



Government of **Western Australia**
Public Transport Authority

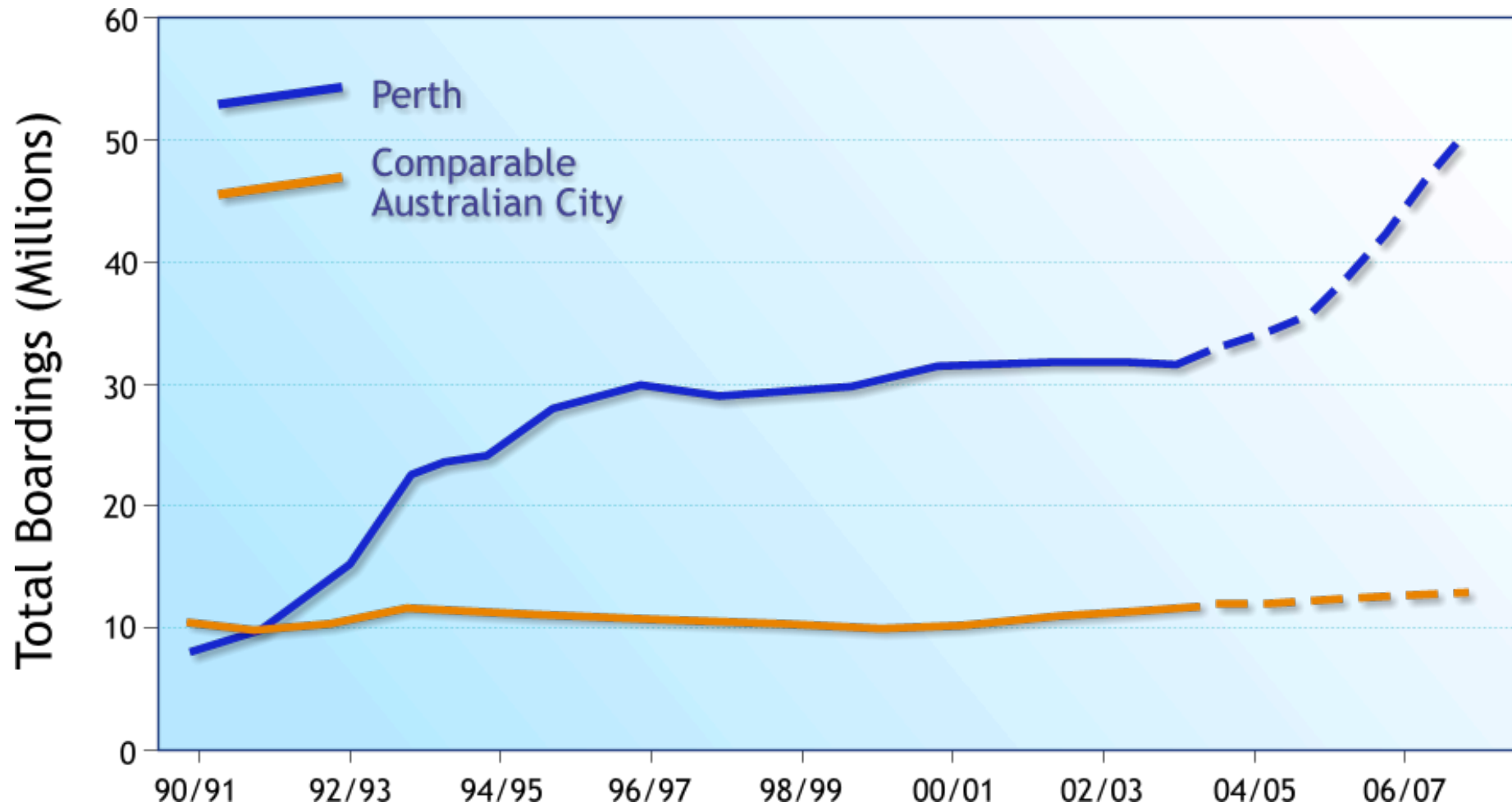
**Bureau of Infrastructure Transport
and Regional Economics
2009 Infrastructure Colloquium
19 June 2009**

**Application of a commuter railway to low density
settlement**

**Peter Martinovich, Director of Rail Infrastructure Planning, Public
Transport Authority of WA**



Government of Western Australia Public Transport Authority





Government of Western Australia Public Transport Authority

Year	Route Kms	Annual Trips
1985	66kms	10 million
2001	95kms	29 million
2005	102kms	33 million
2008	173kms	51 million
Total	173kms	

54 Route kms of the Rapid Transit network is within freeway medians





Perth grew up through the “car age” and continues to mature

- **A small city of 409,000 in 1960 to 1.6 million today**
- **Designed around cars with a comprehensive road system,**
- **Generally low congestion**
- **Expectation of high levels of accessibility & mobility**

However.....

- **Capacity on some major arterial roads & freeways close to the city is now saturated at peak periods**
- **There is limited or no opportunity to increase road capacity**
- **Compared to the past, public transport will have to carry a disproportionate share of new trips**
- **We need to make capacity on the road system for trips not suited to public transport**



Transport & Land Use Integration - Metropolitan Perth

- Built on 40 km wide Swan Coastal plain
- 1.6m population & rising
- Settlement density amongst world's lowest
- Car usage per capita in top four - worldwide
- Major environmental & underground water reserves
- Coastal living preference
- Coastal Corridor -130+ km long & growing
- Limited north-south river crossing points





Government of **Western Australia**
Public Transport Authority

Daily Trips; 20 -24 October 2008

Line	Total Daily Trips (Two way)	Morning Peak Hour Trips (One way)	Suburban Station Stops
Joondalup	57,136	8,226	10
Mandurah	51,117	7,360	9
Armadale	28,849	4,152	17
Fremantle	25,769	3,710	16
Midland	21,165	3,046	12
Total	183,986	26,494	64

Esplanade, Perth Underground, Perth City, Mclver and Claisebrook are assumed to be city stations



Government of Western Australia Public Transport Authority

STATIONS WITH MORE THAN 3000 DAILY BOARDINGS (WE 24 Oct 2008)

Murdoch	6629
Warwick	5123
Fremantle	4604
Bull Creek	4371
Stirling	4233
Whitfords	4227
Joondalup	4225
Glendalough	3594
Midland	3410
Mandurah	3249
Clarkson	3193
Subiaco	3001

STATIONS WITH THE LOWEST DAILY BOARDINGS (WE 24 Oct 2008)

Success Hill	127
Loch Street	145
Woodbridge	163
Seaforth	165
Karrakatta	204
Grant Street	213
East Guildford	245
Challis	268
Swanbourne	362
Welshpool	378
Mt Lawley	403
North Fremantle	411



Government of **Western Australia**
Public Transport Authority

Perth Urban Rail System Percentage Growth – June 2008 to June 2009

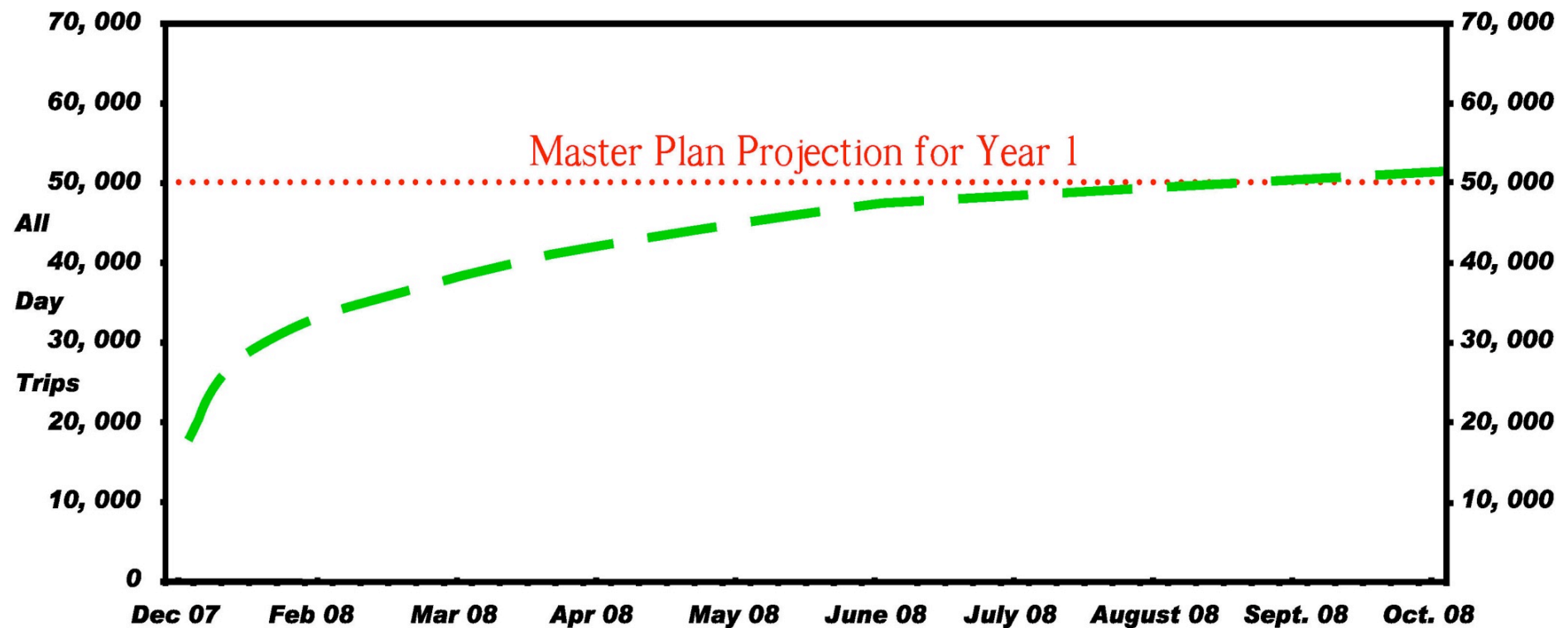
Whole System	12.9%
Fremantle Line	6.8%
Armadale Line	7.9%
Midland Line	9.6%
Joondalup Line	12.7%
Mandurah Line	21.5%



Government of **Western Australia**
Public Transport Authority

Performance of the Perth - Mandurah Line

Projected v Actual Patronage – October 2008



Source: PTA 2008 passenger data



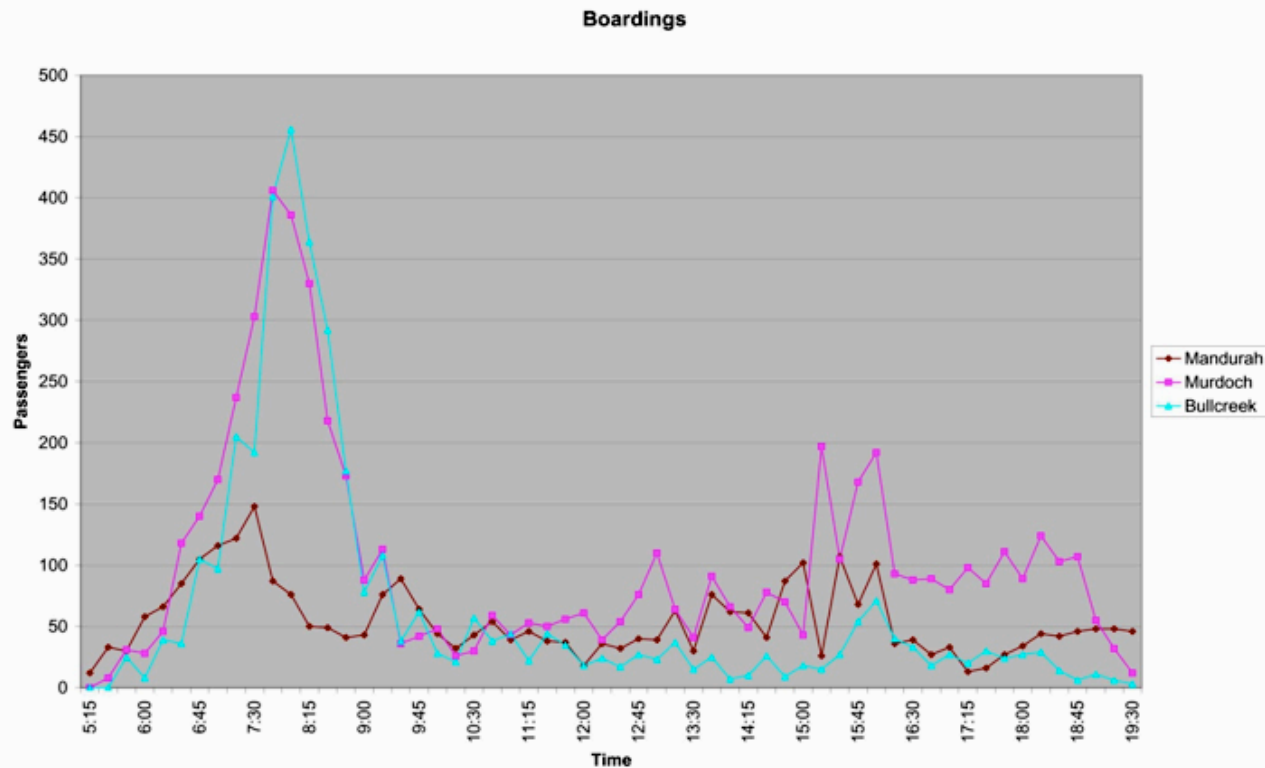
Performance of the Perth to Mandurah Line Station Arrivals at Three Key Stations

Station	All Day (One Way) Boarding's		Commuter Arrival mode		
	Master Plan	October 2008	Bus	Car	Other
Bull Creek	3,110	4,370	NA	NA	NA
Murdoch	4,980	6,630	59%	36%	5%
Mandurah	3,490	3,250	32%	65%	3%
Total	24,950	25,550			



Government of Western Australia Public Transport Authority

Perth – Mandurah Railway Patronage and Modes of Arrival – April 2008





Government of **Western Australia**
Public Transport Authority

Transport & Land Use Integration

Extent of Private Vehicle Dependency in Perth

City	Metres of Road per person	CBD Car Parking spots	Car passengers per 1000 people
Perth	10.7	631	658
Melbourne	7.7	-	594
Sydney	6.2	-	516
Australia average	8.3	489	591
USA average	6.9	468	587
Europe average	2.4	238	396



Sustainability and Public Transport Sydney v Hong Kong

Characteristics of Sydney

- One of the largest urban systems in the world
- More than 300 stations
- 900,000 passenger trips per weekday
- Highest public transport usage in Australia
- Critical in the morning peak -carries the equivalent of 35/40 freeway lanes into the city

Criteria	Hong Kong	Sydney	Perth
No. of Stations	80	320	69
Trips per day	3.7 million	0.9 million	0.18 million
Route kilometres	175	900	173
Activity Density / hectare	440	In the 20's	In the 20's

Note: Density of Activity - Jobs + Population

Source; Glazebrook with some by Martinovich



Sustainability and Public Transport Sydney v Singapore

	Sydney	Singapore
GDP per Capita	29.9	26.8
Percentage of Household Income spent on Transport	16	4.1
Car ownership per 1,000 people	475	65
Percentage of trips by Public Transport	6	55
Percentage of Home Ownership	74	90
Activity Density / hectare	In the 20's	140

Source: Simon Lane



Government of Western Australia Public Transport Authority

Transport & Land Use Integration For Low Density The Application of Mass Transit Rail to Perth

Jeffery Zupan (2004). *“The basic point is that you need density to support public transit. --- once you get above a certain density two things happen. --- you get a decrease in trips by auto and an increase in trips by transit. That threshold seems to be around seven dwellings per acre. Once you cross that line, a **bus company** can put buses out there, because they know they’re going to get enough passengers to support a reasonable frequency of service.*

Seven dwellings per acre at a reasonable dwelling occupancy is equivalent to around 35 to 40 persons per hectare.”

Newman and Kenworthy 2006. *“The redevelopment of new development of urban areas can facilitate the reduction of automobile dependence if Ped Sheds of 300 hectares (1 kilometre radius) are used around local Centres / public transit nodes and 3,000 hectares around town centres. These would have minimum development goals of 10,000 and 100,000 people and jobs respectively.”*

Source for all the above: Urban design to Reduce Automobile Dependence; Opolis, Vol 2, Issue1, 2006 Article 3, Peter Newman & Jeffery Kenworthy



Government of **Western Australia**
Public Transport Authority

Transport & Land Use Integration For Low Density The Application of Mass Transit Rail to Perth

King Cushman. *To support local neighbourhood transit service, a minimum threshold of seven dwellings per acre --- should be present.*

To make a transit system productive when homes are not intensely concentrated , facilities like park-and-ride lots should be provided to encourage people to get themselves concentrated , but on their time, not the transit system's. In this way, a transit system can start out well loaded, offering reasonably fast, high quality service that will be productive even in low density areas.

Whether the public will want to ride transit depends more on the density at the other end of the trip -- . The minimum desirable employment – concentrations --- would be at least 50 employees per net employment acre and greater than 10,000 jobs at those centres.

Source; Exploring the Land Development and Transit Connection, A Walk in the Past, a Challenge for the Future: (from Transit, Land Use & Urban Form); King Cushman, circa 1978



Government of **Western Australia**
Public Transport Authority

Transport & Land Use Integration For Low Density The Application of Mass Transit Rail to Perth

Since 70% of Commuting households now have two or more workers, this suggests that living near work is no longer a simple option to achieve.

This has created greater pressure on time, increasing what is referred to as “chained” trip making; linking the work trip to day care, to food shopping, errands etc. in an effort to reduce travel time on multiple trip purposes has become a central feature

60% of employed women (and 46% of men) make one or more stops on a typical drive home from work.

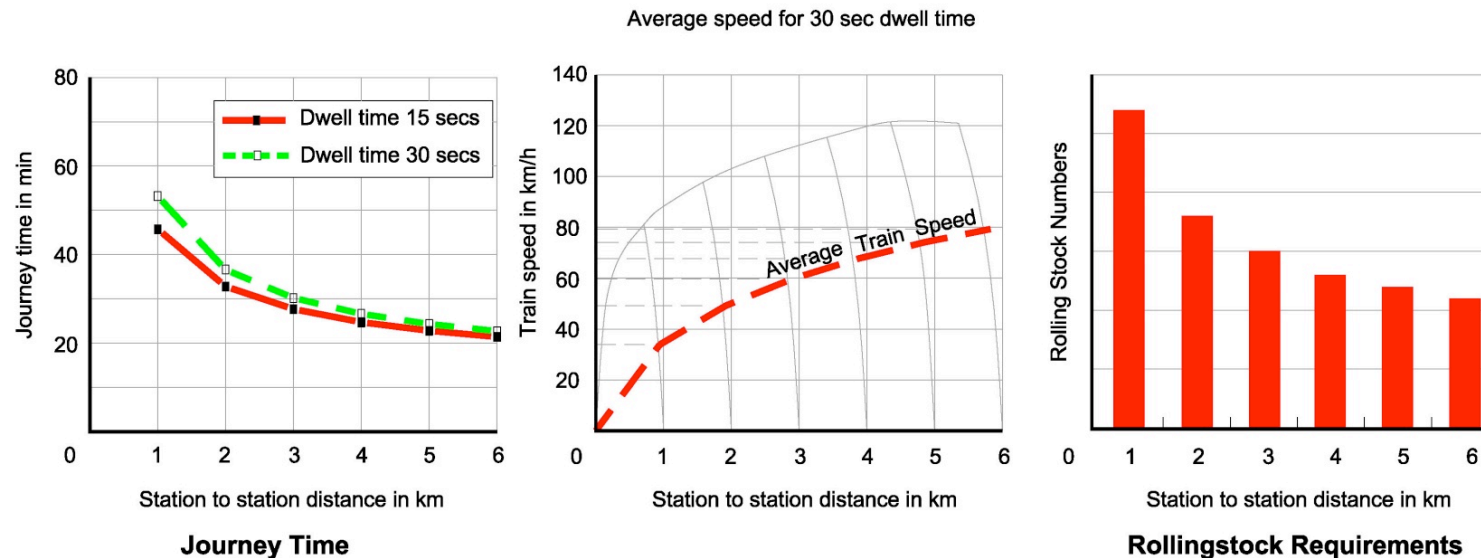
Source; Trend Affecting Public Transit's Effectiveness; A study prepared for the American Public Transportation Association; Bendon Hemily, PhD, November 2004.

This may put Park-and-Ride into an understandable context



Transport & Land Use Integration Designing Mass, Rapid Transit Rail for Low Density

Relationship between Station Spacing, Journey Time, Train Speed and Rollingstock required for a given Task



The Effect of Station Spacing on -

- journey time
- average journey speed; and
- rollingstock requirement

DESIGNING RAPID TRANSIT

Source: Interim Master Plan Currumbine to Clarkson June 2000

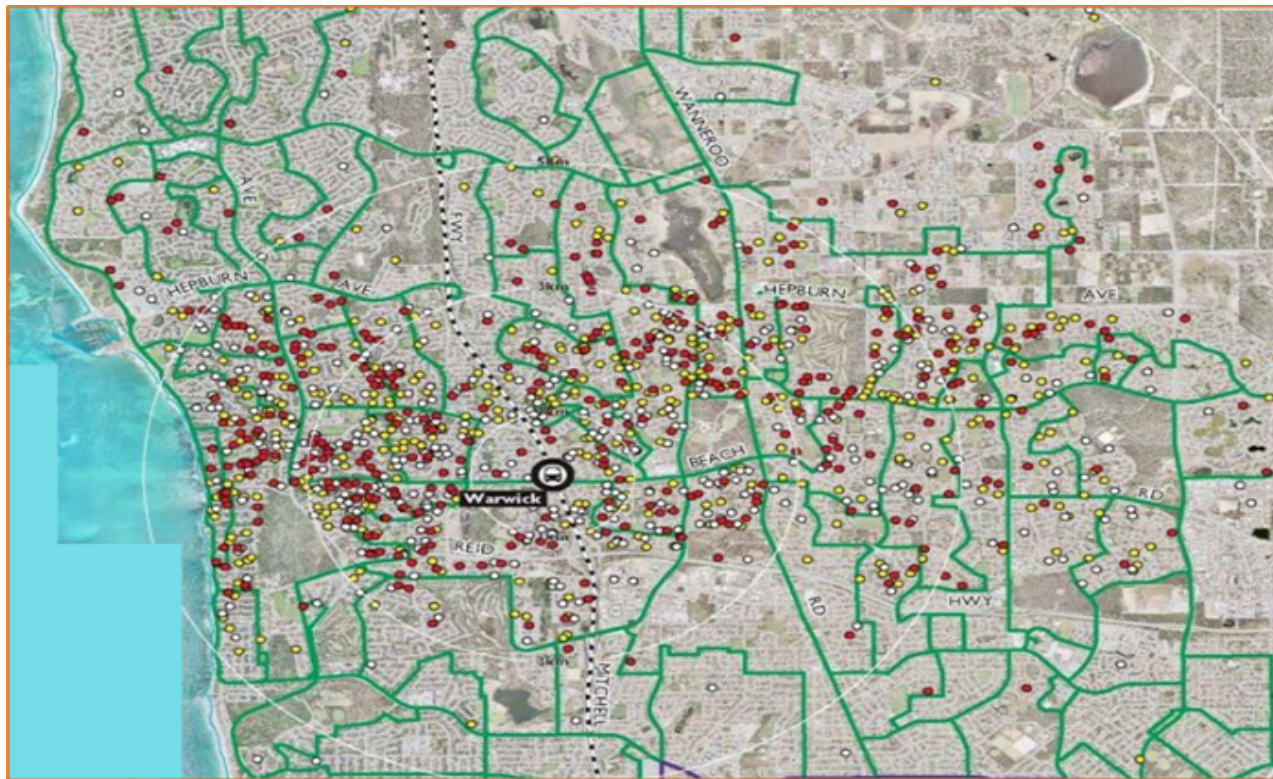
- ❖ **Rapid Transit - 20 stations (Mandurah to Clarkson) provide 59% of Total Patronage**
- ❖ **The Other 49 suburban stations provide the remaining 41% of Patronage**



Government of **Western Australia**
Public Transport Authority

Transport & Land Use Integration

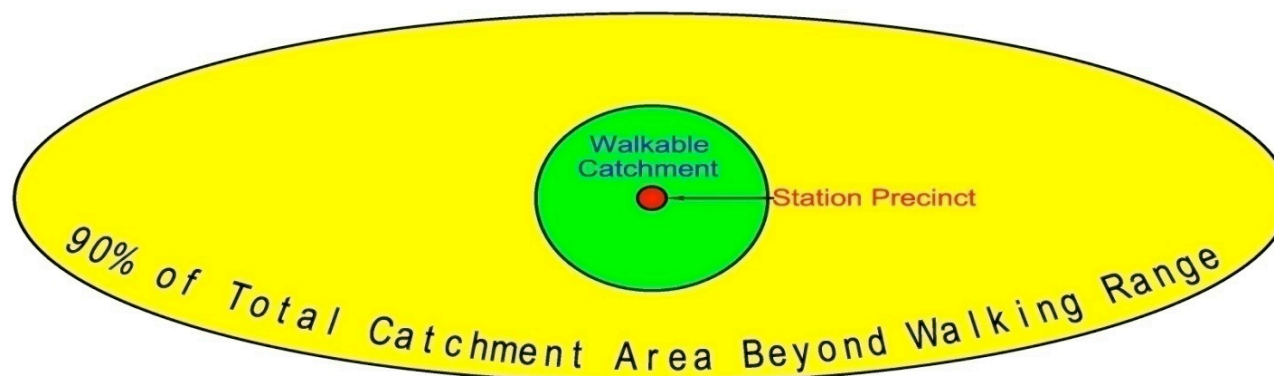
Typical Rapid Transit Station Catchment Access Range by Car



**Warwick Park
& Ride Catchment**
35 km²
90,000 people



Transport & Land Use Integration for Low Density



Perth's low density settlement, limits numbers who walk to a train station, to a max of 500 daily.

Station	Total Daily (one way) Boarding's	Number who walk to the station	Catchment Area / population
Warwick	5,000	500 (max)	35km ² / 90,000
Murdoch	6,600	500 (max)	40km ² / 100,000



Government of **Western Australia**
Public Transport Authority

Transport & Land Use Integration For Low Density The Application of Mass Transit Rail to Perth

Traditional mass transit achieves its “mass” through penetration of high urban density.

In low densities the “masses” must be brought, or come to the railway

The stations become the concentration of population density.

What is needed

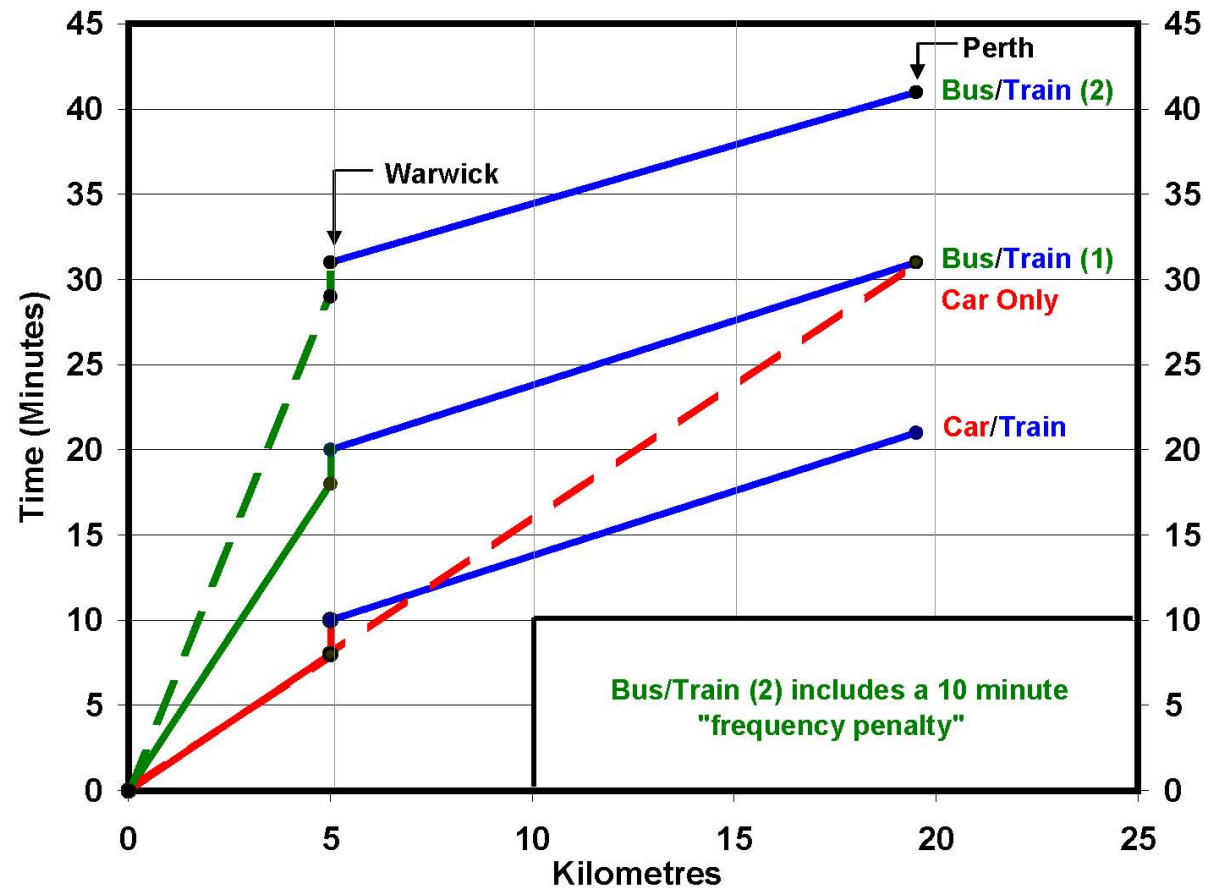
- **Strategically located stations at wider intervals - minimum average spacing of about 3km**
- **Large station precincts that are good modal interchanges to serve large catchments**
- **Frequent services**
- **High standard rolling stock**

**ANOTHER WAY OF DESCRIBING THIS IS DEVELOPMENT
ORIENTATED TRANSIT - ON A METROPOLITAN SCALE**



Government of Western Australia Public Transport Authority

Transport & Land Use Integration Warwick Station - Feeder Characteristics





Government of **Western Australia**
Public Transport Authority

Transport & Land Use Integration Murdoch Station – March 2008



Serving a catchment of around 40 km²



Government of **Western Australia**
Public Transport Authority

Murdoch Station Market Place

Catchment Area	Hectares	4,000
Average Dwelling Density	10 / ha	40,000
Population	2.6 persons / dwelling	104,000
Total trips	3.3 / person / weekday	343,200
Total public transport trips	5% of total trips	17,160
Total, all day, weekday, rail trips	Say 60% of total trips	10,296
Total rail boardings / weekday	50% of (6)	5,148
Total rail boardings / 1000 people		49.5
Total rail boardings / hectare		1.3



Government of **Western Australia**
Public Transport Authority

Perth - Mandurah Railway

Local versus Regional Transport / land use conflicts

Local objectives at individual stations:

- **Maximise development density and non-motorised activity**
- **Maximise accessibility by non-motorised modes**
- **Minimise impacts on surrounding area**

Broader Regional Objectives:

- **Maximise accessibility/convenience by motorised modes**
- **Minimise impact on surrounding area**
- **Integrate with broader non local land use**
- **Requires good sitting to suit broader catchment transport networks**

The broader catchment provides more than 90% of overall patronage



Government of **Western Australia**
Public Transport Authority

Rapid Transit Interchange Models

Warwick



Cockburn



Murdoch



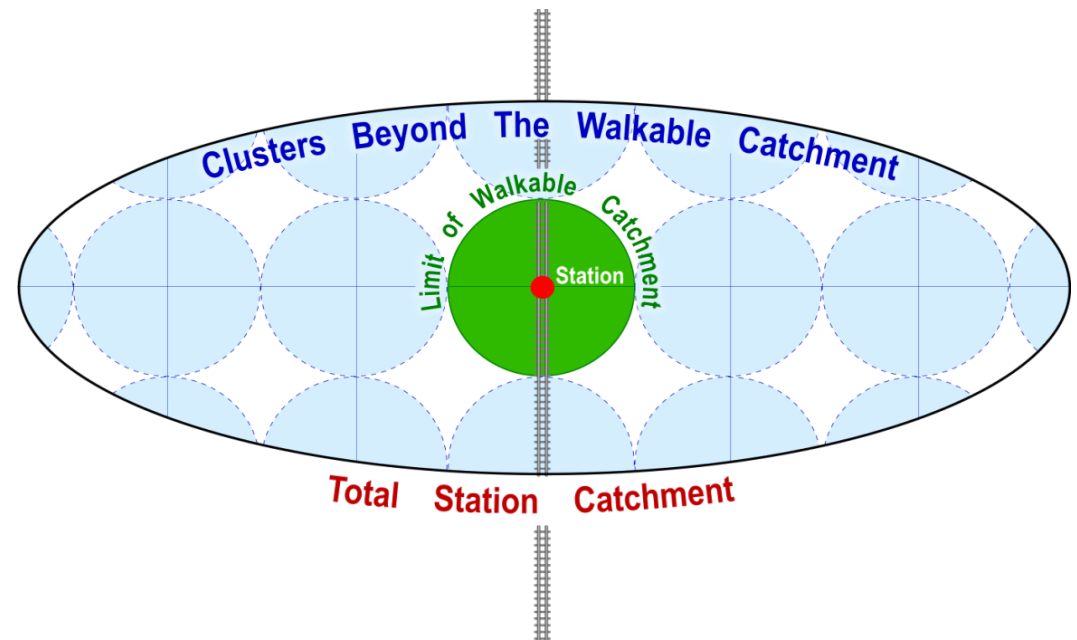
Clarkson





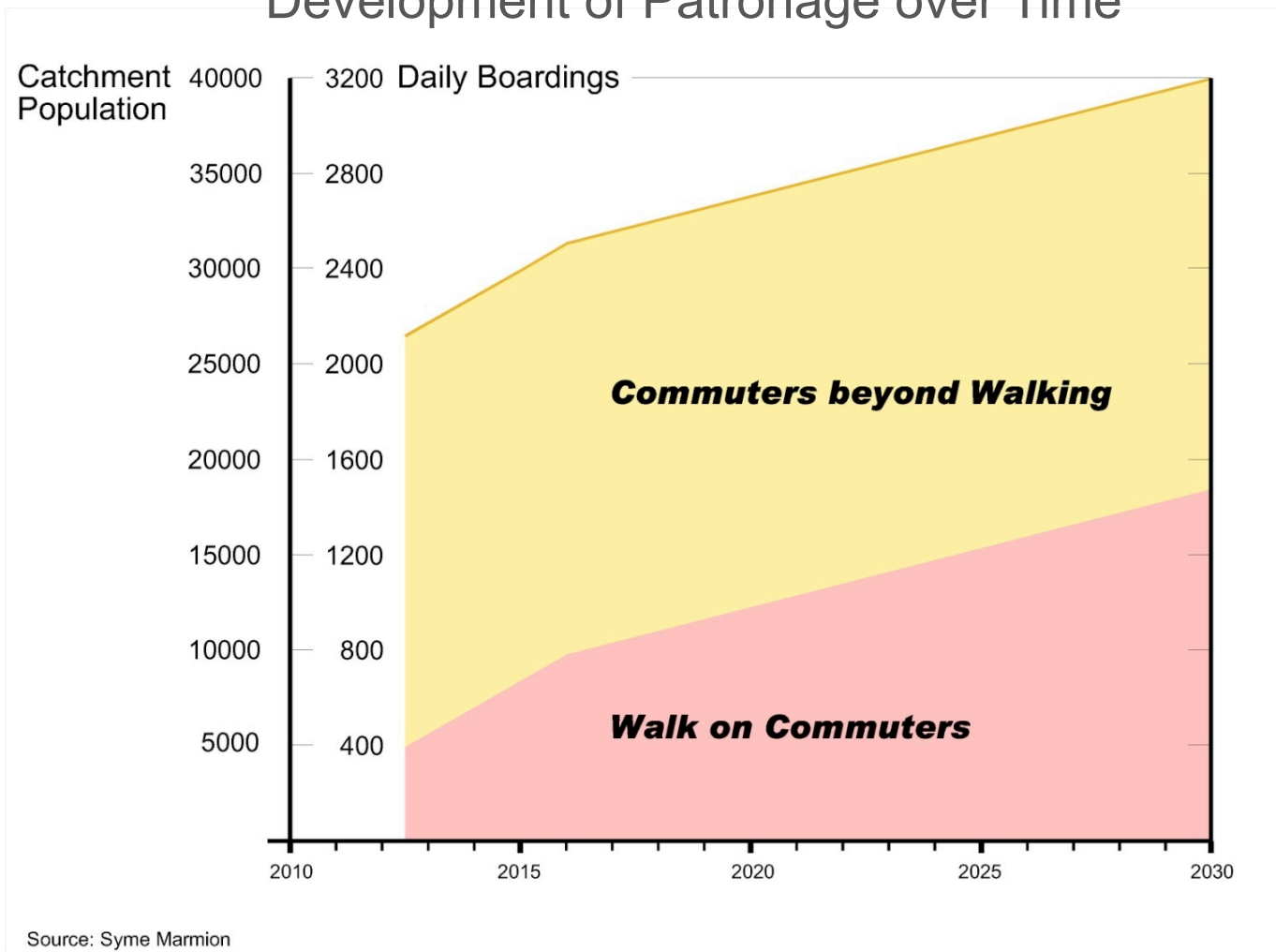
Transport & Land Use Integration For Low Density Transit Orientated Development

- **Conflicting demands arise between immediate precinct needs & the wider catchment**
- **Requirements of Development Oriented Transit on the Metropolitan system should not be lost in the quest for Transit Orientated Development at the local Station Level**





Transit Orientated Development at a “Greenfield” Site Development of Patronage over Time



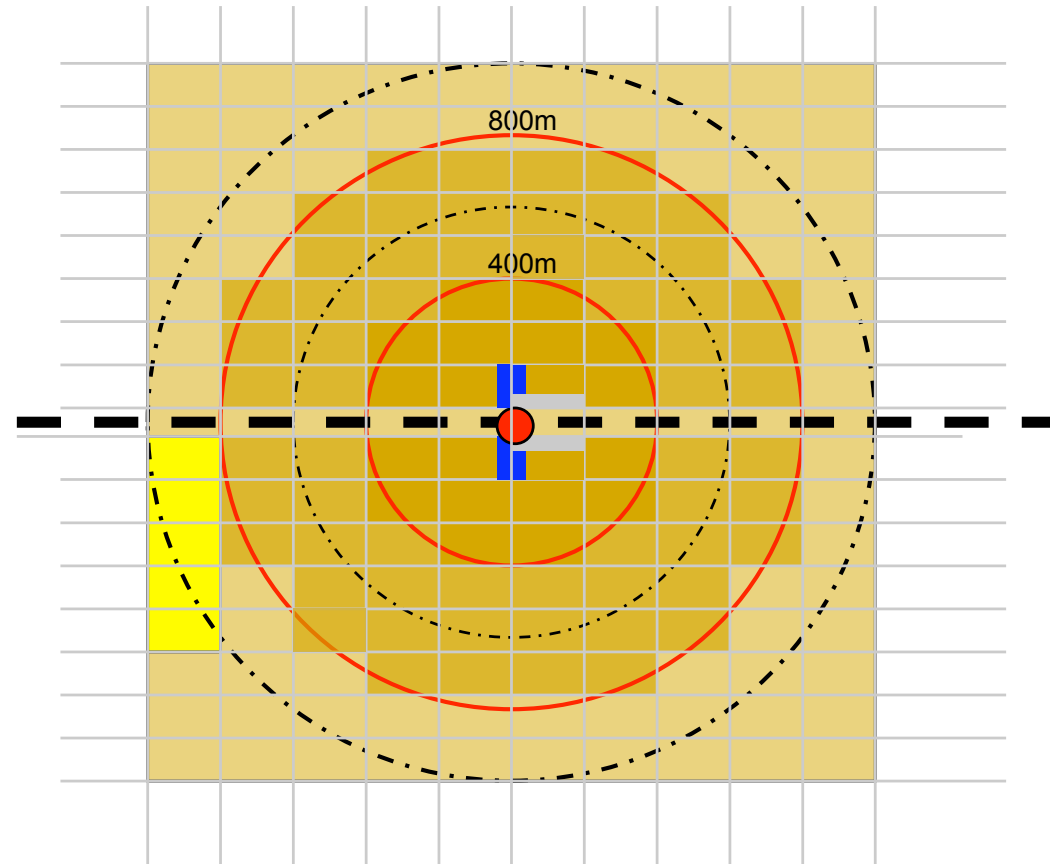


Government of Western Australia Public Transport Authority

Transit Orientated Development The Minimum for Rail Transit

Land Usage

-  R60 (21Ha)- 2520 people
-  R40 (91Ha)- 7280 people
-  R20 (65Ha) – 2600 people
-  Commercial/Retail (3Ha)
-  Education (2Ha)
-  Park and Ride (2Ha)





Government of **Western Australia**
Public Transport Authority

Transit Orientated Development The Minimum for Rail Transit

▪ Walk (from 12,400 people within 1000 metres)	600
▪ Park ' Ride (15Km ² Catchment – Car park limited to 2)	550
▪ Car Drop Off	400
▪ Bus	700
Total	2250



Government of **Western Australia**
Public Transport Authority

Transit Orientated Development Business Case for a Green-fields Site

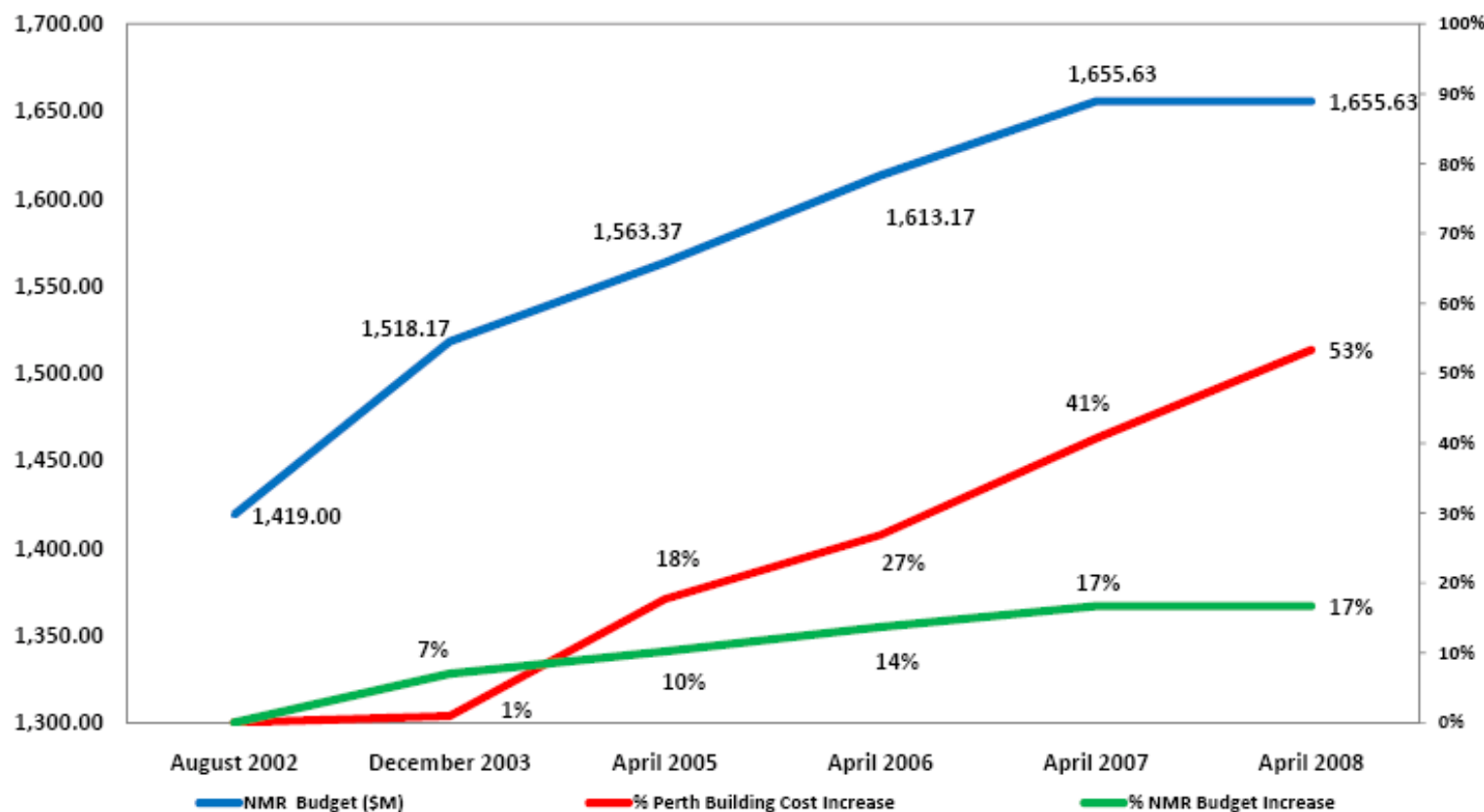
- Minimum Patronage Objective of about 2,000 weekday boarding's
- Catchment population of at least 30,000
- BCR (Infrastructure Australia Guidelines) of 1.5
- Operating costs must be kept within manageable limits
- Generation of substantial (public) non user benefits as the majority of benefits do not accrue to the PTA
- Acceptance by all parties of what is needed to make it happen.

Note that for a TOD we need an absolute minimum population of 10,000 within walking distance of the station to yield up to 700 daily walk-ons



Government of Western Australia Public Transport Authority

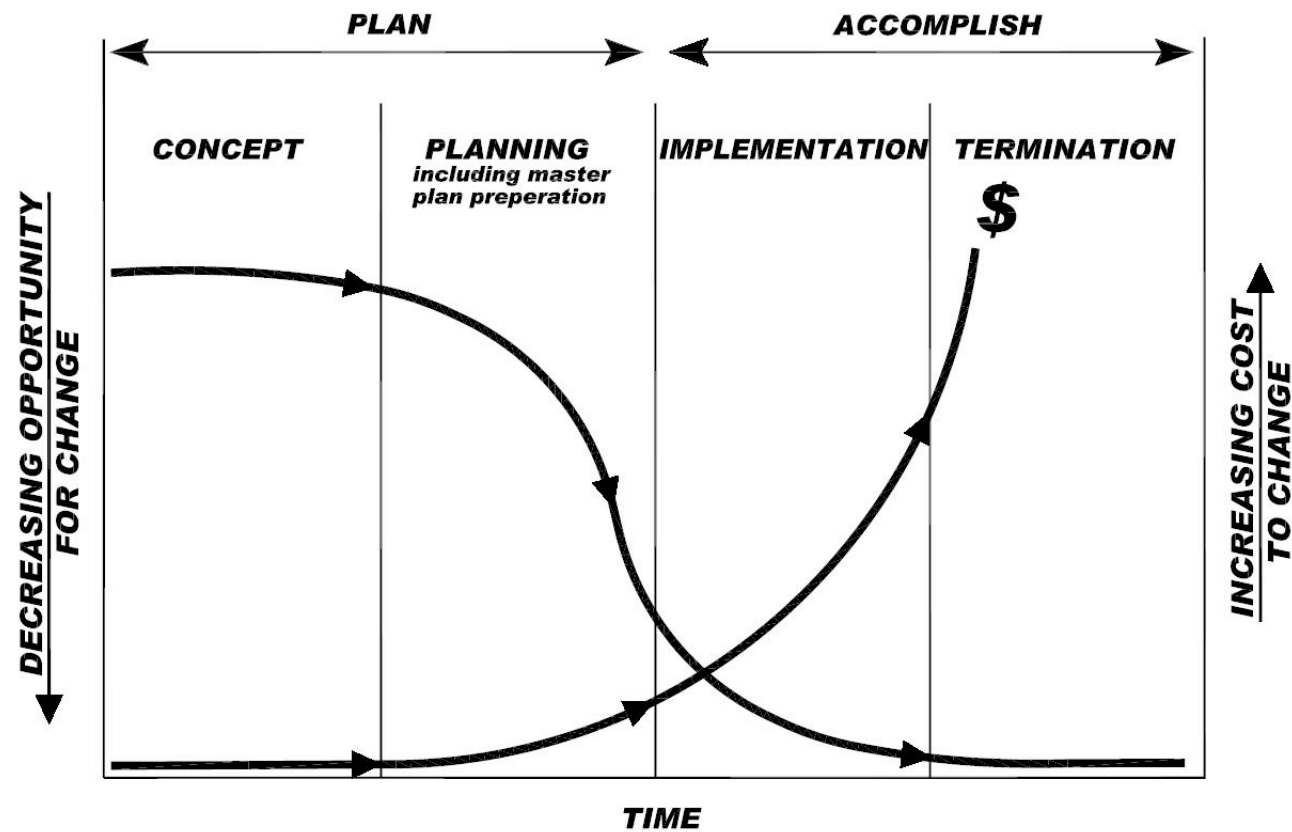
New MetroRail Project Budget and Cost Increase vs. Perth Building Cost Increase between 2002 and 2008





New Metro Rail Project

Criticality of Master Planning in Project Management





Government of **Western Australia**
Public Transport Authority

New Metro Rail Project Criticality of Master Planning in Project Management

