

Newhall Neighborhood Ground Settlement Study

Haley & Aldrich, Inc. recently analyzed ground movement (“settlement” or “ground subsidence”) in the Newhall neighborhood of Hamden, Connecticut over the last decade. Several areas of thick, historical filling that is known to have subsided or may still be subsiding (settling) exist across the neighborhood. The goal of the study was to see if the ground in the neighborhood is still moving and how fast (rate of settlement). This analysis was completed for the Newhall Foundation Evaluation Project. A copy of the report is attached.

How was Settlement Measured?

Haley & Aldrich, Inc. used a technique called InSAR (Interferometric Synthetic Aperture Radar), which analyzes radar images from satellites to measure very small changes in the ground over time (rate of settlement). This method produces a map showing if the movement detected is subsiding (downward movement) or rising (upward movement). This technique is regularly used by scientists and engineers to conduct similar studies of the ground surface for its accuracy and large coverage area. Satellite images of the neighborhood between 2016 and 2024 were analyzed for this study.

What was Found?

- A map of ground movements from 2016 to 2024 across the neighborhood was prepared.
- The map shows the neighborhood is generally stable meaning no unusual or significant ground movements occurred since 2016.
- Specifically, non-public properties are either stable, slowly subsiding by very small amounts, and in some cases, slowly rising by very small amounts. Certain parts of the Old Middle School athletic fields and Rochford Field subsided by small to moderate amounts slowly.

What is the Conclusion?

The ground in the Newhall neighborhood’s non-public properties was generally stable since 2016. Although no similar previous surveys or satellite-based studies were conducted, it is well documented that ground settlements were larger in the past. We expect future settlement rates in the non-public properties to remain the same or decrease. Rising ground movement is caused by factors unrelated to historic land filling or remediation

The rate of settlement is higher in the athletic fields because large amounts of earth were recently placed as part of remediation work. The ground is adjusting to the added weight of the soil and will continue to sink at the small to moderate rate until it stabilizes to very small rates in the next one to two decades.



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10 July 2025
File No. 0211533-000-001-05

Town of Hamden
Department of Economic Development
2750 Dixwell Avenue
Hamden, CT 06518

Attention: Jacqueline James
Director of Economic Development

Subject: Newhall Neighborhood Satellite-Based Settlement Study
Newhall Foundation Evaluation Project
Hamden, Connecticut

Ladies and Gentlemen:

This letter presents the results of our Newhall Neighborhood satellite-based settlement study for the Newhall Foundation Evaluation Project in Hamden, Connecticut. Several localized areas of thick, historical filling that is known to have subsided or may still be subsiding (settling) exist across the neighborhood. This study uses readily available satellite data to measure the recent rate of settlement across the neighborhood. This work was undertaken in accordance with our Agreement dated 21 August 2024.

STUDY METHOD

Historical satellite-based radar measurements of the Earth's surface were analyzed to determine the rate of subsidence (settlement) in the neighborhood. This method is known as InSAR (Interferometric Synthetic Aperture Radar) and uses radar images taken by orbiting satellites since 2016. InSAR produces a map of ground deformation rates that covers a very large area with high precision and spatial resolution. The measured points on the ground are objects that are near stable throughout the period of analysis and include paved and unpaved ground surfaces, buildings, and other fixed features. The points cannot be attributed to specific locations without additional ground-based survey work. Rather, the intent of the method is to measure slight trends of movement across large areas over months and years.

Many InSAR studies measuring ground subsidence and stability of buildings and infrastructure have been completed. As one example, in the New York City area between 2016 and 2023, median subsidence (settlement) rates in areas of thick, historical filling range from 2.7 to 4.6 millimeters/year (mm/yr).¹

¹ Brett Buzzanga et al., Localized uplift, widespread subsidence, and implications for sea level rise in the New York City metropolitan area. Sci. Adv.9, eadi8259(2023). DOI: 10.1126/sciadv.adi8259

ANALYSIS AND RESULTS

The Newhall Foundation Evaluation Project is located in southern Hamden as shown on Figure 1. Radar images covering the entire neighborhood were obtained from the Sentinel-1A satellite. Images from May 17, 2016 through December 13, 2024, a total of 235 images, were analyzed using two different techniques, Small Baseline Subset (SBAS) and Persistent Scatter (PS).

Figure 2 shows the results from each technique as deformation² rates in mm/yr³. In the project area shown in red outlines, deformation rates generally range from about +1.0 to -1.4 mm/yr⁴ using the PS technique and -0.1 to -1.7 mm/yr using the SBAS technique.

The most significant settlement within the study area during the period from 2016 through 2024 is measured in public property areas with known thicker historical filling and recent remedial activity. For example, certain areas of the Old Middle School athletic fields and Rochford Field properties exhibit minor to moderate settlement rates as shown by red-shaded data points. However, non-public properties within the study area exhibit slight settlement to slight heave rates during this time period.

CONCLUSION

The Newhall Foundation Evaluation Project area is relatively stable during the eight-year study period from May 2016 through December 2024. Given the low to no settlement rates measured in non-public property areas and the timeframe of the current project schedule, we recommend:

- No further analyses or monitoring of settlement using the InSAR technique or ground-based survey work.
- Considering the slow rates of settlement, use of manual crack gauges would generally not provide useful data within the project timeframe. In a few cases, manual monitoring using crack gauges across existing foundation cracks could be used when recommended foundations repairs are not performed (e.g., property owner declines repair work and wishes to monitor foundation performance over many years).

Although no similar study of the Newhall Neighborhood was performed in the past, historical anecdotal information and condition assessments suggest that historical settlement rates were higher than those measured in this study. Therefore, we conclude future settlements caused by the presence of the historical fill are likely to be similar or less than the rates in this study provided no significant land filling or groundwater level changes occur.

² Deformation rate data reported herein is movement away from/towards the satellite which images the ground from an angle. As such settlement or uplift (vertical) movement of the ground is somewhat less than the deformation rate. For the results of this study, the difference is not significant and deformation and settlement are used interchangeably herein.

³ 1 millimeter equals 0.039 inches.

⁴ Positive is heave. Negative is settlement/subsidence.

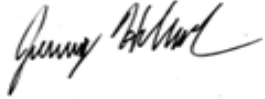
Town of Hamden

10 July 2025

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Sincerely yours,

HALEY & ALDRICH, INC.



Jeremy A. Haugh, P.E.

Senior Associate | Senior Project Manager

Attachments:

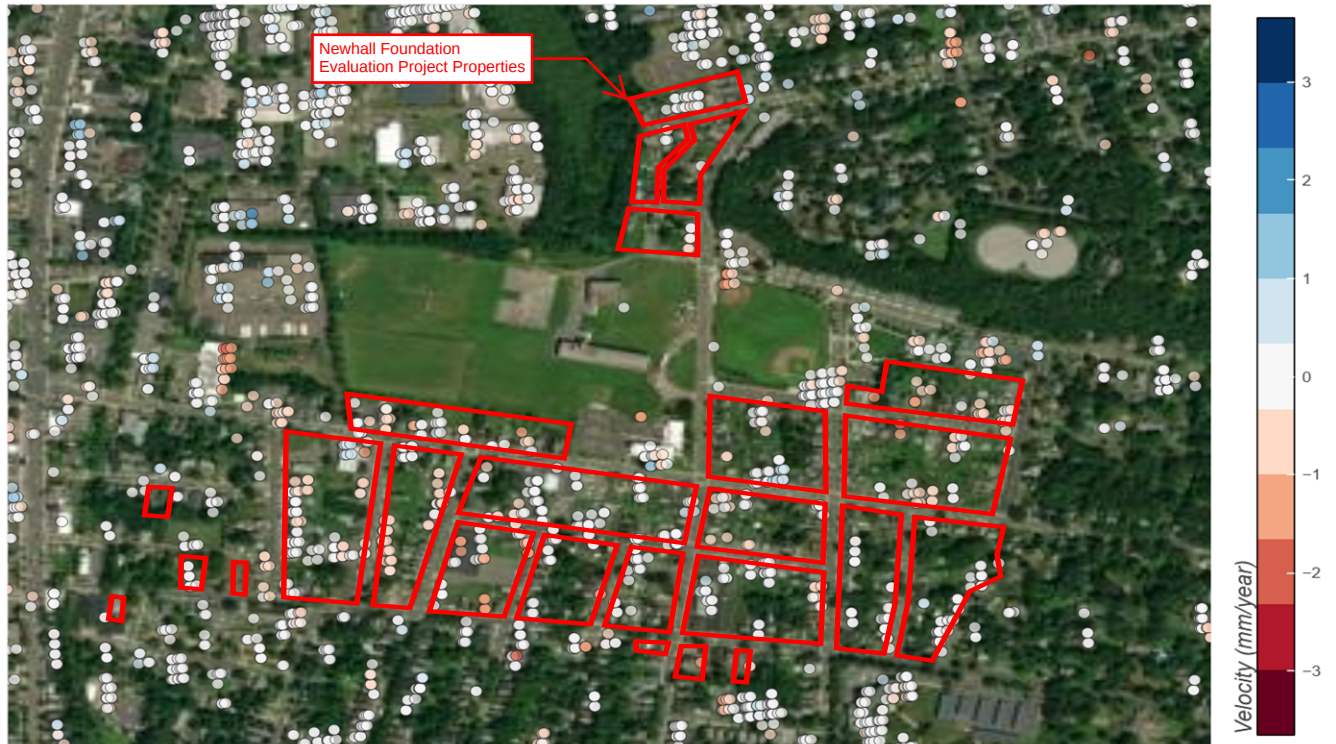
Figure 1 – Project Area

Figure 2 – Deformation Rates InSAR Study

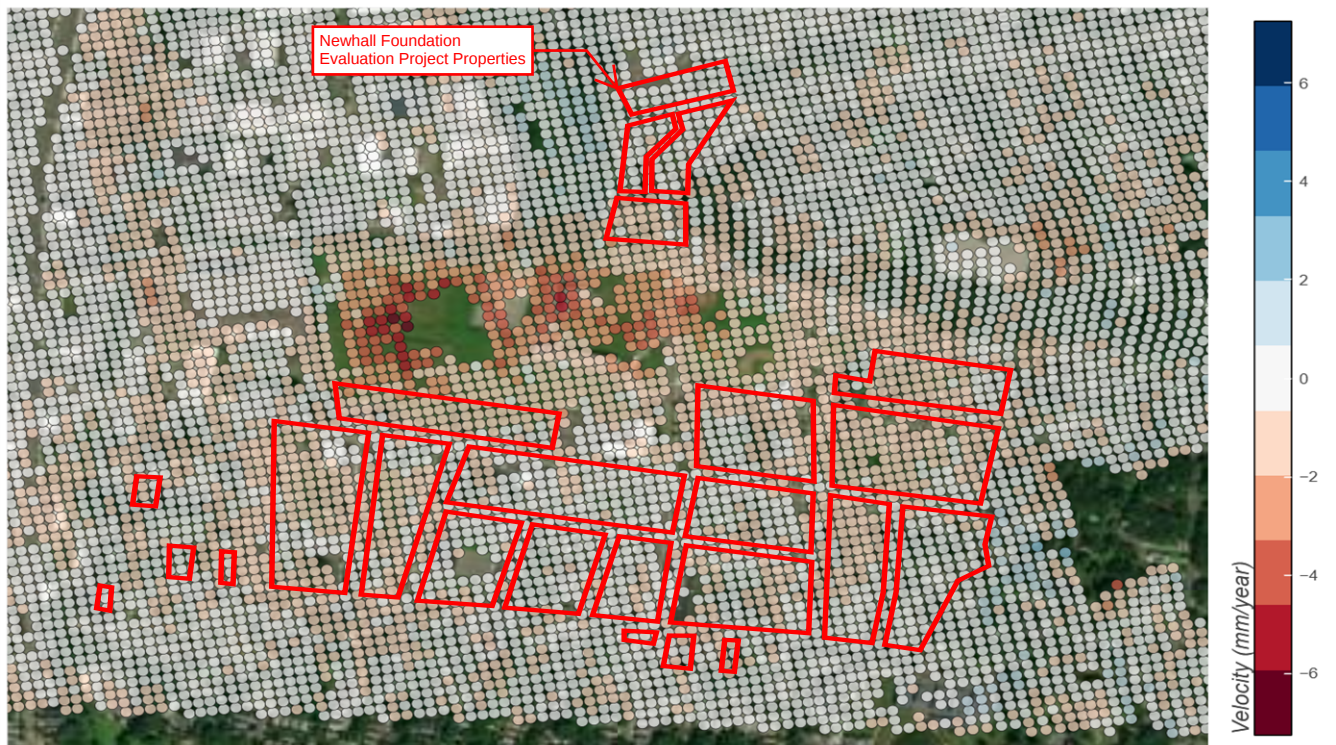
c: Town of Hamden; Attn: Lauren Garrett, Carol Hazen

https://haleyaldrich.sharepoint.com/sites/TownofHamden/Shared Documents/0211533.Newhall Foundation Evaluation/Deliverables/InSAR/2025-0707-HAL-L_Newhall_INSAR-F.docx

Newhall Foundation Evaluation Project (Persistent Scatter (PS), Descending)



Newhall Foundation Evaluation Project (Small Baseline Subset (SBAS), Descending)



Notes:

1. Study period is May 17, 2016 through December 13, 2024.
2. Rates are in millimeters per year (mm/yr).
One mm equals 0.039 inches.
3. Negative rates (red shades) are subsidence (settlement).
Positive rates (blue shades) are uplift (heave).
4. The source data for both plots above is the same; the InSAR analysis method results vary by method used (PS or SBAS).

**HALEY
ALDRICH**

NEWHALL FOUNDATION EVALUATION PROJECT
HAMDEN, CONNECTICUT

DEFORMATION RATES
INSAR STUDY

MAY 2025

FIGURE 2