

Spatial Prioritization Widget Documentation

The relatively high cost of mapping, limited budgets and mapping resources, and the vast areas in need of surveys requires that smaller areas be prioritized for mapping. A consensus-based approach using a participatory geographic information systems (GIS), can spatially prioritize important locations, define additional data collection efforts needed, and identify products needed to inform decision-making. The approach has been used successfully in mapping projects in [Long Island Sound](#), [Washington State](#), and [Lake Michigan](#). The ultimate goal of the prioritization process is to compile mapping suggestions in a standardized and quantitative format from a broad range of user groups (hereafter referred to as 'respondents'). The output from this process can be analyzed to identify consensus areas of highest priority and other locations where collaborative mapping is possible. The Spatial Prioritization widget provides a spatial framework for this collaboration in a web-based application.

The widget can be configured to gather additional information on prioritization apart from simply where mapping is needed, such as the justification for respondent's priorities and the type of map products needed. These are selected from lists (set when configuring the widget), using specific values to enforce data integrity.

The widget works in [Web AppBuilder Developer Edition](#) (WAB DE) or Web AppBuilder on Portal. It cannot be installed in a Web AppBuilder app on ArcGIS Online (AGOL), since that doesn't allow third party widgets. It is designed to work with hosted feature layers on AGOL. This documentation describes how to configure it and set up the feature services that it edits. Read more about configurable widgets in WAB in the [documentation](#). To add the widget to your WAB DE deployment, copy the directory to the default widget repository (client\stemapp\widgets) and it will appear in the Choose Widget window (Figure 1).

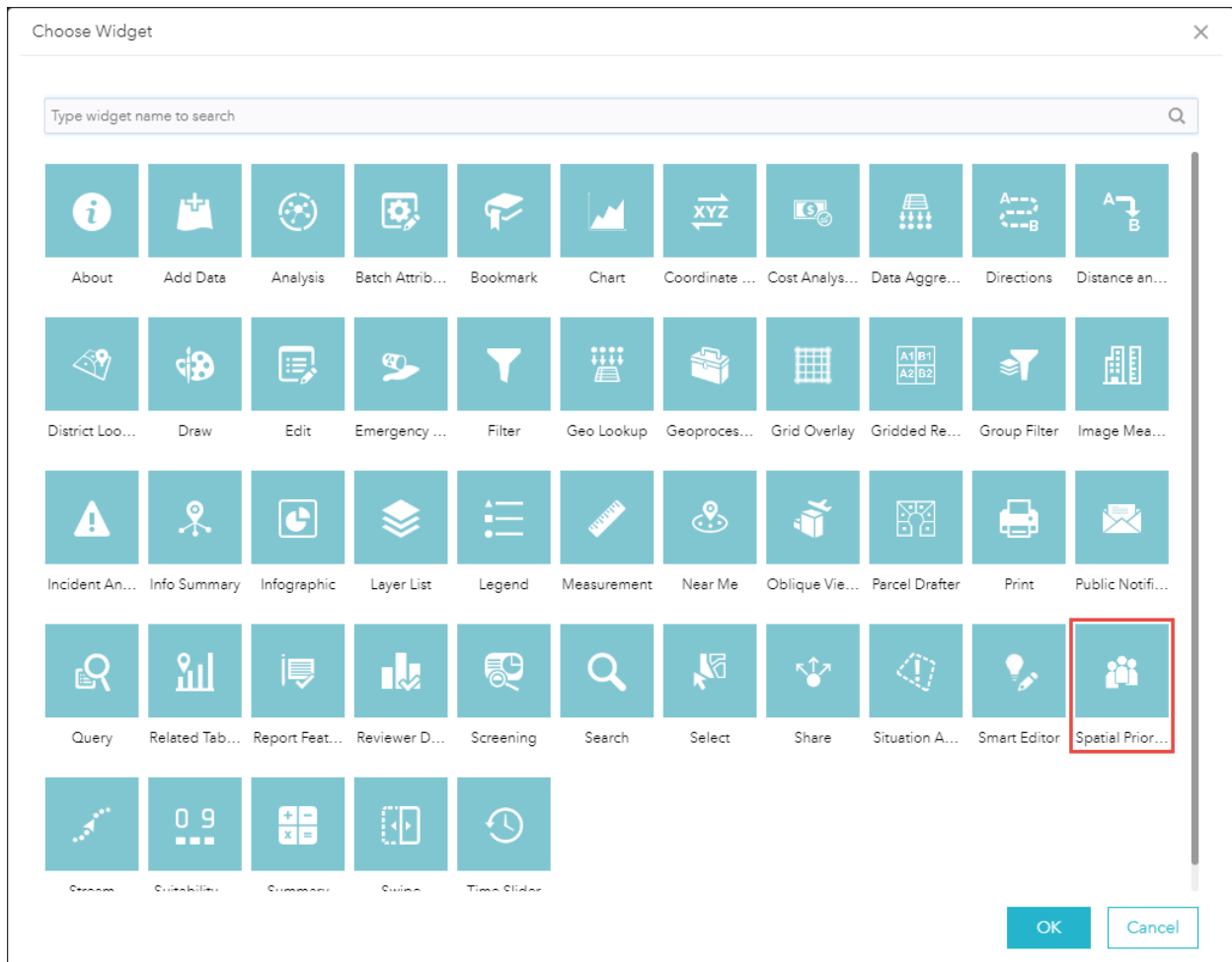


Figure 1: Widget selection screen

Getting Started:

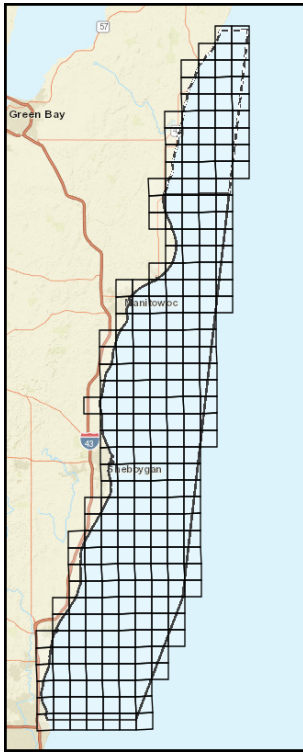


Figure 2: Example polygon prioritization grid

Before setting up the tool, two decisions must be made regarding 1) the spatial resolution of the priorities that can be selected and 2) the method that will be used to assign priority levels. First, to best standardize the results in the analytical stage, the project area must be subdivided into polygon grid cells. Ideally, these cells should be the same size and aligned to a standardized grid reference system. The cell size should be small enough to adequately represent the level of detail needed, but not too small and numerous as to overwhelm the respondents. A grid of 100 cells is probably the minimum that should be considered. Fewer cells will not force respondents to be selective in setting mapping priorities. A grid of 1000 cells may be a useful maximum to consider. Having too many cells not only offers too many choices for respondents but can result in a lack of overlap in suggestions if priorities are spread too thin (a key to consensus and collaboration). The specific number and size of cells will be dictated by the local geography, number of expected respondents, and the specific project goals. Create this prioritization grid with the [Fishnet](#) tool. This grid, published as a hosted feature layer on AGOL, will be edited by the individual respondents as described later in the process. Figure 2 show the grid data set containing 261 cells that was created for the Lake Michigan study area, with a cell size of 4x4 km and aligned to the US National Grid.

The second preliminary decision that must be made before beginning is to determine whether mapping priorities will be set categorically or numerically. There are two methods of prioritizing areas: a categorical (high/medium/low priorities) and a quantitative (coin) method. Either method can be used to convey where and when mapping data are needed.

For the high/medium/low method, the respondent selects the priority based on time frame of importance (Figure 3). This can be specified for respondents but High equates to an immediate need, Medium would be a need desired in the near future, and Low would be a longer-term future need. The respondents can be restricted to how many cells are in each category to force them to prioritize the space (e.g. 1/3 of cells in each category). The application provides a live update of the number of cells allocated in each category.

In the coin method, each respondent is provided a number of virtual coins (e.g. 100) to place anywhere within the prioritization grid that they feel is a priority for future mapping (Figure 4). Respondents allocate the placement of their coins as they would allocate their limited mapping resources over the next several years. More coins in a cell indicates a more urgent need. The application keeps a live accounting of the number of coins available that are remaining to be placed. Constraints are advisable on coin placement as well. For example, the number of coins that could be allocated by a respondent into a single cell can be limited (e.g. 10 maximum). This

will prevent respondents from loading all their coins into one cell (essentially not prioritizing the space).

Preparing the data for publishing

At the minimum, the prioritization grid feature class must contain a field for the prioritization attribute that uses a coded value domain. This can either be an integer or a text field, although for the coins method, an integer field is more suitable. In the geodatabase, create a coded value domain (see [Help](#)). For the coins method, create coded values for the number of coins allocated per cell, not the total allocation amount. If more information is to be gathered about the prioritizations, such as justifications or data products required, add additional fields and coded value domains for these selections. Each selection can have up to three options (primary, secondary, and tertiary selections), with a field needed for each option. The fields for all the cells should all be set with the default values.

The mxd and geodatabase for the Lake Michigan project can be downloaded and used as an example for setting up a hosted feature layer. Do not use a “0” for the domain code of any of the domains, with the exception of the prioritization field for coins. Due to an issue with the drop down selection controller, the selection with a domain code of “0” will show in the list but cannot be selected. The coins selector uses a different controller that doesn’t have this problem.

Setting up feature services and groups

Each respondent will need a separate hosted feature layer published through ArcMap or ArcGIS Pro from the prioritization grid. This is where priorities unique to each respondent will be saved and stored. Publish the service with Query and Update operations allowed under Feature Access.

The names of the feature layer for all respondents have to contain a common string that is not in other feature layers. The naming convention used in other projects has been “*projectID_respondent*” (for example “WCC_Smith”, “WCC_Jones”, etc). In the application, when a user logs in, all content will be searched and only the first 100 item containing that *projectID* string will be returned. While this shouldn’t be a problem for the individual users (since they should only have a single layer exposed to them), when you are testing this as the owner of all those feature layers, the search may not return enough results for you. Because of this, the *projectID* string should be unique.

Open the item page for the feature layer and click the Setting tab. It is recommended to click “Prevent this item from being accidentally deleted.” Under the Feature Layer (hosted) section, click “Enable editing” and select “Update Attributes only”. Since items can only be shared with groups on AGOL, create a group for each respondent that only includes the respondent. Share the respondent’s hosted feature layer with the respondent’s group.

Configuring the widget

This documentation will show how to configure the widget to have the following options:

1. High/medium/low prioritization (Figure 2) or coins (Figure 3) method;
2. A selection (Justification) with primary with optional secondary and tertiary choices;
3. A selection (Map Products) with only a primary choice and not the additional options.

Priority	Current	Selected
High (1-2 years)	0	0
Medium (3-5 years)	0	0
Low (>5 years)	0	0
None	0	0
Total	261	0

Figure 3: High/Medium/Low method

Coins assigned: 0
Coins available: 100
Cells selected: 0

10 Assign Coins(per cell)

Apply Coins

Select a Primary Justification
None

Select a Secondary Justification (Optional)
None

Select a Tertiary Justification (Optional)
None

Apply Only Justification

Select a Map Products
None

Apply Only Map Products

Apply All Reset All Pulldowns

Change attribute display
Priority

Figure 4: Coins method

Add the widget to the WAB installation by following the directions in the WAB help ([Deploy your widget](#)) and add it to a 2D app ([Create an app](#)). The prioritization feature layer should not be included in the web map used in the app. The widget will add that feature layer for that respondent when they log in. The web map ideally should contain other data layers that can be used in the decision-making process in assigning priorities to the cells.

Respondents could view and query this information to understand the limitations of existing information, gaps in existing maps, and help identify priority areas for future mapping.

Selecting the widget and clicking OK (Figure 1) brings up the configuration dialog (Figure 5).

Location	App ID	Popup Callback URL
ccma-l-4181321.nos.noaa	P-4181321-nos-noaa-H	/oauth-callback.html
nccos-coastalsciencemaps-web-dev.azurewebsites.	e-4181321-nos-noaa-t	https://maps.coastalscience.noaa.gov/_assets/mod
maps.coastalscience.noaa.gov	O-4181321-nos-noaa-79	https://maps.coastalscience.noaa.gov/_assets/mod

Figure 5: Spatial Prioritization Configuration screen, ArcGIS Online Settings

ArcGIS Online Settings

Owner Name – this should be automatically filled in with your AGOL account name. If the owner of all the hosted feature layers published from the prioritization grid is someone else, change this to the owner’s account name.

Base Grid Layer Name – this word or phrase must a part of the name of all the hosted feature services (*projectID* in “Setting up feature services and groups”). The widget will search through the hosted feature layers shared with the user and add the first one containing this string.

Portal URL – this should be automatically filled in with your portal URL.

Authentication information – the widget uses the OAuth 2.0 methodology for secure access (see [Authentication in ArcGIS](#)) to the data, using a registered app login. Each web site for the app will have to be registered, including the computer running WAB DE (See [Add Apps](#)). Figure 5 shows an example with three sites: the computer running WAB DE, a production site, and a development site. A Location will be automatically added for the computer running WAB DE. The Location should be just the domain name, without http or https, port, or paths. The App ID is a 16 character string generated when registering the app. The Popup Callback URL is the location of a short html file used in the authentication process. It can be downloaded [here](#) and is also distributed with the widget.

Prioritization Settings

Click the Prioritization Settings tab to select the prioritization method (coins or high/medium/low). A table containing prioritizations, labels, and colors will be automatically filled in using a hosted feature layer in the map in your app or your ArcGIS Online content or a service URL. The feature layer must have a prioritization field with a domain.

Choose the *Prioritization Method*, Coins (Figure 6) or High/Medium/Low (Figure 7), before selecting a feature layer. Select the *Template Layer* (any one of the hosted feature layers created from the prioritization grid for the project) using the Set button and choose the feature layer in the “Set data source” dialog (Figure 6).

The Coins Method:

Configure Spatial Prioritization

Spatial Prioritization

Change widget icon

ArcGIS Online Settings **Prioritization Settings** Filter Additional Settings

Prioritization Method: Coins, High/Med/Low

Template Layer:

Prioritization Field:

Allocated Coins:

Maximum Coins per Cell:

Domain Code	Label	Color
	0	<input type="color" value="black"/>
1	1	<input type="color" value="darkgreen"/>
2	2	<input type="color" value="green"/>
3	3	<input type="color" value="lightgreen"/>
4	4	<input type="color" value="yellowgreen"/>
5	5	<input type="color" value="yellow"/>
6	6	<input type="color" value="orange"/>
7	7	<input type="color" value="red"/>
-	-	<input type="color" value="white"/>

Figure 6: Spatial Prioritization Configuration screen, Prioritization Settings for Coins

Select the *Prioritization Field* to fill out the table. Set the *Allocated Coins* (the total number of coins a respondent can allocate to all cells) and the *Maximum Coins per Cell* (the maximum number of coins the respondent can allocate to a single cell) values. In this example, coins per respondent is set to 100. Any value can be used, but 100 may be easiest and most intuitive for respondents to allocate their priorities in proportion to their mapping interest and resources. A useful guideline is to provide a number of coins equal to $\sim 1/3$ to $1/2$ of the total number of cells in the prioritization grid. This forces the respondents to be selective in setting priorities but yields overlap in priorities among respondents which is a goal of the process. Also of note, very high values (e.g. >500 coins) should likely be avoided due to the burden of time this places on respondents to allocate them all.

The label for each of the prioritizations can be changed, as well as the colors. The colors should be set from the unique values set in the original mxd. If that is not readable, the colors will be randomly assigned.

Note: The transparency of the colors cannot be set in the widget. To do that, after saving the configuration, edit the json file in the \server\apps\n\configs\SpatialPriorization folder (where n=the app number). Search for “prioritizations” and set the “a” value for the color between 0 (fully transparent) and 1 (fully opaque).

The categorical High/Medium/Low method:

Configure Spatial Prioritization

Spatial Prioritization

Change widget icon

ArcGIS Online Settings **Prioritization Settings** Filter Additional Settings

Prioritization Method: Coins High/Med/Low

Template Layer:

Prioritization Field:

Domain Code	Label	Max Cells	Color
3	High Priority	300	<input type="color" value="red"/>
2	Medium priority	<input type="text" value="300"/>	<input type="color" value="yellow"/> <input type="button" value="↑"/> <input type="button" value="↓"/> <input type="button" value="×"/>
1	Low priority	0	<input type="color" value="green"/>
0	No priority	0	<input type="color" value="black"/>

Figure 7: Spatial Prioritization Configuration screen, Prioritization Settings for High/Medium/Low

The prioritization table has an additional field (Max Cells) to regulate how many cells a user can allocate for each prioritization. This prevents respondents from assigning all cells as a high priority (essential not prioritizing the space). A value of 0 in this setting means no limit is set. A useful guideline to achieve good results in this type of process is to allow 1/3 of the total cells to be labeled in each category (high/ medium/low) or at least only allow 1/3 of the cells in the high category with no restrictions on the others.

Rows can be moved or deleted by hovering the mouse over the row and clicking the Move up, Move down, or Delete icons on the right side. The default value for the Prioritization list will be the first item.

Filter

If you want to use only a subset of the polygons in your grid layers, you can add a Filter by building an expression using the fields and data from your template grid. For more detail on how to use this, consult steps 6 and 7 in the [Filter widget](#) documentation. The calculations for the coin allocations or H/M/L selections will only be done on the displayed cells. For example, we used this to set up five different regional prioritizations using a single underlying grid. The grids contained the field “Region” with the attribute of the state names.

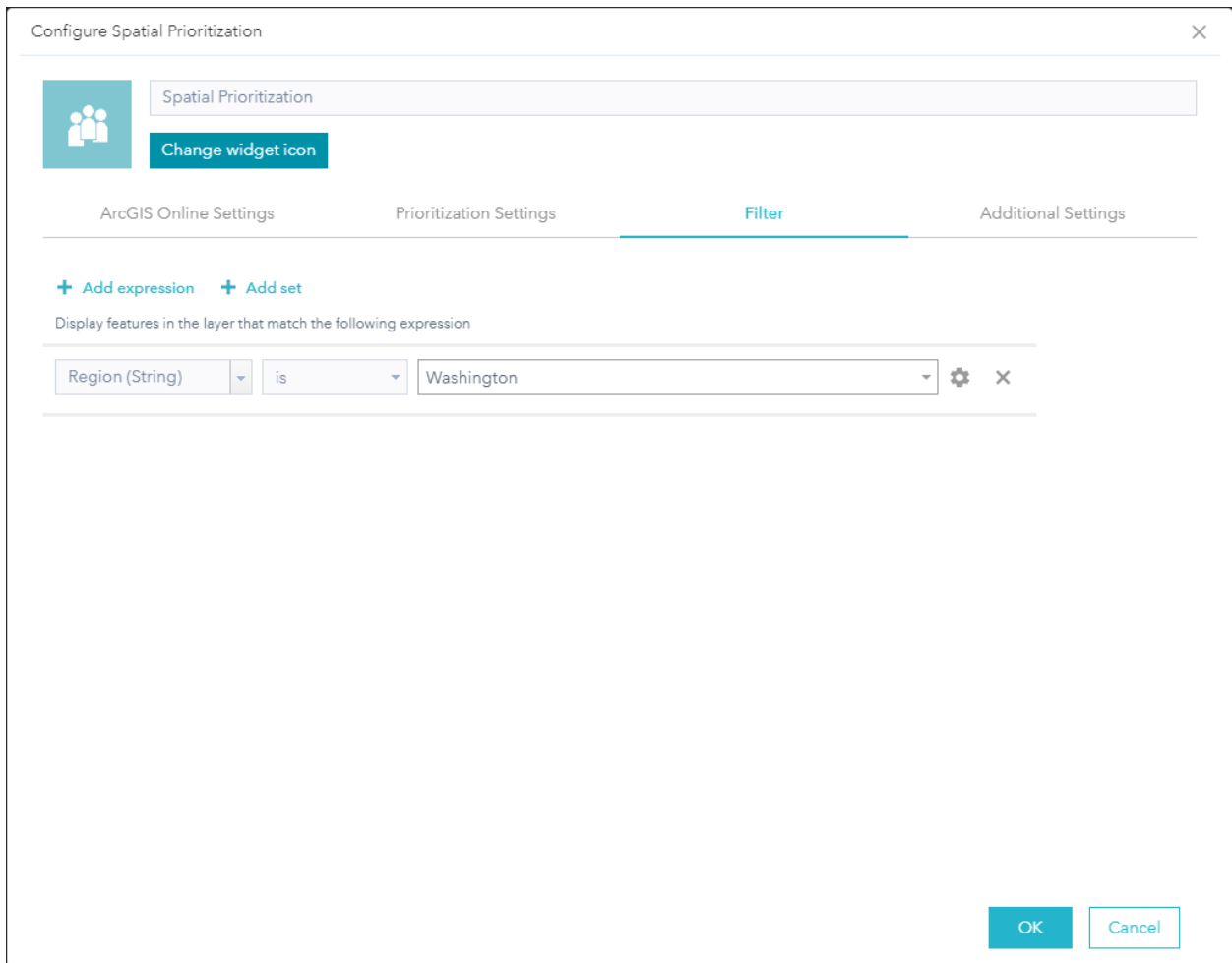


Figure 1: Filtering the grid by region.

Additional Settings

To add additional attributes to the grid cells (Justification, Map Products, etc), click the Additional Settings tab (Figure 8). Click *Add New Selection* to add additional choices (Justification as shown in the example). Choices for this attribute will be presented in a dropdown menu, based on the Selection Name. Note that the name in the Selection table will not be updated until another selection is added or chosen, but it will be saved properly.

The screenshot shows the 'Configure Spatial Prioritization' dialog box with the 'Additional Settings' tab selected. The dialog has a title bar with a close button (X) and a search bar containing 'Spatial Prioritization'. Below the search bar is a 'Change widget icon' button. The main area is divided into four tabs: 'ArcGIS Online Settings', 'Prioritization Settings', 'Filter', and 'Additional Settings' (which is active). On the left side of the 'Additional Settings' tab, there is a '+ Add New Selection' button and a list of selections: 'Selection', 'Justification', and 'Map Products'. The 'Justification' selection is currently selected. The main configuration area for 'Justification' includes: 'Selection Name' (Justification), 'Selection Field' (Primary Justification), a checked 'Add Secondary Selection' checkbox with 'Secondary Field' (Secondary Justification), and a checked 'Add Tertiary Selection' checkbox with 'Tertiary Field' (Tertiary Justification). Below these fields is a table with columns 'Domain Code', 'Label', and 'Color'. The table contains the following rows:

Domain Code	Label	Color
Exploration	Exploration	[Brown]
Fishing (Commerc...	Fishing (Commercial)	[Dark Blue]
Fishing (Recreatio...	Fishing (Recreational)	[Blue]
Cultural	Cultural Heritage & Historical/Maritime Resources	[Dark Green]
Geology	Geology	[Orange]
Energy	Energy	[Pink]
Research	Research	[Purple]
Biota/Important N...	Biota/Important Natural Area	[Dark Blue]
Coastal/Marine Ha...	Coastal/Marine Hazards	[Light Green]

At the bottom right of the dialog are 'OK' and 'Cancel' buttons.

Figure 8: Spatial Prioritization Configuration screen, Additional Settings for Justifications

The *Selection Name* will be the text used in the widget (see Figure 2). Select the Selection Field and if a secondary selection is needed, click *Add Secondary Selection* and choose a *Secondary Field*. Do the same if a tertiary selection is needed. The labels and color can be changed, as well as the order of the rows. The default value for the dropdown lists will be the first item.

Click "Add New Selection" to add additional attributes (Figure 9).

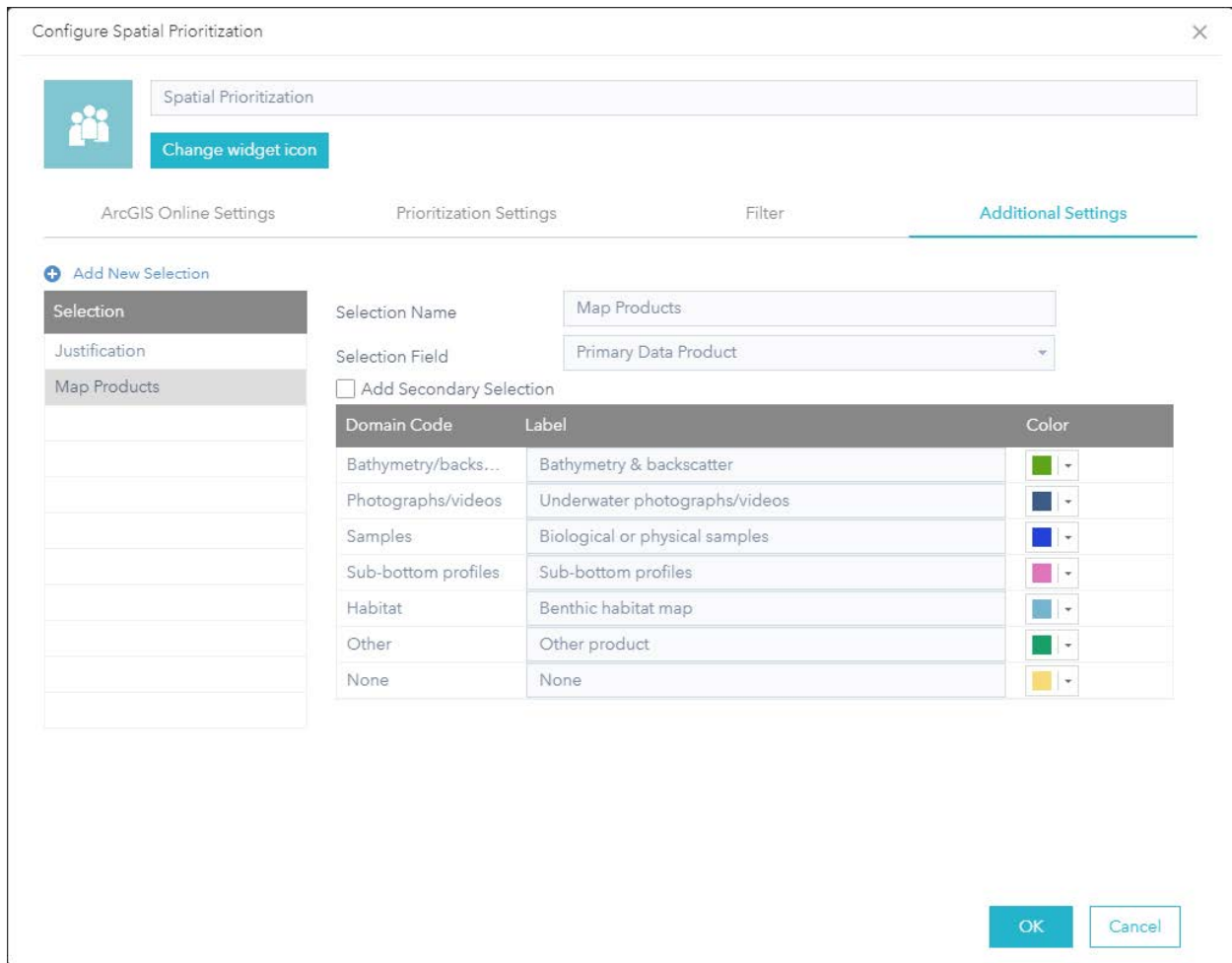


Figure 9: Spatial Prioritization Configuration screen, Additional Settings for Map Products

When everything has been filled out and selected, click OK to save the widget configuration. Finally, save the app configuration. Otherwise, all configurations will be lost. Click Launch to test out the widget.

Follow the direction [here](#) on how to deploy the app on your web server.

To easily monitor the progress of the users in their prioritizations, you can set up an [Operations Dashboard](#) showing how many coins they've allocated (Figure 10) or other metrics.

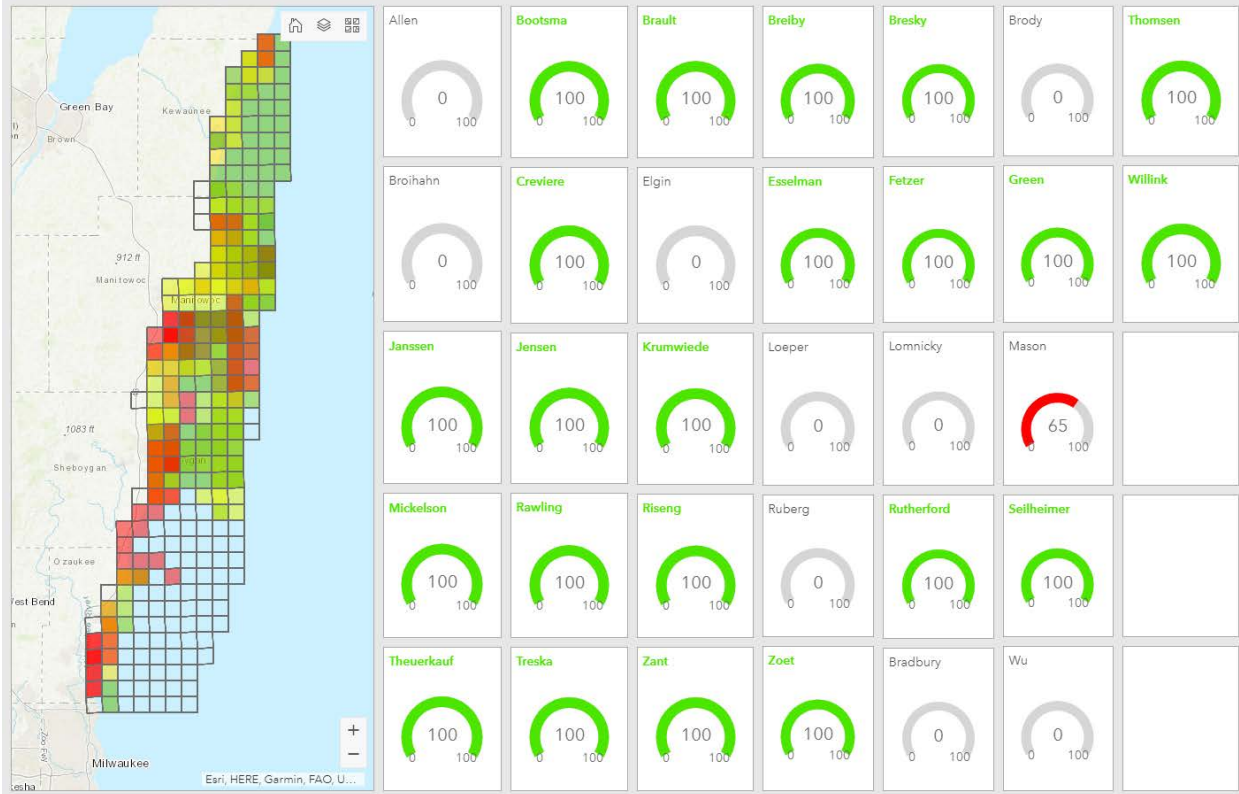


Figure 10: Dashboard showing coins allocated by each respondent

For questions on this widget, contact Ken Buja at ken.buja@noaa.gov