

Boxborough Water Portal

Monitoring spatial and temporal patterns in Boxborough's water quality

Data

The Boxborough Water Portal is designed to allow users to explore patterns of water quality in Boxborough's groundwater over space and time. The portal is framed around an interactive map featuring the following datasets:

- Water quality test results at Boxborough's Public Water System (PWS) wells. Water quality testing at PWS sources is mandated twice a year by the Massachusetts Department of Environmental Protection (MassDEP). At each point on the map where a PWS well exists, circles representing the test result of each water quality compound and sample time are layered. The user can filter through these points by compound and sample time using widgets on the map. The points are symbolized in terms of the ratio between the sample test result and the maximum recommended concentration of the compound. Test results higher than the recommended maximum
- Water quality test results at monitoring wells in Boxborough and Littleton, provided by the Littleton Water Department. This well network was sampled regularly by Littleton Water Department between ___ and ___. The monitoring well points are symbolized as squares whose color represents the fraction of tests conducted at that well that exceeded the maximum recommended threshold for one given compound concentration or other water quality parameter (e.g. pH). Users can filter the points by compound or water quality parameter using widgets on the web map to view the rate of water quality violations in that compound.
- Groundwater discharge permits: The map displays groundwater discharge permit locations in Boxborough symbolized by the permitted flow into groundwater in gallons per day (GPD). In Boxborough, all permitted groundwater discharges are registered as sanitary discharge. The size of the symbol represents the discharge rate.
- Zone 2 Wellhead Protection Areas: Zone 2 Wellhead Protection Areas are delineated for MassDEP using hydrogeologic modeling to determine the region in which aquifers contribute to water supply wells. Boxborough overlaps two Zone 2 areas, one of which contributes to Littleton's water supply wells and another of which contributes to Acton's water supply district.

Layout

Welcome to the Boxborough Water Portal! The website layout has three main components. To the largest panel occupying the center and right hand side of the window are two stacked boxes. The upper part of the panel displays an interactive web map depicting Boxborough and relevant groundwater features. Below the map pane is a pane in which users can create graphics summarizing the water quality data displayed on the map. The left hand pane displays the map's legend. See Figure 1 for a diagram of the window below.

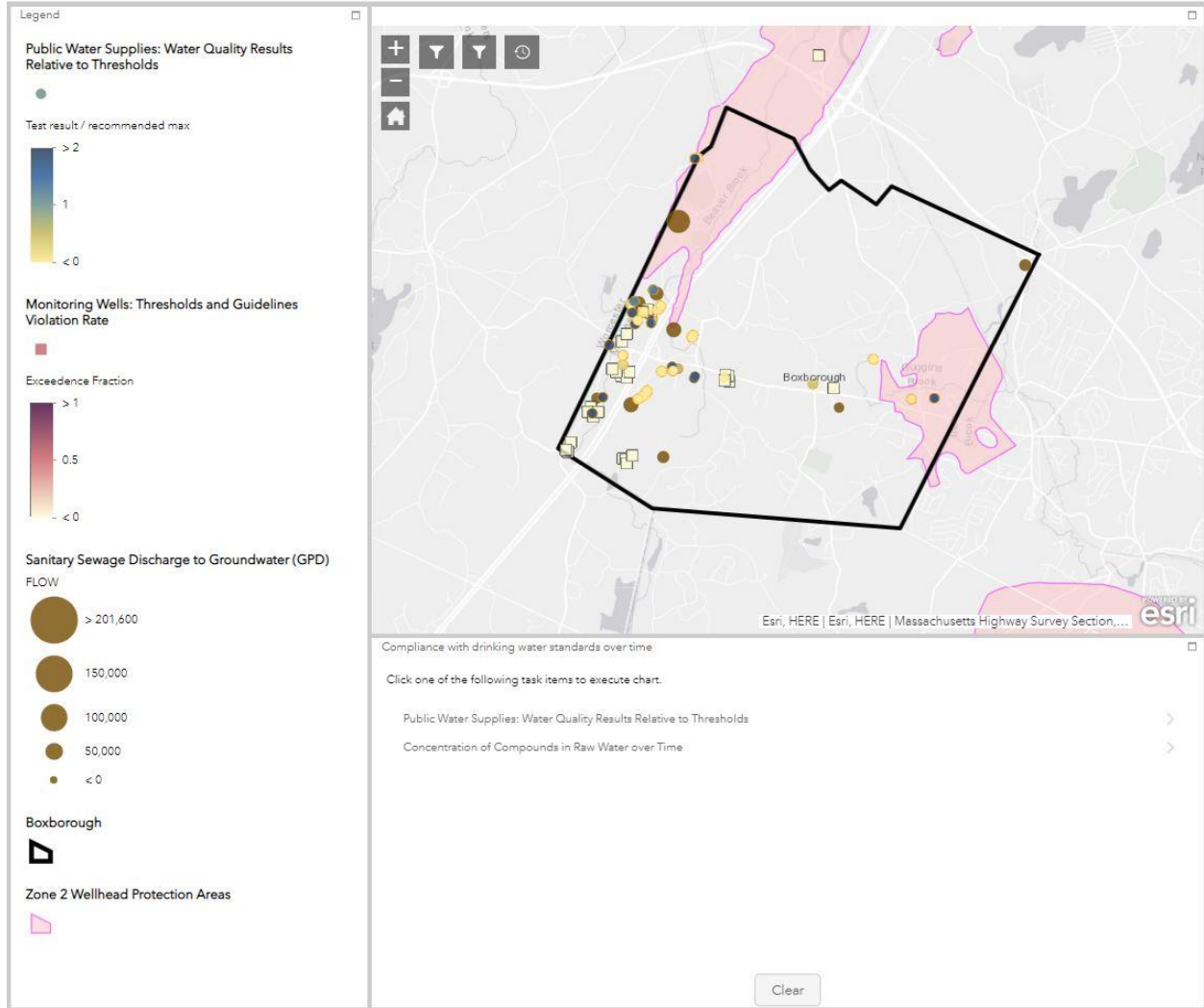


Figure 1: Boxborough Water Portal Layout

Interacting with the data

Interacting with map layers

Users can learn about the characteristics of specific features on the map by clicking on them. Pop-ups will appear to show information about each point, line, or polygon featured on the map. Users can also use the mouse and “+” and “-“ buttons at the top left of the map to zoom in and out and pan around the map’s extent.

In addition to those functions, the map includes three widgets through which users can interact with the data. Buttons that activate the widgets are located in the top left hand corner of the map (Figure 2). The buttons look like dark grey squares, two of which feature funnel symbols and one of which features a clock or stopwatch symbol.

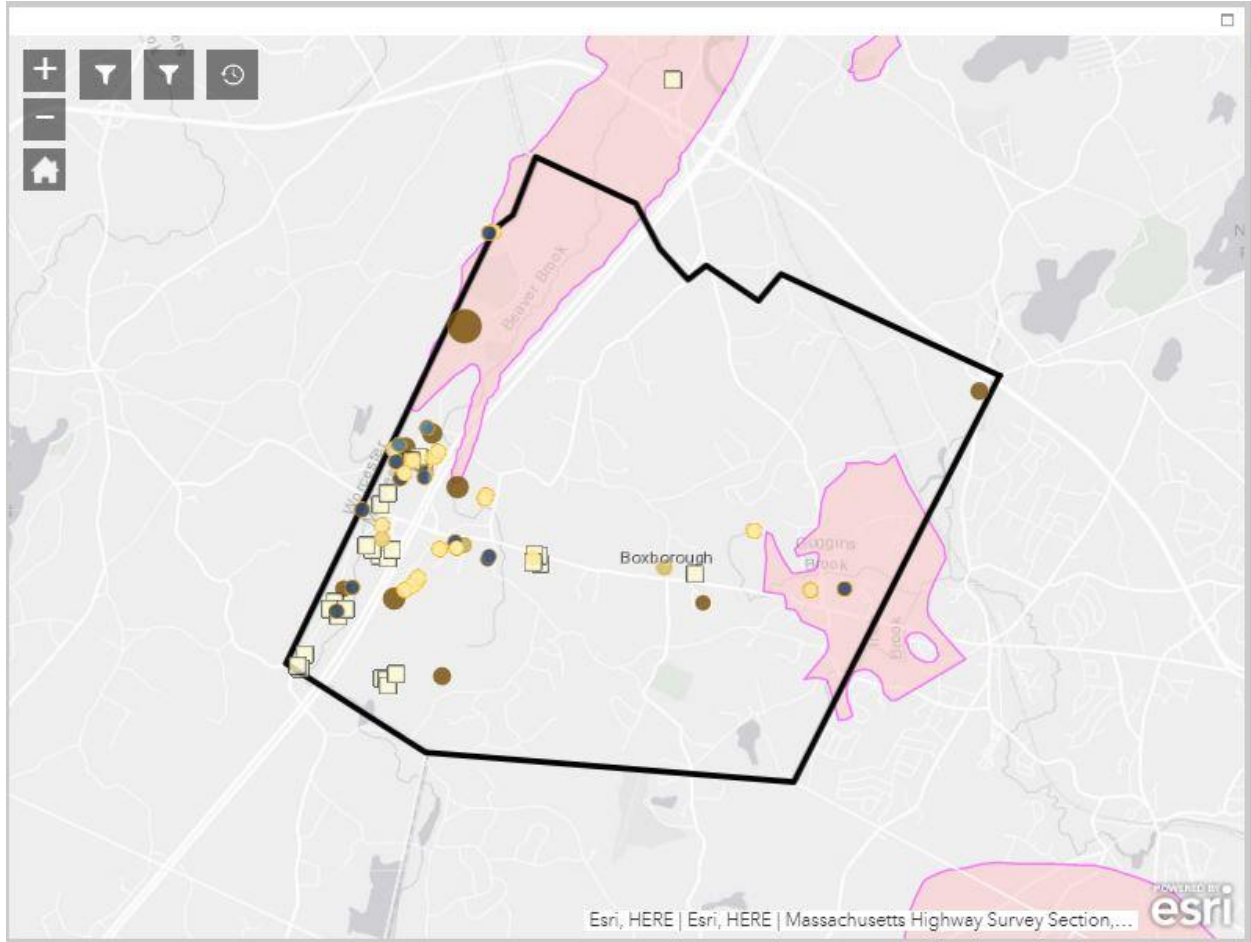


Figure 2: Boxborough web map with filtering and time slider widgets.

The “funnel” buttons each open a filtering widget. The filter widget on the left allows users to filter public water supply test results by compound or water quality parameter tested. Figure 3 shows an image of the filtering widget interface that will open when a user clicks on the first filter widget button.

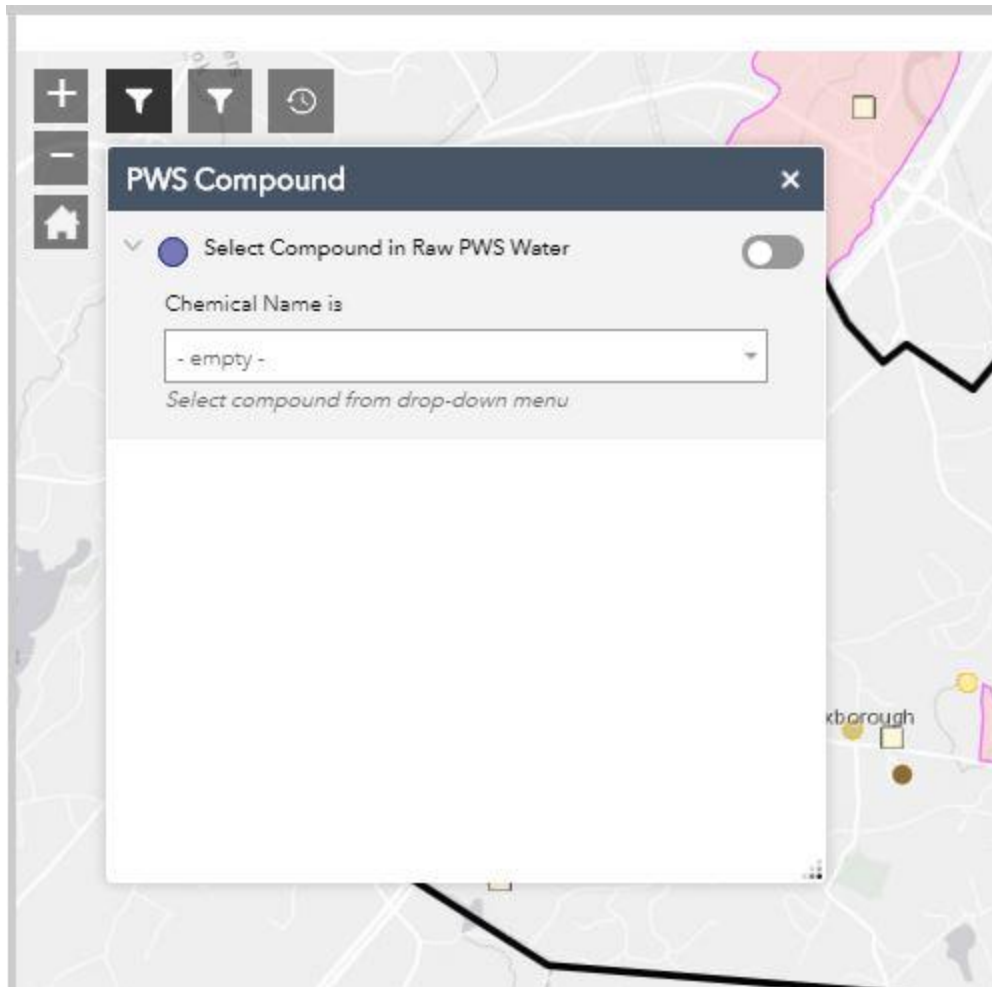


Figure 3: PWS chemical name filter opening screen.

The filter includes a drop-down menu that allows the user to select the compound whose test results the user would like to view on the map. After clicking on the drop-down menu, many compound names will appear. Instead of scrolling to find the appropriate compound, the widget allows users to type the name of the compound into the bar. Matching compounds will appear below. The user should click on the compound in the list that they would like to view (Figure 4).

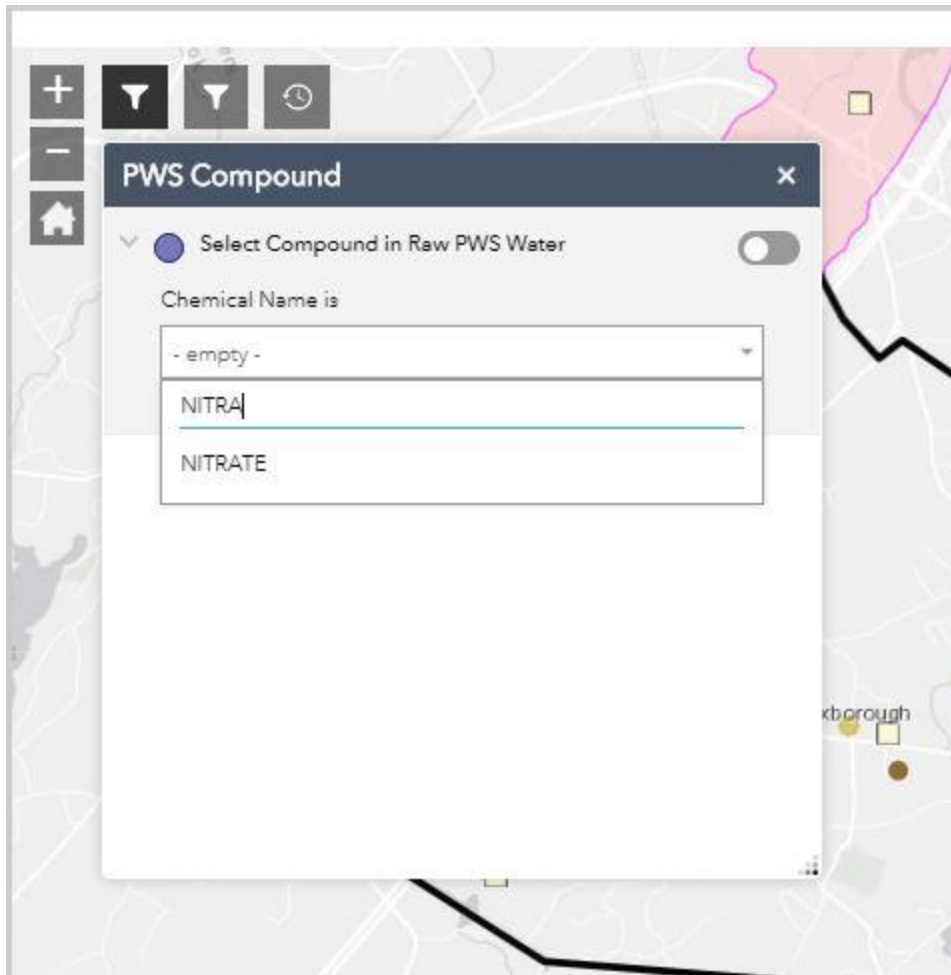


Figure 4: Selecting a water quality compound to view: "Nitrate" example.

The last step after selecting a compound is to apply the filter to the map results. To do this, click on the toggle in the top right corner of the "PWS Compound" filter setup window. The toggle will turn a teal-green color (Figure 5). When the toggle has been applied, some of the PWS point symbols visible around the filter window may shift in color.

Interacting with map layers

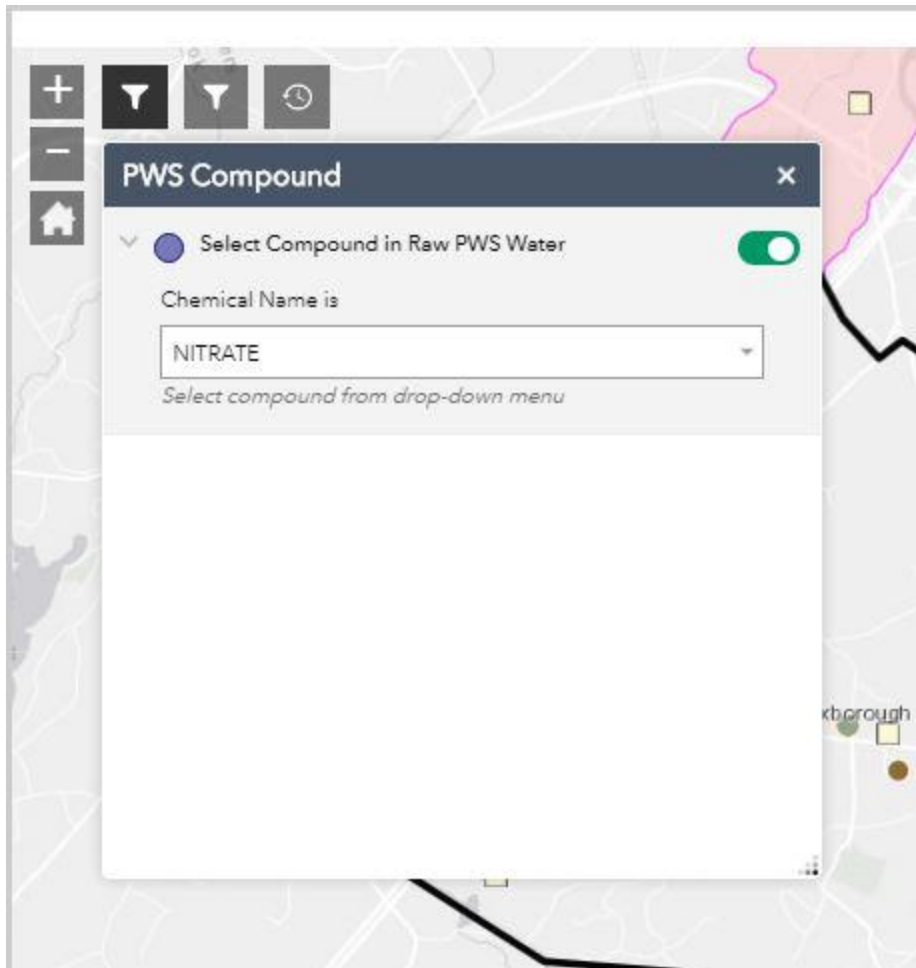


Figure 5: Set and applied PWS compound widget.

Close the “PWS Compound” box using the “X” in the top right corner to obtain an unobscured view of the map.

The second filter widget works the same way, but filters monitoring well water quality results rather than PWS water quality results. Because the monitoring well water quality dataset shows a single point for each location and compound, no further action to refine the monitoring well water quality layer is needed after filtering by compound using the second widget.

Applying the first widget to restrict the PWS water quality layer to displaying one compound only begins to narrow the results. However, there will still be multiple points stacked on top of each other at each PWS location, each representing one time that compound or water quality parameter was tested at that location. To refine the results by time, click on the third widget with the “clock” symbol. This is a “time slider” widget (Figure 6).

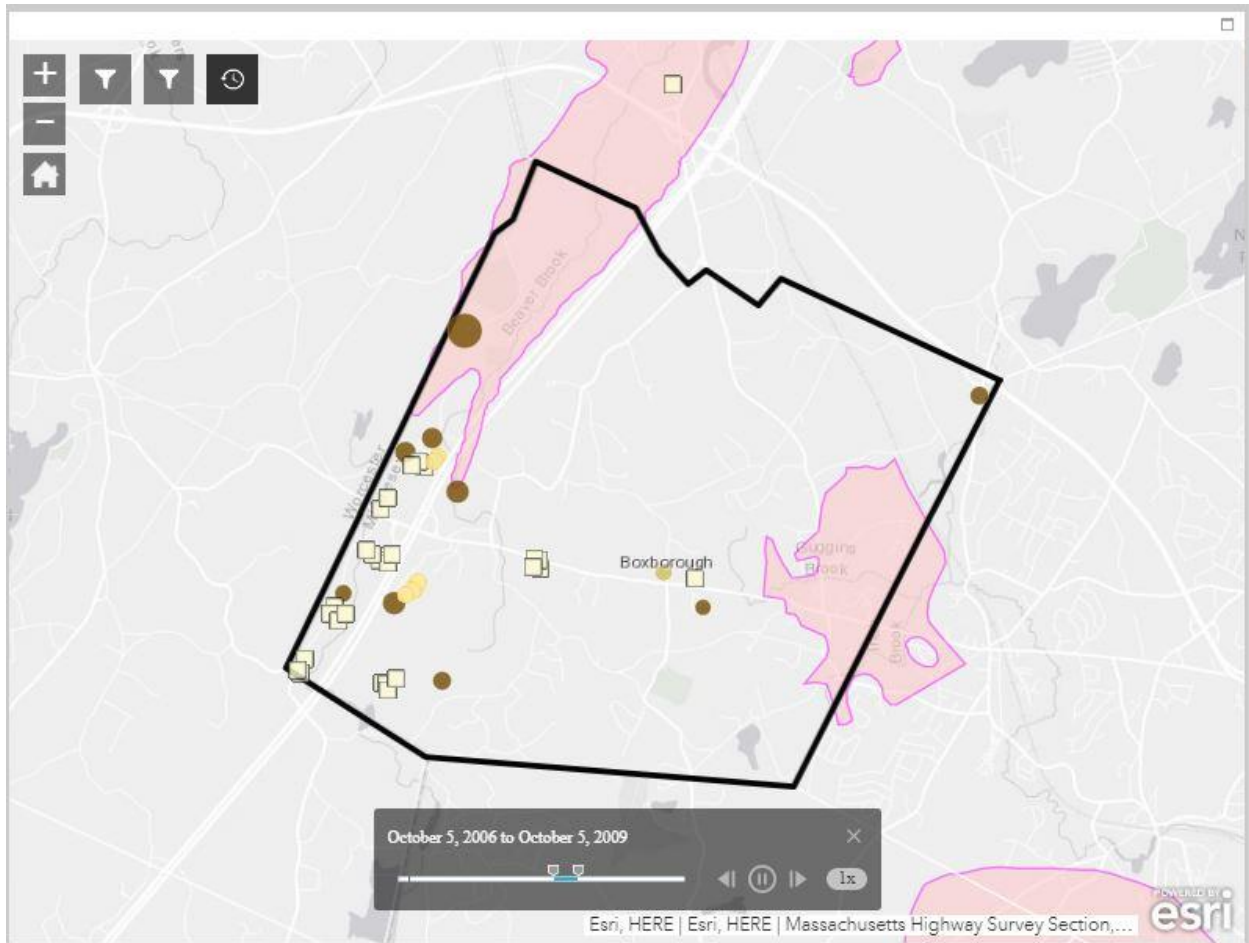


Figure 6: Web map with activated time slider.

The time slider allows the user to view spatial patterns in the PWS layer in two ways. First, the widget “plays” PWS results selected by a narrow time period that shifts over time- essentially allowing the user to view a movie showing how compound concentrations have changed over time. The user can use the buttons on the right to play, pause, accelerate, or slow down the animation.

Second, the user can pause the widget and adjust the downward-pointing arrows on either side of the blue, highlighted portion of the time bar to select which range of dates’ test results are shown on the map. In this respect, the time slider can be used as a filter.

Setting up interactive charts

The lower right pane of the Water Portal allows the user to set up one of two interactive charts. The charts, when configured, will show PWS test results of compounds and time period selected by the user. To create the most meaningful chart, first use the map filter widgets to show only one compound or water quality parameter of interest. Then, open the time slider widget and set the time period on the map to the entire range of sampled dates (1988 to 2020). The blue portion of the time bar should cover the entire bar.

In the chart pane below the map, instructions in black text read “Click one of the following task items to execute chart.” The grey lines below read “Public Water Supplies: Water Quality Results Relative to Thresholds.” This chart will display water quality results as the results are symbolized

on the map; that is, as a ratio between the test result and the maximum recommended level or guideline. This means that regardless of the contaminant the user selects on the map, values greater than 1.0 violate drinking water standards and values lower than 1.0 are permissible for drinking water.

The second line of text reads “Concentration of Compounds in Raw Water over Time.” This chart, when activated, will display water quality test results in actual units of concentration or other water quality units of measurement (e.g. pH, microcuries, etc.).

Click on one of the chart types to begin setting up that chart.

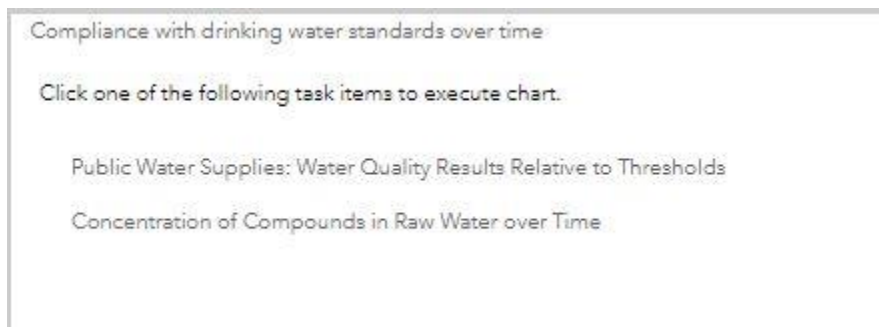


Figure 7: Chart options

The chart options will disappear and a box next to “Use spatial filter to limit features” will appear (Figure 8). Check the box and click “APPLY” in the upper right corner of the pane.

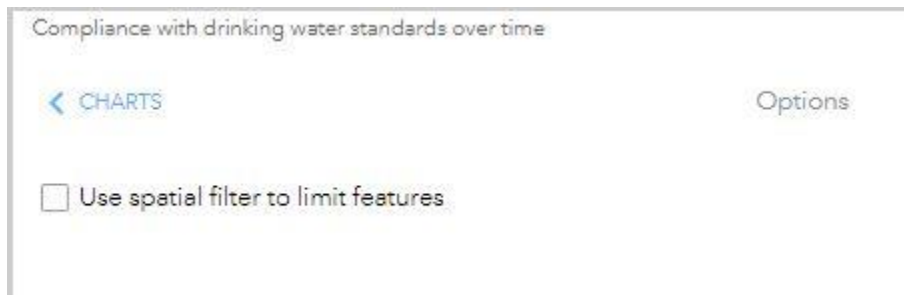


Figure 8: Select options.

When you check the box, two options will appear under it. You can choose to show only features intersecting the current map area, or only features intersecting a user-defined area. If you choose the first option, the chart will show the average water quality result across all the points displayed on the map at the time you make the chart- the points included in the average will not change if you pan or zoom afterwards. If you choose the second option, tools you can use to define a set of points to include in the chart will appear (Figure 9).

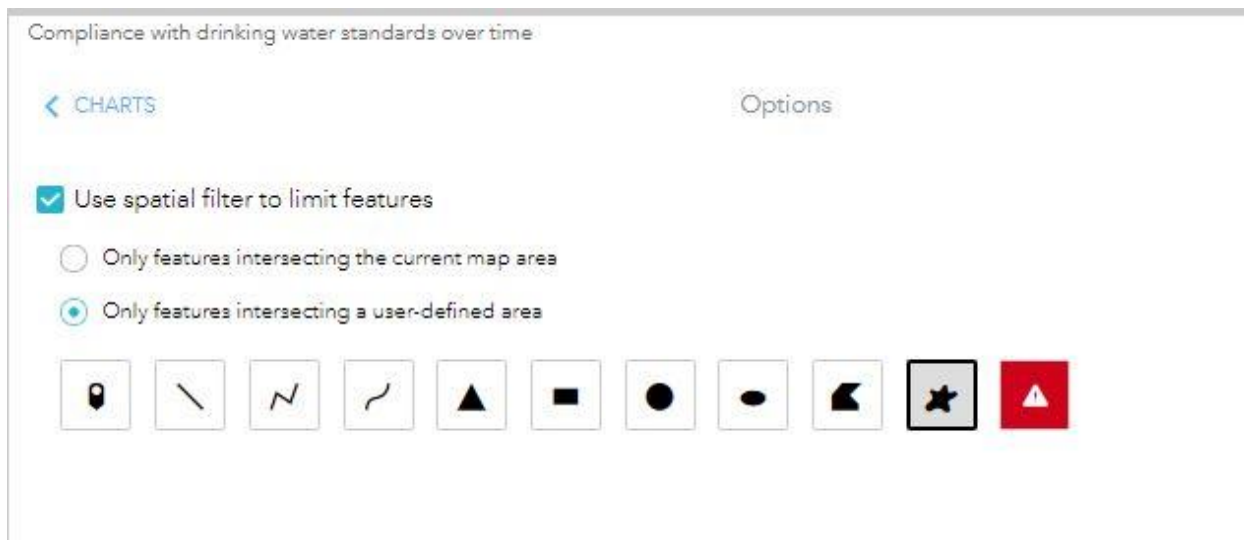


Figure 9: Options for selecting wells to view in chart.

If the user hovers the mouse over the boxes that appear, text explaining the selection mechanism will appear slightly below the box. We recommend selecting the odd shape at the right end of the row. This is the “Freehand Polygon” selection mechanism, which allows the user to trace a shape around the wells they want to view in the chart. The user may draw the polygon around just one well point or a group of well points. If more than one well is included in the hand-drawn polygon, the water quality results at those wells will be averaged in each time period. Figure 10 shows an example polygon drawn around a group of wells just outside of Route 495. When the desired wells are selected, click “APPLY” in the upper right-hand corner.

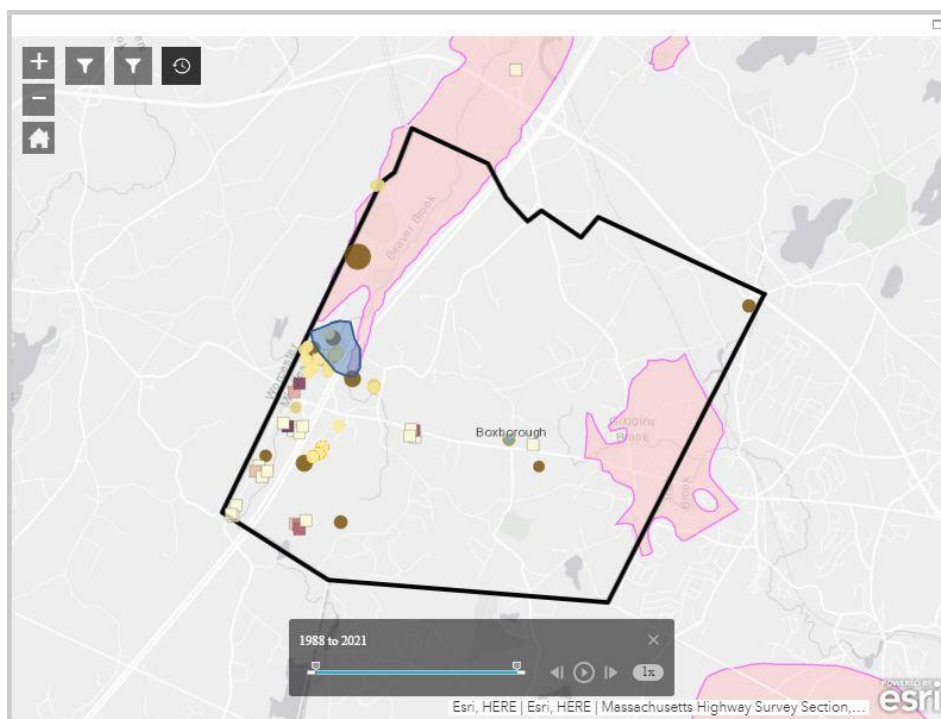
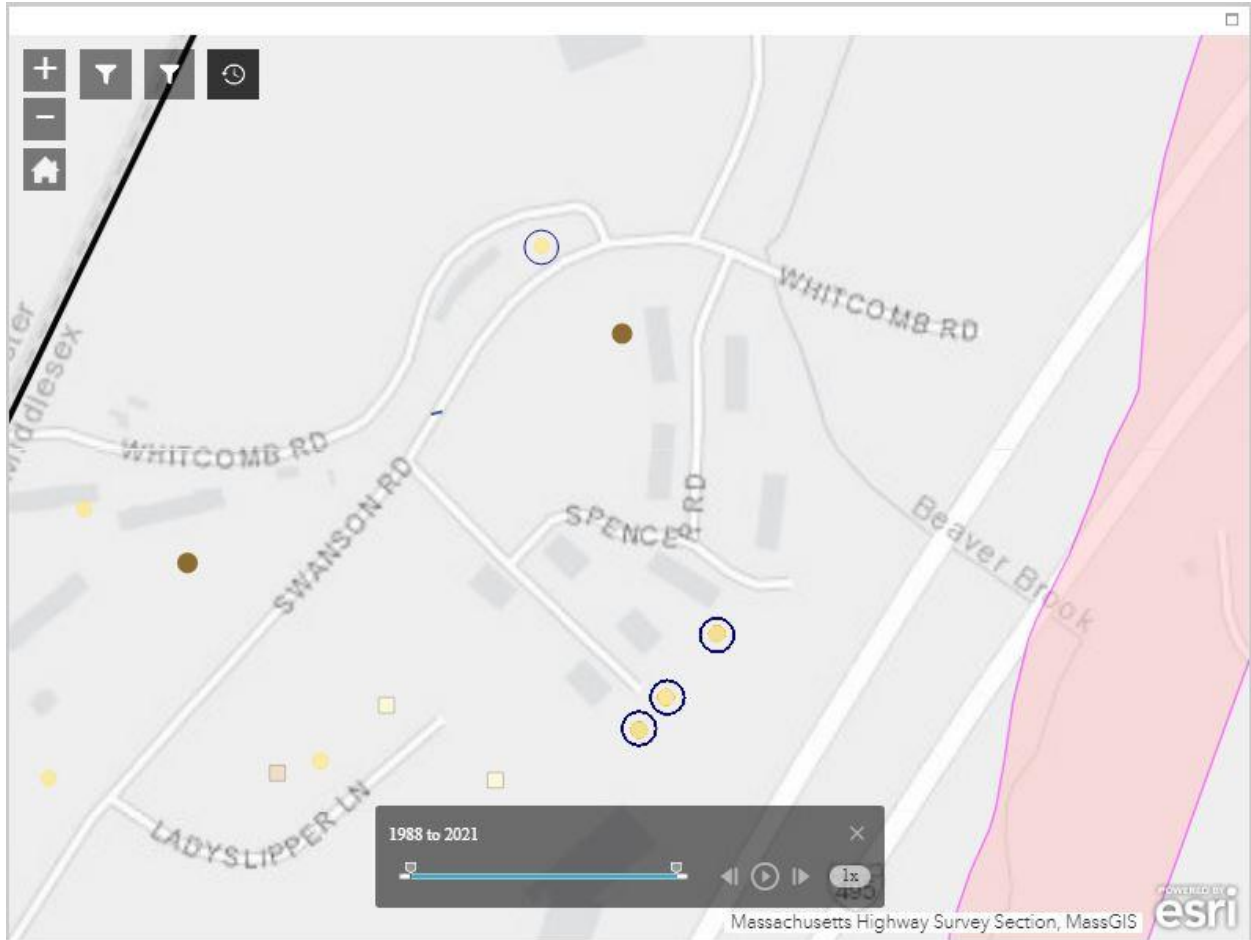


Figure 10: Example spatial selection of wells using the Freehand Polygon tool

The chart displaying average results over time at those wells for the water quality parameter the user selected using the filtering widget will appear in the chart. In this example, the first samples were tested for Nitrate concentration in 2007 and the last samples in April 2020. While the average Nitrate concentration increased between 2014 and 2017, average Nitrate level across the wells' untreated water remained well within recommended guidelines (specifically, less than 20% of the maximum recommended level) for drinking water despite the wells' proximity to two permitted sanitary groundwater discharge points.

At any time, the user may clear the chart by using the "Clear" button at the bottom center of the pane. Before clearing the chart, the user may want to reset the time slider and view the compound concentrations at the individual wells over time using the time slider map animation.



Compliance with drinking water standards over time

Options

Chart Results

Public Water Supplies: Water Quality Results Relative to Thresholds



Shows average ratio between concentration of a user-selected compound and the recommended maximum concentration of that compound in drinking water in a user selected cluster of public water supply wells.

Clear