Why is it so salty?

Have you ever wondered what happens to all the salt that is spread on our streets and sidewalks during the winter? Where does it go? Did you know that there are also other sources of salt pollution, from sewers and water softeners? Eventually, all of this ends up in our groundwater, streams, and rivers. During this activity, you will try and determine which source of salt pollution has caused the increase in salt levels in a stream in Dutchess County, NY.

Background: The Wappinger Creek begins in northern Dutchess County, in an area full of wetlands and small lakes. It drains an area of 135,000 acres and winds through rural areas before moving into populated areas in Dutchess County. Ultimately, it forms a large pond in Wappingers Falls and then empties into the Hudson. Below is a map of the towns that are a part of the watershed.
Land use in the watershed ranges from agriculture and forest to commercial and residential development. Use the map below to estimate which land use type is the most prevalent in the watershed. List the land use types in order from greatest to least:

[Map of land use types]
Part 1: Amount of salt in the creek

Open the data set titled “Total salt” and create two graphs, one that shows the increase in Na and Cl concentrations, and one that shows the total amount of NaCl that is exported from the stream each year.

1. What has happened to the concentrations of Na and Cl in this part of the Wappinger Creek?
2. What has happened to the total amount of NaCl that is exported from the stream?
3. Which of the following sources of salt do you think is the main contributor to the increase in the amount of salt?
   ___ Road salt
   ___ Salt on parking lots
   ___ Deposition
   ___ Sewage
   ___ Water softeners
   ___ Rock weathering

Explain your decision: ____________________________________________________________
____________________________________________________________________________
____________________________________________________________________________

The portion of Wappinger Creek in this study is a smaller watershed, named here as the Cary Institute watershed, comprises 6,243 hectares or 15,500 acres. A major portion of the village of Millbrook is within this watershed, and can be seen in the drawing below as the purple outline. The rest of the watershed is forest, agriculture, and residential.
Part 2: Snowfall and Road Salt

Using the information in the table as well as the graph, answer the questions that follow.

<table>
<thead>
<tr>
<th>winter</th>
<th>snowfall (cm)</th>
<th>DOT used road salt (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996-1997</td>
<td>88</td>
<td>1,190,675</td>
</tr>
<tr>
<td>1997-1998</td>
<td>50</td>
<td>1,442,423</td>
</tr>
<tr>
<td>1998-1999</td>
<td>70</td>
<td>846,722</td>
</tr>
<tr>
<td>1999-2000</td>
<td>81</td>
<td>944,190</td>
</tr>
<tr>
<td>2000-2001</td>
<td>133</td>
<td>1,630,825</td>
</tr>
<tr>
<td>2001-2002</td>
<td>48</td>
<td>628,916</td>
</tr>
<tr>
<td>2002-2003</td>
<td>230</td>
<td>1,783,652</td>
</tr>
<tr>
<td>2003-2004</td>
<td>110</td>
<td>1,036,214</td>
</tr>
<tr>
<td>2004-2005</td>
<td>147</td>
<td>1,190,383</td>
</tr>
</tbody>
</table>

1. In what year was there the most snow? ____________
   a. How much salt was used during that year? _______________

2. In what year was there the least snow? ____________
   a. How much salt was used during that year? _______________

3. Is there a connection between the amount of snowfall and the amount of road salt used? If so, what? Explain.
   ________________________________________________________________________________
   ________________________________________________________________________________

4. Has there been more, less, or about the same amount of snow in the last ten years?
   ________________________________________________________________________________

5. Has there been more, less, or about the same amount of road salt used?
   ________________________________________________________________________________

Part 3: Groupwork

In order to find out what has caused the increase in the salt concentration in this portion of Wappinger Creek, you will investigate data from various sources. Each group will use a different data set.

**Group 1: Road Salt**

In the “Total salt” data set, there is a tab at the bottom called “Road Salt”. Click on that tab and create a graph of the amount of road salt used in the watershed. Make sure you can explain what has happened to the amount of road salt applied in the watershed to the other groups.
**Group 2: Parking lots**

In the “Total Salt” data set, there is a tab at the bottom called “Parking”. Click on that tab and make a graph showing the amount of salt used on parking lots in the village of Millbrook since 1986. Make sure you can explain your graph to your classmates.

**Group 3: Sewage**

In the “Total Salt” data set, there is a tab at the bottom called “Sewage”. Make a graph showing the amount of salt that has come from sewage treatment plants since 1986. Make sure you can explain your graph to your classmates.

**Group 4: Water Softeners**

In the “Total Salt” data set, there is a tab at the bottom called “Softeners”. Make a graph showing the amount of salt that has come from people’s water softeners. Make sure you can explain your graph to your classmates.

**Group 5: Deposition**

In the “Total Salt” data set, there is a tab at the bottom called “Deposition”. Make a graph showing the amount of salt that comes from wet deposition. Make sure you can explain your graph to your classmates.

**Group 6: Weathering**

In the “Total Salt” data set, there is a tab at the bottom called “Weathering”. Make a graph that shows the amount of salt from rock weathering in the area. Make sure you can explain your graph to your classmates.

**Part 4: Share Results**

Now that you have examined one of the sources of salt pollution in more depth, you will learn from your classmates about the rest of the sources. Fill out this chart while your classmates present.

<table>
<thead>
<tr>
<th></th>
<th>Increase, decrease, or no change since 1986?</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road salt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking lots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sewage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water softeners</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deposition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weathering</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Based on this chart only, which source(s) do you believe caused the increase in the salt concentration in the stream? ____________________________________________

2. Do you think these changes in the sources explain all of the increases in the stream?
   ____________________________________________________________________________
   ____________________________________________________________________________

3. Create a pie chart showing the salt budget of this part of the Wappinger Creek. To do this, you first have to calculate the percentage of each use by dividing the amount of salt used in each category by the total amount that was exported in the stream in 2005, which is 2,283,053 kg. Use “other” to express the amount of salt for which we don’t have a specified source. You can create the pie chart in Excel or draw one on your own.
4. What is the largest source of salt to the creek? _____________

Now, compare the salt budget between 1986 and 2005.

<table>
<thead>
<tr>
<th>Source</th>
<th>Kg of salt 1986</th>
<th>Kg salt 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road salt</td>
<td>1,096,590</td>
<td>1,191,689</td>
</tr>
<tr>
<td>Parking areas</td>
<td>98,369</td>
<td>127,367</td>
</tr>
<tr>
<td>Sewage</td>
<td>48,452</td>
<td>57,881</td>
</tr>
<tr>
<td>Softeners</td>
<td>38,500</td>
<td>47,125</td>
</tr>
<tr>
<td>Deposition</td>
<td>15,417</td>
<td>18,246</td>
</tr>
<tr>
<td>Weathering</td>
<td>16,619</td>
<td>13,790</td>
</tr>
<tr>
<td><strong>Total from known sources</strong></td>
<td></td>
<td><strong>2,283,053</strong></td>
</tr>
<tr>
<td><strong>Total NaCl exported from stream</strong></td>
<td><strong>878,781</strong></td>
<td><strong>2,283,053</strong></td>
</tr>
</tbody>
</table>

Subtract the total inputs from the total exports

5. In 1986, the amount of salt that was an input to the stream was ____________ (greater than/less than) the amount of salt that was exported.
6. In 1986, how much salt was ‘missing’? (ie, didn’t get exported) ________________________
7. In 2005, the amount of salt that was an input to the stream was ____________ (greater than/less than) the amount of salt that was exported.
8. In 2005, how much salt was ‘missing’? (ie, was not an input but was exported) ____________
9. How do you think land cover affects the salt concentration in the watershed? What areas of land cover do you think would release the largest amounts of salt pollution?
   ___________________________________________________________________________
   ___________________________________________________________________________
Use this graph to complete the following questions.

10. What does this graph tell you about the behavior of chloride in the stream? How does this relate to the amount of salt that was released into the watershed? Based on this graph, why do you think there is so much ‘extra’ salt in the stream now?

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

11. What can we expect to happen to salt levels in the stream in the future? Why?

______________________________________________________________________________
______________________________________________________________________________

12. Based on what you know about the affects of salt on aquatic organisms, as well as the sources of salt in aquatic ecosystems, write a brief letter to your town’s department of transportation authority explaining your concerns.

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Natural Resource Management Plan for the Wappinger Creek Watershed, Cornell Cooperative Extension of Dutchess County.