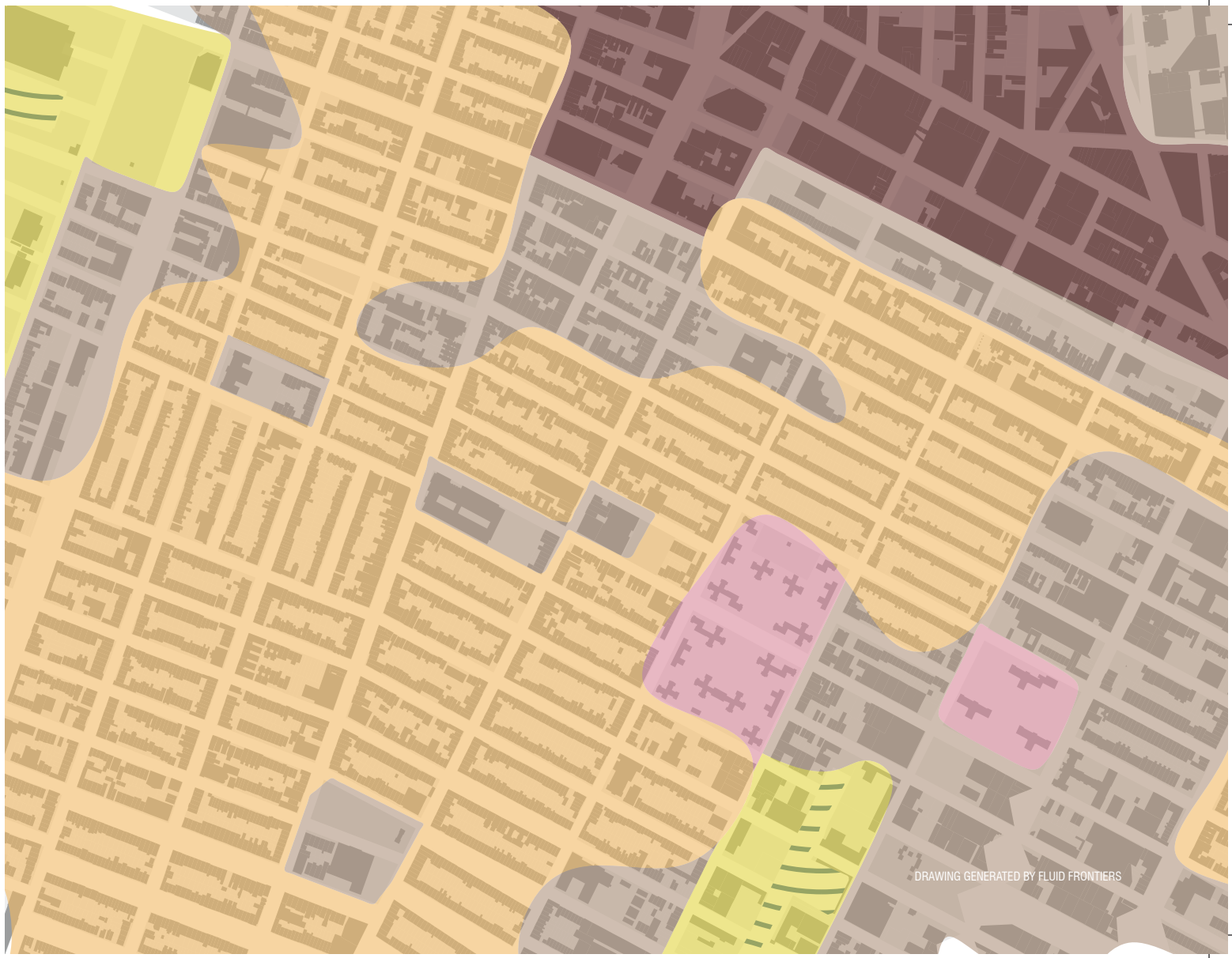
ANALYSIS

The FF team carefully collected and studied GIS data made available by Pratt Institute's Spatial Analysis and Visualization Initiative (SAVI). The land-use, building typologies, and topographic data of the Red Hook Sewershed were later examined. These data, along with other open source information became the foundation of FF operations.

The generated maps were analyzed to reveal the important contributing aspects to stormwater management within the sewershed. For example, the topographic map was color-coded to show the direction of the slope or the flow of water on the surface at a glance. The information the team was able to read/retrieve from the land-use and the building typologies contributed to the research directly. While land use disclosed activities people undertake in a certain land cover, the maps on building typologies informed the team of the physical properties of each building category.



GEOGRAPHIC INFORMATION SYSTEM (GIS)

GIS by SAVI (Spatial Analysis and Visualization Initiative)

Pratt Institute has an on-campus GIS and data analysis lab, SAVI, that provides technical assistance to students, faculty and community based organizations in NYC. The FF team turned to SAVI for guidance on acquiring and analyzing the best available GIS data. SAVI also provided consultation on the development of the GIS analysis methodology.

In addition to understanding the locations of the various political boundaries in relation to the Red Hook Sewershed as noted previously, it was necessary to study the spatial structure of the built and natural environments. The FF team was eager to understand the Red Hook Sewershed through land-use, building typologies and other physical properties that contribute to the prevailing conditions on the ground. Since the underground data regarding the sewer system was/is not available, the FF team focused on above ground conditions and surface properties including those of the buildings. Although quantifying the ground or building surface areas were beyond the scope of the research project, the team felt that this data would inform us about the potential of currently unincorporated areas into the City's stormwater management strategies. The maps in the following sections display the results of land cover, built environment and demographic analyses as well as other explorations of the Red Hook Sewershed.

3D Modeling + SAVI_GIS

Surface formation: Based on GIS maps, including topography and buildings, the team worked on completing a rough 3D model of the entire RH sewershed. In order to visualize the flow of water over the terrain some adjustments were made. For example, the height between the contours was enhanced by 50%: this way the sections cut across selected areas were exaggerated.

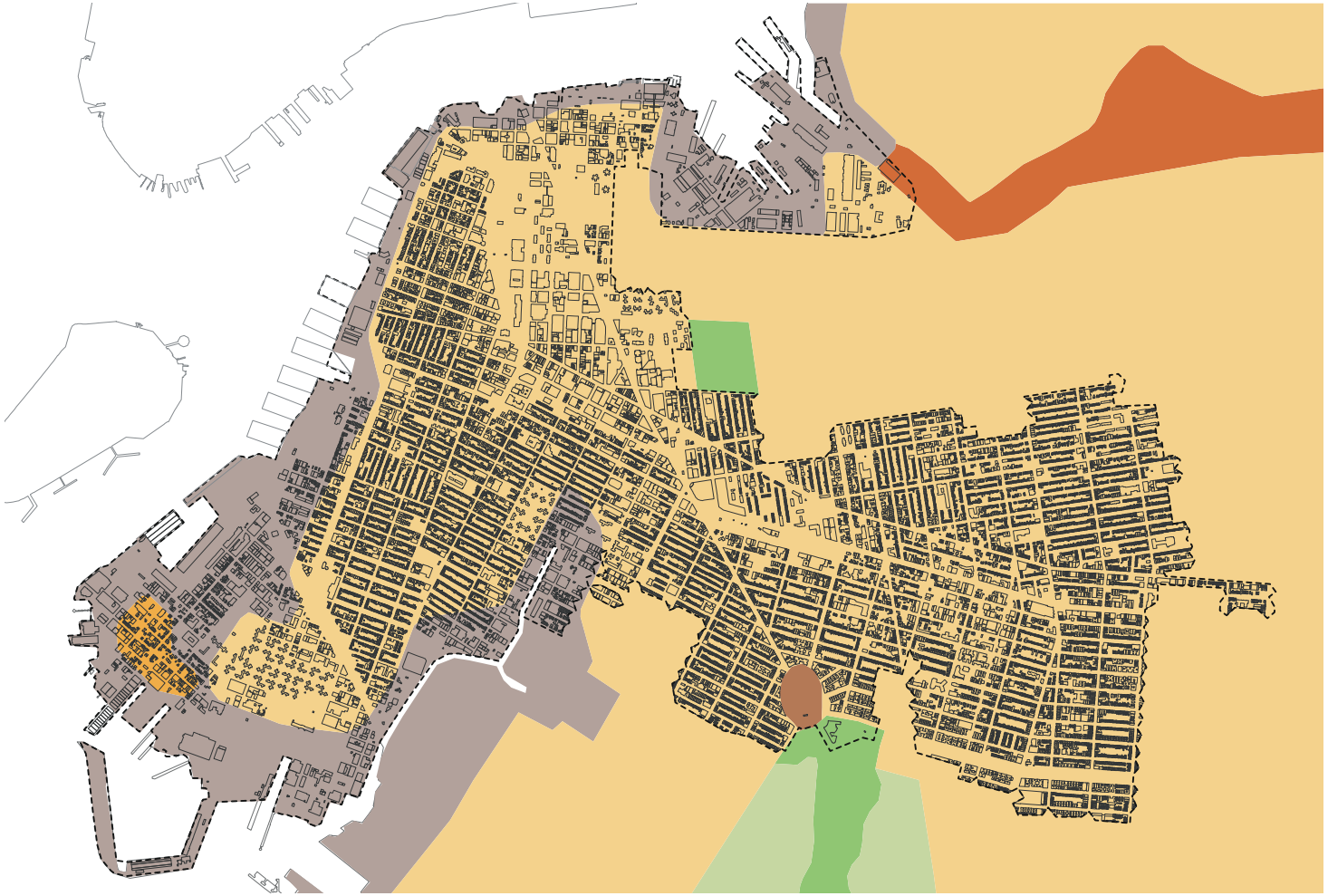
S.W.I.M* Coalition and Open Sewer Atlas NYC

** Stormwater Infrastructure Matters*

Members of the team had been the recipients of a Taconic Fellowship, a fellowship program offered by Pratt Center to support student and community partner research. The research, Open Sewer Atlas, worked with the S.W.I.M. Coalition to reveal and depict the New York City sewer system in an open and engaging way for the City's many diverse water users and stakeholders.

SURFACE ANALYSIS

In the process of reviewing the feasibility of where the implementation of Green Infrastructure would be effective, the team looked into geological formations within the Red Hook Sewershed. Geological maps viewed together with historical maps, reveal the ability of the ground to convey deep infiltration. The team felt these aspects deserve a thorough investigation and assume that new construction projects will provide the opportunity (and the reason) to further explore the correlation between soil and absorption capacities.



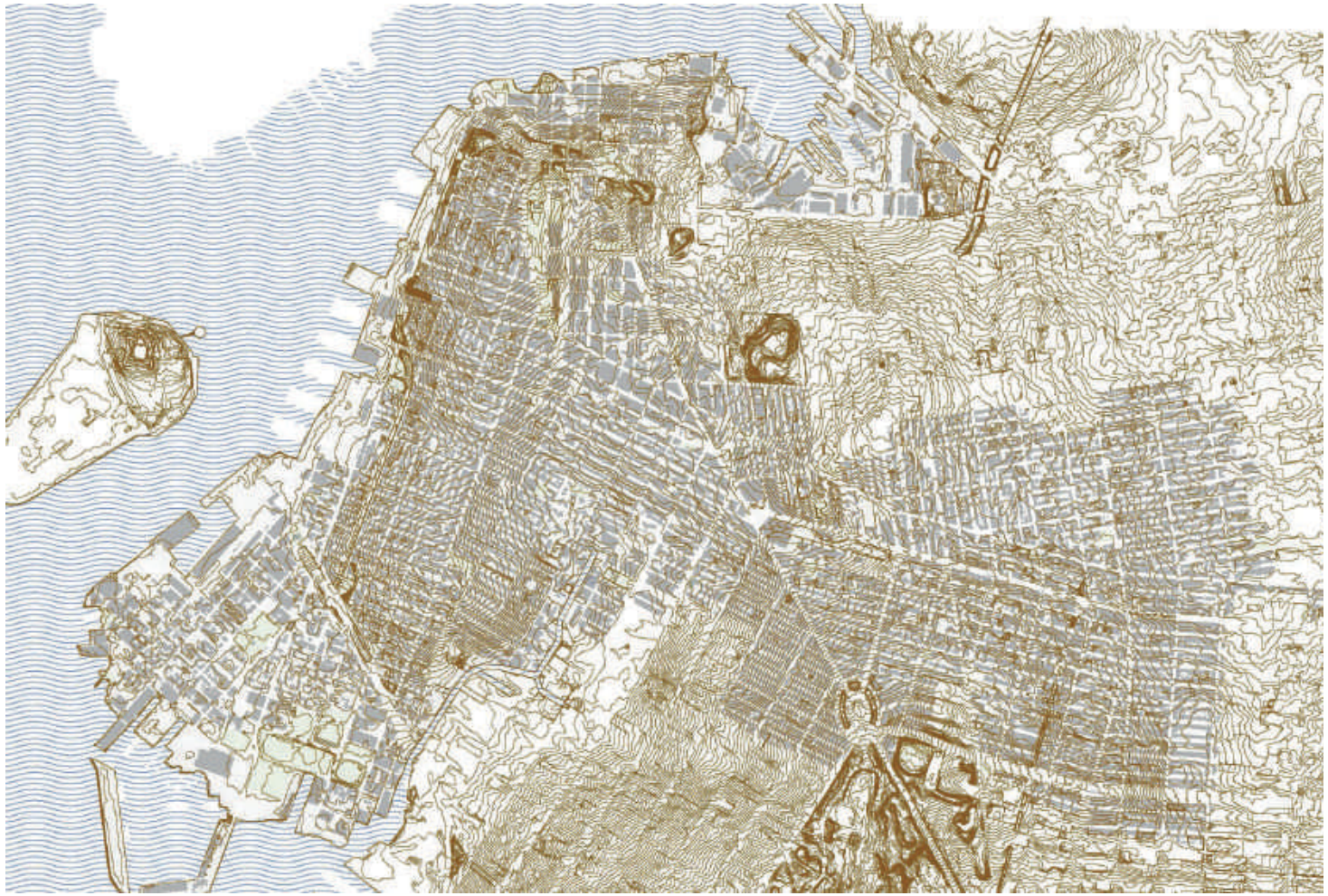
SOIL IN RED HOOK SEWERSHED

- Pavement & Buildings, outwash substratum, 0 to 5 % slope
- Pavement & Buildings, outwash substratum, 0 to 5 % slope
- Pavement & Buildings, wet substratum - Laguardia - Ebbets complex, 0 to 8 %
- Pavement & Buildings - Flatbush-Riverhead complex, 0 to 8 % slope
- Montauk - Foresthills complex, 0 to 8 % slope
- Montauk - Foresthills complex, 0 to 8 % slope
- Montauk - Foresthills - Pavement & buildings complex, 0 to 8 % slope

DRAWING GENERATED BY FLUID FRONTIERS

The topographic map of Red Hook Sewershed describes how the land is sculpted, where the ridges and valleys are and how steep the slopes. Viewed alone, topography is indicative of how stormwater flows within the sewershed; however, the grain of the urban fabric and the extent of the impervious surface cover greatly alters its flow.

In the adjacent map, streets and buildings were superimposed over the topography in order to further expose the relationship between the urban fabric and the natural terrain.

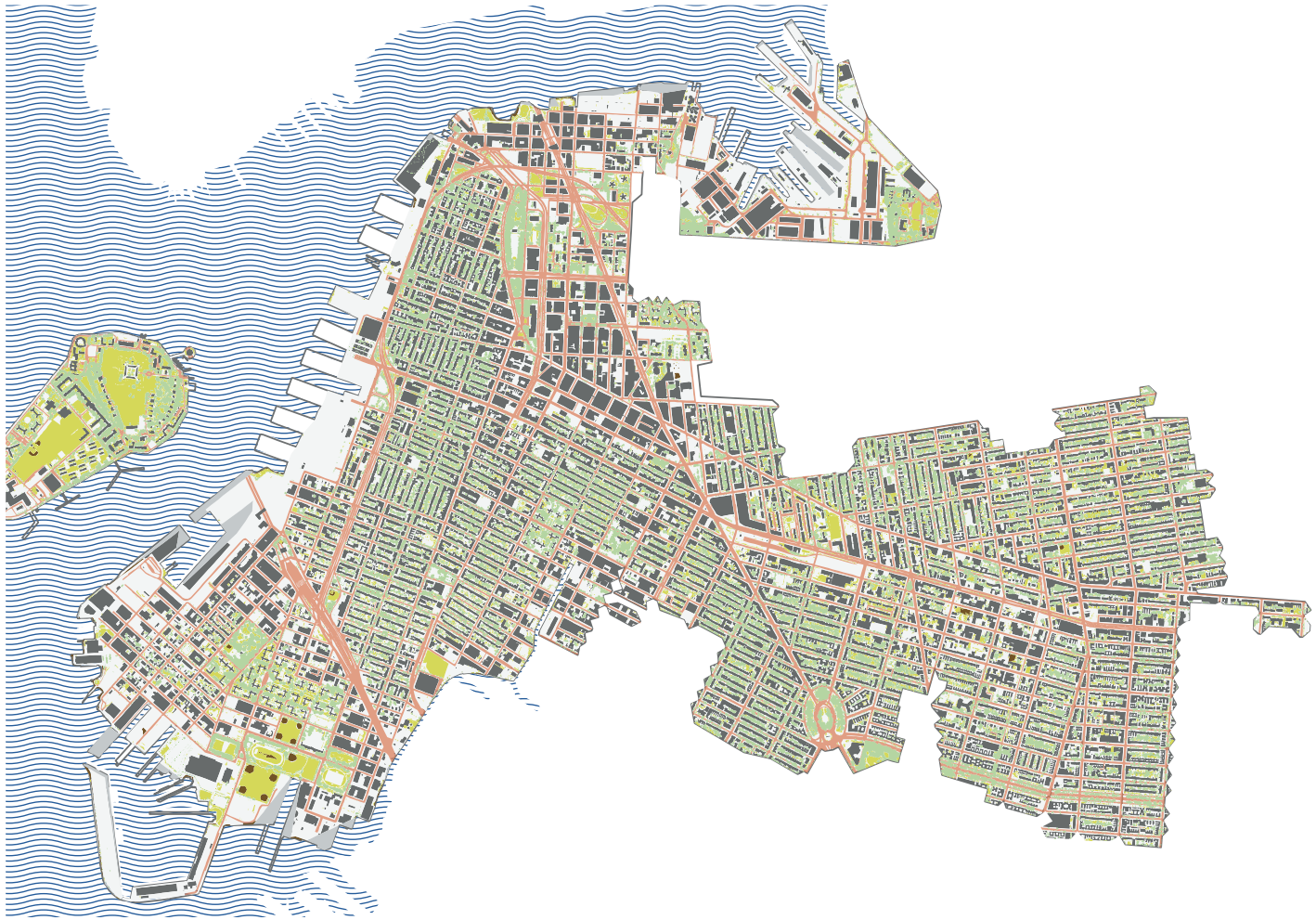


TOPOGRAPHY IN RED HOOK SEWERSHED

- Elevation (1' increment)
- Building Footprints
- Parks and Open Space
- Parcels

DRAWING GENERATED BY FLUID FRONTIERS

Digging a bit deeper. To further elucidate the flow of stormwater overland, the team analyzed the types of surface within the sewershed. This land cover map further details surfaces into their actual land cover types.



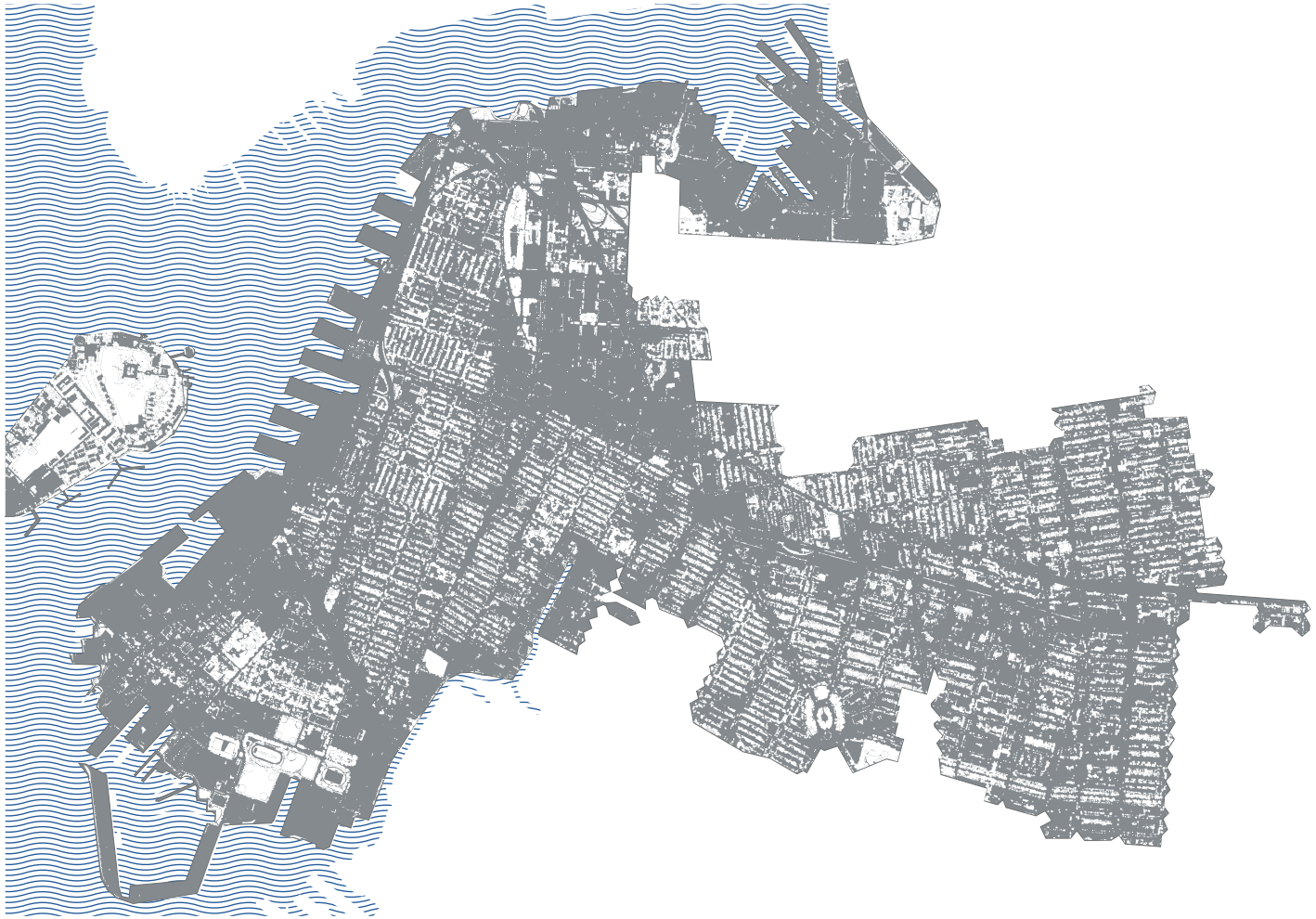
RED HOOK SEWERSHED
TYPES OF SURFACE

- Not Classified
- Tree Canopy
- Grass / Shrub
- Bare Soil
- Water
- Roads / Railroads
- Buildings
- Other Paved Surface

DRAWING GENERATED BY FLUID FRONTIERS

The FF team looked at both pervious and impervious surface analysis maps. The adjacent map renders the impervious and pervious surfaces displaying the ratio in black and white.

Furthermore, like much of New York City, the sewershed shows a high percentage of impervious cover; approximately 79% impervious and 21% pervious surface areas. What is interesting is that in the lower lying areas identified as direct drainage, are the highest concentrations of impervious cover.



IMPERVIOUS COVERAGE IN RED HOOK SEWERSHED

Impervious *(79%)*

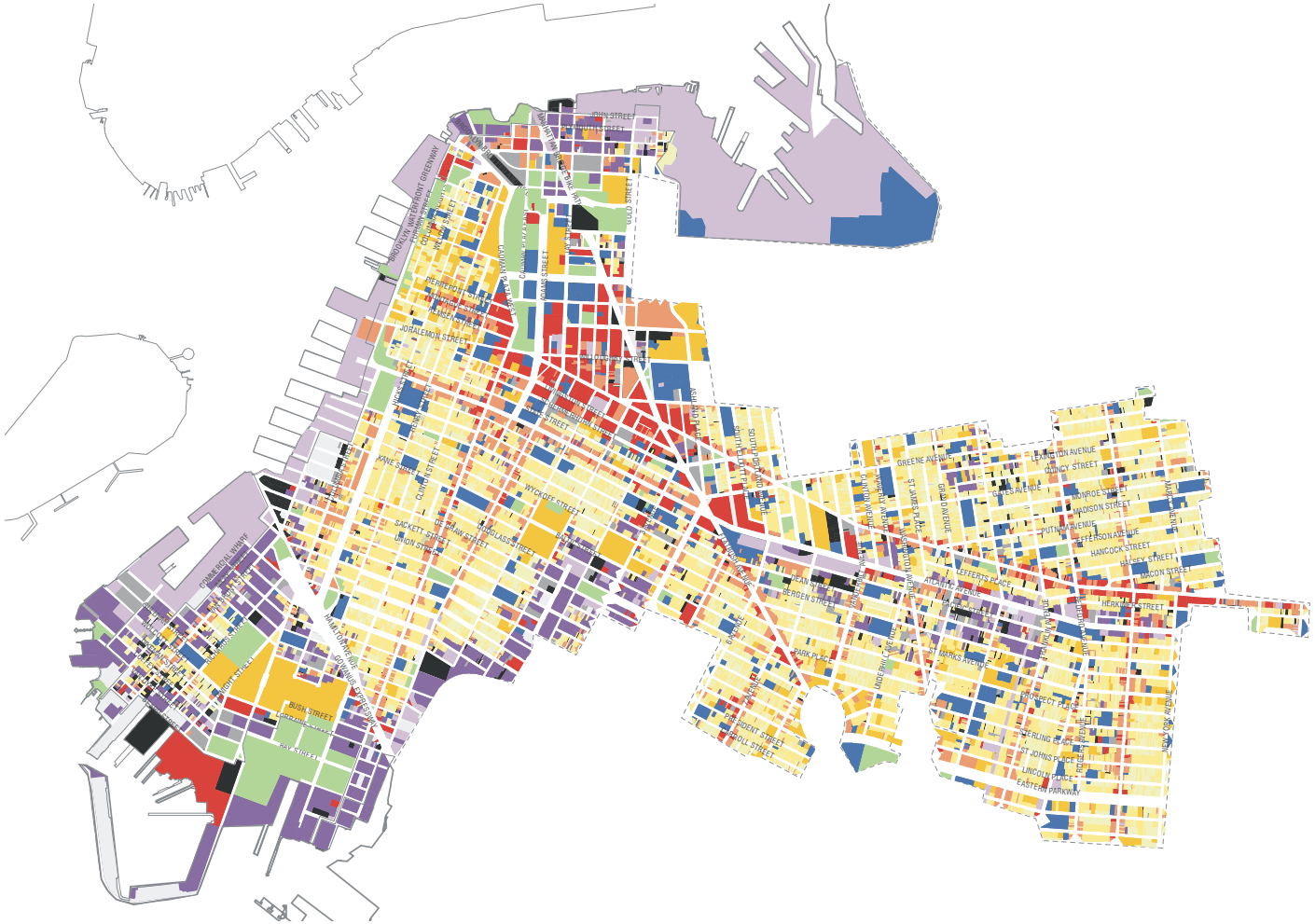
Pervious *(21%)*

DRAWING GENERATED BY FLUID FRONTIERS

LAND USE ANALYSIS

Land use maps distinguish areas for residential use or commercial, industrial, etcetera at the parcel, or tax lot level. The different land uses have very specific ways of utilizing/ engaging with natural resources including power, water and other burdens on the environment. Each land use type presents a different set of opportunities and challenges. FF manipulated the GIS layers to selectively isolate and analyze each land use type. This way all publicly owned land and buildings are viewed separately from commercial development and residential zones to mixed-used areas or industrial zones.

It is important to note that the land use data comes from NYC DCP's MapPLUTO, an incredibly rich GIS layer. Although, the land use data field in particular is known to have many errors, its accuracy is assumed and was instrumental to the team's work.



LAND USE IN RED HOOK SEWERSHED

- One & Two Family Buildings
- Multi-Family Walkup Buildings
- Multi-Family Elevator Buildings
- Mixed Commercial / Residential
- Commercial / Office
- Industrial / Manufacturing
- Transportation / Utility
- Public Facilities & Institutions
- Open Space
- Parking Facilities
- Vacant Land
- Other / No Data

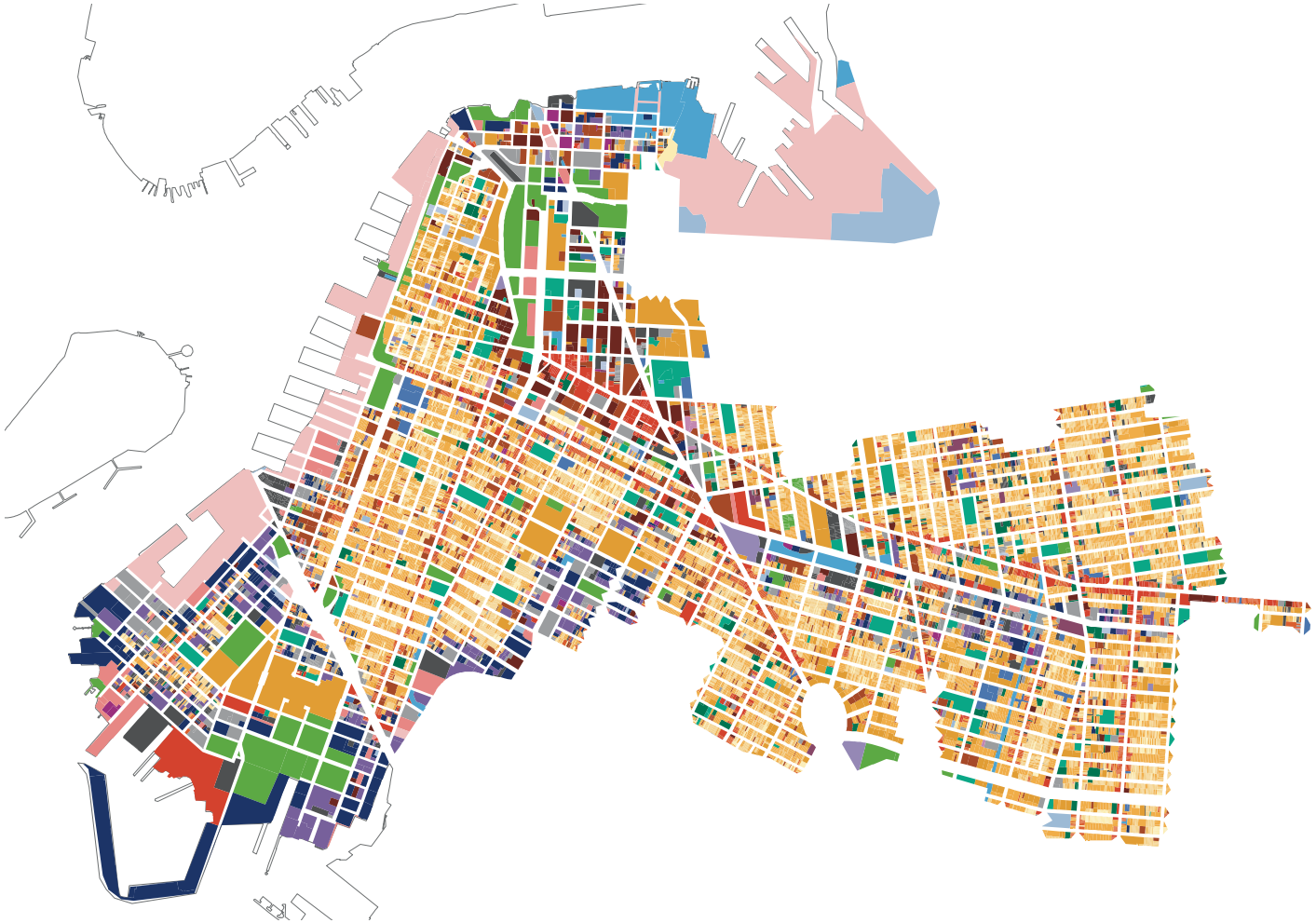
DRAWING GENERATED BY FLUID FRONTIERS

BUILDING TYPE ANALYSIS

This series of building typology maps displays information of buildings in much greater detail. These maps reveal the extent of diverse building types that exist within the Red Hook Sewershed.

Building class, another data field from MapPLUTO, was used to selectively isolate each building type for further review. The FF team intended for typical physical properties or other related aspects that are inherent to each building group to guide the research in identifying stormwater management opportunities and challenges specific to each type.

The team began by developing a hierarchy in relevance to the investigation among the groups. The team eliminated or merged some of the types with wide ranging properties and focused on building properties relating to their physiognomy rather than their program. For example, the high-rise buildings, whether for residential or for office-use, became one of the types.



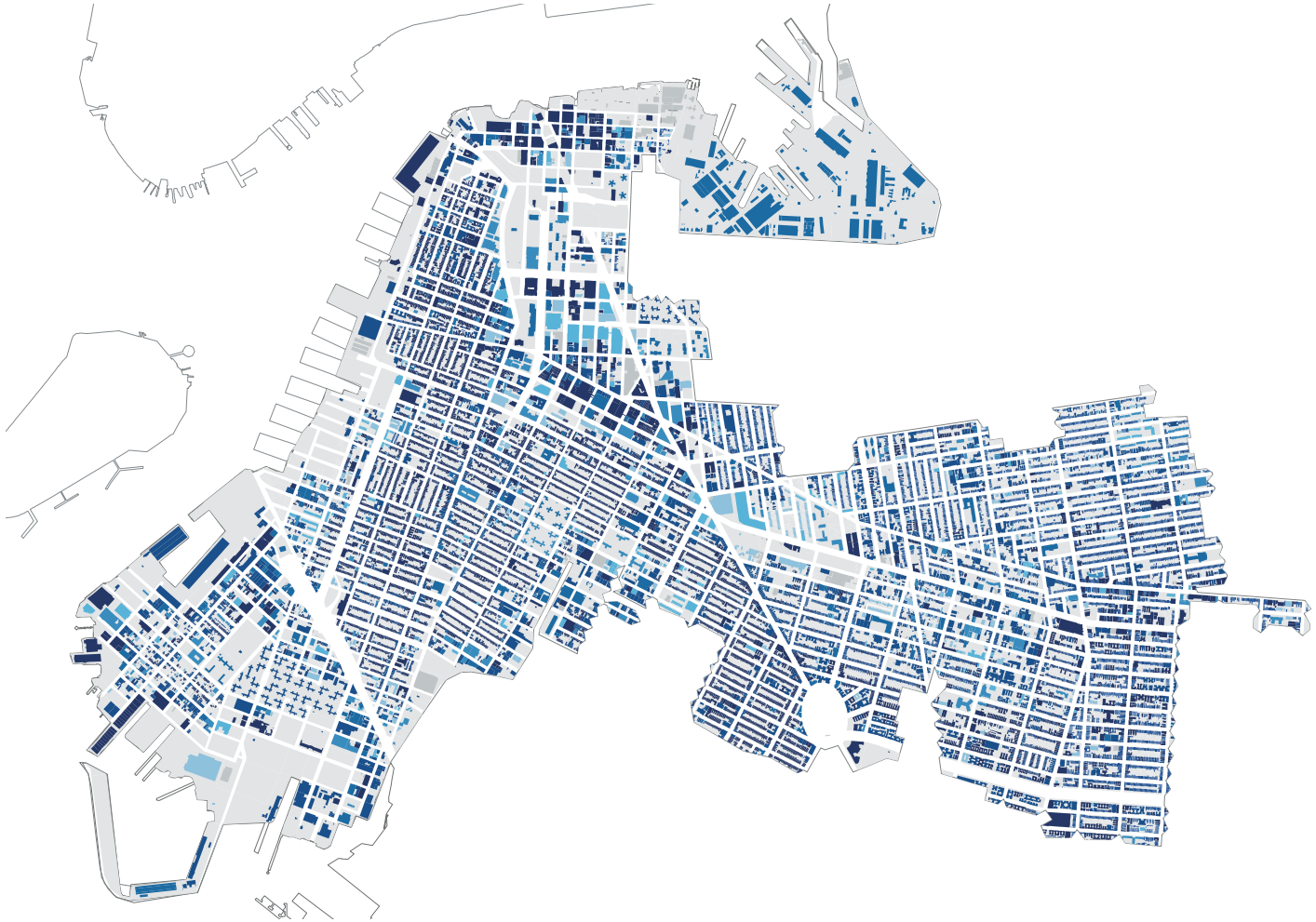
BUILDING TYPOLOGY IN RED HOOK SEWERSHED

- Not Classified
- A - One Family Dwellings
- B - Two Family Dwellings
- C - Walk Up Apartments
- D - Elevator Apartments
- E - Warehouses
- F - Factory and Industrial Buildings
- G - Garages and Gasoline Stations
- H - Hotels
- I - Hospitals and Health
- J - Theatres
- K - Store Buildings
- L - Loft Buildings
- M - Churches, Synagogues, Etc
- N - Asylums and Homes
- O - Office Buildings
- P -Places of Public Assembly and Cultural
- Q - Outdoor Recreation Facilities
- R - Condominiums
- S - Residence - Multiple Use
- T - Transportation Facility
- U - Utility Bureau Properties
- V - Vacant Land
- W - Educational Structures
- Y - Selected Government Installations
- Z - Miscellaneous

DRAWING GENERATED BY FLUID FRONTIERS

How and why would the building age be relevant to this investigation? The adjacent map is a reminder that most of the Red Hook Sewershed was already built / developed during the 1920s and expanding. Most of the sewershed is covered with the impervious surfaces of streets and buildings with very little concern for open, green space. In other words, it is an 'existing to remain' built-environment. This is true for many existing and expanding cities with aging infrastructure. Prevailing urban conditions are challenging all necessary disciplines to design/find innovative solutions that are formally, structurally and otherwise appropriate for the existing context.

The age, size, type of ownership and other properties of existing structures are all factors in determining the scope of stormwater management. Integrating blue/green infrastructure into the planning, design and execution of new construction is perhaps easier and more economical than surgically implementing similar infrastructure into the existing context and historic buildings.



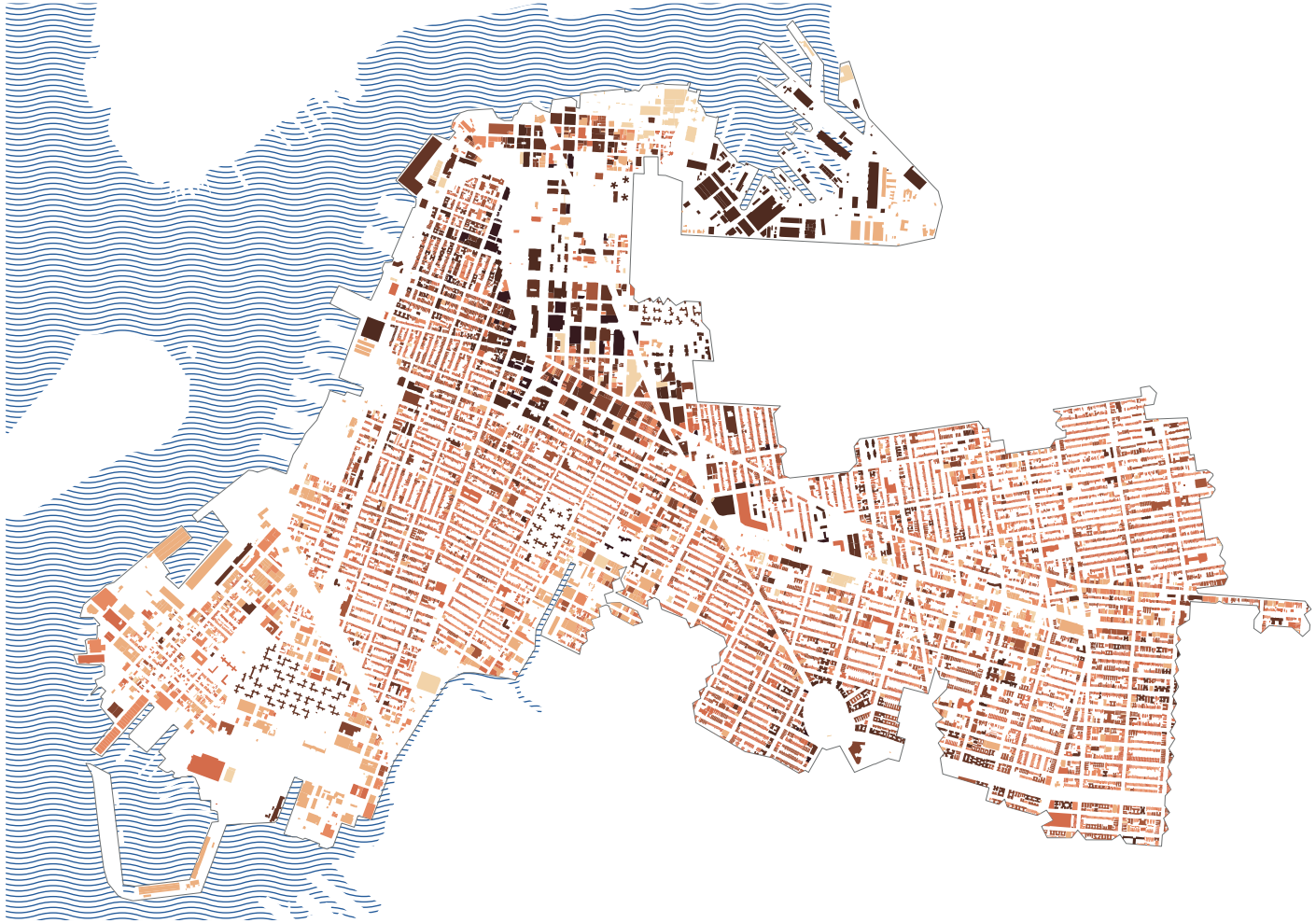
YEAR OF BUILDINGS BUILT IN RED HOOK SEWERSHED

- No Data
- 1920 and before
- 1921 - 1940
- 1941 - 1960
- 1961 - 1980
- 1981 - 2000
- 2001 - 2012

DRAWING GENERATED BY FLUID FRONTIERS

Digging a little deeper into building typologies and properties, the FF team analyzed building heights within the Red Hook Sewershed.

Similar to age and ownership the height of buildings conveys another physical property to factor into stormwater management opportunities and challenges.



HEIGHT OF BUILDINGS IN RED HOOK SEWERSHED

- 0, New Development
- 1 - 10 feet
- 11 - 20 feet
- 21 - 30 feet
- 31 - 40 feet
- 41 - 50 feet
- 51 - 100 feet
- 101 - 150 feet
- 150+ feet

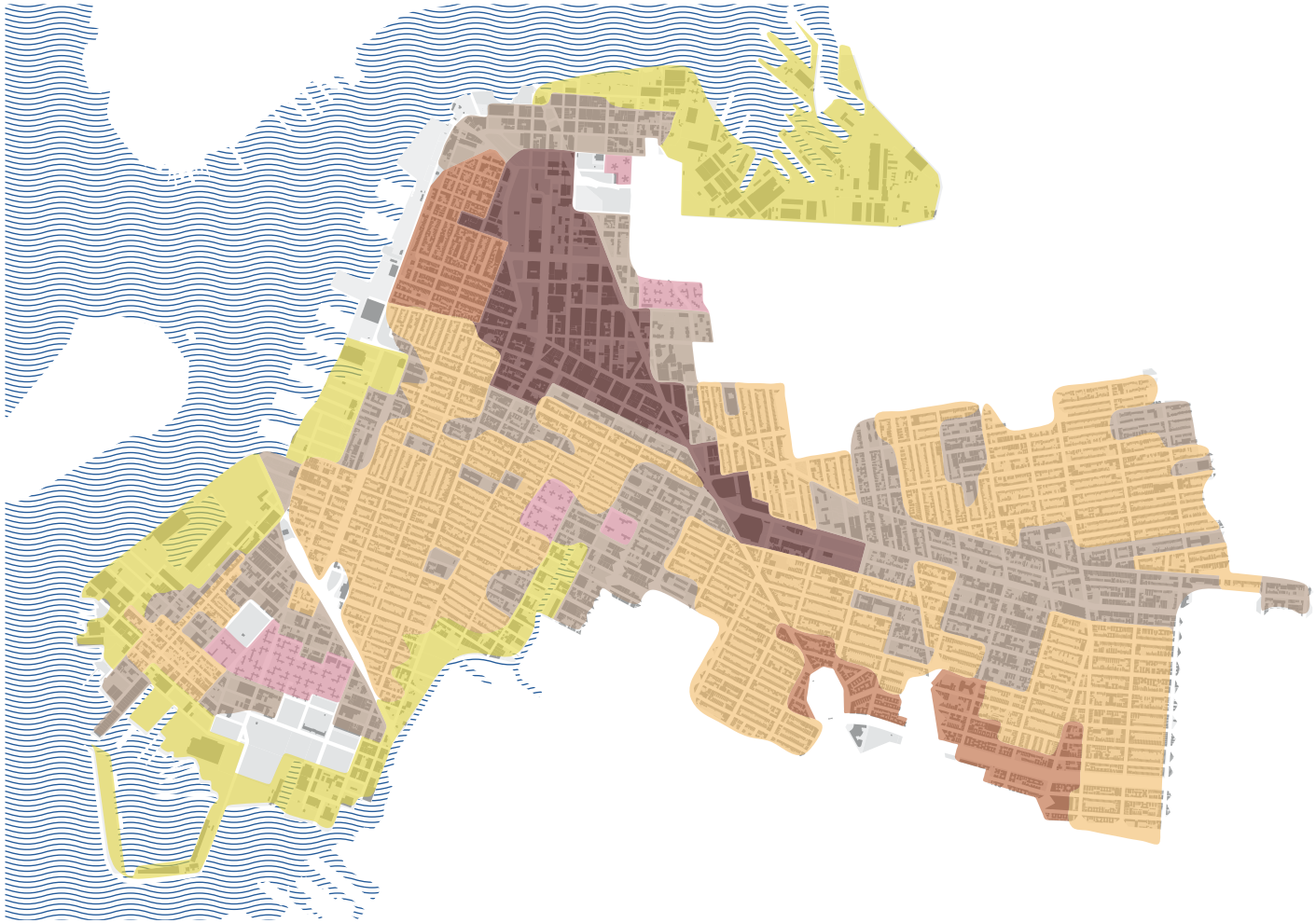
DRAWING GENERATED BY FLUID FRONTIERS

In this series of maps, the team analyzed the potential (capacity) of different building types and how each might contribute to stormwater management differently.

Because there are so many building classes in NYC, it can be confusing to discern the patterns. Therefore, the team aggregated the myriad of building classes into general groups. Engaging in several interpretive steps based on the research objectives, the team superimposed the layer for buiding classes with the layer for building heights. The team felt that the physical properties of the buildings (size and shape) would be more relevant than the 'program' for this study.

Partly due to the governing zoning, the resulting shapes, cloud-like, describe the share of each building type within the Red Hook Sewershed: Industrial buildings; High Rise; Mid Rise; Mixed Height; NYCHA Housing; and Townhouses.

Townhouse typology formed the largest grouping within the Red Hook Sewershed, covering the largest territory (40%). The seminal aspects of townhouse typology are investigated in greater detail in the following pages.

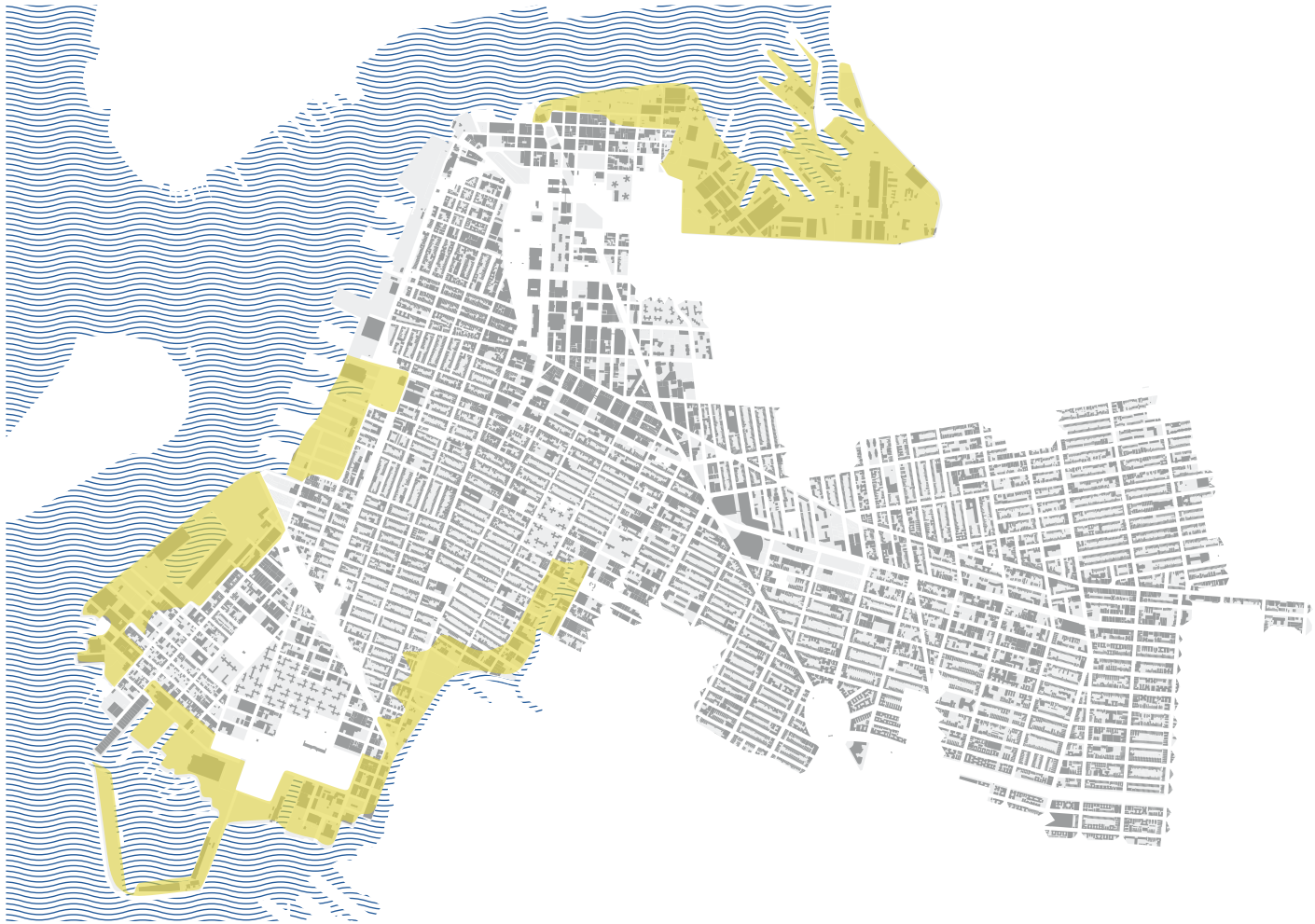


BUILDING GROUPING IN RED HOOK SEWERSHED

- Not Classified
- A - Factory and Industrial Buildings
- B - High-Rise Buildings
- C - Mid-Rise Buildings
- D - Mixed-height
- E - Townhouses
- F - NYCHA Housings

DRAWING GENERATED BY FLUID FRONTIERS

Red Hook Sewershed has a rather high concentration of 'industrial use' buildings due to its historic development as a working harbor in New York City. The industrial zone is on the waterfront and is identified as a direct drainage area. Here, the stormwater is not captured, but instead flows directly to the coastal waters. For now, one can say that these areas are not impacting on the WPCP's capacity and CSO's. However, stormwater flow over extensive industrial parking lots and areas of direct drainage represent challenges to the surrounding water quality. Additionally, extensive flat surfaces, be it the ground or the roof tops, are certainly an invitation to stormwater detention systems.



BUILDING GROUPING IN RED HOOK SEWERSHED

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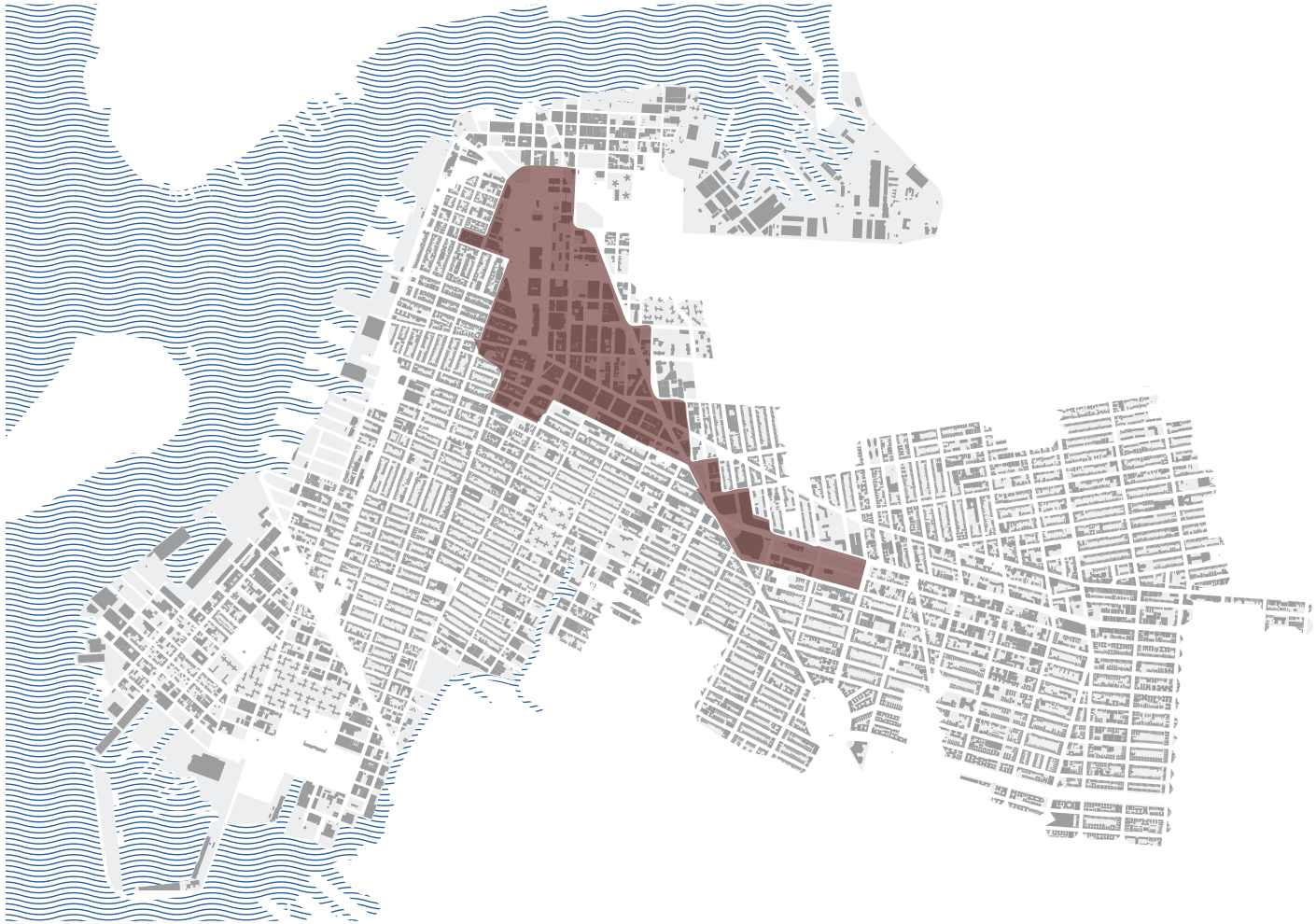
DRAWING GENERATED BY FLUID FRONTIERS

One of the significant characteristic of high-rise buildings, besides the population density that they represent, is the extensive surface area they have and how their materials contribute toward stormwater runoff and urban heat island effect. Also, most high-rise buildings within the urban context are developed over the entire lot leaving hardly any room for GI on the ground.

High-rise is a building type where both positive and negative aspects are nested in the same building surface area. The repetitive formation of the mid-section and the extensive building surface has the potential to host innovative façade systems that can lessen stormwater impact as well as the urban heat island effect.



BUILDING GROUPING IN RED HOOK SEWERSHED

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- B - High-Rise Buildings
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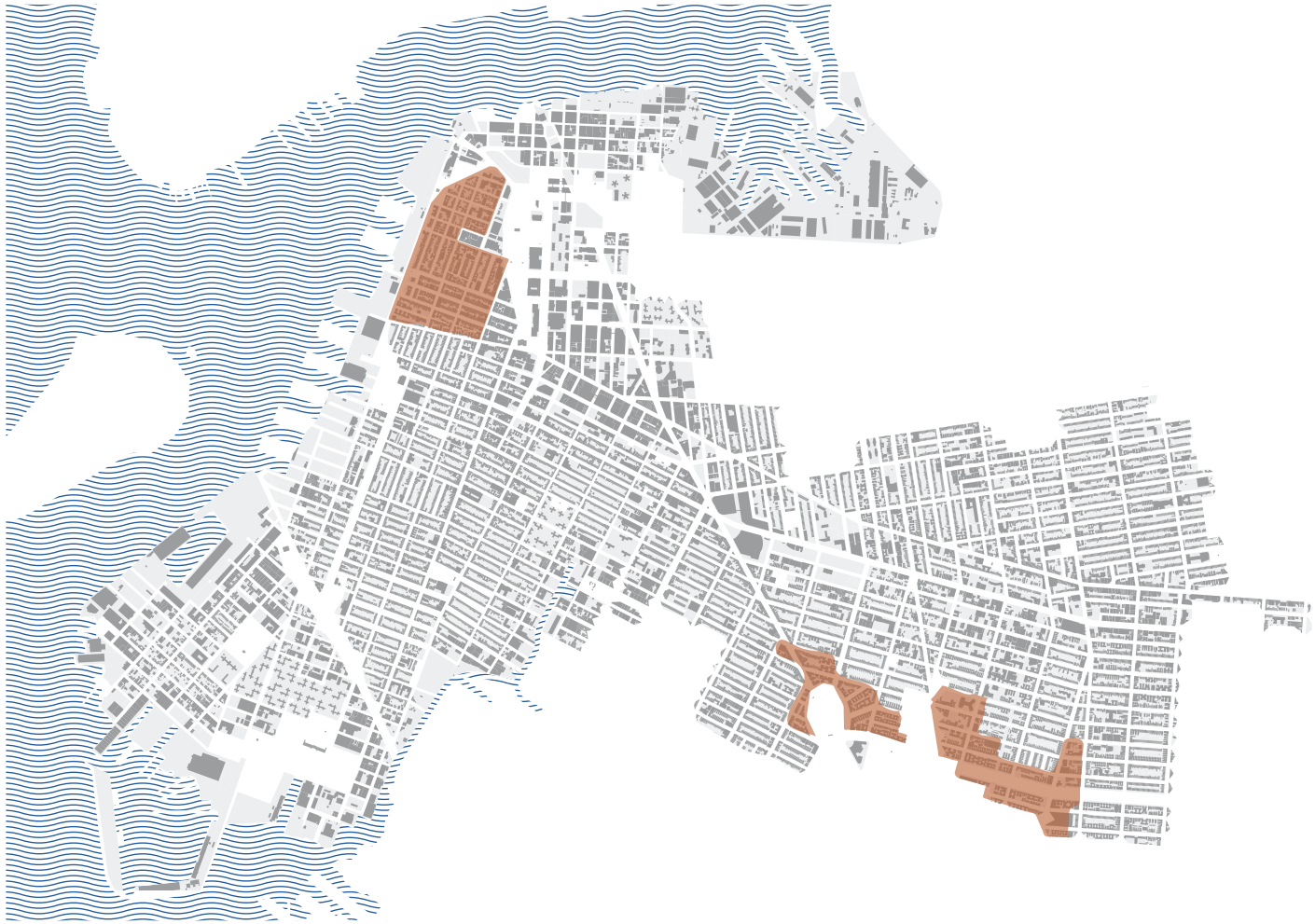
- D - Mixed-height
- E - Townhouses
- F - NYCHA Housings

DRAWING GENERATED BY FLUID FRONTIERS

As with high-rise structures, mid-rise buildings have unique characteristics which represent both opportunities and challenges for stormwater management. By isolating this building type, the team was making its share within the Red Hook sewershed visible.



BUILDING GROUPING IN RED HOOK SEWERSHED

- Not Classified
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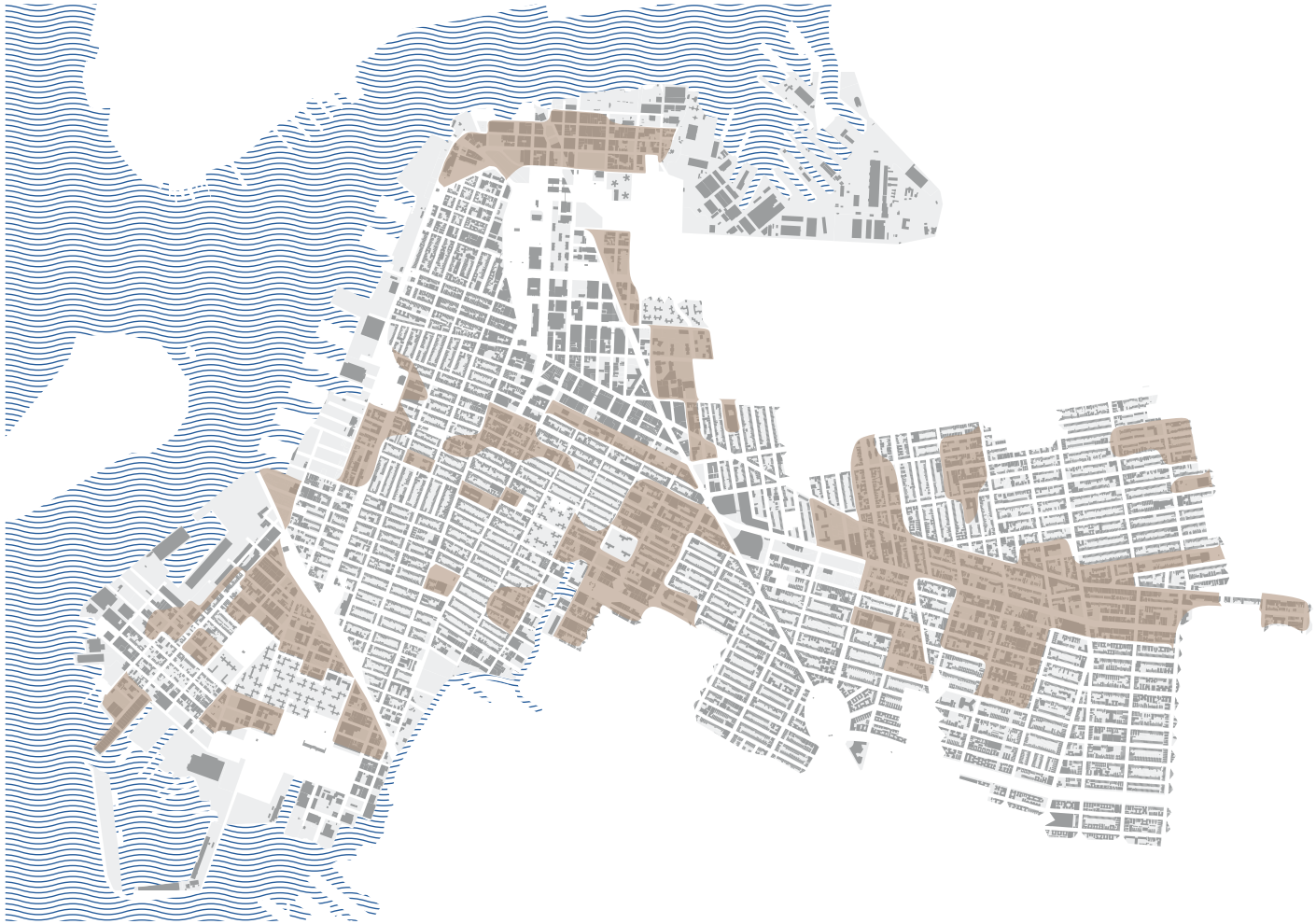
- C - Mid-Rise Buildings
- D - Mixed-height
- E - Townhouses
- F - NYCHA Housings

DRAWING GENERATED BY FLUID FRONTIERS

Areas of mixed-height buildings are perhaps an indication that a re-zoning is in process and the fabric of the neighborhood has begun transformation. In these scenarios , perhaps ‘preservation’ of the existing structures is no longer a viable option. As such, areas of mixed-height may represent an area of opportunity for the integration of extensive blue and green infrastructure in new construction.



BUILDING GROUPING IN RED HOOK SEWERSHED

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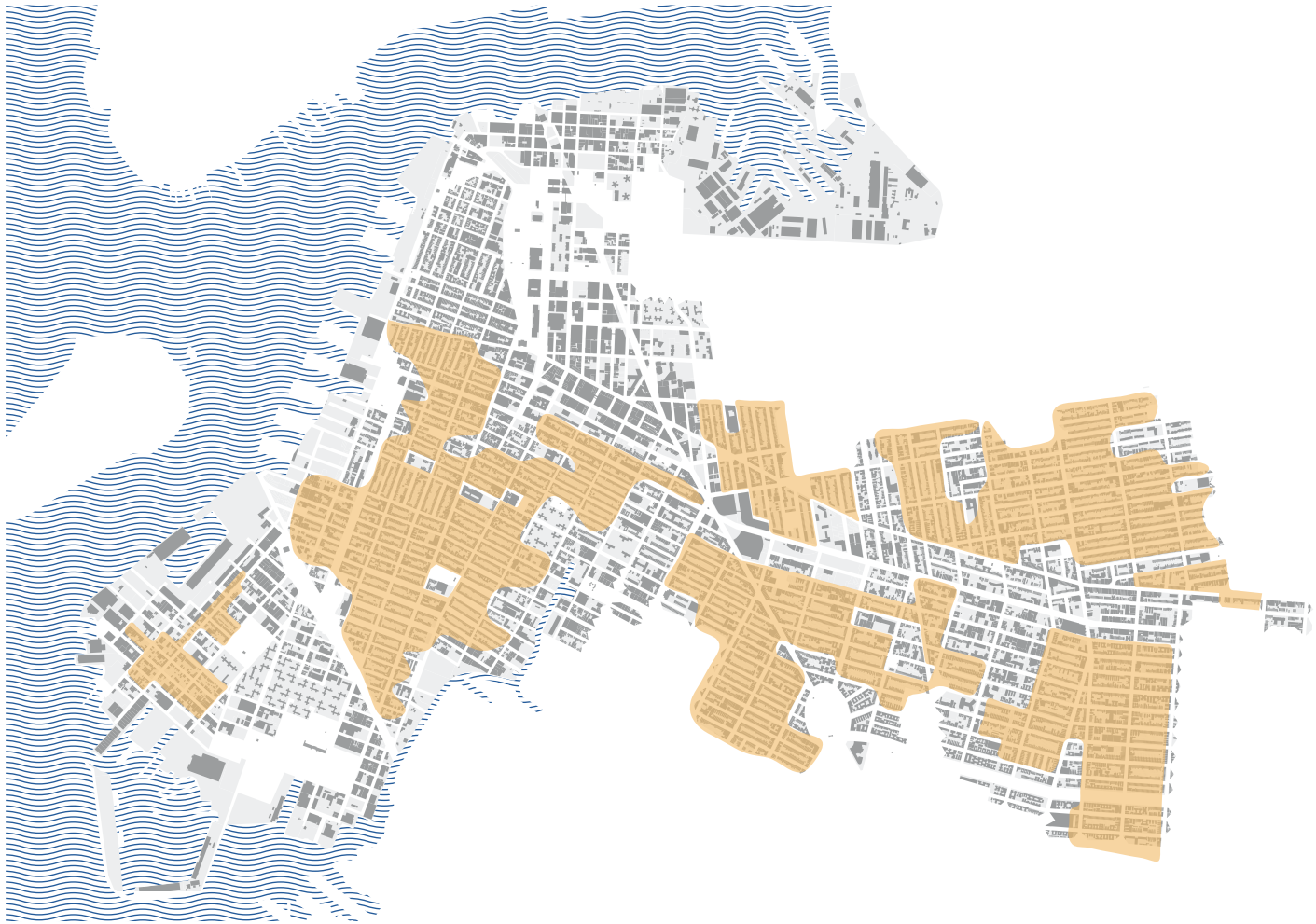
- B - High-Rise Buildings
- C - Mid-Rise Buildings
- D - Mixed-height
- E - Townhouses
- F - NYCHA Housings

DRAWING GENERATED BY FLUID FRONTIERS

Maps for building age, building typology and others confirm the extent of the townhouse type in the Red Hook Sewershed. This townhouse is the oldest and widest spread residential development built based on a standardized urban block. As a unit measure of the city, the entire townhouse block has a unique form, donut-like: the backyards of each lot together form a continuous open space of mostly gardens. The FF team analysis revealed that this typology covers more than 40% of Red Hook Sewershed.

Even though the townhouse type does not represent high population density, its prevalence in Red Hook Sewershed and its uniformity in design allows for standardized approaches to GI implementation. Thus, the townhouse type, is an aggregator of GI implementation and has a great potential to mitigate stormwater runoff and overall CSO's in the Red Hook Sewershed.

A challenge of the townhouse type is they are privately owned. The team believes to inspire a neighborhood to act in unison at the sewershed scale will require outreach and economic incentives.



BUILDING GROUPING IN RED HOOK SEWERSHED

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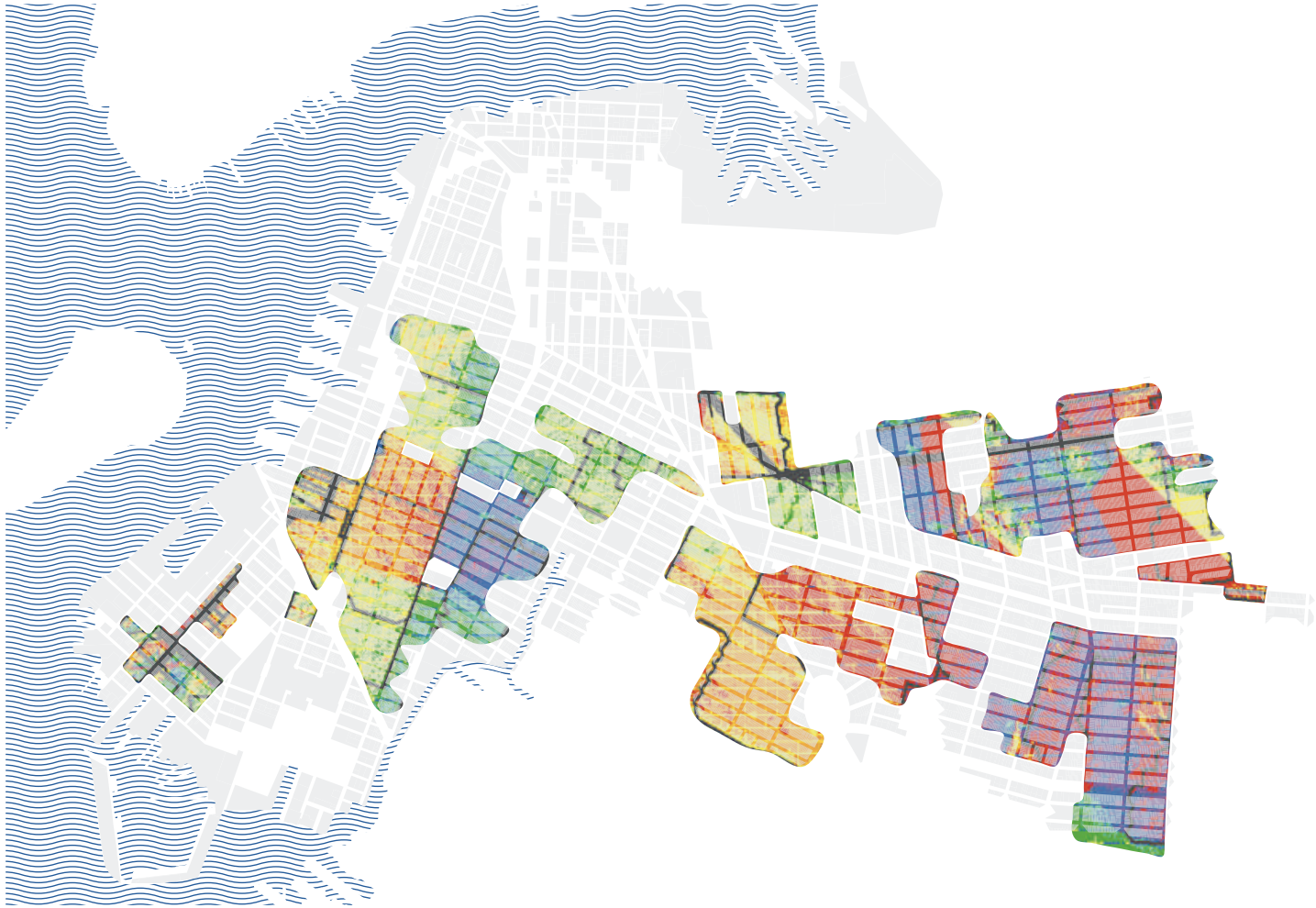
- B - High-Rise Buildings
- C - Mid-Rise Buildings
- D - Mixed-height
- E - Townhouses
- F - NYCHA Housings

DRAWING GENERATED BY FLUID FRONTIERS

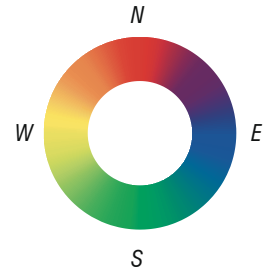
In fitting with the team's approach to understanding the overland flow of stormwater, the map containing the townhouse gross area was superimposed with the topographic information in order to visualize the direction of the slope and thus the flow direction of runoff.



BUILDING GROUPING IN RED HOOK SEWERSHED

C - Townhouses

Direction of Slope



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FF PHYSICAL MODEL

Objective

A physical model was constructed to better visualize the topography and existing built condition of the Red Hook Sewershed. The model serves as a visual guide of water runoff behavior in relation to the topographic character of the area. The model was originally conceived as a tool to facilitate outreach and discussion with community organizations.

Parameter

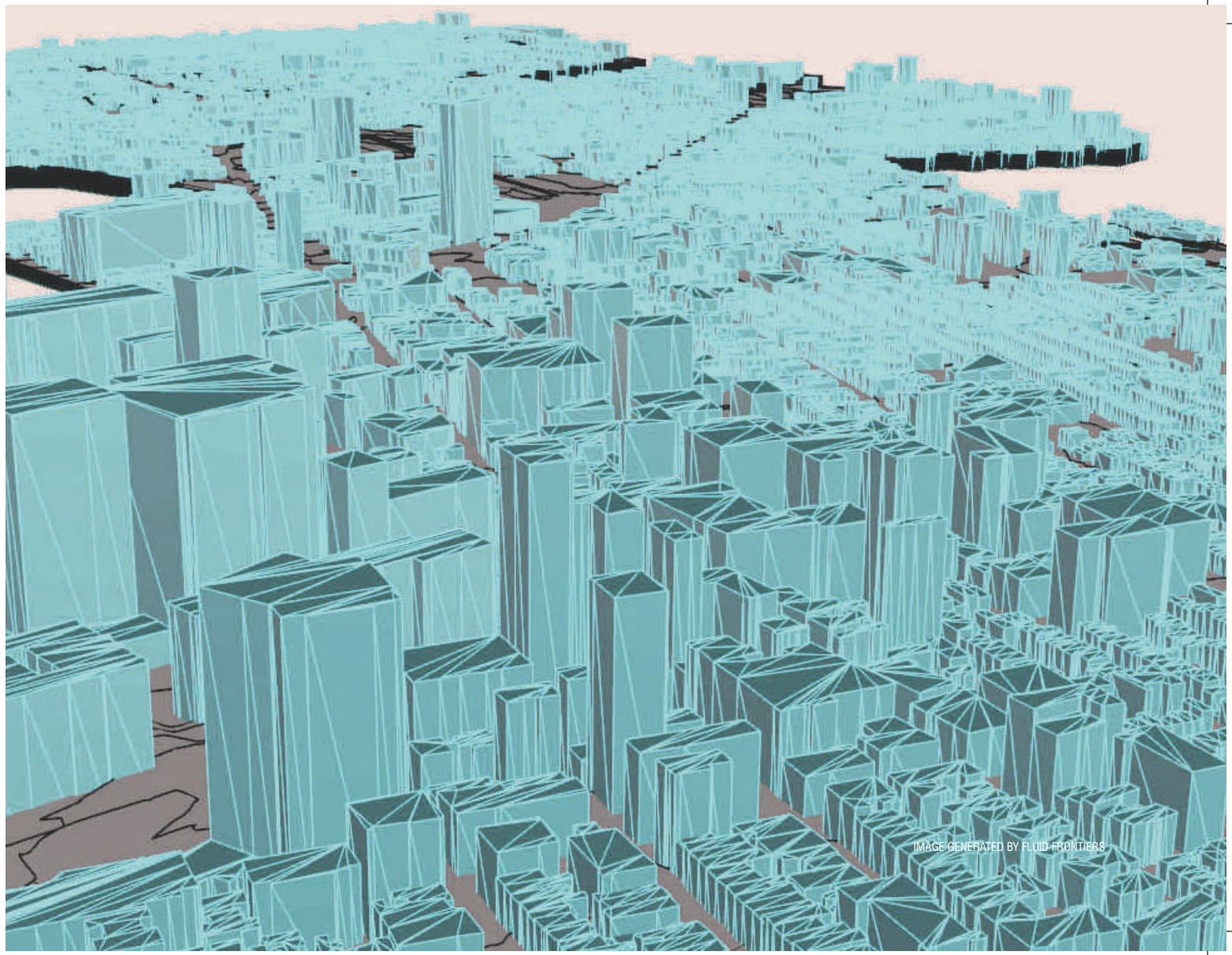
Material: *Light Density Foam*
Scale: *1/256" = 1'-0"*
Dimension: *approx. 5' x 7' x 8.5"*
Software Tool: *ArcGIS, ArcScene, Rhinoceros 5, RhinoCam*
Model construction method: *CNC Milling (with 0.5 ball and 0.25 flat end mill)*

3D Modeling Process

The GIS software ArcMap 10.2 and ArcScene 10.2 were primarily used to extract geographical information on the Red Hook Sewershed. For each information set extracted, the following "layers" were sourced from existing GIS dataset:

"Topography - 2ft contour"
"Building Footprint: "NYC DoITT, Dec 2014"
"Red Hook Wastewater Treatment Plant tributary area (RH sewershed) - NYC DEP, 2007"
"building height"

The extraction process began in ArcMap. Using the layer "RH sewershed" as a mask, building footprint and topographic information were clipped to trim away the geometry that is not included in the sewershed area. Then the shape files were exported as a ".utm" file format.



3d model scene of the Red Hook Sewershed in ***Rhinoceros 5.0 software***

The 2D shape files were then imported into ArcScene in order to convert the information into 3D geometry. Dataset on the roof heights of each building (height from the base elevation) and base elevation data (elevation of topography above sea level) were calculated in order to three-dimensionally extrude the building geometry to correct height. Since ArcScene uses the meter as its default unit and the elevation data was given in feet, the calculation had to incorporate the unit conversion. The resulting 3D geometry was then exported as ".vrml" file format.

The ".vrml" file was imported in the Rhinoceros 5.0 software to be manipulated. The 3D file containing the topography and building dataset was scaled down to 1/256" = 1'0", as it was deemed an appropriate scale based upon feasibility of the final model's dimension (5' x 7' x 8.5"). The height of the model was then scaled vertically in order to exaggerate topography and to better visualize topographic changes of the sewershed.

3D Fabrication Process

RhinoCam, a plug-in program to Rhinoceros 5.0, was used to generate path tools for CNC milling. A scaled replica of the sewershed was carved out of Light Density Foam (building insulation materials) with the CNC mill at the fabrication shop of the School of Architecture, Pratt Institute.

Sectional Analysis

With the aid of a digital model of the sewershed, the team then cut sections across the sewershed for further examination of the topographic condition. Selected longitudinal and latitudinal sections at various locations in the sewershed visualize the location and degree of elevational changes across the sewershed, and highlights local high/low points. The resulting sections are depicted in pages 55 - 61.

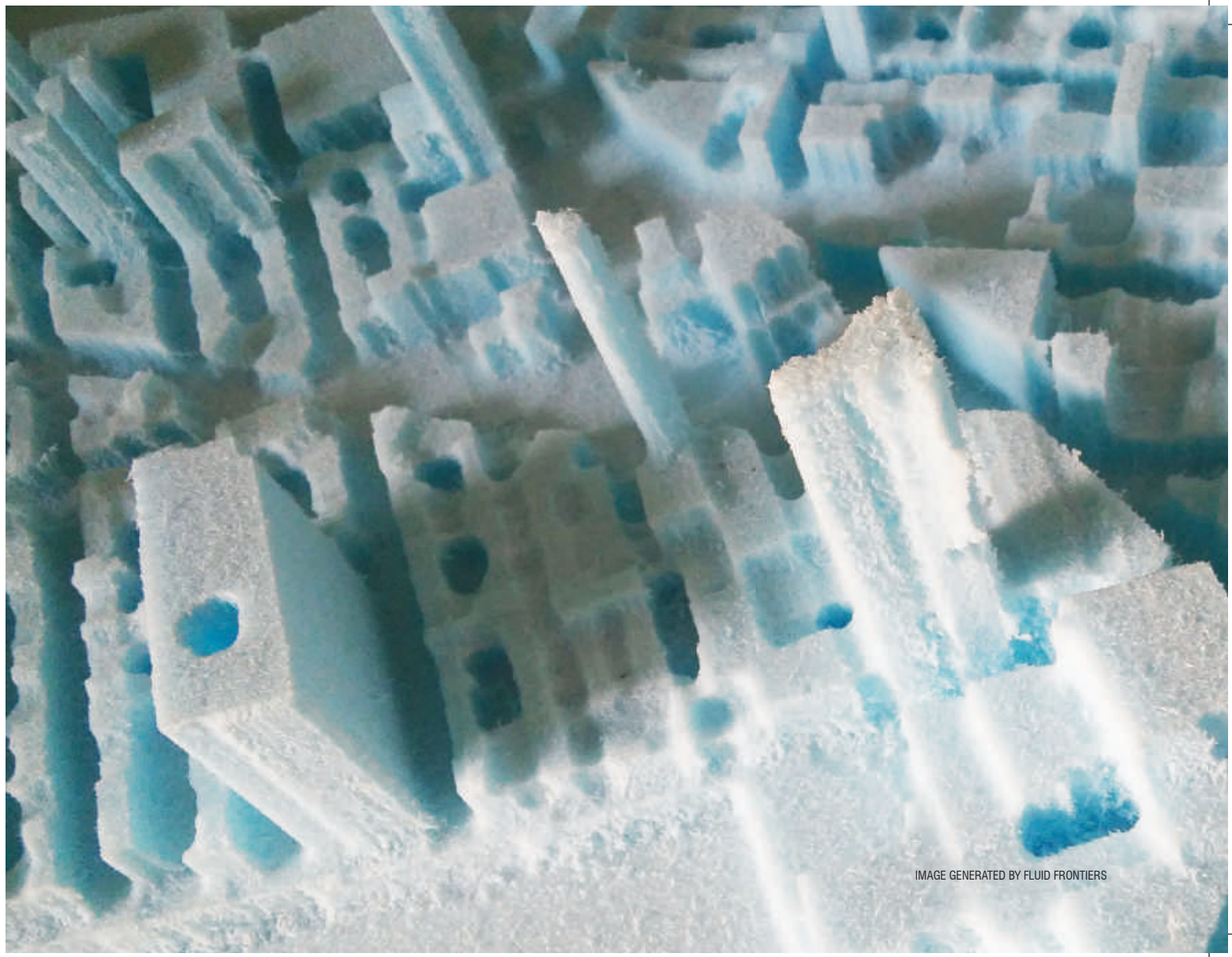


IMAGE GENERATED BY FLUID FRONTIERS

SECTION ACROSS RED HOOK SEWERSHED

SECTION A - A'
Atlantic Avenue

** The section drawing is stretched vertically in order to visualize the topographic change across the sewershed*

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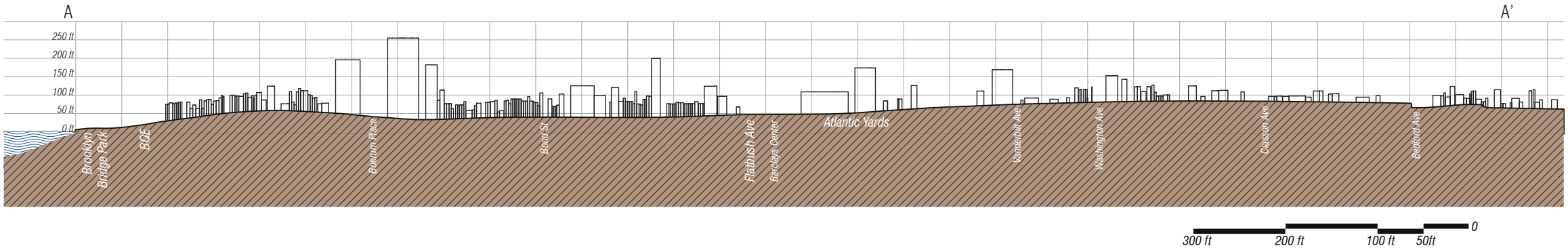

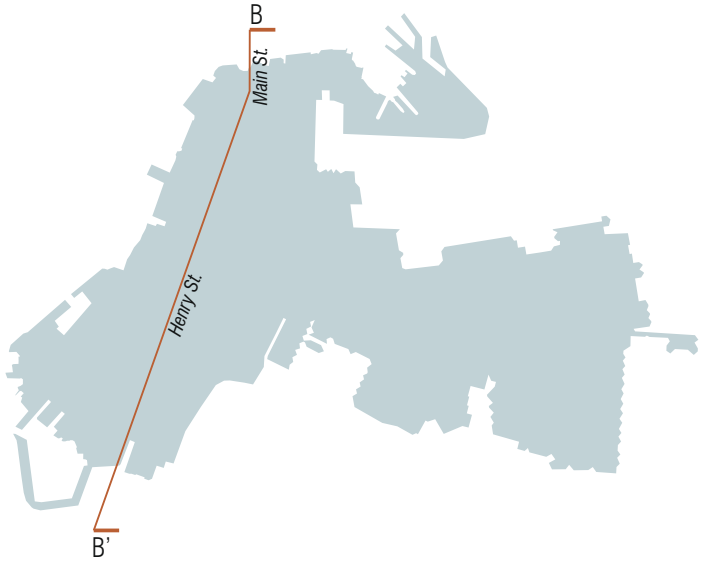

SECTION ACROSS RED HOOK SEWERSHED

SECTION B - B '
Henry Street

** The section drawing is stretched vertically in order to visualize the topographic change across the sewershed*

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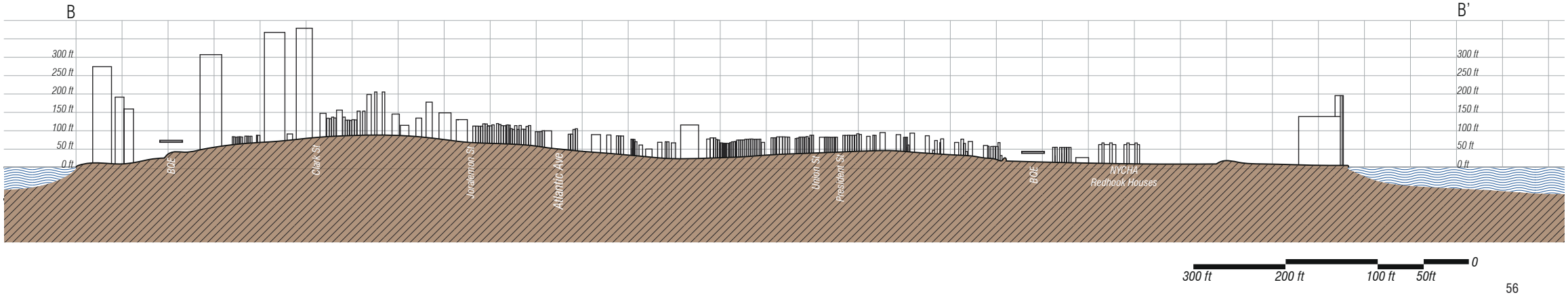

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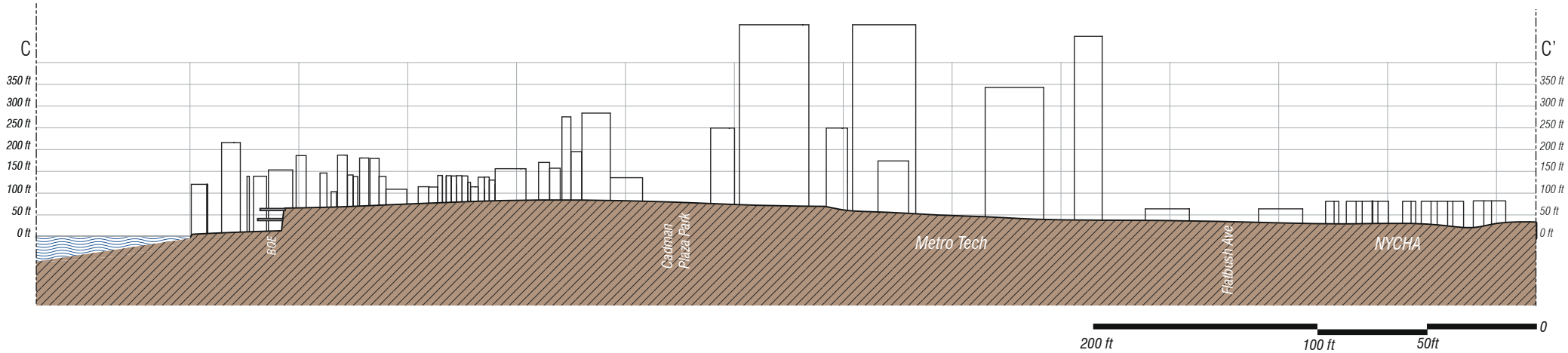
SECTION ACROSS RED HOOK SEWERSHED

SECTION C- C'
Montague Street
Myrtle Avenue

** The section drawing is stretched vertically in order to visualize the topographic change across the sewershed*

DRAWING GENERATED BY FLUID FRONTIERS

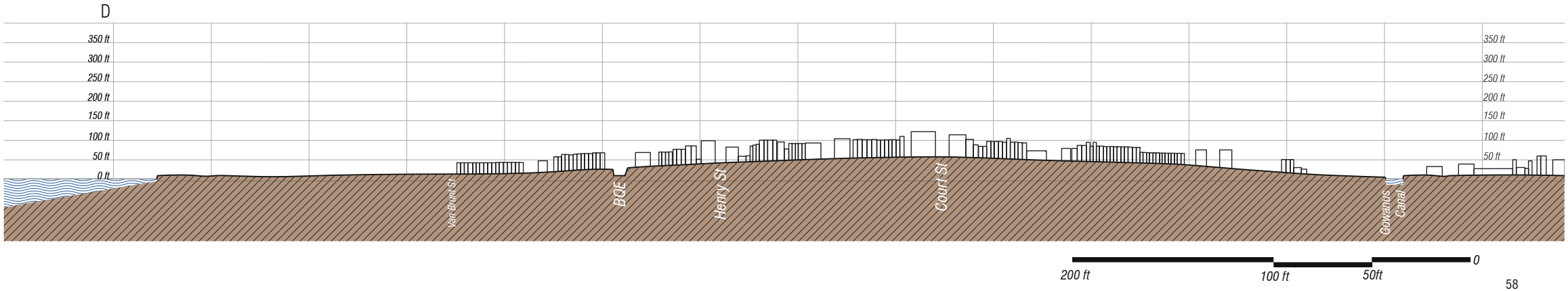


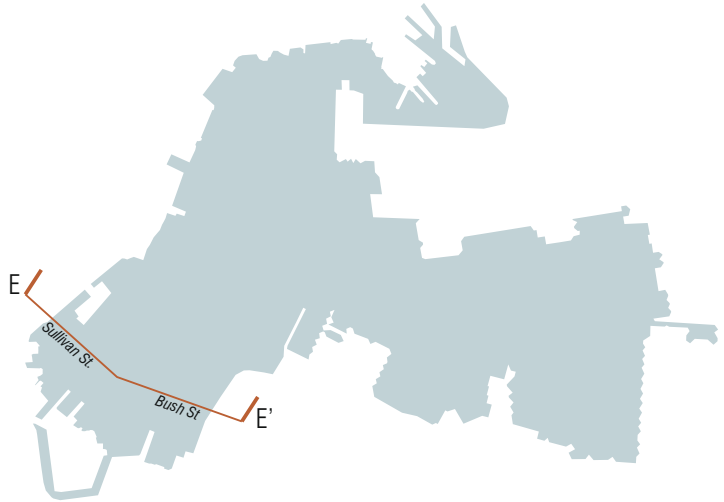
SECTION ACROSS RED HOOK SEWERSHED

SECTION D - D'
President Street

** The section drawing is stretched vertically in order to visualize the topographic change across the sewershed*

DRAWING GENERATED BY FLUID FRONTIERS



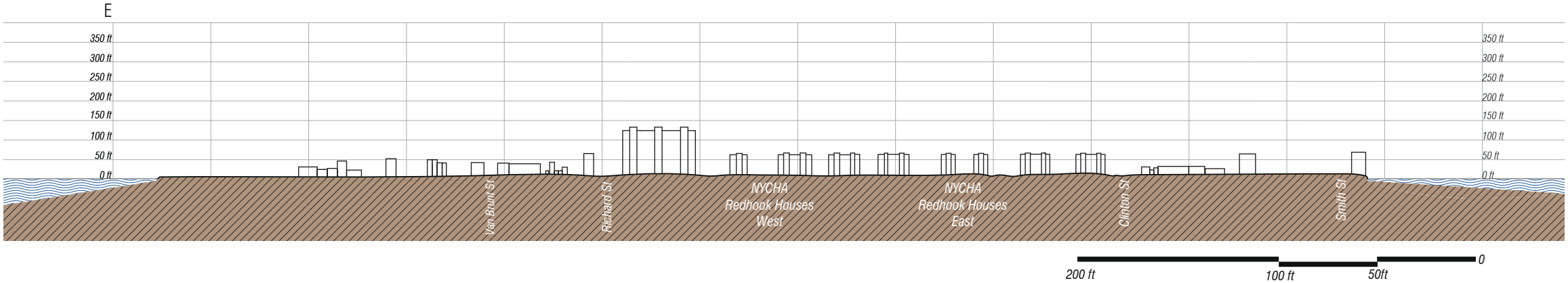


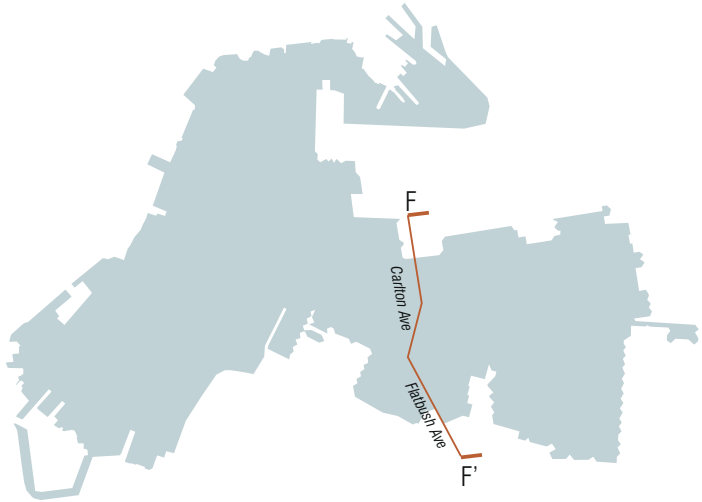
SECTION ACROSS RED HOOK SEWERSHED

SECTION E - E'
Sullivan Street
Bush Street

** The section drawing is stretched vertically in order to visualize the topographic change across the sewershed*

DRAWING GENERATED BY FLUID FRONTIERS



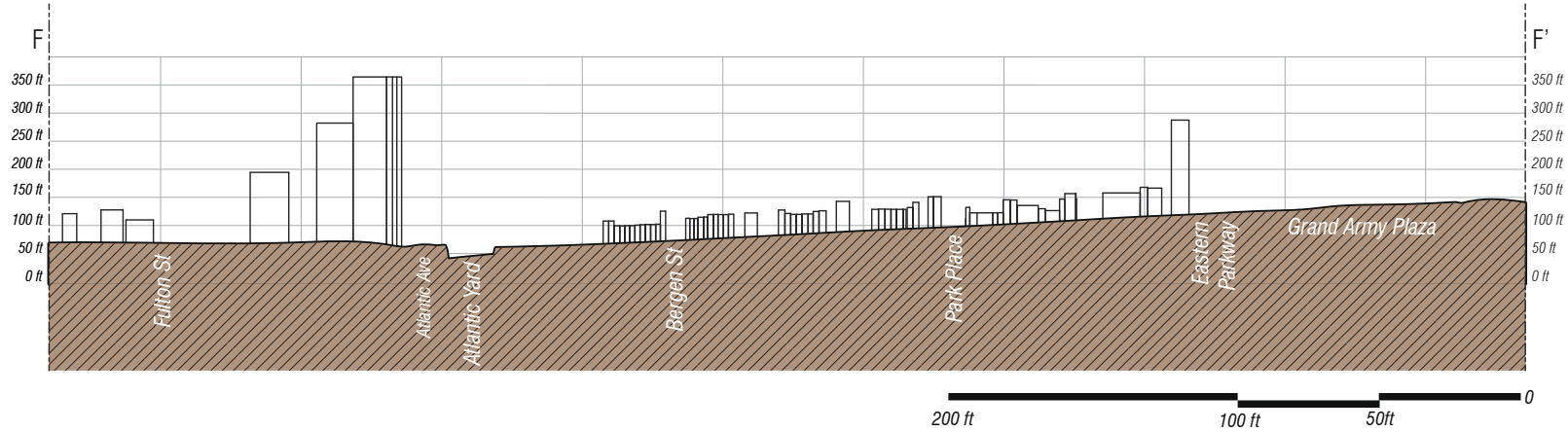


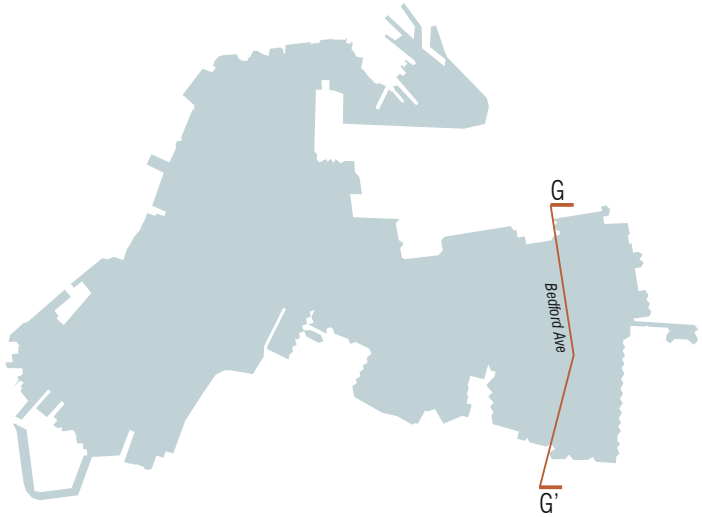
SECTION ACROSS RED HOOK SEWERSHED

SECTION F - F'
Carlton Avenue
Flatbush Avenue

** The section drawing is stretched vertically in order to visualize the topographic change across the sewershed*

DRAWING GENERATED BY FLUID FRONTIERS





SECTION ACROSS RED HOOK SEWERSHED

SECTION G - G'
Bedford Avenue

** The section drawing is stretched vertically in order to visualize the topographic change across the sewershed*

DRAWING GENERATED BY FLUID FRONTIERS