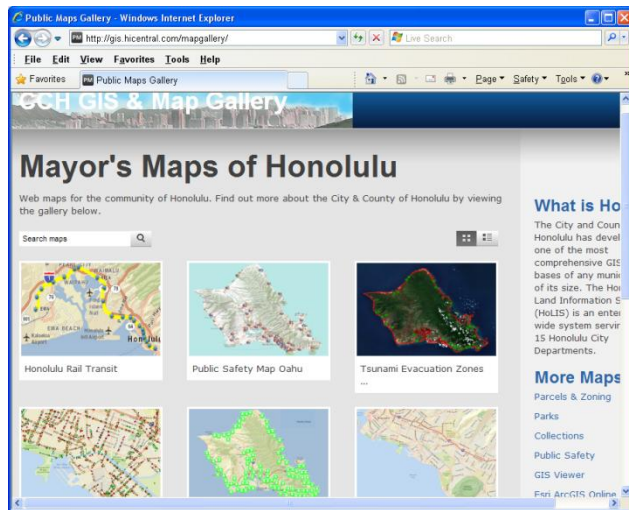


Guide to GIS for Honolulu Hackers (part 1)

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OK, maybe you've heard that a lot of City and County of Honolulu (CCH) data is publically available through REST map services published by HOLIS (Honolulu Land Information System), the Department of Planning and Permitting (DPP) GIS group. Perhaps you've even seen the "intelligent web maps" gallery of "Mayor's Maps" they've published:

<http://gis.hicentral.com/mapgallery/>



Or perhaps you've used their "focused map applications" to find information on parcels, parks, refuse collection or public safety:

<http://gis.hicentral.com/>



If you haven't tried any of the above, try them now.

GIS 101

Before you can start creating your own intelligent web maps or focused map applications, you need to know a bit about GIS, or geographic information systems. Here's a great summary article by Dennis Hollier on "GIS in Hawaii" from the December 2011 issue of Hawaii Business:

<http://www.hawaiibusiness.com/Hawaii-Business/December-2011/GIS-in-Hawaii/>

If you don't read the entire article right now, at least read the final paragraph:

"Nowadays, almost every government agency tells at least part of its story in a public layer or a database accessible through GIS. This has given rise to an unprecedented cascade of government information into private hands."

Rather than give you an entire course in GIS, here's all you need to know:

$$\text{GIS} = ((\text{maps} + \text{data}) * \text{analysis}) ^ \text{web}$$

Let's break it into parts:

MAPS $\text{GIS} = ((\text{maps} + \text{data}) * \text{analysis}) ^ \text{web}$

FEATURES

It has been said that 90% of government data has a spatial component. This means it can be put on a map. In GIS we put data on a map using features that are either points (one X,Y coordinate), lines (a series of X,Y coordinates that are connected), or polygons (a series of X,Y coordinates that enclose an area). Point features are used to represent something at a single location like a well or an antenna. Line features are used to represent linear features like streets or streams. Polygon features are used to represent areas like tax parcels or zoning areas.

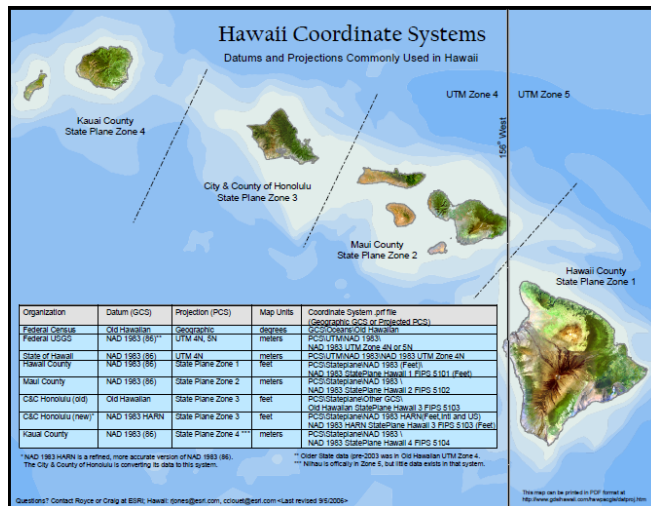
COORDINATES

The X,Y coordinates used to represent features are stored in a coordinate system. The most commonly know coordinate system uses longitude (X) and latitude (Y). Longitude values range from minus 180 to plus 180 degrees and latitude values range from minus 90 to plus 90 degrees. This is a geographic coordinate system (GCS). The two most common GCS used in Hawaii are named WGS84 and NAD83 HARN. These are spherical coordinate systems that locate a position on a spherical globe.

To show features on a flat map, we change the spherical coordinates into flat, or projected, coordinates (PCS). The two most common PCS used in Hawaii are “UTM” (Universal Transverse Mercator) and “State Plane”. However, to use our Hawaii data on the web (which is international), the most common PCS is “WGS 1984 Web Mercator (Auxiliary Sphere)”.

In most cases you will be working with map services and the coordinate system information will be handled automatically, but if you start working with raw data you may need to learn more about coordinate systems. Here’s a link to a good reference on coordinate systems for Hawaii:

<http://www.gdsihawaii.com/hawpacgis/docs/HawaiiCooSys.pdf>



DATA GIS = ((maps + **data**) * analysis) ^ web

ATTRIBUTES

A key value of GIS is that not only does it put features on a map, it also stores information (attributes) about each of those features. A point feature such as a well might have attributes such as depth of the well, diameter of the well, who drilled the well, etc. A line feature such as a street might have attributes such as street name, address range, direction (one way streets), etc. A polygon feature such as a tax parcel might have attributes such as TMK (tax map key number), owner, permit data, etc. These attributes are usually stored in a relational database.

It is the combination features and their related attribute (maps + data) that provides a great deal of the power of GIS. A map feature can be symbolized by any of its attributes. For example, a tax parcel could be symbolized by its land value, showing higher value parcel using a brighter color. A big part of the value of GIS comes from being able to quickly create different types of maps based on different data. Cartographers are experts at doing this.

ANALYSIS GIS = ((maps + data) * **analysis**) ^ web

Once you have features and attributes stored in a GIS, not only can you quickly create different types of maps for visualization, you also can perform analysis on that data. You can use proximity analysis to find out what things are near what other things. You can use geospatial analysis to see if there are significant spatial patterns in the data and to make predictions in areas of sparse or unknown data. You can use temporal analysis to look for patterns or change over time. Analysis is the “force multiplier” of GIS.

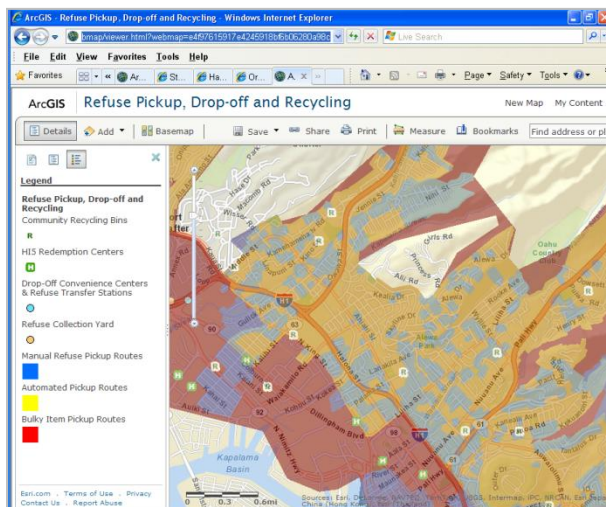
WEB GIS = ((maps + data) * analysis) ^ **web**

Features (maps) and their related attributes (data) have been used by desktop GIS users for visualization and analysis for several decades now. What is changing is that now that same power of GIS is becoming available over the internet using the web. The power of GIS is now available to citizens using intelligent web maps and focused map applications. The power of GIS is also available to developers who can create their own intelligent web maps and focused map applications. Here is what you need to know.

MAP SERVICES

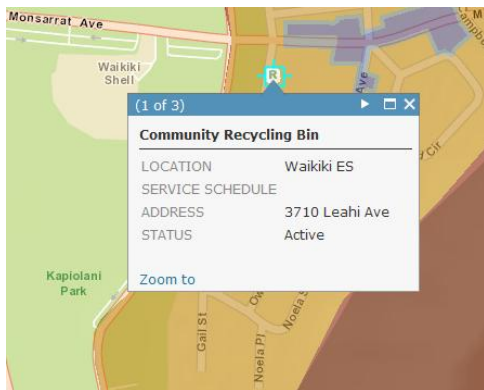
While the City and County of Honolulu does have an FTP site where you can download their GIS data, there is a more efficient way of consuming city GIS data using map services. The intelligent web maps and focused map applications you tried using the links back on page 1 all depend on map services published by HOLIS. These map services are available to you as a developer also. Let’s take a look at one right now, the intelligent web map called “Refuse Pickup, Drop-off and Recycling”. Here’s the link, give it a try:

<http://www.arcgis.com/home/webmap/viewer.html?webmap=e4f97615917e4245918bf6b06280a98c>

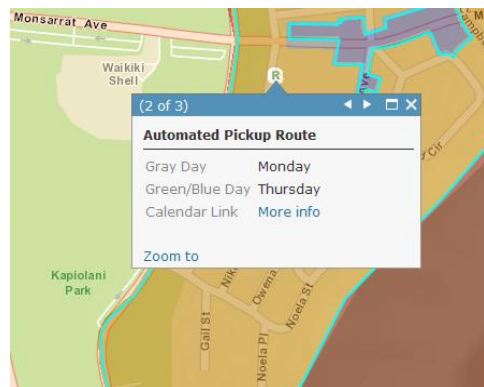




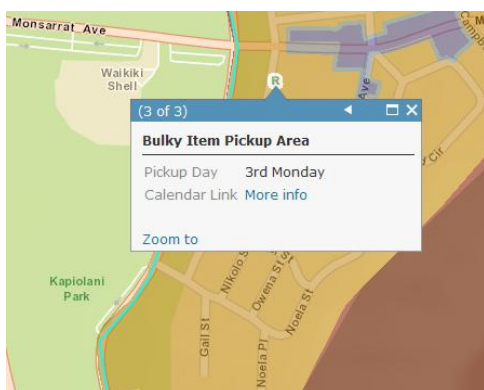
In this example I've moved to an area near the Waikiki Shell. I can see there is a basemap that shows the streets and some place names. Some areas on the basemap are colored in and represent polygon features that outline refuse collection areas. There are also point features like the community recycling bin on Leahi Ave. This intelligent web map has been set up so that if you click on the map you will see the attributes (data) related to that spot on the map.



I have clicked on the "R" representing the community recycling bin point feature. The web map returns information (attributes) about that feature. In this example the bin is at Waikiki Elementary School at 3710 Leahi Ave and it is active. Notice that it says "(1 of 3)" in the upper left corner of the window. I click the right-pointing triangle on the upper right.



I now see a second page of information. These are attributes of a Automated Pickup Route polygon feature that covers this area (outlined in light blue). I can see that in this area their gray (general refuse pickup) day is Monday. Their green (yard waste pickup) and blue (recycling pickup) day is Thursday. I can also click the "More info" for a link to a webpage with more information.



I click the right triangle again and I see information on a third feature, the Bulky Item Pickup Area polygon feature that covers this area (outlined in blue). I can see that bulky item pickup is on the third Monday of every month and again there is a link I can click if I want more information.

To understand how to make an intelligent web map like this, you need to understand map services. Here’s a link to the page that shows the map services used to create this web map along with some other information:

<http://www.arcgis.com/home/item.html?id=e4f97615917e4245918bf6b06280a98c>

Refuse Pickup, Drop-off and Recycling

City and County of Honolulu refuse pickup days, drop-off and recycling locations
 Web Map by hollisgis (last modified: December 21, 2011)
 ☆☆☆☆☆ (0 ratings, 135 views)
 Facebook Twitter

Open Share

Description
 Map of automated and manual refuse pickup areas along with gray, green and blue pickup days for automated pickup areas. Also bulky pickup days are shown along with drop-off and recycling locations.

Access and Use Constraints

Map Contents

Refuse Pickup, Drop-off and Recycling:
<http://gis.hicentral.com/arcgis/rest/services/OperEnv/MapServer>
 Place Names:
<http://gis.hicentral.com/arcgis/rest/services/BaseAerialLabels/MapServer>
 Streets:
http://services.arcgisonline.com/ArcGIS/rest/services/World_Street_Map/MapServer

The “Map Contents” area shows the three map services that were used to create this intelligent web map.

The bottom one, “Streets” is the basemap service that underlies the other services.

The next one up is “Place Names” which is not turned on by default.

The map service we’re interested in is called “Refuse Pickup, Drop-off and Recycling”. By looking at the URL we can see that it is hosted at gis.hicentral.com. We can also see that it is a REST service created by ArcGIS Server and that the service name is “OperEnv”. Click on the link to get more detailed information:

<http://gis.hicentral.com/arcgis/rest/services/OperEnv/MapServer>

HOLIS has named the service “OperEnv” since it is an “operational” (as opposed to basemap) service of data from CCH Environmental Services (ENV). The key area we’re interested is called “Layers”:

Layers:

- [Community Recycling Bins](#) (0)
- [HI5 Redemption Centers](#) (1)
- [Drop-Off Convenience Centers & Refuse Transfer Stations](#) (2)
- [Refuse Collection Yard](#) (3)
- [Manual Refuse Pickup Routes](#) (4)
- [Automated Pickup Routes](#) (5)
- [Bulky Item Pickup Routes](#) (6)

Here you can see that this map service is actually composed of seven different layers. Each layer is one particular feature type with a unique set of attributes.

Let’s start by looking at the “Community Recycling Bins” layer in more detail.

<http://gis.hicentral.com/ArcGIS/rest/services/OperEnv/MapServer/0>

Layer: Community Recycling Bins (ID: 0)

Display Field: LOCATION
Type: Feature Layer
Geometry Type: esriGeometryPoint
Description:
Definition Expression:
Copyright Text:
Min. Scale: 0
Max. Scale: 0
Default Visibility: True

Notice the “Geometry Type”. This tells you this map service layer is a set of points and their related attributes.

Also notice “Min.Scale” and “Max.Scale”. Some map service layers are only shown at certain map scales. If there are zeros for both values then the map service layer is drawn at all scales.

Also note that “Default Visibility” is true, meaning that the layer will be turned on by default when the map service is first added. There is next a bunch of numbers (under Extent) which have to do with the coordinate system. We can ignore those for now.

Drawing Info:

Renderer:
 Simple Renderer:
 Symbol:
 Picture Marker Symbol:
 R
Label:
 Description:
 Transparency: 0
 Labeling Info: N/A

Fields:

- OBJECTID (Type: esriFieldTypeOID, Alias: OBJECTID)
- OBJECTID_1 (Type: esriFieldTypeInteger, Alias: OBJECTID_1)
- LOCATION (Type: esriFieldTypeString, Alias: LOCATION, Length: 40)
- SVS_SCH (Type: esriFieldTypeString, Alias: SVS_SCH, Length: 50)
- ADDRESS (Type: esriFieldTypeString, Alias: ADDRESS, Length: 50)
- STATUS (Type: esriFieldTypeString, Alias: STATUS, Length: 7)
- GLOBALID (Type: esriFieldTypeGUID, Alias: GLOBALID, Length: 38)
- shape (Type: esriFieldTypeGeometry, Alias: shape)

“Drawing Info” tells how each point symbol will be drawn. In this case each community recycling bin will be shown using a picture marker symbol “R”.

“Fields” identifies the attributes (data) that are available for each of the point features. It shows the data type and data length as well as any pre-defined aliases.

The “shape” field is the data field that stores the actual X,Y coordinate of the point.

The final line in the layer definition is “Supported Operations”.

Supported Operations: [Query](#)

In this case, “Query” is a supported operation. What does this mean? Click on it and find out.

<http://gis.hicentral.com/ArcGIS/rest/services/OperEnv/MapServer/0/query>

This becomes important if you're building your own focused map application using one of the three Esri API's – JavaScript, Flex or Silverlight (which we'll talk about later).

You can query the layer and return a filtered set of point features. You can filter based on location. There are several spatial operators that can be used. For example, "Show me all the recycling bins with five miles of my current location".

You can also filter based on attributes. For example, "Show me all the recycling bins that whose status is active".

In the bottom box you can control how the features are returned to you. Do you only want the ID's of the returned features or the geometry (X,Y coordinates) also? Which fields do you want returned? And how would you like it formatted – HTML (as an HTML page), JSON (as a JSON object), AMF (as an Action Message Format object), or KMZ (as a KMZ file).

You can get more information on all of these options and the full ArcGIS Server REST API here:

<http://services.arcgisonline.com/ArcGIS/SDK/REST/index.html?overview.html>

In "Guide to GIS for Honolulu Hackers (part 2)" I'll show you how you can use ArcGIS Online resources to easily build your own intelligent web maps for Honolulu. Here's the link to Part 2:

<http://gdsihawaii.com/GIS4hackers/GIS4hackersPart2.pdf>.