

Analyzing Traffic Congestion in Downtown San Diego Using GIS

Introduction

Traffic congestion is a persistent challenge in urban areas, affecting daily commutes, air quality, and economic productivity. As a graduate student in Construction Engineering with a strong interest in traffic engineering, I explored this issue through a project that leveraged Geographic Information Systems (GIS) to analyze traffic congestion in Downtown San Diego, identify key contributing factors, and propose data-driven solutions for improving mobility.

Project Objectives

The primary goal of my project was to answer the research question: *What are the primary factors causing traffic congestion in San Diego, and how can GIS analysis help identify potential solutions?* By visualizing congestion patterns and correlating them with urban infrastructure and population density, I aimed to provide insights into possible mitigation strategies.

Data Collection and GIS Mapping

To conduct this analysis, I gathered data from multiple sources, including:

- **City of San Diego's Open Data Portal** (Traffic volume data)
- **SanGIS/SANDAG Regional Data Warehouse** (Land use, road network, and population density)
- **Caltrans Performance Measurement System (PeMS)** (Highway traffic conditions)

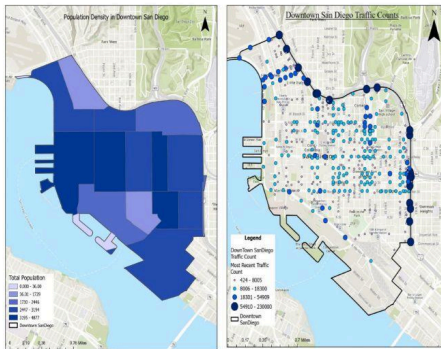
Using **ArcGIS Pro**, I created maps that illustrated:

- **Traffic volume patterns** across different times and locations
- **Congestion correlations** with land use, population density, and road infrastructure
- **Key congestion hotspots** in the central business district and surrounding areas
- **Influence of major urban features**, such as office buildings, universities, and parking facilities

Traffic Analysis in Downtown San Diego

What are the primary factors causing traffic congestion in downtown San Diego?

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INTRODUCTION

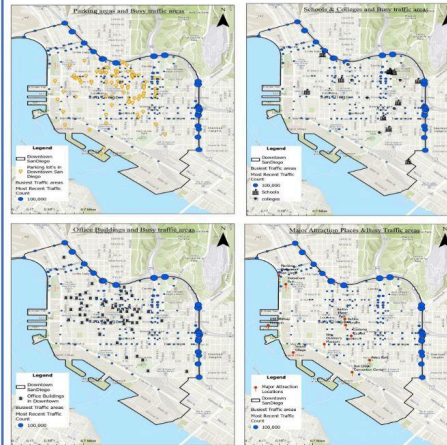
Downtown San Diego experiences significant traffic congestion during peak hours, with the morning rush occurring between 7:00 AM and 9:00 AM and the evening rush between 4:00 PM and 6:00 PM on weekdays. These time windows see the heaviest traffic on major roads and freeways leading into and out of the city center, creating challenges for commuters and visitors alike.

CONTRIBUTING FACTORS TO TRAFFIC

- **High Activity Density:** Downtown is a hub for business, shopping, dining, and entertainment.
- **Limited Street Capacity:** Narrow streets not designed for high traffic volumes.
- **Parking Challenges:** Limited parking leads to increased circling and congestion.
- **Events and Conventions:** Frequent large events significantly increase traffic, especially near convention centers.
- **School Traffic:** The increase in parents driving children to school has led to a notable rise in traffic during school hours.

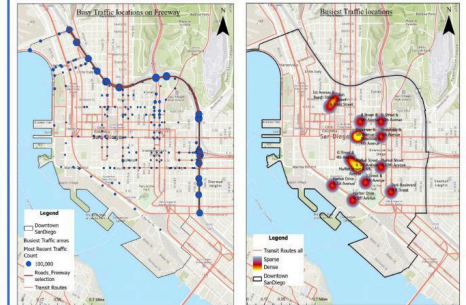
DATA USED

- Population Data: SANDAG, SanGIS.
- Road: SanGIS Regional Data Warehouse, Caltrans highway data.
- Schools: SanGIS location data.
- Transit Routes: SANDAG transportation datasets.
- Places: SanGIS community planning layers.
- Traffic Volume Data: AADT: Caltrans Traffic Census Program.
- Data range: 2020 – 2022.



RESULT OF STUDY

- The study's findings reveal the top 10 busiest intersections. These congestion hotspots are primarily due to several factors:
- High concentration of offices, leading to commuter traffic.
 - Public and private parking facilities, causing circling and congestion.
 - Increased traffic from parents dropping off students at schools.
 - Hotspots like Gaslamp Quarter and Balboa Theatre attracting visitors.
 - Intersection with major transit routes, creating bottlenecks.



IMPROVEMENT AREAS

- Encourage the use of public transit options like buses and trolleys to alleviate road congestion.
- Implement intelligent transportation systems using adaptive software to improve mobility throughout the region. This includes upgrading traffic signals, using video detection, and communication upgrades to optimize traffic flow.
- Deploy real-time parking information systems to guide drivers to available parking spots, minimizing circling and reducing congestion.
- Align urban development with transit needs, promoting Transit-Oriented Development and multi-modal infrastructure.

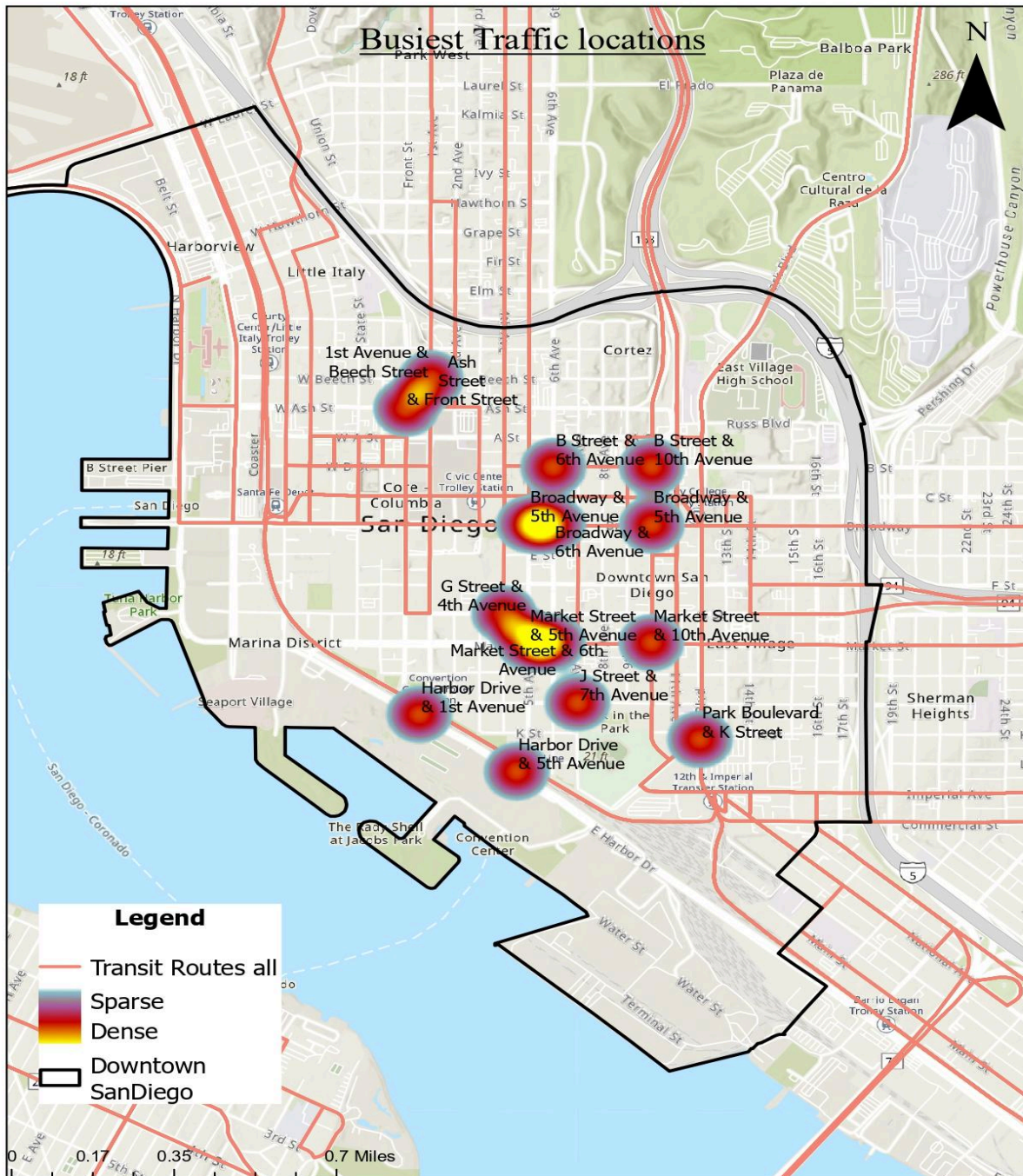


Findings and Key Insights

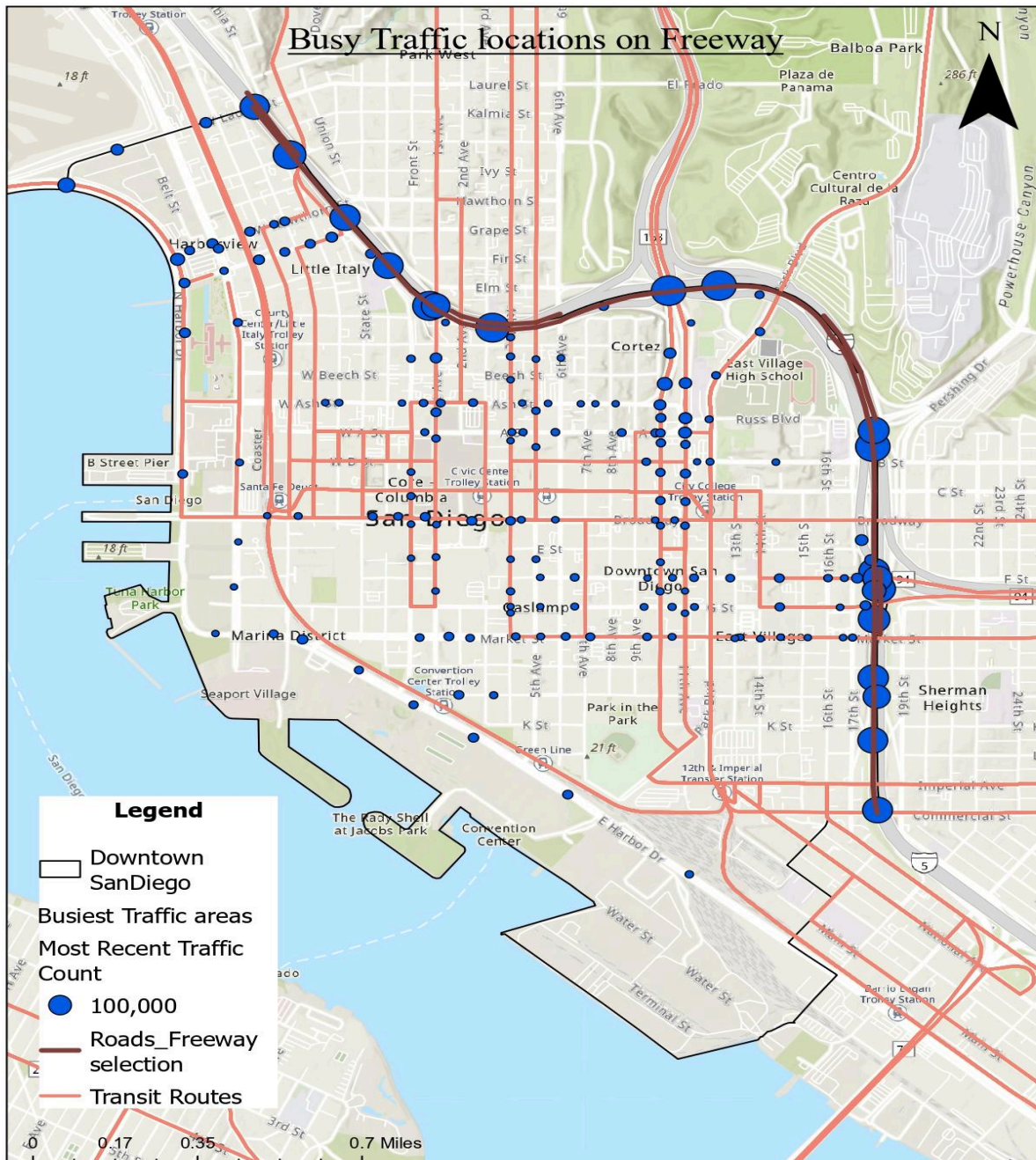
Through GIS analysis, I identified several major congestion factors:

1. **Parking Lot Scarcity:** The lack of sufficient parking spaces led to vehicles circling in search of spots, exacerbating traffic bottlenecks.

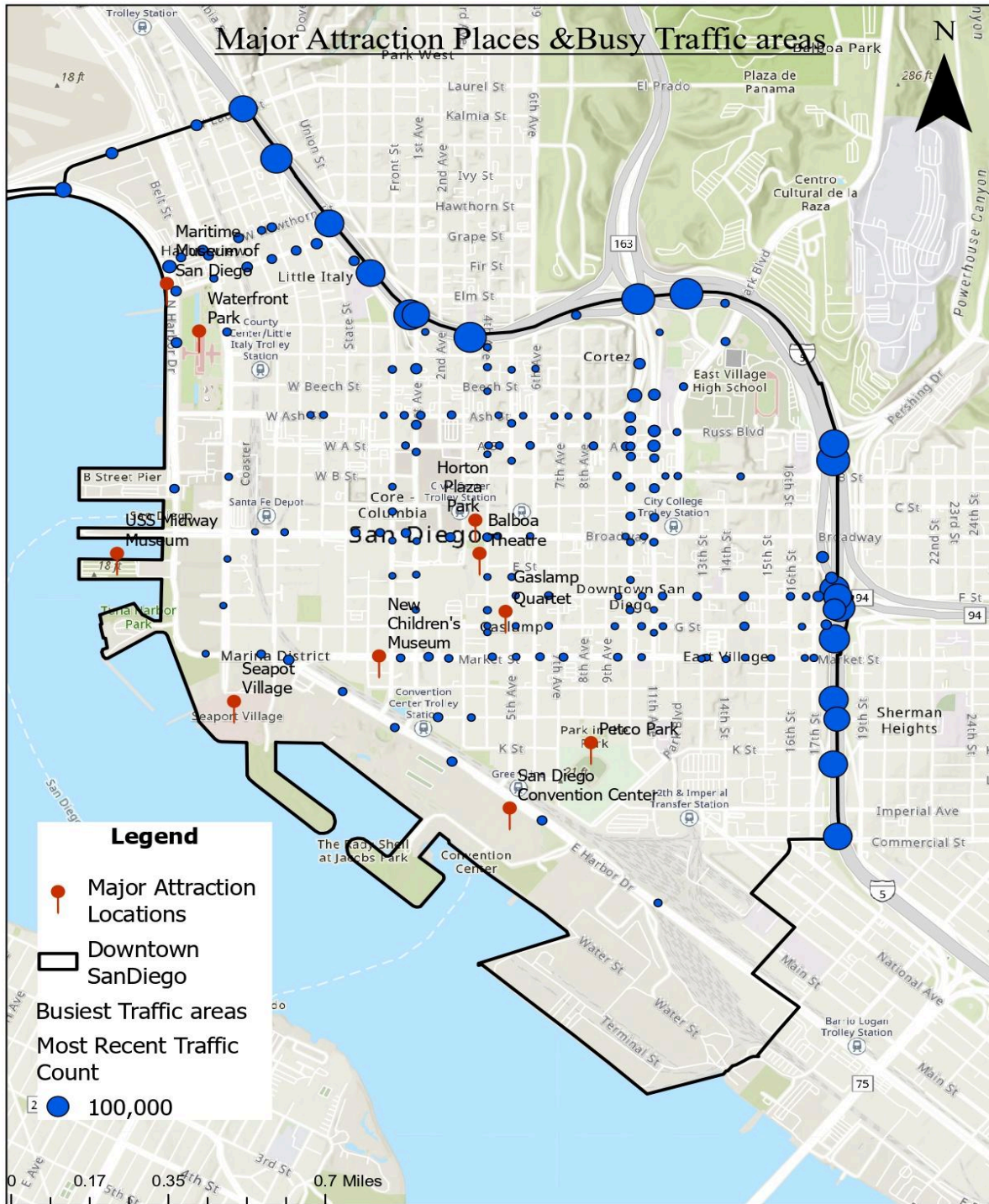
2. **High-Density Zones:** Areas with a mix of commercial, residential, and educational institutions experienced consistent congestion, particularly during peak hours.



3. **Traffic Flow on Freeways:** Major freeway junctions near Downtown San Diego exhibited significant congestion due to high commuter volume.



4. **Tourist and Event-Driven Congestion:** Attractions and event venues contributed to periodic spikes in traffic, further straining infrastructure.



Proposed Solutions

Based on the findings, I recommended the following strategies to improve urban mobility in Downtown San Diego:

1. **Enhancing Public Transit:** Encouraging the use of buses and trolleys to reduce road congestion.
2. **Implementing Intelligent Transportation Systems:** Upgrading traffic signals, deploying video detection, and enhancing communication infrastructure to optimize traffic flow.
3. **Real-Time Parking Information Systems:** Installing systems that guide drivers to available parking spots, minimizing unnecessary circulation and reducing congestion.
4. **Transit-Oriented Development (TOD):** Aligning urban development with public transit to promote multi-modal infrastructure and sustainable mobility.

Conclusion

This project demonstrated how GIS analysis can be a powerful tool in understanding and addressing urban traffic congestion. By leveraging spatial data, city planners and engineers can make informed decisions to enhance transportation efficiency, improve quality of life, and work towards sustainable urban development.

As a student passionate about transportation engineering, this project deepened my understanding of real-world congestion issues and potential technological solutions. Moving forward, I aim to continue exploring innovative strategies for improving urban mobility through data-driven approaches.