

## **Problem Statement**

Over the last few years, the issue of housing density and restrictions on development has become increasingly prominent as housing prices have increased across the US. Nowhere is this more relevant than in New York City, where construction of any kind is among the most difficult and expensive in the nation. One particular issue the city has to address, as it tries to relieve congestion and discourage driving, is developing new housing with access to the city's public transportation system.

## **Introduction**

This project will seek to address the above problem by determining what percentage of the recent housing developments are built close enough to MTA subway stations to be considered accessible to residents there, and where or not this is related to the zoning regulations in that area. The subway system is the most used part of the city's public transportation network, and while it has its flaws, it is the most comprehensive in the country (Arcadis, 2017). Real estate near train stations is certainly valuable in NYC, making it attractive for developers, but the high property values and wealth among those already living in those places often makes the pushback to development more formidable (Read, 2022). The city has recently tried to roll back some of the onerous restrictions on housing development that local homeowners can use to block new construction, such as long environmental reviews, on how far apart buildings need to be, or how tall buildings are allowed to be, among others (Berkovitz, 2022). However, many restrictions are still in place. As the city tries to transition to being more development friendly, it is unclear how much of what is restricting new housing is due to those existing regulations, execution by local authorities, or other factors entirely.

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For this analysis, data was collected from the NYC OpenData Portal on the locations of public and private housing development projects that the city determined to be affordable in order to see how affordable housing was being constructed with respect to the subway and different city zoning codes. To determine these relationships, shapefiles for the locations of NYC subway stations and lines were collected from the OpenData Portal, and a shapefile of the city zoning districts and their attributes was downloaded from the NYC Department of City Planning website. Multiple maps were made to determine and visualize these two relationships, one overlaying the location of these affordable housing developments with ten minute walking distance isochrones to subway stations, and one overlaying the developments with zoning districts colored by how restrictive they are. Additionally, further non-mapping analysis was done to see if there was a difference in density of new affordable housing developments near subway stations in different types of zoning districts and if there were differences between larger housing developments and the overall dataset.

Construction in New York City will likely always be harder than in any other place in the US. After all, it's the nation's most populous and most densely populated city, presenting obstacles that few other places do. However, as the city seeks to encourage more residents to stop driving cars, both to reduce traffic congestion and for environmental reasons, it needs to develop more affordable housing, particularly affordable housing with access to public transit (Bellafonte, 2022). If the city is unable to build in such a manner, it risks forcing development to take place further and further outside the city center, creating urban sprawl, something that has already made many American cities heavily dependent on cars (Timperley, 2022). This analysis will help to evaluate the question of whether or not the new housing being built in the city provides its residents with sufficient access to the subway system and whether or not the city's

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zoning policies are impacting the development of new affordable housing, both near subway

stations and in general.

## **Data and Methods**

For this analysis, four datasets were used, three of which were retrieved from the NYC OpenData Portal. The first dataset used was the Affordable Housing Production by Building dataset, which contains every development since 2014 that the NYC Housing Preservation and Development (HPD) considers to be an affordable housing development. The information includes each building's location, as well as the number of units and the descriptions of the different types of units included in the project. The other datasets that were used from the portal were the Subway Stations and Subway Lines datasets, both of which only contain the locations of the part of the subway system they are mapping

Another dataset used in the analysis was the NYC GIS Zoning features shapefile from the Department of City Planning. This dataset contains the polygons for city zoning districts, as well as the classifications for each type of district. The residential districts are classified on a scale from 1 to 10 in terms of the city's determination of the housing density allowed in those districts and other restrictions on residential building development, such as minimum lot sizes and regulations on large scale building equipment. Mixed-use commercial and residential districts can also be converted to this scale. Only districts with explicit rules for residential zoning were included in the analysis, so some manufacturing and special purpose zoning districts were not included in the analysis.

For the mapping analysis, the open source software QGIS was used. For the first map the Open Street Map(OSM) standard map was used as a basemap, and the subway stations and lines were plotted above it. To determine access to subway stations, the Open Route Service (ORS)

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plugin was used to make isochrones around the stations, representing areas where one could walk to the station within 10 minutes, as determined by calculations using the OSM database. Then, using the Python package Geopandas, the point layer with subway stations was overlaid with the zoning districts shapefile to determine the level of zoning restriction each subway station resided in. This zoning restrictions column was then added to the shapefile of the subway station isochrones such that each isochrone could be colored based on how restrictive the zoning rules in the area were. The isochrones were colored such that lighter colors indicated less strict zoning rules in an area, and the subway stations and lines were plotted above them to remain visible. A legend was added, to make the nature of all map elements clear, as well as other essential map elements.

For the second map, the isochrones, unhighlighted, were plotted above the OSM standard basemap, and the subway stations and lines were plotted above that layer. Above these layers, the point layer indicating the locations of NYC affordable housing developments was plotted, in order to determine if the developments were located within ten minutes of the subway system. Additionally, this map could be compared with the map of isochrones by zoning restrictions to see if the zoning regulations had an impact on the number of affordable housing developments.

Finally, for the third map, an almost identical procedure as the second map was used, except that only affordable housing development projects with over 100 units set to be constructed were selected. This was done to see if there was a difference in where large affordable housing was being built compared to the overall dataset.

Finally, non-mapping analysis was done to give a more exact answer to the questions of what percentage of affordable housing developments are within a ten minute walk of a subway station, whether less restrictive zoning districts tend to have more developments, and whether

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this changes for larger development projects. The GeoPandas contains function was used to determine what percentage of developments were within a 10-minute walk to subway isochrone, and it was also used to determine which kinds of zoning districts near subways tended to have the most affordable housing locations, for both the total affordable housing development set and the set restricted to only those with over 100 units.

## Results

For the question of whether or not new affordable housing was being built with sufficient access to subway stations, the second map below, Figure 2, shows that the large majority of new developments are within a ten minute walk of a subway station. Part of this is because the system is quite extensive and covers a lot of the city, but this also means that there is room to develop affordable housing within city confines and in city centers, as opposed to building outwards and creating urban sprawl. The map may actually exaggerate the extent to which new homes are built within ten minutes of a station, since computing the exact number in GeoPandas found that just short of 75% of the developments were within an isochrone, but many of those not included are just beyond the boundaries of one and so the map is still very representative of the state of new affordable housing developments with respect to subway accessibility. Affordable developments with greater than 100 units tended to be within an isochrone of a subway station at a similar rate, 73% instead of 74% for the total dataset.

In terms of whether or not zoning is restricting development near subway stations, when it comes to the total dataset of new developments the answer is not immediately clear from the maps Figure 1 and Figure 2. While there is significantly less development in the heavily restricted areas in southeast Brooklyn and east Queens, there is not a concentration of locations in the upzoned areas of Manhattan. Rather, areas in central Brooklyn and the Bronx with

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restrictions in the middle or lighter end of the scale tended to have the highest density of new affordable housing developments. However, when looking at Figure 3, showing the locations of the larger developments, there is a much more significant difference between differently restricted zoning areas, as the upzoned areas in and around Manhattan have the vast majority of the large developments, while those with heavier restrictions have almost none at all. These results were confirmed by the analysis in GeoPandas which showed that for the general dataset, isochrones in zoning districts in the 7-8 range on the scale out of 10 tended to have the highest concentration of developments, while isochrones in the 9-10 range had the highest concentration of developments among those in the greater than 100 units dataset.

## Maps

Figure 1

# NYC 10-Minute Walk to Subway Isochrones by Zoning Restrictions

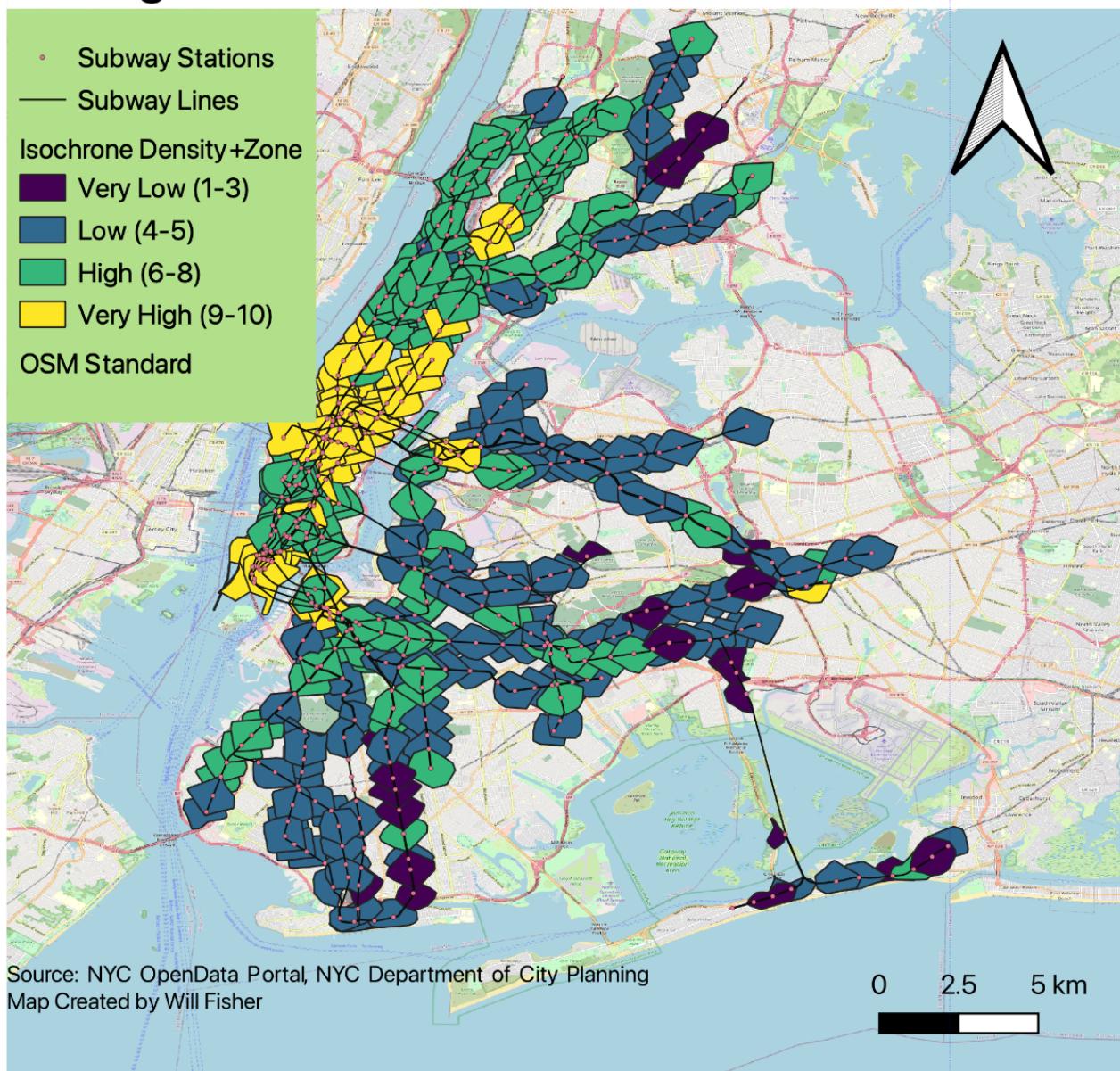


Figure 2

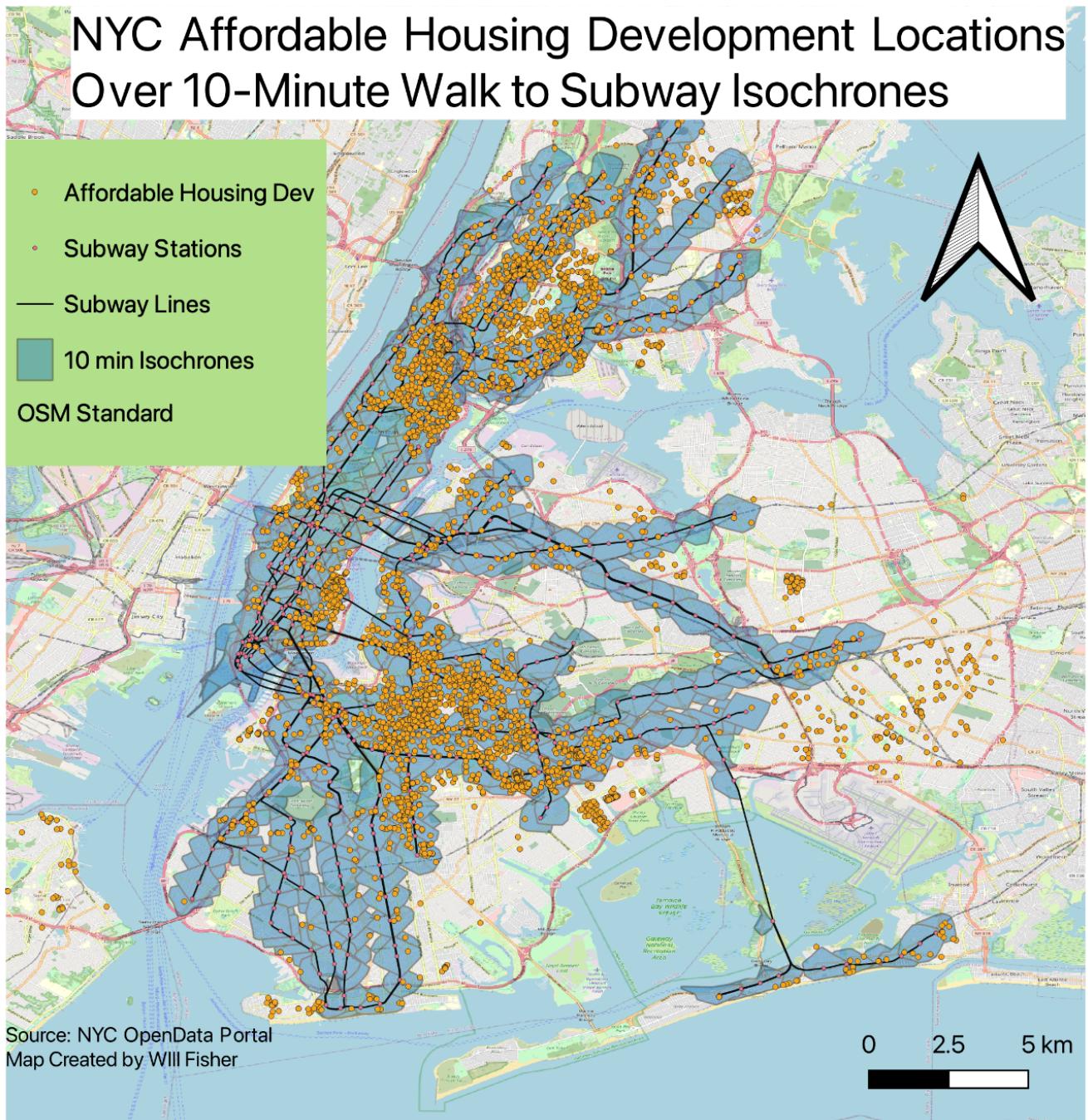
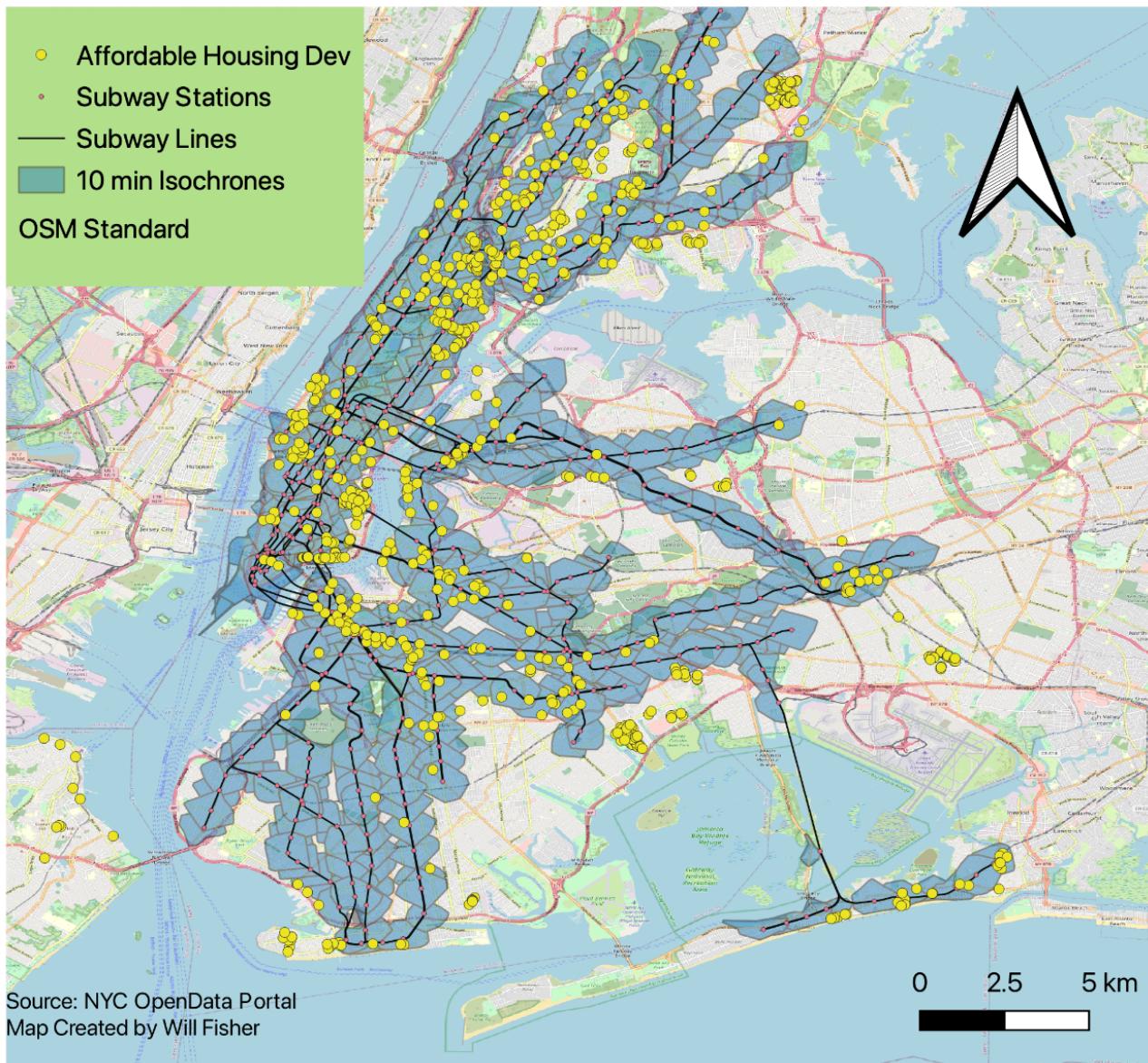


Figure 3

## NYC Affordable Housing Development Locations Over 10-Minute Walk to Subway Isochrones (>100 Units)



## Conclusion

Overall, New York City is seeing affordable homes being newly developed in such a way that a significant majority of them are within a reasonable distance of a station in the city's subway system. Although there is certainly room for improvement, since about a quarter of the new developments are beyond ten minutes away from a station, it still shows that most of the new housing for those who need it most is built near accessible transportation. Generally, having areas with less restrictive zoning requirements tend to better facilitate this kind of development, although this relationship is more clear for larger affordable housing developments than for the entirety of affordable housing developments overall. However, given how expensive the cost of living in NYC is and how much it has risen over the past decade, any improvement in making new affordable housing should be welcomed by the city, particularly if that affordable housing is also transit accessible such that it can contribute to the city's goal of reducing driving.

Where housing is built is a complex issue in general, and certainly in NYC, so there are definitely some limitations to this analysis. For example, even though central Manhattan has the fewest zoning restrictions, there may just be less affordable housing built there simply because it's the most desirable location for real estate, not because of regulations, and this analysis did not take neighborhood cost into account. Additionally, this analysis did not take into account the potential occupancy of each development, instead treating them equally, so developments that were being built in denser areas in and around Manhattan may have had as much space for residents as several developments in the outer boroughs combined. Also, the affordable housing classification the city provided to the developments was rather broad, so there could be very

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different characteristics from one development in the data to the next in terms of available apartments for low-income residents versus middle-income residents.

Going forward, there are a couple areas of research that could enhance this analysis. First, this analysis used isochrones for walking ten minutes to the nearest subway station as a measure of accessibility, which can be kind of crude. Alternatively, one could analyze average commute times and/or subway service at the nearby stations to figure out how accessible to public transit the different housing locations are. Another way that this analysis could be improved upon is if there was research into how public and private affordable housing is built in different locations with respect to zoning and transit accessibility. The different factors involved in the different kinds of development may lead to different responses to accessibility needs and housing regulations.

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