

Is the Schoharie Really that Scary?

Antonio Campedelli, Matthew Cullen, Anna Mahony

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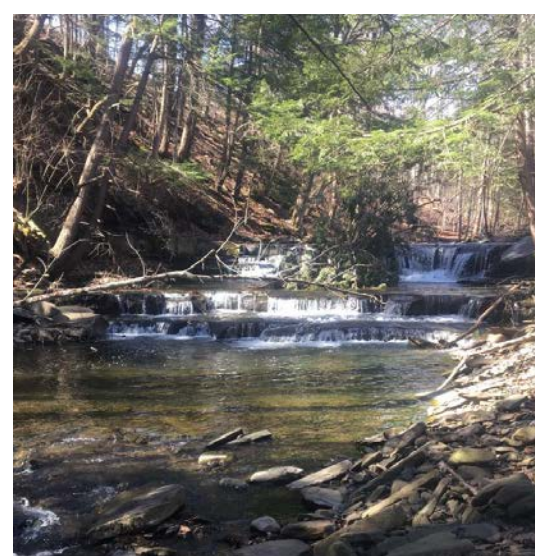
Introduction

Goals

- Use analytical methods and a variety of instruments to compare water samples from different rivers and creeks within the Capital Region
- Determine what is in Union College's tap water

Water Samples

- Five sources of water were analyzed: **Bowman's Creek (BC)**, **Wilsey Creek (WC)**, **Schoharie River (SCH)**, **Mohawk River (MKR)** and **tap water (TAP)**
- Water samples BC, WC and SCH were all from the **Schoharie River Center**
 - WC and BC are tributaries to the SCH
 - The samples are expected to contain similar levels of ions
 - WC is supposed to be a very clean creek
- The three Schoharie River samples were compared to the sample from the MKR
 - SCH is a tributary to the Mohawk River
 - Expected to see Cl⁻ in MKR due to road salt used in winter [1]
 - Ca²⁺ expected in high amounts [2]
 - Also expected to see trace amounts of metals such as Cu, Sr, Fe [2]
- The samples were also compared to **tap water** from **Union College**
- TAP is known to contain ions and metals
 - Low levels of Ba and Ca from naturally occurring sources [3]
 - Chloride from road salt [3]
 - Cu from galvanized pipes and natural deposits [3]
 - Zn in water comes from brass fittings [4]



Techniques

- Water samples were analyzed through various techniques
- The pH of each of the five water samples were determined from a **calibrated pH probe**
- Concentrations of Cl⁻ in the five water samples were measured by **ion selective electrode**
- The amount of Ca²⁺ in each of the five water samples was determined by **atomic absorption spectrophotometry**
- Ca²⁺, Cl⁻ concentrations in each water sample were measured by **ion chromatography**
- Al, Fe, Cu, Sr, Ba, and Zn levels in the water samples were measured by **inductively coupled plasma - mass spectrometry**
- Alkalinity concentrations in the samples were determined by **total alkalinity titrations**

Methods and Materials

pH Analysis

- A pH electrode calibrated using **pH 4, 7, and 10 buffers** was employed to measure the pH of the water samples
- KNO₃ was used as an **ionic strength adjuster** to increase the conductivity of the solution

Chloride Analysis by Ion Selective Electrode (ISE)

- Concentrations of Cl⁻ were determined by an ion selective electrode using an external calibration curve and standard addition
- External calibration curve method:** three standard solutions containing 10.0, 50.0, and 100.0-ppm Cl⁻ were prepared using 2.0-M KNO₃ as the **ionic strength adjuster (ISA)**
- Standard addition method:** three Cl⁻ test solutions of approximately 10-ppm concentration, with potassium nitrate were prepared. This was only done for the **TAP sample**, due to its **high ion content**.

Calcium Analysis by Atomic Absorption Spectrophotometry (AAS)

- Calcium concentration of each sample was determined **by AAS**
- Three working standard solutions with ranges 1-10-ppm Ca²⁺ were prepared along with dilutions from the samples with ranges 1-10-ppm Ca²⁺
- All water samples were analyzed in triplicate

Total Alkalinity Measurements

- 100-mL of each water sample was titrated with 0.02-N H₂SO₄
- Total alkalinity** was then calculated using the amount of acid needed to reach the **endpoint of the titration** using **methyl orange** as an indicator

Anion and Cation Analysis by Ion Chromatography (IC)

- Two different instruments were used in the Geology Department at Union College. Concentrations of **cations** were measured using the **DX-500** and **anions** using the **ICS-2100**

Metal Analysis by Inductively Coupled Plasma - Mass Spectrometry

- Concentrations of Al, Fe, Cu, Sr, Ba, and Zn were measured using the **Agilent 8900 ICP-MS** in the Geology Department at Union College

Results & Discussion

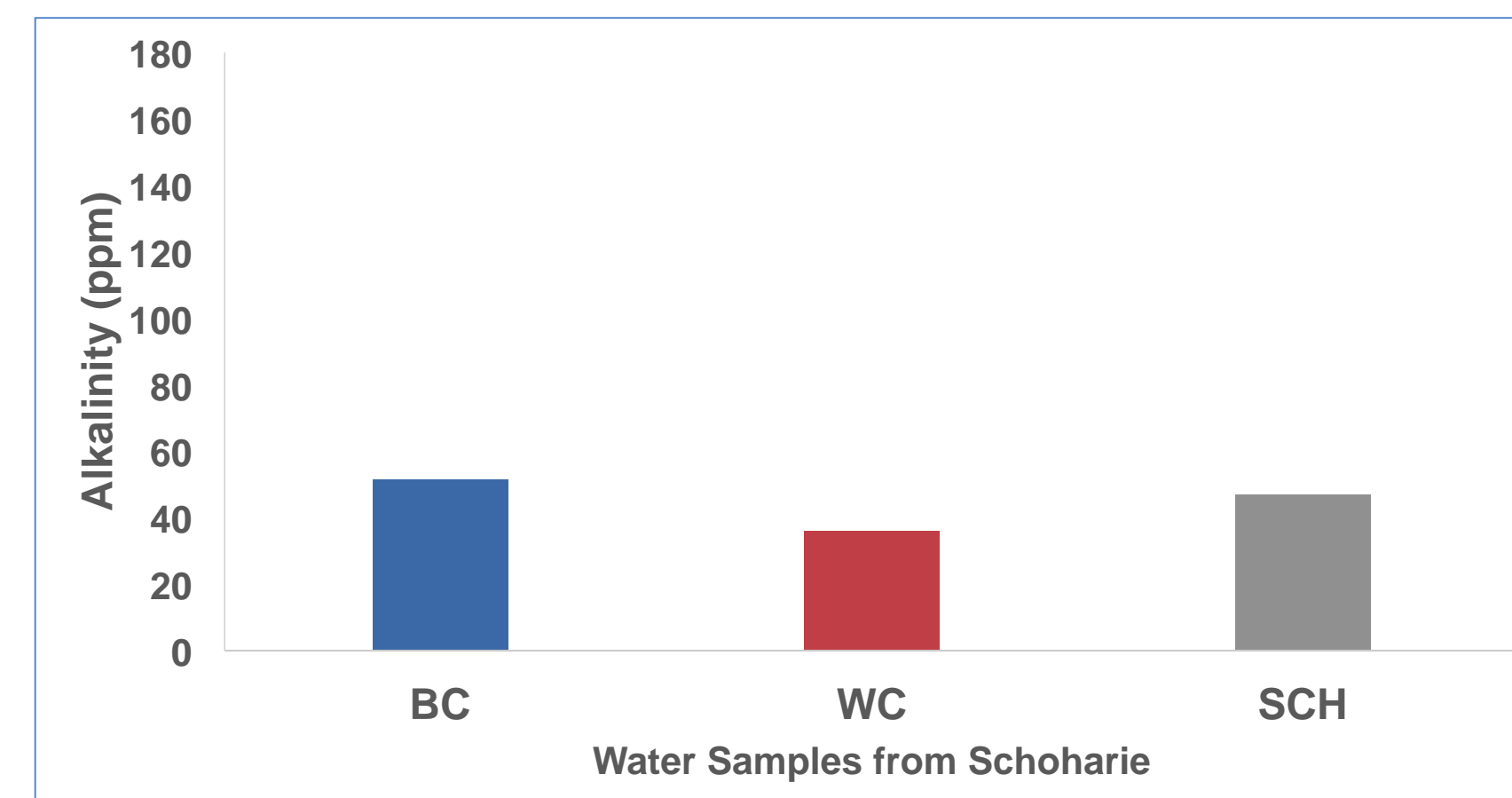


Figure 1. Total Alkalinity of the three water samples from the Schoharie Region: Bowman's Creek, Wilsey Creek and the Schoharie River.

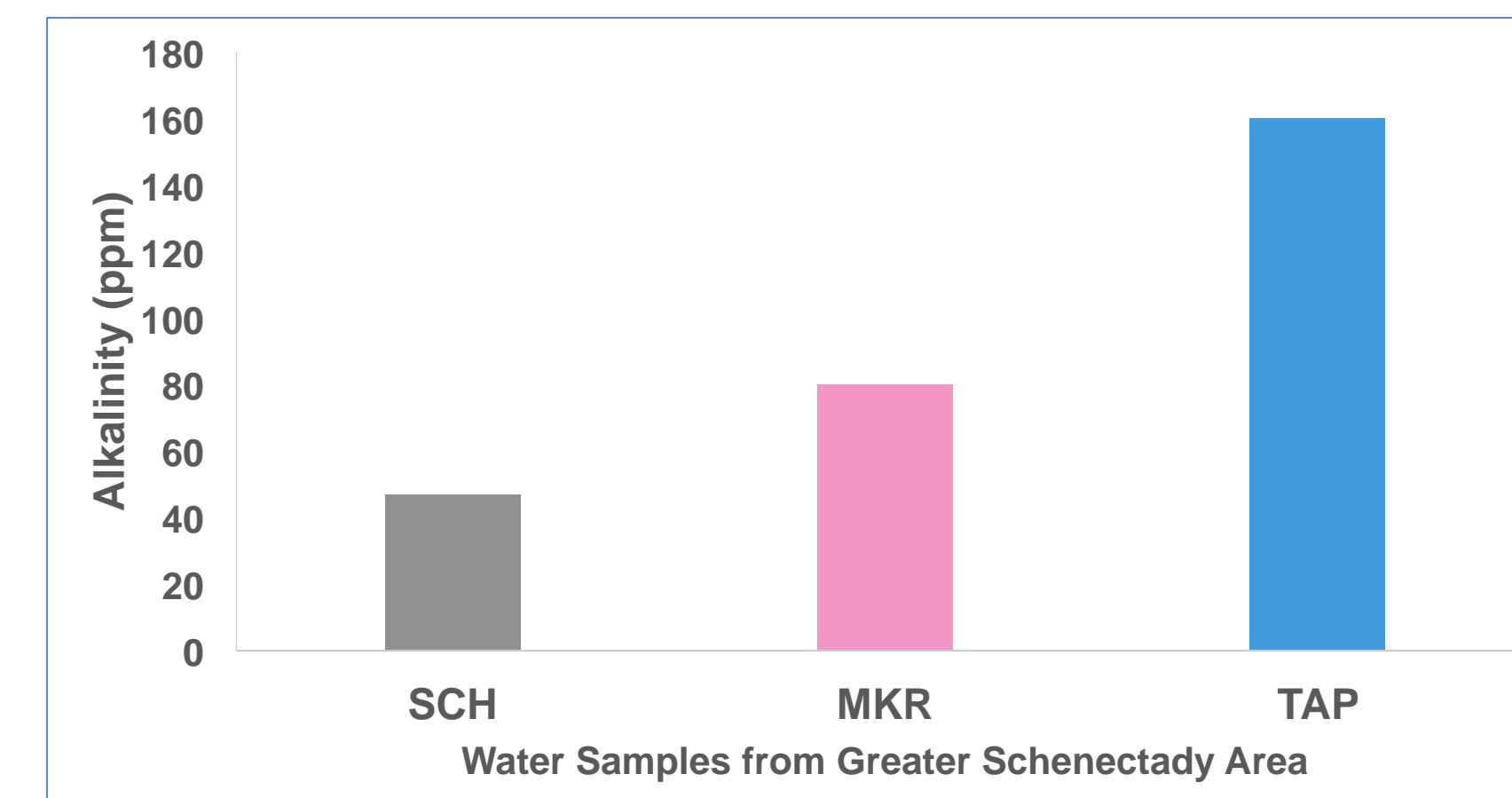


Figure 2. Total Alkalinity of the Schoharie River compared to tap water and the Mohawk River sample.

- Bowman's Creek, Wilsey Creek and the Schoharie River all had relatively similar alkalinity values, ranging from about 36 to 52 ppm.
- Mohawk River had a much higher alkalinity (160 ppm) than both tap water (80 ppm) and the Schoharie samples.

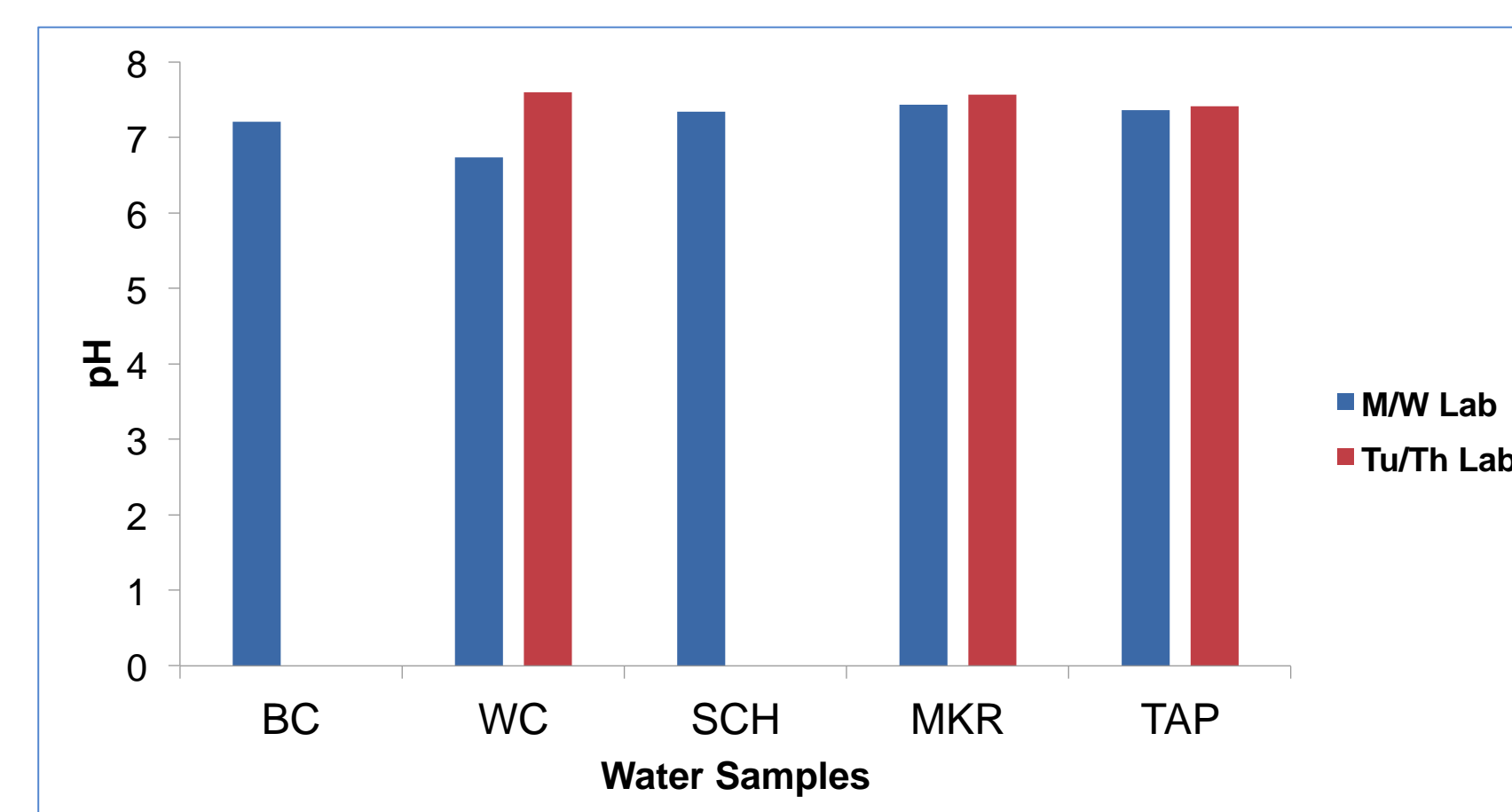


Figure 3. Comparison of pH's of all five samples taken by two different labs. BC and SCH were only analyzed by the Monday/Wednesday lab.

- pH's are all above 7 (except WC pH from M/W lab)
- pH's are all relatively similar

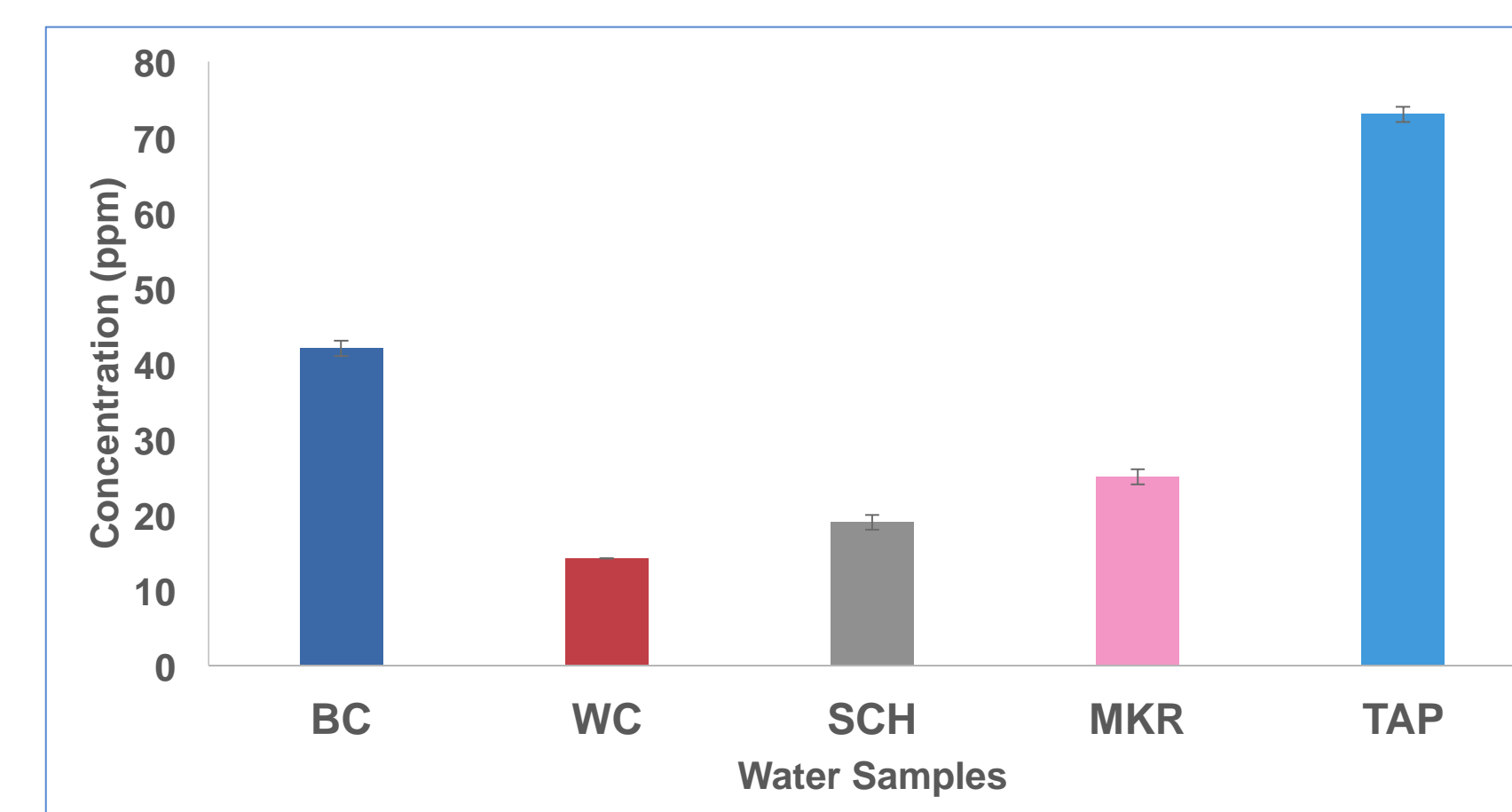


Figure 4. Chloride concentrations of all five water samples determined by external calibration.

- TAP had the highest chloride content (73 ppm). BC also had a relatively high Cl⁻ concentration (42 ppm) compared to the rest.

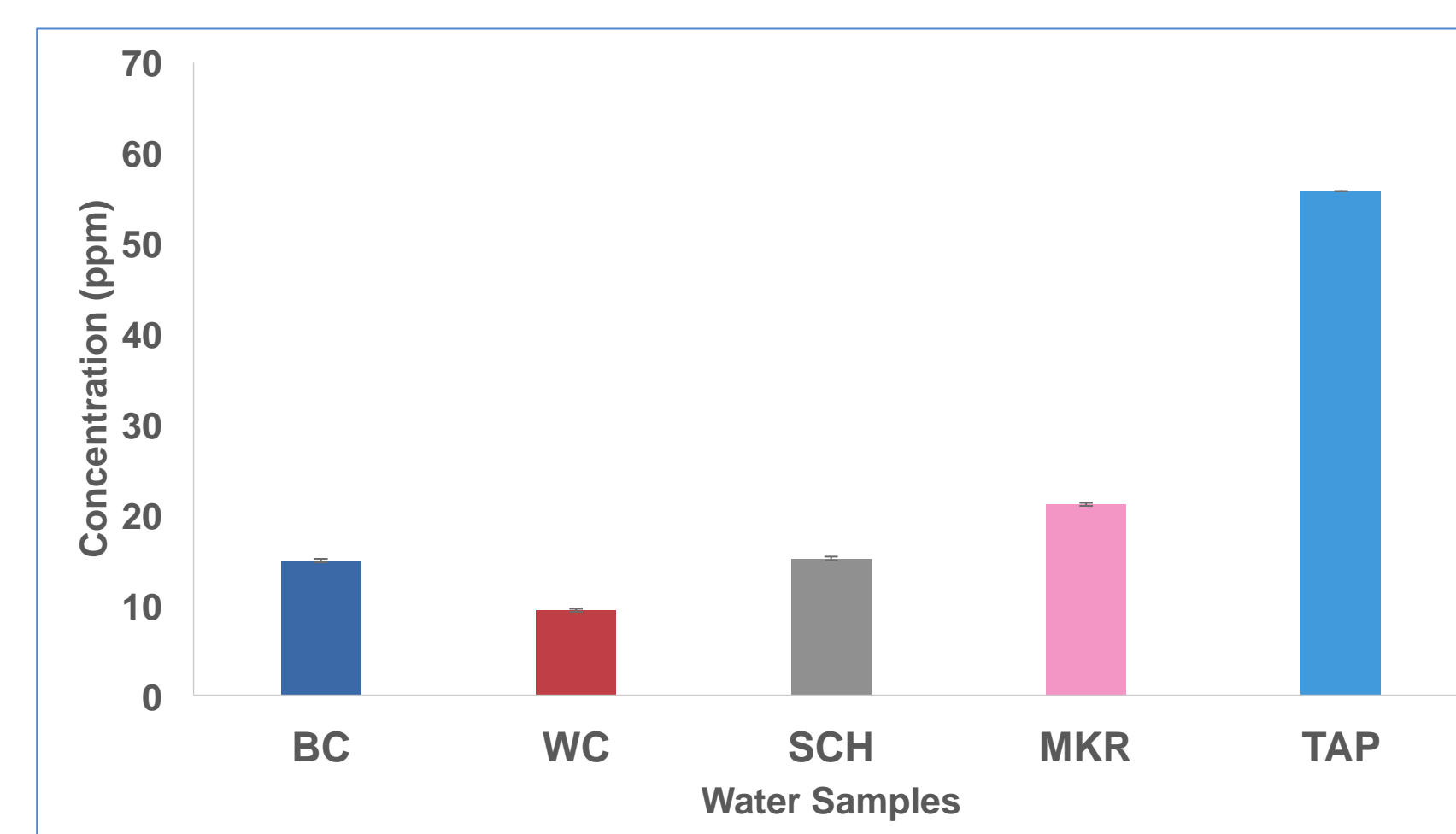


Figure 5. Using three working standards, the calcium concentration in all five water samples was analyzed in triplicate using AAS.

- TAP had the highest calcium content (55.70 ±0.01 ppm determined by AAS, and 65.80 ±0.03 ppm determined by IC)
- All concentrations determined by IC were systematically higher than those determined by AAS

Table I. Concentration of Cl⁻ in TAP samples were assessed by standard addition, external standards and ion chromatography

Chloride Concentration in Tap Water Comparing Standard Addition and External Standard Methods	
Cl ⁻ (ppm) Std. Add.	TAP 81.1
Cl ⁻ (ppm) Ext. Std.	87 ±1
Cl ⁻ (ppm) IC Data	74.5 ±0.1

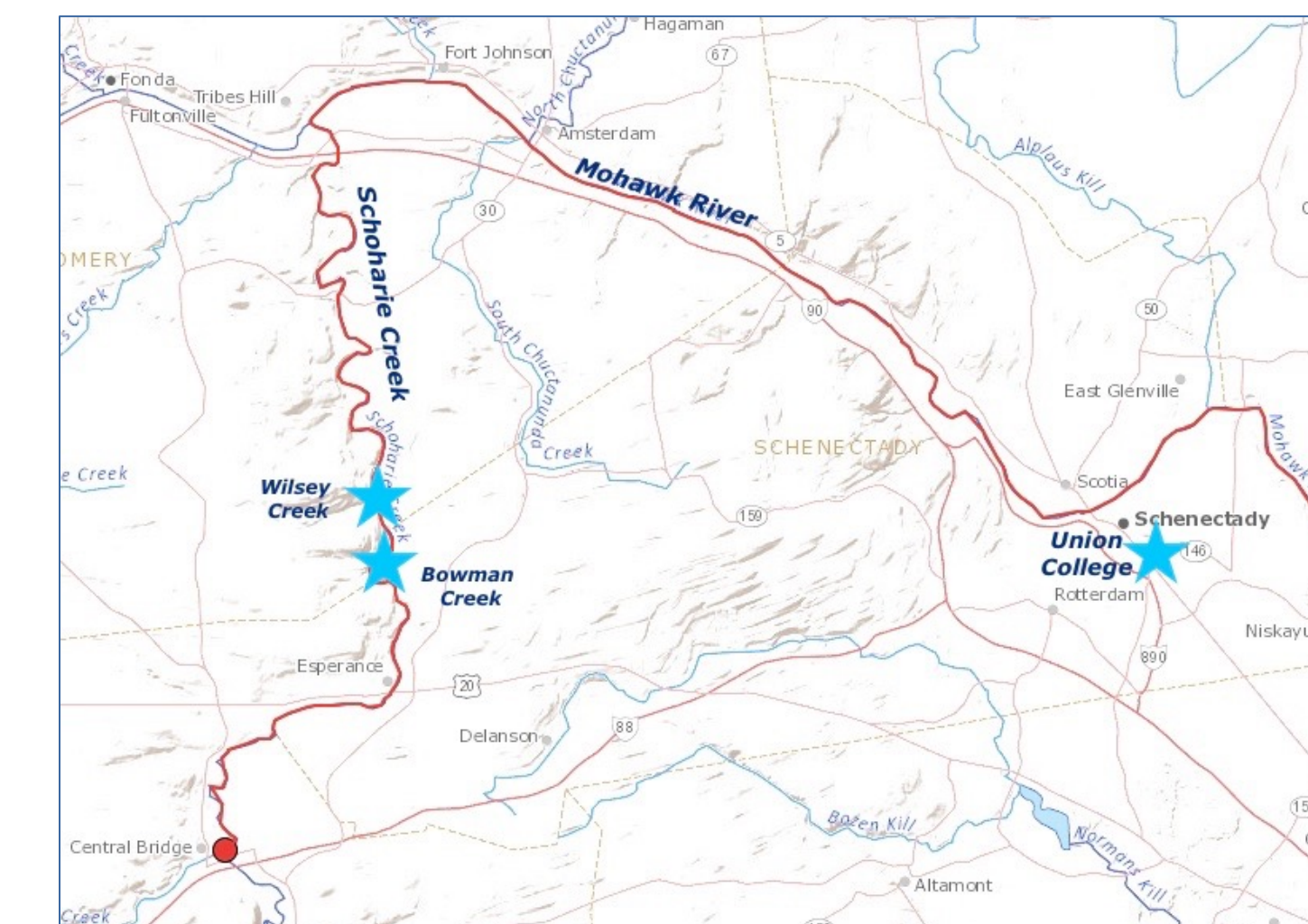
- Performed Grubbs test and found that one data point failed and was determined to be an outlier thus Cl⁻ is the average of two data points
- There is variation between determined Cl⁻ content from the three methods
- It was expected that standard addition would show a lower concentration than external standards because it accounts for interfering ions that would contribute to signal in Ext. Std.

Table II. Concentrations of various metals in all five samples were assessed in triplicate using ICP-MS.

Metal Concentrations (ppb)						
Sample	Al	Fe	Cu	Sr	Ba	Zn
BC	76 ±6	50 ±4	1.9 ±0.2	70 ±20	12 ±3	0.8 ±0.4
WC	115 ±6	100 ±10	11 ±4	37 ±3	5.5 ±0.4	3 ±4
SCH	350 ±10	268 ±9	16.1 ±0.2	48 ±3	18 ±2	2.3 ±0.3
MKR	180 ±40	140 ±50	1.4 ±0.3	260 ±60	26 ±8	4 ±1
TAP	6 ±1	6 ±2	450 ±40	500 ±80	49 ±9	150 ±20

- SCH is much higher in Al and Fe than WC and BC
- There is a lot of Cu, Sr and Zn in TAP
 - Zn and Cu are due to galvanized water pipes and brass fittings
- MKR had high levels of Al, Fe and Sr, but not as high as other samples
- The absolute error was inconsistent from run to run
- Group 2 metals tend to behave similarly so their trends are similar

Map of Sampling Locations



Conclusions

- Schoharie River is clean (as hypothesized)
 - Most of the Schoharie region data gave similar data for alkalinity, pH, and calcium concentrations as expected
 - SCH is low in alkalinity, chloride, and calcium and has a normal pH
- There was some variance in Al, Fe, and Sr concentrations between the Schoharie samples
- As predicted, WC yielded low concentrations of all analytes of interest, with the exceptions of Al and Fe, which are common ground metals
- As predicted there were high levels of Cu in the TAP sample, as well as Zn and Sr, which is most likely due to brass fittings in the pipes
- IC was most accurate form of measurement of Cl⁻ concentration [3]
- Analyzing Ca²⁺ concentration by AAS and IC yielded similar trends
- Predictions for tap water were supported by data
 - Calcium concentrations (55.7 ppm from working standards and 65.9 ppm from IC) were close to Schenectady quality report data (53.6 ppm) [3]
 - Chloride data (see Table 1) were higher than the report showed (42.4 ppm) [3]
 - Concentration of Cu determined by ICP-MS (450 ±40 ppb) was similar to expected levels (392 ppb) [3]
 - Ba levels were higher (49 ±9 ppb) compared to the report data (19.0 ppb) [3]

Acknowledgements

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