HOW TO USE THE VERMONT DAM SCREENING TOOL

Introduction

This web map is intended for watershed managers, conservation practitioners, landowners, and others to view and interact with the results of the **Vermont Dam Screen**. The final products as well as the source and intermediate datasets are included to help users understand how the values in final products were produced.

The **Vermont Dam Screen** includes metrics in four broad classes that indicate how dams or their removal might affect aquatic life in the Vermont portion of the Lake Champlain Basin:

- **Connectivity**: These metrics assess the current state of aquatic connectivity above and below existing dams.
- **Contributing Watershed[1] Condition**: These metrics assess landscape condition upstream of a dam, which affects the potential of its river network to support healthy aquatic life.
- **Ecological Values**: These metrics assess the presence of high-conservation-value aquatic species, or diversity of species, below a dam and potentially able to take advantage of expanding aquatic habitat.
- **Stream Size[2]**: A well-connected river network with streams of diverse sizes will support a more diverse and healthy aquatic biota.

The final **Dam Screen** combines 17 component layers, with weights determined by an advisory committee. Component layers, in turn, are based on multiple source datasets. Final products, components, and sources are nested hierarchically in the map in group layers (map layers that contain other map layers) in a way that reflects how the Dam Screen was created.

Users are encouraged to explore the values of the component layers to understand which ones are important for particular dams. Values of component layers and their data sources will help practitioners understand the impacts of individual dams and the potential for aquatic habitat improvement. Detailed descriptions and methodologies are included for each layer and group layer in the map. A report will be available that will explain the methodology and results in detail.

Dam Screen component layers are briefly described below.

Connectivity

- density of dams and falls along rivers above each dam or on the downstream flowpath from that dam to Lake Champlain;
- density of culverts within the local watershed[3] immediately above or below a dam;
- number of active hydroelectric dams on the downstream flowpath (unlikely to be removed in the near future, hence relatively permanent barriers);

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[1] We define the contributing watershed as the entire upstream area draining toward a dam, regardless of any barriers that exist upstream.
[2] Our proxy for size is stream order. We use Strahler stream order. The smallest tributaries begin as order 1, and each time a tributary of the same order joins the order increases by 1 (a tributary of lower order has no effect).
[3] We define a local watershed as the area draining to the stream segment between a given dam and the next dam upstream or downstream.

- length of the upstream functional river network, which may become available to aquatic species formerly blocked by a dam;
- increase in total network size - above and below a dam - should the dam be removed (calculated as the minimum of the upstream or downstream network length).
- Additional connectivity information helps provide context, though it is not included in the screen metrics:
  - location of a dam above or below the fall-line to Lake Champlain, which generally acts as a barrier to some species migrating up from the Lake;
  - total number of barriers between dam and Lake Champlain;
  - distance to the river mouth at Lake Champlain.

Contributing Watershed Condition

- percent of the watershed in developed land uses (roads, buildings, etc.). We use this measurement as a proxy for impermeable surface, which tends to increase stormwater runoff and may cause streams to rise more rapidly during intense storms.
- percent of the watershed in natural land cover. Natural cover, mostly forest and wetlands, helps reduce runoff and filter nutrients, which tends to promote healthy aquatic systems.
- percent of the watershed in agricultural land use. Agricultural activities tend to increase nutrient runoff, which all other things being equal may detract from healthy aquatic systems.
- percent of the watershed conserved through fee or easement with a significant level of protection (GAP 3 or better). Conserved lands tend to remain in natural cover for the foreseeable future, allowing investments in aquatic improvements to pay off over time.

Ecological Values

- presence of fish species that typically migrate from Lake Champlain upstream for a portion of their life cycle, where potential habitat for these species exists upstream of the dam;
- percent of the below-dam network with brook trout (higher priority) or rainbow or brown trout (lower priority);
- total number of native fish species present within the local river network immediately below a dam;
- rare, threatened, endangered, or uncommon fish species included in Vermont's Natural Heritage Inventory that are present within the local river network immediately below a dam;
- rare, threatened, endangered, uncommon or common mussels species present within the local river network immediately below a dam.

Stream Size

- stream orders present in the network above a dam that are not present in the network below it. Since dams with very small downstream networks often have many additional orders upstream, we weighted this metric by size of downstream network.

These instructions will help you learn how to use the map by guiding you through a typical workflow. The most important features are treated first. Browse the **_bolded and underlined_** headers to find sections of interest, or follow all instructions to learn about all features of the map. Names of layers and group layers are **bolded** in the text. Internet Explorer is used in these instructions, but the user experience should be similar with other browsers. Red text refers to red annotation in the explanatory map images.

Splash Screen

When the web map is first opened a splash screen will appear. Read the text on the splash screen and the legal disclosures and privacy statements. *The data presented in this map are not intended to be prescriptive. Field work and direct knowledge of the landscape are essential to making good conservation decisions.* If you accept the Terms of Use and Website Privacy policy and understand the data access and constraints, click the check box on the lower left and then click "OK" on the lower right.
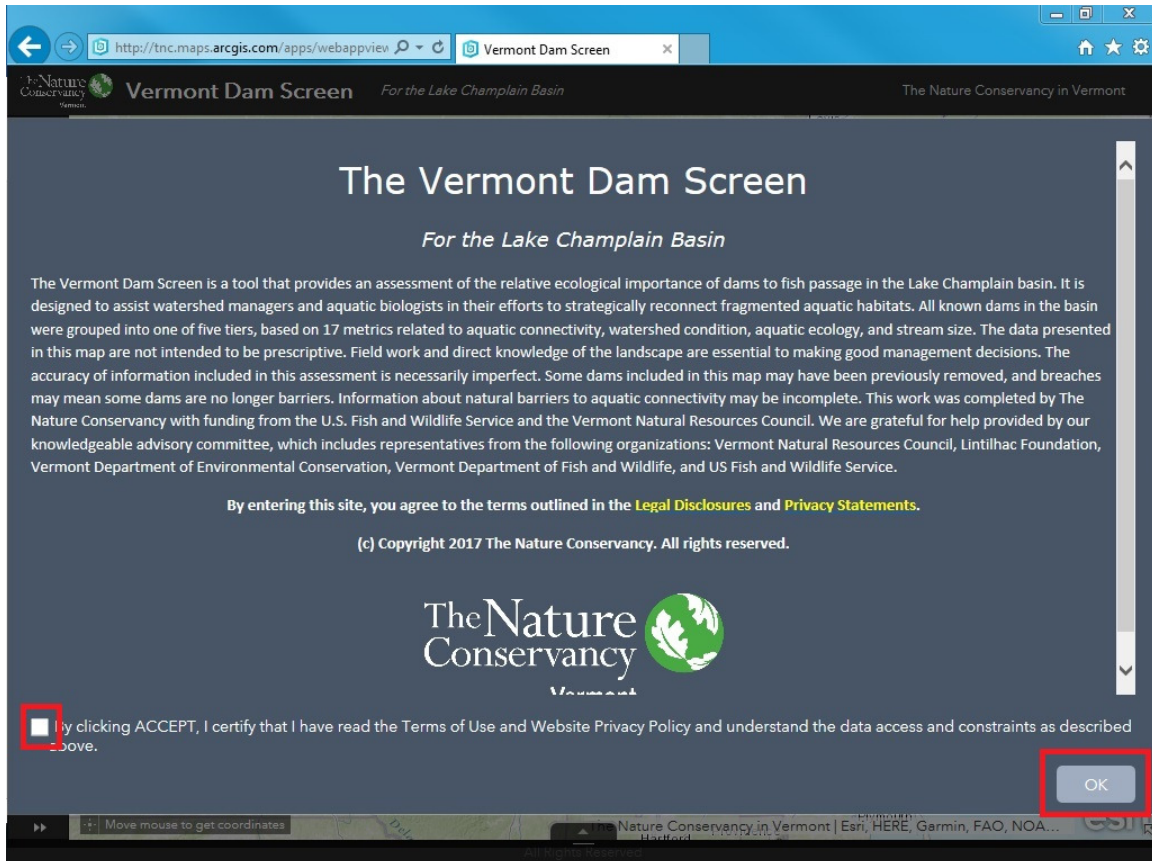
After accepting the Terms of Use and Website Privacy policy, a map will appear with a blue outline depicting the area draining to the Vermont portion of Lake Champlain.

Widget Panel

A widget panel is visible on the upper left side of the screen. Widgets allow you to interact with the map. The names of the widgets are visible while hovering the mouse over them.
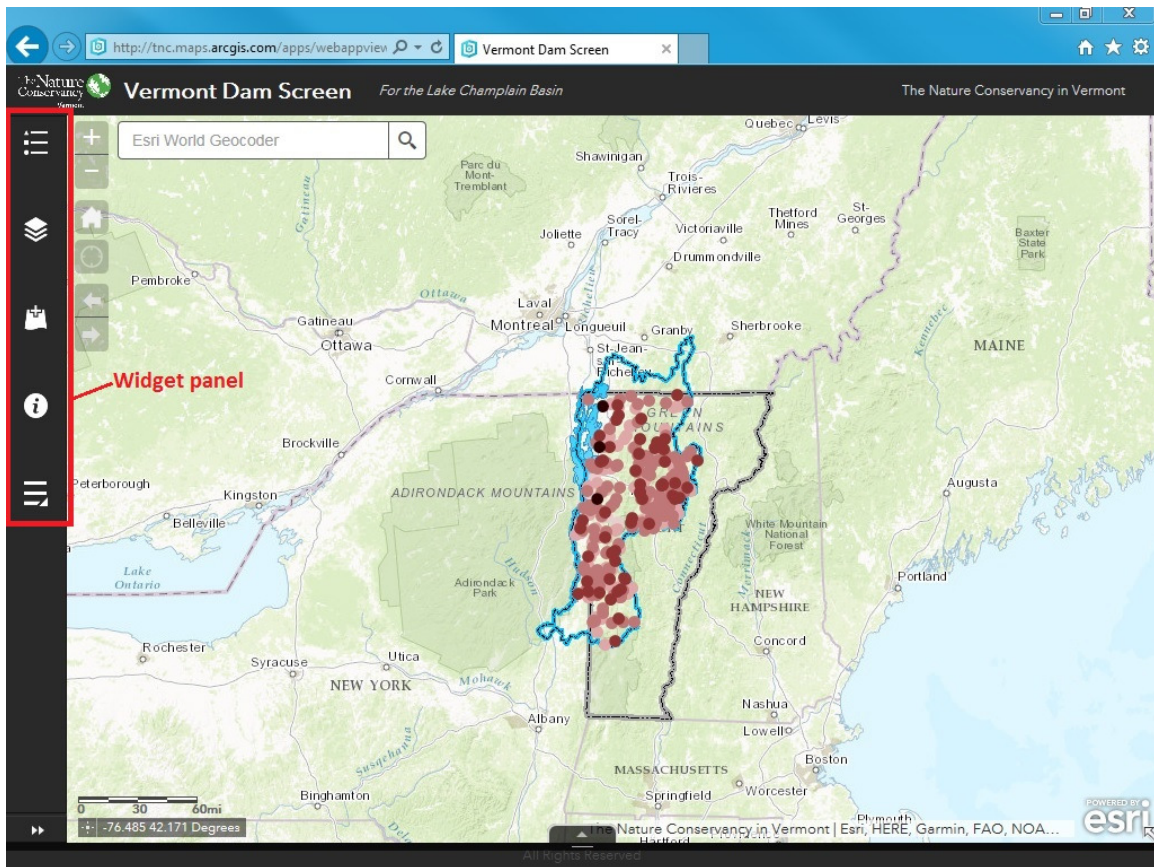
Using Layers and Group Layers

The second widget from the top is the Layer List. Clicking the Layer List widget will display the group layers and data layers available for viewing in the map. After opening the Layer List, notice that the widget panel is now horizontal (with the Layer List icon now second from left).

A group layer is a layer in the map that contains additional layers and/or other group layers.

Initially, only the **Dam Screen Layers** group layer is visible in the list.

Hiding Layers and Group Layers in the List: Hide or reveal the layers and group layers under any group layer by clicking the small triangle on the left side of the layer name.

Click the small triangle on the left side of the **Dam Screen Layers** group layer to reveal additional group layers.
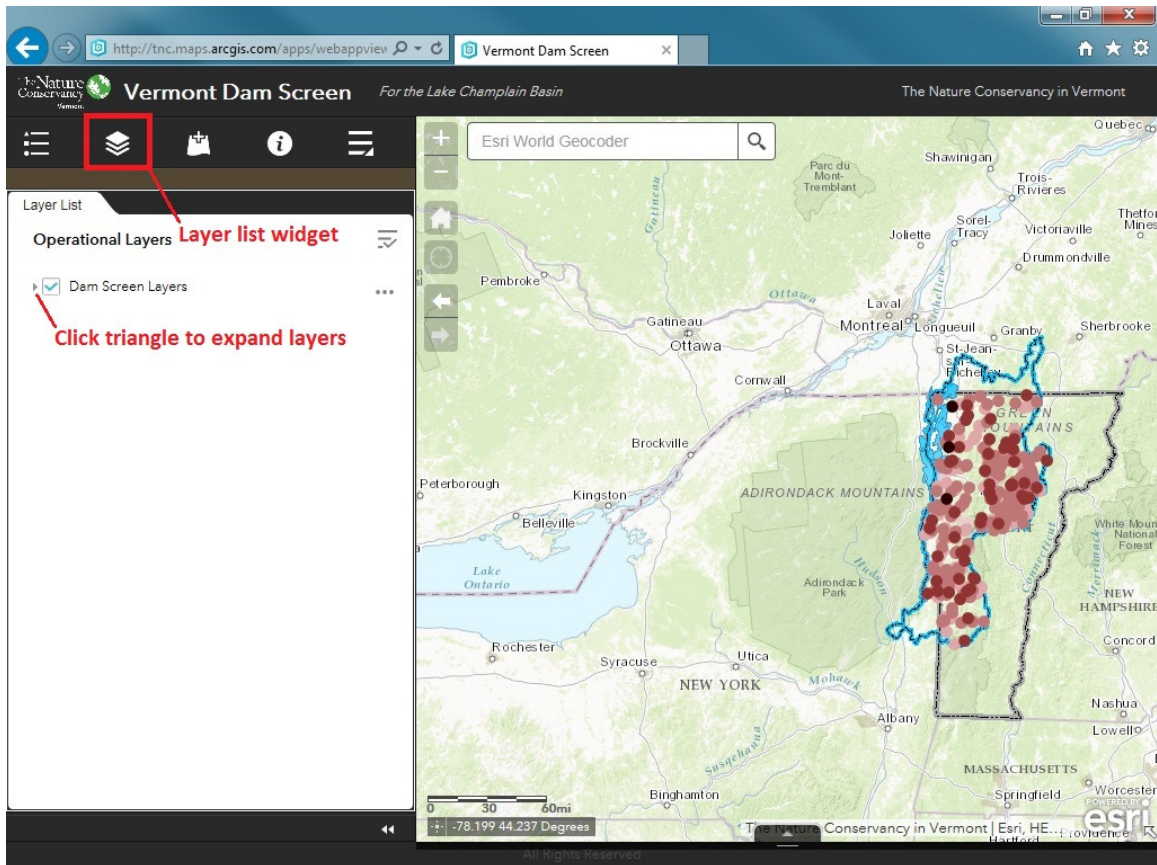
Six additional group layers will appear.

Clicking a check box to left side of a group layer will display that group layer, and any of its sub-groups that are also checked, on the map.

To display any individual data layer, all sub-groups and higher groups that it belongs to must also be checked. The **Dam Screen Layers** group layer at the top of the hierarchy must be checked to see *any* of the layers or group layers beneath it.

Layers higher in the list will display on top of the ones below, so to make a particular layer visible, be sure any group layers above it are unchecked.

Throughout the web map, the most relevant and useful layers and group layers are checked by default. The first four group layers and the **Base Data** group layer are checked by default.
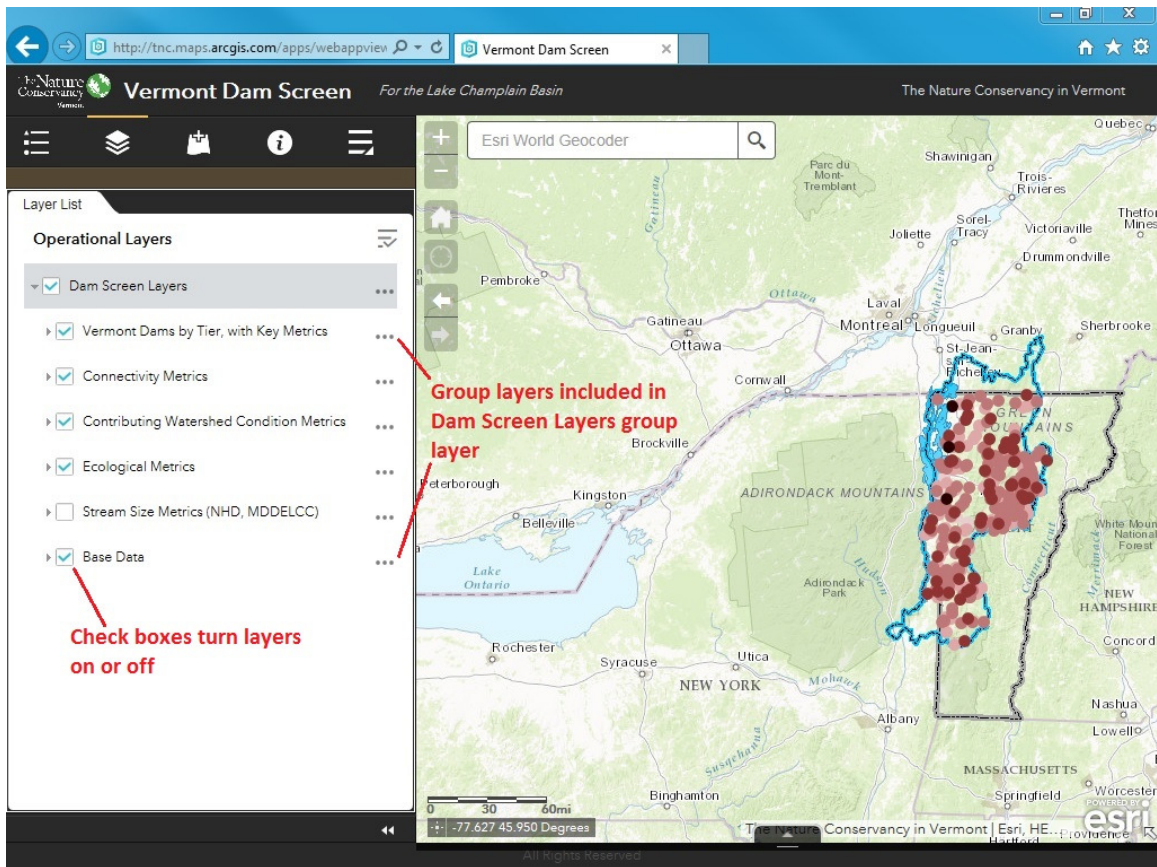
Explore the Vermont Dams by Tier, with Key Metrics Data Layer

This top-most data layer summarizes the ecological importance of each dam as indicated by the Dam Screen. Dams are placed in one of five tiers, from very high to very low.

Layer Symbology: Click the arrow next to **Vermont Dams by Tier, with Key Metrics,** or click on the layer name itself, to view layer symbology.

Zoom: To zoom in to an area of interest on the map, move the mouse to hover over that area and double click or rotate the mouse wheel forward until you are zoomed in sufficiently. Or click the '+' sign on the zoom tool in the upper left corner of the map and pan to the area of interest by clicking and dragging on the map.

The back arrow and forward arrow located below the +/- zoom tools are a convenient way to zoom to previous and next extents. Repeat clicks will continue moving backward to earlier extents or forward again to the present one.

The house symbol will return to the default extent showing the entire focus area.

In this example, we will zoom in to the area indicated by the arrow on the map below.
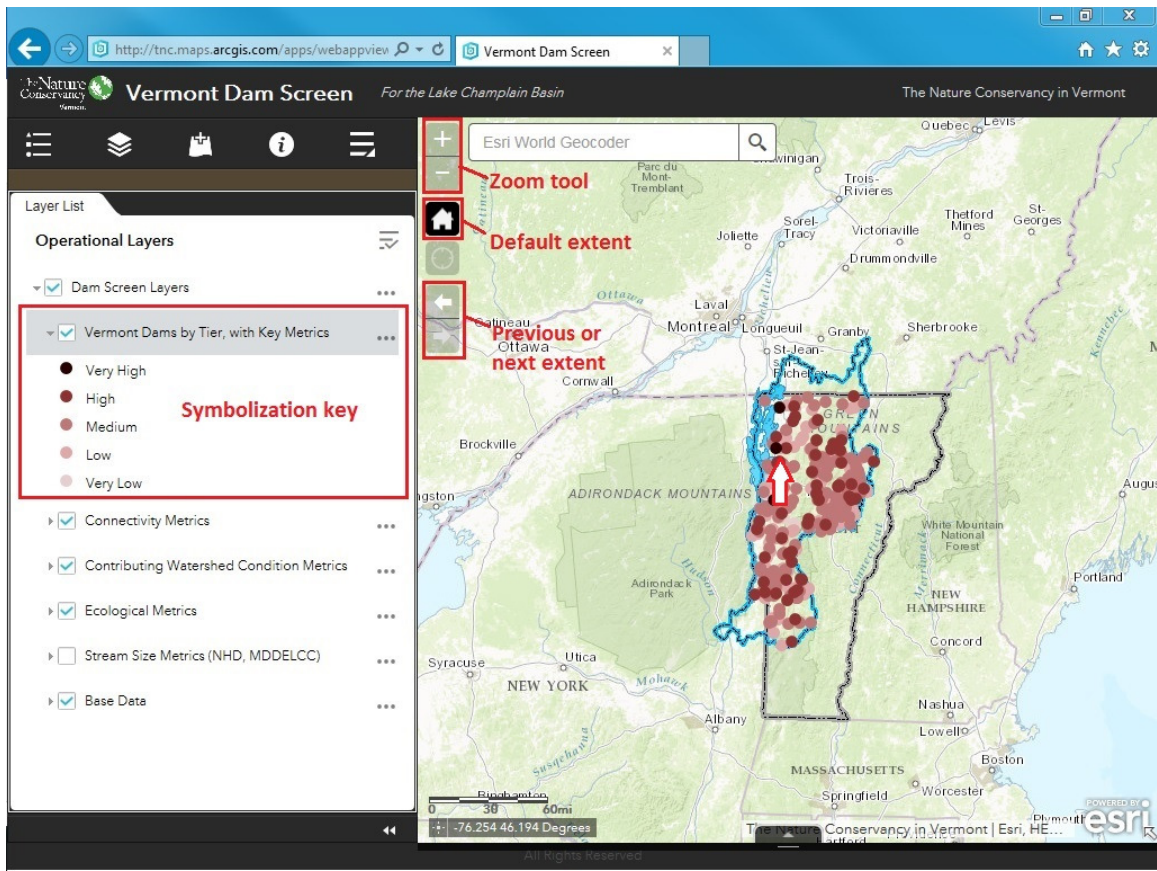
Notice below that five dams are visible in the zoomed-in extent, with dot colors symbolizing all five tiers within the dam screen.

Data Labels: Labels for each dam indicate the value for the active data layer, in this case the Dam Screen Tier (VL for very low, L, for low, M for medium, H for high, and VH for very high).

Additional Information About a Data Layer: More information about the active data layer (in this case the **Vermont Dams by Tier**) can be accessed by clicking on the three dots following the layer name.
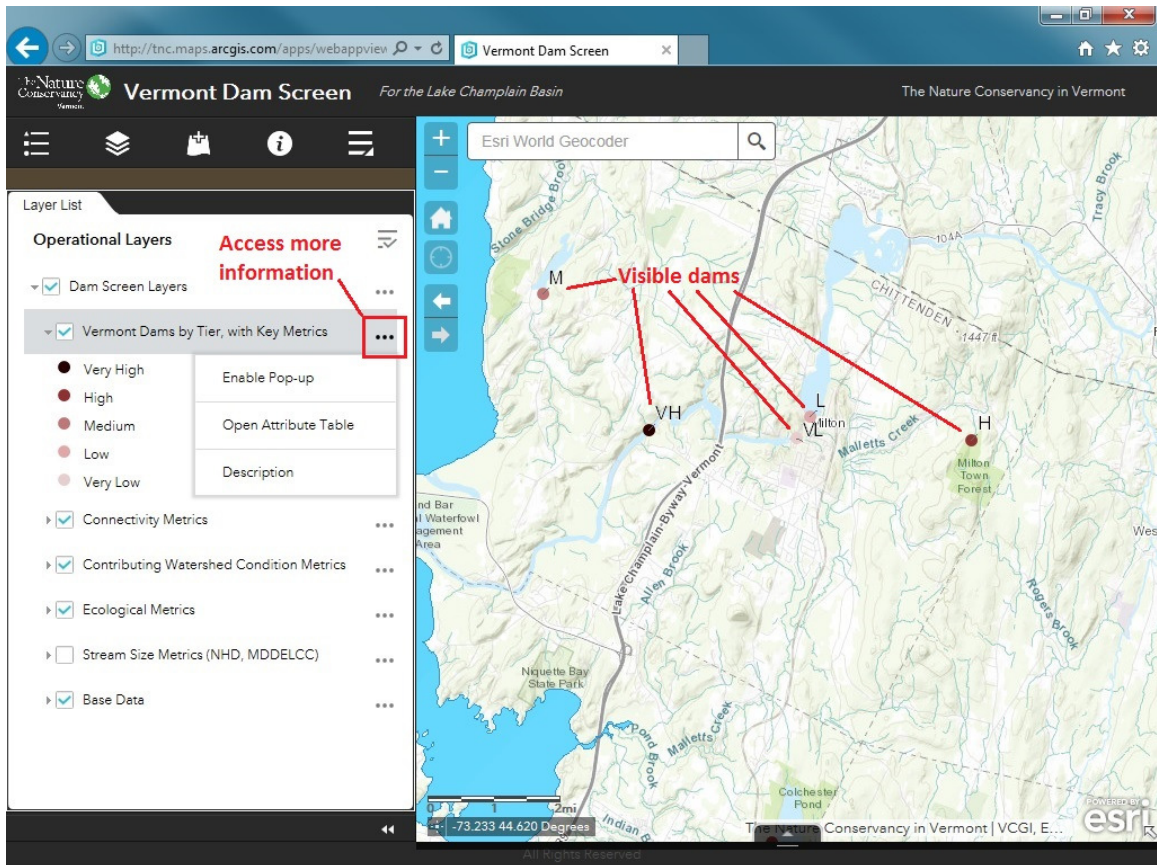
The menu that opens after clicking on the three dots displays three choices:

Enable Pop-up will allow you to click on an area of interest in the map and a pop-up will display information about it from the active data layer. The example below shows the pop-up for the dam with StateID 128.02, with all information available in the main data table (see Explore Metric and Supplementary Data Layers later in this document for an explanation of the attributes listed).

- **Open Attribute Table** will open a table in a window at the bottom of the map screen with all information available for this data layer and for items visible in the current map extent.
  - For large tables, you will need to scroll right and/or down to see all information.
  - This table can be ordered by one of the fields by clicking on that field name.
  - Under Options, field visibility can be altered, records can be filtered, or records can be exported as a csv file.
  - Click the small X on the tab to the right of the attribute table name to close the table. If more than one table is open, several tabs will be visible.

Description will open a new browser window with information about this data layer. The Description page is essential for understanding the metrics included in the Dam Screen. It explains what the raw numbers mean and how they were derived. To close this window without losing the map, click on the X for that browser tab only (see below).

Explore Metric and Supplementary Data Layers

Density of Barriers Upstream, Understanding Data Tools

Close the pop-up and table, uncheck **Vermont Dams by Tier, with Key Metrics** to allow data further down the list to display, and hide the symbology by clicking the small triangle to the left of the layer name or on the layer name itself. (Clicking repeatedly will expand or hide the symbology details.)

Click the small triangle on the left side of the **Connectivity Metrics** group layer, or on the group name itself, to expand that group, revealing the five sub-group layers that it includes.

Click the check box next to **Density of Dams/Falls in Linear Network (BAT)**[4] to turn on this sub-group layer. Click the small triangle next to the layer name, or on the group name itself, to reveal two metric data layers and one supplementary group layer that are included in this group layer.

*Density of Barriers Upstream and ***Density of Barriers in Downstream Flowpath** are the first two metrics in the Vermont Dam Screen. The * in the layer name indicates that this metric is incorporated in the dam screen, and the number of points in parentheses indicates this metric's weight out of a total 100 points.

In this example, the third element of the **Density of Dams/Falls in Linear Network (BAT)** group layer is a **Streams and Watersheds** sub-group layer, which displays stream lines and local watershed boundaries**.** Lack of a leading * indicates

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[4] The abbreviation in parentheses after the layer or group layer name indicates the data source (see Description for details).

that these data layers are not metrics, but merely provide context for map display or for understanding the derivation of the metric. Other metrics have different supplementary information displayed, listed below the metric itself.

Turn on the first metric – ***Density of Barriers Upstream** – by clicking its check box, and show its symbology by clicking on the small triangle to its left or on the layer name itself.

The metric will display on the map, with dot colors symbolizing the range of values across all dams.

Map Labels: Each dam is now labeled with its value for this specific metric in dams per mile of stream above the dam (the map must be zoomed in sufficiently to see these labels). Dam metric labels are always black. For some metrics, supplementary data layers will also have labels – these are italicized and in color to distinguish them from the dam metric labels.
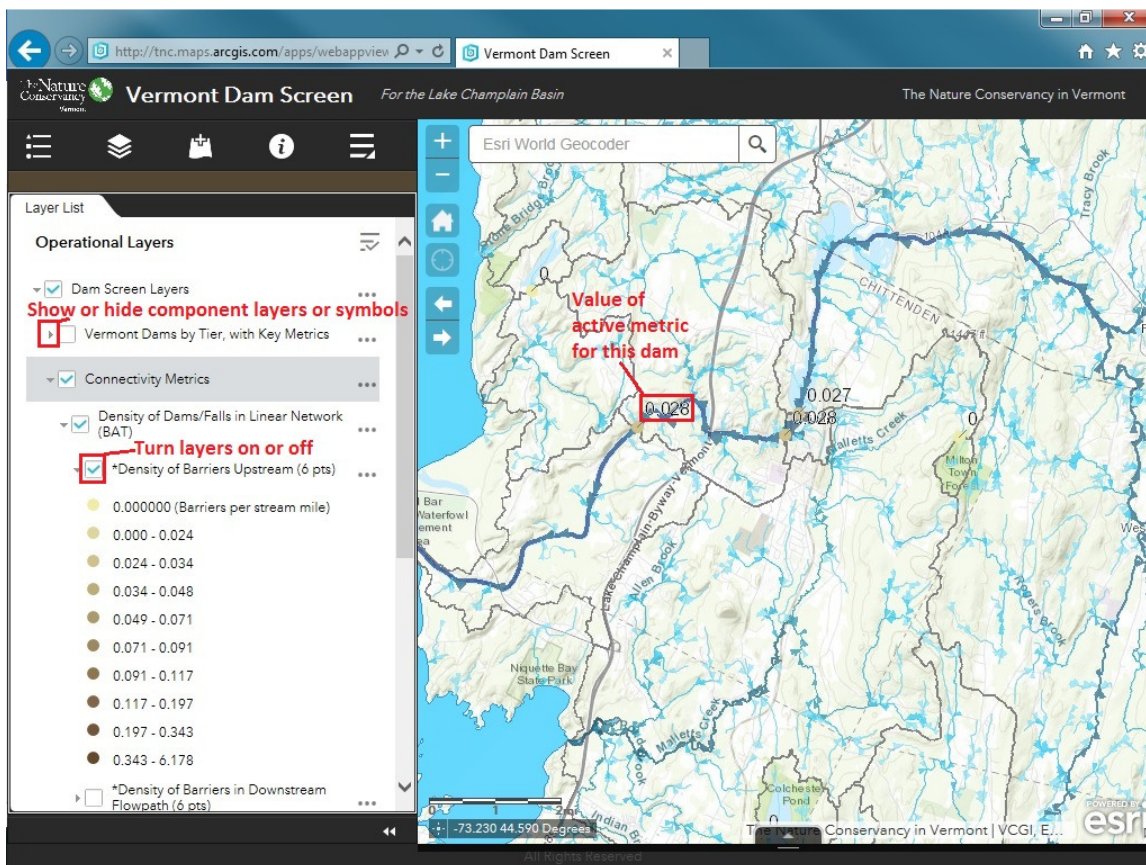
For this and any other data layer, you can access additional information by clicking on the three dots next to the data layer name (see the detailed instructions above for the **Vermont Dams by Tier, with Key Metrics**).

Legend: Click the left-most icon on the widget bar to generate a legend showing symbology for all active layers, minus the check boxes and arrows and extra layer names you see on the layers list.
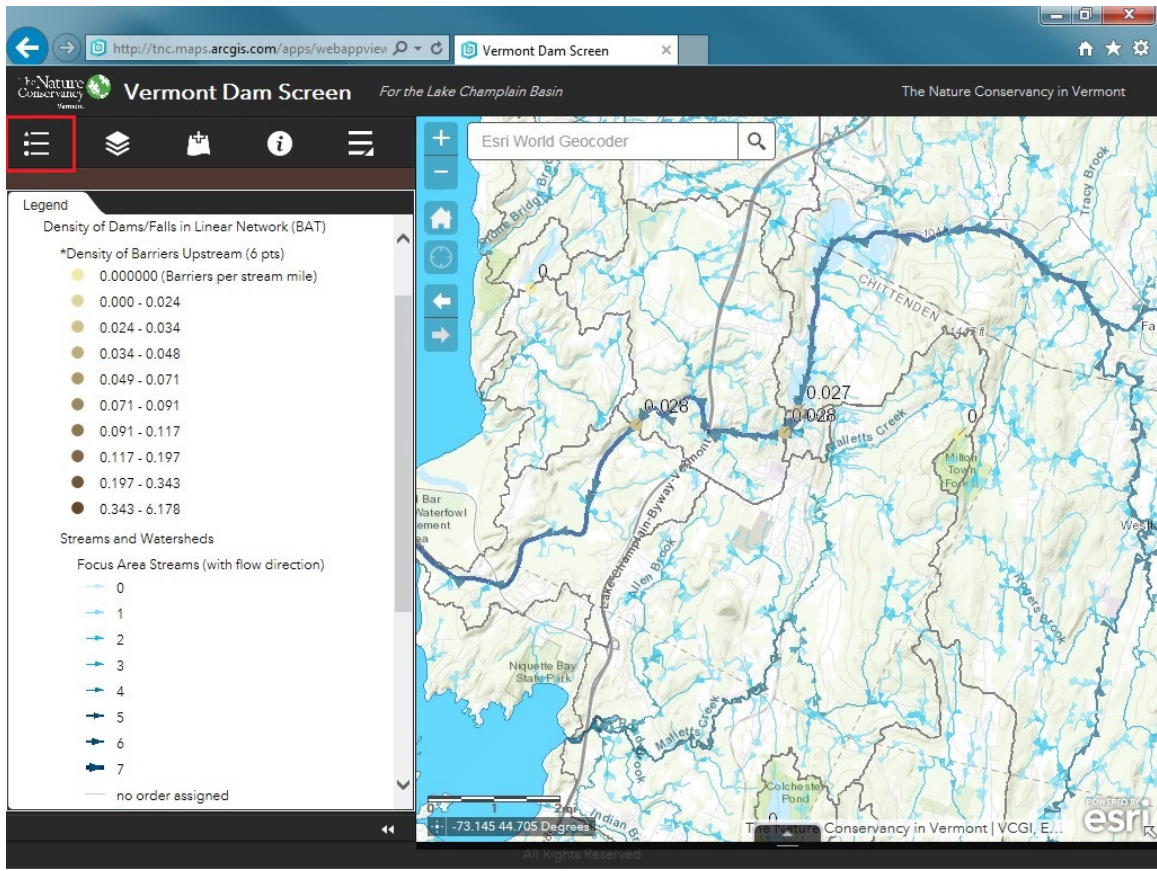
Developed Land in Contributing Watershed, Understanding Metric Values

To explore a second metric, first click the layers list icon in the widget bar to go back to the layers list.

Hide the components of the **Connectivity Metrics** group layer by clicking the arrow left of the group layer name or the group layer name itself. Uncheck the box beside the **Connectivity Metrics** group layer to turn it off, ensuring that these data layers don't over-ride those lower down the list. (Turning off the highest category in the hierarchy of layers is a short-cut that saves turning off every component data layer or group layer).

Be sure the check box next to the **Contributing Watershed Condition Metrics** group layer is checked to turn it on. Expand this group layer by clicking the small triangle to the left of the group layer, or on the layer name itself.

Turn on the **Land Cover** group layer by checking the box to the left of the group layer name. Expand this layer by clicking the small triangle to the left of the group layer, or on the layer name itself.

Turn on ***Developed Land in Contributing Watershed** data layer by checking the box to the left of the data layer name, and open its symbology by clicking the triangle to the left of the data layer name or the data layer name itself. The leading * indicates that this metric is included in the Dam Screen.

Also turn on **Land Cover Class** (scroll further down the list) by checking the box beside that data layer and open its symbology by clicking the triangle to the left of the data layer name or the data layer name itself. This data layer has no leading *, so it is provided only for context.

Enable Pop-ups and Open Attribute Table for ***Developed Land in Contributing Watershed** by clicking the three dots to the right of the layer name and then selecting those two options from the menu**.**

The illustration below shows land cover by three categories (developed, natural, agricultural). It also shows the pop-up for the same dam as shown in the previous example, and the attribute table for all five dams in this map extent (see previous section for an introduction to pop-ups and attribute tables).

This metric indicates the percent developed land in the entire contributing watershed (all areas draining to a particular dam, ignoring the presence of any upstream barriers). Note that land cover displayed at this very local scale may not correspond to conditions across that much broader landscape.

WR Values: Notice that both pop-up and attribute table display both a raw value for this metric, and a value starting with "WR". These are "weighted ranks", which convert the value of this metric for each dam to a rank from least to greatest, compute the percent of dams at or below this rank, and multiply that percent by the weight assigned to this metric. The total of all WR values determines a dam's overall score for the Dam Screen.

This particular metric has a weight of 5 points (as indicated in parentheses after the data layer name in both layer list and pop-up).

The WRPercentDeveloped value indicates that this dam received 2.20 out of a possible 5 points for this individual metric. The dams receiving the highest possible score for this metric (5 points) have no developed land in their contributing watersheds, while the dam receiving 0 points has 77.8% developed land.

Clicking on the WRPercentDeveloped field heading in the Attribute table will sort dams by their score for this metric. Zooming the map to full extent will include all dams in the list.

To close the attribute table, click on the X on the right side of its tab. If more than one table is open, more than one tab will appear.

To return the map to its original state, turn off the **Land Cover** group layer, collapse all group layers, and turn on the **Vermont Dams by Tier, with Key Metrics** layer again. Use the house symbol in the zoom tools to return to the default map extent.
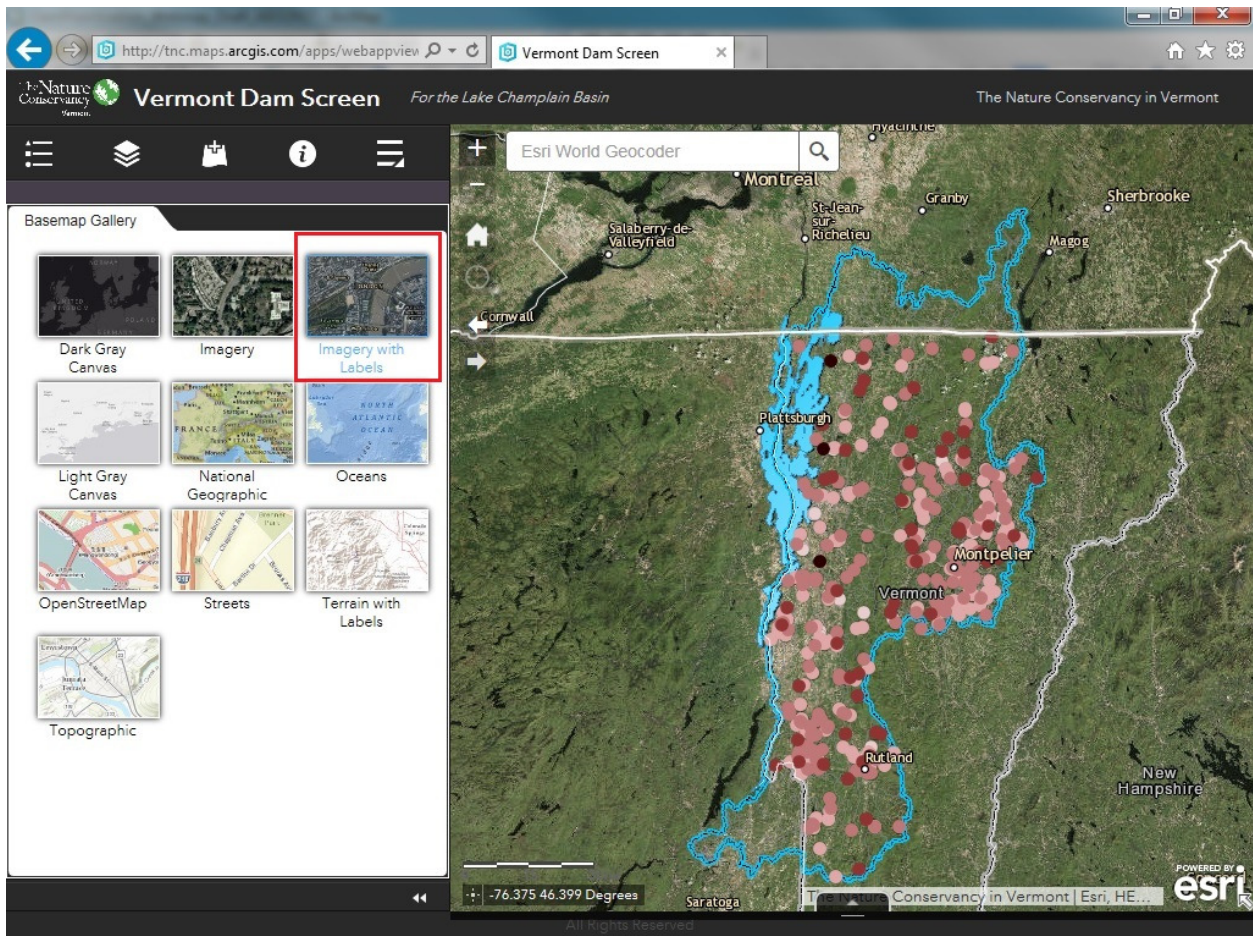
Other Tools

Changing Basemaps: Click the "more" widget on the right side of the widget panel.
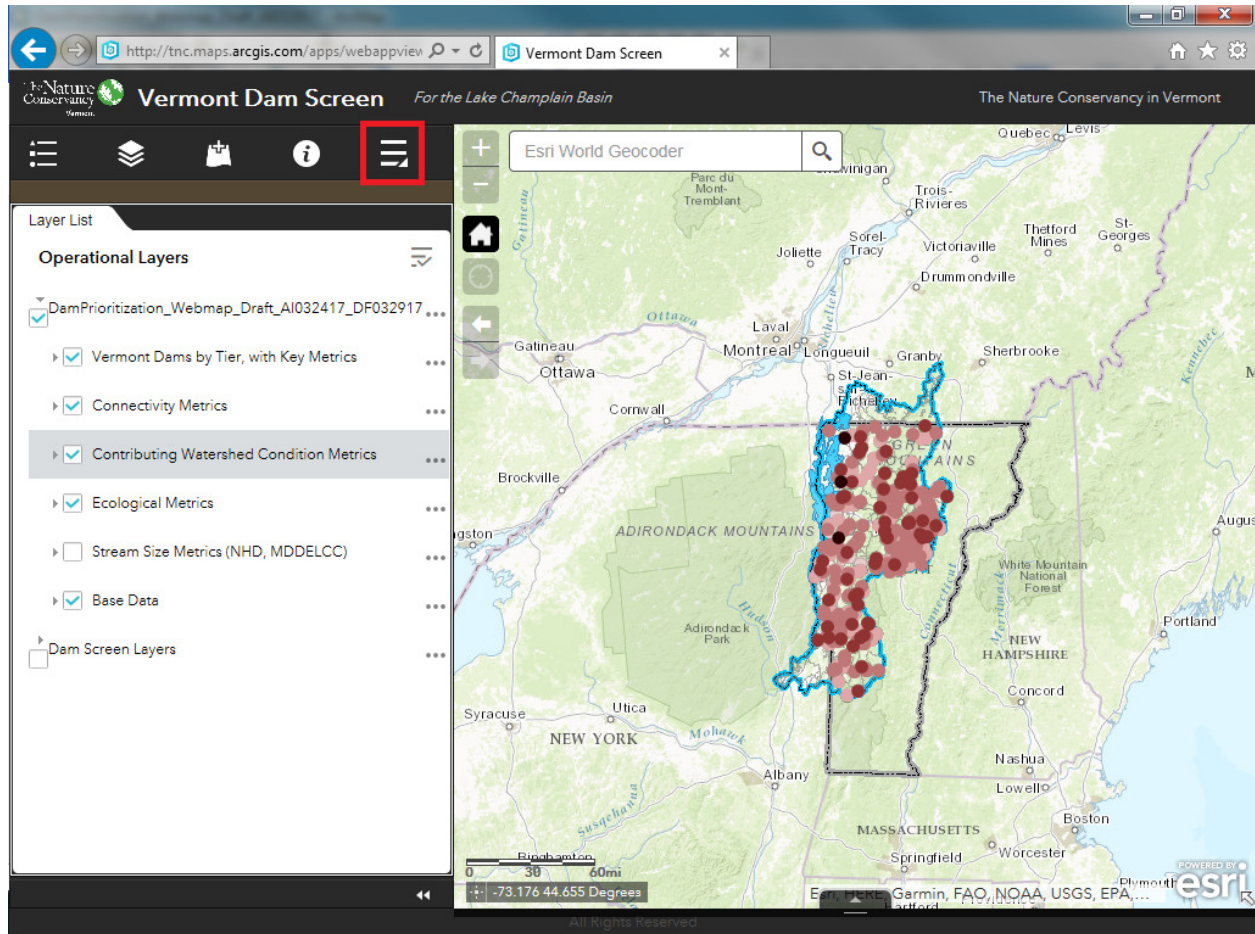

Additional widgets appear on the left side of the map.

Click the Basemap Gallery widget. When the screen with basemap options opens, click the Imagery with Labels basemap. Zoom in further to see more detail.

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- The **Topographic** basemap is loaded by default.
- A total of 10 basemaps are available.

To return the map to its original state, click the **Topographic** basemap, click the Layer List widget, and click the house symbol in zoom tools to zoom to the previous extent.

Map Overview: Show the location of the current map extent in the broader landscape by clicking the arrow in the extreme lower right corner of the map. As you scroll in and out, the grey box in the corner will adjust to show the current map extent and the scale will change to show the broader geographic context.
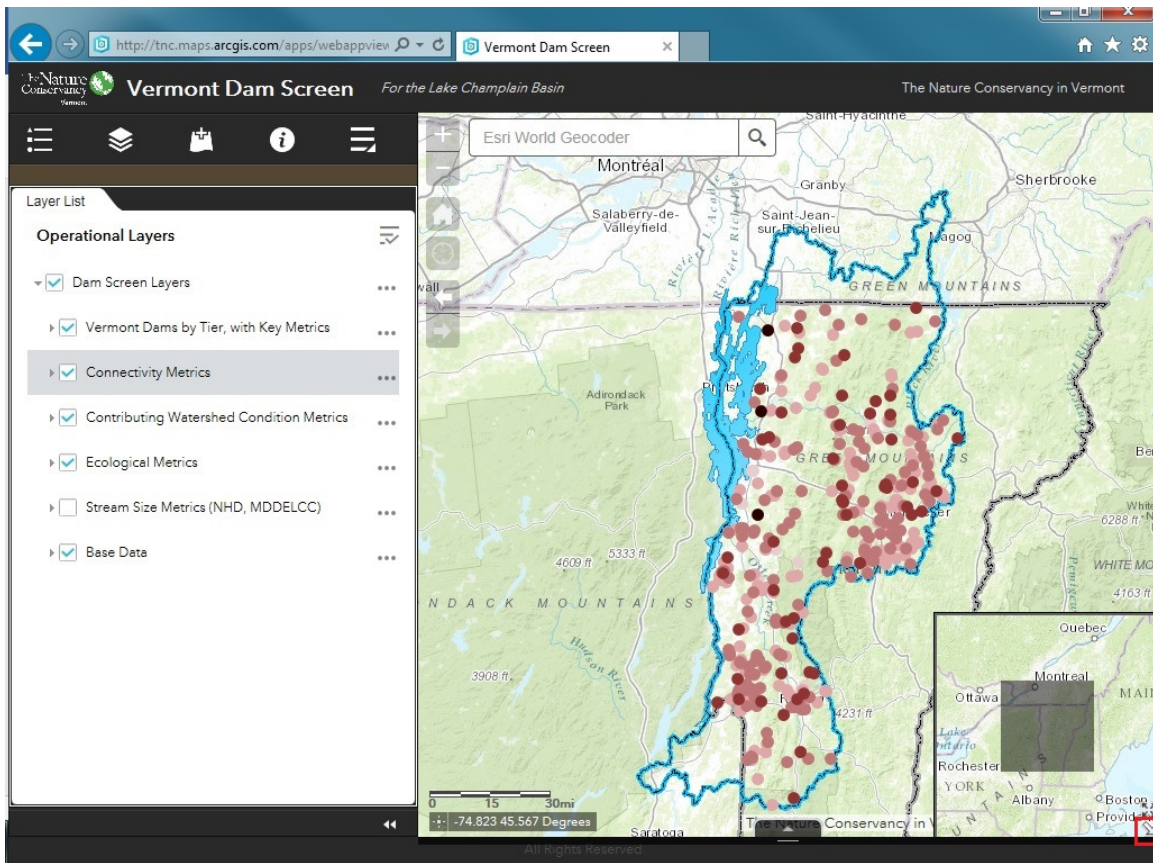
Explore additional Dam Screen components and sources by hiding and revealing nested layers and symbology, turning on and off group layers and data layers, and opening and reading descriptions and citations.

Other Widgets

Instructions for additional functionality and widgets will be available here soon. Please revisit the web map at a later time to find updated instructions in this same location!