



LIGHTRAIL, STREETCARS, &  
**THE MYTH**  
OF “HIGH CAPACITY TRANSIT”

By John A. Charles, Jr. | May 2011

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For the past several decades, TriMet has promoted passenger rail as “High Capacity Transit (HCT).” In planning documents, the agency defines HCT as a mode “characterized by using larger vehicles and/or more frequent service to provide faster, more convenient and more reliable service for a larger number of passengers than a standard fixed-route bus line.”

The specific services that TriMet offers within the alleged HCT category include light rail, commuter rail and the Portland streetcar.

HCT is desirable when there are large numbers of people moving to geographically constrained destinations within a short period of time – such as commuters traveling to downtown San Francisco or midtown Manhattan. It is questionable whether the Portland region has a need for such services, due to low regional population densities and the dispersed nature of regional employment. Many people live in the suburbs or beyond, and many employment centers are also located in those same areas, so travel patterns are scattered and complex.

However, there are “special events” each year where HCT might be valuable, and those events were the focus of this research. During 2010, five different events were chosen to see if the light rail/streetcar system actually provides the high-capacity service needed to move large numbers of passengers. Those events were:

- The Green Building Home Show at the Multnomah County Expo Center in March;
- Opening night at the Cirque du Soleil in April;
- The final playoff game of the season for the Portland Trail Blazers in May;
- The day after Thanksgiving (“Black Friday”) at Cascade Station shopping mall near Portland International Airport; and
- December 22 at the Gresham Civic Center retail/residential complex, focused around the newest TriMet light rail station, which opened on December 1.

By spreading the investigation throughout the year, and choosing different locations, the research team was able to examine travel patterns in various weather conditions and time periods. All events were served by auto access as well as rail. In some cases parking was free; in other cases it was quite expensive.

With a strong mix of travel options, each event offered a good opportunity to study the choices people make in real time. This is important because transportation planners at Metro, TriMet, ODOT and other agencies routinely make multi-billion-dollar decisions based on travel surveys, computer models or simply their own personal beliefs about how people *should* travel. They rarely have any direct knowledge of how people *actually* travel under specific conditions of time, mode availability, parking pricing and geographic constraints.

The goal of this research was to compare the dominant planning assumptions in Portland with observed travel behavior in specific event settings.

## **GREEN BUILDING HOME SHOW, EXPO CENTER**

This trade show was chosen for study because it focused on so-called “Green Building,” thus it was presumed that the participants would have an above-average willingness to travel by some mode other than private automobile. The geographic focus was the terminus of the Yellow MAX line, on the east edge of the parking lot at the Expo Center. This is also the location for the parking entrance, which is controlled by gate access.

Parking is expensive at the Expo Center – \$7 per car, or \$6 for carpools of 3 or more. There is no easily available on-street parking that people can use for free anywhere in the vicinity of the Expo Center. This controlled access for both transit and auto use makes the Expo Center an ideal location to study travel choices by conventioners.

Researchers manually counted all passengers exiting the MAX and walking towards the Expo Center. These were recorded as “trips.” Occasionally, people left the MAX and walked north to unknown destinations. Those trips were not recorded.

Researchers also counted the number of passengers in vehicles paying to park. Based on the observations, average vehicle occupancy was calculated and used to determine the total number of “passenger-trips” by automobile (number of vehicles x the average vehicle occupancy). The number of passenger-trips is used to determine the “market share” of each mode – MAX and automobile – in percentage terms.

# SUMMARY OF OBSERVATION

## SATURDAY, MARCH 27, 2010

	NUMBER OF TRIPS (TO EXPO CENTER)	AVERAGE VEHICLE OCUPANCY	TOTAL PASSENGER TRIPS	MODE SHARE
LIGHTRAIL	251	N/A	251	21%
AUTOMOBILE	516	1.8	929	79%
TOTAL	767	N/A	1180	100%

WEATHER: Blue sky and sunny  
TIME OF OBSERVATION: 11:25am-1:25pm

## SUNDAY, MARCH 28, 2010

	NUMBER OF TRIPS (TO EXPO CENTER)	AVERAGE VEHICLE OCUPANCY	TOTAL PASSENGER TRIPS	MODE SHARE
LIGHTRAIL	265	N/A	265	18%
AUTOMOBILE	654	1.8	1177	82%
TOTAL	919	N/A	1442	100%

WEATHER: Blue sky and sunny  
TIME OF OBSERVATION: 12:25am-2:45pm

**DISCUSSION:** The results showed that MAX was not the primary means of travel on either day, though rail use was respectable at roughly 20% of all passenger-trips. However, given that this was a “Green” home show, and on-site parking was highly controlled and expensive, some rail advocates might find 20% market share to be disappointing.

## CIRQUE DU SOLEIL

This popular circus show appears in Portland about every two years and has traditionally set up in the large vacant lot in the South Waterfront district just south of the Marquam Bridge on Moody Avenue. Since access to the site is constrained and the area is served by the streetcar, a two-lane road (Moody) and even the aerial tram, it offers an unusual opportunity to study travel patterns.

The streetcar observer was positioned at the stop on SW River Parkway about 300 yards north of the circus entrance, on the assumption that most people arriving from the city center would get off there rather than ride past the circus to the next stop at the OHSU Health and Healing building. The researcher observed all trips to and from the streetcar and counted only those where the passenger came from or headed to the south (the direction of the circus tent). Any trips to or from the north were considered non-event trips.



*The SW Moody Street stop is about 300 yards north of the circus tent.*

The auto counter was positioned at the entrance to the paid parking lot (\$10 per car fee required) adjacent to the circus tent. He manually counted all vehicles and occupants entering the lot.

After the show started, parked cars were also counted at two paid lots on Moody Avenue to the south (\$7 per car). A scan was also conducted of cars parked on nearby streets, including SW Sheridan, Arthur Street and Water Avenue. There is a structured parking facility about 200 yards to the north of the circus on Moody, but that lot was not monitored. Thus, the auto counts below are somewhat understated.



*Auto use was the preferred mode of travel for most circus patrons on opening night in 2010.*

## SUMMARY OF OBSERVATION

<b>FRIDAY, APRIL 29, 2010</b> Opening Night, 8:00 p.m. Show				
	NUMBER OF TRIPS (INBOUND TO CIRCUS)	AVERAGE VEHICLE OCUPANCY	TOTAL PASSENGER TRIPS	MODE SHARE
<b>STREETCAR</b>	110	N/A	110	8%
<b>AUTOMOBILE</b>		2.2	1245	92%
AUTO @ \$10	408			
AUTO @ \$7	98			
AUTO ON STREET	60			
<b>TOTAL</b>	676	N/A	1355	100%

**Weather: Cool and Clear**  
**Time of Observation: 6:20 p.m. – 8:10 p.m.**

**DISCUSSION:** The results show that the streetcar is essentially irrelevant to a major event in the South Waterfront district, even when the cost of parking is high (while the streetcar is free). The streetcar is simply too slow and inconvenient and has such little carrying capacity that it would not be able to serve a high-volume event even if consumer demand existed.

The research team also investigated the possibility that some people might arrive by aerial tram, since TriMet actually considers the tram to be part of Portland's formal transit system. However, the operating hours of the tram on April 29th were such that anyone arriving by tram would be unable to take back up the hill after the show, so it seemed unlikely that anyone would use it. A short amount of time (roughly 15 minutes) was taken to sit by the tram and observe, but no one got off who was headed to the circus. At the end of that period the researcher got on the streetcar (30 minutes before show time), and he was the only passenger who took the train north to the vicinity of the circus.

## **PORTLAND TRAIL BLAZER PLAYOFF GAME AGAINST THE PHOENIX SUNS**

This was an excellent event to monitor rail travel because all four MAX lines have stops right at the Rose Garden, and this was a playoff game on a Saturday afternoon when presumably people would have extra time to travel by transit. However, the research site did have a few drawbacks. While it was easy to count all off-bound trips on the Yellow Line, the large number of people getting on and off some of the east-west trains made it impossible to accurately count every trip to the game, especially for trains arriving in the final 30 minutes before tipoff. In those cases, best estimates were made.

Also, since auto access to the Rose Garden is not controlled and there are hundreds of possible nearby locations for people to park, no attempt was made to count auto trips. It was decided that the primary focus of this observation would be on MAX utilization, and mode share would be calculated by dividing rail use against total estimated attendance.

For east-west trains, 40 trains were observed bi-directionally during the research period, and a total of 78 individual train cars were observed. Each car discharged an average of 48 passengers, though on 5-6 instances the trains were filled to capacity.

On the Yellow Line, there were 12 bi-directional trains and 24 train cars; the average number of passengers exiting was 20 per train-car. At no time did the Yellow Line take on or discharge a full load of passengers.

# SUMMARY OF OBSERVATION

<b>SATURDAY, MAY 1, 2010</b>			
Sellout crowd of at least 20,500 • Game starting time: 1:30 p.m.			
	ALL INBOUND TRIPS	ESTIMATED TOTAL ATTENDANCE	MODE SHARE
YELLOW LINE	491		
RED/GREEN/BLUE	3,747		
<b>TOTAL</b>	4,238	20,500	20.6%

Weather: Sunny and Mild, Occasional Sprinkles  
 Time of Observation: Noon-1:45 p.m.  
 Location of observers: MAX Yellow Line station, MAX Blue/Red/Green Line station

**DISCUSSION:** This event showed the most robust use of rail transit, which was not a surprise. However, it also showed the limitations of the light rail system. The 20% market share was achieved over a nearly two-hour period before the game.

The problem at this or any similar event would be at the back end. When 20,500 people all leave the building at the same time, the light rail system would be swamped. Many people forget that due to the MAX alignment on downtown surface streets, where we have short blocks, there is a maximum of only two cars per train on Portland light rail, and trains traveling in the same direction must be spaced at least two minutes apart due to safety and operational requirements.

This makes light rail a low-capacity system, relative to other transit options. Even if people were Velcroed to the outside of the train cars, MAX is simply not capable of moving very many people in a short period.

A real HCT system, such as BART in San Francisco or the subways in New York and Washington, can have up to nine rail cars per train, and those cars are larger than light rail cars. They also have their own right-of-way, allowing them to travel much faster than light rail does.

Since at least 5-6 trains arrived at the Rose Garden in the 30 minutes preceding the game with “crush-loads” (meaning every square inch of seated and standing capacity was occupied), it would be impossible for the 3,727 passengers who arrived via the Blue/Green/Red Lines during the pre-game period to all get on the train immediately after the game. While most fans don’t mind arriving quite early,



and many do so deliberately to eat and drink on-site (the basketball version of “tailgating”), at the end of the game no one wants to spend another 90 minutes waiting for a train.

Rubber-tired vehicles have a much better chance of dispersing large crowds because they can be used in all locations surrounding the Rose Garden and can travel to an infinite number of potential destinations. Rail is limited to one fixed route going north (which was not heavily used) and one fixed route going east-west.

## **CASCADE STATION SHOPPING CENTER**

Cascade Station is a new shopping mall built just to the east of the Portland International Airport on the south side of Airport Way. It was originally envisioned as a so-called “transit-oriented development” (TOD) centered around the Red MAX line. In fact, TOD was put forward by planners at the time as the primary justification for building MAX.

Cascade Station was considered an ideal site for TOD because it was flat, easily served by infrastructure and completely vacant. Total acreage of the site is 120 acres, and more than half of that has been built out since the Red Line opened in September 2001.

The observations for this study were limited to the east end of Cascade Station, which is clearly delineated by a traffic light at the entrance to the project near the Airport Way overpass. The east end is substantially built out, it has its own dedicated light rail station and it is dominated by retail stores that would be of interest to shoppers on Black Friday. Also, the access is entirely controlled; there are only two entrances for automobiles/cyclists/pedestrians, and one light rail station. Thus, every trip in and out of the project can be easily observed.

In contrast, the west end of Cascade Station is relatively underdeveloped, and the development that does exist is primarily office space with one hotel, a few small stores and a college classroom building. Thus, travel patterns on this end would be very different than on the east end—much more oriented to peak-hour travel on weekdays for office workers, rather than all-day shoppers.

# SUMMARY OF OBSERVATION

## FRIDAY, NOVEMBER 26, 2010

"Black Friday"

	ALL TRIPS, IN AND OUT	AVERAGE VEHICLE OCUPANCY	TOTAL PASSENGER TRIPS	MODE SHARE
LIGHTRAIL	120	N/A	120	2.2%
AUTOMOBILE	4,803	1.725	8,286	98.5%
BICYCLE	2	N/A	2	0.2%
PEDESTRIAN	2	N/A	2	0.2%
TOTAL	4,927	N/A	8,410	100%

TIME OF OBSERVATION: 2:45 p.m.-4:45 p.m.

## SATURDAY, NOVEMBER 27, 2010

	ALL TRIPS, IN AND OUT	AVERAGE VEHICLE OCUPANCY	TOTAL PASSENGER TRIPS	MODE SHARE
LIGHTRAIL	213	N/A	213	2.2%
AUTOMOBILE	5,087	1.825	9,284	97.7%
BICYCLE	1	N/A	1	0.01%
PEDESTRIAN	0	N/A	0	0%
TOTAL	5,300	N/A	9,497	100%

TIME OF OBSERVATION: 2:00 p.m.-4:00 p.m.

**DISCUSSION:** The observations show that travel patterns at Cascade Station are entirely dominated by the private automobile. Notwithstanding the availability of light rail, the travel patterns at this site are indistinguishable from those at any suburban mall such as Washington Square.

In fact, the history of development at Cascade Station reveals how difficult it is to create the ideal TOD conditions desired by Portland planners. The original design imposed by city planners at Cascade Station included a prohibition on stores greater than 60,000 SF in size. As a result, no development occurred for more than four years after the Red Line opened. In February 2005, the Portland Development Commission conceded defeat and began the process of relaxing the zoning ordinances, allowing one store with a footprint greater than 200,000 SF and two other large-format stores.

The anchor turned out to be Swedish retailer IKEA, with a 280,000 SF store, while other large stores include Target and Best Buy. These stores and the dozens of other chain retailers are serviced by vast amounts of free parking built directly across the street from the light rail station.



*MAX was supposed to be a “catalyst for transit-oriented development” at Cascade Station near the airport, but all the stores are built away from the MAX stop and serviced by large parking lots.*

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## GRESHAM CIVIC STATION

Gresham Civic Station was chosen as a site for a number of reasons. One is that it is the only suburban location. Another is that the area has been intensively planned for more than 25 years, with expectations that this would be a showcase for suburban TOD. The entire area was bare dirt when the Blue MAX line opened in 1986 and offered the possibility of a “blank slate” for planners to create high-density, mixed-use developments focused around light rail. Unfortunately, the land was sold several times, and various development concepts were conceived but never built into the 1990s. A major north-south road, Civic Drive, was built to link Burnside Avenue with Division Street, but for several years no other construction took place.

Eventually, much of the site was built-out, featuring a shopping center, an LA Fitness Center, a medical complex and several hundred units of housing. Initially, the neighborhood did not have its own dedicated light rail station, so anyone who wanted to get to the site had to walk a short distance east to the Gresham City Hall station. However, on December 1 TriMet celebrated the opening of the Gresham Civic light rail station.

Since this was the most complex of the sites we monitored, counting was done for two different peak periods. For work commuting, we counted from 7:00 a.m. to 9:00 a.m., focusing especially on the four east portals from which many of the on-site residents would leave. For the shopping peak period, we monitored from 10:30 a.m. to 12:30 p.m., focusing more on the five Division Street portals and the Civic Drive connection with Burnside.



*Although there are hundreds of apartments close to the newest MAX station at Gresham Civic Center, few of the tenants use light rail.*

# SUMMARY OF OBSERVATION

## WEDNESDAY, DECEMBER 22, 2010

### Commute Trips

	ALL TRIPS, IN AND OUT	AVERAGE VEHICLE OCUPANCY	TOTAL PASSENGER TRIPS	MODE SHARE
LIGHTRAIL	24	N/A	24	2.2%
AUTOMOBILE	953	1.12	1,070	96.3%
BICYCLE	2	N/A	2	0.18%
PEDESTRIAN	15	1	15	1.4%
TOTAL	994	N/A	1,111	100%

TIME OF OBSERVATION: 7:00 a.m.-9:00 a.m.

## WEDNESDAY, DECEMBER 22, 2010

### Shopping Trips

	ALL TRIPS, IN AND OUT	AVERAGE VEHICLE OCUPANCY	TOTAL PASSENGER TRIPS	MODE SHARE
LIGHTRAIL	96	N/A	96	2.30%
AUTOMOBILE	3,181	1.27	4,031	96.8%
BICYCLE	37	N/A	37	0.9%
PEDESTRIAN	1	1	1	0.02%
TOTAL	3,315	N/A	4,165	100%

TIME OF OBSERVATION: 10:30 a.m.-12:30 a.m.

**DISCUSSION:** As a TOD, Gresham Civic Center offers all the amenities that TriMet/Metro planners originally hoped for: a mixture of high-density housing products (apartments, condos, townhomes and single family houses), numerous retail shopping choices and office space. The site also offers a mixture of transportation modes. However, in an obvious bow to market forces, parking is reasonably available in all areas; and for some of the housing projects there are even gated parking lots. Predictably, private auto use is the dominant mode choice for most trips to and from the site. The TOD probably has a higher than normal percentage of people walking from their homes to retail sites (intra-site trips as opposed to the inter-site trips we were monitoring) at certain times and days, but overall more than 96% of passenger-trips are taken via the private automobile.

The new light rail station is one of the least-used on the entire TriMet system, and given the multi-million price tag, it is questionable that it was justified. The Gresham City Hall station is less than 100 yards from the east edge of the Civic Station property, and it is likely that regular MAX patrons would use the train with or without a new station.

## **ANALYSIS OF OBSERVATIONS**

Each of the five events provided different insights into travel behavior, but overall it's clear that Portland area residents prefer driving, even when the cost of parking is quite high. The Cirque du Soleil event was the greatest example of this: The free streetcar had minimal ridership, while the most expensive parking (\$10 p/car) was in such great demand that a Portland police officer was needed for the entire period to direct traffic; and lines waiting to get in backed up with 20 or more cars on Moody Street, which is a narrow, two-lane road.

The reasons for this mismatch are simple: The streetcar only has 30 seats, one car per train, arrives only 4-5 times per hour and travels at roughly 5 MPH. It also serves only a tiny fraction of the potential market for circus tickets. In other words, the streetcar is not "mass" transit, it is not "rapid" transit, and in fact doesn't even qualify as transit because it has such poor coverage of the region. For the purpose of serving any kind of high-volume event, the streetcar is uniquely unsuited to the task.

The experience at the Green Home Show also showed a strong preference for auto use, even under conditions of expensive parking and a "progressive" audience. For a show catering to the most environmentally-minded consumers in the region, 18-21% mode share is not impressive, and even that overstates the importance of rail because most people who arrived by train undoubtedly needed a car to first reach the train.

In fact, many conventioners were induced to drive by the availability of free TriMet parking at the rail stop immediately south of the Expo Center (Portland International Raceway). The author, who travelled partially by light rail to do the research (parking first near the Killingsworth Avenue station), observed a significant number of people boarding the train at the Raceway stop and subsequently getting off there after leaving the Expo Center.

Relatively few people likely would be able to leave their house, board the Yellow Line (or any MAX line) to the Expo Center and never use a car, especially since many people made purchases at the trade show that would be difficult to carry on transit.

The two-day observations at Cascade Station were perhaps the most revealing in terms of assessing the oft-made claim that light rail is a “catalyst for development.” Light rail is not only irrelevant to the commercial success of Cascade Station, it is a barrier to continued development due to density requirements near rail stations.

Currently, the successful stores such as IKEA are located as far as possible from the light rail station and buffered by a large parking lot. This is not an accident. Large-scale property development investors have a formula for commercial success, and close rail access is not part of the formula.

## CONCLUSION

TriMet, Metro, the city of Portland and other institutional advocates of rail transit all have promoted the myth that light rail, the streetcar, the commuter train in Washington County and the aerial tram are part of a successful “high-capacity” transit system that carries large volumes of passengers quickly and efficiently to their destinations. This is simply not the case. Residences and employers are so dispersed in the Portland region that there are relatively few occasions when HCT is even necessary, and on those occasions, the Portland rail system is inadequate because it is not truly a high-capacity system.

For comparison, the highest-throughput mass transit facility in America is a simple busway managed by the Port Authority of New York-New Jersey (PANYNJ). On weekdays between 6:00 a.m.-10:00 a.m., PANYNJ operates a 2.5 mi eastbound contra-flow Exclusive Bus Lane (XBL) along westbound Route 495 to Lincoln Tunnel from the New Jersey Turnpike. The XBL carries 1,700 buses and 62,000 passengers each morning, on average, saving about 15-20 minutes in travel time. This averages about 1 bus every 8 seconds for a 4-hour period, with roughly 37 seated passengers per bus.

The highest-throughput location on the Portland MAX system is at the Steel Bridge, where four light rail lines must cross. Currently there are 74 in-bound

trains between 6-10 a.m., on weekdays, or one train every 3.24 minutes. Based on the theoretical maximum number of seats, we could expect roughly 10,404 passengers at most.

The Lincoln Tunnel XBL throughput is 5.9 times higher, and that's not even the theoretical maximum, that's the observed daily usage. The average weekday use of MAX crossing the Steel Bridge at the peak period is likely far lower than 10,404 because most trains are not full except for a brief, two-hour window.

**Role of the streetcar.** The 92% market share for auto use at the circus punctures the myth that fixed-guideway transit is critical to the development of the South Waterfront District. In fact, at those few hours when large numbers of people need to be moved, the private automobile does the heavy lifting. Moreover, forthcoming research by the author demonstrates that on a daily basis, when accounting for all trips in and out of the South Waterfront district by all modes, the streetcar carries only 9% of passenger-trips, while autos and trucks account for 79% of passenger-trips and 100% of freight tonnage. The district is highly auto-dependent and will remain so regardless of planner fantasies.

This does not portend well for the new \$160 million transit bridge being planned for the exact location where the circus tent was erected. This new bridge is expected to serve both the streetcar and the \$1.5 billion light rail extension to Milwaukie. Since auto access is highly constrained and many new development projects are planned for the district, levels of traffic congestion in and around HWY 43 will get much worse as financial resources are diverted for rail transit.

As the central city continues to decline as an employment center (which it will in percentage terms), the need for HCT will decline as well. Local policymakers would do well to learn from this study and begin planning for smaller, more nimble transit vehicles such as shuttles, jitneys and mini-buses, which can serve many dispersed locations at lower per-trip cost than fixed-guideway transit.

For large, special events, bus transit (both public and private) will be the best way of moving large volumes of people into and out of constrained areas. The more that local elected officials commit vast sums of public dollars to rail, the more difficult it will become to provide these important transit services.

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