

# A People's Audit of the Mon-Oakland Connector

Why Shuttles (With or Without Drivers) in the Mon-Oakland Corridor Are Not a Mass Transportation Solution



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**“Even during this pandemic, I am still taking the bus everyday; to work in Oakland, to buy groceries in Squirrel Hill or Homestead, and to get my son to doctor’s appointments at Children’s Hospital. Because we don’t have weekend service on the 93, I have to take two buses and choose between arriving at work an hour early or late. Having the 75 to take us directly to Southside grocery stores and Oakland would be a huge benefit for me and my neighbors.”**

**Deanna Turner, Hazelwood Resident & Public Transit Rider**

# Introduction

The City of Pittsburgh's proposed Mon-Oakland Connector (MOC) purports to ease ["moving among Hazelwood, Greenfield, Oakland, and Squirrel Hill without the use of a personal vehicle ... \[as well as allow\] residents in the Hazelwood neighborhood to access jobs and amenities in these other neighborhoods."](#)

The City has allocated \$23 million from its unrestricted Capital budget to build a new roadway through Schenley Park between the Hazelwood Green development site and Carnegie Mellon University (CMU) & Pitt campuses. The proposed roadway would exclusively serve a number private-operated but publicly accessible "micromobility solutions" -- shuttles, e-scooters, pods, etc. -- however, operations details have been largely removed from the City's recent plans and specifics around fare costs, ADA accessibility, electric vehicles, and public v private ownership have left residents' questions unanswered.

Residents of affected neighborhoods have put forward an alternative transportation plan entitled, "Our Money, Our Solutions". Their plan centers Port Authority transit service improvements: extending the 75 from the South Side over the Hot Metal Bridge into Hazelwood, and providing weekend service on the 93. In addition, residents are calling for transit-signal priority (green lights for buses) to speed up service, streetscape improvements, and investments in closing major gaps in the pedestrian and bike networks.

This report shows that resident recommendations around public transit improvements would be vastly more effective at achieving the mass mobility goals laid out by residents, the City and the stakeholder institutions -- like Hazelwood Green, CMU, Pitt, and UPMC -- than the proposed MOC roadway through Schenley Park. We break it down for you in the following analysis.

As a note, the City's proposal has been difficult to pin down because it has shared so little about the MOC's specifics. This analysis draws from the most recent publicly available information about the project; first, a set of Right-to-Know documents from Spring 2019 that lays out the anticipated speed of shuttle connections to various destinations; and second, the City's [Mon-Oakland Mobility plan](#) report on routing and ridership. The City's plan for a driverless micro-transit shuttle service **would presumably use the most optimistic projections for a successful "transit" deployment in the Mon-Oakland corridor**, and would remain largely similar to having a manned micro-transit shuttle service except for the additional operating cost. It is important also to recognize that because the City in this latest and final plan only anticipates building a road, and not running any transportation service, that there is no guarantee that any of these best-case projections or scenarios would be put forward by a private operator.

# The People’s Audit: A Breakdown

## The Mon-Oakland Shuttle Serves the Least Number of People at High Cost

Using the numbers from the [Hazelwood Green Long-Range Transportation Plan](#) (LRTP), we added a comparison for the Mon-Oakland Connector for Capital Cost measures as well as ridership served.

It becomes clear that the Mon-Oakland Connector is the project serving the least number of future riders, while coming at a significant price tag.

Currently the Almono site is built out for 90,000 square feet of development, but this is soon expanding to almost 8 million square feet of development.

| Almono Projections | Total Projected Transit Trips<br>(Using 17% Citywide Transit Estimate) |                       |        |
|--------------------|--|-----------------------|--------|
|                    | Year   | Total Projected Trips |        |
| Phase 1 Buildout   | 2028   | 20,413                | 3,470  |
| Full Buildout      | 2040   | 61,000                | 10,500 |

When estimating the maximum capacity of the Mon-Oakland Connector, a generous estimate was applied using an estimate of 9- to 15-person capacity shuttles operating in the shorter Oakland-Hazelwood Green loop at 30 minutes each. Even with this estimate, the Mon-Oakland Connector lagged significantly behind every other transit alternative, with its maximum servicing only 38% of demanded transit trips. Contrast this with a Bus Rapid Transit solution on Second Avenue, which would serve all demanded transit trips with additional capacity to spare. **Shuttle consolidation—where CMU, University of Pittsburgh, and UPMC have more coordinated shuttle operations—provides similar levels of service to the Mon-Oakland Connector without any public funding requirements.**

| Weekday Peak Hour and Daily Capacity by Project | Max Passengers Per Vehicle | Peak Hour Capacity | Daily Capacity | % of Projected 10,500 Ridership |
|---|----------------------------|--------------------|----------------|---------------------------------|
| Bus Rapid Transit on Second Avenue              | 80                         | 960                | 14,080         | 134%                            |
| Commuter Ferry                                  | 149                        | 596                | 5,960          | 57%                             |
| Oakland-Hazelwood South Side Gondola            | 8                          | 960                | 17,280         | 165%                            |
| Consolidated Shuttle Services                   | 50                         | 300                | 4,400          | 42%                             |
| Frequent, Fast One-Seat Ride to Oakland         | 50                         | 600                | 8,800          | 84%                             |
| Mon-Oakland Connector                           | 15                         | 270*               | 3,960          | 38%                             |

LRTP, Appendix B, Table 4 + \*Estimates from Mon-Oakland Mobility Plan

We then compared the transit assignment estimates (assigning riders by preference for faster, rapid service) to the estimates projected for the Mon-Oakland Connector (daily ridership estimates of 1,244 total). This projected ridership estimate again compares **fairly evenly with consolidated shuttle services**.

| Conceptual Ridership Estimates and Remaining Capacity by Project | % of Daily Boardings | HG-Generated Weekday Ridership | Remaining Daily Weekday Capacity |
|--|----------------------|--------------------------------|----------------------------------|
| Bus Rapid Transit on Second Avenue                               | 40%                  | 4,200                          | 9,900                            |
| Commuter Ferry   | 10%                  | 1,000                          | 5,000                            |
| Oakland-Hazelwood South Side Gondola                             | 25%                  | 2,600                          | 14,700                           |
| Consolidated Shuttle Services                                    | 10%                  | 1,000                          | 3,400                            |
| Frequent, Fast One-Seat Ride to Oakland                          | 15%                  | 1,600                          | 7,200                            |
| Mon-Oakland Connector*   | 11.8%                | 1,244*                         | 2,716                            |

LRTP, Appendix B, Table 5 + \*Estimates from Mon-Oakland Mobility Plan

Without even comparing the staggering operating cost differences and simply looking at the estimated capital cost, it becomes hard to understand why the Mon-Oakland Connector was selected for capital funding. Its maximum capacity only seems suitable for a very short term till 2028, whereas the Second Avenue BRT provides an extremely viable long-term solution.

| Estimated Capital Costs by Project                | Definition                            | Comparable Project Unit Costs                                    | Estimated Capital Cost |
|---|---------------------------------------|--|------------------------|
| Bus Rapid Transit on Second Avenue                | 4 mile alignment with 6 stops         | Pittsburgh Downtown-Uptown Oakland East End BRT (\$13.4M / mile) | \$54M                  |
| Commuter Ferry                                    | 4 new docks; 5 new commuter ferries   | Washington State Ferries (\$3M/dock, \$2M/boat)                  | \$22M                  |
| Oakland-Hazelwood South Side Gondola              | 1.6 alignment with 3 stations         | Portland Aerial Tram (\$43.5 M /mile), 15% for an add. station   | \$80M                  |
| New Park and Ride Facilities                      | Up to 3 new facilities                | Comparable Local Park & Ride projects                            | ~\$1M                  |
| Consolidated Shuttle Services                     | Consolidated Pitt, CMU, UPMC shuttles |  | None                   |
| Frequent, Fast One-Seat Ride to Oakland (PAAC)    | PAAC operated rapid service           |  | None                   |
| Frequent, Fast One-Seat Ride to Oakland (Private) | Privately operated rapid service      |  | None                   |
| Mon-Oakland Connector                             | "Interim rapid transit connection"    |  | \$23M                  |

L RTP, Appendix B, Table 1 + Estimates from Mon-Oakland Mobility Plan

With free fares and operating cost estimates on the Mon-Oakland Connector only available during its five-year pilot phase (p.38-39 of the Mon-Oakland Mobility Plan), the \$23M capital investment and additional \$16M vehicle purchase and operating costs amounts to a total of \$39M for a 5 year short term solution.

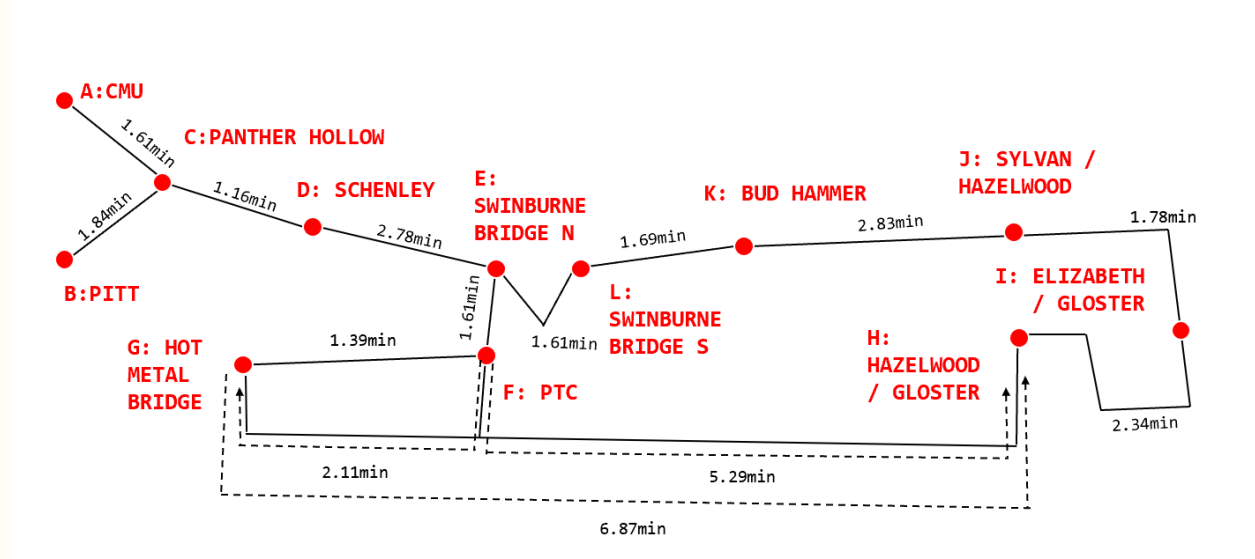
| Description                                | AV (Unmanned)       | AV (Manned)         | EV (Manned)         |
|--|---------------------|---------------------|---------------------|
| Prepare for Pilot                          | \$124,400           | \$124,400           | \$104,400           |
| Conduct Testing                            | \$66,575            | \$66,575            | \$17,975            |
| <b>Subtotal - Pilot Preparation</b>        | <b>\$190,975</b>    | <b>\$190,975</b>    | <b>\$122,375</b>    |
| Conduct the Pilot (O&M Service) - Lease    | \$14,562,961        | \$16,404,442        | \$16,819,634        |
| <b>Total Cost - Lease</b>                  | <b>\$14,753,936</b> | <b>\$16,595,417</b> | <b>\$16,942,009</b> |
| Conduct the Pilot (O&M Service) - Purchase | \$10,366,285        | \$12,552,675        | \$15,963,999        |
| <b>Total Cost - Purchase</b>               | <b>\$10,557,260</b> | <b>\$12,743,650</b> | <b>\$16,086,374</b> |

## All Else Equal, the Travel Times Don't Justify the Cost

We recreated their path and calculated the fastest possible travel times given shuttles traveling at a maximum of 15 mph. This did not take into account elevation, which for spots such as the transition from Swinburne Bridge South to North requires such a significant change in elevation that the City has proposed using an elevator for the shuttles to reach one level or the other. Elevator wait, roadway traffic, and the other unexpecteds of travel on shared right-of-ways are not included in these estimates of travel times as well.

| Mon-Oakland Loop            | City's Estimate of Time | Our Estimate of Time | Notes  |
|-----------------------------|-------------------------|----------------------|--|
| Full Loop ("Worst Case")    | 44                      | 52.2                 | 1 min / stop, visiting all stops                   |
| Oakland Loop                | 19                      | 19.25                | 1 min / stop, visiting all stops                   |
| Hollow Corridor             | 5                       | 5.94                 | Going one way, 1 min at each stop                  |
| Sylvan/Hazelwood corridor   | 7                       | 12.46                | If the route were to connect back to Swinburne     |
| Sylvan/Hazelwood corridor   | 7                       | 8.67                 | If the route were not to connect back to Swinburne |
| Hazelwood Green to PTC loop | 10                      | 27.86                | Complete PTC and Hazelwood loop                    |
| PTC* to Hollow Corridor     | 3                       | 7.76                 | From Panther Hollow to PTC                         |

\*PTC: Pittsburgh Technology Center





We calculated the time it would take to travel from Second & Hazelwood using the Mon-Oakland travel times of 15 mph, with 1 minute per stop. The total time ends up being 22 minutes to either the University of Pittsburgh stop on Forbes and Bigelow, or the Carnegie Mellon University stop on Neville Street below Forbes, which requires an elevator ride or long set of stairs to get to the university.

In running a comparison taking into account transfer and walking times, it is hard to see significant benefit to the shuttle over existing transit options. With the proposed extension of the 75, shown farther below in the report, the travel time savings becomes even more significant.

|  | Transit + Walking Time | Existing Transit Options | Mon-Oakland Time* | Mon-Oakland (MO) Route  |
|--|------------------------|--------------------------|-------------------|-------------------------|
| <b>Second &amp; Hazelwood to Beacon &amp; Murray</b>       | 11 min                 | 93                       | 33 min            | MO to Forbes, 61        |
| <b>Second &amp; Hazelwood to Grant Street &amp; 6th St</b> | 23-25 min              | 56, 57                   | 42 min            | MO + walk to 5th, 61/71 |
| <b>Second &amp; Hazelwood to CMU</b>                       | 23-25 min              | 93 to 61, 56 to 61/67/69 | 22 min            | MO                      |
| <b>Second &amp; Hazelwood to UPitt</b>                     | 28-34min               | 93, 56 to 61/67/69       | 22 min            | MO                      |
| <b>Second &amp; Hazelwood to UPMC Montefiore</b>           | 25-29 min              | 93, 56 to 61/67/69       | 32 min            | MO + walk               |
| <b>Second &amp; Hazelwood to UPMC Presbyterian</b>         | 26-30 min              | 93, 56 to 61/67/69       | 34 min            | MO + walk               |

\*See Appendix Tables 1 and 2 for Mon-Oakland Hazelwood to Oakland time calculations

## The Mon-Oakland Shuttle Leaves Half of Commuters Without Options

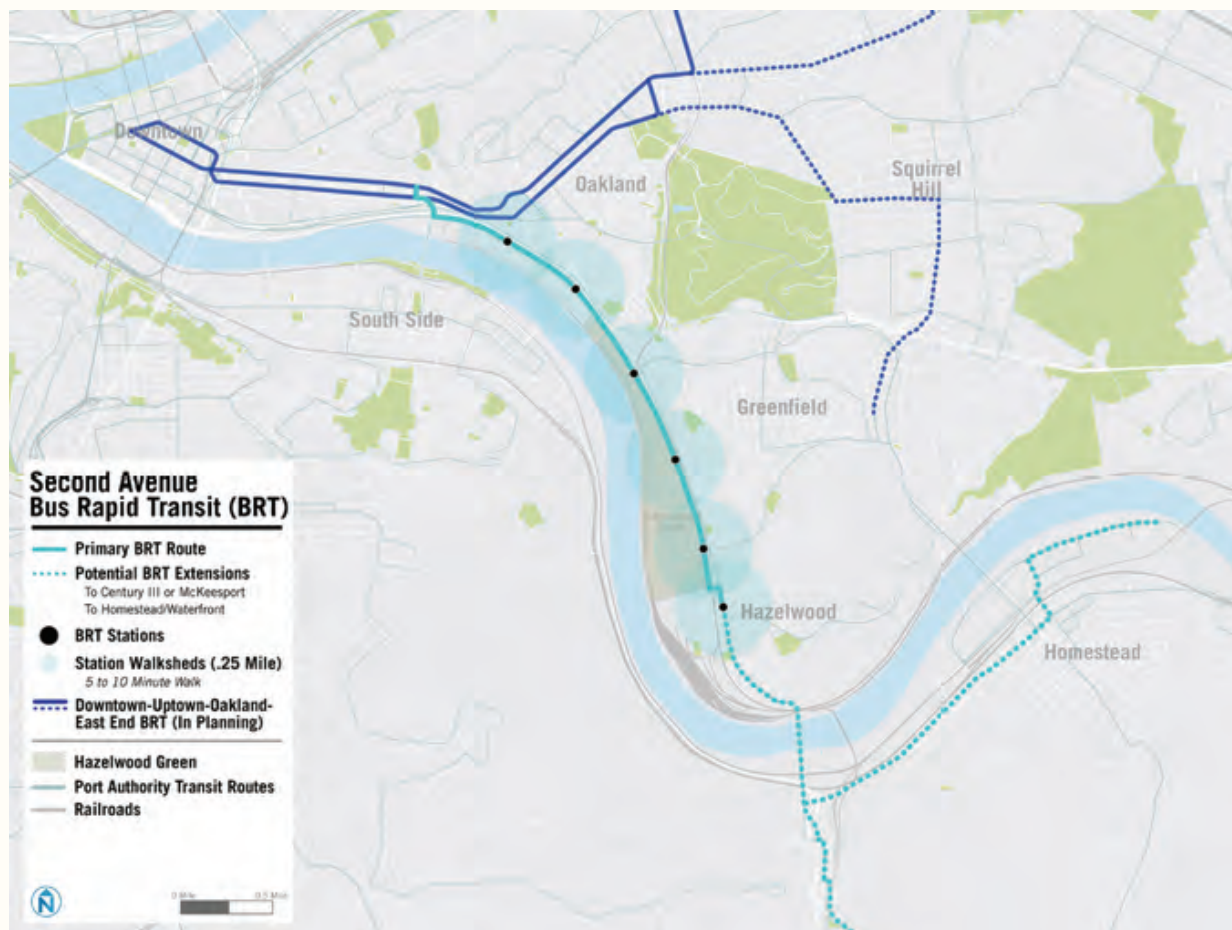
According to SPC 2020 Trip Estimates, more than half of trips from / to Hazelwood go downtown.

|   | Hazelwood |
|---|-----------|
| <b>Pittsburgh Chateau Area</b>            | 20        |
| <b>Pittsburgh Lower North Side</b>        | 28        |
| <b>Pittsburgh Upper North Side</b>        | 14        |
| <b>Allegheny County Northwest</b>         | 13        |
| <b>Allegheny County North (remainder)</b> | 40        |

|                                       |              |
|---------------------------------------|--------------|
| Hazelwood                             | 12           |
| Squirrel Hill                         | 375          |
| Oakland                               | 1,205        |
| South Side                            | 131          |
| Shadyside                             | 64           |
| Waterfront (Homestead, Munhall(part)) | 110          |
| Downtown                              | 1,650        |
| East Liberty                          | 42           |
| Strip District                        | 37           |
| Pittsburgh East (remainder)           | 113          |
| Hays Lincoln Place                    | 68           |
| Allegheny County East                 | 203          |
| Allegheny County Southeast            | 220          |
| Allegheny County West                 | 40           |
| Washington County                     | 3            |
| Westmoreland County                   | 2            |
| Midtown/Uptown                        | 172          |
| Highland Park                         | 15           |
| Homewood/Lincoln-Lemington            | 53           |
| Pittsburgh Southwest (remainder)      | 144          |
| Allegheny County Southcentral         | 80           |
|                                       | <b>4,854</b> |

According to these travel forecasts, though a significant number of trips with Hazelwood cross Oakland, just as many trips involve downtown. Transit solutions connecting Hazelwood corridors to transit passages downtown would better serve the needs for those needing to travel or connector downtown than the current Mon-Oakland Connector proposal,

The Second Avenue BRT would link in more directly to the current proposed Downtown BRT at a much higher volume than the Mon-Oakland Connector. Current travel time end to end (800 Mifflin Rd to Brady St & Second Ave) by car is 16 minutes, and with BRT improvements, the run time could be cut by half. Even at 16 minutes, this corridor is competitive with the travel times estimated on the Mon-Oakland shuttle loops.



# Our Money, Our Solutions Transit Proposals

## Increasing Service on the 93

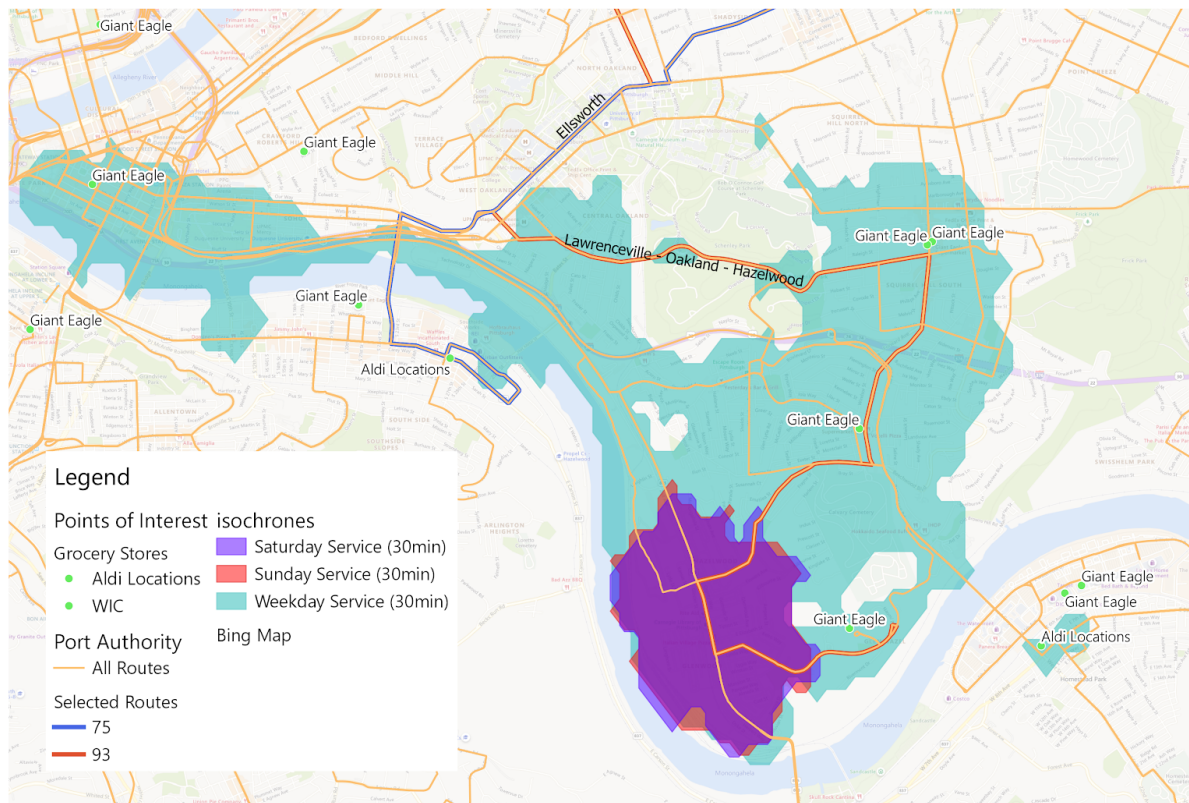
Pittsburghers for Public Transit worked with residents and community groups on the [Our Money, Our Solutions](#) proposal which garnered over 1000 signatures. In the proposal, this asked for infrastructure and transportation service that residents had repeatedly requested over the years. As the proposal states:

*"Investment in transit, pedestrian and bike infrastructure is critical to achieving an equitable and environmentally sustainable city. Over the years, our communities have asked for accessible sidewalks, bike trail connections, expanded transit service and safe pedestrian crossings on busy streets—and those requests have been documented in countless community plans and at City and County agencies."*

In particular, **weekend service on the 93** at a minimum frequency of once every 40 minutes **has been requested in multiple years, documented in Port Authority service requests in 2015, 2016 and 2017**. Currently, the 93 runs only on weekdays and provides residents with convenient, crucial access to a number of amenity-rich neighborhoods. Currently without the 93, weekend trips to these same neighborhoods take residents 3x as long.

|   | Weekday (93) | Weekend (56 to 71, 61) |
|---|--------------|------------------------|
| Second & Hazelwood to Beacon & Murray     | 11           | 28                     |
| Beacon & Murray to Blvd of Allies & Craft | 9            | 21                     |

This difference is most obvious when you take a look at what is accessible from Hazelwood via transit on a weekday vs. weekend. The 93 route passes 3 different Giant Eagle grocery stores, and this addresses a major food desert issue in the neighborhood. An extension of service on the 93 would drastically improve current transit access in the neighborhood. Investment in the Mon Oakland Connector does nothing to improve residents' access to food. This map also suggests that weekend service for other Hazelwood routes would provide regional access outside of the neighborhood to downtown that is currently lacking.



## Extension of the 75

An extension of the 75 across the Hot Metal bridge into Hazelwood would create a previously missing connection between Hazelwood and South Side Flats, as well as adding another option for accessing Oakland area destinations. The runtime of the extension would be comparable to the current 56 and 57 service, with the extension running on the same route lines after crossing Hot Metal bridge.

The 57 segment following Blair River Rd. from Second Avenue and Hazelwood to Second Avenue and Lincoln Place (Hot Metal Bridge) takes 5 minutes by transit.

The 56 segment following Second Avenue from Second Avenue and Hazelwood to Second Avenue and Lincoln Place (Hot Metal Bridge) takes 4 minutes by transit.

Crossing the bridge takes approximately 2 minutes. This bridge is crossed twice.

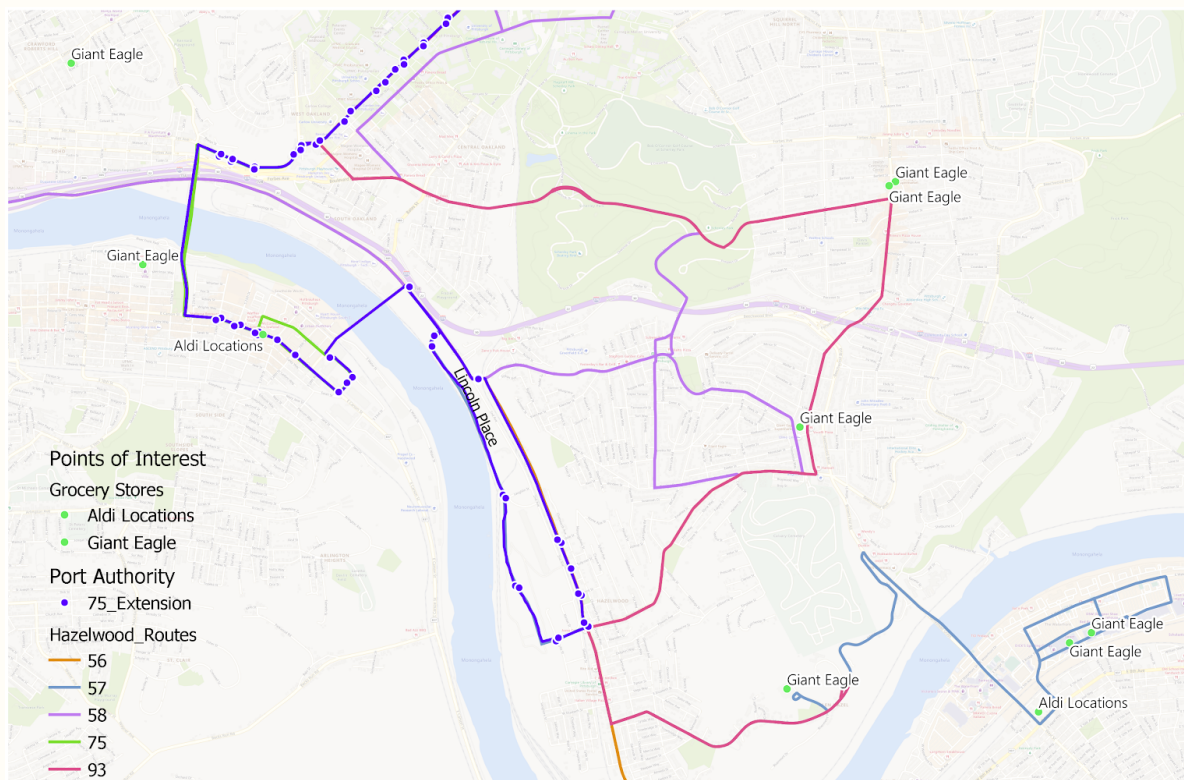


In changing the loop of the 75, it would make sense to alter the route so that it comes around Sarah St. and continues down Carson St. as usual, but without the loop on Sydney street. This takes off 4 minutes of running time and 0.34 miles off the route.

This makes the extension a total of **9 minutes (3.66 miles)**, with additional buffers for variability in running time. This extension would not require any additional capital expenditures or facilities changes, with existing stops in place for the 57 and 56.

This connection from Hazelwood to South Side flats also provides another option for food access: the Aldi and Giant Eagle accessible on the current 75 route.

An approximate estimate of the additional operating cost for this extension is estimated using PAAC's 2018 NTD data. With an additional 9 minutes of Vehicle Revenue Time and 3.66 miles of Vehicle Revenue Miles, the additional operating cost per trip is approximately \$20.34. Over 182 weekday trips a day, 64 weekend trips a day, the yearly cost with the same level of service is \$1.1M. This route provides the same level of coverage as the Mon-Oakland Connector with far greater capacity and far lower cost.



When we break down travel times on the extended 75, we see that with the exception of CMU (due to a 10-minute walking time from 5th and Craig), the run times are similar or improved:

|  | Transit   | Route        | Mon-Oakland Time | Mon-Oakland Route       |
|--|-----------|--------------|------------------|-------------------------|
| <b>Second &amp; Hazelwood to Beacon &amp; Murray</b>       | 11 min    | 93           | 34               | MO to Forbes, 61        |
| <b>Second &amp; Hazelwood to Grant Street &amp; 6th St</b> | 23-25 min | 56, 57       | 43               | MO + walk to 5th, 61/71 |
| <b>Second &amp; Hazelwood to CMU</b>                       | 36        | 75 Extension | 22               | MO                      |
| <b>Second &amp; Hazelwood to UPitt</b>                     | 26        | 75 Extension | 22               | MO                      |
| <b>Second &amp; Hazelwood to UPMC Montefiore</b>           | 21        | 75 Extension | 32               | MO + walk               |
| <b>Second &amp; Hazelwood to UPMC Presbyterian</b>         | 23        | 75 Extension | 34               | MO + walk               |

# Conclusion

This report comes during the outbreak of COVID-19, a pandemic that has shown the critical importance of giving communities access to food and healthcare. Extending access to transit, which has been the lifeblood of critical front-line workers, would improve access to grocery stores and hospitals in a way that sustains communities and meets the long-term capacity needs of the area and of future economic redevelopment.

Unfortunately, the Mon-Oakland Connector does not prove itself worthwhile in the same way. It falls short of [the City's own Mobility Principles](#) by introducing motorized vehicles into a park setting and serving university campuses rather than grocery stores. Its benefits to riders could be achieved by university and hospital shuttle consolidation without the need for public funding, while serving only 11% of the projected demanded ridership to the Hazelwood area. Shuttles would also fail to provide benefit to the vast majority of downtown commuters. Most importantly, when examining the travel time of the Mon-Oakland Connector compared to transit improvements, the primary benefit is a 13-minute travel boost to CMU.

Does this justify an investment of \$39 million (\$23 million of which is public money)?

We hope that the public and private stakeholders in this project consider longer term solutions that grow community access and increase capacity for greater regional growth and economic opportunity. We believe those solutions are access to public transit, not micro-mobility shuttles.



# Appendix

The following times for the Mon-Oakland were calculated by retracing the connector path. The “City” column came from the Mon-Oakland connector times received in Spring 2019 Right to Know Requests from the city, compared to a retraced path that calculated speeds at 15mph, with the City’s projection of 1 minute per stop. Table 1 summarizes the loop times calculated from Table 2’s point to point times. Once again, these travel times do not take into account mixed- traffic slowdowns, the variability of the Swinburne shuttle elevator, or wait times for shuttle arrival.

The hazel\_to\_oak corridor, from 2nd Ave and Hazelwood to the CMU stop, is the Mon-Oakland time used in the comparison with Oakland travel times.

**Table 1: Mon-Oakland Connector Loop Times**

| Looptype | Loopname                   | City | Calculated | Notes  |
|----------|----------------------------|------|------------|--|
| loop     | full_loop                  | 44   | 52.2       | 1 min / stop, visiting all stops                             |
| loop     | oakland_loop               | 19   | 19.25      | 1 min / stop, visiting all stops                             |
| corridor | hollow_corridor            | 5    | 5.94       | Going one way, 1 min at Panther Hollow and 1 min at Schenley |
| corridor | sylvan-hazelwood_swinburne | 7    | 12.46      | If the route were to connect back to Swinburne               |
| corridor | sylvan-hazelwood           | 7    | 8.67       | If the route were not to connect back to Swinburne           |
| loop     | hazelgreen_ptc_loop        | 10   | 27.86      | Complete PTC and Hazelwood loop                              |
| corridor | ptc_hollow_corridor        | 3    | 7.8        | From Panther Hollow to PTC                                   |
| corridor | hazel_to_oak               | NA   | 22.3       | From 2nd Ave and Hazelwood to CMU                            |

**Table 2: Mon-Oakland Connector Point to Point Times**

| direction | pattern   | min  | meters | stopIndex | stopTo | node_from      | node_to        |
|-----------|-----------|------|--------|-----------|--------|----------------|----------------|
| SB_START  | full_loop | 1.61 | 648    | 0         | 1      | CMU            | PANTHER HOLLOW |
| SB_START  | full_loop | 1.84 | 741    | 1         | 2      | PANTHER HOLLOW | HILLMAN        |

|          |              |      |      |    |    |                        |                        |
|----------|--------------|------|------|----|----|------------------------|------------------------|
| SB_START | full_loop    | 1.84 | 741  | 2  | 1  | HILLMAN                | PANTHER HOLLOW         |
| SB_START | full_loop    | 1.16 | 467  | 1  | 4  | PANTHER HOLLOW         | SCHENLEY               |
| SB_START | full_loop    | 2.78 | 1120 | 4  | 5  | SCHENLEY               | SWINBURNE<br>BRIDGE N  |
| SB_START | full_loop    | 0.82 | 329  | 5  | 6  | SWINBURNE<br>BRIDGE N  | PTC                    |
| SB_START | full_loop    | 1.39 | 558  | 6  | 7  | PTC                    | HOT METAL<br>BRIDGE    |
| SB_START | full_loop    | 2.12 | 852  | 7  | 6  | HOT METAL<br>BRIDGE    | PTC                    |
| SB_START | full_loop    | 5.29 | 2130 | 7  | 9  | PTC                    | HAZELWOOD &<br>GLOSTER |
| SB_START | full_loop    | 2.34 | 941  | 9  | 10 | HAZELWOOD &<br>GLOSTER | ELIZABETH &<br>GLOSTER |
| SB_START | full_loop    | 1.78 | 716  | 10 | 11 | ELIZABETH &<br>GLOSTER | SYLVAN &<br>HAZELWOOD  |
| SB_START | full_loop    | 2.83 | 1139 | 11 | 12 | SYLVAN &<br>HAZELWOOD  | BUD HAMMER             |
| SB_START | full_loop    | 1.69 | 678  | 12 | 13 | BUD HAMMER             | SWINBURNE<br>BRIDGE S  |
| SB_START | full_loop    | 1.16 | 466  | 13 | 5  | SWINBURNE<br>BRIDGE S  | SWINBURNE<br>BRIDGE N  |
| SB_START | full_loop    | 2.78 | 1120 | 5  | 4  | SWINBURNE<br>BRIDGE N  | SCHENLEY               |
| SB_START | full_loop    | 1.16 | 467  | 4  | 1  | SCHENLEY               | PANTHER HOLLOW         |
| SB_START | full_loop    | 1.61 | 648  | 1  | 0  | PANTHER HOLLOW         | CMU                    |
| SB_START | oakland_loop | 1.61 | 648  | 0  | 1  | CMU                    | PANTHER HOLLOW         |
| SB_START | oakland_loop | 1.84 | 741  | 1  | 2  | PANTHER HOLLOW         | HILLMAN                |
| SB_START | oakland_loop | 1.84 | 741  | 2  | 1  | HILLMAN                | PANTHER HOLLOW         |
| SB_START | oakland_loop | 1.16 | 467  | 1  | 4  | PANTHER HOLLOW         | SCHENLEY               |
| SB_START | oakland_loop | 2.78 | 1120 | 4  | 5  | SCHENLEY               | SWINBURNE<br>BRIDGE N  |
| SB_START | oakland_loop | 2.78 | 1120 | 5  | 4  | SWINBURNE<br>BRIDGE N  | SCHENLEY               |
| SB_START | oakland_loop | 1.16 | 467  | 4  | 1  | SCHENLEY               | PANTHER HOLLOW         |
| SB_START | oakland_loop | 1.61 | 648  | 1  | 0  | PANTHER HOLLOW         | CMU                    |

|          |                           |      |      |    |    |                     |                     |
|----------|---------------------------|------|------|----|----|---------------------|---------------------|
| SB_START | oakland_loop              | 1.61 | 648  | 0  | 1  | CMU                 | PANTHER HOLLOW      |
| SB_START | oakland_loop              | 1.84 | 741  | 1  | 2  | PANTHER HOLLOW      | HILLMAN             |
| SB_START | hollow_corridor           | 1.16 | 467  | 1  | 4  | PANTHER HOLLOW      | SCHENLEY            |
| SB_START | hollow_corridor           | 2.78 | 1120 | 4  | 5  | SCHENLEY            | SWINBURNE BRIDGE N  |
| SB_START | sylvan-hazelwood_corridor | 2.83 | 1139 | 11 | 12 | SYLVAN & HAZELWOOD  | BUD HAMMER          |
| SB_START | sylvan-hazelwood_corridor | 1.69 | 678  | 12 | 13 | BUD HAMMER          | SWINBURNE BRIDGE S  |
| SB_START | sylvan-hazelwood_corridor | 1.16 | 466  | 13 | 5  | SWINBURNE BRIDGE S  | SWINBURNE BRIDGE N  |
| SB_START | sylvan-hazelwood_corridor | 2.78 | 1120 | 5  | 4  | SWINBURNE BRIDGE N  | SCHENLEY            |
| SB_START | hazegreen_ptc_loop        | 0.82 | 329  | 5  | 6  | SWINBURNE BRIDGE N  | PTC                 |
| SB_START | hazegreen_ptc_loop        | 1.39 | 558  | 6  | 7  | PTC                 | HOT METAL BRIDGE    |
| SB_START | hazegreen_ptc_loop        | 6.87 | 2262 | 6  | 7  | HOT METAL BRIDGE    | HAZELWOOD & GLOSTER |
| SB_START | hazegreen_ptc_loop        | 2.34 | 941  | 9  | 10 | HAZELWOOD & GLOSTER | ELIZABETH & GLOSTER |
| SB_START | hazegreen_ptc_loop        | 1.78 | 716  | 10 | 11 | ELIZABETH & GLOSTER | SYLVAN & HAZELWOOD  |
| SB_START | hazegreen_ptc_loop        | 2.83 | 1139 | 11 | 12 | SYLVAN & HAZELWOOD  | BUD HAMMER          |
| SB_START | hazegreen_ptc_loop        | 1.69 | 678  | 12 | 13 | BUD HAMMER          | SWINBURNE BRIDGE S  |
| SB_START | hazegreen_ptc_loop        | 1.16 | 466  | 13 | 5  | SWINBURNE BRIDGE S  | SWINBURNE BRIDGE N  |
| SB_START | ptc_hollow_corridor       | 1.16 | 467  | 1  | 4  | PANTHER HOLLOW      | SCHENLEY            |
| SB_START | ptc_hollow_corridor       | 2.78 | 1120 | 4  | 5  | SCHENLEY            | SWINBURNE BRIDGE N  |
| SB_START | ptc_hollow_corridor       | 0.82 | 329  | 5  | 6  | SWINBURNE BRIDGE N  | PTC                 |
| SB_START | hazel_to_oak              | 2.34 | 941  | 9  | 10 | HAZELWOOD & GLOSTER | ELIZABETH & GLOSTER |

|          |              |      |      |    |    |                        |                       |
|----------|--------------|------|------|----|----|------------------------|-----------------------|
| SB_START | hazel_to_oak | 1.78 | 716  | 10 | 11 | ELIZABETH &<br>GLOSTER | SYLVAN &<br>HAZELWOOD |
| SB_START | hazel_to_oak | 2.83 | 1139 | 11 | 12 | SYLVAN &<br>HAZELWOOD  | BUD HAMMER            |
| SB_START | hazel_to_oak | 1.69 | 678  | 12 | 13 | BUD HAMMER             | SWINBURNE<br>BRIDGE S |
| SB_START | hazel_to_oak | 1.16 | 466  | 13 | 5  | SWINBURNE<br>BRIDGE S  | SWINBURNE<br>BRIDGE N |
| SB_START | hazel_to_oak | 2.78 | 1120 | 5  | 4  | SWINBURNE<br>BRIDGE N  | SCHENLEY              |
| SB_START | hazel_to_oak | 1.16 | 467  | 4  | 1  | SCHENLEY               | PANTHER HOLLOW        |
| SB_START | hazel_to_oak | 1.61 | 648  | 1  | 0  | PANTHER HOLLOW         | CMU                   |