PPD 631 – GIS for Policy, Planning, and Development

"Evaluation of Tsunami Risks to Midway, San Diego"

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1. Introduction

A tsunami is a sequence of extraordinarily lengthy ocean waves that travel at great speed and are caused by seismic activity below or close to the ocean floor. Tsunamis originate from two sources: distant and nearby. Remote tsunamis, which are caused by earthquakes off the shores of Chile, Alaska, Hawaii, and Japan, have struck California most frequently. The largest remote tsunami to ever impact southern California occurred in 1960 as a result of a 9.5-magnitude earthquake off the coast of Chile. The tsunami produced 4-foot waves at Santa Monica and Port Hueneme and seriously damaged the harbors at Long Beach and Los Angeles. There have only been four recorded locally generated tsunamis since 1800. The biggest occurred in Santa Barbara and Ventura County in 1812. Six to ten foot waves were reported, causing damage to a few minor buildings and the destruction of numerous ships (Alert San Diego, n.d.).

2. Background

Although the likelihood of a tsunami striking the shore is minimal in San Diego County, it is nevertheless vital to evaluate the risk of a tsunami in the area. Thirteen tsunamis big enough to inflict harm or damage have occurred in the past 150 years. San Diego has a tsunami advisory in place to alert the public when a big wave is approaching. San Diego's 70 miles of coastline make it vulnerable to tsunamis, even in the event of a far-off earthquake. A tsunami can strike the coast of California without an earthquake. There are other circumstances that could result in San Diego being devastated by a tsunami (La Jolla, n.d.).

I selected Midway district in San Diego, as it is one of the most important district with significant amount of population which potentially impacted by the tsunami. Midway has 24,921 residents as of 2021, with a median age of 33.1. There are 40.26% girls and 59.74% males among them. In Midway, 83.46% of the population is made up of citizens who were born in the US, compared to 9.53% who were not. In addition, non-citizens form 7.01% of the population. A total of 16,705

people in Midway currently live in the same house as they did last year (point2homes, n.d).

The Midway District has traditionally been a commercial center featuring eateries, shops, lodging facilities, and apartments. Pachenga Arena hosts major performances, and the Sports Arena Shopping Center is located nearby. The neighborhood serves as a vital link between Old Town, Downtown, the beaches, Loma Portal, Point Loma, North Bay, and Peninsula. With new commercial and residential options, the Midway District is experiencing a massive makeover.

When rising tides, strong waves, and other factors are taken into account, sea levels in San Diego and the rest of the West Coast could rise by four to eight inches over the course of the next 26 years, according to recent models from the USGS, the National Oceanic and Atmospheric Administration, and state models. The Midway Rising development team wants to construct 4,000 additional homes, including 2,000 affordable homes, a new sports complex, retail space, and open space. In its current form, the project would be the biggest affordable housing development ever constructed in San Diego. However, the increasing water table is causing environmental and local planning professionals to express alarm (Handy & Hargrove, 2023).

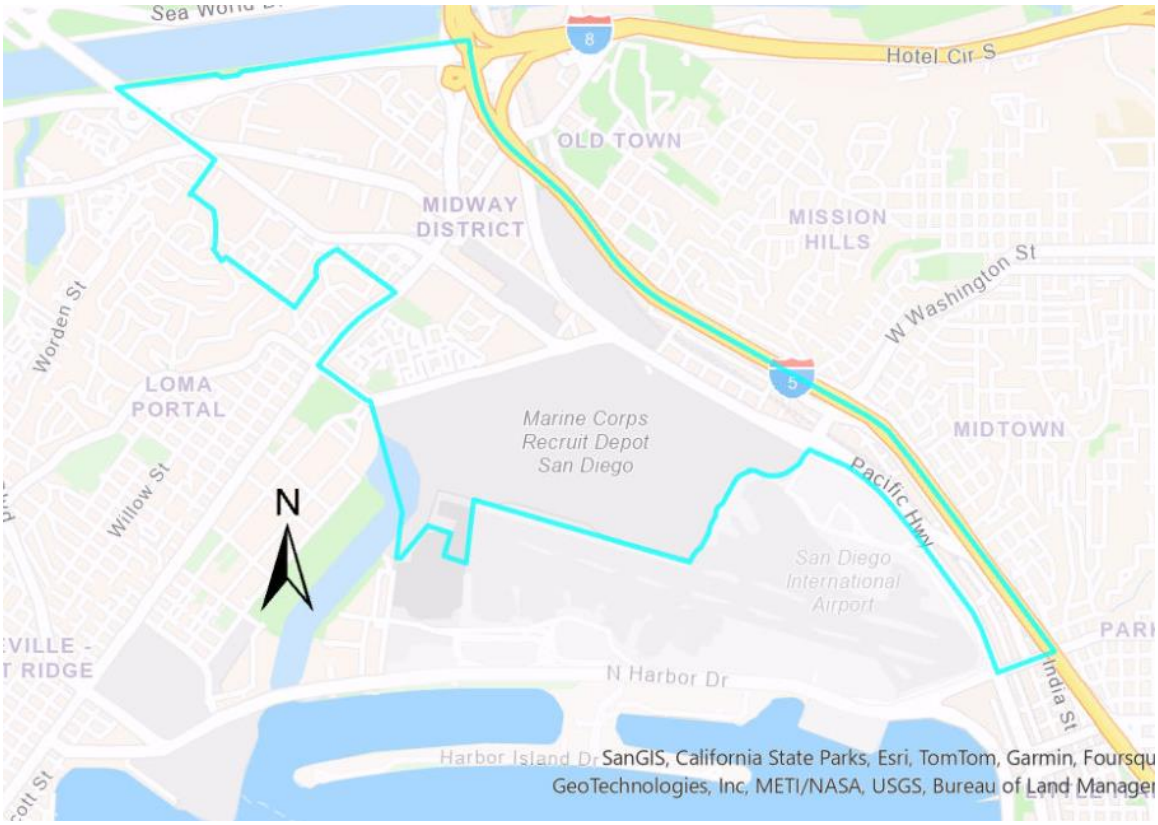
Increasing sea levels poses the greatest threat to tsunamis. Because rising sea levels can enable tsunamis to travel deeper inland and inflict much more damage, they have the potential to exacerbate already destructive tsunamis. Rising sea levels also lead to more exposed beaches, which increases the vulnerability of these coastal populations to an approaching tsunami by eliminating the natural buffer that would have previously absorbed the intensity of the wave.

3. Data Collection

Data is curated from diverse sources, encompassing Midway area courtesy of San Diego Open GIS Data Portal, sea level rise courtesy of the California State Geoportal, Arcgis online data, and demographic information derived from various sources.

Figure 1.

Midway District Map (Study Area)



4. Methodology

A variety of parameters were identified and then information concerning each parameter was collected to generate the primary database. The parameters that I identify and take in to consideration are:

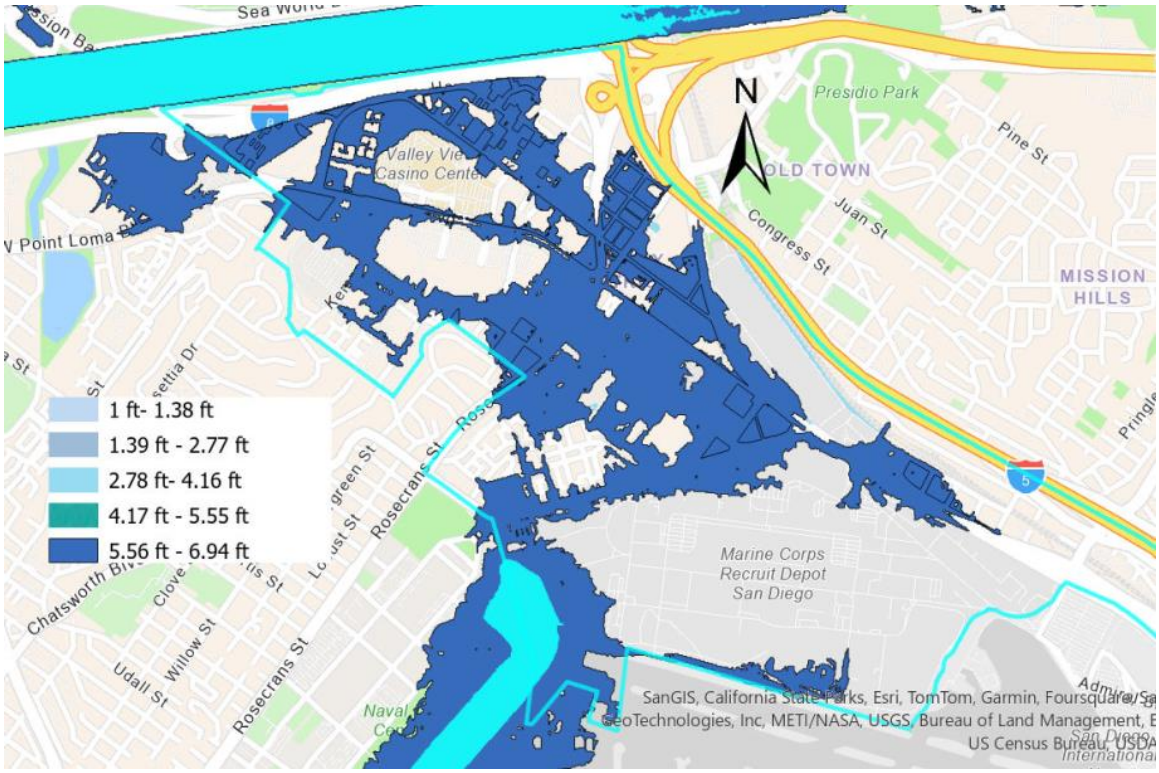
1. Sociological Data Population:
   - Median Income of the Population.
   - Building Usage & Population Density.

2. . Economic Data Land use:
   - Business Sites (shops, storage rooms, taverns, hotels, etc.).
   - Services (schools, hospitals, etc.).

When the predicted or observed tsunami height is more than 1.0 meter (3.3 feet) or the impact is unknown, the warning centers often issue a tsunami warning (tsunami.gov, n.d.).. I will analyse the sea level rise up to 6.94 feet and its impact on the selected parameters above.

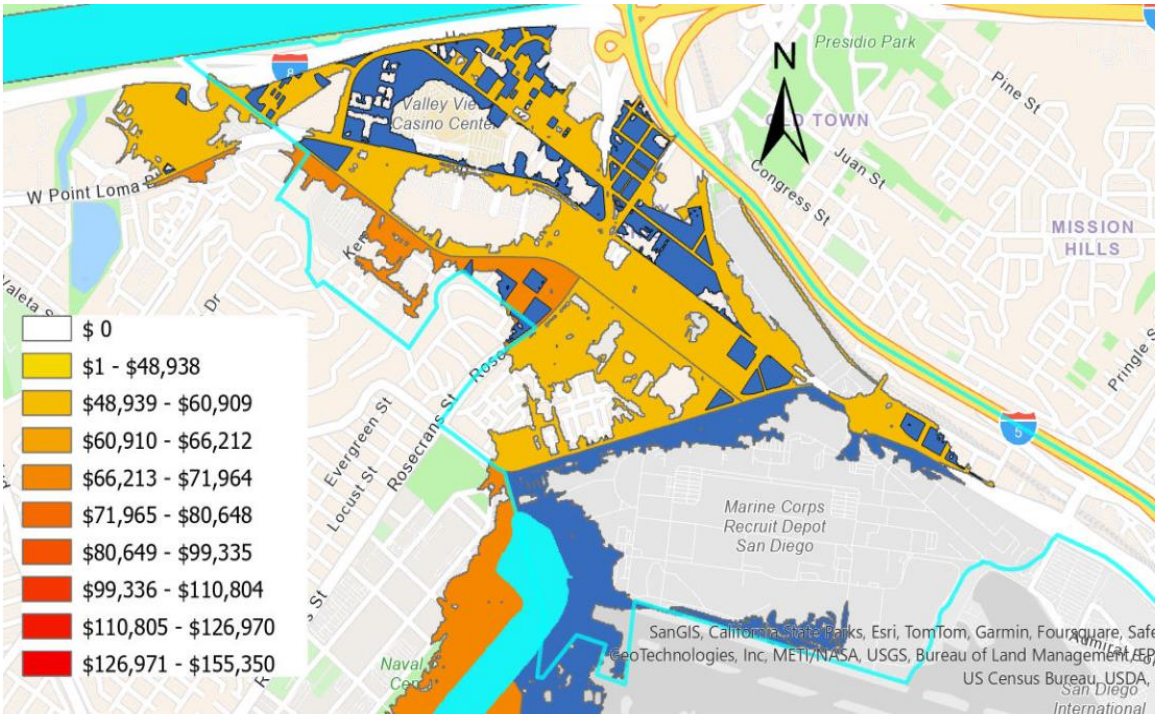
5. Analysis

Figure 2
The Inundation Depth Zones (up to 6.94 feet) of the study area.



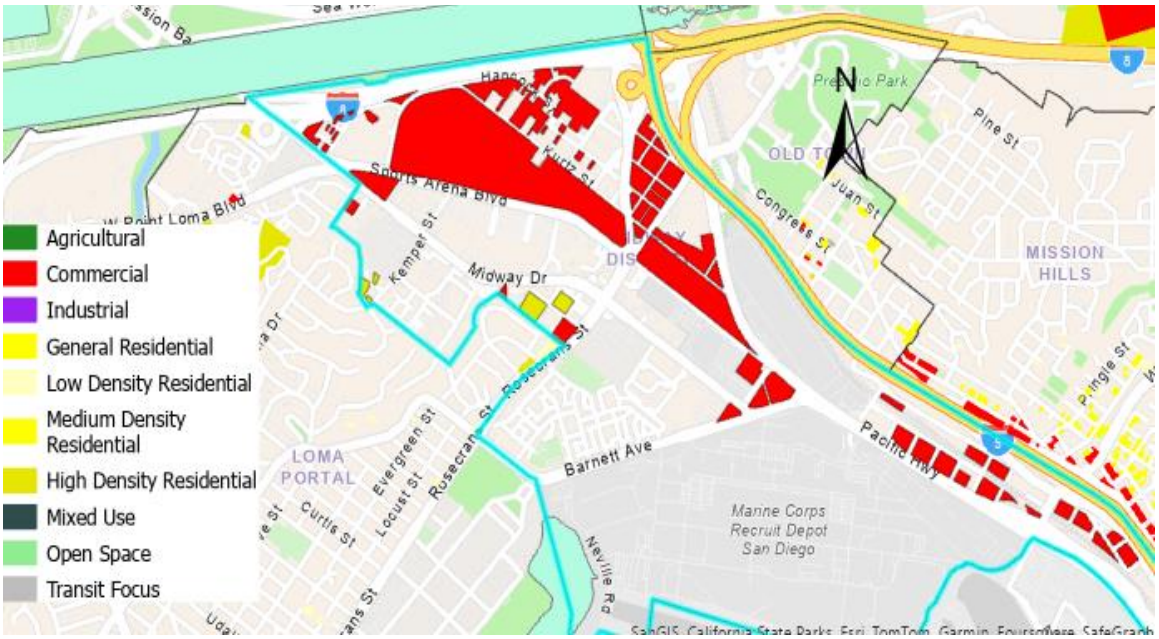
The map shows that half of Midway District will be impacted by the rising sea level. We can say that this district has a high vulnerability to tsunami hazards. The sea water will enter from the two water areas in the north and southwest parts of the district. The long area to the southeast, which aligns with the Pacific Highway, is not impacted, so we can describe this area as a safe zone. Aside from that, the neighboring districts in the Northeast and West are not impacted. This map can inform the public to stay alert when a tsunami warning is issued and to evacuate to the northeast, southeast, and west parts of the district.

Figure 3
Map showing the area with median income of the population per year within the study area.



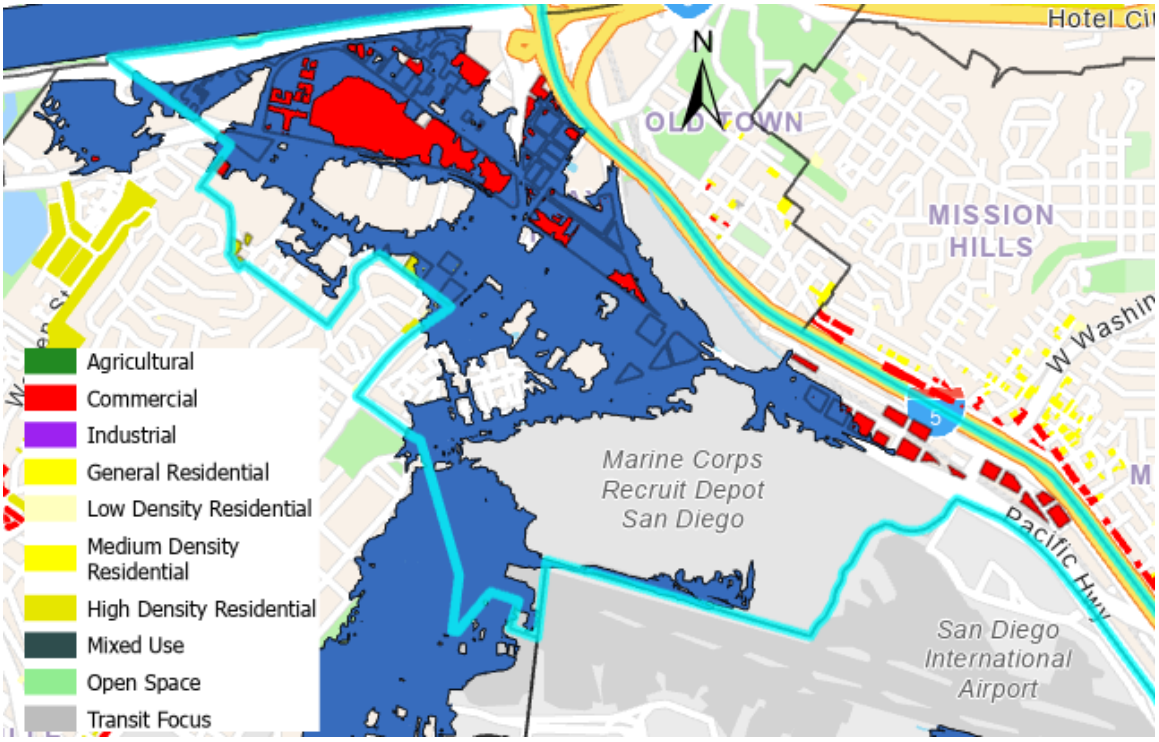
From the map, we can see that residents who have a median income between $48,939 and $60,909 will be affected the most by the rising sea level. Based on the 2024 poverty guidelines by the Office of Assistant Secretary for Planning and Evaluation, residents in those income ranges are living in poverty. The government of San Diego County should make a plan to provide incentives to assist them in recovering from the tsunami attack since they are the people who need it the most.

Figure 4
The building usage within the study area



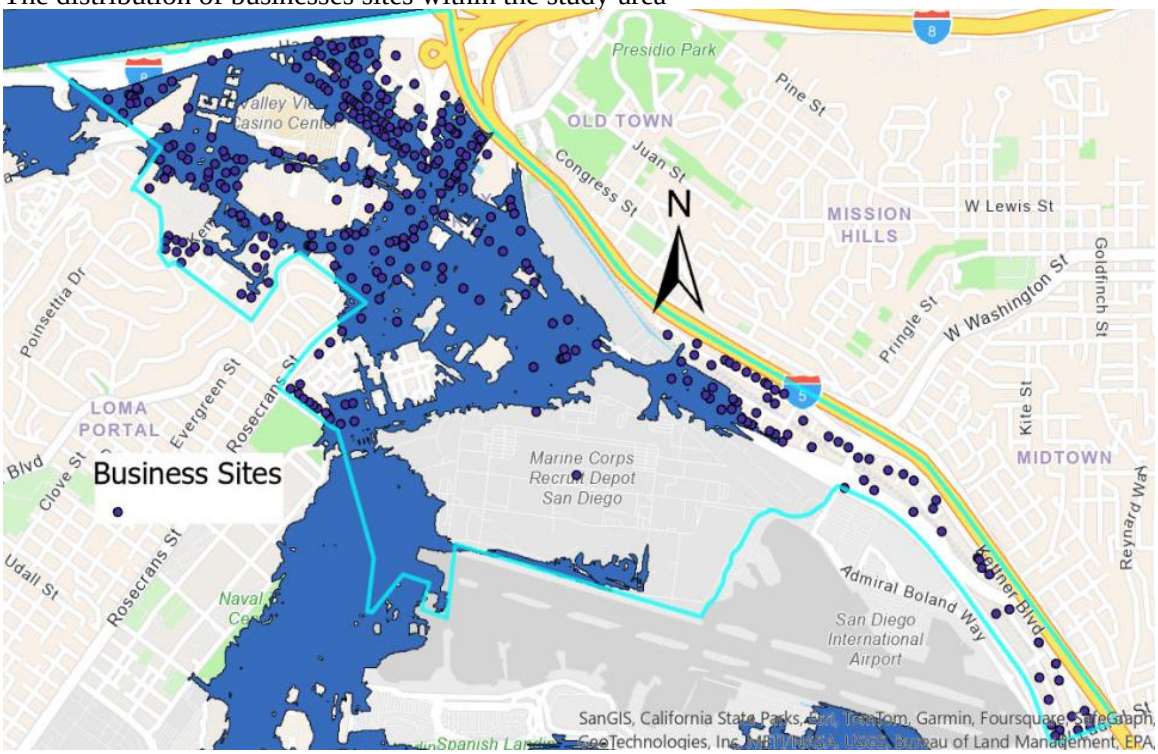
The map above describes that Midway District consists of commercial areas, low-density residential, and high-density residential.

Figure 5
The buildings affected by rising sea level based on usage.



The map shows that a large part of the district will be impacted by the rising sea level. Most likely, it will affect low-density residential and commercial areas. It could highly impact the economy sustainability in the district.

Figure 6.
The distribution of businesses sites within the study area



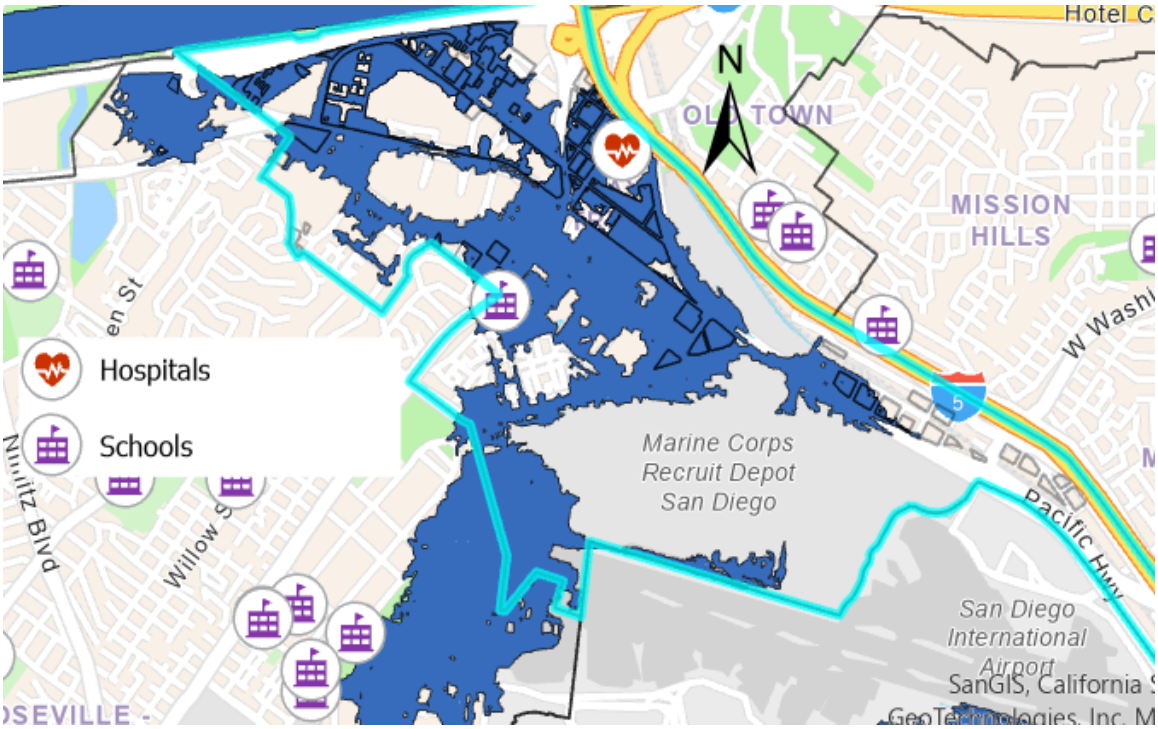
Point	4406630300	528	BENCHSD HOME COR...
Point	4411810800	93	VIP SD INC
Point	4411810800	632	HABANOS CAFE INC
Point	4411811300	37	PALLARDY MATT
Point	4411811300	61	LIVOLSI CORPORATION

0 of 984 selected Filters:

0 of 694 selected

The number of business sites within the study area is 984, and after using the summarize tool in ArcGis, it is known that the number of business sites affected by the tsunami is 694.

Figure 7
Map showing services within the study area



SAN DIEGO COUNTY PSYCHIATRIC HOSPITAL
3851 ROSECRANS STREET
SAN DIEGO
Dewey Elementary
3251 Rosecrans Street
3251 Rosecrans St.
San Diego

One hospital named San Diego County Psychatric Hospital located at 3851 Rosecrans Street and one school named Dewey Elementary School located at 3251 Rosecrans Street are affected by the

sea level rise. The government of San Diego must have a well-planned evacuation plan for these two service buildings since they host patients and children. It is necessary since they have limitations in mobility and need more assistance for directions during evacuation.

6. Limitations

The data on the business sites layer does not include how many employees each business has, so we cannot estimate the number of employees who will be impacted by the tsunami. The detailed data on the number of people living in the residential area was also not available during the working course of the project. It is predicted that the number of individuals will constantly change within this busy commercial district and public services. Therefore, I exclude the population number of people who will be affected by the tsunami in this project.

7. Conclusions

Based on the information and analysis conducted using GIS, we can conclude that Midway District, San Diego, has the vulnerability to be affected by a tsunami due to its location in between water areas. The government of San Diego County must create plans to evacuate several categories of people who inhabit the Midway district. They are residents, business owners and employees, students, medical staff, and patients. Each category needs a different evacuation plan because of the characteristic differences. Despite its size compared to the size of San Diego County, this district plays an important role since it has a wide range of occupancies. Even though the chance of a tsunami is low in the area, a well-thought-out plan is still required to save lives and economics.

Reference:

Alert San Diego.(n.d). *Tsunami.* Retrieved April 25, 2024
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Handy, S. & Hargrove, D. (2023, November 16). *Midway Water Rising: How rising sea levels may impact Sports Arena redevelopment*. Retrieved April 25, 2024
https://www.cbs8.com/article/news/local/midway-water-rising-rising-sea-levels-sports-arena/509-ae0b57c9-4486-4724-847d-aee12d500f6b

La Jolla (n.d). *Tsunami in San Diego*. Retrieved April 25, 2024
https://lajolla.com/article/tsunami-san-diego/

Point2homes (n.d). *Midway, San Diego, CA Demographics*. Retrieved April 25,2024
https://www.point2homes.com/US/Neighborhood/CA/San-Diego/Midway-Demographics.html

Tsunami.gov (n.d). *Tsunami Frequently Asked Questions*. Retrieved April 25, 2024.
https://www.tsunami.gov/?page=tsunamiFAQ#:~:text=In%20general%2C%20the%20warning%20centers,(1.6%20and%203.3%20feet)

Data Sources:

California State Geoportal https://gis.data.ca.gov/

San Diego Geographic Information Source https://www.sangis.org

The Office of Assistant Secretary for Planning and Evaluation https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines