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MELBOURNE AND METROPOLITAN TRAMWAYS BOARD

ENGINEERING DEPARTMENT

PLANNING BRANCH.

TRAVEL TIME CONTOURS FOR TRAVEL BY TRAM AND TRAIN FROM THE CENTRAL CITY BUSINESS AREA.

JULY 1966

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The purpose of this exercise is to demonstrate that the average central city worker can command a greater inner suburban travel area for travel times up to a total journey time of 35 minutes by using trams with a scheduled speed of 10 m.p.h. instead of suburban railways operating on present day timetables. If however the scheduled speed of the tram is increased to 15 m.p.h. the advantage would still be with the tram for total journey times up to 55 minutes.

The reasons are of course:-

(a) Tram stops in the Central City Area are more conveniently placed.

(b) Tram headways are shorter.

(c) Suburban tram stops are more closely spaced.

(d) Tram routes are more closely spaced.

The advantage of suburban railways for the outer suburbs is beyond dispute.

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1. INTRODUCTION.

The purpose of this exercise is to demonstrate the advantage of tramway over suburban railway type of operation for travel to and from the inner suburban area for the average central city worker, and of course the importance of preserving these advantages in the planning of underground tramways. It is based on walking at 4 feet per second from the journey origin to the tram or train and also from the tram or train to the journey destination. Railway travel is based on current timetables. Though tram headways are based on current timetables, scheduled speeds are based on a minimum of 10 m.p.h. being representative of present day travel in congested streets, and a maximum of 15 m.p.h.* as a reasonable upper limit that could be achieved with modern trams on routes cleared of traffic congestion and with traffic lights favourably biased. Waiting times are taken to be 50% of the average headway for services leaving the city terminus between 2.00 p.m. and 3.00 p.m. on normal week days up to a maximum waiting time of 10 minutes.

The walking time at the Central City Business Area is based on the "weighted average" for the distribution of workers determined by the survey carried out by the Melbourne City Council in 1961 and 1962.

Travel time contours have been plotted for 20, 30, 40 and 60 minutes travel.

The choice of distribution of central city workers was one of convenience, however it is considered that this would be closely related to both the distribution of activity and travel requirements.

*Refer Information - Tram 980 (P.C.C. Equipment) Testing Branch Report No. 13/1/144.

2. WEIGHTED AVERAGE WALKING TIME FOR THE CENTRAL CITY BUSINESS AREA.

It is assumed that the traffic lights average cycle is 75 seconds with 40% "WALK" phase, so that 60% of the pedestrians are held up for half the "DON'T WALK" phase of 45 seconds which represents an average delay of 0.22 minutes per pedestrian per light. Though traffic light cycles and "DON'T WALK" phases vary considerably, and pedestrian observance is not 100%, the overall effect of the traffic light delay is found to be minor. Walking distances are based on footpaths and right angle crossing of streets.

Though most people claim that they walk faster than the assumed average walking speed of 4 feet per second (2⅔ m.p.h.), it is nevertheless considered to be reasonable for periods when footpaths are crowded - periods when most people are making their journeys.

2.1 Travel Time to Flinders Street and Princes Bridge Railway Station.

It is assumed that people west of William Street would use Spencer Street Railway Station. This would be within half a block of the probable true division line and the number involved would be relatively small.

Passengers using Spencer Street Railway Station have been ignored as they only represent approximately ⅛th of the total rail patronage.

The weighted average to the entrance gates is 10 minutes (Refer appendix 1.).

To this must be added the time to reach the appropriate trains. The additional distances vary from 280 feet for platforms 2 and 3 to almost 800 feet from a point midway between Elizabeth Street, Swanston Street and of Degraves Street, to the Princes Bridge trains. When allowance is made for delays at barriers and negotiating steps and ramps the following were assumed.

Entrance to Platforms 2 to 11	2 minutes.
Degraves Street to Princes Bridge Platform	4 minutes.

The corresponding time to the entrance to Flinders Street Station if the underground railway stations as at present proposed were in operation, would be 3½ minutes less. That is, the average walking time for a central city worker to walk to a railway station entrance would be reduced from 10 to about 6½ minutes. This could represent

a daily saving in time of 7 minutes per person which for over 10⁵,000 people, based on an 8 hour working day would represent a saving in time equivalent to 1,500 man hrs per normal week day.

2.2 Travel to Loop Lines.

The corresponding weighted averages for the time taken to walk to stations from routes is as follows:-

Swanston Street	(No similar service in Elizabeth Street).	8¼ minutes.
Swanston Street	(Similar service in Elizabeth Street).	5½ minutes.
Elizabeth Street	(No similar service in William Street).	7½ minutes.
Elizabeth Street	(Similar service in William Street).	6¼ minutes.
William Street	(No similar service in other streets).	6½ minutes.
William Street	(Similar service in Swanston Street).	4¾ minutes.
William Street	(Similar service in Elizabeth Street).	4½ minutes.
Bourke Street		5¼ minutes.
Collins Street		5¾ minutes.
Flinders Street		7¾ minutes.
Batman Avenue		10¼ minutes.

3. Travel Time from Suburban Rail Stations.

These are based on half the average headway for trains leaving Flinders Street or Princes Bridge Railway Stations between 2.00 p.m. and 6.00 p.m., according to the current week-day timetables. (Refer appendix 2).

Walking in radial directions from suburban railway stations has been assumed. The summary for all stations is set out in appendix 3. The time contours are indicated on Drawings 770 to 773.

4. Travel between City Terminals.

These are similarly based on half the average headway for trams leaving the city terminus between 2.00 p.m. and 6.00 p.m. according to the current week-day timetables. (Refer appendix 4).

As the tram stops are spaced about 1/8th mile apart (1/8th of one inch on Drawings Y70 to Y73), walking distances have been assumed in a radial direction and the ripple that should show on the contour has been smoothed out.

The summary for all tram routes is given in appendix 5.

The time contours are indicated on Drawings Y70 to Y73.

6. THE AREA COMMANDED WITHIN EACH TRAVEL TIME CONTOUR.

The area of travel that can be commanded from the Central City Business Area for various travel times is as set out in the following table.

Areas enclosed by Travel Time Contours.

Travel Time	Drawing No.	Railway and Walking	Tram 10m.p.h. and Walking	Tram 15 m.p.h. and Walking
20 minutes	Y70	3 sq.miles	5 sq.miles	8½ sq.miles
30 minutes	Y71	14½ 4½ sq.miles	16 sq.miles	30 sq.miles
40 minutes	Y72	39 sq.miles	55 sq.miles	80 sq.miles
60 minutes	Y73	144 44 sq.miles	82 82 sq.miles	115 sq.miles

For travel times of 20 minutes only, three suburban railway stations can be reached under average conditions namely Jolimont, Richmond and East Richmond. The 3 square miles credited to train and walking consists chiefly of the area that can be commanded by walking only.

For travel times of approximately 35 minutes the area that can be commanded by the railway and trams at 10 m.p.h. are approximately equal.

If however the tram speed is accelerated to 15 m.p.h., the tram would on the average maintain its advantage up to 55 minutes total journey time.

Beyond the limit of the 60 minutes travel contour the advantage of the railway type of operation cannot be disputed.

6. FACTORS WHICH DETERMINE AREA WITHIN A GIVEN TRAVEL TIME CONTOUR FROM THE CENTRAL CITY BUSINESS AREA.

The following are the essential factors which determine the maximum area that can be enclosed within a given travel time contour. These factors are of course of great importance in the planning of underground tram or suburban railway routes.

6.1 The walking distance in the Central City Business Area to the boarding point should be a minimum.

This is of great importance as it affects the location of the entire contour (ignoring barriers such as the sea front), as distinct from the walking distance at the outer end of a railway or tram journey where the effect on the contour is local only. The walking distance is determined by the following.

6.1.1 The route should traverse the area to be served.

This is in preference to originating (and terminating) at the nearest perimeter which is born out by the following average walking times.

Batman Avenue Terminus	14½ minutes.
Flinders Street Railway Station	12 minutes.
Swanston Street Trams	8½ minutes.

The difference between Batman Avenue Terminus and Swanston Street trams represents 10% of a 60 minutes journey.

6.1.2 The route should pass through the centres of gravity of activity of the areas it is to exclusively serve.

This is born out by the Bourke Street and Elizabeth Street trams which both pass approximately through the centre of gravity of employment of the Central City Business Area, as follows:-

Bourke Street trams	5½ minutes.
Collins Street trams	5⅝ minutes.
Flinders Street trams	7⅜ minutes.

also

Elizabeth Street trams	7½ minutes.
Swanston Street trams*	8½ minutes.
William Street trams.	9½ minutes.

*. Service exclusively confined to this street.

The difference between Bourke Street and Flinders Street or between Elizabeth Street and William Street are over 10% of a 20 minute journey.

However when deciding the location of a service that may be duplicated later it would be preferable to bias it away from the likely route of the duplicated service. This is born out by the comparison between Swanston Street and Elizabeth Street assuming a duplicated service in William Street.

	Elizabeth Street Trams	Swanston Street Trams
Average walking time. No alternative service.	7¼ minutes	6½ minutes
If there is a duplicate service in William Street.	6½ minutes	5½ minutes
Average walking time for duplicate service in William Street.	4½ minutes*	4⅔ minutes*
Overall average walking time with duplicate services.	5⅔ minutes	5¼ minutes
% of total patronage	68%	58%

*William Street trams.

6.1.3. <u>The route should approximate to the longest axis.</u>

Where the area concerned approximates to an ellipse or rectangle the service should preferably be in the direction of the longest axis. This is born out in the case of Bourke Street which approximates to the longest axis and Elizabeth Street, the shortest, where the average walking time to the latter is 2 minutes greater.

6.1.4 <u>The spacing of the routes should be a minimum.</u>

While other factors enter into this consideration, such as operating costs and headways, the duplication of a service such as in both Swanston Street and William Street will substantially reduce walking times as follows:-

Swanston Street trams

No similar service in William Street 8½ minutes
Similar service in William Street 5½ minutes

William Street trams

No similar service in any other street 9½ minutes
Similar service in Swanston Street 4½ minutes

6.1.5 Stops should be spaced along a route to give minimum average walking distance.

This is born out by the average walking times to Flinders Street Railway Station entrance of 10 minutes compared with 7½ minutes to the Flinders Street trams. Though both routes are closely parallel the railway has one stop only and this meets the above requirement for Elizabeth and Swanston Streets only, whereas the tram route with a stop at each cross street meets these requirements for the full length of Flinders Street. This also relieves congestion on footpaths that would arise from all the passengers having to convert onto a single stop or station.

6.2 The headway should be a minimum.

Though this is obvious, its importance however depends on both the average and maximum waiting time relative to the overall journey time. Though an average waiting time equal to half the headway has been used for determining the location of the time contours, it is not intended to underrate the importance of the frustration felt by a person who having just missed a train or tram has to wait the full headway.

However it is considered reasonable to assume that headways less than 10% of the overall journey time would be of diminishing importance.

The approximate average headways as set out in the following table are of interest.

APPROXIMATE HEADWAYS "DOWN" SERVICES.

Departure Time	Railways	Tram
2.00 p.m. to 5.00 p.m.	8½ to 12½ 10½ minutes	4 to 6 5 minutes
5.00 p.m. to 6.00 p.m.	6 to 8½ 6½ minutes	3 to 5 4 minutes

This indicates that on an average the headways for trams to the inner suburbs and trains to the outer suburbs are near a reasonable minimum, as far as overall journey time is concerned.

Here the trams have an appreciable advantage of the order of 3 minutes shorter average waiting time in the off peak service.

6.3 The vehicles travel time should be a reasonable minimum.

This is determined by directness of route, number of intermediate stops, acceleration, deceleration and running speed. Though the railways average scheduled speeds are in excess of 20 m.p.h. they only show to advantage for overall journey times in a few limited locations in the inner suburban area which are near railway stations.

The economic aspects of the time involved should be considered in relationship to overall average journey times, however the psychological aspect of a "smart service" should not be under estimated.

The effect of increasing the average tram speed from 10 to 15 m.p.h. is significant as illustrated by the following table. The square route of the ratio gives an indication of the effect on journey time.

Time Contour	20 Min.	30 Min.	40 Min.	60 Min.
Area sq. miles				
10 m.p.h.	5	15	35	82
15 m.p.h.	8½	30	60	115
Ratio	1.70	1.80	1.70	1.40
$\sqrt{(\text{Ratio})}$	1.30	1.37	1.30	1.18

Further discussion of this aspect is considered to be outside the scope of this exercise.

6.4 Routes should be spaced so that contours approach a circumferential pattern.

In order to obtain the maximum area within a particular time contour, routes should be such that the time contour approaches a circumferential line.

A study of the time contours reveal a gap north of the Heidelberg railway line and east of the East Preston tram route, while the spacing of the tram lines to the north give time contours which approximate to a circumferential line.

6.5 Stops should be spaced to reduce the area of overlapping to a minimum without a substantial area of windows.

This is of course a criterion for the maximum area within a given time contour but conflicts with the spacing of stops for shorter time contours. However, there are many other factors which are outside the scope of this exercise that must also be considered in deciding the location of stops.

7. CONCLUSION.

This exercise illustrates the importance of integrating a Central City Business Area underground tramway system into the existing inner suburban tramway system as a means of serving the inner areas with the greatest economy of overall travel time as distinct from a similar underground railway system integrated into the Victorian Railways suburban rail system for serving the outer suburban areas.

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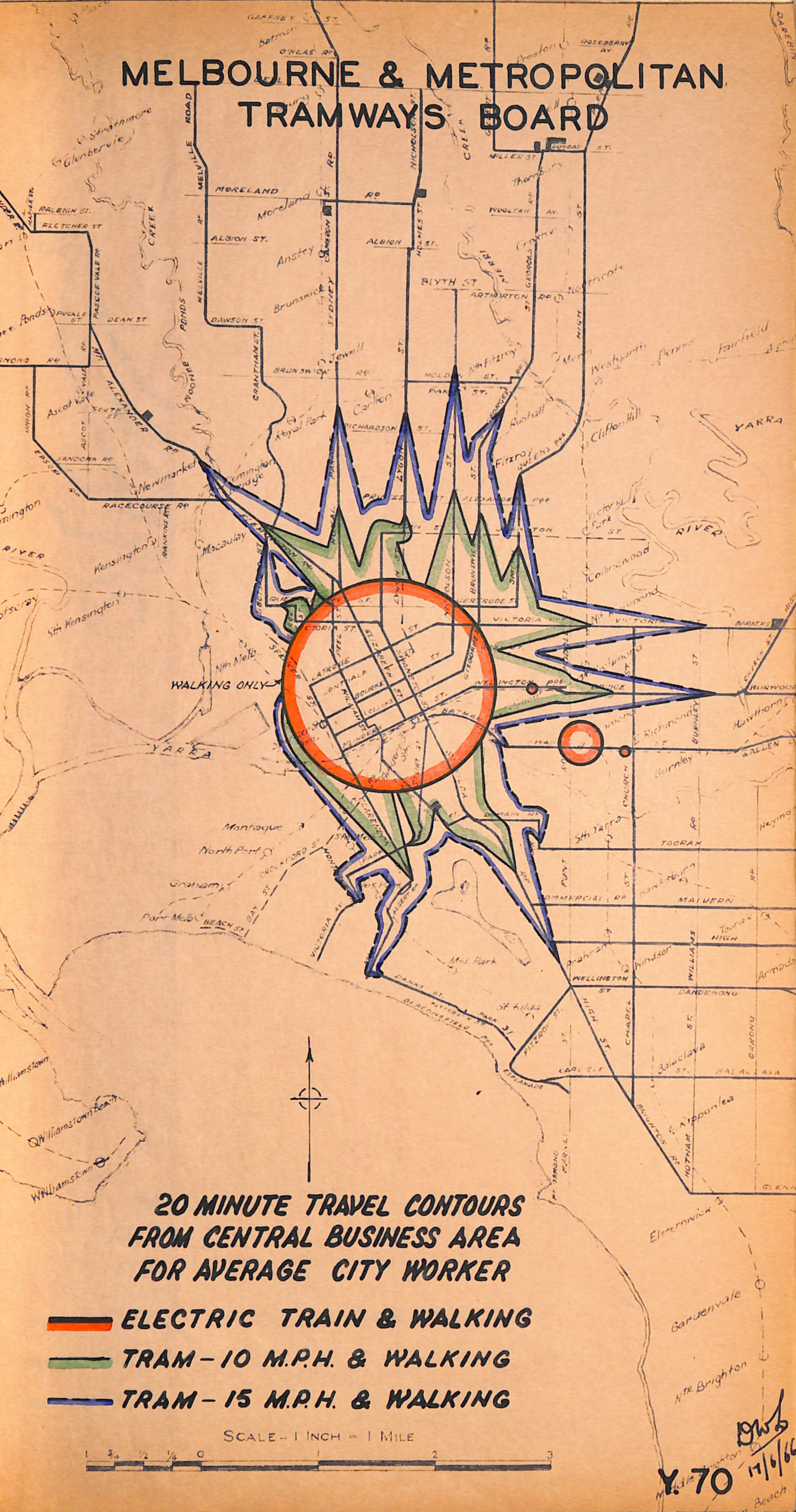

20 MINUTE TRAVEL CONTOURS FROM CENTRAL BUSINESS AREA FOR AVERAGE CITY WORKER

- ELECTRIC TRAIN & WALKING
- TRAM – 10 M.P.H. & WALKING
- TRAM – 15 M.P.H. & WALKING

SCALE – 1 INCH = 1 MILE

1 3/4 1/2 1/4 0 1 2 3

Y.70 17/6/66

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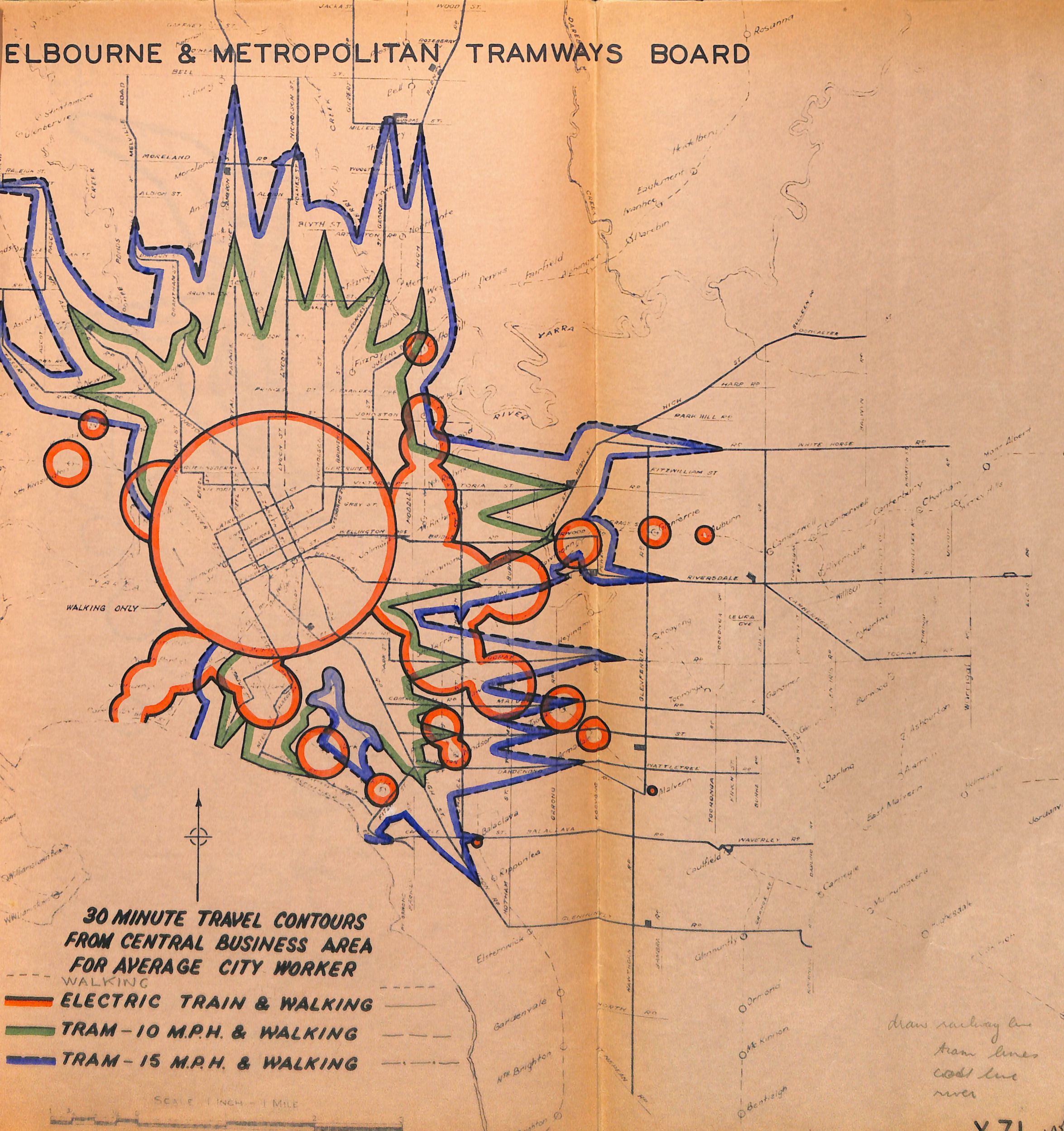

Y.71

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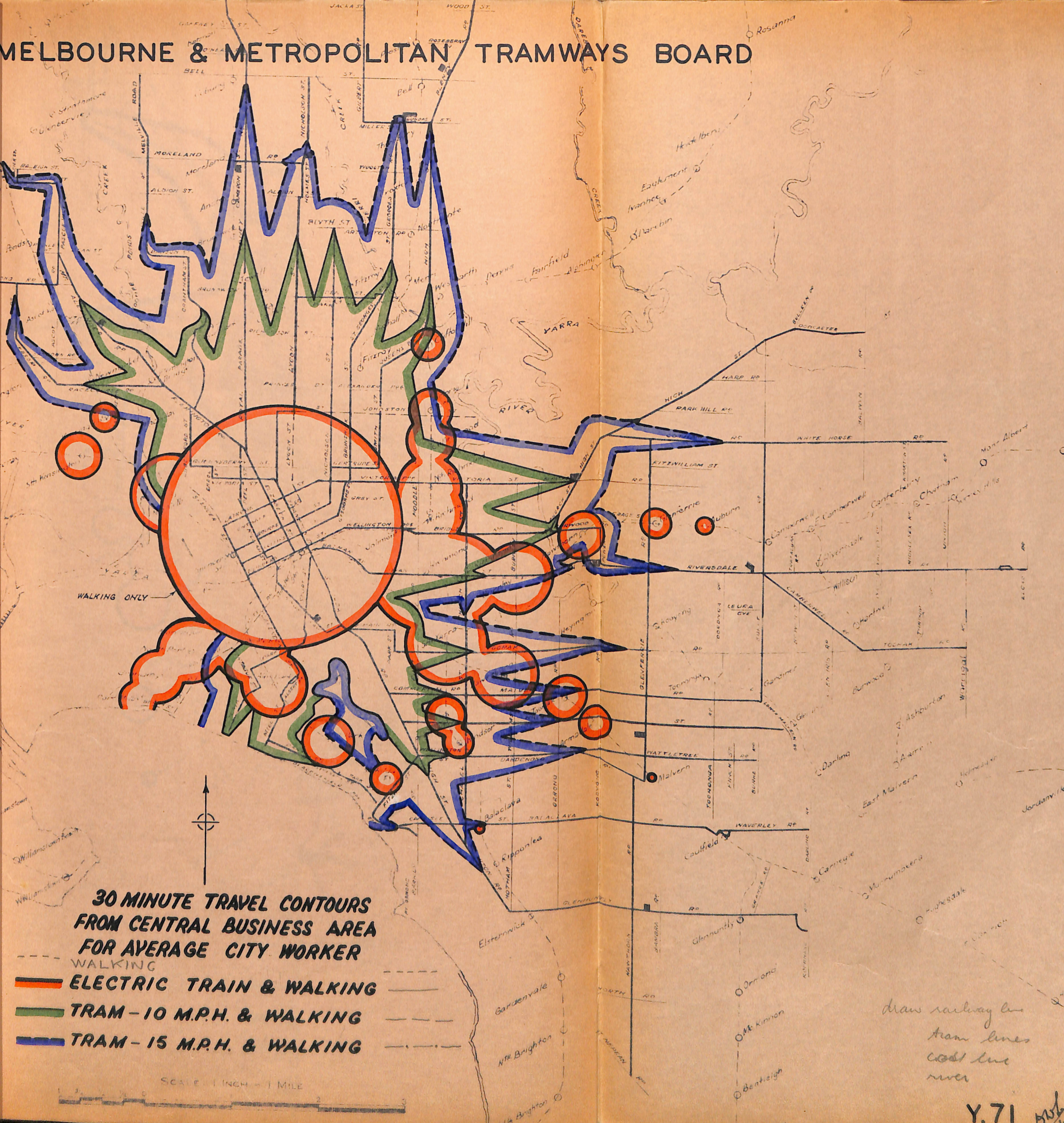

Y.71

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40 MINUTE TRAVEL CONTOURS FROM CENTRAL BUSINESS AREA FOR AVERAGE CITY WORKER

- ELECTRIC TRAIN & WALKING
- TRAM – 10 M.P.H. & WALKING
- TRAM – 15 M.P.H. & WALKING

SCALE – 1 INCH = 1 MILE

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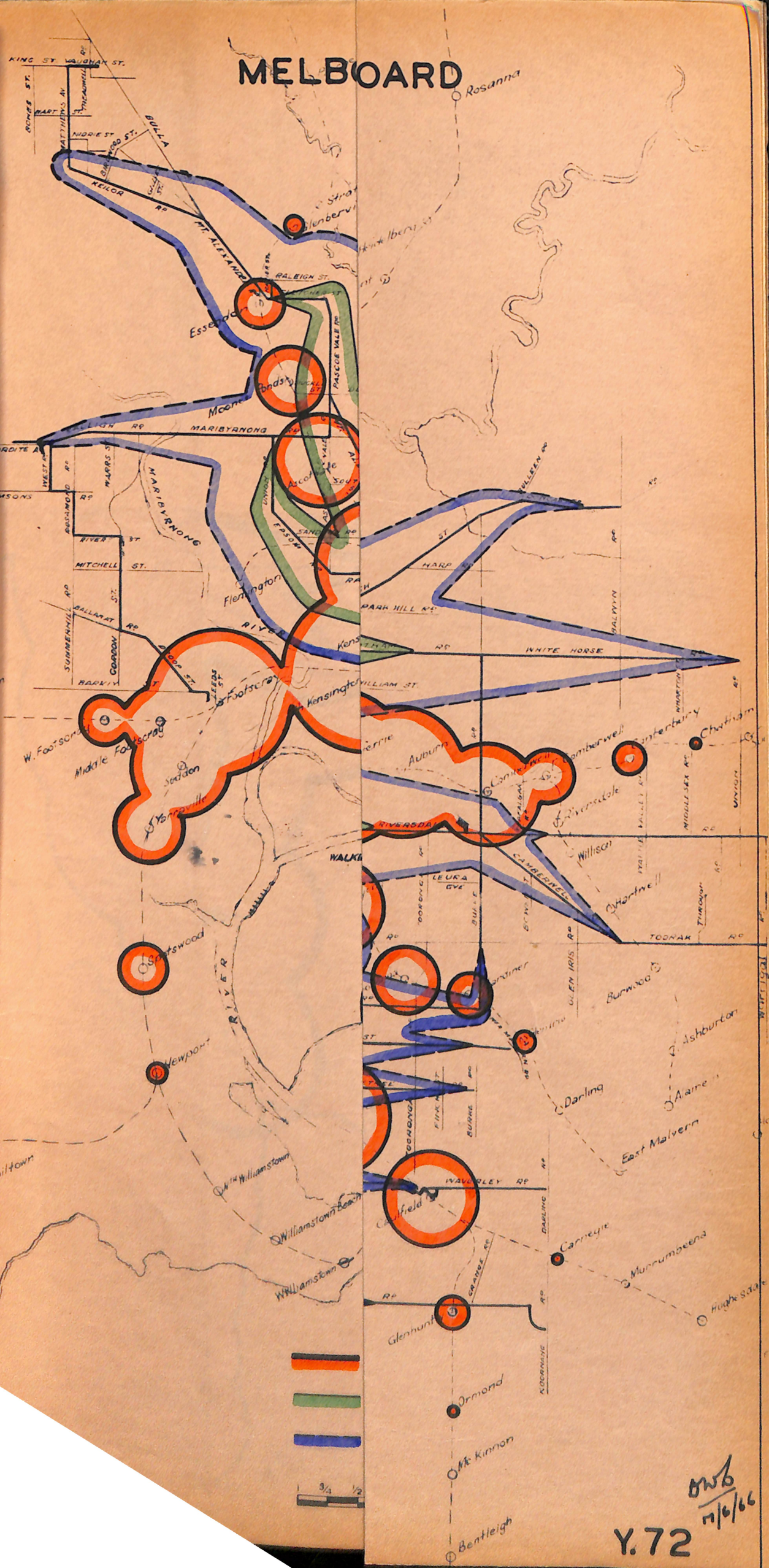
Y.72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