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City of Norfolk Underground Storage Tank Analysis

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Introduction

According to The Norfolk Environmental Commission, the City of Norfolk may contain thousands of abandoned Underground Storage Tanks (USTs), most often used for storing petroleum at filling stations or for fuel oils (such as kerosene) for homes and businesses, which represent a hazard to the City of Norfolk and its surrounding environment (Norfolk Environmental Commission , 2018). The Norfolk Environmental Commission feels that "Although the Norfolk Fire Department has been recording the location, installation and/or removal of new/abandoned USTs as the tanks, the recording process is insufficient/inaccurate and in desperate need of automation (Norfolk Environmental Commission, 2018)", and in an effort to rectify the situation is digitizing their current records system and attempting to incorporate GIS into the maintaining of that database. The Norfolk Environmental commission has identified five actions which they believe would improve the current situation:

1. better understand the scope of the problem.
2. automate the record keeping system.
3. begin comparing the record data with actual street information.
4. contact heating oil delivery companies to compare their UST customer lists and past records with the existing records.
5. publicize the issue and apply pressure to get regulatory change so that every real estate transaction must provide a record of no UST or the results of an inspection indicating "None Found" (Norfolk Environmental Commission , 2018).

To aid the commission in reaching these goals, the focus of this project is to create a database of USTs, maps to more easily track tank locations, provide analysis of areas where leaks are more likely to occur and the possible environmental concerns surrounding those areas, and create a web map application that will be both informative and useful to tank inspection reporting in the field for the City of Norfolk.

In order to meet all of those objectives, I employed a three-phase approach:

Phase 1: Use GIS software to analyze and identify tank locations based on permit records maintained by the Fire Marshall's Office.

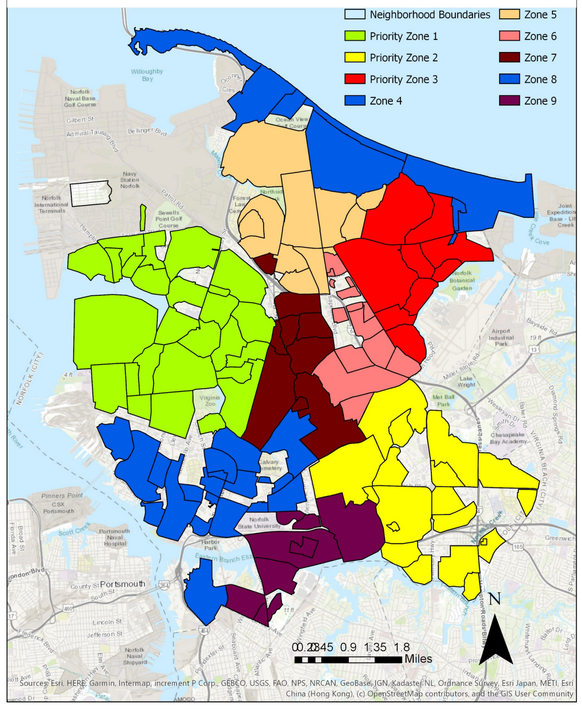
Phase 2: Identify areas where leaking tanks may pose a greater environmental risk to wetlands or groundwater supplies, and areas where storm surge or flooding may contribute to increased corrosion or damage to USTs in the City of Norfolk.

Phase 3: Incorporate the results of analysis into a web-based map that is accessible to inspectors in the field to help enable reporting and mitigating actions as required and allow for Norfolk's UST database to be updated by field agents upon completion of an inspection.

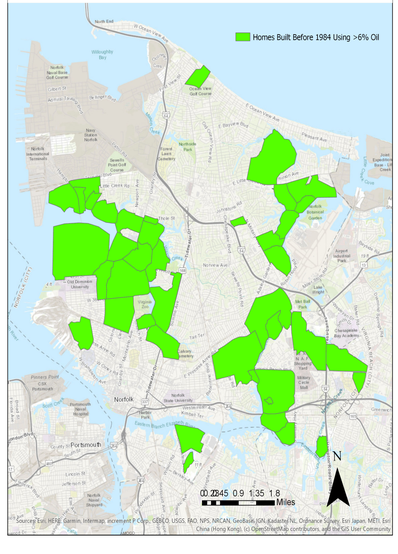
Acknowledgements

I would like to acknowledge the City of Norfolk for the use of several shapefiles used in my analysis, the Norfolk Environmental Commission for bringing such an interesting topic to my attention, and Dr. Liu for help and guidance throughout the process.

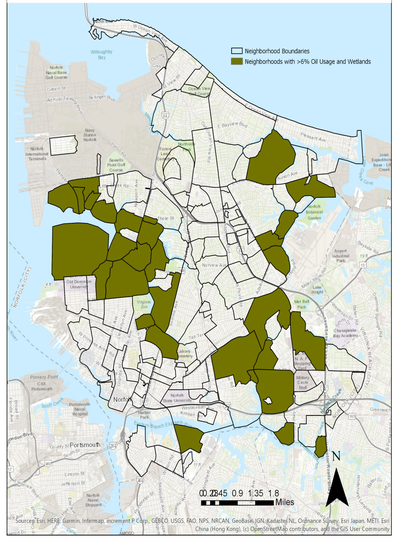
City of Norfolk Homes Tank Verification Zones



City of Norfolk
Homes Homes Built Before 1984 Using >6% Oil



City of Norfolk Neighborhoods with >6% Oil Usage and Wetlands



Method

The focus area for this analysis was the City of Norfolk.
Using small sample of the UST records maintained by the Fire Marshall's Office, I began by geocoding the addresses using GPS Visualizer's address locator to find the latitude and longitude coordinates. The geocode results were then combined with records containing the address, inspection information, and fields that I thought would be useful in the continued tracking and recording of information about USTs in Norfolk in an attribute table. I used the Create XY Event tool in ArcGIS Pro to create a shapefile for tank locations in the City of Norfolk. Shapefiles for neighborhood locations, storm surge areas, and wetland data were gathered from the City of Norfolk's Open Data GIS website. The criteria used for analysis was:

1) neighborhoods with most homes built prior to 1984
2) neighborhoods with greater than 6% of homes using heating oil
3)neighborhoods containing wetland
4)neighborhoods impacted by category 1 through 4 storm surges.

Theory One - Homes with USTs installed prior to 1984 in neighborhoods with wetlands or where storm surge was more prevalent would experience greater corrosion, and therefore be more susceptible to leaks. In cases where wetlands were near leaking USTs, greater risk to wetland ecosystems would be expected.
Theory Two - Neighborhoods where greater than 6% of homes relied on fuel oils as an energy source for heating would be more likely to contain USTs.

Results

Analysis by Age and Oil Use

Analysis of neighborhoods built prior to 1984 shows that 42 neighborhoods have greater than 6% of the homes using oil as the primary energy source for heating homes. This equates to roughly 19,419 land parcels roughly divided into three core areas.

Analysis by Wetland Location

The result of my analysis is that of the 126 neighborhoods, 68 (47,963 parcels) contain wetlands. As with the parcels impacted by storm surge, the moisture of the soil could cause USTs installed before the 1984 regulations to corrode faster and present a greater chance of leaking.

Final Analysis

For the final analysis, I took into account the neighborhoods with the greatest number of homes built prior to 1984, reliance on fuel oil for heating energy, the impacts of storm surge, and proximity to wetland areas and created a map that has the City of Norfolk split into 9 zones. Priority Zones 1 through 3 are those areas that meet all 4 criteria examined and are likely to contain the most USTs with the greatest potential to contain leaking or degraded USTs. The remainder of the zones (4 through 9) are grouped together for ease of tracking as the process of cataloging and reporting the status of USTs in the city of Norfolk.

Unfortunately, the Fire Marshall's Office has been unable to provide more records for inclusion in this project to date.