Optimizing a Distribution Warehouse in the Puget Sound Region

Abstract

Seattle is being hit with an explosive wave of growth and expansion. New trendy neighborhoods are inflaming land costs while simultaneously creating new businesses. The purpose of this project is to look at possible sites to build a new food distribution warehouse. The warehouse will need to be in an adequately zoned parcel and outside of freshly gentrified and growing areas, for the sake of this analysis denoted "trendy areas." The parcel needs to be the right size, near a freight line or have port access, and be nearby as many food serving facilities as possible. Ultimately, the analysis revealed the perfect parcel is a little over 5500 meters squared and in the Lake Union neighborhood. There are 440 food facilities within 2 miles. The parcel is currently a biotech company but a slightly smaller parcel directly across the street is a frozen food distribution warehouse. When potential business is combined with plenty of income streams a reliable and robust supply chain a business could make tremendous capital. A centrally located warehouse would cut shipping costs as well as CO2 emissions. The goal of this analysis is to locate the right location to make this reality.

Introduction

Both King County and the City of Seattle have had a tremendous boom in growth and expansion over the last 20 years. This growth has given way to methodically planned neighborhoods outside of the city proper. Many of these areas are filled with growing residential populations, fun attractions, and above all, good food. In Seattle there is a coffee shop around every corner and town-like suburban neighborhoods which are filled with small eateries and even large grocers. To keep up with this urban sprawl and proliferation of eateries, it is necessary to create the supply chains which brings in the food that sits on the shelves and is stocked in coffee shops and restaurants alike.

My goal is to find the perfect location for a warehouse which can act as a central means of distribution to the food service industry in King County. The warehouse needs to be in the best position possible to accept and disperse goods at the greatest quantity and the lowest price. This project will begin to show me the methods used by professionals in the field of supply chain management. While this is only an entry level analysis, I should find an area which would serve as a suitable staging area in a real-world atmosphere.



Figure 1. King County Locator



 Figure 2. Trendy Neighborhoods, represented in purple
 Table 1: List of the neighborhoods

Methods

Projecting every data to the proper spatial reference is necessary for every step of this analysis. After checking online documentation for the datasets, it was determined the Define tool was unnecessary. To speed to the process up a batch project was used to carry out changing the spatial reference in one step. You can see which datasets are used in the warehouse location analysis, all changes are in the table below. While I considered using the original spatial reference included in most data sets I personally settled with WGS_1984_UTM_Zone_10N due to its versatility.

Name (With URL Link)	Original Spatial Reference	Name after projection
Food_FacilitesMultiple_ClassesFor_ King_Countyfood_facilities_point.shp	NAD 1983 HARN StatePlane Washington North FIPS 4601 Feet	KCFood
FGTSWA.gbd	NAD 1983 HARN StatePlane Washington North FIPS 4601 Feet	Freight
kc_neighborhoods.shp	NAD 1983 HARN StatePlane Washington North FIPS 4601 Feet	KCNeighbor
wtrbdy.shp	NAD 1983 HARN StatePlane Washington North FIPS 4601 Feet	Waterbodies
King_County_Parcelsparcel_area.shp	NAD 1983 HARN StatePlane Washington North FIPS 4601 Feet	KCParcels
zoning_kc_consol_20.shp	NAD 1983 HARN StatePlane Washington North FIPS 4601 Feet	KCZones
kingco.shp	NAD 1983 HARN StatePlane Washington North FIPS 4601 Feet	KCBasemap

Table 2. List of datasets used for analysis and also changed to WGS_1984_UTM_Zone_10N

Based on distribution of KCFood points of interest It is clear the analysis should be focused on the Puget Sound Region. (See Locator Map Below)



Figure 3. King County Eatery Distribution

The "KCZones" dataset is conveniently pre-organized into designated zoning types. Data for the industrial zones can be exported as a new shapefile, "KCIndustrial." KCIndustrial is the target zoning for the warehouse. However the zoning needs to be reflected in the "KCParcel" file, begin by a clip command to slim things down. Use the KCParcel to clip KCIndustrial. Export data and name the layer "KCIndustClip." As a rule of thumb when a new shapefile is sharpened down to create something more accurate, the old shapefile can be removed from the dataframe if it is no longer needed. Continuing with KCIndustrial, we need to weed out parcels which are too small, the easiest way is to create a new column in the attribute table called area. After creating "AREA" calculate its geometry and select by attributes, query for parcels larger than 5,000m². For the sake of capital restraints, this analysis will put the cap at 20,000m². The resulting dataset "KCIndustSized" shows appropriately zoned and sized parcels.

Now that a suitable pool of parcels has been generated we need to begin intergrating other datasets. Finding parcels surrounding the freight lines can be accomplished by creating a small buffer zone around the rails and intersecting nearby parcels. The freight file is meant for all of Washington, I recommend preforming a clip with the "KCBorder" shapefile to slim things down a little bit. Call the resulting shapefile "KCFreight" and immediately make a 20m buffer around it. The buffer should either add enough distance on either side to adjust for the rail area and some fences which might be in-between. Name the layer "KCFreightBuffer", use this dataset in a near command. Make Input Features: KCIndustSized and the Near Features: KCFreightBuffer. Select by attributes in KCIndustSized, note the new column "NEAR_DIST" query for parcels which are equal to 0. Everything equal to 0 is intersecting the buffer line and should be exported to its own dataset called "KCParcelFreight." This is a list of all industrially zoned parcels near a major freight shipping line.

The next piece of the analysis involves removing parcels from a trendy neighborhood. I opted to consult a magazine which <u>wrote an editorial about some of these trendy neighborhoods</u>. Using the neighborhood shapefile downloaded from the King County GIS Portal, query for the hoods mentioned in the article. After preforming a select by attributes consider something like the following query:

''L_HOOD'' = 'BALLARD' OR ''L_HOOD'' = 'CAPITOL HILL' OR ''L_HOOD'' = 'WEST SEATTLE' OR ''L_HOOD'' = 'UNIVERSITY DISTRICT' OR ''L_HOOD'' = 'QUEEN ANNE' OR ''S_HOOD'' = 'Belltown' OR ''S_HOOD'' = 'International District' OR ''S_HOOD'' = 'Fremont' OR ''S_HOOD'' = 'Pioneer Square'

While some may try to use the Erase Tool to erase parcels inside of trendy areas, this may leave residual parts of the parcel, skewing results. During this analysis we recommend using the Near Tool again. The first step in this process we should remove the previous NEAR_DIST and NEAR_FID from the attribute table in the KCParcelFreight. Next start the near tool and enter KCParcelFreight as the input and "KCTrendy" as the Near Features. I also opted to enter a Search Radius for 100 meters to keep a small gentrification buffer around the trendy areas. Now that a new NEAR_DIST as been generated we can preform another query. I recommend using something like "**NEAR_DIST**" > -1. Every parcel within the search distance should have a positive number, parcels within the KCTrendy boundarys will equal zero, the query accepts both. Once the entities are selected, navigate to the editor and start an editing session for the KCFreightBuffer shapefile. Hit the Delete Selected Features at the top of the attribute table. The result should have removed the parcels near or in a trendy neighborhood. Change the name of KCFreightBuffer to "KCParcelCanidates."

The last part of analysis is figuring out which parcels within 2 miles of the maximum number of food related businesses, a 2-mile buffer zone around the KCParcelCanidates layer should suffice, call it "KCCanidatesBuffer." Create a new short integer column in the new shapefile's attributes called "COUNT." Use the field calculator so all its entities equal 1. Next, use the Buffer radius to clip off unnecessary points from "KCFood," using Join and Relate, Join KCCanidatesBuffer based on spatial location to the new file KCFoodCanidateClip. Ensure the first bullet is selected and check the sum box, label the new file "KCCanidatesBufferCount." To make life easier, preform another Join on the KCParcelCanidates, this time select "join attributes from a table" and specify the based-on FID to FID. The count should now correlate the amount of food facilities in the area and which parcels have the most. This satisfies all the criteria, the parcel with the most food facilities should indicate the optimal location for the warehouse.

Results

We found the best parcel to be located within the SouthEast section of the Lake Union Neighborhood. Lake Union shares the neighborhood border with Capital Hill. The eastern side of I5 marks the dividing line. This parcel narrowly escaped the KCTrendy buffer zone. The parcel is nearby a freight line, an ocean port, and within 2 miles of 440 food serving facilities. A quick google search revealed this parcel is currently a biotech company. However, the parcel across the street is slightly smaller and is functioning as <u>a frozen food warehouse</u>. The ideal parcel satisfies all criteria presented in the project proposal:

1. The warehouse must be in a single industrially zoned parcel larger than 5000 square meters.

(It's assumed possible to buy out an existing warehouse or business in the area)

2. The warehouse must be outside of a "trendy neighborhood." Some industrial zones taper on the inside of gentrified neighborhoods. To keep costs down these areas need to be avoided. (A list of trendy neighborhoods will be provided)

3. The ideal location will be closest to as many food using areas as possible. (Including coffee shops, restaurants, and shops and supermarkets.) This will help minimize the footprint of moving out products.

4. Finally, the parcel needs to be accessible by a heavy freight line, preferably somewhere near a rail network or nearby the Port of Seattle or Magnolia shipping areas.



Figure 4: Large scale view of ideal parcel space



Figure 5: Small scale view of ideal parcel space



Figure 6: Buffer area and Food Facilities inside the 2 mile radius.



Figure 7: The 2nd, 3rd, 4th, and 5th best parcels in their respective order.

Discussion

The objective of my project is to find the best location for a warehouse in Seattle. Simply put, warehouse managers and procurement experts know the two most important things to keeping a warehouse business operational is maintaining demand for products and ensuring a robust and reliable supply chain. This project presents means to achieve both of those criteria while simultaneously choosing a location which (would in theory) have lower initial capital costs. A supply and distribution business within 2 miles of over 440 potential business opportunities and many more developing right now, the potential is near limitless. With this much opportunity it would be easy to create a warehouse which exclusively deliver its wares by bike, or someone crazy of the sort. The only limitations of the analysis are the limited price analysis statistics, it would be ideal to know initial start up costs vs long term income.

With explosive land prices all over the Puget Sound region, it is easy to see no matter the parcel the initial capital investment would be steep. However, new growth will also bring in new capital and present even more rewards.

Conclusion

In the end there were many potential candidates, but the optimal location was clearly separated from all others. The best parcel is in South Lake Union. The parcel is 5839 meters squared, it is directly off the I-5 and a rail route. With the parcel's proximity to Lake Union it could potentially accept small shipments in its port, this would be a best-case scenario. It should be acknowledged the trendy neighborhood does give a good idea of areas to avoid, however it doesn't exclusively take cost into consideration.

Trendy neighborhoods often have the most development of cute eateries and new restaurants. Parcels nearby will have an advantage over areas which already have an established number of eateries. Close runner-ups to the South Lake Union location can be found in Georgetown, directly under downtown. Any of these locations would be phenomenal to build a business at.

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