button.
- (o) No Errors or Warnings appeared, so Click Publish
- (p) Next to Draw this map service, click the option for Using tiles from a cache.
-  Publishing the data to ArcGIS online may take a few minutes.
- (q) After publishing you will get a message that indicates that the Web Layer was published successfully and you can view cache status in the job status pane.
- (r) Click on the Jobs button beside Publish button, then wait until it finishes caching.
- (s) After finishing caching, close the job status pane

Step 3: Test the tiled map

Now that you have tiled map, you can test it in ArcGIS Pro to verify that the layer looks the way you want it to. However, give the layer time to complete tile construction. If you Preview the layer before the tiles are finished, it will display dynamically.

- ❶ **a** Insert tab > New Map > Name (Test)
- ❷ **b** In the Catalog pane, Go to your Portal tab
- ❸ **c** Drag and drop your tiled map **CampusTest_<first name+last initial>**.
- ❹ **d** Use the pan and zoom tools to navigate the tiled map.

The map looks good at all scales so there is no need to redesign it before publishing to ArcGIS Online.

- ❺ **e** In the scale window, type **3000** and press Enter.
- ❻ Are you constrained to viewing only the specific scales dictated by the tiling scheme?

You have verified that your tiled map meets your needs. You are now ready to publish a tiled map package to ArcGIS Online.

Step 4: Generate a tile package to create a tile layer

Although you could publish your tile layer directly to ArcGIS Online, you will use the alternate approach to generate the tile package and share it online and ultimately create a layer from it.

- a In ArcGIS Pro, make sure you are signed in to ArcGIS Online.

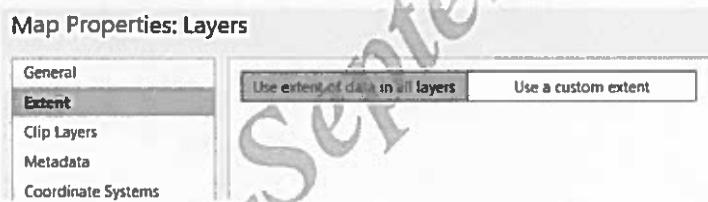
Hint: on the top right side you will see your user name and organization name.

- b Close the Test map > Go back to your original map .

Remember, you set a limited area to use for the full extent command. Now you want to create tiles for the entire campus area, so you will change the data frame extent.

- c Open the data frame properties again and click the Data Frame tab.

- d Click the Extent of data in all layers option.



- e Click OK.

- f From the Bookmarks menu, choose Campus.

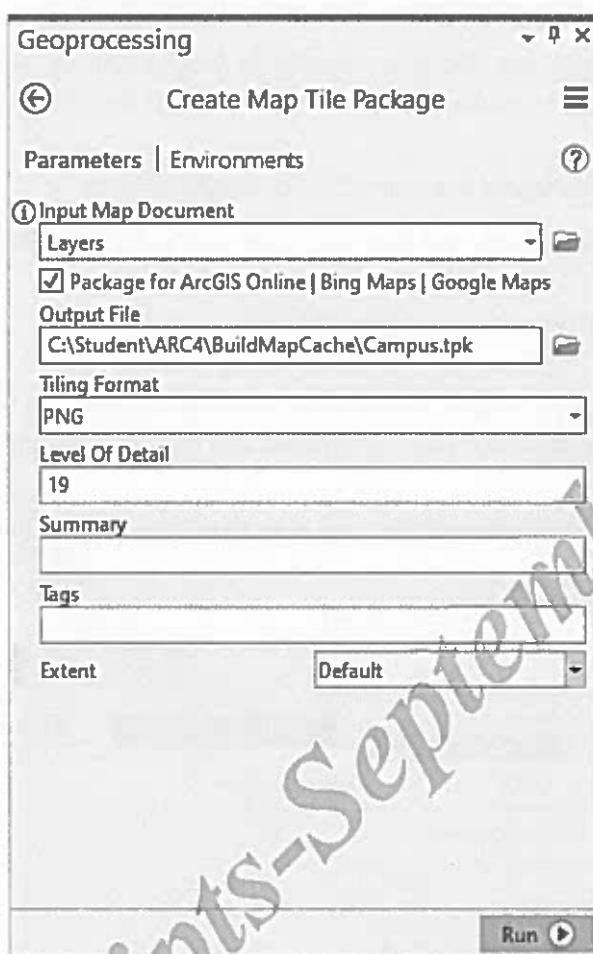
- g From the Analysis tab, choose Tools.

- h In the Search field type Tile > choose Create Map Tile Package.

Progress though the Create Map Tile Package Pane as follows:

- For Input, choose Layers
- For output, browse to C:\Student\SHAR\BuildMapCache
- For Name type Campus_<first name+last initial>.
- For Level Of Detail type 19

Leave the other fields as defaults, your pane should look like the below picture.

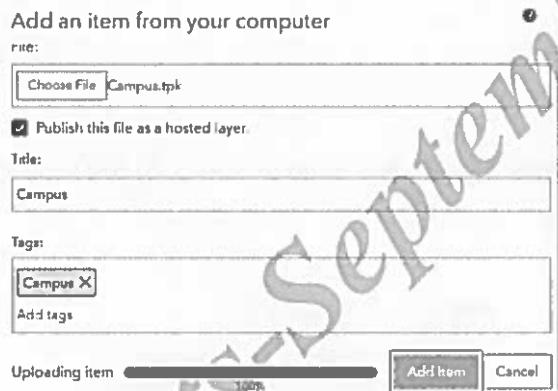


- i Click Run > After finishing you will get a spatial reference warning message.
- j Save your Project.

LESSON 4

Step 5: Examine your tile layer created from tile package in ArcGIS Online

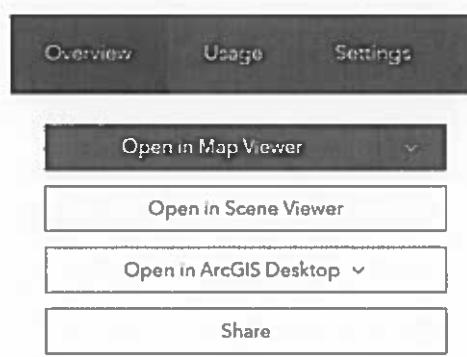
- a Restore your browser for ArcGIS Online, or if necessary, open a new browser window and sign in to ArcGIS Online.
- b Go to My Content.
- c On the top left click the Add Item button > choose From your Computer
- d For file Browse to C:\Student\SHAR\BuildMapCache and choose Campus_<your initial>
- e For Tags Type Campus and make sure that Publish this file as a hosted layer is checked.



- f Click Add Item.

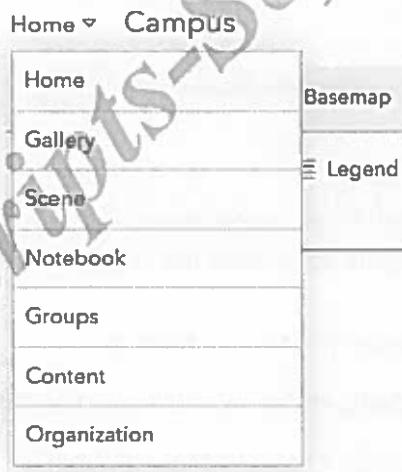
The properties page for your new tile package opens. Although the tile package has been created, it typically takes some time to upload the tiles associated with the package.

- g Scroll down to see the status of the tiles published
- h Click show current tile details, make sure they all published with 100% complete
- i Navigate to Overview tab, Click Open in Map Viewer





- j) Examine your Tile Layer by Zooming in and out.
j) After you finish go to Content from the context menu on the top left.



Step 6: Update tiles

You can Update your Tile Package on ArcGIS online

- ④ Go to My Content, if necessary.
- ⑤ Click the link for the Campus_<first name+last initial> tile package to open its item Description.
- ⑥ Click Update.

Notice that you can upload an updated tile package from your local computer. After you do that, A tiled layer will be recreated for you. You would use the same layer name so that any web maps or apps would continue to work as expected.

- ⑦ Close the Update Item dialog box.
- ⑧ Save your Project and exit ArcGIS Pro.

You have finished this exercise.

Lesson review

1. Why is creating a test cache important?

2. When choosing to cache a map service, you must pre-create the tiles.

- a. True
- b. False

3. A cached map service hosted by ArcGIS Online is called _____.

LESSON 4

Answers to Lesson 4 questions

Exercise 4: Build a cache for the Esri campus (page 4-19)

1. What is the coordinate system being used?

WGS 1984 Web Mercator (auxiliary sphere).

2. What is the projected coordinate system being used?

NAD_1983_HARN_StatePlane_California_V_FIPS_0405_Feet.

3. Are you constrained to viewing only the specific scales dictated by the tiling scheme?

No, ArcGIS Pro can interpolate in between scale levels. Note that other clients such as web maps and apps would be constrained by the available tiles (scale levels).

ITI-Conscripts-September 2025

A

Answers to lesson review questions

Lesson 1: Sharing GIS resources online (page 1-24)

1. After you save a web map in ArcGIS Online, can anyone else access it?

No, not until you share it.

2. If your data includes many layers, changes infrequently, and is made up of contiguous polygons, it should be considered an operational layer.

b. False

3. Explain the role of ArcGIS for Desktop in sharing GIS content online.

ArcGIS for Desktop allows you to share multiple forms of GIS content online such as data layers, data files, and tools.

Lesson 2: Authoring operational content (page 2-32)

1. Operational content that is shared with ArcGIS Online is typically published as a map service.

b. False

2. When you publish a feature service to ArcGIS Online, what happens to the data?

The data is automatically copied to the server.

3. What is a hosted layer?

A hosted layer implies that it is an Esri-hosted service in ArcGIS Online.

Lesson 3: Creating web apps (page 3-18)

1. Built-in web app templates and custom web apps made with Web AppBuilder must be hosted exclusively in ArcGIS Online.
 - b. False
2. Feature services support editing.
 - a. True

Lesson 4: Authoring basemap content (page 4-32)

1. Why is creating a test cache important?

Creating a cache can take considerable time and computer resources. Using a smaller area can help you verify the appropriate cache options before committing entirely.
2. When choosing to cache a map service, you must pre-create the tiles.
 - b. False
3. A cached map service hosted by ArcGIS Online is called hostedtiledmapservice.