

MANLY OVAL CAR PARK DEMAND FORECASTING STUDY



FOR

MANLY COUNCIL

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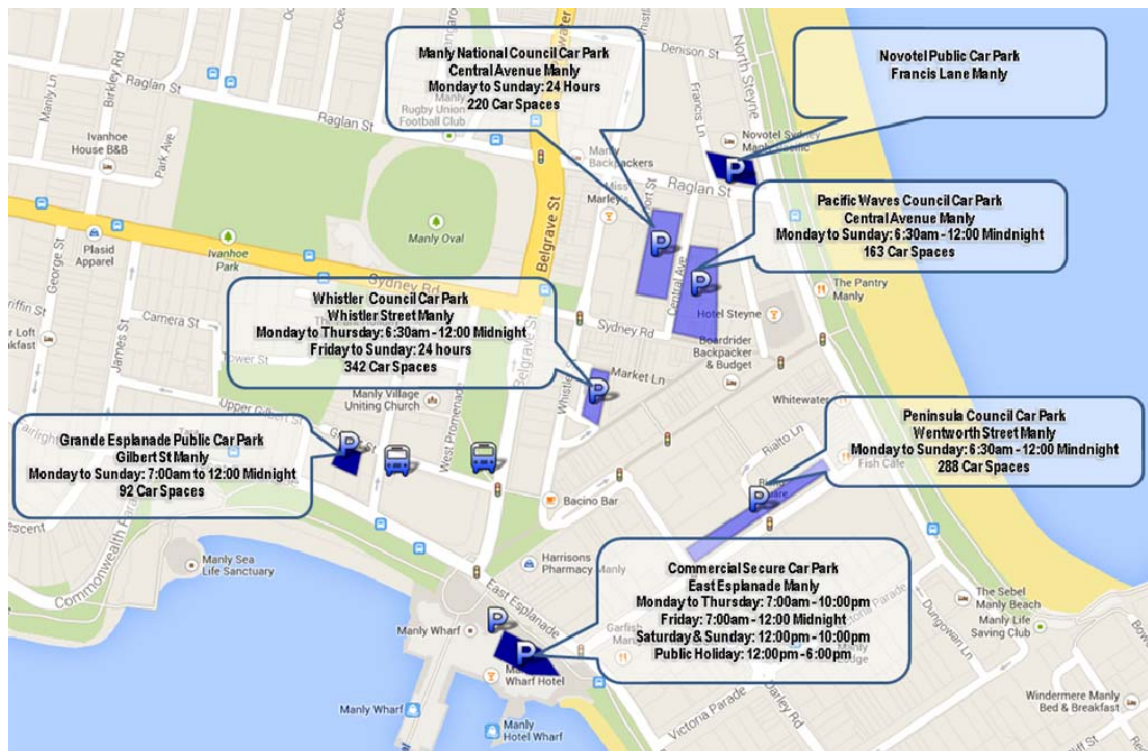
1. INTRODUCTION

1.1 BACKGROUND

As part of the *Manly 2015* Masterplan, Manly City Council proposes to demolish the existing Whistler Street car park and construct a new 800 space car park beneath Manly Oval.

Bitzios Consulting has been commissioned by Council to estimate forecast parking demands using detailed survey data in order to verify parking demand assumptions previously used in the feasibility report entitled *Financial and Commercial Review of Manly 2015 Car Park and Town Centre Proposals*.

Existing car parks in and around the Manly CBD are shown in Figure 1.1.



Source: Google Maps

Figure 1.1: Manly CBD Existing Car Parks

The project involved interview surveys with car park users with a view to developing a parking cost/time elasticity model in order to test a range of parking scenarios at the proposed Manly Oval car park. A base year of 2013 was adopted along with a demand forecast horizon of 2033.

1.2 SCOPE

The scope of work for this study included:

- undertaking a Manly CBD parking preference survey (via customer interviews);
- analysis of existing usage data from a number of off street car parks in the CBD;
- creation of a time/cost parking elasticity model (choice model);
- Manly Oval car park parking demand forecasting using the parking model; and
- parking scenario analysis based on modifying time and cost assumptions.

2. INTERCEPT SURVEYS

2.1 QUESTIONNAIRE DESIGN

Parking usage characteristics and parking preference surveys were undertaken by Traffic Data and Control (TDC) on Thursday 10th of October, 2013 and on Saturday 12th of October, 2013. The two-page questionnaire consisted of two sections. The first section included general questions to identify parking usage characteristics such as location of residence, customer type ('early bird', resident card), trip destination in the CBD, trip purpose, duration of stay, etc.

The second part of the questionnaire involved a preference survey identifying which car park customers would use when Whistler Council car park was demolished, testing parking price and walk time elasticities and importance of adequate signage and search time to find an empty parking space on car park choice. The survey questionnaire form has been included in Appendix A. The preference survey randomly selected parking costs and times to identify parking location choices under various scenarios. These "games" are often used in developing choice models under consumer choice theory.

2.2 IMPLEMENTATION

The survey methodology involved intercepting car park customers on their way back to their parked car at one or more of the pedestrian access points to three of the four off street Council car parks in the CBD (Whistler Street, Manly National, and Pacific Waves). The interviews were conducted from 7am to 9pm on both survey days, while each individual interview lasted approximately 1-2 minutes.

2.3 GENERAL RESULTS

A total of 287 interviews were completed on the Thursday and 417 interviews on the Saturday. The parking survey data provided a range of information required for parking demand forecasting and establishing the cost/time elasticity model. In addition to the surveyed information, duration of stay and occupancy data was made available for each of the Council car parks and this was used for expanding the survey sample to the total parking "population".

Figure 2.1 below indicates that only 28% of car park customers on a Thursday and 15% on a Saturday are Manly Council residents.

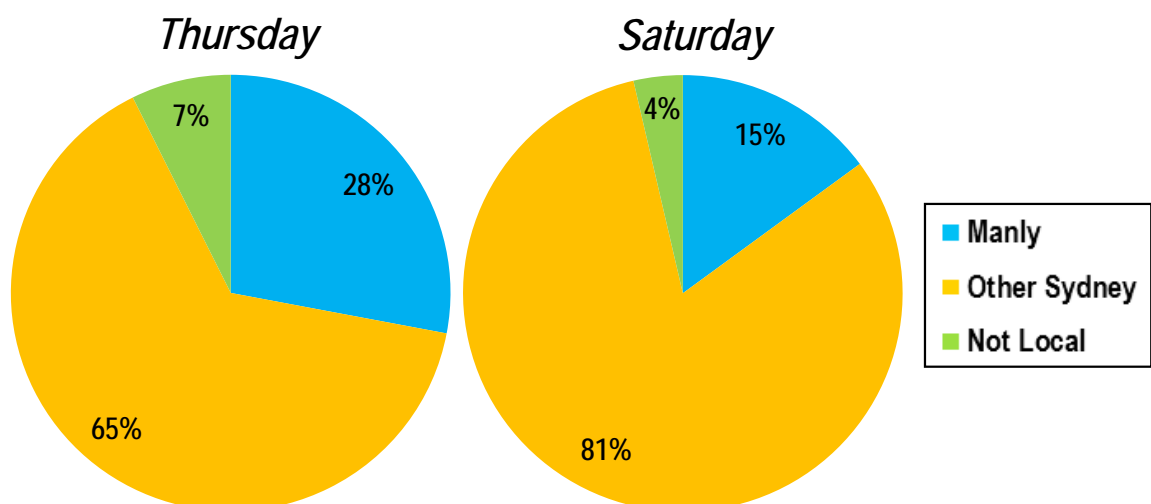


Figure 2.1: Car Park Customer Place of Residence

The survey results also indicate that approximately 30% of Manly residents who responded own a resident card for parking. Only 5.9% of all parkers interviewed take advantage of the "early bird" offer. Also, the proportion of prepaid account users was 8.4% on Thursday and only 3.1% on Saturday.

Figure 2.2 below shows that typical walking distance from the car park to the final destination is generally up to 400m. Customers were willing to walk a longer distance between the car park and their destination in the CBD on the Saturday with 20% of respondents walking over 400m, compared to only 7% on the Thursday.

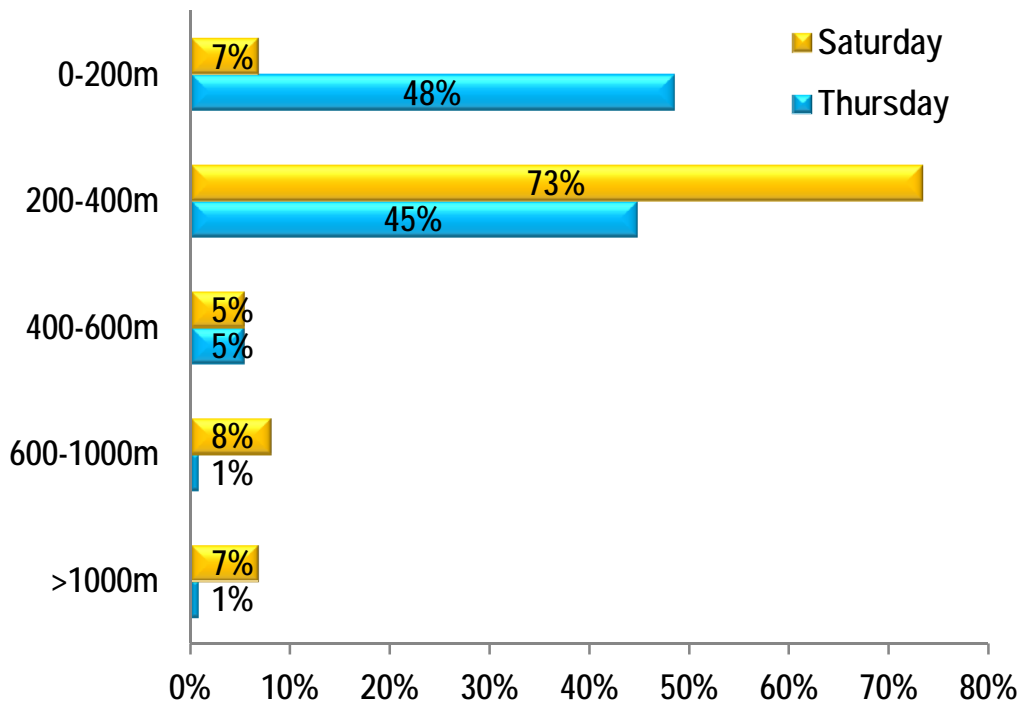


Figure 2.2: Average Walking Distance between Car Park and Destination

As can be seen from Figure 2.3 below, the majority of the customers currently do not pay for parking (85% on Thursday and 74% on Saturday). Only 7% of customers use long-term parking (5+ hours), paying the maximum parking fee of \$33.

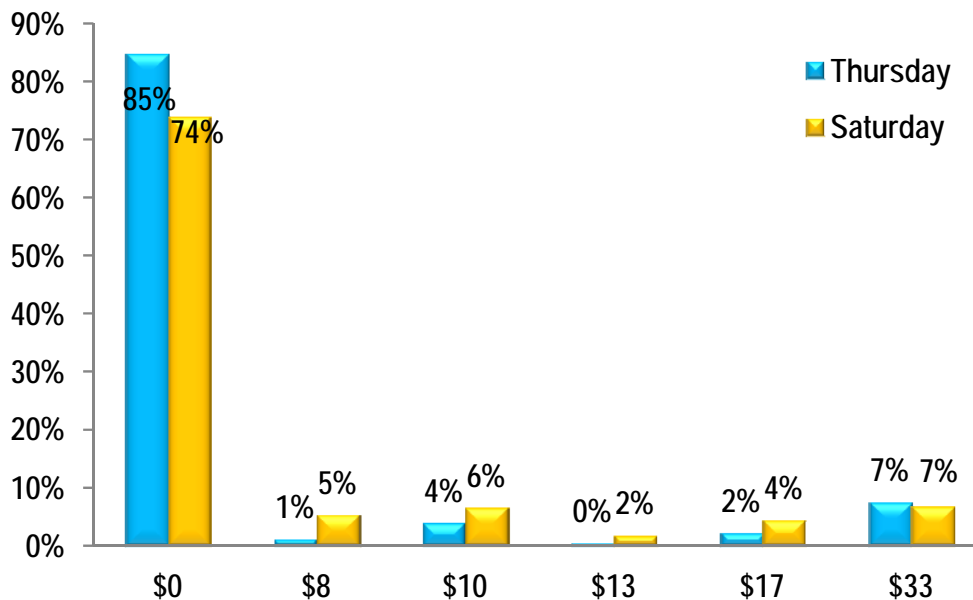


Figure 2.3: Amount Paid for Parking

Figure 2.4 provides a trip purpose comparison between the Thursday and the Saturday surveyed. As expected, there is a larger proportion of personal business trips during the week and more recreation-based trips on the Saturday.

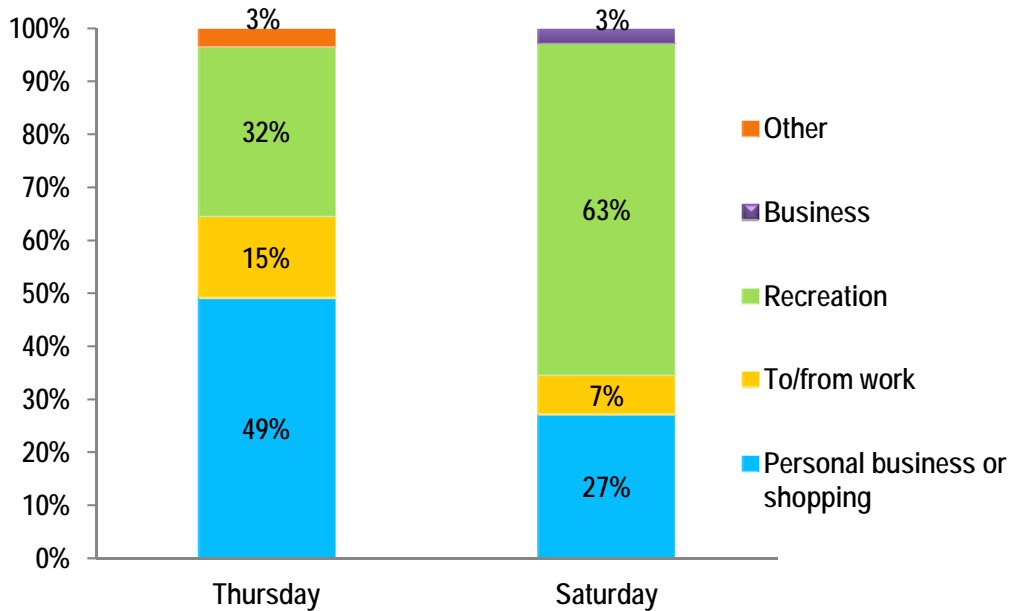


Figure 2.4: Trip Purpose

The parking survey results suggest that the majority of respondents park in Manly CBD at least once per week, while 29% of Thursday's respondents and 16% of Saturday's respondents park there at least four times a week.

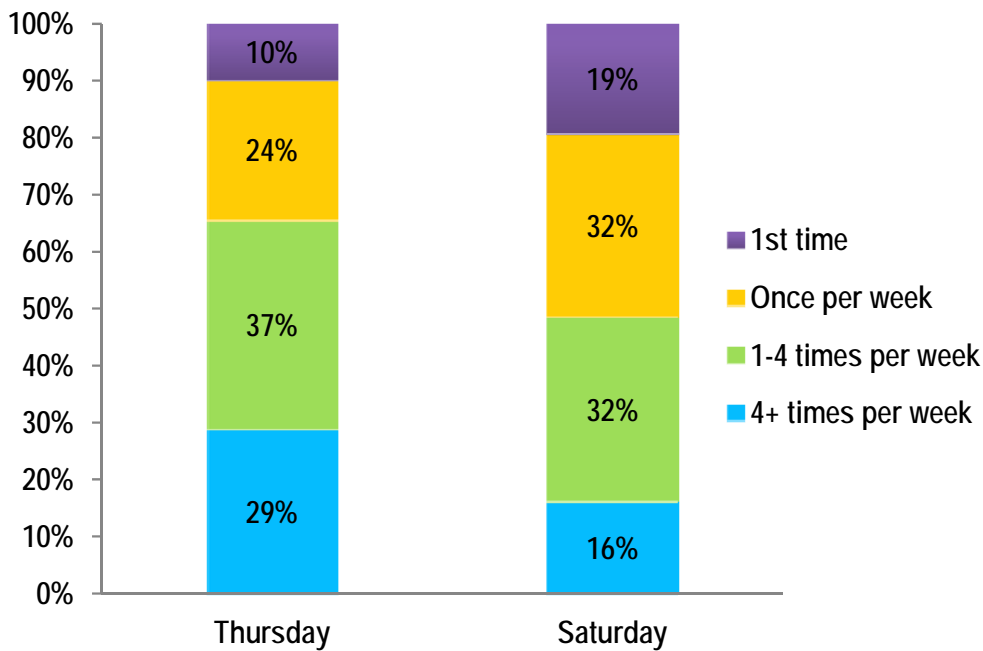


Figure 2.5: Parking Frequency in Manly CBD

Average parking cost by parking duration has been provided in Figure 2.6. A large proportion of residents appear to take up the opportunity for parking for free for up to two hours. The average value paid for parking was generally lower on the Thursday compared to the Saturday partly due to the provision of 'early-bird' parking during the week.

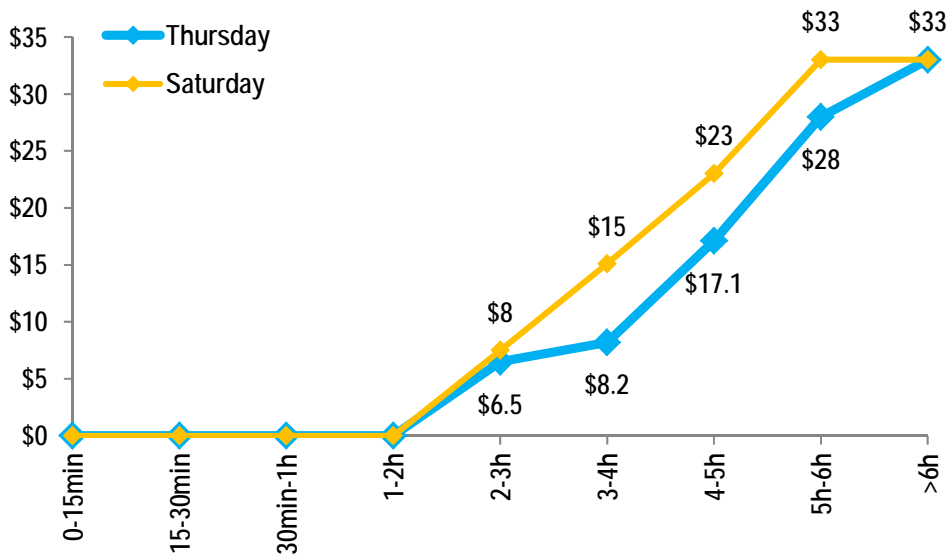


Figure 2.6: Parking Cost and Duration

Figure 2.7 below indicates that the average parking cost increases proportionally with walking distance, indicating that long-stay parkers (who pay more for parking) are less sensitive to walking distance compared to “drop-in” customers. This is expected as the incremental walking time, as a proportion of the entire trip time is far less for an all day trip.

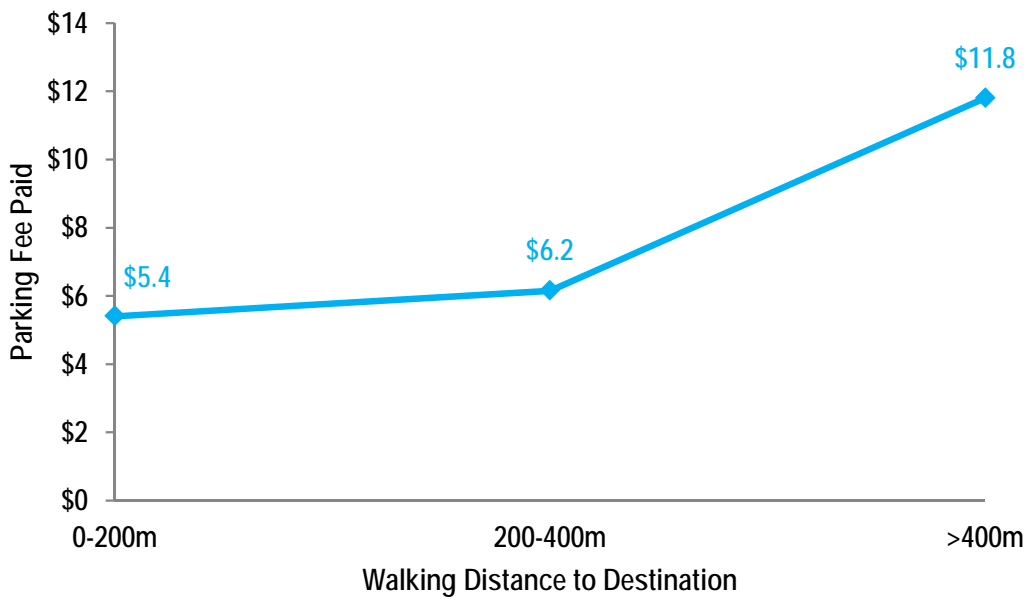


Figure 2.7: Average Parking Cost and Walking Distance

One of the survey questions specifically asked respondents what they would do once the Whistler Street car park was demolished and the Manly Oval car park was constructed. This question was posed for existing Whistler Street car park users as well as users of Manly National and Pacific Waves car parks.. Firstly, the proportion of car park customers who said that they would divert from the Whistler Street car park was identified as shown in Figure 2.8 below.

The survey results suggest that 26% of the Whistler Street car park's customers stated that they would move to the proposed Manly Oval car park once the Whistler Street facility was demolished.

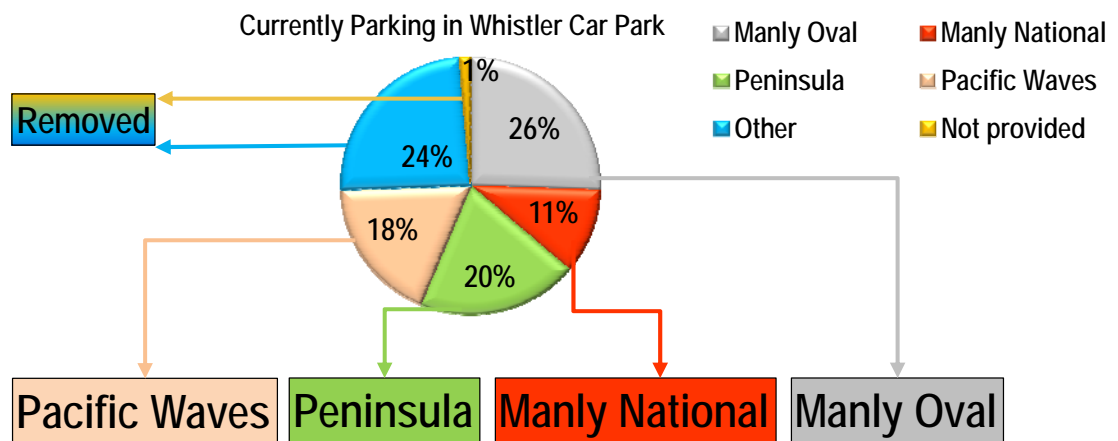


Figure 2.8: Whistler Car Park Customers Expected Diversion to Attractions

The results in Figure 2.8 need to be considered in the context that respondents may not recognise the influences of parking capacity and delays at Pacific Waves, Peninsula and Manly National Car parks would have on their car park choice once many parkers try and divert from Whistler to these alternative facilities. That is, a parking time/cost elasticity model provides a better indication of likely diversion to Whistler Street car park based on parking capacity and delay considerations as well.

Only 5% of customers at the Pacific Waves car park stated that they would divert to the proposed Manly Oval car park whereas 83% would continue using the Pacific Waves car park. It is important to note that these respondents would be assuming the same level of capacity/ease of finding a space at Pacific Waves as currently exists. The survey also indicates that 33% of customers at the Manly National car park would be expected to divert to the proposed Manly Oval car park whereas 56% would continue using the Manly National car park. Again, these results are on the basis that respondents presume the same level of service at the alternative car parks as they are currently used to, which is unlikely to be the case with more demand at these facilities when they are already approaching capacity.

3. PARKING MODEL DEVELOPMENT

3.1 SOFTWARE

Gretl (*Gnu Regression, Econometrics and Time-series Library*) open-source statistical analysis software package was used for developing the parking cost/time elasticity model (or parking choice model). Gretl software is mainly used for econometric analysis. With its easy to use intuitive interface, it enables a wide variety of estimations, time series methods and limited dependent variables including logit, probit, and interval regression.

3.2 TESTING MULTINOMIAL VERSUS BINOMIAL CHOICE

Initially, the multinomial logit estimation was used for establishing the model; essentially as a choice between Manly Oval and each of the alternative car parks. The logarithmic regression attempted to estimate parameters for walk time, parking cost, search time and signage for each of the four parking options.

When running the multi-nominal regression, the parking preference data was found to be heavily correlated between the alternative sites, resulting in poor models and some parameters moving in counter-intuitive directions. In addition, the presence of signage did not appear to be a significant variable.

Due to these issues, a binomial logit model formulation was tested with only time and cost variables, as discussed below.

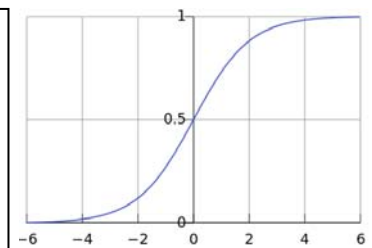
3.3 BINOMIAL MODEL EVALUATION

The binomial model compares Manly Oval car park and the “best option of the rest of the car parks in the choice set” (Manly National, Peninsula and Pacific Waves) considering parking cost, walk time and search time. The binomial choice model, also known as the choice “S” curve is of the form:

$$\% \text{ using Manly Oval} = \frac{e^{-(\text{generalised cost of the alternative})}}{e^{-(\text{generalised cost of the alternative})} + e^{-(\text{generalised cost of Manly Oval})}}$$

Or, represented as (where Manly Oval = 2 and alternative = 1):

$$\% \text{ using Manly Oval} = \frac{1}{e^{(a \times \text{cost}1 - b \times \text{cost}2 + c \times \text{time}1 - d \times \text{time}2 + \text{etc...})}}$$



Using the above formulation, the exponent was regressed in Gretl with the following form:

$$M = C^*U + W_{Manly}^*V + C^*X + W_{BestAlt}^*Y + S_{BestAlt}^*Z, \text{ where}$$

- c - parking cost;
- u – Manly Oval car park cost coefficient (GRETl model output);
- w_{Manly} – walking time from Manly Oval car park to destination;
- x - best alternative’s cost coefficient (GRETl model output);
- y - best alternative’s walk time coefficient (GRETl model output);
- s – best alternative’s search time; and
- z - best alternative’s search time coefficient (GRETl model output).

Table 3.1 below provides the coefficient used in the parking model for both Thursday and Saturday.

Table 3.1: Coefficients from GRETLM Model

Day	Cost_Manly	Walk_Manly	Cost_BestAlt	Walk_BestAlt	Search_BestAlt
Thursday	0.0320068	0.0153434	-0.0769681	-0.027497	-0.0229678
Saturday	0.0320068	0.0153434	-0.0769681	-0.027497	-0.0229678

3.4 PARKING MARKET SEGMENTATION

The parking market was segmented to five categories as follows:

- free parking with resident card;
- free parking without resident card;
- paid for parking \$1-\$15;
- paid for parking \$15-\$30; and
- paid for parking over \$30.

The data was split between free and paid parking, whereas paid parking was also split to three categories based on the parking cost. Without any segmentation, the model would simply be input into the average parking fee paid, which would reduce the sensitivity of the results.

The proportion of each market segment was determined from the survey data, along with the segments average parking fee paid and this data was used in the parking model application.

3.5 PARKING MODEL APPLICATION AND SCENARIOS

3.5.1 Scenarios

The binomial logit model was used for testing three parking model scenarios as follows:

- **High Scenario**
 - 10 minute congestion to access other car parks (i.e. not Manly Oval);
 - 220 on-street parking bays removed from the Manly CBD; and
 - 20% discount in Manly Oval car park fees;
- **Medium Scenario**
 - 5 minute congestion to access other car parks;
 - 140 on-street parking bays removed from the Manly CBD; and
 - no discount parking at Manly Oval car park;
- **Low Scenario**
 - no congestion to access other car parks;
 - 62 on-street parking bays removed from the Manly CBD; and
 - no discount parking at Manly Oval car park.

3.5.2 Methodology – Direct Demand

The direct demand component of the usage of Manly Oval car park is the proportion of users who would use the facility purely on time and cost comparison reasons, without considering if the alternative car parks were full. The “diversion” methodology below accounts for parking diversions due to capacity being reached.

Each of the five parking market segments was subdivided into eight categories based on Table 3.2 below, resulting in 40 categories (or sets of inputs) for application of the model. The proportion that each category is of the total population was determined from the survey sample.

The *Manly Oval Car Park_Category* and *Best Alternative Car Park_Category* were found by dividing data to three categories based on the average walking distances (i.e. walking distance ranges) from the car park to

the destination and the *Combined_Code* combined Manly and "Alternative" site's codes to create scenarios to code into the model.

The coefficients found when applying the binomial logit model were used to calculate the split between customers choosing the Manly Oval car park versus an alternative car park in the Manly CBD, for each of the forty categories (8 walk distance categories x 5 price categories) and for each of the three scenarios (low, medium, high).

Table 3.2: Parking Segments Division to Categories

Manly Oval Car Park_Category	Best Alternative Car Park_Category	Combined Code	Count	Proportion
1	1	1_1	36	13%
1	2	1_2	9	3%
2	1	2_1	42	15%
2	2	2_2	22	8%
2	3	2_3	0	0%
3	1	3_1	161	58%
3	2	3_2	3	1%
3	2	3_3	4	1%

The weighted average of forty categories was calculated in order to determine the final percentage split between Manly Oval and the best alternative car park for each scenario.

3.5.3 Diversion Methodology and Assumptions

It was assumed that if one of the four car parks available in the Manly CBD (Manly Oval, Peninsula, Manly National, and Pacific Waves) would reach its capacity, then the parking overflow would be equally split between the other three car parks. If two car parks reach their capacity the overflow is split between the other two that still have free capacity and if Peninsula, Manly National, and Pacific Waves are all full the overflow would divert to Manly Oval car park. This incremental analysis was undertaken in a spreadsheet.

Under the Low Scenario, 62 on-street parking bays were removed. The customers previously using on-street parking were diverted to Manly National and Manly Oval car park assuming a 50/50 split, as these car parks are located the closest to the streets from where the on-street parking was removed from.

A total of 141 on-street parking bays were removed under Medium Scenario and 220 bays under High Scenario. Customers previously using these spaces were diverted to other car parks using the following split assumptions:

- 30% Manly National;
- 30% Pacific Waves;
- 30% Manly Oval; and
- 10% Peninsula.

4. PARKING MODEL RESULTS

4.1 HIGH SCENARIO

4.1.1 2013

Analysis of the parking data suggested that, based on the survey answers in regards people's parking preference assuming Whistler Council car park will be demolished, firstly the Peninsula car park would reach its capacity at 9am and Pacific Waves reaches it capacity at 10am. It has been assumed that one third of the overflow from the Peninsula car park would use both of the two other major car parks in the CBD (Pacific Waves and Manly National) whereas one third would use the proposed Manly Oval car park. The Manly Oval car park maximum occupancy under the High Scenario is expected to be 280 bays on Thursday (the peak being from 10am-2pm) and 341 bays on Saturday, peaking at 2pm, as shown in Figure 4.1 below.

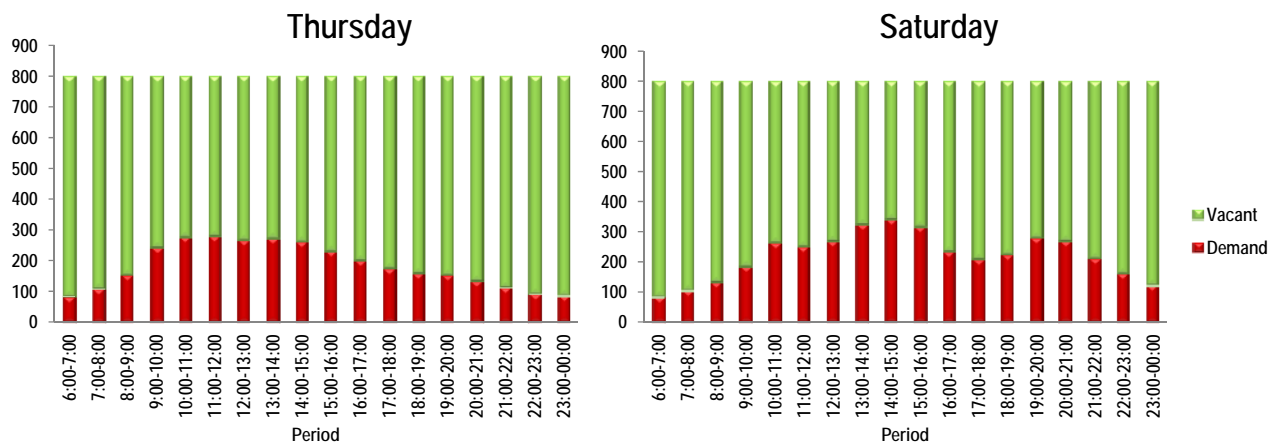


Figure 4.1: Manly Oval Expected Occupancy (2013) – High Scenario

4.1.2 2033

The parking demand forecast for 2033 has been based on the assumption that the current Manly CBD Commercial GFA of 111,124m² would increase by 46,783 m² (42%) to a total of 157,907 m². The same 42% increase was also applied to 2013 parking demand. Figure 4.2 below indicates that maximum forecast occupancy is expected to increase to 618 parking bays on Thursday and 747 on Saturday.

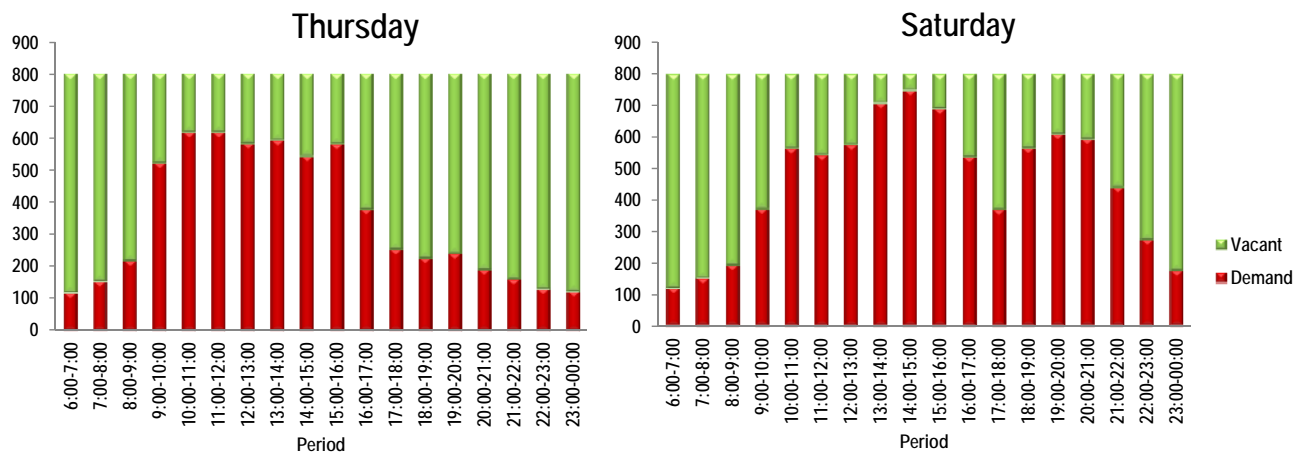


Figure 4.2: Manly Oval Expected Occupancy (2033) – High Scenario

4.2 MEDIUM SCENARIO

4.2.1 2013

Under the medium scenario, Manly Oval maximum occupancy is expected to be 241 spaces on Thursday and 286 spaces on Saturday. The weekday peak is at 10am and the weekend peak at 2pm (refer to Figure 4.3 below).

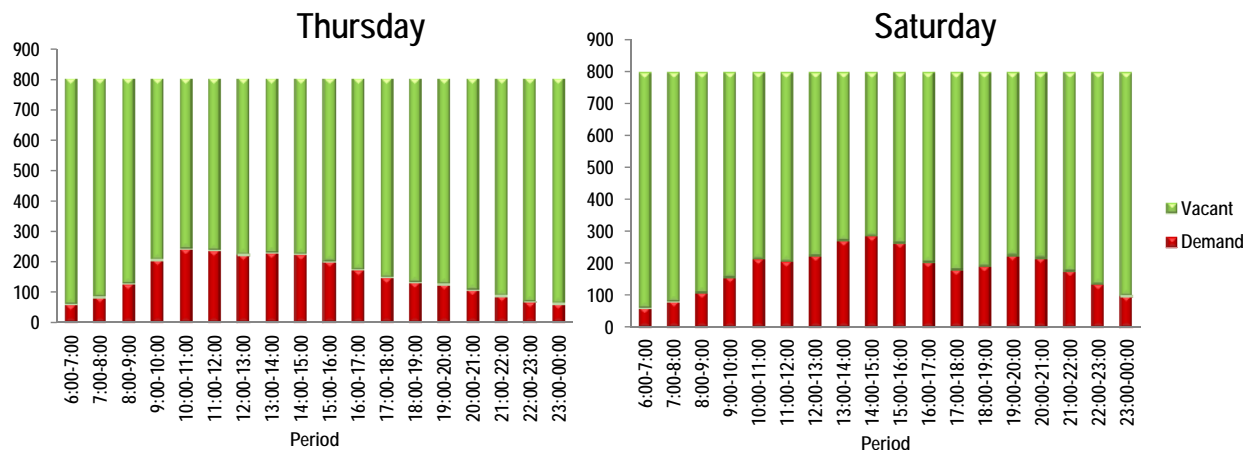


Figure 4.3: Manly Oval Expected Occupancy (2013) – Medium Scenario

4.2.2 2033

Manly Oval peak is expected to occur again at 10am during a typical weekday and at 2pm at the weekend, with maximum usage at 525 and 606 parking spaces, respectively (refer to Figure 4.4).

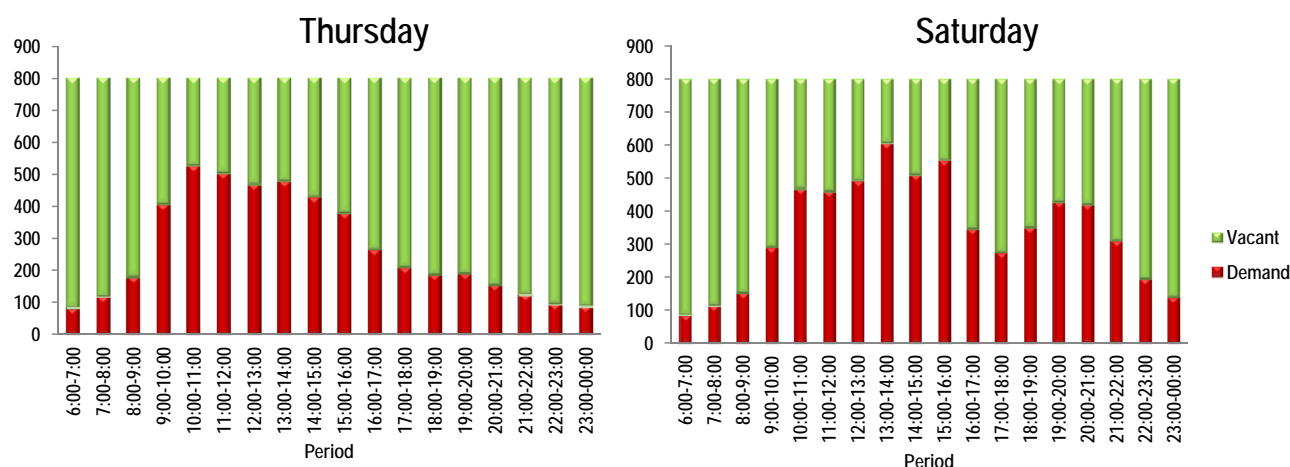


Figure 4.4: Manly Oval Expected Occupancy (2033) – Medium Scenario

4.3 LOW SCENARIO

4.3.1 2013

The Low Scenario, which assumes that there would be no congestion to access other car parks, there would be no discount parking in Manly Oval car park, and only 62 on-street parking bays would be removed from Manly CBD, indicates that a maximum of 178 bays would be used on Thursday and 225 on Saturday, as shown in Figure 4.5 below.

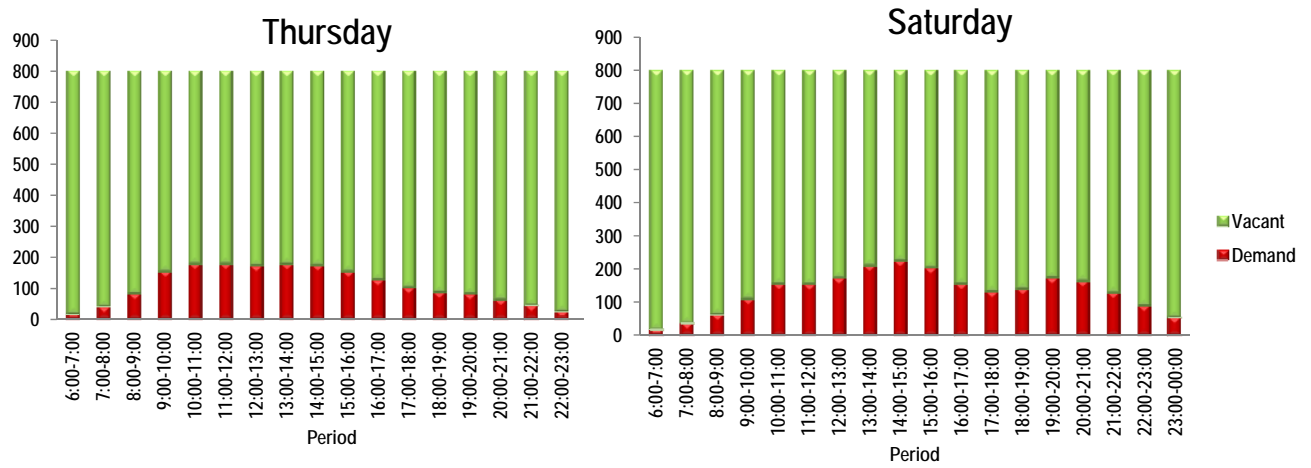


Figure 4.5: Manly Oval Expected Occupancy (2013) – Low Scenario

4.3.2 2033

Year 2033 parking demand prediction suggests that 387 bays would be occupied on a weekday and 498 during a weekend day, as shown in Figure 4.6 below.

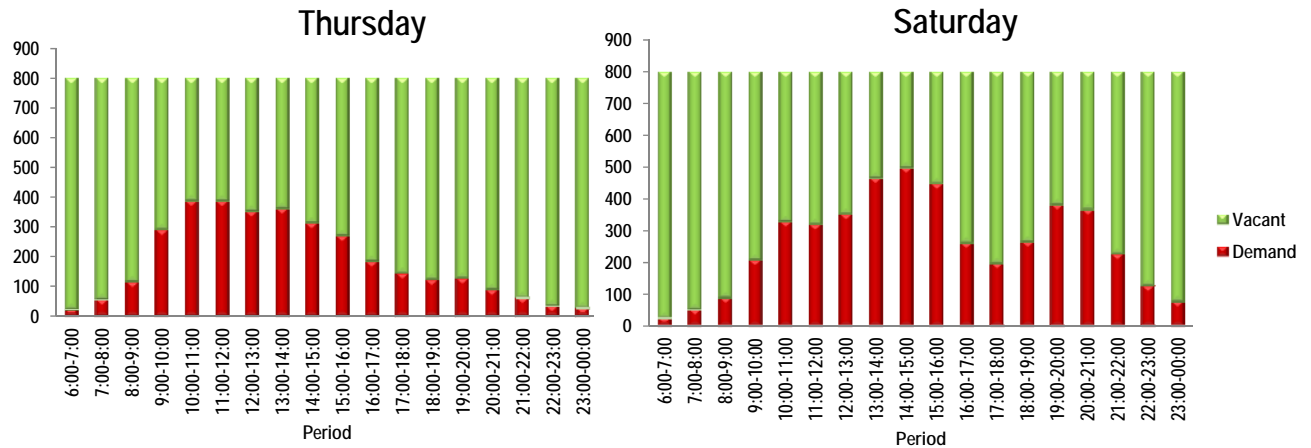


Figure 4.6: Manly Oval Expected Occupancy (2033) – Low Scenario

5. RESULTS SUMMARY

5.1 SCENARIO RESULTS COMPARISON

Figure 5.1 below provides a comparison of maximum parking demand under each scenario on Thursday and Figure 5.4 on Saturday, between 2013 and 2033. It also shows typical daily parking demand profile for both year 2013 and 2033.

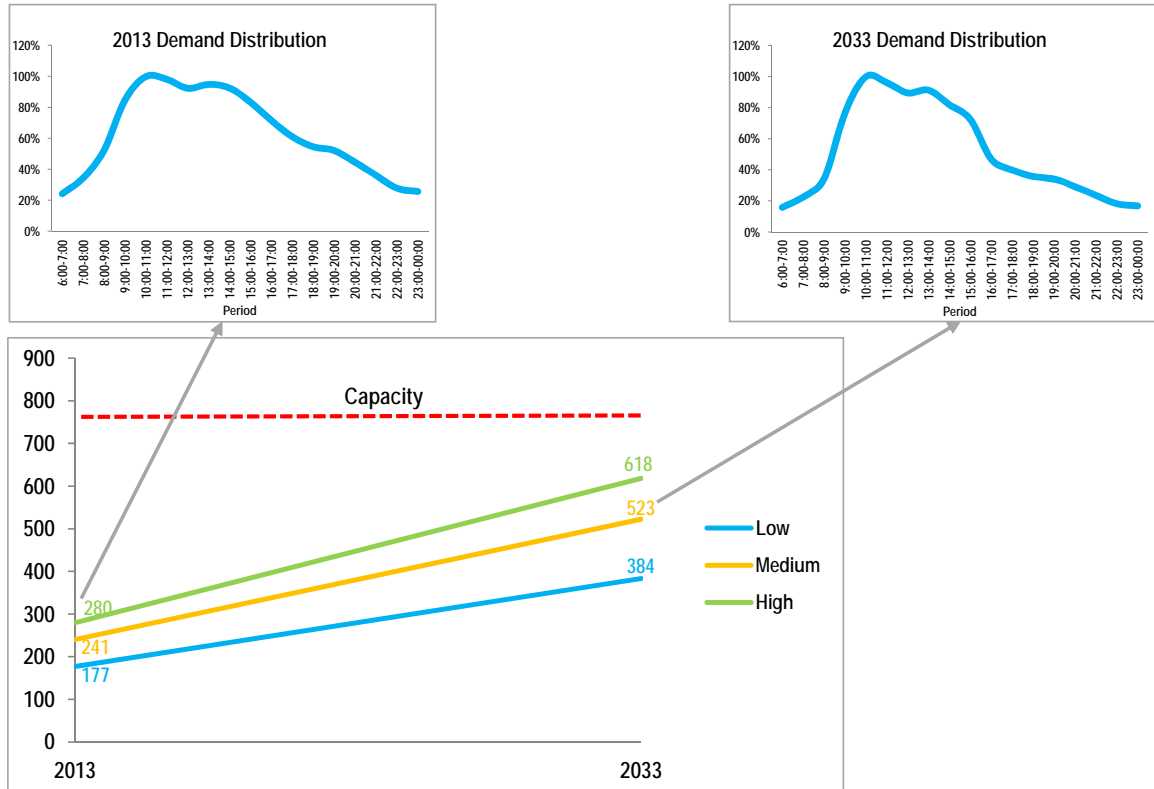


Figure 5.1: Manly Oval Parking Demand Summary (Thursday)

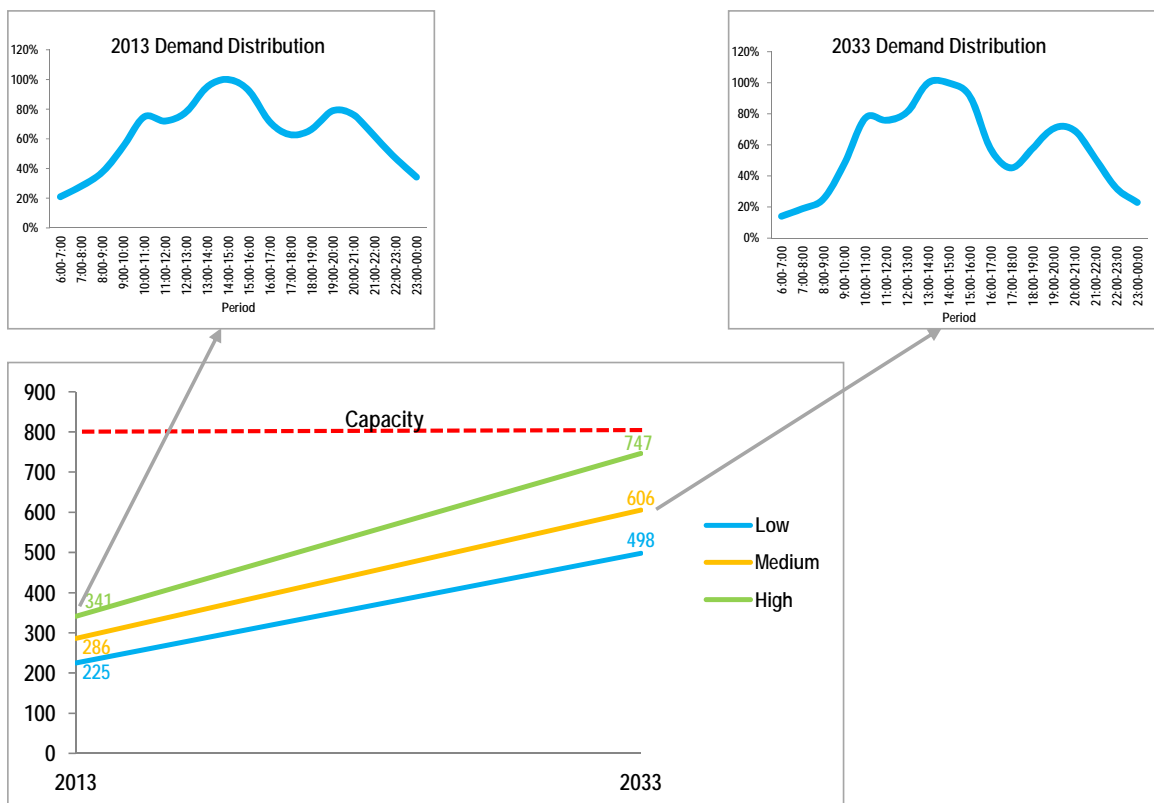


Figure 5.2: Manly Oval Parking Demand Summary (Saturday)

5.2 PEAK PARKING DEMANDS BY YEAR

Table 5.1 summarises peak parking demand in Manly Oval car park for all scenarios.

Table 5.1: Maximum Parking Demand Comparison

Scenario	Thursday		Saturday	
	2013	2033	2013	2033
High	280	618	341	747
Medium	241	525	286	606
Low	178	387	225	498

5.3 MEDIUM SCENARIO PARKING DEMANDS, ARRIVALS AND TURNOVER

For the medium scenario, further calculations were undertaken based on current relationships between arrival times, turnover and peak parking demand to develop the year-by-year medium scenario results in Table 5.2 and 5.3.

Table 5.2: Medium Scenario-Parking Demands, Arrivals and Duration of Stay (Thursday)

Time / Year	2013	2014	2015	2016	2017	2018	2019	2020
6:00-7:00	58	60	61	62	63	64	66	67
7:00-8:00	83	85	86	88	90	92	93	95
8:00-9:00	126	129	131	134	137	139	142	145
9:00-10:00	204	214	224	234	243	253	263	273
10:00-11:00	241	255	269	283	297	311	325	339
11:00-12:00	236	250	263	276	289	303	316	329
12:00-13:00	222	235	247	259	271	284	296	308
13:00-14:00	228	241	253	266	278	291	303	315
14:00-15:00	223	233	243	254	264	274	284	295
15:00-16:00	201	209	218	227	236	245	254	263
16:00-17:00	172	176	179	183	187	190	194	198
17:00-18:00	147	150	153	156	159	162	165	168
18:00-19:00	131	134	137	140	142	145	148	151
19:00-20:00	126	128	131	133	136	139	141	144
20:00-21:00	107	109	112	114	116	118	121	123
21:00-22:00	87	89	91	92	94	96	98	100
22:00-23:00	67	68	70	71	72	74	75	77
23:00-00:00	62	63	64	66	67	68	70	71
Total entries	1130	1176	1222	1268	1313	1359	1405	1451
Average duration of stay (hrs)	2.06	2.10	2.13	2.17	2.20	2.24	2.27	2.31

Table 5.3: Medium Scenario-Parking Demands, Arrivals and Duration of Stay (Saturday)

Time / Year	2013	2014	2015	2016	2017	2018	2019	2020
6:00-7:00	60	61	62	64	65	66	67	69
7:00-8:00	81	82	84	86	87	89	91	92
8:00-9:00	107	109	112	114	116	118	121	123
9:00-10:00	157	164	170	177	184	190	197	204
10:00-11:00	214	227	239	252	265	278	290	303
11:00-12:00	206	219	231	244	257	269	282	295
12:00-13:00	223	237	250	264	277	290	304	317
13:00-14:00	272	288	305	322	338	355	372	389
14:00-15:00	286	302	318	334	350	366	382	398
15:00-16:00	264	279	293	308	322	337	351	366
16:00-17:00	204	211	218	225	233	240	247	254
17:00-18:00	179	184	189	194	198	203	208	213
18:00-19:00	190	198	206	214	222	230	238	246
19:00-20:00	226	236	246	256	266	276	286	297
20:00-21:00	218	228	238	248	258	268	279	289
21:00-22:00	176	183	190	196	203	210	216	223
22:00-23:00	135	138	141	144	147	150	153	156
23:00-00:00	98	100	102	104	106	108	110	112
Total entries	1197	1271	1344	1418	1492	1566	1639	1713
Average duration of stay (hrs)	2.60	2.60	2.61	2.61	2.61	2.61	2.62	2.62

6. RECOMMENDED CAR PARK SIZE

The modelling suggests that the Manly Oval car park would open with a weekend demand of approximately 250 – 300 bays growing to a demand of 600 – 700 bays in 2033.

It would be prudent to cater for at least 10 years of demand when constructing the facility and target a typical maximum parking utilisation of 85% of capacity. On this basis, 500 bays (approximately) would be suggested initially, increasing to 800 bays ultimately as demand increases. The staging of construction would however be dependent on a range of economic and financial considerations and it may be more cost effective to build the entire car park at one time.

APPENDIX A

SURVEY QUESTIONNAIRE

Surveyor: Date: Time:

Car Park Location:

MANLY CBD PARKING PREFERENCE SURVEY Form ID:

Introductory statement:
 Hi, we are conducting a very quick survey about parking to help Manly Council improve off street parking in the CBD.
 Do you have 2 minutes to answer a few quick questions?

<i>Which suburb do you reside in?</i>	<input type="text"/>	If "Manly", do you have a resident card?	<input type="text"/>
<i>(if a tourist in a hotel or other accomodation, write "not local")</i>		Early bird parker?	<input type="text"/>

Where have you been in the CBD?
(nearest cross streets or major feature or major development)

What is the main purpose of your trip today?

Personal business or shopping <input type="text"/>	Recreation <input type="text"/>
To/from work <input type="text"/>	Other (specify) <input type="text"/>

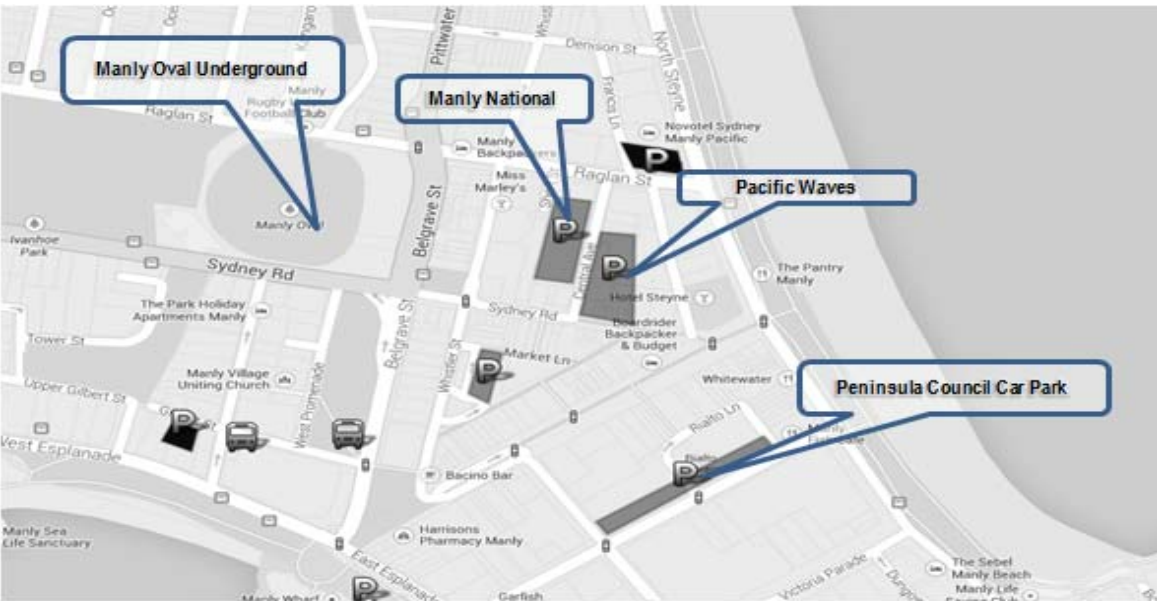
How long have you been parked for? Hours Minutes

<i>How often do you park in the Manly CBD?</i>	<i>Prepaid account parking? (Y or N)</i>
>4 times per week <input type="text"/>	< once per week <input type="text"/>
1-4 times per week <input type="text"/>	First time <input type="text"/>

If the Whistler Street Car Park is demolished, and a new car park is built under Manly Oval, where do you think you'll park instead? (show map)

The new car park under Manly Oval <input type="text"/>	Pacific Waves <input type="text"/>
Manly National <input type="text"/>	Other (specify) <input type="text"/>
Peninsula <input type="text"/>	

Go to page 2 to only if answer is not "Other"



MANLY CBD PARKING PREFERENCE SURVEY

For each of the following scenarios, please select which car park you would have parked in for this trip if the Whistler Street Car Park was not available, and there was a new car park under Manly Oval. [Show Form](#)

Scenario 1

1. Fee at the Manly oval car park was **50% more than** the fee at the other car parks
2. Took an extra **0** minutes at the alternative car park to find an empty parking space
3. Had **clear** signage directing me to the Manly Oval car park entry

Car park choice:

The new car park under Manly Oval

Pacific Waves

Manly National

Other (specify)

Peninsula

Scenario 2

1. Fee at the Manly oval car park was **50% more than** the fee at the other car parks
2. Took an extra **2** minutes at the alternative car park to find an empty parking space
3. Had **no** signage directing me to the Manly Oval car park entry

Car park choice:

The new car park under Manly Oval

Pacific Waves

Manly National

Other (specify)

Peninsula

Scenario 3

1. Fee at the Manly oval car park was **the same as** the fee at the other car parks
2. Took an extra **5** minutes at the alternative car park to find an empty parking space
3. Had **clear** signage directing me to the Manly Oval car park entry

Car park choice:

The new car park under Manly Oval

Pacific Waves

Manly National

Other (specify)

Peninsula

