OARS

FOR THE SUDBURY ASSABET & CONCORD RIVERS

OARS Conductivity and Chloride Surveys

January 26, 2023

While salting roads in winter makes travel much easier in New England's snow, it has adverse impacts on life in our rivers and streams. High amounts of salt in rivers and streams can be toxic to freshwater life, and the EPA has established a concentration threshold for chloride[1] (a major component of road salt) to protect fresh water aquatic life. Road salt can also adversely affect groundwater, and both public and private wells in Massachusetts have been contaminated by road salt runoff. Because it is associated with adverse effects in our rivers, OARS has been monitoring salt levels in the watershed for a number of years. We have monitored chloride in water samples to get a direct measure of salt concentrations, and we also monitor in-situ conductivity, which is an inexpensive surrogate for chloride.

OARS analyzed water samples for chloride between 2018 and 2020. The following plot shows those chloride measurements plotted against specific conductance (conductivity adjusted for a standard temperature of 25°C). Our linear regression on this data has an R^2 value of 0.96 (out of a 0-1 range), which means that there is a very strong correlation between chloride and specific conductance. Our regression also lines up very closely with similar regressions conducted by other studies in our region. This strong correlation between chloride and specific conductance allows us to make conclusions with confidence about chloride based on easily collectable conductivity measurements. The data in the plot also show that there were many samples where chloride concentrations exceeded the EPA continuous concentration threshold of 230 mg/L, so these high levels that we have documented are known to be detrimental to freshwater aquatic life.

1 EPA, 2002, "National Recommended Water Quality Criteria: 2002", EPA 822-R-02-047, U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

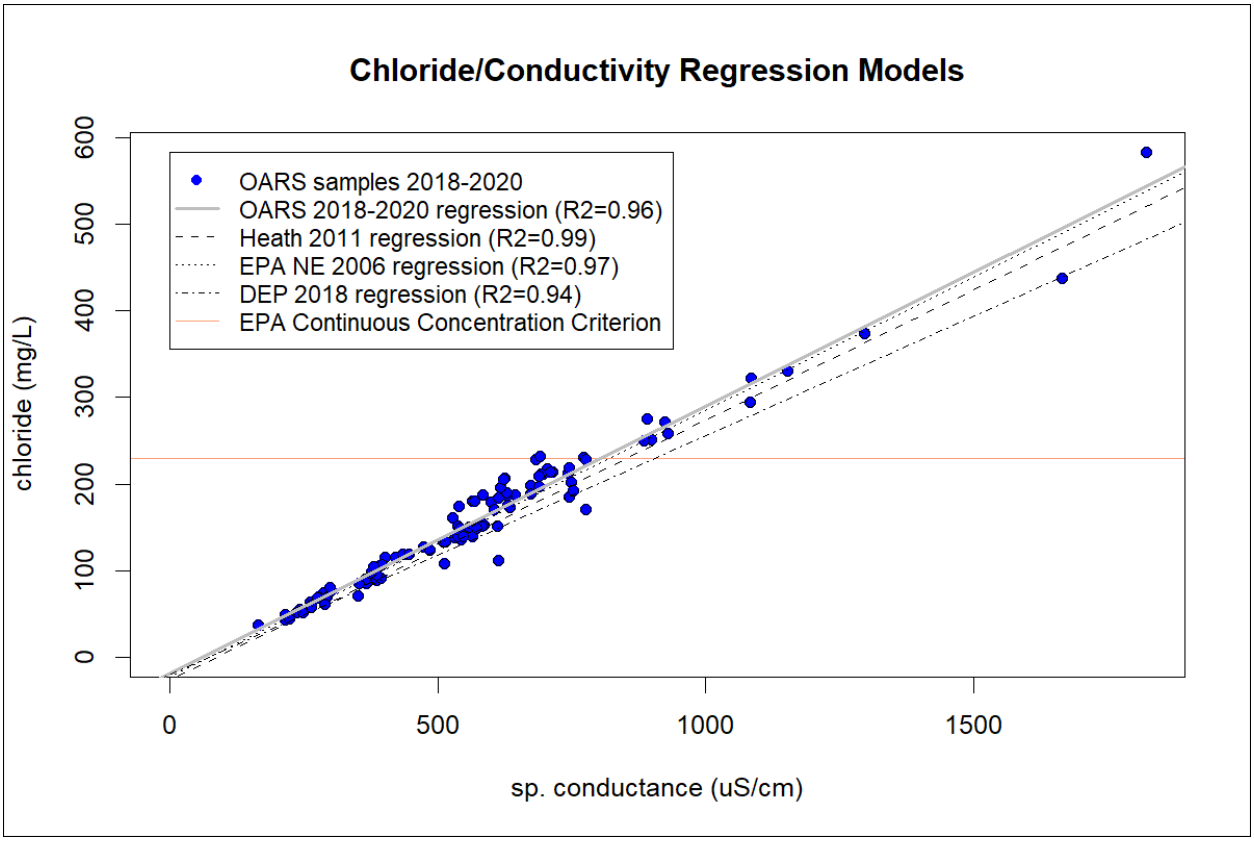


Figure 1: Chloride-Conductivity regression comparison. The OARS 2018–2020 regression line was calculated from OARS samples (shown with dots). Other well-known regression models that have been calculated for the New England region are Heath 2011[2], EPA NE 2006[3], and DEP 2018[4].

Long-term Conductivity Monitoring

The correlation between chloride and conductivity is very convenient for monitoring. Conductivity is easy to monitor with a handheld meter, and OARS has been monitoring conductivity throughout the watershed for more than 20 years. Our data are showing a disturbing trend of increasing conductivity in all of our waterbodies. This in turn can be translated to a trend of increasing chloride. And, as can be seen in the following time-series graphs (from our 2020–2021 Water Quality Report), the conductivity (specific conductance) levels often exceed 800 uS/cm, which is the specific conductance that corresponds to the EPA's 230 mg/L of chloride based on our regression model.

[2] Heath D, Belaval M, 2011, Baseline Assessment of Stream Water Quality in the I-93 Tri-Town Project Area from December 1, 2009 to April 7, 2010, New England Water Works Association, Vol. CXXV, No. 4, December 2011.

[3] Referenced in Heath 2011 article.

[4] DEP, 2018, Massachusetts Consolidated Assessment and Listing Methodology (CALM)
Guidance Manual for the 2018 Reporting Cycle. Massachusetts Division of Watershed Management Watershed Planning Program, May 3, 2018. CN 455.0.

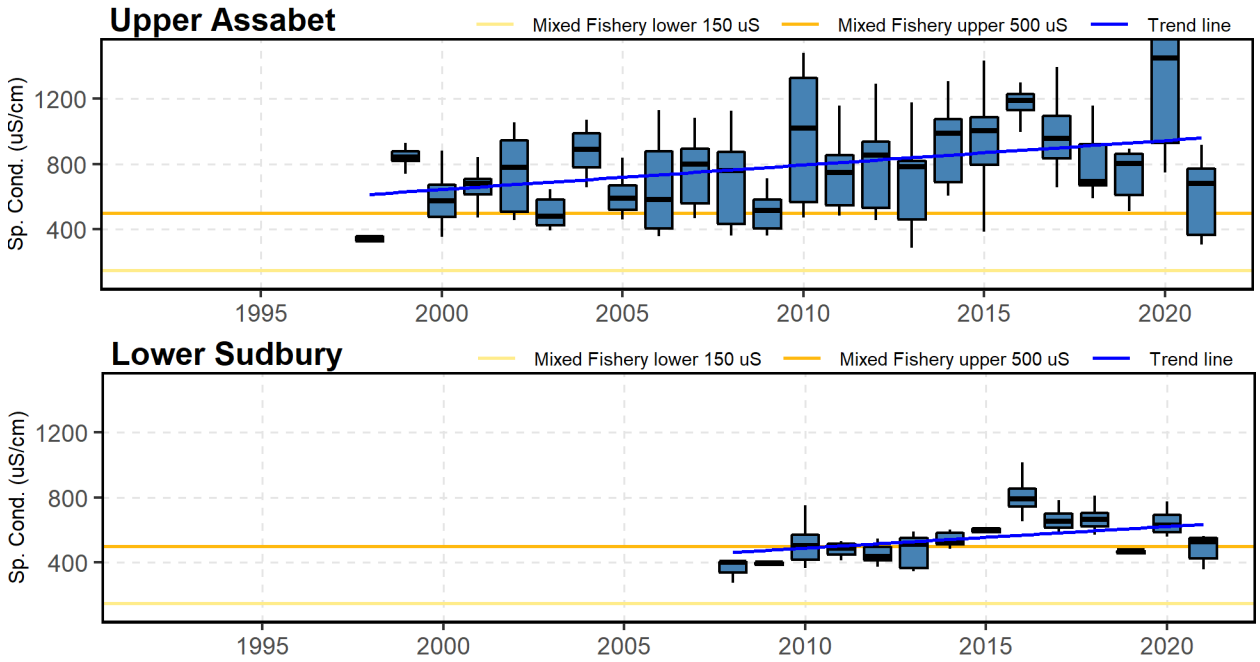


Figure 2: Boxplots of specific conductance by year in the Upper Assabet and Lower Sudbury sections of our rivers. Trend lines show an increasing trend in both sections. Each box plot represents approximately 9–15 data points during the months of July, August, and September. The boxes depict the middle 50% of the data values. The vertical lines depict the upper and lower 25% of the data values. And the middle horizontal line depicts the median value.

Stream Conductivity Surveys

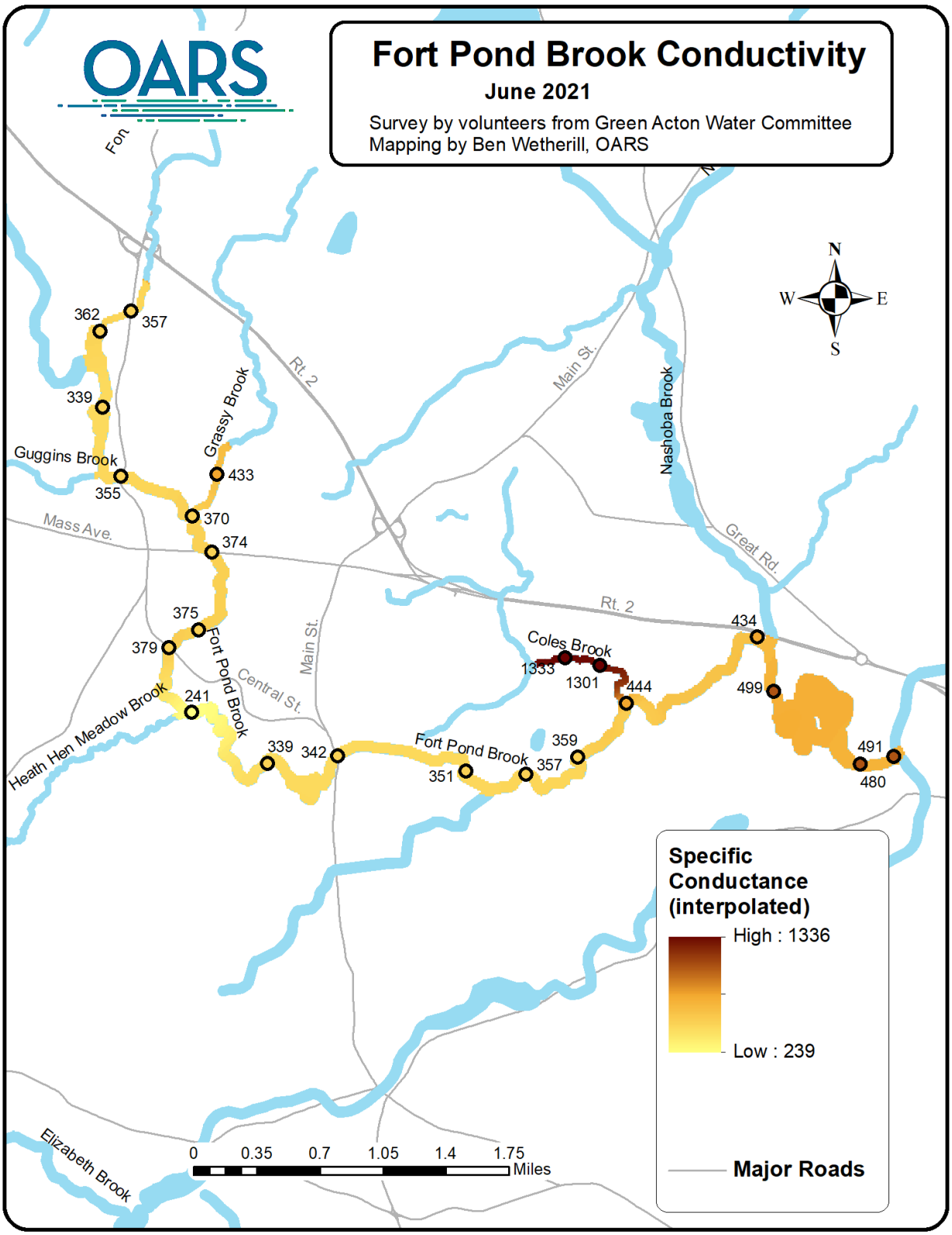
OARS has found another opportunity to leverage this correlation between chloride and conductivity. Because it is so easy to measure conductivity with our handheld meters, it is very easy to conduct a stream survey of conductivity levels from the source of the stream to the mouth. Such a survey can be used to identify conductivity hotspots, which can be inferred to be chloride hot spots. And we can then work with local communities and the state highway department to address the sources of salt pollution. OARS has been recruiting members of our water quality volunteer community to conduct these surveys in a stream or brook that they are familiar with. So far, we have had three volunteer groups step forward to conduct surveys. The following maps show the results of their surveys, and you can see how the surveys very clearly highlight the hot spots. Please let us know if you would like to conduct a survey of your local brook. It is very easy and we provide all the materials. All you need is some transportation and a free day to explore the streams and woods.

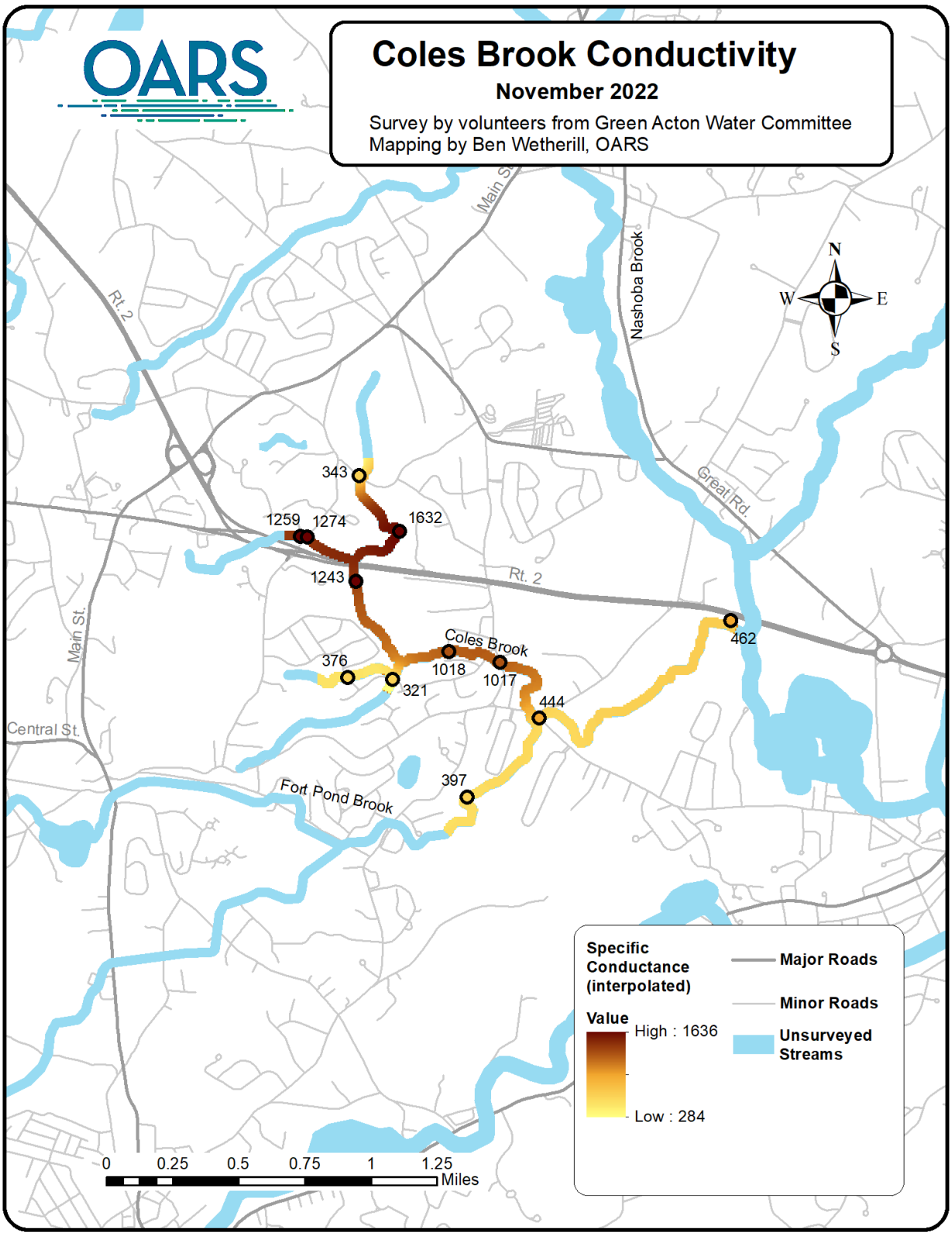
Following are maps for …

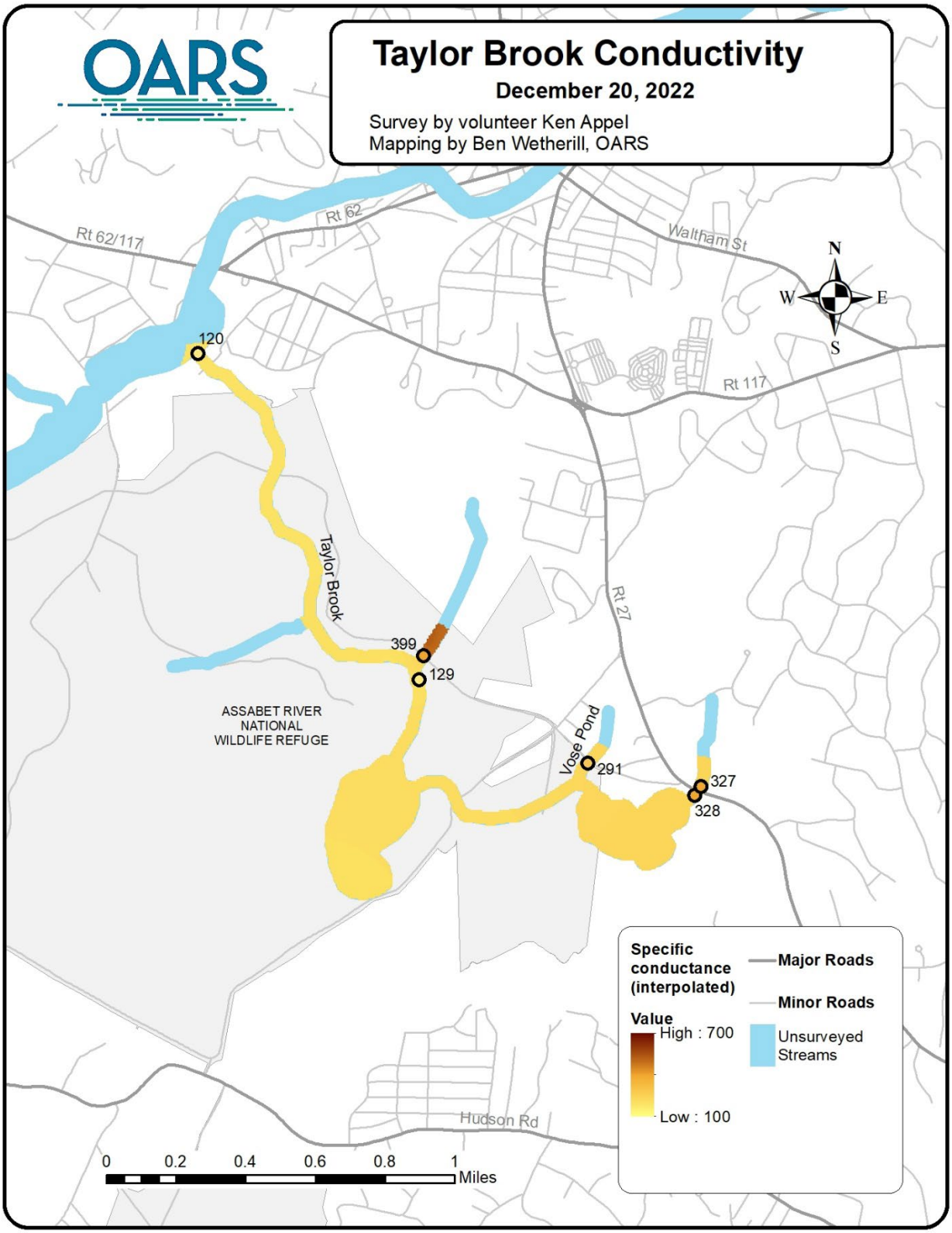
1. Fort Pond Brook, conducted by Lucy Kirschner and the Green Acton Water Committee in 2021—This survey identified a minor hot spot from Rt. 2 feeding into Warners Pond, and it identified a major hot spot in Coles Brook with an unknown source.
2. Coles Brook, conducted by Kim Kastens and the Green Acton Water Committee in 2022—This survey was conducted to follow up on the hot spot identified in the Fort Pond Brook survey. This survey tracked the primary source of chloride to the Acton Public Works facility north of Rt. 2, but it also identified an additional major source coming in from the west, source unknown. This is an opportunity for a third survey.

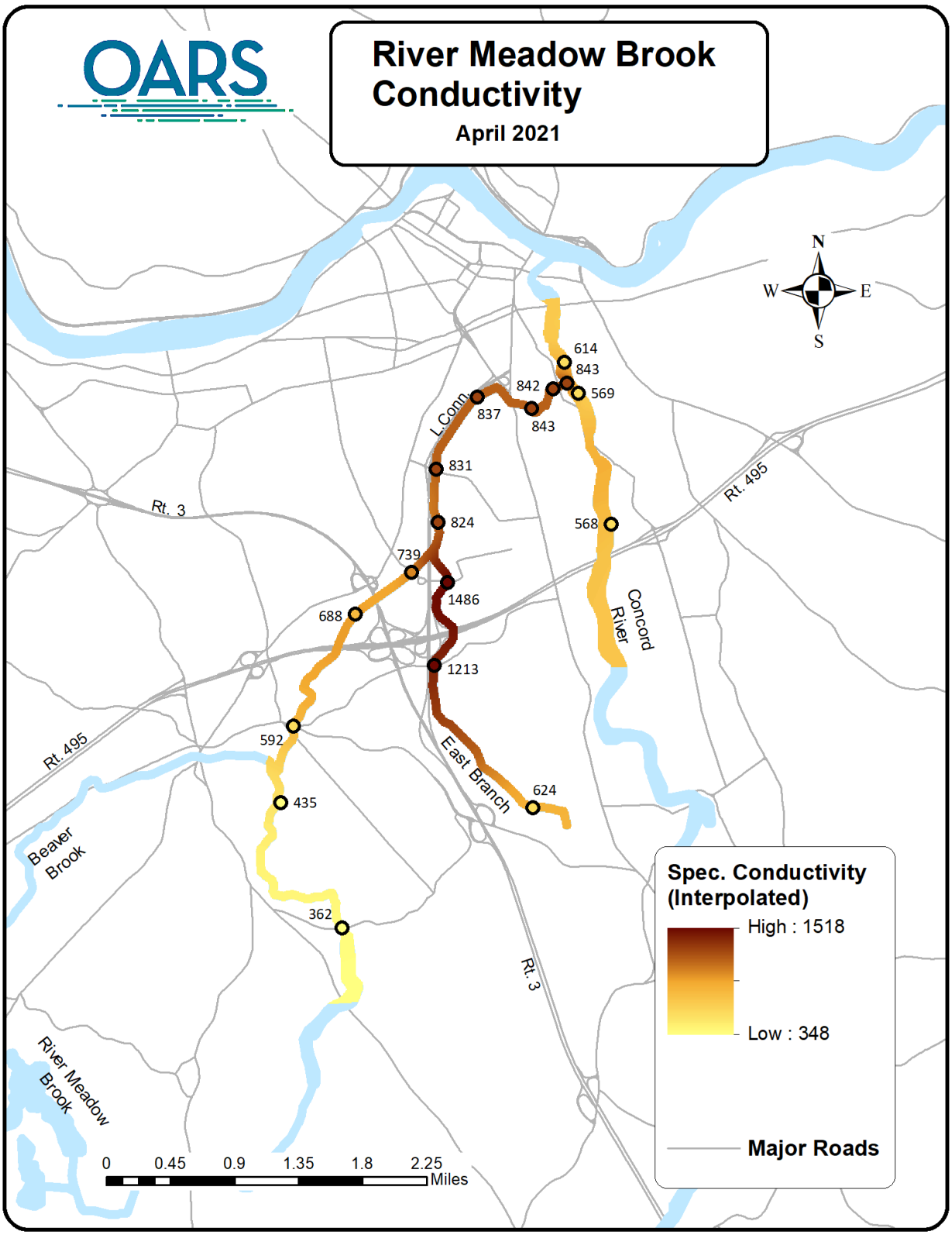
3. Taylor Brook, conducted by Ken Appel in 2022—This survey confirmed that Taylor Brook is in quite good shape regarding conductivity and chloride, but it did highlight a minor chloride source coming into the brook from the direction of the Maynard Technology Park and High School.
4. River Meadow Brook, conducted by OARS in 2021—This was our first survey to test the concept, and it very clearly highlighted the locations of pollution in the brook and the probable cause of the pollution from road salt from the highways (Rt. 495, Rt. 3, and Lowell Connector). OARS has shared this map with Mass DEP so that they can work with Mass DOT to address the salt pollution.

Note that the color-coded conductivity scales are not the same in each map. The scales differ in order to highlight the local hot-spots relative to each individual brook.


OARS
Fort Pond Brook Conductivity
June 2021
Survey by volunteers from Green Acton Water Committee
Mapping by Ben Wetherill, OARS
N
W
E
S
Fon
362
357
339
Guggins Brook
355
Grassy Brook
433
370
374
Mass Ave.
Rt. 2
Main St.
Nashoba Brook
Great Rd.
375
379
Fort Pond Brook
Central St.
Main St.
241
Heath Hen Meadow Brook
339
342
Fort Pond Brook
351
359
357
Coles Brook
1333
1301
444
434
499
491
480
Elizabeth Brook
0
0.35
0.7
1.05
1.4
1.75
Miles
Specific Conductance (interpolated)
High : 1336
Low : 239
Major Roads


OARS
Coles Brook Conductivity
November 2022
Survey by volunteers from Green Acton Water Committee
Mapping by Ben Wetherill, OARS
Main St.
Nashoba Brook
Rt. 2
Great Rd.
Main St.
Central St.
Fort Pond Brook
Coles Brook
343
1259
1274
1632
1243
376
1018
1017
321
444
462
397
N
W
E
S
0
0.25
0.5
0.75
1
1.25
Miles
Specific Conductance (interpolated)
Value
High : 1636
Low : 284
Major Roads
Minor Roads
Unsurveyed Streams


OARS
Taylor Brook Conductivity
December 20, 2022
Survey by volunteer Ken Appel
Mapping by Ben Wetherill, OARS
Rt 62/117
Rt 62
Waltham St
Rt 117
Rt 27
Taylor Brook
Vose Pond
ASSABET RIVER
NATIONAL
WILDLIFE REFUGE
Hudson Rd
120
399
129
291
327
328
N
W
E
S
0
0.2
0.4
0.6
0.8
1
Miles
Specific conductance (interpolated)
Value
High : 700
Low : 100
Major Roads
Minor Roads
Unsurveyed Streams


OARS
River Meadow Brook
Conductivity
April 2021
N
W
E
S
614
843
842
569
837
843
L Conn.
831
824
568
739
1486
688
1213
592
435
362
624
East Branch
Concord River
Rt. 3
Rt. 495
Rt. 495
Rt. 3
Beaver Brook
River Meadow Brook
0
0.45
0.9
1.35
1.8
2.25
Miles
Spec. Conductivity (Interpolated)
High : 1518
Low : 348
Major Roads