

Enhancing Sustainability in The River Mile Development
Robyn Bardmesser, Wyatt Edeker, Eliza Grace, Jessica Hertzberg

Project Context

The River Mile Development is an upcoming mixed-use, high density neighborhood in Denver's urban core, revitalizing the South Platte River waterfront. It is pivotal for Denver because of its history of land use and transportation. Back before cars dominated our urban landscapes, Denver was a high-density city that you could traverse by tramlines. With the advent of the car and centering all urban development around the mobility of single occupancy vehicles, Denver was remade into low density sprawl. This is an inefficient and environmentally costly form of land use because of the land conversion, impacts of the emissions from cars, and all the infrastructure needed to support that. Restoring a high density, walkable public realm is a precondition for a thriving city that fights climate change, but changing what has already been built and habits that have been cemented for decades is hard. The future River Mile development will drive us towards this vision of Denver. It is the redevelopment of Elitch Gardens, a 63 acre site at the convergence of multimodal transportation in the city. Our capstone project consisted of three deliverables that altogether enhance the sustainability of The River Mile development. We created a Transit Plaza Master Plan, conducted a study on the autonomous transit system around the site, and evaluated options for a solar facade.

Transit Plaza

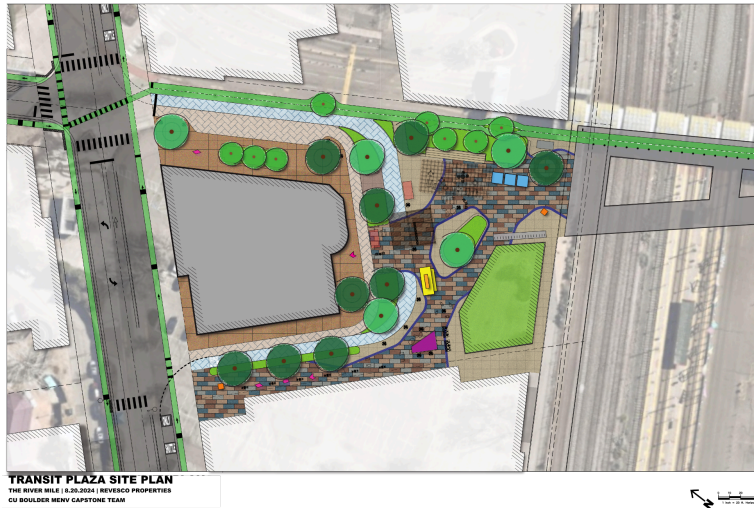
The Transit Plaza is a 0.79 acre pocket park welcoming visitors, commuters, and residents to the River Mile crossing over from Ball Arena and the RTD Light Rail Stop on the bike/ped bridge. We started with the constraints and features of the Plaza. Of note, is the autonomous circulator shuttle stop, the 9th Street Mews, which is a pedestrian only connection to the Riverfront Plaza. We collaborated with our partners to develop four principles guiding this plan.

1. Reduce conflicts between travel modes, for example rideshare and pedestrians.
2. Sustainable and ecological design choices.
3. Cultivate a feeling of safety and inclusivity.
4. Draw people in through activities and use, comfort, and sociability. At the end of the day, people gravitate towards community, and we designed the Transit Plaza to become part of that fabric for The River Mile.

We started by looking at transit-oriented public spaces around the world and narrowed down to four case studies around the United States that are similar in size and context to The Transit Plaza and provide an active use aside from transportation. These are Rosslyn, VA, Southwest D.C. Waterfront, Decatur, Georgia, and Philadelphia. We took inspiration from these sites on how to leverage the traffic from a transit stop and harmonize with neighborhood placemaking. We also researched who would be using the Transit Plaza, at what times of day and year, what their needs are, and how they might move around the space. This research informed our mobility and wayfinding designs.

We started by ideating ways the transit plaza could be used based on the case studies we researched and ideas we came up with as a team. We prioritized placemaking ideas that enhanced mobility, created a feeling of safety, and developed a sense of place. We looked at both permanent elements and events and programming that could enhance the site and we translated those ideas into the design. Once we had developed a working list of all of the ways the Transit Plaza could be used, we began to explore how to create space that complemented the usages and the users of The Transit Plaza. We looked at all of this space we had and started by planning for the mobility needs of users. We added a bike lane for riders coming over the bridge, a big walking path for pedestrians, and a dedicated lane for the autonomous shuttle to drop off and pick up passengers. We then chose to explore four designs that each hyper-focused on a different goal. We called these our design overlays and they were Aesthetic, Mobility+, Play, and Commercial. As we progressed, each of these plans was formalized into CAD, an engineering drawing software, and shown to the River Mile Team for feedback.

After reviewing our four overlay designs again, we worked with Reveso and the project team to identify the best elements of each design. We then created one final design that incorporated the best



parts of each overlay. In addition to the design of permanent infrastructure, placemaking is an important layer to our master plan. We developed a wayfinding map with recommended signage to help people move throughout the space and plans for lighting the Transit Plaza to increase safety measures. We created a profile of native, low-water planting that was chosen to include plants that bloom throughout the season and that are pollinator friendly, and we also created dedicated space for art and play along with market space, greenspace, an urban cabana, and so much more.

Autonomous Shuttle

The River Mile design incorporates a dedicated shuttle lane, which will connect to Union Station by 2035 and Meow Wolf by 2050. You might be wondering why an AV shuttle system is relevant to an MENV Capstone project. Well, they are electric, zero-emission vehicles that reduce local transportation's carbon footprint. Additionally, they:

- Enhance safety by reducing traffic fatalities, as 94% of crashes result from human error.
- They save time through improved last-mile connectivity which reduces the need for single-occupancy vehicles, and
- They offer cost-effective public transportation, as The River Mile's shuttle service will be free and connect to existing RTD lines.

For the study, we selected cases to dig into based on their relevance to the river mile:

1. **First is the Colorado School of Mines' Rover Project:** which was the largest AV deployment attempt in the US at the time, we investigated why this project was taken off the roads after 4 months, providing many lessons learned right here in Colorado.
2. **Next is the Move Nona Project in Florida:** which is the largest AV network still operating in the states, which demonstrates how to integrate with existing city infrastructure.
3. **Third, we studied the Zoox Project in California** known for its advanced technology. As you can see in the photos, the company is developing systems to navigate ambiguous situations on the road such as construction, bikers, and emergency vehicles.

These studies informed us on the do's and don'ts of operational logistics and public engagement strategies.

Our research included ten interviews with AV industry experts, CDOT staff, and the National Highway Traffic Safety Administration director, which deepened our understanding of the state and future of the industry. All of this interviewing and research lead to three main takeaways.

1. **Our first takeaway is the importance of Public Engagement & First Responder Training:** Successful public engagement was crucial in Move Nona's success, whereas its absence contributed to the downfall of the Mines Rover Project.
2. **Second, Wayfinding & Information Access proved essential for user experience.** We recommended a robust information system with digital displays, clear maps, and real-time shuttle

tracking.

3. **Our final takeaway is the importance of advancements in Accessibility:** AV shuttles are increasingly being designed for inclusivity with features like self-deploying ramps and wheelchair locks, increasing equitable access to this transit system.

Since The River Mile's AV shuttles won't launch until 2035, we propose interim uses for the shuttle lane, such as parklets, street vendors, art installations, and movable planters. We also recommend gathering public feedback before launch, displaying information to engage the public in decision making such as a voting on what art should be displayed on the shuttle or what the shuttle service should be named.

Overall, the AV shuttle initiative supports The River Mile's emission reduction goals while utilizing micro mobility to connect the site to greater Denver.

Solar Facade Study

This solar panel study analyzes three options for using facade solar along the retaining wall of The River Mile, facing the Consolidated Main Line (CML). System 1 is sized at 425 kW, System 2 is at 151 kW, and System 3 is at 105 kW. System 1 has been designed to take full advantage of the wall, providing the maximum amount of power within that space. System 2 is designed to make the transit plaza building operate at net-zero parameters with the panels being installed at 90 degrees. System 3 also allows the Transit Plaza building to operate at a net-zero capacity with the difference being the panels will be installed at 20 degrees along the face of the wall. The viability of a project like this has been proven around the world and in Colorado. As solar panels and the subsequent systems around them improve, solar walls have been able to take shape. Where once solar panels could only exist in very specific circumstances they can now exist in a broader environment.

The three proposed solar panel systems offer distinct approaches to optimizing energy production for the River Mile project, each with unique advantages and trade-offs.

Coverage and Space Utilization:

- **System 1** covers the largest area at 15,930 square feet, fully utilizing the southeast wall of the River Mile.
- **System 2** and **System 3** do not have specified coverage areas but have reduced installation costs and smaller footprints.

Panel Orientation and Seasonal Performance:

- **System 1** is set at a 90-degree angle (perpendicular to the ground), optimizing for winter performance and providing consistent year-round power.
- **System 2** is set at a 90-degree angle and optimizes annual energy balance. This provides net-zero power generation for the Transit Plaza Building.
- **System 3** is set at a 20-degree angle, optimizing for summer performance and accepting reduced winter output. This provides net-zero power generation for the Transit Plaza Building.

Energy Production and Net-Zero Capability:

- **System 1** produces the highest annual energy at 437,024 kWh, sufficient for 53 households, providing the most significant impact in terms of energy offset.
- **System 2** produces 163,980 kWh annually, specifically targeting the Transit Plaza Building's needs, achieving net-zero energy status.
- **System 3** produces 156,512 kWh annually, also exceeding the building's annual power requirements but with lower total energy production compared to System 1.

Installation and Maintenance Costs:

- **System 1** implies higher costs due to the larger number of panels and extensive coverage area.
- **System 2** and **System 3** would likely incur lower installation costs due to fewer panels and a smaller footprint. System 2 may have lower installation costs than System 3, according to Namaste Solar.