Final Report by Christopher Fryett for MountainView Remote Sensing Fellowship.
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In early 1950's the Billings Regional Landfill was established. It is located 4.8 kilometers south of the City of Billings, and about 0.7 kilometers south of the Yellowstone River. Since the 1950's the landfill has changed significantly. In the early years soon after its founding, the area was crossed by dirt roads which were eventually replaced by asphalt and concrete and the addition of scales, public drop boxes. The layout of the landfall also changed including development of a composting area, and segregation of materials by type. Adjacent to the landfill is residential, agricultural, light industrial, and recreational areas. An expansion to the landfill shortly after 2017 increased the property by 350 acres of which 842 acres existed. The objective of the project was as follows:

1. Obtain digital imagery near the timeframe the landfill was established.
2. Obtain digital imagery of the land area post 1950's
3. Identify land areas (roads, watersheds, buildings)
4. Select locations around the property border for sample retrieval.

Data Sources. Using aerial imagery from 1951 until 2017, we evaluated landscape changes in and around the landfill. The images were obtained from the Montana State Library Geographic Information Clearing House and the US Department of Agriculture Farm Services Agency. The images were imported into ESRI ArcMap 10.8, and the Project Coordinate System was set to Montana State Plane 1983. The GPS data points were marked using a Garmin Oregon 750t, and the results were added using the XY coordinate tool in ArcMap.

Results. Evident in the earliest aerial photo, the land supported a simple road system with seemingly limited impact to the local soil and water. As time went on the hilly terrain was modified, and new roads were established. The type of material being deposited in a small area coming from the City of Billings and surrounding counties grew over time. There are general areas for commercial garbage trucks to deposit their load, while other areas of the landfill are designated for general public deposits. To simplify directing people around the landfill, zones were defined for shrubs, cement, furniture, and miscellaneous items. Over the years these zones have moved around, such as the scrubs were on the northeast side of the property, and then moved to the far east and also in the middle of the landfill.

As illustrated in Figure 1, one section of the landfill is now a natural gas field. Between 1997 and 2017 the landfill started to collect enough natural gas from decomposing trash to heat 2,100 homes and power trucks hauling garbage. There are over a dozen pipes above ground in this area. Plant growth is present and could be an area of attraction for various animals.

Development of the road system since 1951 is illustrated in Figure 2. The road features created in ArcMap demonstrate the extensive growth over the decades. The landfill internally shows a number of established roadways. Due to the presence of this gas field, we hypothesized that volatile organic compounds may be present in environmental media. To investigate this hypothesis fieldwork was performed to collect samples around the property for analysis. The selection site for the 6 sample locations required being on public land, close to the landfill, and near watersheds. There were challenges in getting close, due to private ownership restricting some access to the desired sample sites.

In Figure 1 a high-level portrayal of the zones are identified with sample retrieval data points. Three types of samples were retrieved during the winter: soil, plants, and snow. On December

16, 2020 the 6 sites were visited. There was visible snow present in the area to allow samples to be taken from the top layer. Soil was still loose enough to dig 7 inches in depth, and there were visible plants easily accessible in the same location. The samples were stored in a glass vial able to hold up to 10mL of liquid. The same vials were used to store the dirt and a plant with roots. A small spade was used to transfer the material into the vials before caping them. The vials were brought to Montana State University Billings research lab and stored at 27°C. To identify the types of compounds in these sample a Gas Chromatography Mass Spectrometer is being used. The results have not been completed but are being processed.

Next Steps. The future of this project potentially will involve obtaining samples within the property line with permission from the City of Billings. Of interest is the natural gas field as it is close to a few watersheds, roads, and residential areas. In addition, there are animals, such as deer and birds eating from the land who could be consuming undesirable material that has degraded over the decades. A major river is less than a mile away which could potentially carry hazards into the environment. A graphical view of all of these outstanding items in a detailed map would be helpful in decision making in the future as the landfill grows. An independent analysis by a public institution like Montana State University Billings (MSUB) would allow an unbiased assessment of the area. The City of Billings in the past has performed compound analysis where they paid the organization. MSUB could submit a grant request, which is independent to the City of Billings who owns the property.

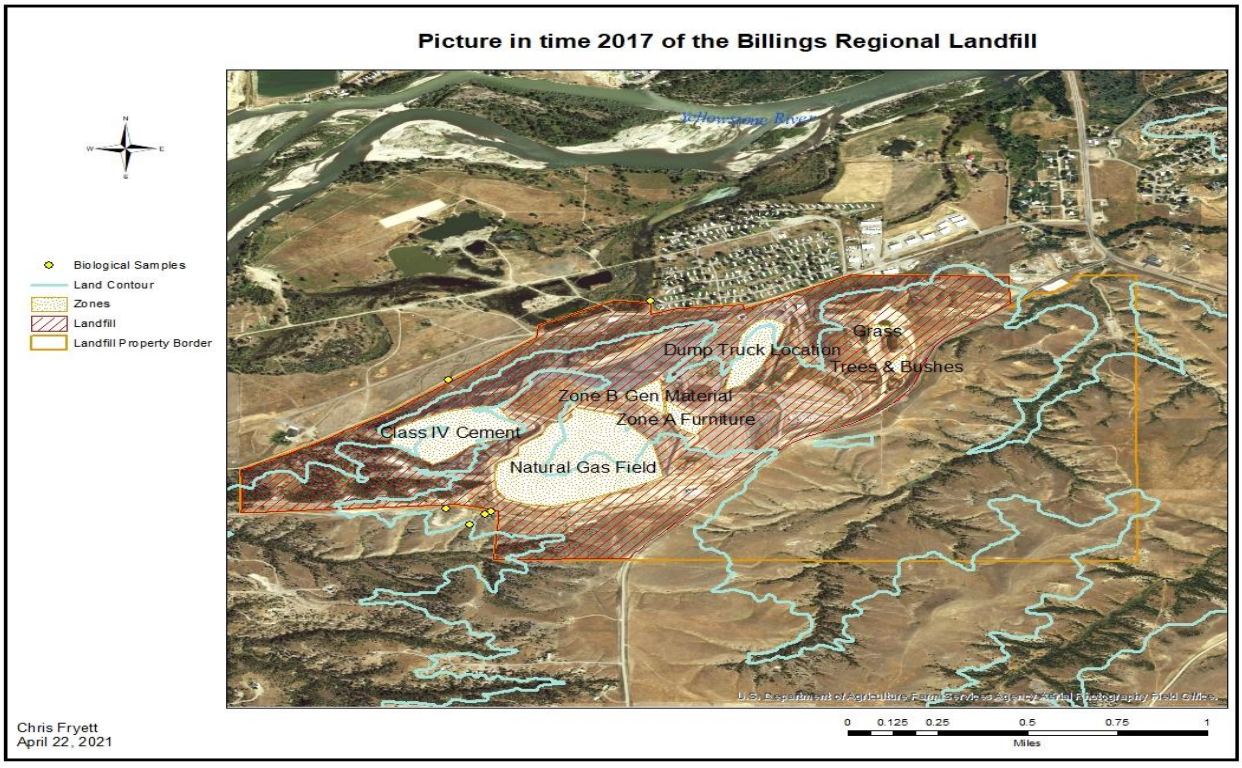

Figure 1 – Delineation of refuse zones within the property line of Billings Regional Landfill

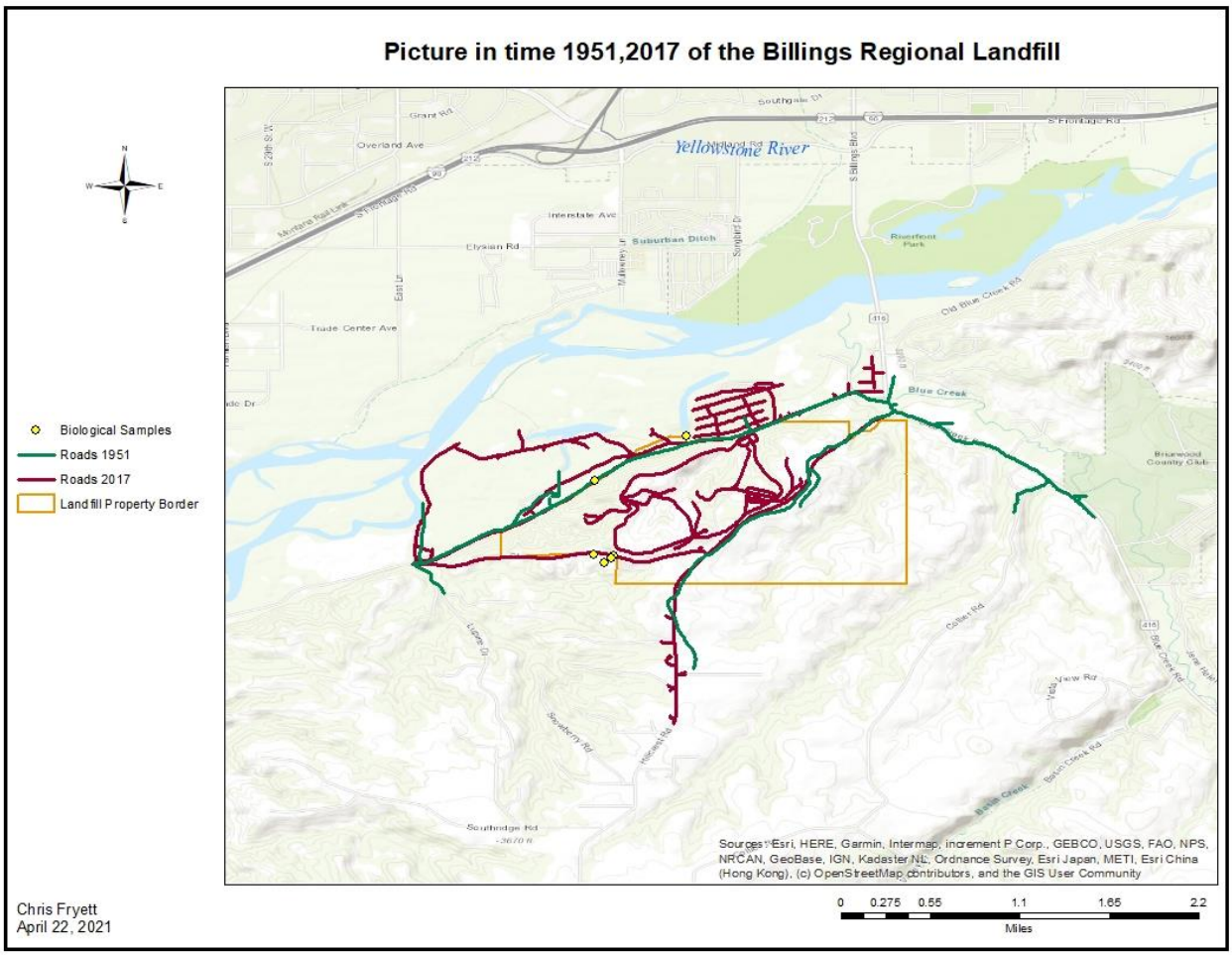

Figure 2 - Road System Near and On Billings Regional Landfill