



Fresh Pond Reservation Census Program Report Data Documentation

Last updated: June 11, 2024

Cambridge Water Department | Cambridge, MA

[Read the report](#)

Table of Contents

Sensors Used to Quantify Usership.....	2
Active Sensors.....	2
Multi Sensors	2
Sensor Caveats	3
Quality Control	4
Calculating Total Usership at Fresh Pond Reservation.....	4
Calculating User Averages at Fresh Pond Reservation.....	6
Average Usership by Hour of Day	6
Average Usership by Day of Week.....	6
Entrance Station Calculations	7

Sensors Used to Quantify Usership

Active Sensors

CWD uses passive infrared ("PYRO") sensors to quantify users in both directions of travel along the Perimeter Road and at popular entrances to Fresh Pond Reservation. All sensors are manufactured by the company [Eco-Counter](#). CWD currently has six active sensors (Figure 1). Two (WTPMULTI and LFP) are located on the Perimeter Road. The remaining four are at popular entrances to FPR.

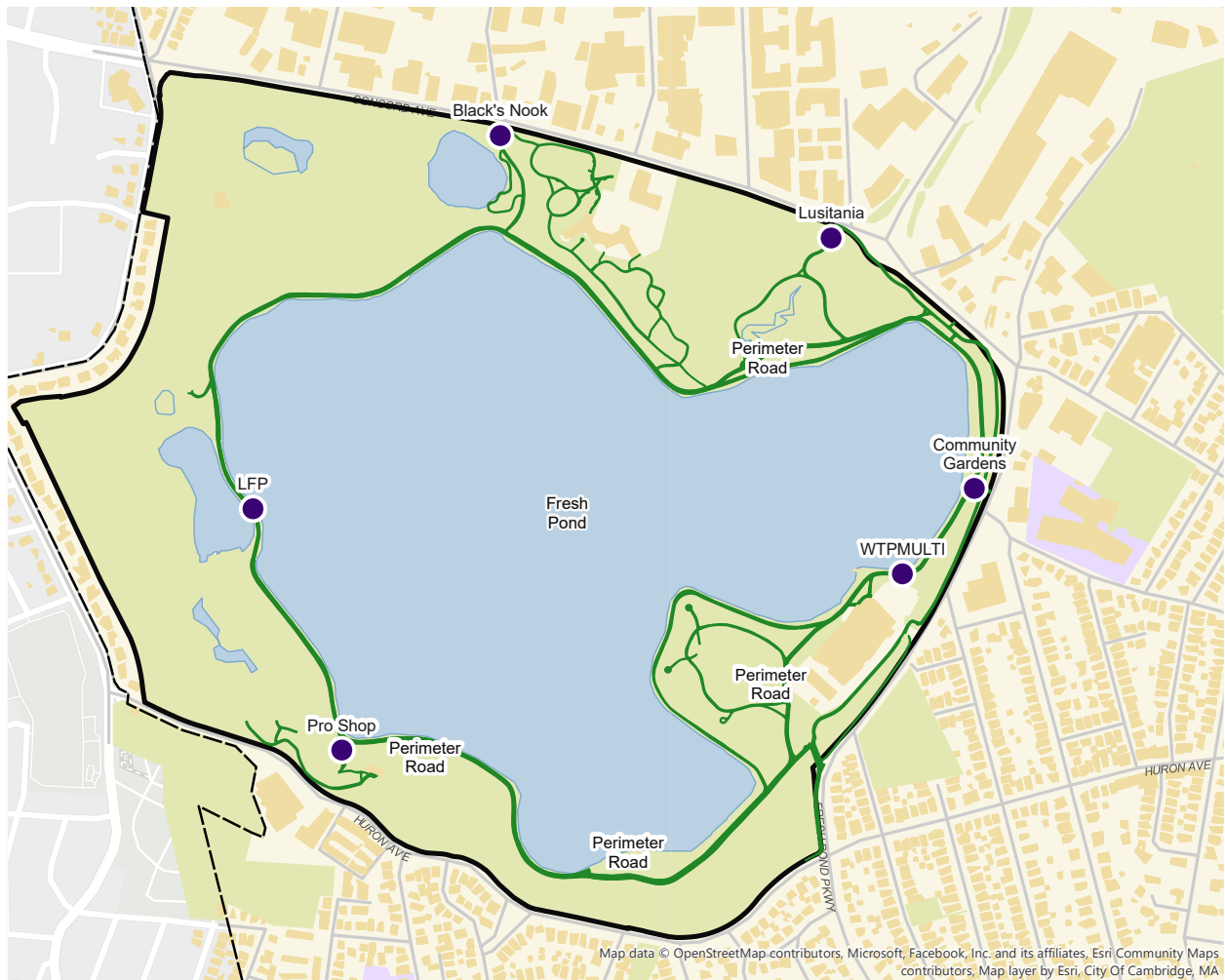


Figure 1: Active Sensors at Fresh Pond Reservation (purple dots)

Multi Sensors

The WTPMULTI sensor on the Perimeter Road is a "multi" counting station. This type of station has an additional pavement sensor (an inductive "ZELT loop") used to differentiate between cyclists and pedestrians. It is currently CWD's only multi sensor. All other sensors group bicycle and pedestrians counts together.

A second multi sensor along the Fresh Pond Bike Path (BPMULTI) was decommissioned in 2024. See Figure 2 for the WTPMULTI and BPMULTI sensor locations.



Figure 2: Multi Sensors at Fresh Pond Reservation

Sensor Caveats

The ZELT loop and PYRO sensors count users separately. Because of this, the multi sensors have periods where pedestrian and bicycle counts were not available because the ZELT loop was either malfunctioning or had not yet been installed, but do have total user counts from the PYRO sensor. Therefore, the sum of pedestrian and bicycle counts for a site is not always equal total usership for the site.

The PYRO sensors can only detect users taller than three feet, so small children and dogs are not included in user totals. Although the sensors can categorize users by direction of travel, all usership statistics in this report are the total of users moving in both directions.

Quality Control

CWD staff inspect the "Eco-counter" sensors approximately weekly to check for physical damage or environmental changes that could impact the sensor. During these inspections, CWD tests that each sensor is counting properly by crossing the sensor once in each direction and confirming that the counts were recorded. CWD also extracts the usership counts from the sensors approximately weekly and analyzes the data for unusual patterns that could indicate a sensor malfunction. When problems are identified, CWD removes inaccurate counts from the dataset at hourly intervals and makes any necessary repairs to the sensors as quickly as possible.

CWD also conducts periodic hour-long visual surveys to ensure sensor performance over longer periods of time. The most common cause of sensor counts differing from visual survey counts is groups of people crossing the sensor at the exact same time. When this happens, the PYRO sensors often undercount, capturing only the person closest to the sensor.

Because sensors have a tendency to undercount groups, and because CWD removes erroneous data, counts should be interpreted as a conservative estimate of users at each counting station.

Calculating Total Usership at Fresh Pond Reservation

CWD calculates total usership at Fresh Pond Reservation using hourly datasets from the Perimeter Road sensors (LFP and WTPMULTI) (Figure 3). After removing any erroneous hourly data points, CWD averages the number of users at LFP and WTPMULTI at hourly intervals for the entire period of record. If user counts are missing for an hour at one Perimeter Road station but not the other, data from the non-missing station is used to represent average usership for that hour. If data are missing from both stations during an hour, then usership for that hour is also missing from the averaged dataset.

It is rare for hourly data to be missing from the LFP and WTPMULTI stations at the exact same time. However, overlap does occur. Time periods where hourly data are missing at both LFP and WTPMULTI (and therefore missing from the averaged hourly dataset) are as follows:

- November 15, 2012 at 12:00 am until December 3, 2012 at 12:00 pm
- January 17, 2014 at 11:00 pm until January 23, 2014 at 12:00 am
- April 15, 2014 at 11:00 pm until April 16, 2014 at 1:00 pm
- January 27, 2015 at 12:00 am until January 28, 2015 at 2:00 pm
- February 2, 2015 at 12:00 am until February 3, 2015 at 12:00 am
- February 8, 2015 at 11:00 am until February 11, 2015 at 3:00 pm
- February 15, 2015 at 6:00 pm until February 17, 2015 at 12:00 am
- March 13, 2022 at 2:00 am until March 13, 2022 at 3:00 am
- March 12, 2023 at 2:00 am until March 12, 2023 at 3:00 am

Usership totals that encompass these time periods are undercounts since CWD does not estimate usership during periods of missing data.

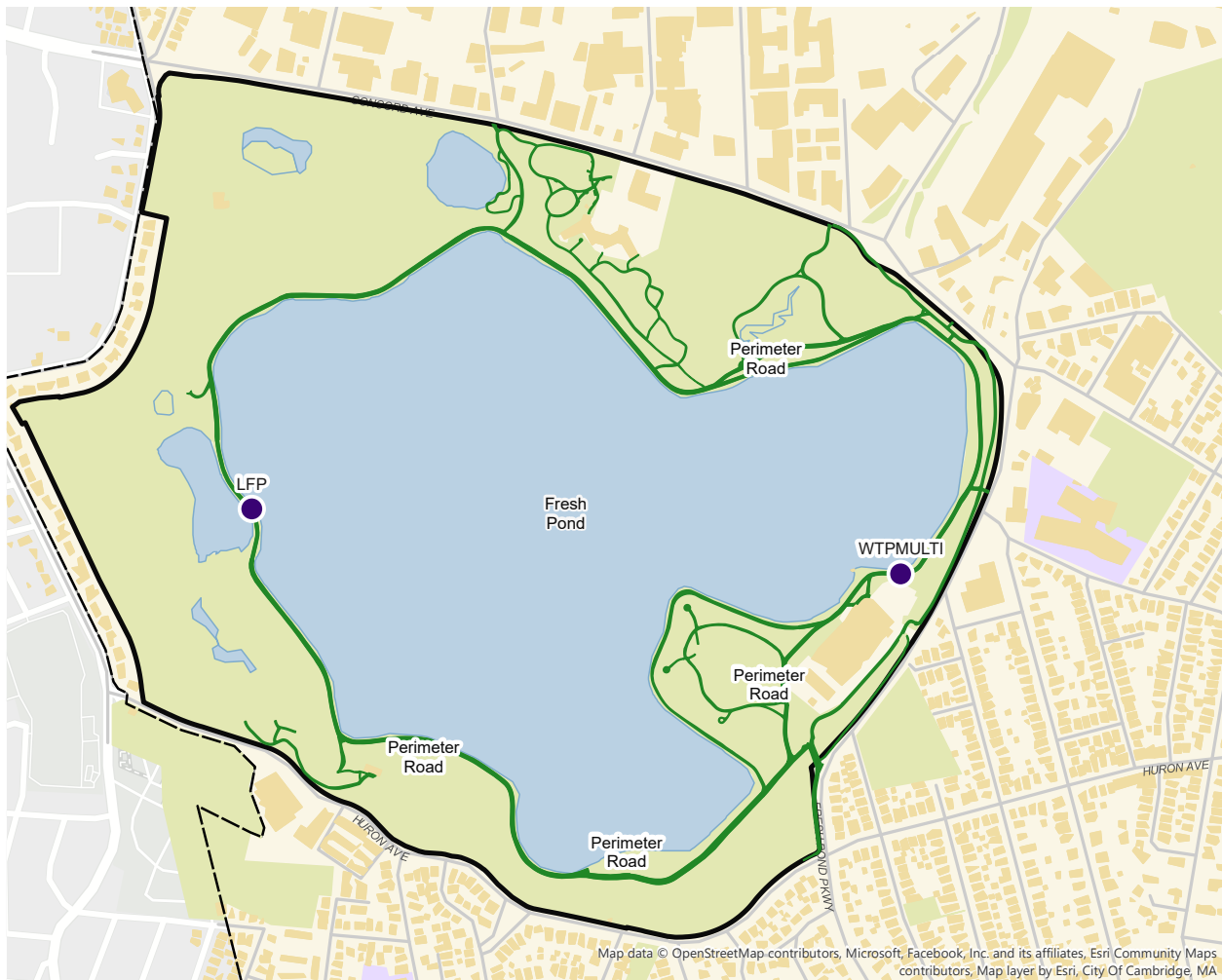


Figure 3: Perimeter Road Sensors

Hourly data from WTPMULTI during two construction projects were also excluded from hourly usership calculations. Although data were not missing during these time periods, construction detours routed users away from the WTPMULTI sensor, resulting in low counts that were not reflective of actual usership along the Perimeter Road. User counts from the LFP sensor were used to represent average usership during these time periods instead. The construction project detour time periods are as follows:

- May 1, 2014 through October 31, 2014 (Kingsley Park construction detour)
- May 25, 2017 through June 7, 2018 (Drainage and Community Gardens construction detour)

CWD calculates usership totals for each year and (and for each month within each year) by summing the averaged hourly dataset.

Users must cross at least one of the Perimeter Road sensors (WTPMULTI and/or LFP) to be included in the Fresh Pond Reservation usership totals. Users who complete multiple circuits of the Perimeter Road loop, crossing one or both sensors multiple times, would be "double counted" since the sensors cannot determine user identity. Users who do not cross either sensor, such as

those users only visiting Kingsley Park from the FPR parking areas, are not captured in usership totals (Figure 4).

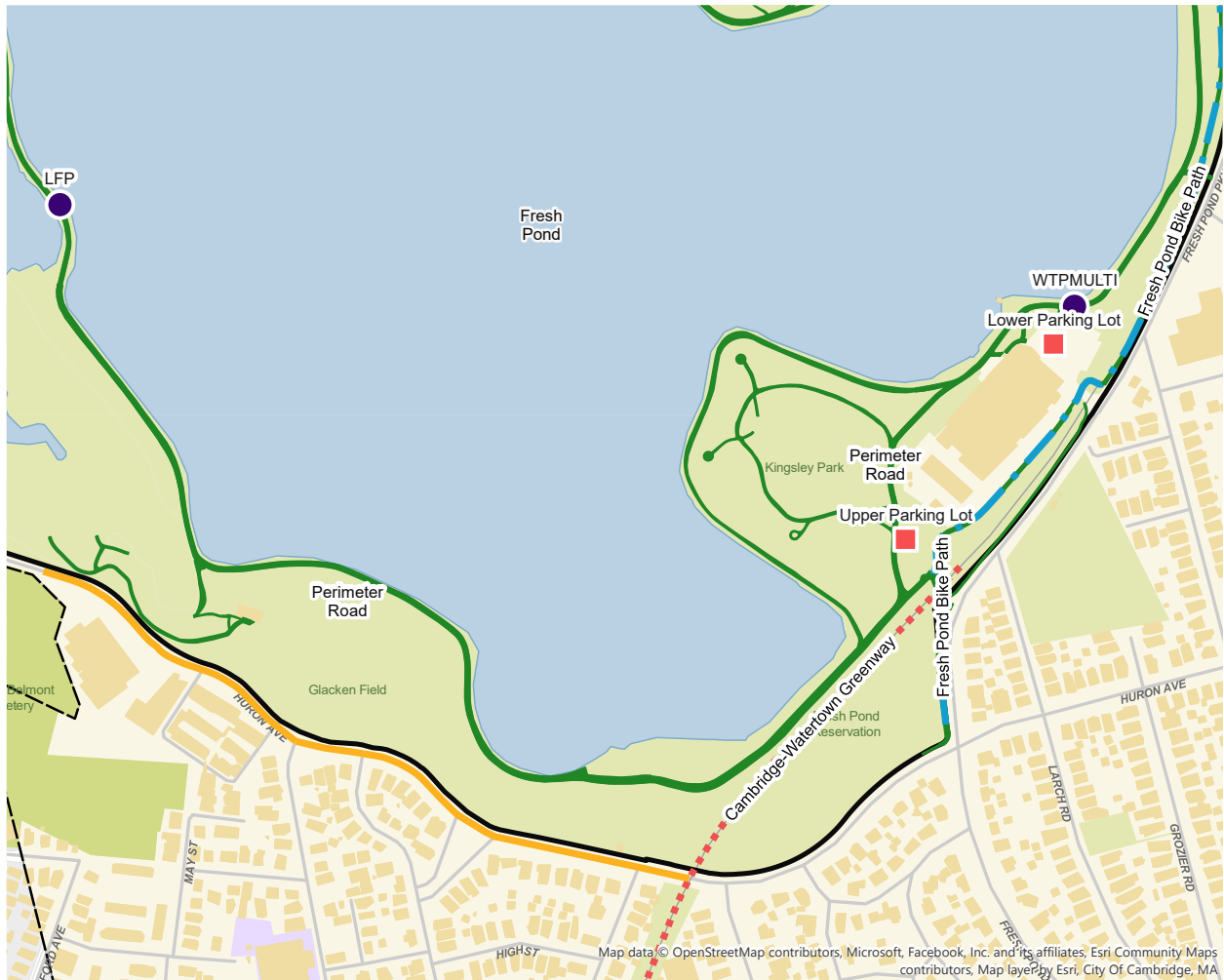


Figure 4: Location of Kingsley Park Relative to Fresh Pond Reservation Parking Lots and Perimeter Road Sensor Locations

Calculating User Averages at Fresh Pond Reservation

Average Usership by Hour of Day

CWD calculates average hourly usership at Fresh Pond Reservation by grouping the averaged Perimeter Road hourly dataset by year and hour (12:00 am to 11:00 pm), then calculating average usership for each hour category. Hours with missing data are ignored in the average calculation.

Average Usership by Day of Week

CWD calculates average usership by day of week category (Sunday - Saturday) by first calculating total usership for each day of every year. This is accomplished by first summing the hourly averaged Perimeter Road dataset by calendar day (January 1 - December 31) for each year. These daily totals are then grouped by year and day of week category (Sunday - Saturday) and averaged. Daily totals

with one or more hours of missing data are excluded from day of week average usership calculations.

Entrance Station Calculations

Usership statistics for entrance stations (Figure 5) are calculated similarly to the Perimeter Road stations, using the hourly datasets for each individual entrance station after erroneous data points have been removed. Similar to the Perimeter Road hourly dataset, CWD does not estimate usership at entrances during periods of missing data. This, along with the tendency for sensors to undercount groups of users, indicates that entrance totals are likely an undercount of users. Entrance station statistics are equal to the sum of users entering and existing at each location.



Figure 5: Entrance Stations at Fresh Pond Reservation