ArcGIS Pro SDK for .NET: Approaches for Pro Extensibility

Uma Harano, Esri Inc.

Matthias Schenker, Esri Switzerland Ltd.

2024 ESRI EUROPEAN DEVELOPER SUMMIT

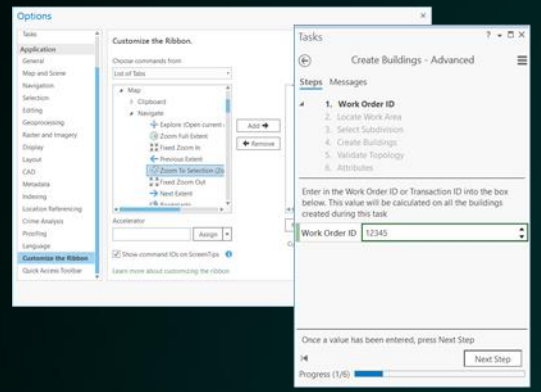
Session Overview

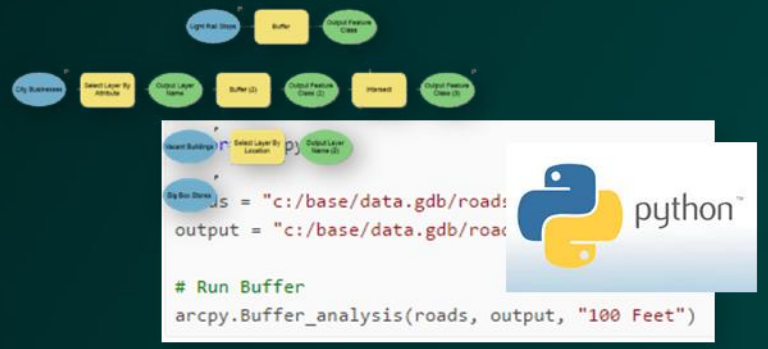
- Extending ArcGIS Pro
- Patterns and APIs
- Updates and What’s Coming
- Resources

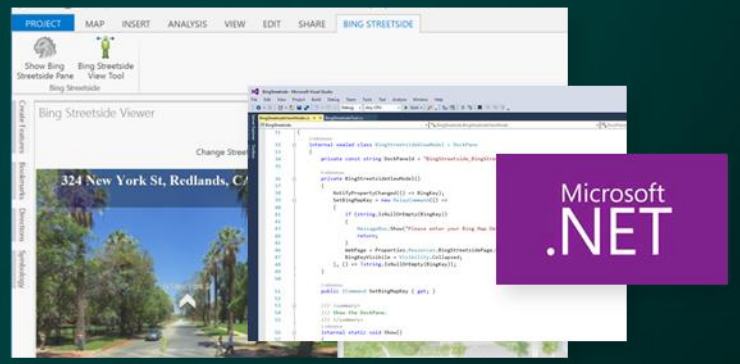
Extending ArcGIS Pro

Options:

- Configure UI through settings, and workflows through Tasks
- Automate using geoprocessing and Python
- Extend with your own custom tools and solutions using the ArcGIS Pro SDK for .NET



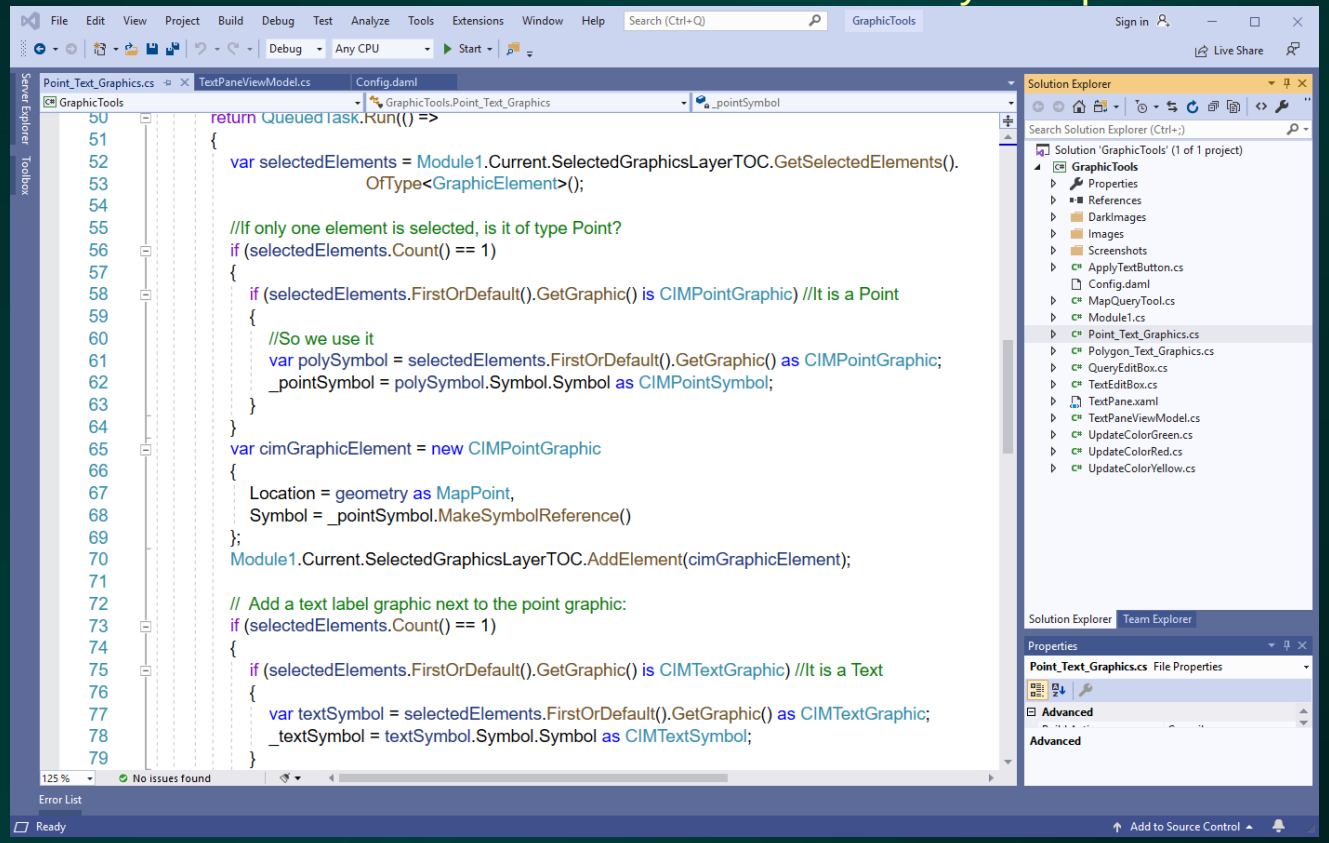




User Perspectives

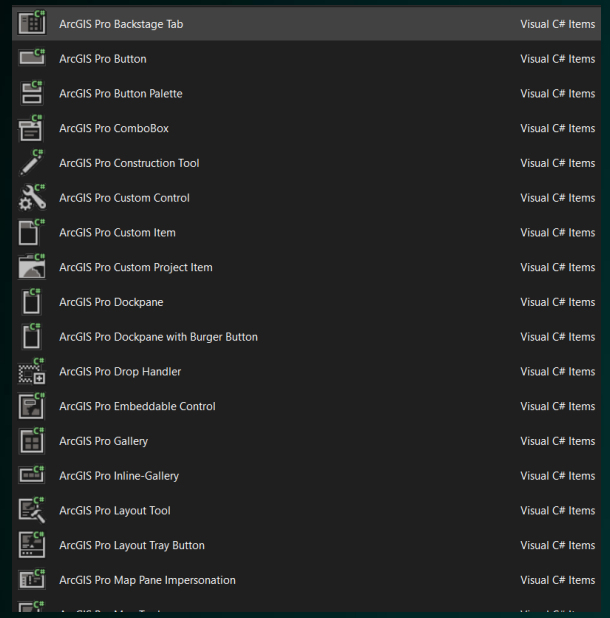
- Many GIS development backgrounds
  - Microsoft .NET
  - ArcObjects SDK
  - New to ArcGIS Pro
  - New to ArcGIS entirely

Pro SDK Community Samples in C#

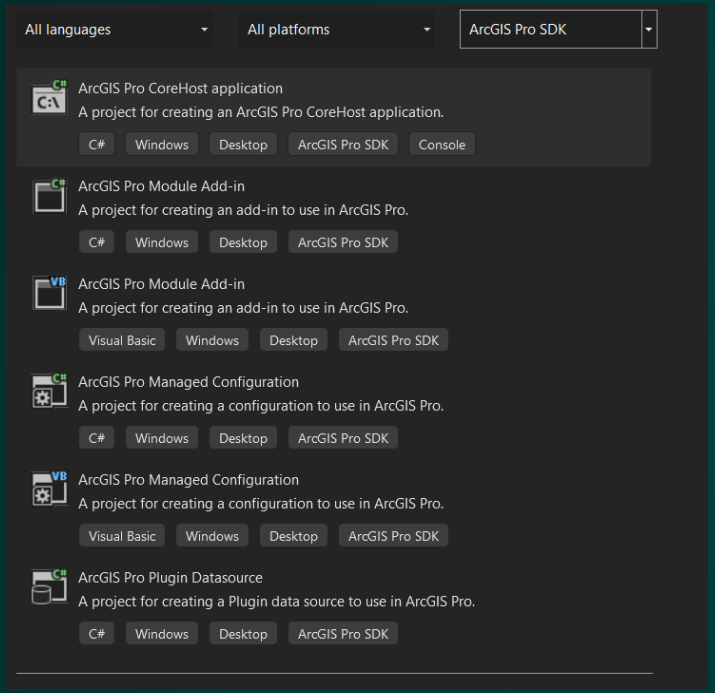


ArcGIS Pro SDK for Microsoft .NET

- Templates and tools for Visual Studio 2022, C# and VB.NET
- Access to the many Pro APIs – Editing, Layout, Map Exploration, etc.
- .NET Desktop Development – WPF, MVVM, Asynchronous programming, etc.
- Releases are in sync with Pro



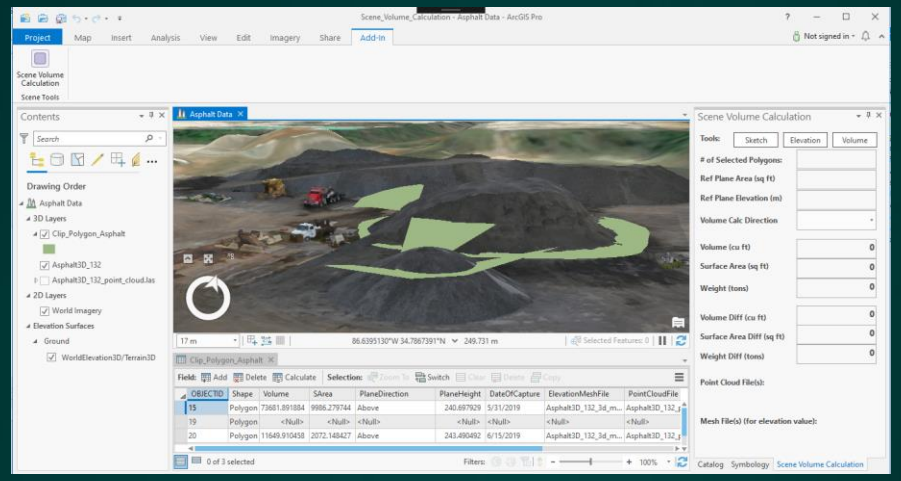
Item Templates



Project Templates

Extending ArcGIS Pro with the Pro SDK

- Add new functionality to Pro
  - Create new tools and routines
  - Custom controls, panes, settings
- Streamline workflows
  - Focus on essential operations
  - Tailor the UI for your organization
  - Organize ribbon with new and existing tools
  - Reduce clicks, repetitive tasks and operations
  - Leverage your industry data
- Make Pro your own
  - Control the startup UI / UX
  - Custom branding



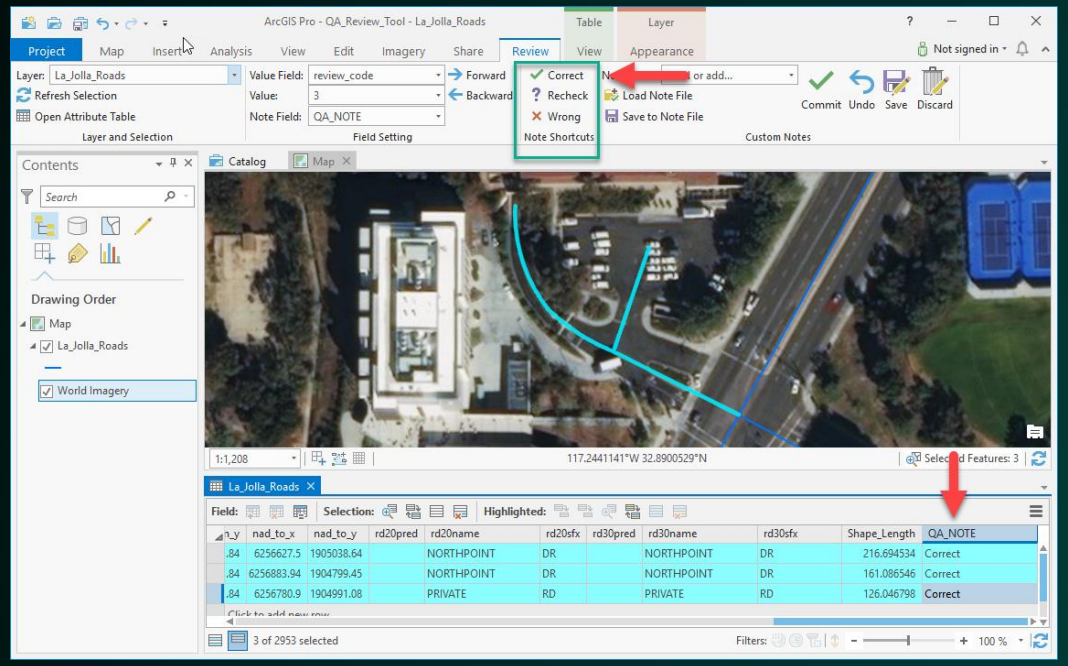
Build new tools to extend ArcGIS Pro

Rebrand ArcGIS Pro

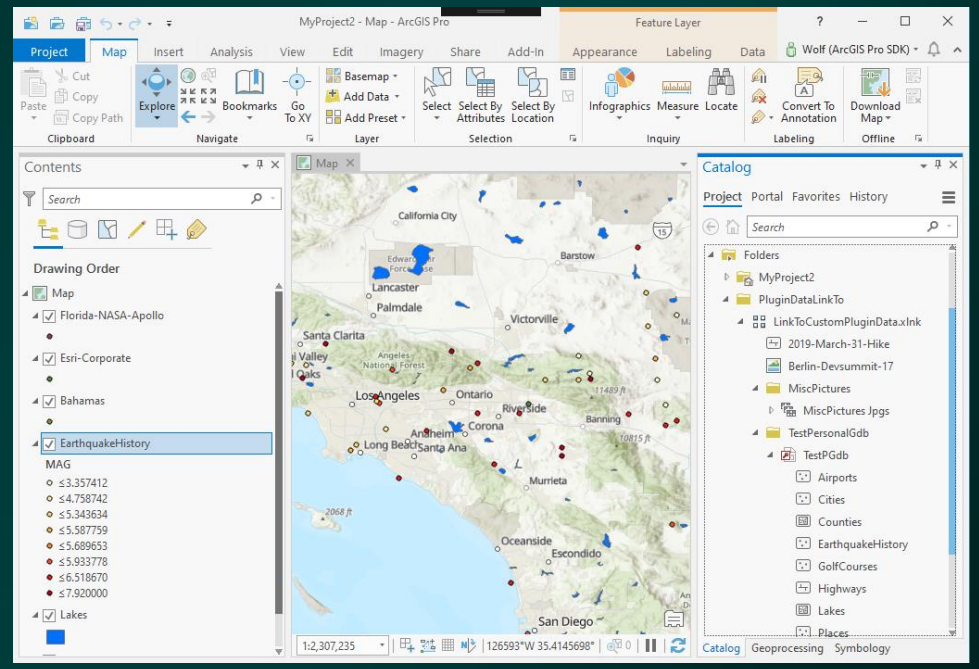
Extensibility Patterns

Add-Ins – Develop new tools and functionality to extend Pro
Managed Configurations – All Add-in capabilities + additional customization of Pro UI / UX
Plugin Datasources – Custom data source integration with Pro
CoreHost Apps – Standalone apps for 64-bit Geodatabase and Geometry access

Editing Add-In Sample



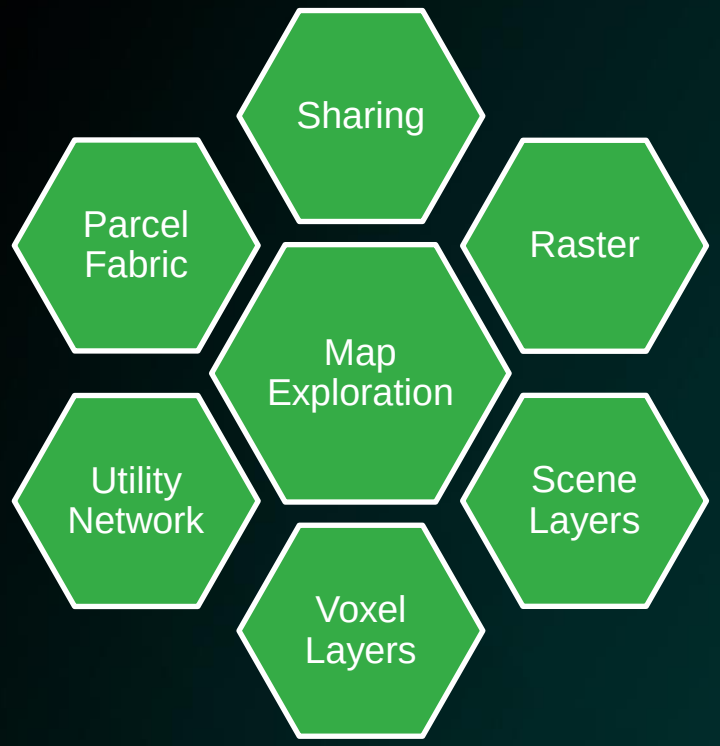
Plugin Datasource Sample



What’s possible with the SDK?

- **Content** – manage Pro project items and connections to Portal to consume and integrate online data
- **Device Location** - manage GNSS device connections, visualize device positions and collect data
- **Editing** – develop powerful feature editing tools and create and manage 2D and 3D editing operations
- **Extensions** – work with Data Reviewer and Workflow Manager items
- **Framework** – customize and extend the Pro UI, add and remove controls from the ribbon
- **Geodatabase** – access file and enterprise datasets, manage queries, searches, selections and versions, and create and modify geodatabase schema
- **Geometry** – build and manage feature geometries and perform spatial operations
- **Geoprocessing** – run geoprocessing tools and python scripts from add-in tools and routines
- **Layouts** – build custom layouts and elements, manage layout views and selections
- **Map Authoring** – author maps, manage layers, define and set layer renderers

What’s possible with the SDK?



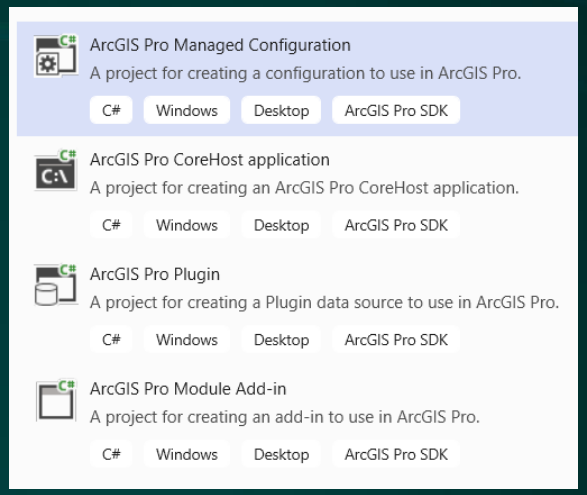
- **Map Exploration** – build and manage animations, control the camera and build new map tools
- **Metadata** – create custom metadata forms using the Metadata Toolkit
- **Parcel Fabric** - create editing tools, manage parcel seeds, types and records
- **Raster** – work with raster datasets, layers and colorizers
- **Real-time** – manage real-time stream layers, events and tracking data
- **Scene Layers** – manage scene layer content with selection and symbology
- **Sharing** – access and search content, folders, and groups of a portal or online organization
- **Tasks** – access and manage Tasks within the UI
- **Topology** – explore and manage topology rules, errors, validation and the topology graph
- **Utility Network** – create custom utility network tools, traces and workflows
- **3D Analyst**– create and manage tin, las dataset, point cloud, and terrain layers and associated line of sight analysis and rendering

Patterns and APIs

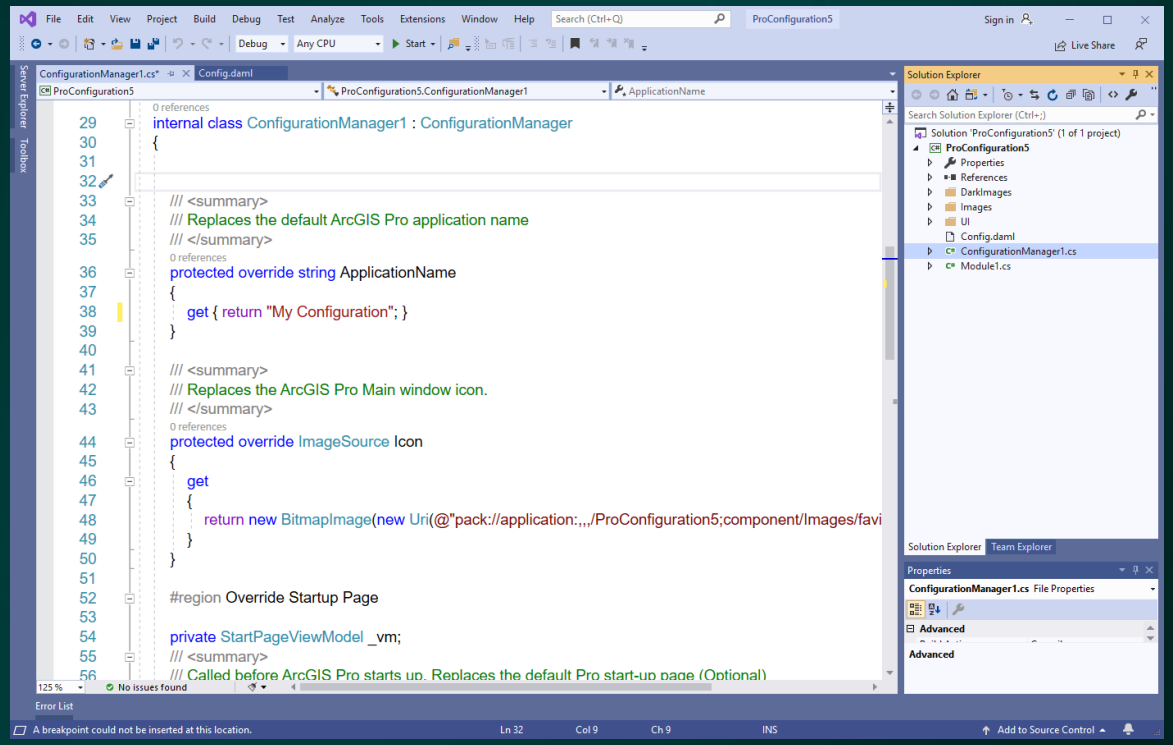
Patterns and Templates

- Each pattern is defined from SDK Project Templates
- SDK Project Templates for Visual Studio
  - Basic framework for UI, module and classes
  - Basic file components

Pro SDK Templates



Configuration Template



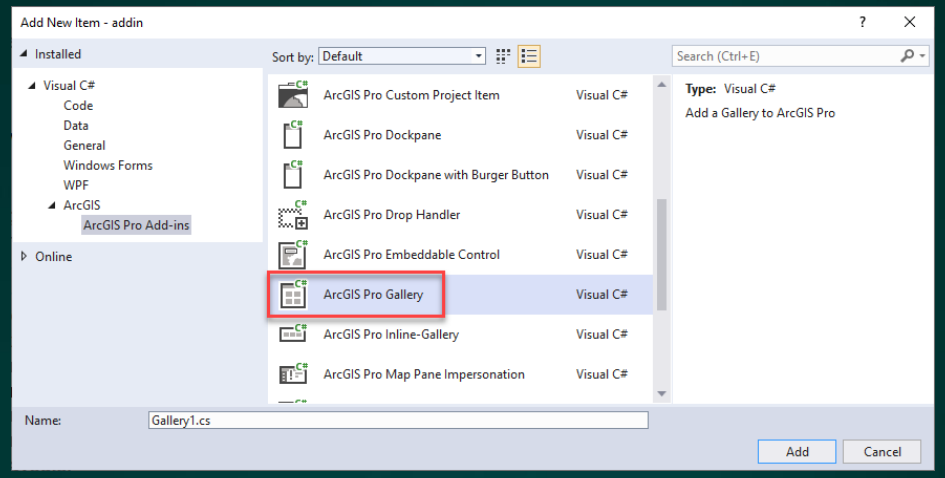
Item Templates

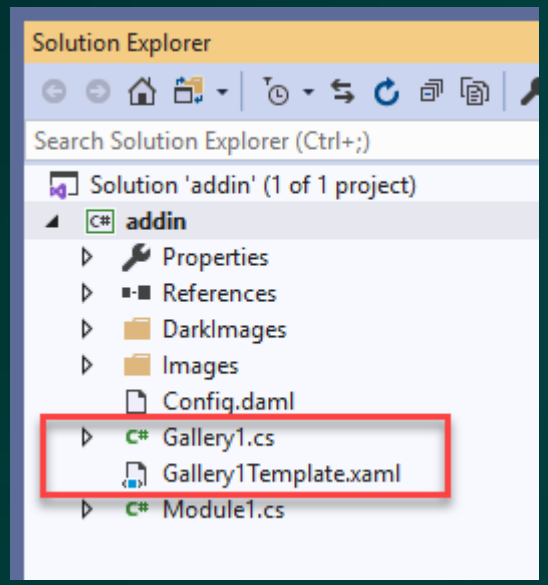
- SDK templates in Visual Studio
- Item templates listing

ArcGIS Pro Module Add-in Project template
ArcGIS Pro Managed Configurations Project template
ArcGIS Pro Plugin Project template
ArcGIS Pro CoreHost Application Project template
ArcGIS Pro Backstage Tab
ArcGIS Pro Button
ArcGIS Pro Button Palette
ArcGIS Pro Combo Box
ArcGIS Pro Construction Tool
ArcGIS Pro Custom Control
ArcGIS Pro Custom Item
ArcGIS Pro Custom Project Item
ArcGIS Pro Dockpane
ArcGIS Pro Dockpane with Burger Button
ArcGIS Pro Drop Handler
ArcGIS Pro Embeddable Control

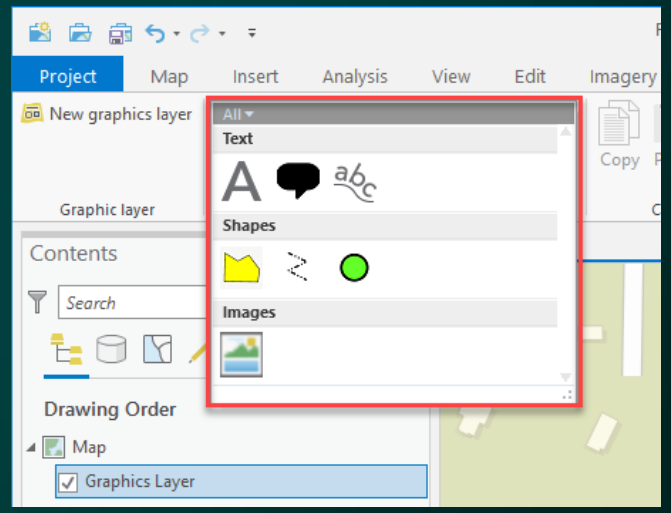
ArcGIS Pro Inline-Gallery
ArcGIS Pro Map Pane Impersonation
ArcGIS Pro Map Tool
ArcGIS Pro Menu
ArcGIS Pro Pane
ArcGIS Pro Property Sheet
ArcGIS Pro ProWindow
ArcGIS Pro Split Button

Choosing the Pro Gallery template





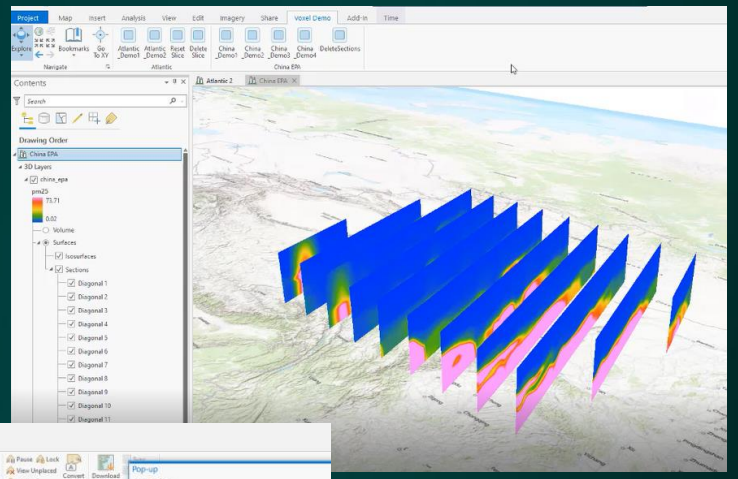
Graphics Layers sample



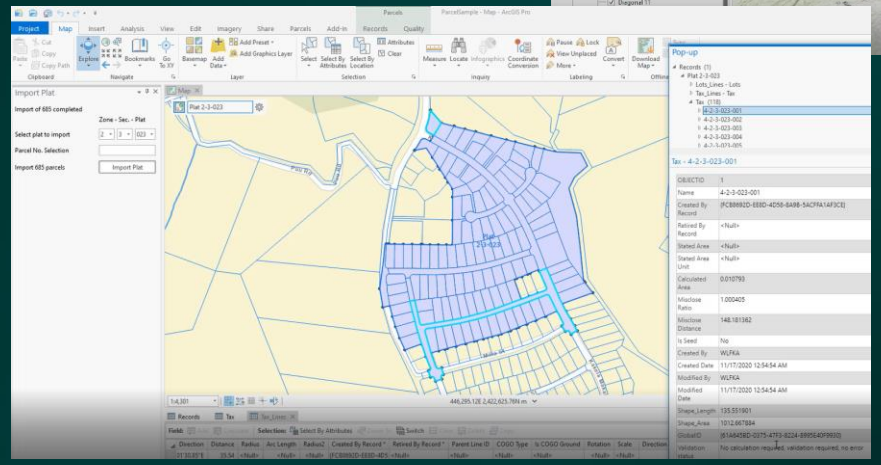
ArcGIS Pro APIs

- The SDK provides access to the Pro APIs
- APIs are installed directly with ArcGIS Pro

Voxel Layers API

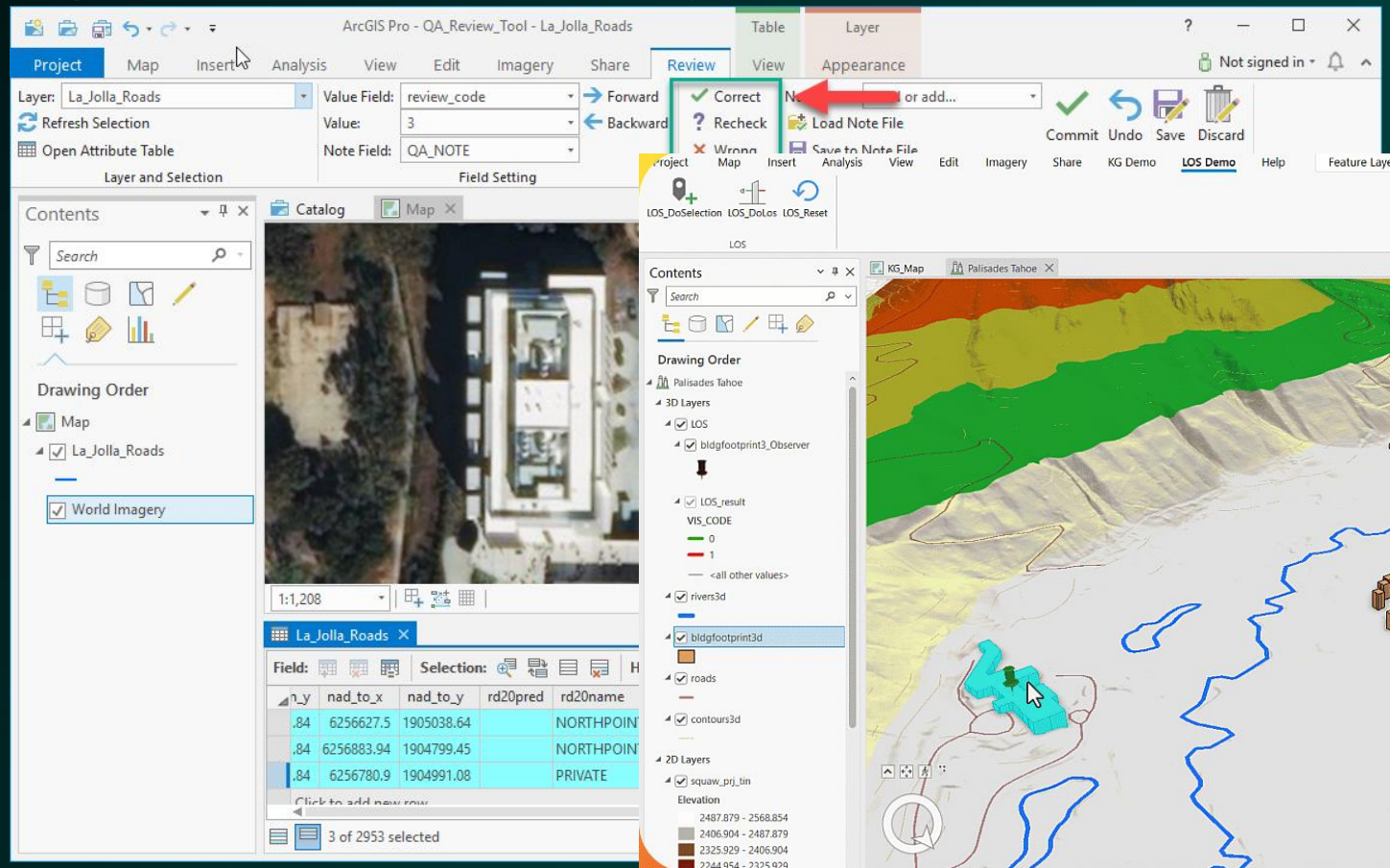


Parcel Fabric API



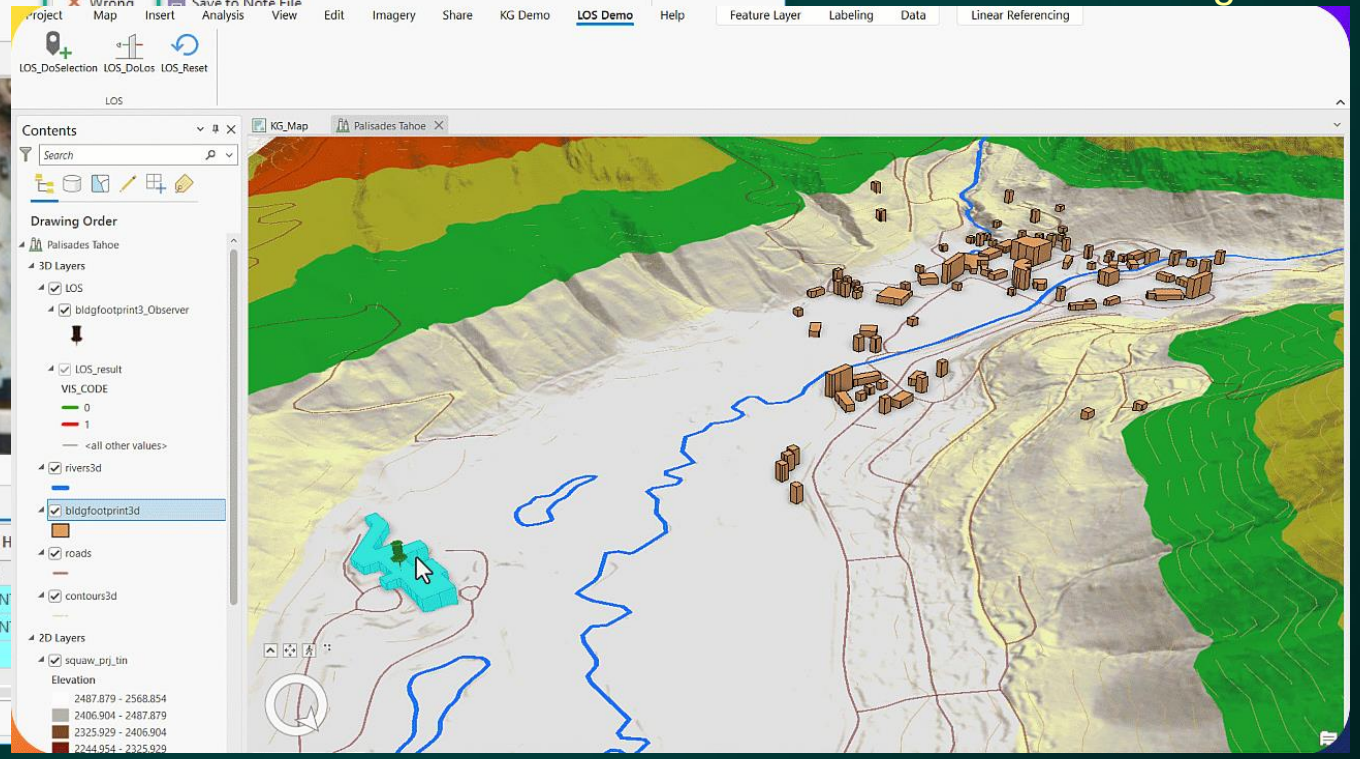
Pro SDK Extensibility Patterns

Add-Ins – Develop new tools and functionality to extend Pro



Editing Add-In Sample

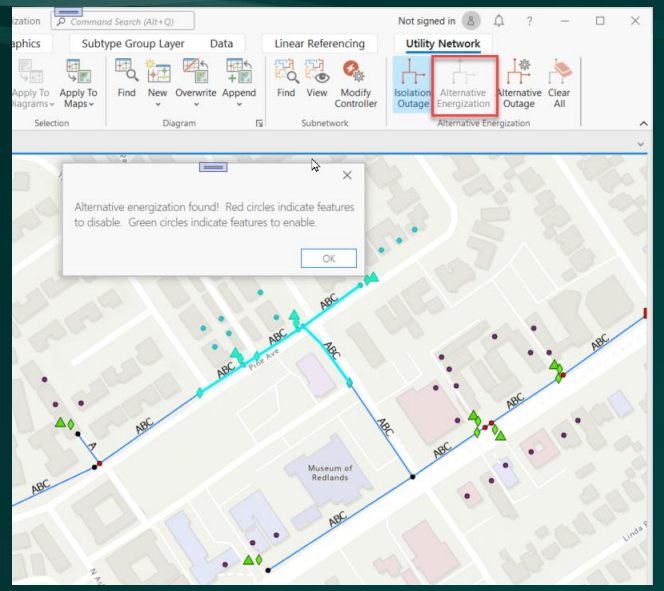
Geometry 3D Analyst Line of Sight API



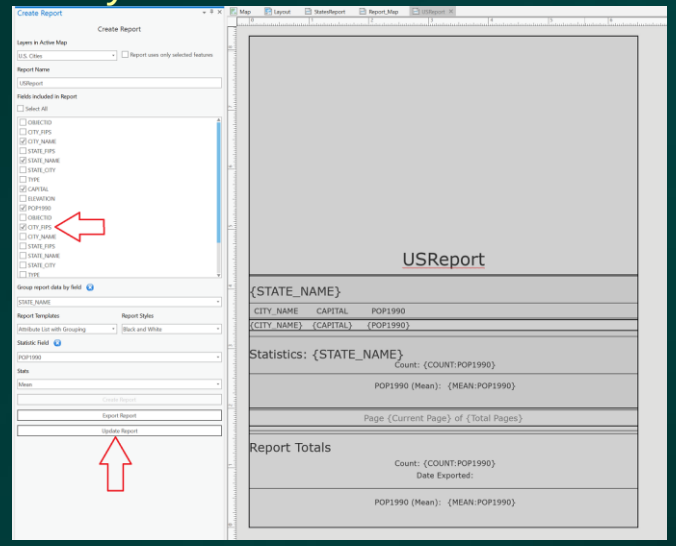
Pro SDK Extensibility Patterns

Use Cases

- Custom Tools and Analysis
- Data Management and Editing
- Integration with External Systems
- Automation
- Reporting and Visualization
- Workflow Integration and Collaboration



Utility Network Custom Tools

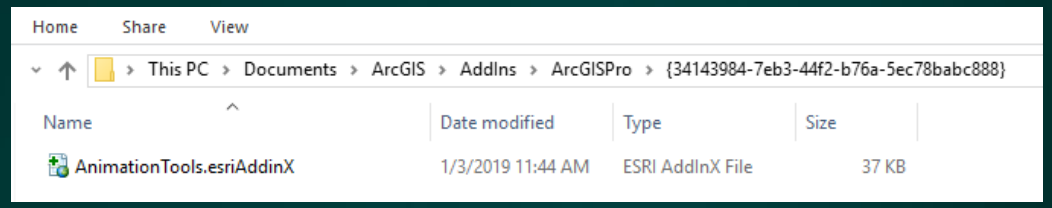


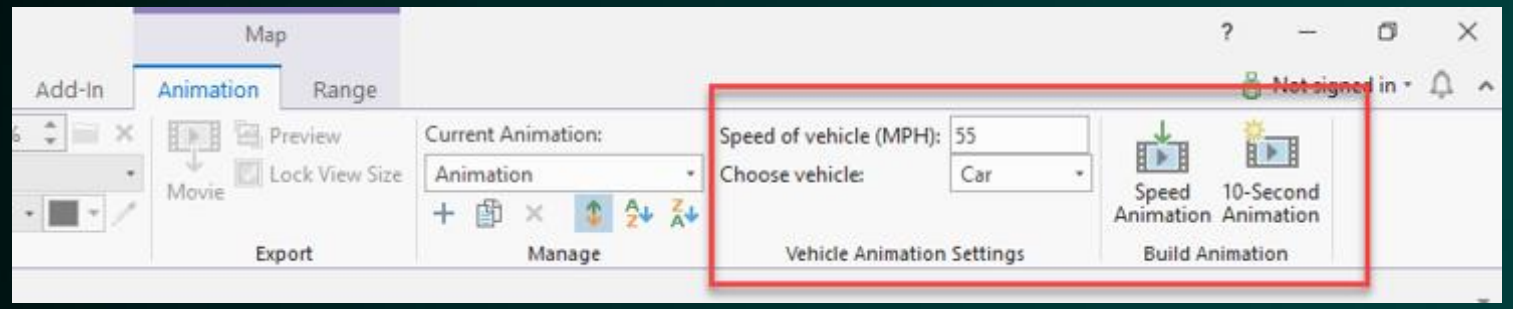
Create Custom Reports

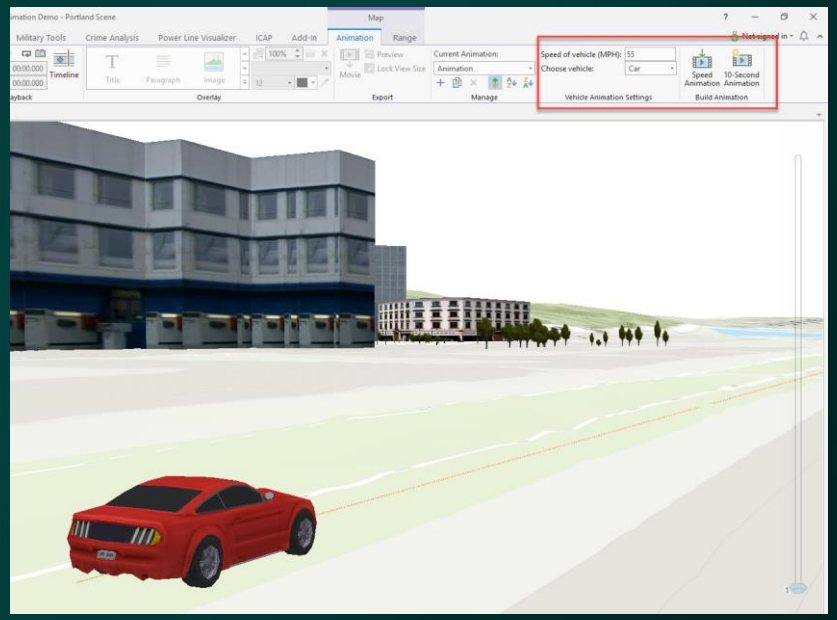
How does a Pro add-in work?

- Extends ArcGIS Pro through:
  - Pro buttons, tools, dockpanes, controls, etc.
  - Custom functionality you create with Pro APIs
- Packaged within a single, compressed file with an .esriaddinX file extension
  - C:\Users\<UserName>\Documents\ArcGIS\AddIns\ArcGISPro
- As Pro starts, it looks for add-ins placed in well-known folders and loads them

Animation Tools Sample Add-in



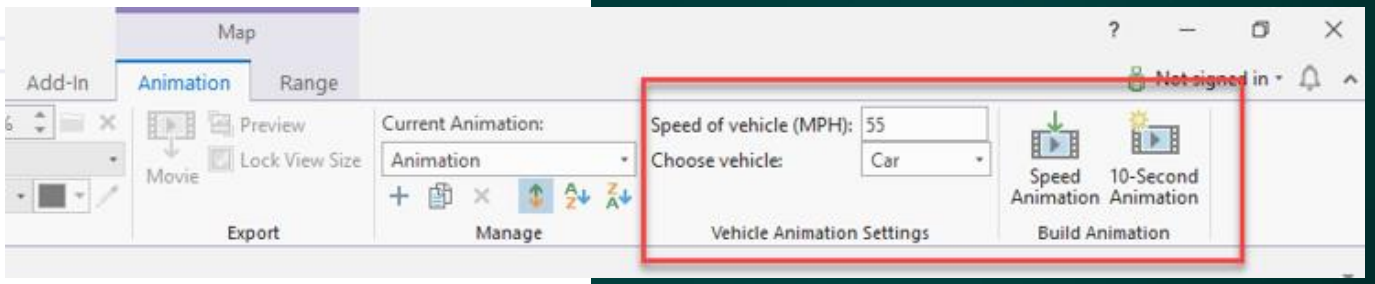




Desktop Application Markup Language (DAML)

- Add-ins use DAML to define the UI elements in Pro
  - Buttons, Dockpane, Galleries, Property Sheets, Tools, …

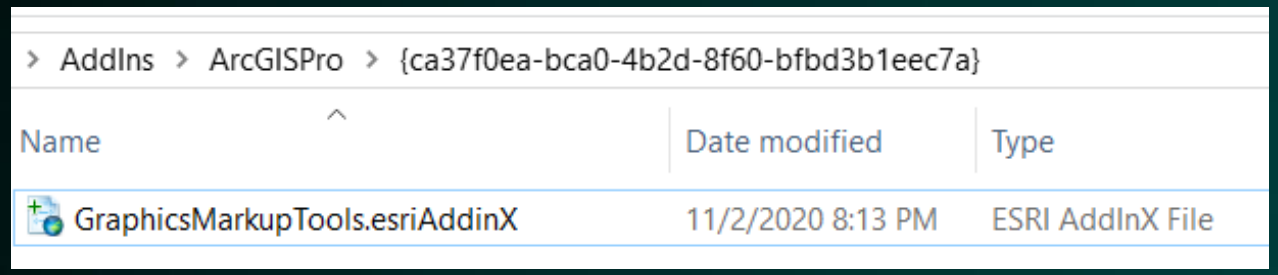
```
29  </AddInInfo>
30  <modules>
31    <updateModule refID="esri_mapping">
32      <tabs>
33        <updateTab refID="esri_mapping_animationTab">
34          <insertGroup refID="AnimationTools_Group1"  />
35          <insertGroup refID="AnimationTools_Group2"  />
36        </updateTab>
37      </tabs>
38    </updateModule>
39    <insertModule id="AnimationTools_Module" className="Module1" autoLoad="false" caption="Animation Tools Sample">
40      <groups>
41        <group id="AnimationTools_Group1" caption="Vehicle Animation Settings" appearsOnAddInTab="false">
42          <!-- host controls within groups -->
43          <editBox refID="AnimationTools_SpeedEditBox" size="middle" />
44          <comboBox refID="AnimationTools_VehicleListComboBox" />
45        </group>
46        <group id="AnimationTools_Group2" caption="Build Animation" appearsOnAddInTab="false">
47          <!-- host controls within groups -->
48          <button refID="AnimationTools_SpeedKeyframesButton" size="large" />
49          <button refID="AnimationTools_TenSecondKeyframesButton" size="large" />
50        </group>
51      </groups>
```

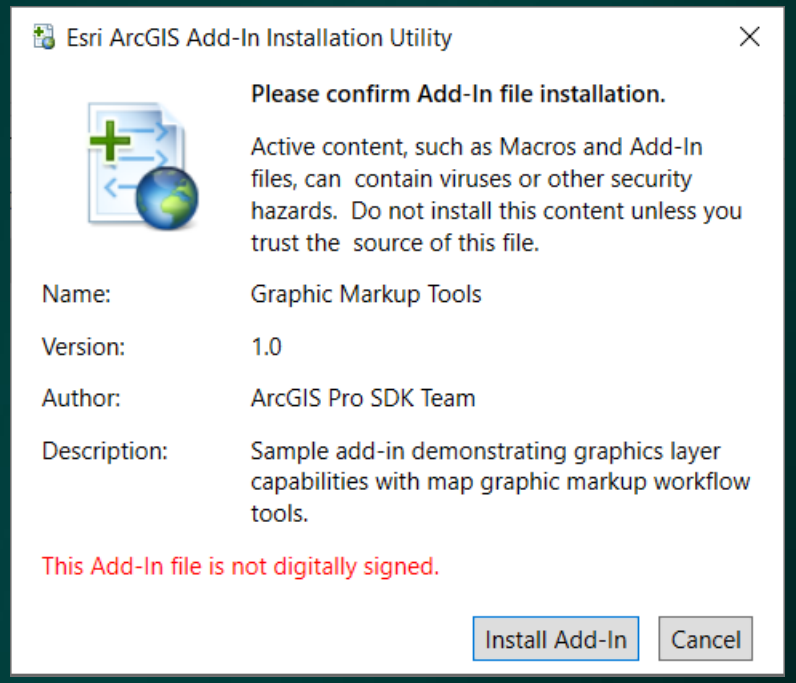


Installing Add-ins

- Simple double-click install
- No administrator privileges required
- No installation .exe to run or build
- No add or remove programs

C:\Users\<UserName>\Documents\ArcGIS\AddIns\ArcGISPro





Considerations

- Opportunities:
  - Powerful, and provide most of what your users are looking for
  - Developers can customize the UI by building new custom tools, buttons and panes
  - Build custom processes with .NET
  - Integrate third party libraries

- Considerations:
  - Do you need control over the start-up process? >> Configurations
  - Do you have a data format that you want to use as a layer or table? >> Plugin datasources
  - Do you need to run a scheduled geodatabase process? >> CoreHost apps

Pro SDK Extensibility Patterns

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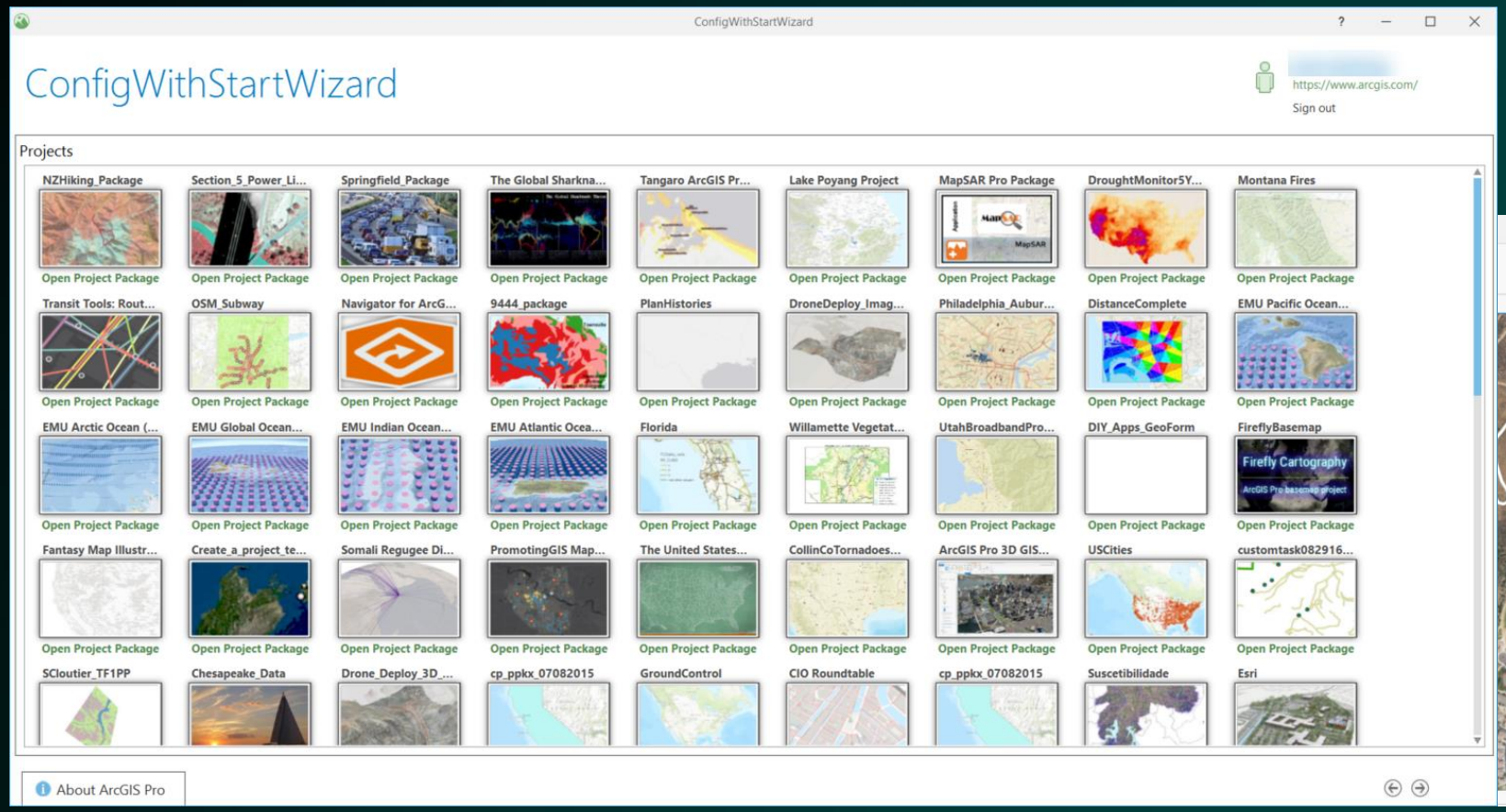
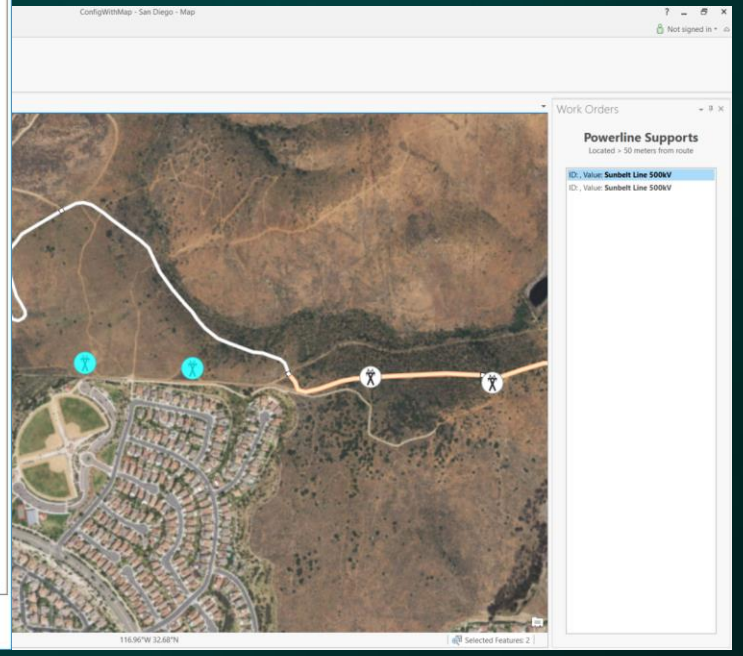
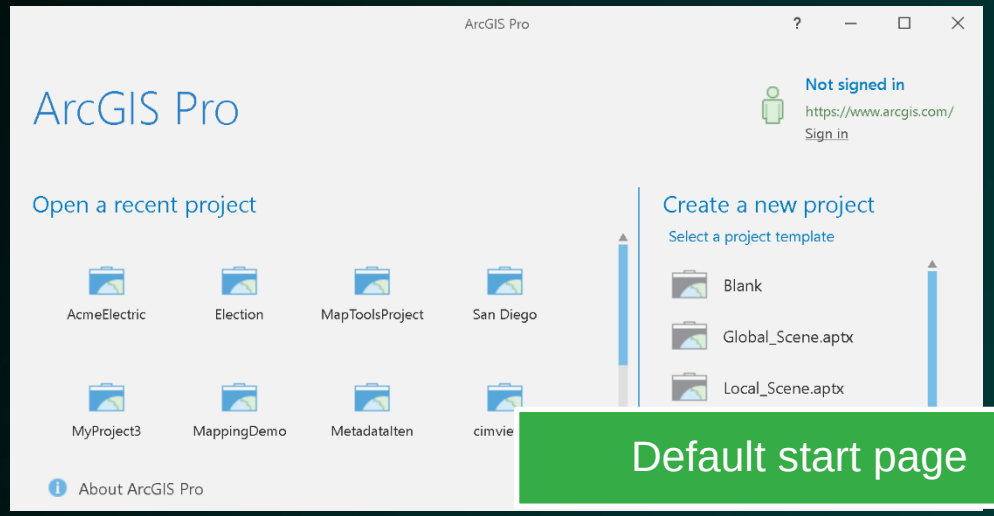
Managed Configurations – All Add-in capabilities + additional customization of Pro UI / UX



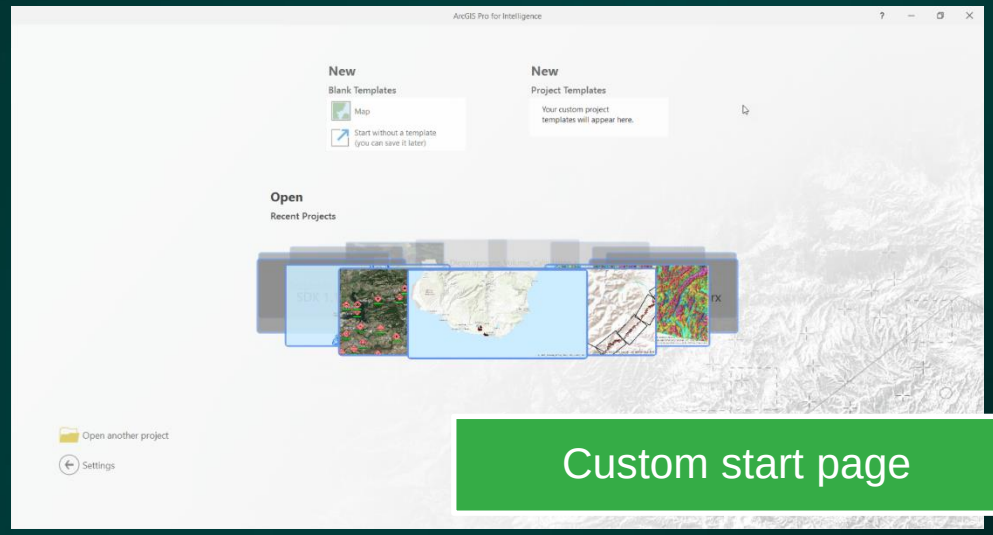


What is an ArcGIS Pro Configuration?

- Includes all functionality of an add-in plus:
  - Change the application title and icon
  - Change the application splash, start page, and about page
  - Conditional customization of the UI
- Packaged within a single compressed file - .ProConfigX file extension
- Stored at: C:\Users\<UserName>\Documents\ArcGIS\AddIns\ArcGISPro\Configurations



Default start page



Custom start page

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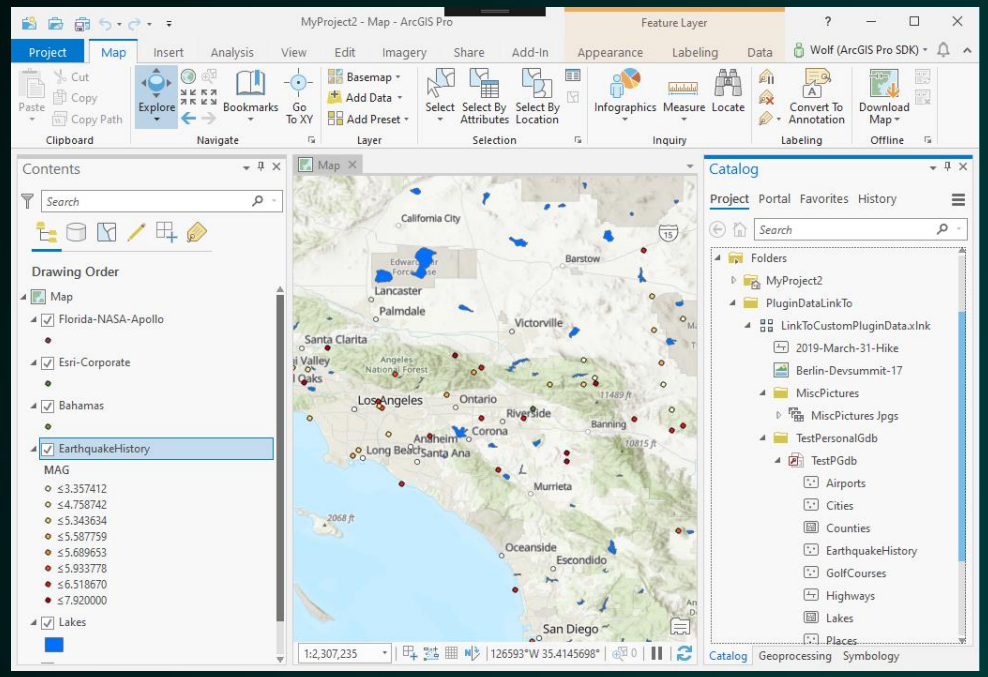
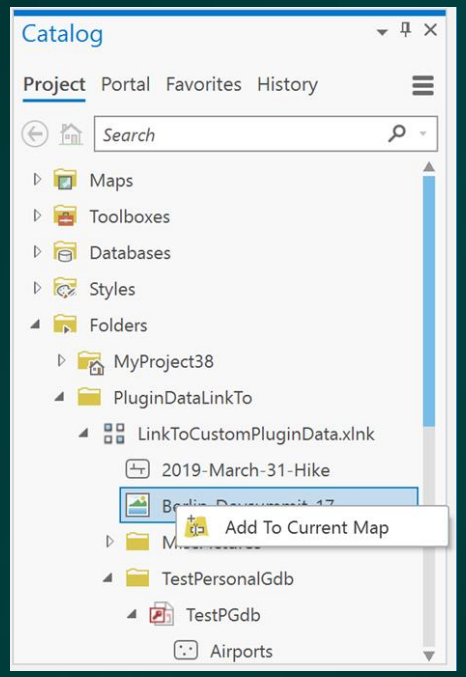
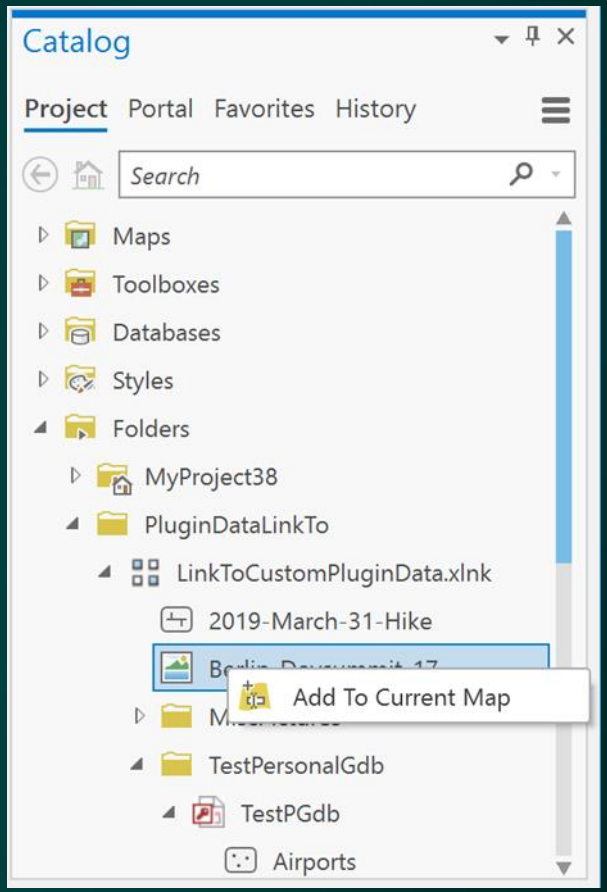
Plugin Datasources – Custom data source integration with ArcGIS Pro





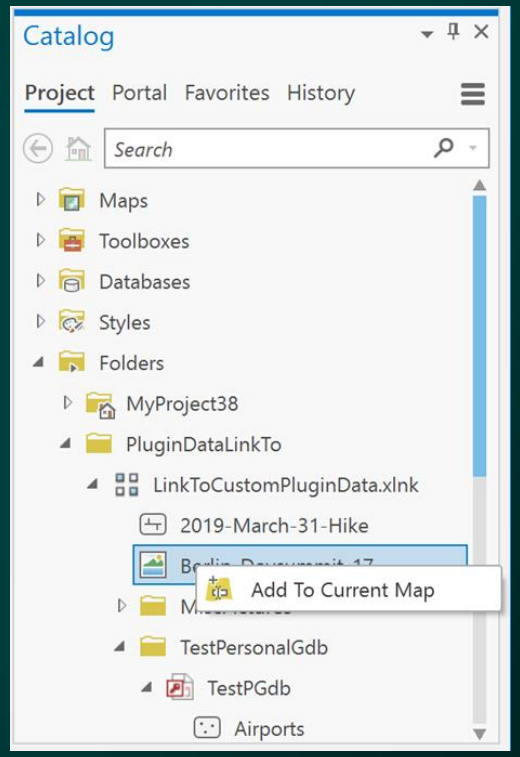
Plugin Datasources

- The Plugin Datasource framework allows developers to make custom datasources available for use in Pro
  - Access in Pro is read-only
  - Access is in the form of tables or feature classes
  - Access is file-based
- Examples of custom data sources – Image files, GPS data, proprietary file formats



Plugin Datasources

- ArcGIS Pro supports data from a large variety of data sources and formats from shape files to Oracle databases
- Plugin Datasources allow access to other data sources like relational databases such as MySQL, non-relational databases and other proprietary and file-based data stores
- Documentation
  - ProConcepts introduction and concepts
  - ProGuide – walk through guide
  - Samples to try, and build on



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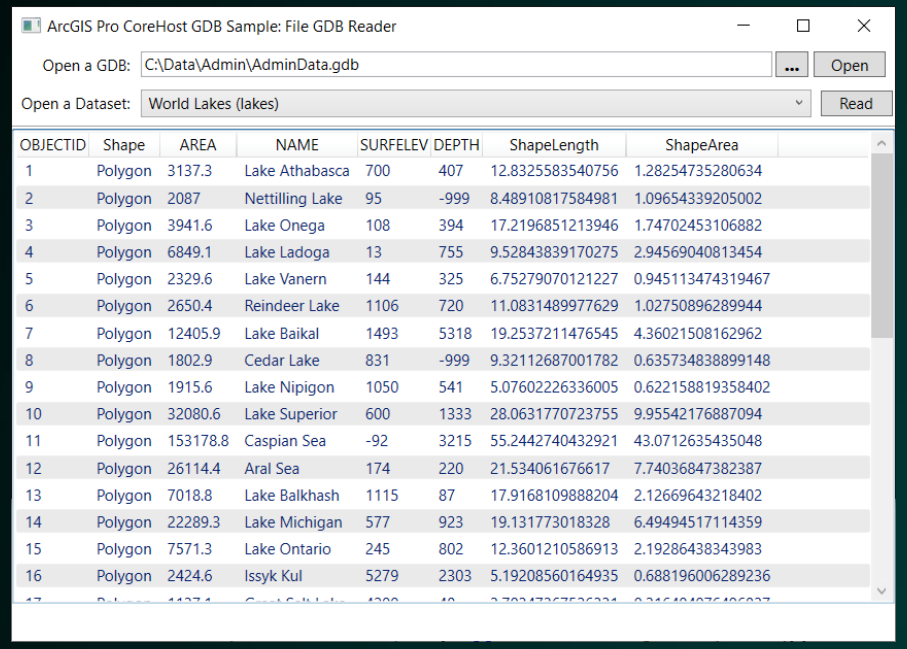
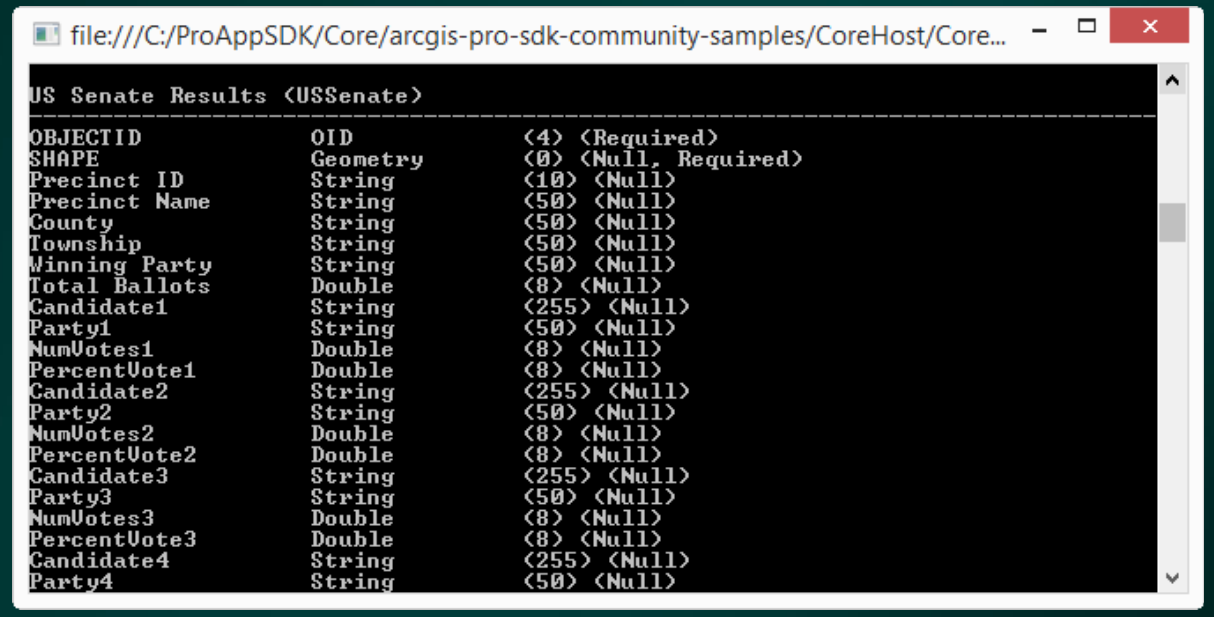
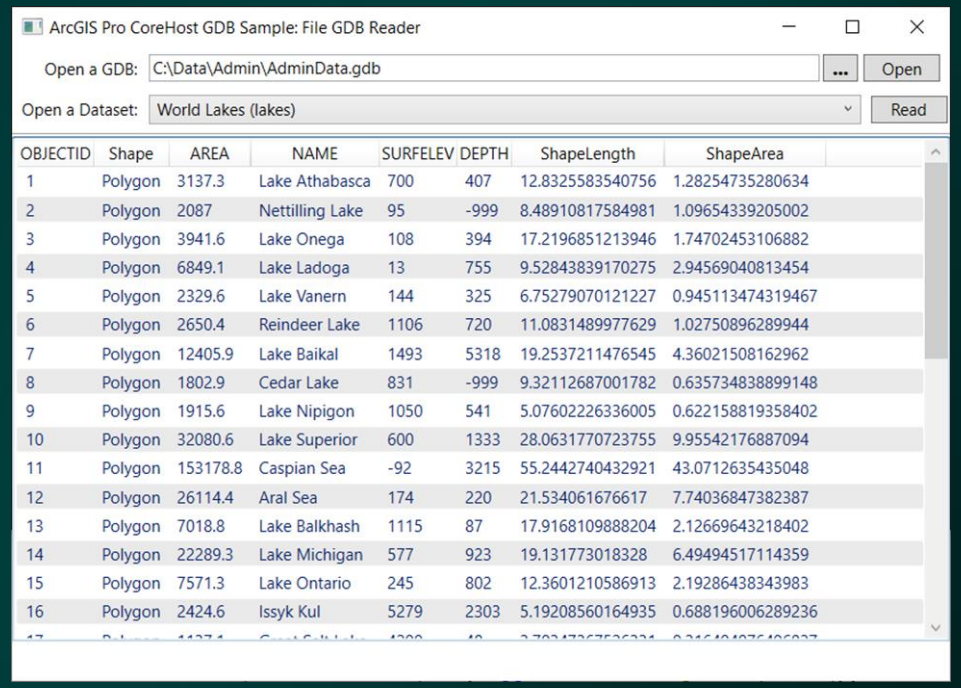


OBJECTID	Shape	AREA	NAME	SURFELEV	DEPTH	ShapeLength	ShapeArea
1	Polygon	3137.3	Lake Athabasca	700	407	12.8325583540756	1.28254735280634
2	Polygon	2087	Nettilling Lake	95	-999	8.48910817584981	1.09654339205002
3	Polygon	3941.6	Lake Onega	108	394	17.2196851213946	1.74702453106882
4	Polygon	6849.1	Lake Ladoga	13	755	9.52843839170275	2.94569040813454
5	Polygon	2329.6	Lake Vanern	144	325	6.75279070121227	0.945113474319467
6	Polygon	2650.4	Reindeer Lake	1106	720	11.0831489977629	1.02750896289944
7	Polygon	12405.9	Lake Baikal	1493	5318	19.2537211476545	4.36021508162962
8	Polygon	1802.9	Cedar Lake	831	-999	9.32112687001782	0.635734838899148
9	Polygon	1915.6	Lake Nipigon	1050	541	5.07602226336005	0.622158819358402
10	Polygon	32080.6	Lake Superior	600	1333	28.0631770723755	9.95542176887094
11	Polygon	153178.8	Caspian Sea	-92	3215	55.2442740432921	43.0712635435048
12	Polygon	26114.4	Aral Sea	174	220	21.534061676617	7.74036847382387
13	Polygon	7018.8	Lake Balkhash	1115	87	17.9168109888204	2.12669643218402
14	Polygon	22289.3	Lake Michigan	577	923	19.131773018328	6.49494517114359
15	Polygon	7571.3	Lake Ontario	245	802	12.3601210586913	2.19286438343983
16	Polygon	2424.6	Issyk Kul	5279	2303	5.19208560164935	0.688196006289236



CoreHost Applications

- Stand-alone application with a subset of Pro Assemblies
  - ArcGIS.CoreHost assembly – API to manage CoreHost functions
  - ArcGIS.Core assembly – Includes Geodatabase and Geometry classes
- CoreHost Applications have limited access
  - Geodatabase classes
  - Geometry classes
- CoreHost Application options
  - Windows Console application
  - WPF application



OBJECTID	Shape	AREA	NAME	SURFELEV	DEPTH	ShapeLength	ShapeArea
1	Polygon	3137.3	Lake Athabasca	700	407	12.8325583540756	1.28254735280634
2	Polygon	2087	Nettilling Lake	95	-999	8.48910817584981	1.09654339205002
3	Polygon	3941.6	Lake Onega	108	394	17.2196851213946	1.74702453106882
4	Polygon	6849.1	Lake Ladoga	13	755	9.52843839170275	2.94569040813454
5	Polygon	2329.6	Lake Vanern	144	325	6.75279070121227	0.945113474319467
6	Polygon	2650.4	Reindeer Lake	1106	720	11.0831489977629	1.02750896289944
7	Polygon	12405.9	Lake Baikal	1493	5318	19.2537211476545	4.36021508162962
8	Polygon	1802.9	Cedar Lake	831	-999	9.32112687001782	0.635734838899148
9	Polygon	1915.6	Lake Nipigon	1050	541	5.07602226336005	0.622158819358402
10	Polygon	32080.6	Lake Superior	600	1333	28.0631770723755	9.95542176887094
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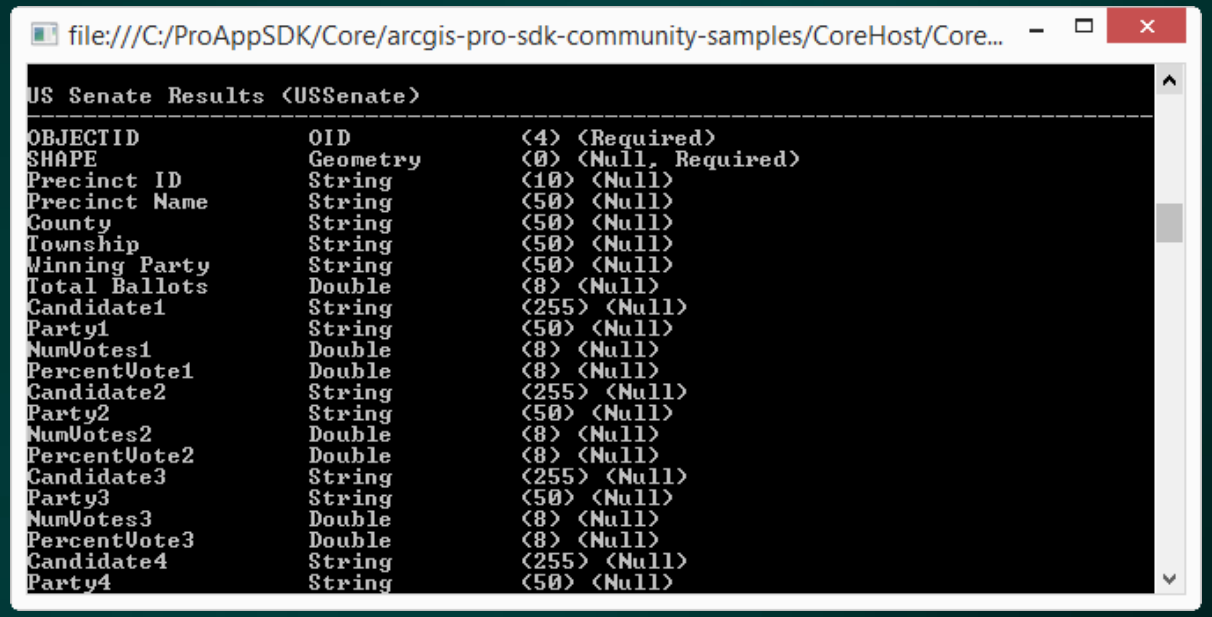
CoreHost Applications

- Scheduled routines
- Editing in standalone mode

- Documentation
  - ProConcepts introduction and concepts
  - Samples to try, and build on



Updates & What’s Coming

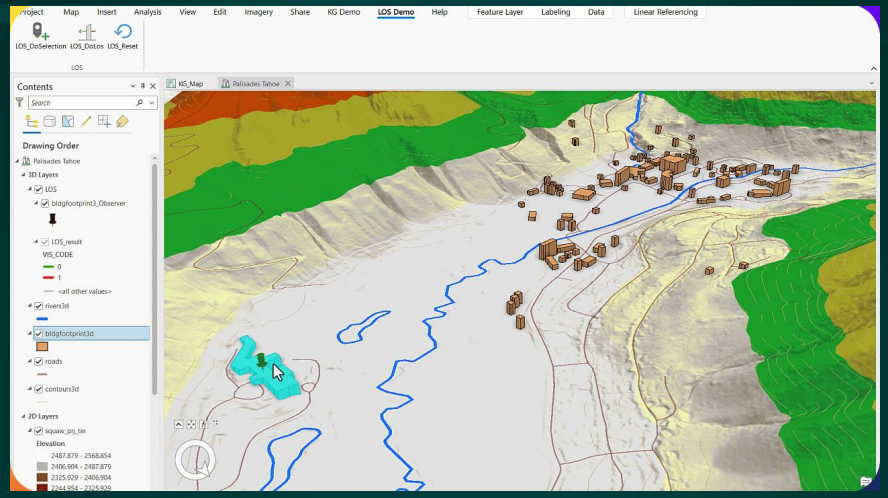
```
// show the compass and pass the
mapRotation state data
Compass(rotation = mapRotation) {
    // reset the ComposableMap viewpoint
rotation to point north using the
mapViewModel
    mapViewModel.setViewpointRotation(0.0)
}
```

```
val queryParameters =
QueryParameters().apply {
    whereClause = "price > 200"
}
viewModelScope.launch {

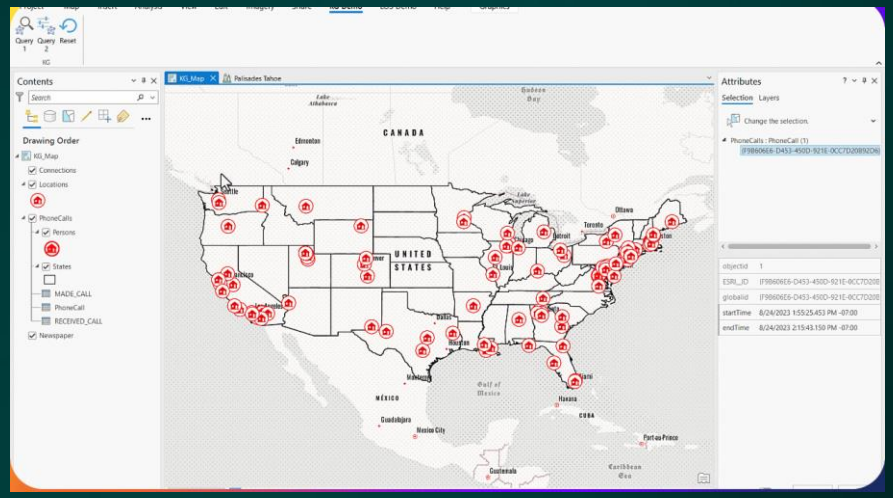
featureTable.queryFeatures(queryParam
).onFailure {
        showError("Feature query fail
    }.onSuccess { featureQueryResult
        val featureResult =
featureQueryResults.firstOrNull()
    }
}
```

What’s New in ArcGIS Pro 3.4 SDK

- Knowledge Graphs API
  - Schema, Entity, and Relationship edits
- 3D Analyst API
  - Additional interpolation, GetZs capabilities
- Bulk layer load
- LAS Point cursor performance
- GDB enhancements for Linear Referencing
- Map frame styling with grid styles
- Open and Save Portal Projects (beta)



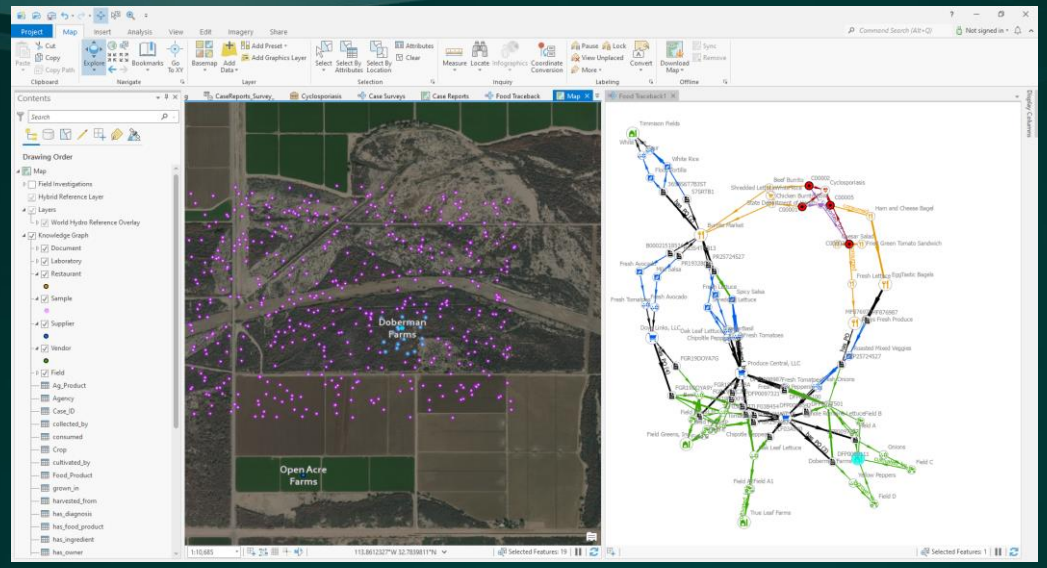
3D Analyst API enhancements



Knowledge Graph API enhancements

Road Ahead 2025

ArcGIS Pro SDK 3.5+

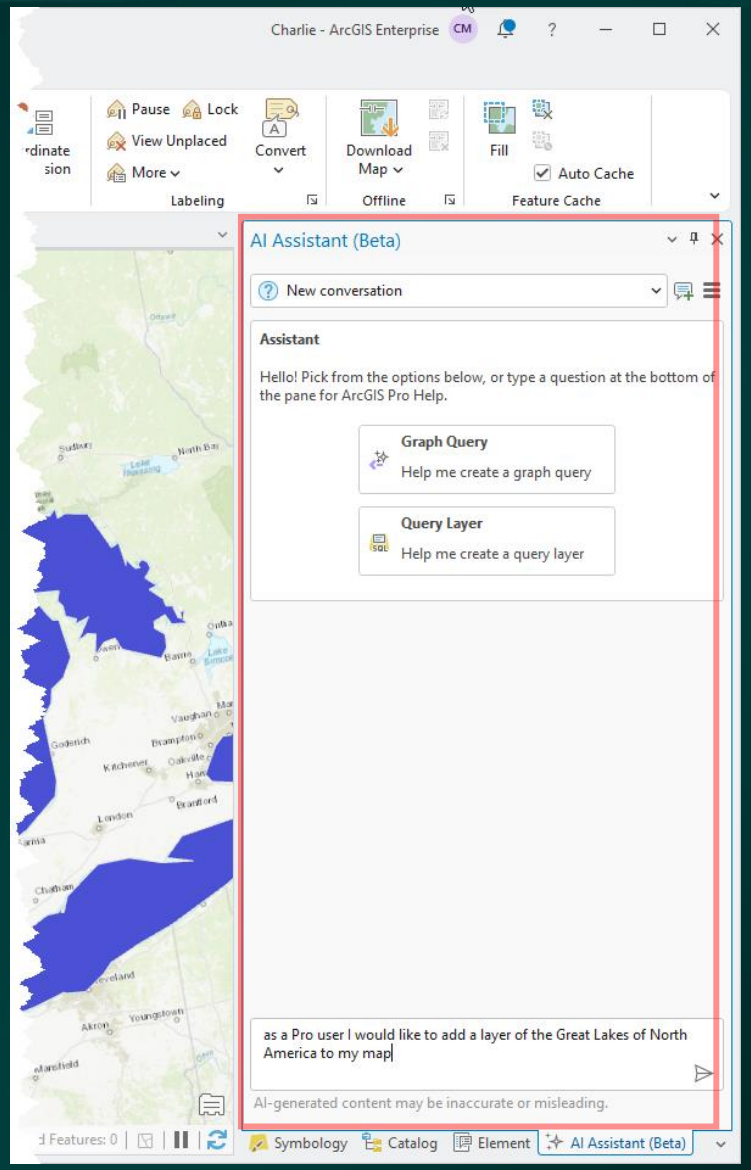


- Knowledge Graph API Enhancements
  - Link import, centralities
  - Investigation project item
- Pro AI Assistant w/ extensibility via actions + skills
- Portal project API enhancements.
  - Open, Create, Save, etc.
- Stereo Map + LAS Editing workflows
  - Continuing in ArcGIS Pro 3.5
- 3.5 planned for May timeframe

Road Ahead – 2025 – ArcGIS Pro Assistants

Designed to empower users and boost productivity with AI in Pro

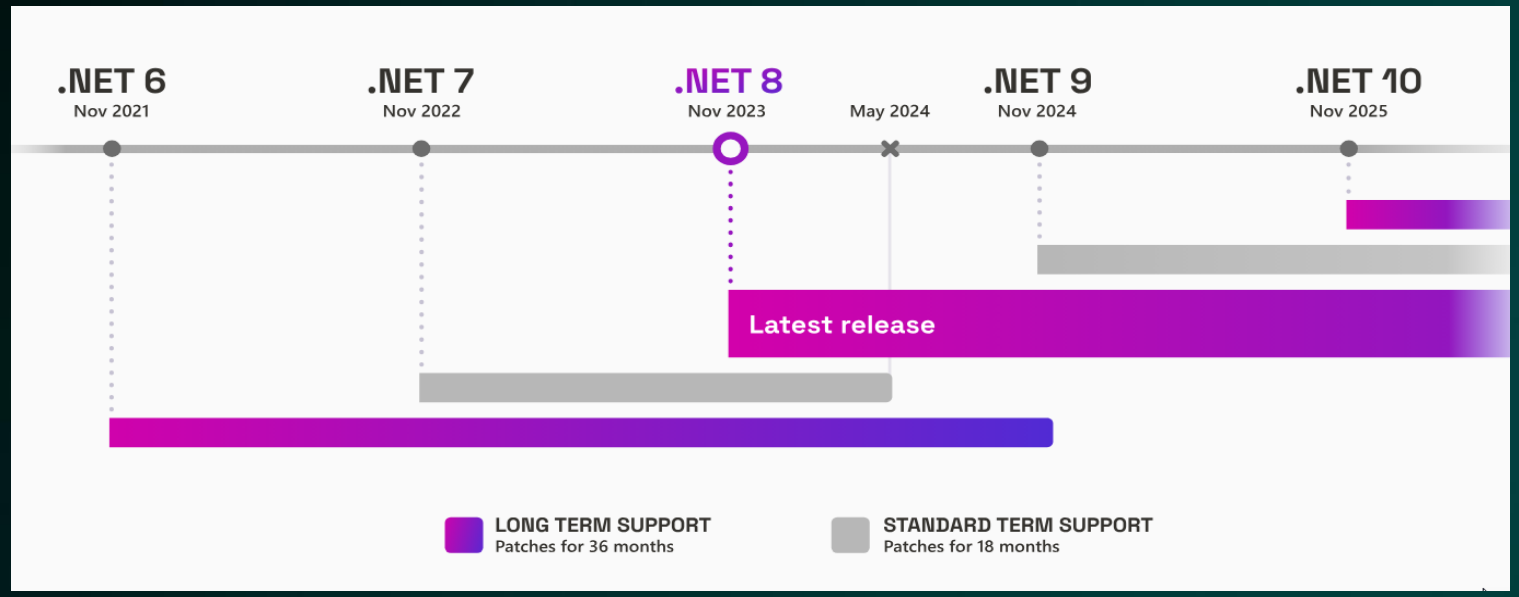
- Provides an Application-Wide “Pro Assistant”
  - Chat-based/natural language experience to explore the Pro help and execute tasks (implemented as “skill functions”)
    - Pro Application will provide many “out of box” skill functions for mapping, visualization, analysis
      - Zoom, Add content, Symbolize data, Filter data, Geocode, Layout, do analysis, etc.
    - **Extensible by 3rd parties who can add their own custom skill functions**
  - 3.4 ArcGIS Pro AI Assistant experience is part of the EAC only
    - Opt-in. Available as a separate installer
  - 3.5 at Beta, 3.6 Available for General Distribution
    - Functionality will continue to be built incrementally over multiple releases



Road Ahead 2025-26 .NET 10

Move to .NET 10

- ArcGIS Pro will move to .NET 10 – specific release not finalized.
  - Not anticipated as a **breaking change** at this time. Next .NET release with LTS



ArcGIS Pro SDK Resources

```
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```
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featureTable.queryFeatures(queryParam
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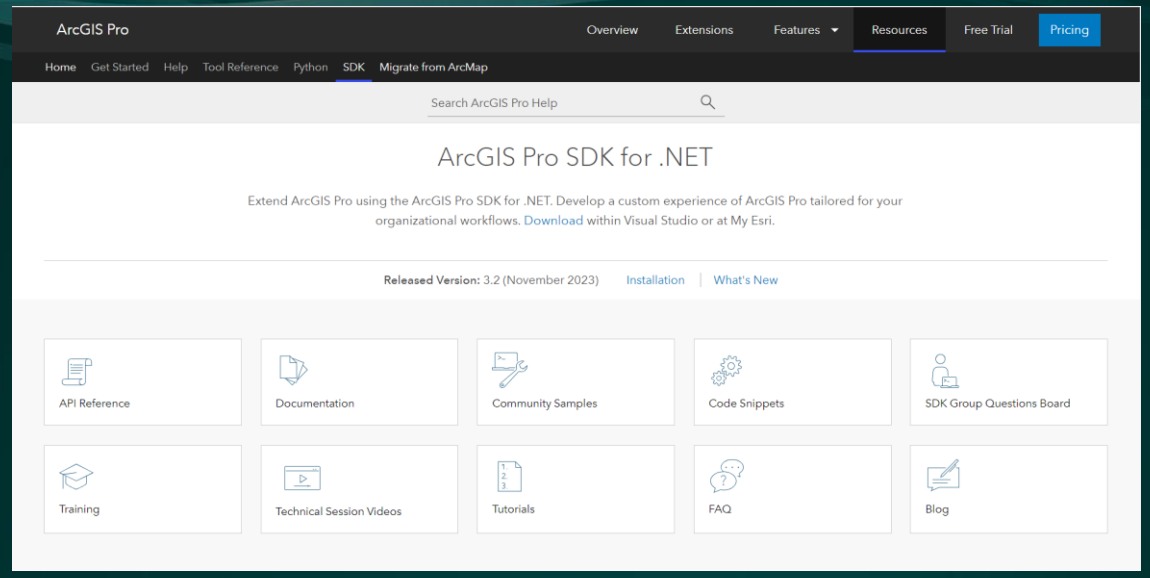
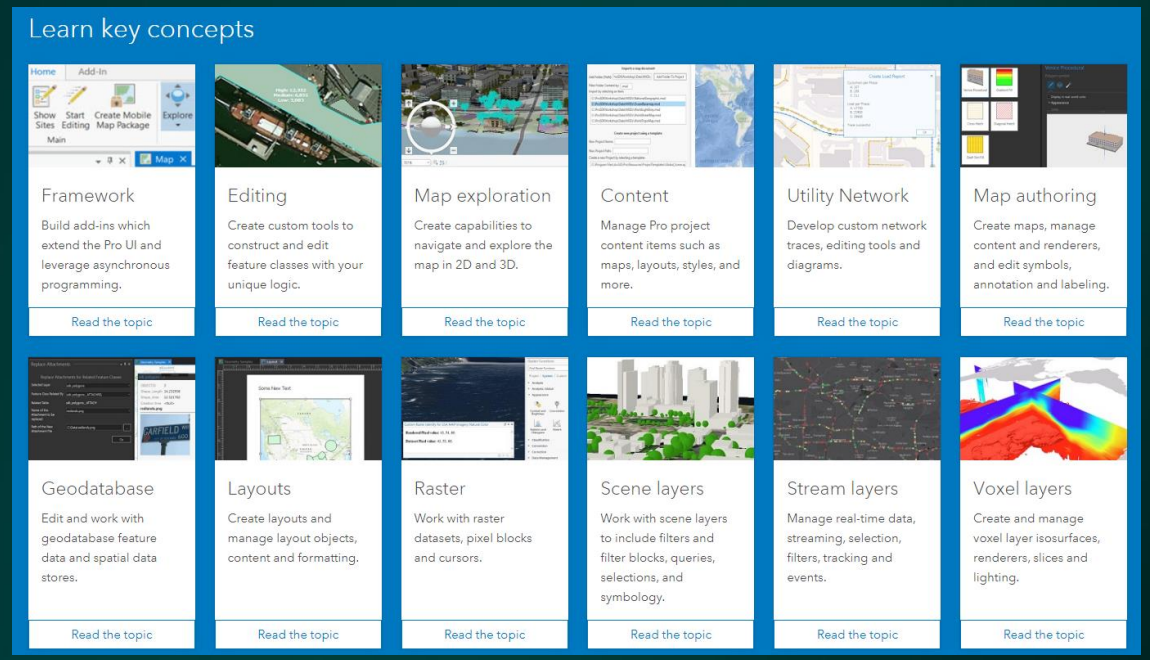
    }.onSuccess { featureQueryResult
        val featureResult =
featureQueryResults.firstOrNull()
    }
}
```

SDK Resources

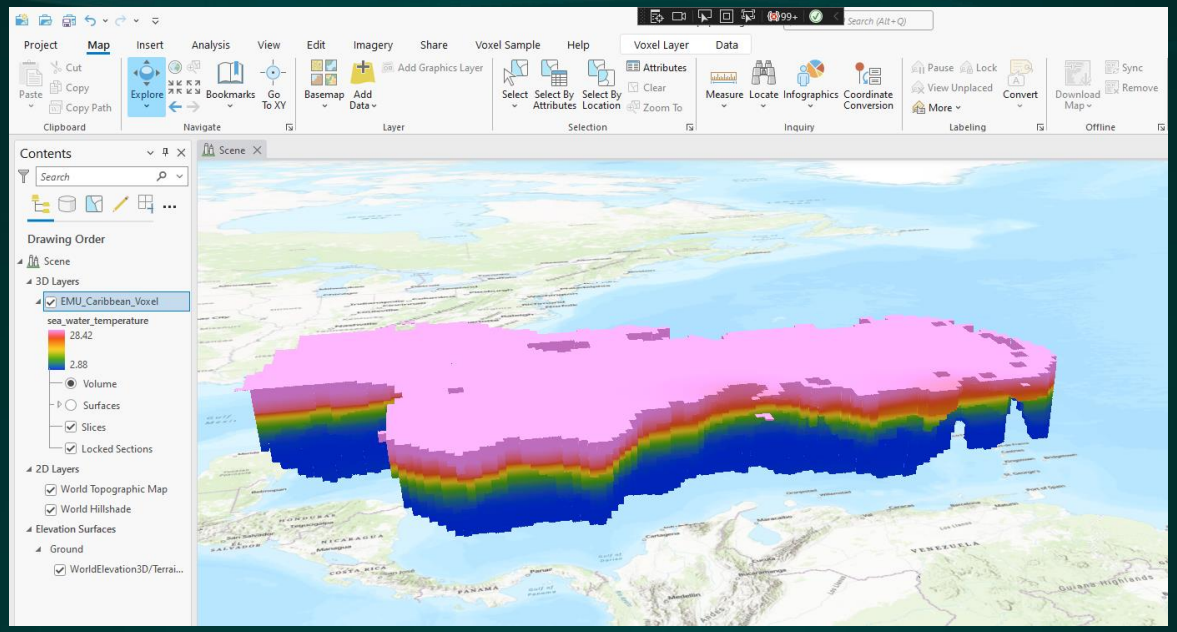
- Landing Page –
  - https://pro.arcgis.com/en/pro-app/sdk/
- Links to all the Resources
  - API Reference, Samples and Documentation
  - ArcGIS Tutorials
  - Pro SDK Group on Esri Community
  - Tech session video recordings
  - ArcGIS Blog posts





Samples and Documentation

- Community samples on GitHub
  - Ready to use C# solutions
- Code snippets for all patterns and APIs
- API Reference
- Concept and Guide documents on GitHub

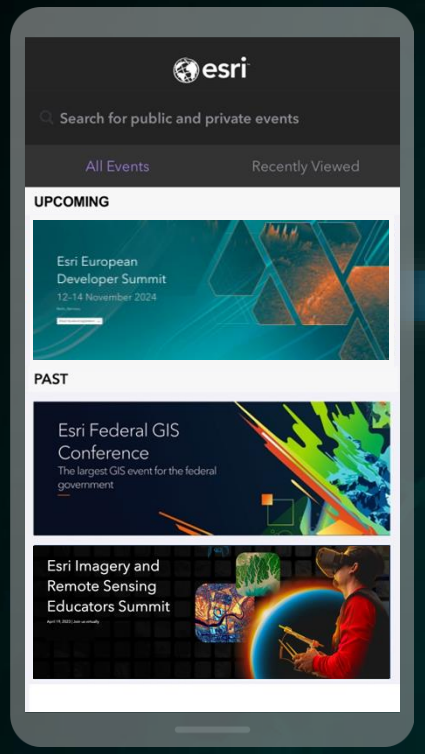


Voxel Layers API

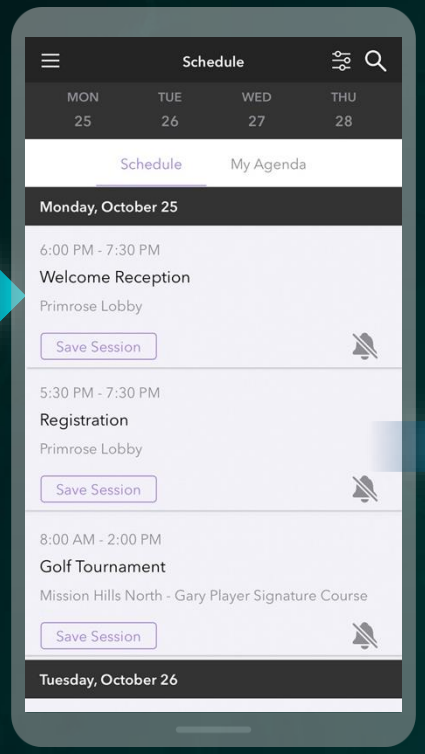
Voxel Layers API

Please Share Your Feedback in the App

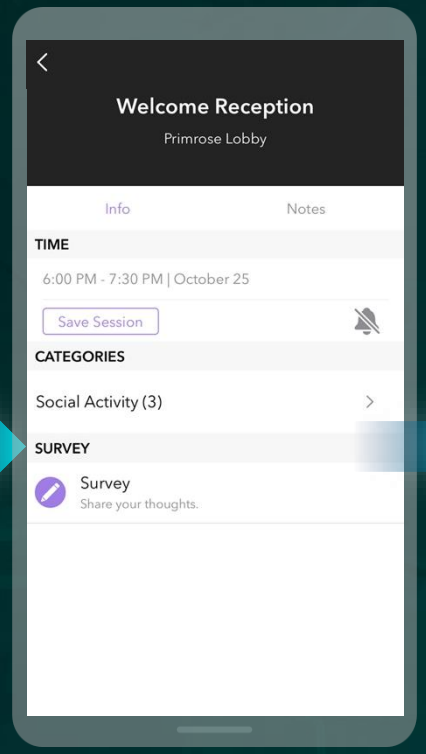
Download the Esri Events app and find your event



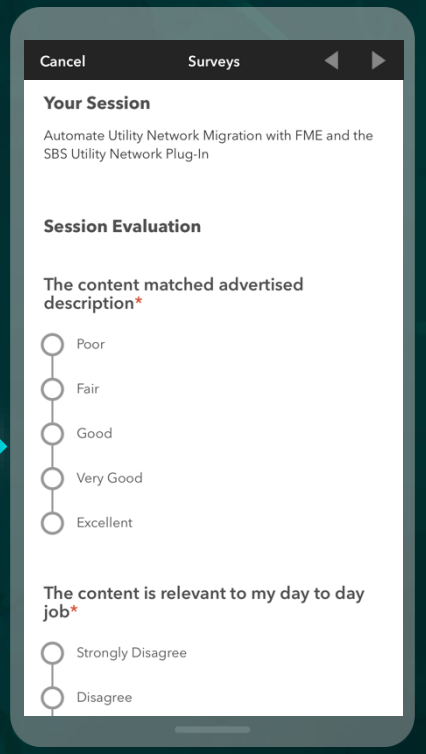
Select the session you attended



Scroll down to "Survey"



Log in to access the survey



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