# Analysis of Soil at a Flooding Site in Avon, New York

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## Abstract

A residential area in East Avon frequently floods in response to rainfall or snowmelt events and the water remains pooled in place long afterwards. This study seeks to determine the cause of the flooding. Soil samples were collected from several locations at the site and analyzed to determine the array of grain sizes present. It was determined that approximately 47% of the sediment at the site is smaller than 63 microns, which is the threshold for silts and clays (mud), meaning that approximately 53% of the sediment is sand sized or larger. The large amount of smaller grain sizes, combined with poor sorting within the soil, result in small pore spaces and a lack of connectivity between the pores. This makes it difficult for the soil to drain water, and hence, ponding occurs.

## Introduction

Nune Park is a mobile home community built in the 80's in a heavily glaciated area in East Avon, New York (Fig. 1). In recent years the park has experienced significant flooding events with stagnant water collecting in yards for weeks (Fig. 2). Flooding has caused damage to the foundations of homes, resulting in some trailers becoming unlevel and sinking into the ground. It has also caused significant damage to the road and homeowners walkways. Prior attempts have been made to mitigate the flooding but none have seen successful.

The specific area of interest is on the east side, at the end of the road (Fig. 1). Nearby, a stream crosses the road, flowing from east to west (Fig. 1). A second stream is located to the west of the road and flows northward until it joins the other stream (Fig. 3).


**Figure 1:** Map of East Avon. Red circle highlights the private road. Blue arrow represents area of study (Caltopo, 2020).

**Figure 2:** Stagnant water pooling in area of interest. A trench was dug to try to drain the water. The amount of water shown in the Figure represents a relatively low pooling depth, as it can get much deeper (2020).

**Figure 3:** Aerial photograph of Nune Park. Outlined are the streams and ponds (blue) and the ditch (red) (Caltopo, 2020).

## Methods

### Sample Collection

Soil samples were taken from six sites across the south end of the park (Fig. 4). The sites were chosen to represent the variety of locations where flooding occurs. At each site, a hole of at least 6 inches was dug and then one shovelful of sediment was collected from the edge of the hole. The samples were mixed together to create a composite sample, representative of sediment in the flooded area.


**Figure 4 (Left)** Nune Park with the six sampling sites marked at the south end. (Google Earth Pro, 2020)

### Soil Analysis

Initial sieving was done to separate the mud and the sand in the composite. To do this, a dispersant was added and the mixture was sonicated. This ensured that the smaller particles did not flocculate. The mixture was then sieved at 63 µm over a 1000 mL graduated cylinder. Smaller grains (mud) went through the sieve and collected in the cylinder, while the larger grains were separated out. The larger grains were dried in an oven. The larger grained material was then dry sieved to separate into seven different sizes and weighed individually. A pipette analysis was done on the mud, which entailed stirring the mixture in the graduated cylinder after which a specific amount was extracted at predetermined time intervals. This method provides a means of collecting the varying grain sizes present as the particles fall out of suspension according to size. Each extraction was then dried in the oven, and subsequently weighed individually as well. The recorded masses were used to determine relative grain size and sorting of the composite sample.

**Figure 5 (Right)** Pipette extraction being done by Maddy Waldock in the wee hours of the night (2020).

### Map and Field Observations

Satellite maps were used to determine land use changes in the area through time. Observed changes were verified on the ground.


**Figure 6:** Satellite image of Nune Park in 1994. Blue dot is study area (Google Earth, 2020).

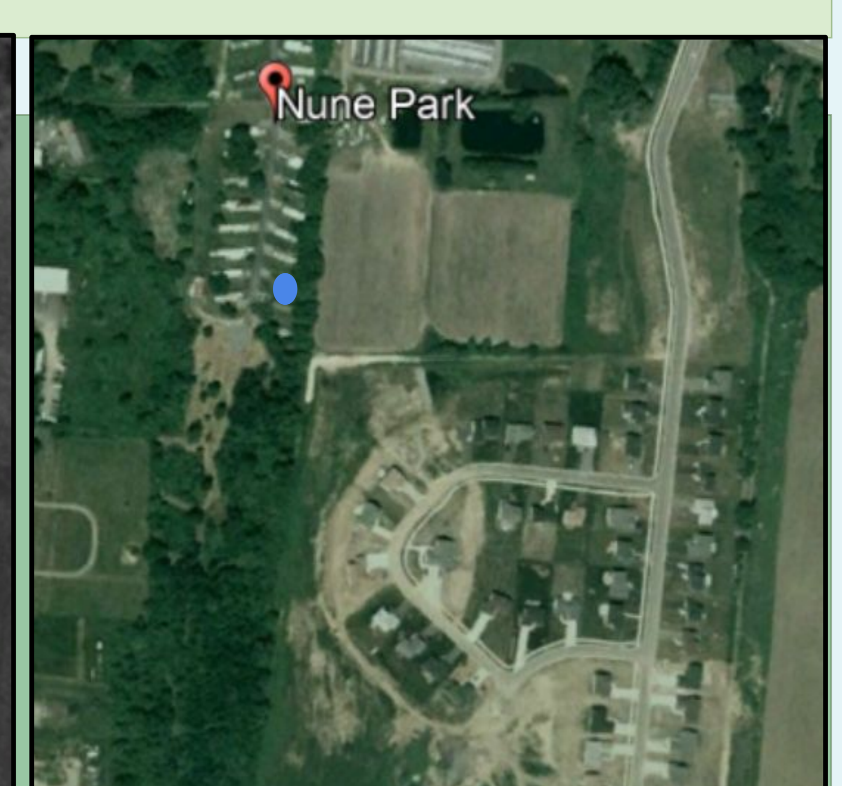


**Figure 7:** Satellite image of Nune Park in 2006. Royal Springs subdivision is being built. Blue dot is the study area (Google Earth, 2020).

## Results and Discussion

### Sample Results

Roughly 46.5% of the composite sample was smaller than 63 um, meaning almost half of the sample was mud (Fig. 8). Mud-sized particles tend to flocculate (clump), which can hinder drainage. The frequency curve generated from the mass of sieved materials suggest poor sorting (Fig. 8), which can also hinder drainage. The curve does not account for many larger clasts that were pulled from the composite sample, so as to not damage any of the sieves. These excluded clasts would contribute to higher frequencies at lower phi sizes, again indicating poor sorting. Collectively, the sediment analysis suggests that the soil is prone to pool water.

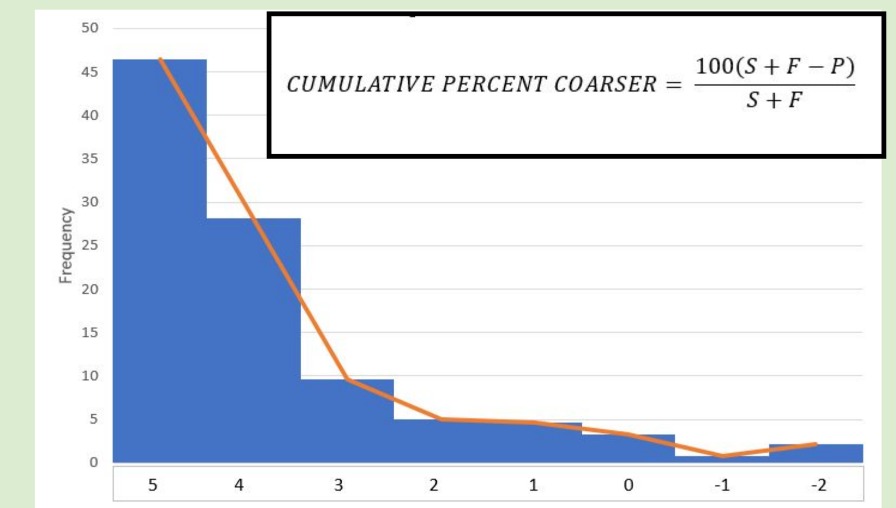


**Figure 8 (Right):** Grain size frequency curve that illustrates sample sorting, with phi units on the x-axis, higher numbers representing smaller grains.

### Map Results

The natural gradient of the area was shallowly sloping towards the stream (Fig. 1). Building of the road and the nearby neighborhood is likely to have impacted the local water drainage. Most notably, the flooding events began with the construction of the Royal Springs neighborhood (Fig. 6 & 7) from former farmland. This area is directly southeast of Nune Park and is located at a higher elevation, therefore, the surface runoff from this region (see A in Fig. 6) flows towards the study area (Figs 1 & 6). Residential areas have a higher impervious surface area than farmland, meaning that rainwater does not penetrate into the ground as easily (OEHHA, 2020). This means that more water is traveling along the surface into Nune Park after Royal Springs was built and therefore is contributing heavily to the flooding.

## Conclusion

The flooding problem at Nune Park is likely due to changes in land use up-gradient from the study area coupled with the soil conditions at the site. Runoff towards the study area has increased because of the presence of the new neighborhood. The water is pooling in Nune Park because of the poor sorting and dominance of mud-sized particles in the local soil. The most practical solution to minimize future flooding would be to ditch the area between the two neighborhoods and direct runoff into the stream and away from Nune Park. versed, the most practical response to this should be a re-gradation of the sediment in the area, so as to remediate the current drainage issues.

## Acknowledgements

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### Citations

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