

## Project Title

Amber White, Navajo Preparatory School, Farmington, New Mexico

Project ID#

### Q1: Research Question/Engineering Goal

The Navajo Nation has experienced environmental disasters. Our reservation has 523 abandoned uranium mines that are both remnants of the cold-war era and currently EPA Superfund Cleanup sites. The Church Rock Uranium Mill Spill occurred in New Mexico on July 16, 1979, when United Nuclear Corporation's uranium tailings disposal pond at its uranium mill in Church Rock. There was the recent 2015 Gold King Mine wastewater spill, which poisoned the Animas River flowing through Farmington, New Mexico. Now we have experienced a torrent of sulfur dioxide gas building up in the air we breathe, during winter temperature inversions. When sulfur dioxide (SO<sub>2</sub>) combines with water (H<sub>2</sub>O) vapor, such as in our eyes, nose, or mouth, sulfurous acid H<sub>2</sub>SO<sub>3</sub> is formed. Clearly, accommodation needs to be made for the health and safety of the residents of the Navajo Nation. The problem was to identify how to protect the health of people while still providing the industry they need to support them.

### Q3: Data Analysis & Results

The all-time high SO<sub>2</sub> Level, January 13, 2020, Farmington, NM was 329 µg/m<sup>3</sup>. This exceeded the EPA Standard of 212 µg/m<sup>3</sup>. After the morning sun warmed up the cold air pocket, the temperature inversion and high levels of sulfur dioxide fell to acceptable levels. The San Juan Gas plant emitted almost 1.6 million pounds of sulfur dioxide between October 2016 and November 30, 2018. This may have been caused by unusual wear of compression valves and other parts, which could have exacerbated by water (H<sub>2</sub>O) combining with sulfur dioxide (SO<sub>2</sub>) to form sulfurous acid (H<sub>2</sub>SO<sub>3</sub>). The SO<sub>2</sub> data falls in the 101-150 AQI range, indicating unhealthy for sensitive groups. On December 3, 2020, sulfur dioxide was reaching hazardous levels even data was first being gathered for this research report. EPA standard of 75 ppb of SO<sub>2</sub> was converted into 212 µg/m<sup>3</sup>. 212 µg/m<sup>3</sup> is considerably smaller than the concentration of SO<sub>2</sub> of 329 µg/m<sup>3</sup>. 75 ppb is the EPA standard for one-hour maximums over a 3-year period. 329 µg/m<sup>3</sup> clearly exceeded this (75 ppb is equivalent to 212 µg/m<sup>3</sup>). Thus, sulfur dioxide is a serious problem when winter temperature inversions exist in the Farmington, NM area.

### Q2: Methodology/Project Design

**Research Question:** Can sulfur dioxide levels in the Farmington, NM region during winter temperature inversions present a health hazard to members of the Navajo Nation? **Hypothesis:** The levels of atmospheric sulfur dioxide in the Farmington, NM area can exceed the EPA 1-hour daily maximum standard, due to overnight thermal inversions, and this is deleterious to plant, animal, and human life on the Navajo Nation.

The variables in my experiment are:

- Concentration of sulfur dioxide, in µg/m<sup>3</sup>
- EPA standard for sulfur dioxide, in µg/m<sup>3</sup>
- Time of day

The following are the materials and equipment and experimental procedures used.

- The Weather Channel application
- iPhone

A. Download The Weather Channel "app" to my smart phone.

B. Document sulfur dioxide concentrations along with the time of day of the peak concentrations.

### Q4: Interpretation & Conclusions

Sulfurous acid can affect you when breathed in and by passing through your skin. Sulfurous acid is a corrosive chemical and contact can severely irritate and burn the skin and eyes with possible eye damage. Breathing sulfurous acid can irritate the nose and throat. Breathing sulfurous acid can irritate the lungs causing coughing and/or shortness of breath. Higher exposures can cause a build-up of fluid in the lungs (pulmonary edema), a medical emergency, with severe shortness of breath.

I have documented that sulfur dioxide levels during winter temperature inversions exceeded EPA standards. Also, when exposed to water vapor, sulfur dioxide (SO<sub>2</sub>) and water (H<sub>2</sub>O) combine to form sulfurous acid (H<sub>2</sub>SO<sub>3</sub>).

Thus, my hypothesis that "Sulfur Dioxide levels in the Farmington, NM region during winter temperature inversions can present a health hazard to members of the Navajo Nation" was accepted.

