

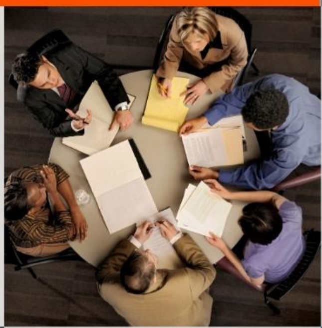

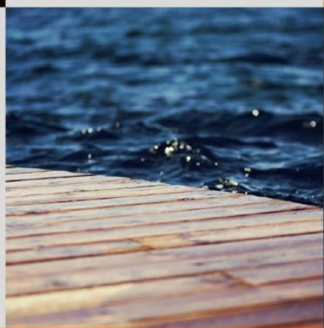

Kennett River

Tourism Infrastructure Improvements

FINAL REPORT

Prepared for Colac Otway Shire
By Planit Consulting Pty Ltd

September 2021

J6914 | J6914-REP-001



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Project Details

Project Name	Kennett River Tourism Infrastructure Improvements
Client	Colac Otway Shire
Client Project Manager	SR
Authors	SR
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Disclaimer

Contents

1 Background

Planit Engineering has been engaged by the Colac Otway Shire Council to undertake an assessment of the number and type of facilities required for a new public toilet planned for Kennett River.

As part of an overall suite of works in the area, Council plans to convert an existing informal parking area near the south side of the Kennet River into a new carpark featuring formal parking areas and set time limits. The new carpark will give Council greater control over parking in the area with large coaches being banned and set time limits being applied.

With these controls in place, Council does not anticipate that the carpark will be the first stop for most visitors to the Great Ocean Road from outside the region. Council's intention is that the new toilet will primarily serve users of the carpark.

The purpose of this report is to investigate and report on expected waiting times for several configurations of toilet facilities.

2 Proposed Works

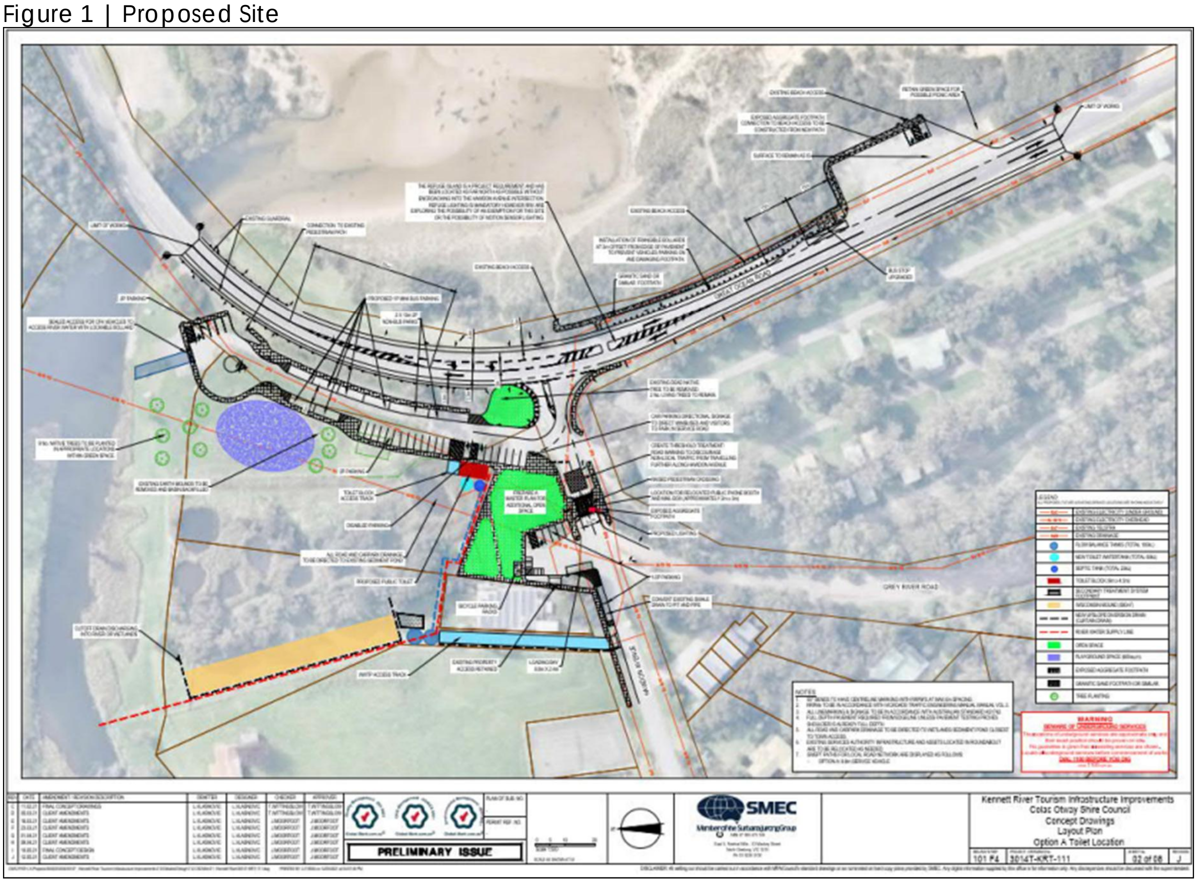
2.1 General

As part of a suite of improvement works at Kennett River, Council plans to replace an existing informal parking area near the Kennet River with a formalised carpark with designate spaces for cars, minibuses and motorbikes. Part of these works includes public toilet facilities for visitors using the new carpark.

2.2 Subject site

The subject site is located between Hawdon Avenue and the Kennet River and is adjacent to the Great Ocean Road.

Figure 1 | Proposed Site



2.3 Existing Parking Area

The existing informal parking area is located at the end of a sealed road on the south side of the Kennet River and provides access for fishing and recreation including the new walkway around the river. The CFA also uses this access for filling tankers from the river.

Nearby features include Hawdon Avenue, the Koala Café, parklands, and access to the beach. Visitor attractions include viewing birdlife and koalas along Hawdon Avenue.

The area currently does not contain designated parking bays and is not subject to time limits, so Council has little control over visitor numbers, length of stays, and where visitors park.

2.4 Proposed Carpark

To control the amount of parking in the area, Council plans to convert the informal parking area into a formal car park. The new carpark will feature clearly designated spaces with set time limits that will be enforced by Council. Time limits planned for all visitors will be strictly enforced.

Council has advised that the total number of designated spaces will be:

Description	Passenger per Vehicle	No. of parks
Car 2P parking limit	3.5	26
Car 1/2P	3.5	7
22 seat Bus 1P	22	6
RV parks 2P	3	2
Motorbikes	1	6

Table 1 Carpark Configuration

2.5 Expected Use

The carpark is intended for tourists and visitors to the area but is not intended to be a designated stopping point for larger tour operators. To reinforce this, Council has specifically banned coaches from the site. Council does not anticipate that the carpark will be used as a first stop toilet break for tour operators along the Great Ocean Road.

Council anticipates that cars will remain in the area for the full two hours (26 spaces) or for 30 minutes (7 spaces) only and that buses will remain for one hour. In that time, Council expects visitors to use the café and walkway around the Kennet River and view local wildlife. Council does not expect this carpark to be the primary access point for beach users.

The site will be a destination for both international and domestic tourists and the figures used are based on normal tourist numbers without any restrictions on travel.

3 Assessment

3.1 Design Parameters

Planit Consulting has based its assessment of the number and type of facilities required for the four-hour peak period from 10am to 2pm with all available parking spaces being used. This matches with the Council's expectations for time visitors are expected to stay.

3.1.1 Car Park Visitors

The number of vehicles and the expected passengers in each are:

Item	Description	Passengers per vehicle	No. of parks	4-hour peak Visitors	Visitors per hour
1	Car 2P parking limit	3.5	26	182	45.5
2	Car 1/2P	3.5	7	196	49
3	22 seat Bus 1P	22	6	528	132
4	RV parks 2P	3	2	12	3
5	Motorbikes	1	6	24	6
	Total			942	235.5

Table 2 Design Parameters

Notes:
Based on the site being a tourist route, we expect an average of 3.5 passengers per car.

3.1.2 Other Visitors

To account for other visitors that may not have arrived from the car park, we have included an allowance for 10 extra visitors per hour from the beach or the town.

3.1.3 Total Visitors

We have assumed a 50/50 split between Female and Male users as follows:

Source	Visitors per hour Total	Visitors per hour Female	Visitors per hour Male
Car Park	235.5	117.75	117.75
Other Users	10	5	5
Total	245.5	122.75	122.75
Allow	*246*	*123*	*123*

Table 3 Total Visitor Numbers

3.2 Design Codes

Toilets are required to comply with the:

- DDA compliant (Federal Disability Discrimination Act 1992)
- CPTED guidelines

3.3 Methods of Analysis

Planit Consulting has undertaken a preliminary estimate of the number of facilities required using the Australian Buildings Code Board (ABCB) Sanitary Facilities Calculator. The Calculator is based on the National Construction Code and the Building Code of Australia (BCA). It is available for download from the ABCB's web site at https://www.abcb.gov.au/Connect/Articles/2019/11/20/Sanitary-Facilities-Calculator.

The results provide context and background on the minimum requirements for the required number of accessible unisex, male ambulant, and female ambulant sanitary compartments at Kennett River.

We have then analysed and confirmed the minimum requirements using mathematical techniques based on queuing theory. This approach provides mathematically based estimates for expected queueing times, time spent in the cubicle and the 90th percentile of the waiting time distribution depending on the number of facilities provided.

3.4 Building Code of Australia

The BCA provides design parameters for a range of different buildings depending on the nature and intended use.

Our estimate is based on a Class 9 building, which is a building of a public nature. Class 9 buildings include health care, schools, sports venues, public halls, cafes, restaurants, and aged care. The design parameters for these account for expected staff, visitors, and resident numbers, and make provision for the expected length of stay and other activities. For example, figures for aged care include showers and meals, cafes and restaurants are based on eating and drinking, and theatres allow for peaks during intermission.

We have based our design on Class 9b buildings - sports venues because the design parameters offer the closest match to Kennett River. Sports venues include an allowance for:

- A peak factor for times such as breaks in play, which will mimic the arrival of minibuses.
- Use based mainly around attending the event with some allowance for eating and drinking, but not at the rates expected in a restaurant or café.

The design parameters for a Class 9b building of this type are as follows:

Gender	Item	Parameter
Female	Closet pans	1 for 15 patrons, one additional for every 60 patrons or part thereof
Female	Washbasins	1 for the first 60 patrons, two for up to 200 patrons
Male	Closet pans	1 for every 250 patrons
Male	Washbasins	1 for every 150 patrons
Male	Urinals	1 for every 100 patrons
Unisex Accessible	Closet Pan	Al least one

Table 4 Class 9b Building Requirements

Based on these parameters, the minimum numbers for each type of facility required at Kennett River are:

Gender	Item	No.	Hourly Capacity	Adequate
Female	Closet Pans	3	135	Yes
Female	Wash basins	2	200	Yes
Male	Closet Pans	1	250	Yes
Male	Wash basins	1	150	Yes
Male	Urinals	2	200	Yes
Unisex	Closet Pan	1	NA	Yes

Table 5 Facilities Required

3.4.1 Male Closet Pans

BCA guidelines require only one male closet pan. Planit Consulting advised that this provides no capacity to deal with peaks and recommends that as a minimum at least two closet pans should be made available for males.

3.4.2 Washbasins

By providing non gender specific washbasins outside the building, we should be able to reduce the total number. The final number will be provided by the Queueing Analysis.

3.4.3 DDA Provision

A minimum of one accessible unisex sanitary compartment is required for the facility.

3.5 Queueing Analysis

Queuing theory is an established mathematical model used to estimate the average waiting time in a system. It is based on the expected rate of arrivals, the number of facilities available, and the average usage time and is an ideal tool to analyse the expected behaviour of a public toilet facility.

The theory provides probabilistic results based on established statistical parameter.

- Model type
- Arrival Rate
- Average Minutes Between Arrivals
- Service Rate

Planit's assessment is based on a M/S/S queue which simulates a single queue with more than one parallel service.

Arrivals occur at a rate according to a Poisson process and usage times have an exponential distribution. If there are more than the services can cater for, the arrivals will enter the queue.

3.5.1 Expected Usage Times

Usage times for Female and male closet pans has been based on research undertaken at Ghent University in 2017. Figures for the

Use	Usage Time (s)
Female Closet Pan	90*
Male Closet Pan	60*
Male Urinal	40
Washbasin	40

Table 6 Expected Usage Times

* Source: *Ghent University. "No more queueing at the ladies' room: How transgender-friendliness may help in battling female-unfriendly toilet culture." ScienceDaily. ScienceDaily, 14 July 2017. <www.sciencedaily.com/releases/2017/07/170714142749.htm>.*

3.5.2 Assumed Facility Usage Rates

Given the location of the site, a high proportion of visitors are likely to have travelled from outside the area or may be anticipating a long drive to get to their next destination. Travel times from Melbourne Airport are likely to exceed two hours. On this basis, Planit has assumed that this will not be the first stop for these visitors.

Based on this, Planit anticipates that 70% of visitors will use the toilet facilities during their one-hour visit with peak usage on arrival and before departure.

The expected breakdown in usage is as follows:

Type	Arrivals per hour	% Usage	Visitors per hour
Female	123	70%	86.1
Male Cubicle	123	20%	24.6

Male Urinals	123	50%	61.5
All Washbasins	246	70%	172.2

Table 7 Assumed Facility Usage Rates

3.5.3 Advantages of Unisex Compartments

Providing unisex facilities will be more efficient and better use of resource than providing gender divided facilities.

Gender divided facilities can impose additional limits on capacity. For example, if two or more people of the same gender arrive at the same time, some may find they have to wait, even though facilities set aside for the other gender are vacant. When this occurs there is capacity in the system that is not used.

If all facilities are unisex, this does not happen. Use of the facility follows the "next cab off the rank" principal where the next visitor can choose any available cubicle. This is a fairer system that ensures that 100% of capacity is in use before anyone must wait.

3.5.4 DDA and Unisex Compartments

Queuing time analysis is based on mean arrival times and mean usage times. For this project, Planit has based its assessment on the following figures.

3.5.5 Total Time in Use

User	No. per hour	Average Usage Time (s)	total Cubicle time/hr (s)
Females	86.1	90	7,749
Males	24.6	60	1,476
Total	110.7		9,225

Table 8 Total Time in Use

3.5.6 Average Usage time - Unisex

Parameter	Value
No Users per hour	110.7
Total usage time (s)	9,225
Average usage time (s)	83.3
Cubicle Capacity Customers/hour	43.2

Table 9 Average Usage Times

3.5.7 Queueing Parameter Used - Gender Divided

Planit Consulting has used the following rates of usage in the queueing analysis.

Gender	Type	% of total	No. per Hour
Female	Closet Pan	70%	86.1
Male	Closet Pan	20%	24.6

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Male	Urinal	50%	61.5
All	Washbasins	70%	172.2

Table 10 Visitor Usage Numbers

3.5.8 Configurations Modelled

Council has requested Planit model the following configurations:

Scenario 1

- 1 DDA change room/cubicle
- 3 Unisex cubicles
- 2 male urinals
- 3 Washbasins

Scenario 2

- 1 DDA change room/cubicle
- 4 Unisex cubicles
- 2 male urinals

In addition, for comparison, Planit has modelled gender divided facilities as follows:

- 4 Female Closet Pans
- 3 Female Closet Pans*
- 2 Male Closet Pan*
- 3 Male Closet Pans

4 Results

4.1.1 Summary of Queueing Analysis

Configuration	No	Average time spent in line (s)	Average number of customers in line	80% Wait time (s)	90% Wait time (s)
1 DDA, 3 Unisex	4	19.8	0.61	31.3	71.1
1 DDA, 4 Unisex	5	4.9	0.15	0.0	11.9
2 Male Urinals*	2	5.3	0.09	0.0	16.9
3 Washbasins	3	14.9	0.71	25.9	51.2
4 Female Closet Pans	4	10.4	0.25	3.2	37.0
3 Female Closet Pans*	3	55.0	1.32	101.2	174.8
2 Male Closet Pans	2	2.6	0.00	0.0	0.0
1 Male Closet Pan*	1	41.7	0.28	73.0	143.3

Table 11 Summary of Queueing Analysis

* Minimum BCA requirements - provided for comparison.

4.1.2 Acceptable Performance

Planit Consulting has used the 90th percentile of the waiting time distribution being no more than 60 seconds as the performance criterion for confirming the minimum number of each type of facility required.

This is based on a study undertaken by Works Consultancy Services New Zealand in 1998 to revise the tables in the New Zealand Building Code on the number of sanitary facilities to be provided in buildings.

The 90th percentile represents the maximum length of time that 90% of visitors will need to wait. For example, Planit has calculated the 90% wait time for a cubicle in a facility with one DDA and three unisex compartments will be 71.1 seconds. This means that with one DDA and three unisex compartments, one in ten users will need to wait in line for at least 71.1 seconds before a cubicle becomes available.

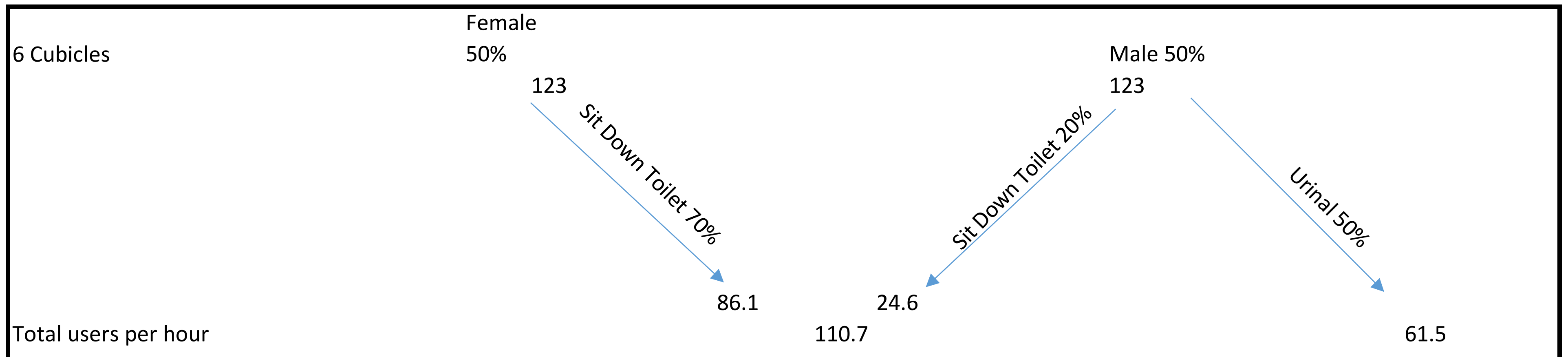
4.1.3 Wait Times

Configuration	Critical Component	90% Wait time (s)
Scenario 1 1 DDA changeroom/cubicle 3 Unisex Cubicles 2 Male Urinals	DDA/Unisex Cubicle	71.1
Scenario 2 1 DDA changeroom/cubicle 4 Unisex Cubicles 2 Male Urinals	DDA/Unisex Cubicle	11.9

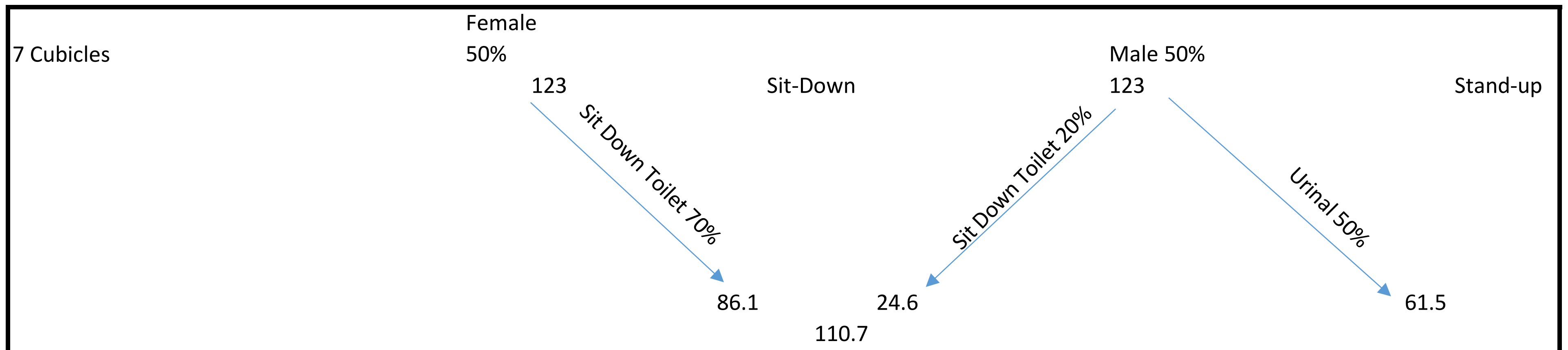
Table 12 Wait Times

Appendix A - BCA Assessment

No Arrivals (Over 4 hrs)	
Car park	942
Walk in	40
Total	982
Total Average Visitors per hour	245.5



Users per hour	Cub.1	Cub.2	Cub.3	Cub.4	U.1	U.2
	27.7	27.7	27.7	27.7	30.8	30.8



Users per hour	Cub.1	Cub.2	Cub.3	Cub.4	Cub.5	U.1	U.2
	22.1	22.1	22.1	22.1	22.1	30.8	30.8

4.1.3 Wait Times

Configuration	Critical Component	90% Wait time (s)
Scenario 1 1 DDA changeroom/cubicle 3 Unisex Cubicles 2 Male Urinals	DDA/Unisex Cubicle	71.1
Scenario 2 1 DDA changeroom/cubicle 4 Unisex Cubicles 2 Male Urinals	DDA/Unisex Cubicle	11.9

Table 12 Wait Times

ABCB

Sanitary Facilities

National Construction Code

Help Guide

Calculator

Building address

Address line 1	
Address line 2	

Colour Guide		
Input	Calculated	NA

Building classification

Class 9b - sports venues or the like

Required sanitary facilities

Gender	Design Occupancy	User Group	Closet Pans	Urinals	Washbasins	Showers	Baths
Male	0	employees	0	0	0	NA	NA
Female	0	employees	0	NA	0	NA	NA
Male	150	spectators or patrons	1	2	1	NA	NA
Female	150	spectators or patrons	4	NA	2	NA	NA
Male		participants	0	0	0	0	0
Female		participants	0	NA	0	0	0

NOTE: In calculating the number of facilities to be provided, under **F2.1** and **F2.3** an accessible unisex facility required for people with a disability may be counted once for each sex. An accessible unisex facility comprises one closet pan, one washbasin and adequate means of disposal of sanitary products. This concession means that for each wash basin and closet pan counted above, you may deduct one for each accessible unisex facility provided. This concession does **NOT** apply to urinals. Refer to **F2.2** for further details.

Notes - for the selected building class

F2.3(b) If not more than 10 people are employed, a unisex facility may be provided instead of facilities for each sex.	F2.3(d) Employees and the public may share the same facilities in a Class 6 and 9b building (other than a school or early childhood centre) provided the number of facilities provided is not less than the total number of facilities for employees plus those required for the public.	Where shower facilities are required, refer to F2.4(b) for requirements for the provision of accessible unisex showers.	NIL	One unisex accessible adult change facility must be provided in an accessible part of a Class 9b sports venue or the like that has a design occupancy of not less than 35,000 spectators, OR contains a swimming pool that has a perimeter of not less than 70m and that is required by Table D3.1 to be accessible. Refer to F2.9 for further details.

Calculating the required number of accessible and ambulant unisex sanitary facilities

Number of levels in your building (including ground level)	1
Number of banks of toilets in your building per level	1
Required number of accessible unisex sanitary compartments per level	1
Required number of male ambulant sanitary compartments per level	1
Required number of female ambulant sanitary compartments per level	1
Required total number of accessible unisex sanitary compartments	1
Required total number of ambulant sanitary compartments	2

NOTE - ACCESSIBLE UNISEX SANITARY COMPARTMENT - These comprise of: a closet pan, washbasin, shelf or benchtop, and adequate means of disposal of sanitary products. The design of the accessible unisex sanitary facility must comply with AS 1428.1. **Refer to F2.4** for further information on accessible sanitary facilities.

NOTE - BANKS of SANITARY COMPARTMENTS: Due to the individual nature of building projects and their intended use, the definition of a 'bank' of sanitary compartments can be subjective. This calculator is intended as a guide only.

NOTE - ACCESSIBLE ADULT CHANGE FACILITIES: This part of the calculator does **not** address the requirements for accessible adult change facilities. **Refer to F2.9** for the relevant requirements.

Appendix B - M/M/s Queue Assessment

M/M/s Queue

Inputs: 1xDDA, 3xUnisex Pans

Arrival rate (l)	110.7	Customers per hour
	0.54	Average time (m) between arrivals
Rate per Cubicle (m)	43.2	Customers per hour per Cubicle
	1.39	Average Usage time (m)
Number of Cubicles (s)	4	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.068
Average number of customers in line	L_q	0.609
Average time spent in line (hrs)	W_q	0.006
Average time spent in line (s)		19.818
Average time spent in the system (hrs)	**W**	0.029
Average time spent in the system (s)		103.179
Average number of customers in system	**L**	3.173
Probability that the time in the queue is 0	$W_q(0)$	0.658
Probability that the time in the queue is		90.0%
no more than t time units. Time (m)	71.14 s	
Utilization (traffic intensity)	**r**	0.641

Steady-state Distribution

n	p_n
0	0.068192
1	0.174799
2	0.224035
3	0.191426
4	0.122672
5	0.078613
6	0.050378
7	0.032284
8	0.020689
9	0.013258
10	0.008496
11	0.005445
12	0.003489
13	0.002236
14	0.001433
15	0.000918
16	0.000588
17	0.000377
18	0.000242
19	0.000155
20	0.000099
21	0.000064
22	0.000041
23	0.000026
24	0.000017
25	0.000011
26	0.000007
27	0.000004
28	0.000003
29	0.000002
30	0.000001
31	0.000001

M/M/s Queue

Inputs: 1xDDA, 4xUnisex Pans

Arrival rate (l)	110.7	Customers per hour
	0.54	Average time (m) between arrivals
Rate per Cubicle (m)	43.2	Customers per hour per Cubicle
	1.39	Average Usage time (m)
Number of Cubicles (s)	5	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.075
Average number of customers in line	L_q	0.149
Average time spent in line (hrs)	W_q	0.001
Average time spent in line (s)		4.851
Average time spent in the system (hrs)	**W**	0.025
Average time spent in the system (s)		88.211
Average number of customers in system	**L**	2.712
Probability that the time in the queue is 0	$W_q(0)$	0.858
Probability that the time in the queue is		90.0%
no more than t time units. Time (m)	11.86 s	
Utilization (traffic intensity)	r	0.513

Steady-state Distribution

n	p_n
0	0.074922
1	0.192050
2	0.246145
3	0.210318
4	0.134779
5	0.069097
6	0.035424
7	0.018161
8	0.009310
9	0.004773
10	0.002447
11	0.001255
12	0.000643
13	0.000330
14	0.000169
15	0.000087
16	0.000044
17	0.000023
18	0.000012
19	0.000006
20	0.000003
21	0.000002
22	0.000001

M/M/s Queue

Inputs: 2 Male Urinal

Arrival rate (l)	61.5	Customers per hour
	0.98	Average time (m) between arrivals
Rate per Urinal (m)	90.0	Customers per hour per Urinal
	0.67	Average Usage time (m)
Number of Urinals (s)	2	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.491
Average number of customers in line	L_q	0.090
Average time spent in line (hrs)	W_q	0.001
Average time spent in line (s)		5.287
Average time spent in the system (hrs)	**W**	0.013
Average time spent in the system (s)		45.287
Average number of customers in system	**L**	0.774
Probability that the time in the queue is 0	$W_q(0)$	0.826
Probability that the time in the queue is		90.0%
no more than t time units. Time (m)	16.85 s	
Utilization (traffic intensity)	r	0.342

Steady-state Distribution

n	p_n
0	0.490683
1	0.335300
2	0.114561
3	0.039142
4	0.013373
5	0.004569
6	0.001561
7	0.000533
8	0.000182
9	0.000062
10	0.000021
11	0.000007
12	0.000002
13	0.000001

M/M/s Queue

Inputs: Unisex Washbasins

Arrival rate (l)	172.2	Customers per hour
	0.35	Average time (m) between arrivals
Rate per Washbasin (m)	90.00	Customers per hour per Washbasin
	0.67	Average Usage time (m)
Number of Washbasins (s)	3	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.126
Average number of customers in line	L_q	0.712
Average time spent in line (hrs)	W_q	0.004
Average time spent in line (s)		14.891
Average time spent in the system (hrs)	**W**	0.015
Average time spent in the system (s)		54.891
Average number of customers in system	**L**	2.626
Probability that the time in the queue is 0	$W_q(0)$	0.595
Probability that the time in the queue is		89.9%
no more than t time units. Time (m)	51.25 s	
Utilization (traffic intensity)	r	0.638

Steady-state Distribution

n	p_n
0	0.125523
1	0.240168
2	0.229761
3	0.146536
4	0.093458
5	0.059605
6	0.038015
7	0.024245
8	0.015463
9	0.009862
10	0.006290
11	0.004011
12	0.002558
13	0.001632
14	0.001041
15	0.000664
16	0.000423
17	0.000270
18	0.000172
19	0.000110
20	0.000070
21	0.000045
22	0.000028
23	0.000018
24	0.000012
25	0.000007
26	0.000005
27	0.000003
28	0.000002
29	0.000001
30	0.000001

M/M/s Queue

Inputs: Female Ambulant Closet Pan

Arrival rate (l)	86.1	Customers per hour
	0.70	Average time (m) between arrivals
Rate per Cubicle (m)	40.0	Customers per hour per Cubicle
	1.50	Average Usage time (m)
Number of Cubicles (s)	4	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.110
Average number of customers in line	L_q	0.249
Average time spent in line (hrs)	W_q	0.003
Average time spent in line (s)		10.404
Average time spent in the system (hrs)	**W**	0.028
Average time spent in the system (s)		100.404
Average number of customers in system	**L**	2.401
Probability that the time in the queue is 0	$W_q(0)$	0.786
Probability that the time in the queue is		90.0%
no more than t time units. Time (m)	37.02 s	
Utilization (traffic intensity)	**r**	0.538

Steady-state Distribution

n	p_n
0	0.110279
1	0.237376
2	0.255476
3	0.183304
4	0.098640
5	0.053081
6	0.028564
7	0.015371
8	0.008272
9	0.004451
10	0.002395
11	0.001289
12	0.000694
13	0.000373
14	0.000201
15	0.000108
16	0.000058
17	0.000031
18	0.000017
19	0.000009
20	0.000005
21	0.000003
22	0.000001
23	0.000001

M/M/s Queue

Inputs: Female Ambulant Closet Pan

Arrival rate (l)	86.1	Customers per hour
	0.70	Average time (m) between arrivals
Rate per Cubicle (m)	40.0	Customers per hour per Cubicle
	1.50	Average Usage time (m)
Number of Cubicles (s)	3	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.088
Average number of customers in line	L_q	1.316
Average time spent in line (hrs)	W_q	0.015
Average time spent in line (s)		55.037
Average time spent in the system (hrs)	**W**	0.040
Average time spent in the system (s)		145.037
Average number of customers in system	**L**	3.469
Probability that the time in the queue is 0	$W_q(0)$	0.482
Probability that the time in the queue is		90.0%
no more than t time units. Time (m)	174.80 s	
Utilization (traffic intensity)	**r**	0.718

Steady-state Distribution

n	p_n
0	0.088083
1	0.189598
2	0.204055
3	0.146410
4	0.105049
5	0.075373
6	0.054080
7	0.038802
8	0.027841
9	0.019976
10	0.014333
11	0.010284
12	0.007378
13	0.005294
14	0.003798
15	0.002725
16	0.001955
17	0.001403
18	0.001007
19	0.000722
20	0.000518
21	0.000372
22	0.000267
23	0.000191
24	0.000137
25	0.000099
26	0.000071
27	0.000051
28	0.000036
29	0.000026
30	0.000019
31	0.000013
32	0.000010
33	0.000007
34	0.000005
35	0.000004
36	0.000003
37	0.000002
38	0.000001
39	0.000001

M/M/s Queue

Inputs: Male Ambulant Closet Pan

Arrival rate (l)	24.6	Customers per hour
	2.44	Average time (m) between arrivals
Rate per Cubicle (m)	60.0	Customers per hour per Cubicle
	1.00	Average Usage time (m)
Number of Cubicles (s)	2	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.660
Average number of customers in line	L_q	0.018
Average time spent in line (hrs)	W_q	0.001
Average time spent in line (s)		2.632
Average time spent in the system (hrs)	**W**	0.017
Average time spent in the system (s)		62.632
Average number of customers in system	**L**	0.428
Probability that the time in the queue is 0	$W_q(0)$	0.930
Probability that the time in the queue is		93.0%
no more than t time units. Time (m)	0.00 s	
Utilization (traffic intensity)	r	0.205

Steady-state Distribution

n	p_n
0	0.659751
1	0.270498
2	0.055452
3	0.011368
4	0.002330
5	0.000478
6	0.000098
7	0.000020
8	0.000004
9	0.000001

M/M/s Queue

Inputs: Male Ambulant Closet Pan

Arrival rate (l)	24.6	Customers per hour
	2.44	Average time (m) between arrivals
Rate per Cubicle (m)	60.0	Customers per hour per Cubicle
	1.00	Average Usage time (m)
Number of Cubicles (s)	1	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.590
Average number of customers in line	L_q	0.285
Average time spent in line (hrs)	W_q	0.012
Average time spent in line (s)		41.695
Average time spent in the system (hrs)	**W**	0.028
Average time spent in the system (s)		101.695
Average number of customers in system	**L**	0.695
Probability that the time in the queue is 0	$W_q(0)$	0.590
Probability that the time in the queue is		90.0%
no more than t time units. Time (m)	143.34 s	
Utilization (traffic intensity)	r	0.410

Steady-state Distribution

n	p_n
0	0.590000
1	0.241900
2	0.099179
3	0.040663
4	0.016672
5	0.006836
6	0.002803
7	0.001149
8	0.000471
9	0.000193
10	0.000079
11	0.000032
12	0.000013
13	0.000005
14	0.000002
15	0.000001

M/M/s Queue

Inputs: 1xDDA, 3xUnisex Pans

Arrival rate (l)	110.7	Customers per hour
	0.54	Average time (m) between arrivals
Rate per Cubicle (m)	43.2	Customers per hour per Cubicle
	1.39	Average Usage time (m)
Number of Cubicles (s)	4	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.068
Average number of customers in line	L_q	0.609
Average time spent in line (hrs)	W_q	0.006
Average time spent in line (s)		19.818
Average time spent in the system (hrs)	**W**	0.029
Average time spent in the system (s)		103.179
Average number of customers in system	**L**	3.173
Probability that the time in the queue is 0	$W_q(0)$	0.658
Probability that the time in the queue is		80.1%
no more than t time units. Time (m)	31.26 s	
Utilization (traffic intensity)	**r**	0.641

Steady-state Distribution

n	p_n
0	0.068192
1	0.174799
2	0.224035
3	0.191426
4	0.122672
5	0.078613
6	0.050378
7	0.032284
8	0.020689
9	0.013258
10	0.008496
11	0.005445
12	0.003489
13	0.002236
14	0.001433
15	0.000918
16	0.000588
17	0.000377
18	0.000242
19	0.000155
20	0.000099
21	0.000064
22	0.000041
23	0.000026
24	0.000017
25	0.000011
26	0.000007
27	0.000004
28	0.000003
29	0.000002
30	0.000001
31	0.000001

M/M/s Queue

Inputs: 1xDDA, 4xUnisex Pans

Arrival rate (l)	110.7	Customers per hour
	0.54	Average time (m) between arrivals
Rate per Cubicle (m)	43.2	Customers per hour per Cubicle
	1.39	Average Usage time (m)
Number of Cubicles (s)	5	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.075
Average number of customers in line	L_q	0.149
Average time spent in line (hrs)	W_q	0.001
Average time spent in line (s)		4.851
Average time spent in the system (hrs)	**W**	0.025
Average time spent in the system (s)		88.211
Average number of customers in system	**L**	2.712
Probability that the time in the queue is 0	$W_q(0)$	0.858
Probability that the time in the queue is		85.8%
no more than t time units. Time (m)	0.00 s	
Utilization (traffic intensity)	r	0.513

Steady-state Distribution

n	p_n
0	0.074922
1	0.192050
2	0.246145
3	0.210318
4	0.134779
5	0.069097
6	0.035424
7	0.018161
8	0.009310
9	0.004773
10	0.002447
11	0.001255
12	0.000643
13	0.000330
14	0.000169
15	0.000087
16	0.000044
17	0.000023
18	0.000012
19	0.000006
20	0.000003
21	0.000002
22	0.000001

M/M/s Queue

Inputs: Male Urinal

Arrival rate (l)	61.5	Customers per hour
	0.98	Average time (m) between arrivals
Rate per Urinal (m)	90.0	Customers per hour per Urinal
	0.67	Average Usage time (m)
Number of Urinals (s)	2	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.491
Average number of customers in line	L_q	0.090
Average time spent in line (hrs)	W_q	0.001
Average time spent in line (s)		5.287
Average time spent in the system (hrs)	**W**	0.013
Average time spent in the system (s)		45.287
Average number of customers in system	**L**	0.774
Probability that the time in the queue is 0	$W_q(0)$	0.826
Probability that the time in the queue is no more than t time units. Time (m)	0.00 s	
Utilization (traffic intensity)	**r**	0.342

Steady-state Distribution

n	p_n
0	0.490683
1	0.335300
2	0.114561
3	0.039142
4	0.013373
5	0.004569
6	0.001561
7	0.000533
8	0.000182
9	0.000062
10	0.000021
11	0.000007
12	0.000002
13	0.000001

M/M/s Queue

Inputs: Unisex Washbasins

Arrival rate (l)	172.2	Customers per hour
	0.35	Average time (m) between arrivals
Rate per Washbasin (m)	90.00	Customers per hour per Washbasin
	0.67	Average Usage time (m)
Number of Washbasins (s)	3	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.126
Average number of customers in line	L_q	0.712
Average time spent in line (hrs)	W_q	0.004
Average time spent in line (s)		14.891
Average time spent in the system (hrs)	**W**	0.015
Average time spent in the system (s)		54.891
Average number of customers in system	**L**	2.626
Probability that the time in the queue is 0	$W_q(0)$	0.595
Probability that the time in the queue is no more than t time units. Time (m)	25.95 s	80.0%
Utilization (traffic intensity)	**r**	0.638

Steady-state Distribution

n	p_n
0	0.125523
1	0.240168
2	0.229761
3	0.146536
4	0.093458
5	0.059605
6	0.038015
7	0.024245
8	0.015463
9	0.009862
10	0.006290
11	0.004011
12	0.002558
13	0.001632
14	0.001041
15	0.000664
16	0.000423
17	0.000270
18	0.000172
19	0.000110
20	0.000070
21	0.000045
22	0.000028
23	0.000018
24	0.000012
25	0.000007
26	0.000005
27	0.000003
28	0.000002
29	0.000001
30	0.000001

M/M/s Queue

Inputs: Female Ambulant Closet Pan

Arrival rate (l)	86.1	Customers per hour
	0.70	Average time (m) between arrivals
Rate per Cubicle (m)	40.0	Customers per hour per Cubicle
	1.50	Average Usage time (m)
Number of Cubicles (s)	4	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.110
Average number of customers in line	L_q	0.249
Average time spent in line (hrs)	W_q	0.003
Average time spent in line (s)		10.404
Average time spent in the system (hrs)	W	0.028
Average time spent in the system (s)		100.404
Average number of customers in system	L	2.401
Probability that the time in the queue is 0	$W_q(0)$	0.786
Probability that the time in the queue is no more than t time units. Time (m)	3.21 s	80.0%
Utilization (traffic intensity)	r	0.538

Steady-state Distribution

n	p_n
0	0.110279
1	0.237376
2	0.255476
3	0.183304
4	0.098640
5	0.053081
6	0.028564
7	0.015371
8	0.008272
9	0.004451
10	0.002395
11	0.001289
12	0.000694
13	0.000373
14	0.000201
15	0.000108
16	0.000058
17	0.000031
18	0.000017
19	0.000009
20	0.000005
21	0.000003
22	0.000001
23	0.000001

M/M/s Queue

Inputs: Female Ambulant Closet Pan

Arrival rate (l)	86.1	Customers per hour
	0.70	Average time (m) between arrivals
Rate per Cubicle (m)	40.0	Customers per hour per Cubicle
	1.50	Average Usage time (m)
Number of Cubicles (s)	3	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.088
Average number of customers in line	L_q	1.316
Average time spent in line (hrs)	W_q	0.015
Average time spent in line (s)		55.037
Average time spent in the system (hrs)	**W**	0.040
Average time spent in the system (s)		145.037
Average number of customers in system	**L**	3.469
Probability that the time in the queue is 0	$W_q(0)$	0.482
Probability that the time in the queue is		80.0%
no more than t time units. Time (m)	101.15 s	
Utilization (traffic intensity)	**r**	0.718

Steady-state Distribution

n	p_n
0	0.088083
1	0.189598
2	0.204055
3	0.146410
4	0.105049
5	0.075373
6	0.054080
7	0.038802
8	0.027841
9	0.019976
10	0.014333
11	0.010284
12	0.007378
13	0.005294
14	0.003798
15	0.002725
16	0.001955
17	0.001403
18	0.001007
19	0.000722
20	0.000518
21	0.000372
22	0.000267
23	0.000191
24	0.000137
25	0.000099
26	0.000071
27	0.000051
28	0.000036
29	0.000026
30	0.000019
31	0.000013
32	0.000010
33	0.000007
34	0.000005
35	0.000004
36	0.000003
37	0.000002
38	0.000001
39	0.000001

M/M/s Queue

Inputs: Male Ambulant Closet Pan

Arrival rate (l)	24.6	Customers per hour
	2.44	Average time (m) between arrivals
Rate per Cubicle (m)	60.0	Customers per hour per Cubicle
	1.00	Average Usage time (m)
Number of Cubicles (s)	2	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.660
Average number of customers in line	L_q	0.018
Average time spent in line (hrs)	W_q	0.001
Average time spent in line (s)		2.632
Average time spent in the system (hrs)	**W**	0.017
Average time spent in the system (s)		62.632
Average number of customers in system	**L**	0.428
Probability that the time in the queue is 0	$W_q(0)$	0.930
Probability that the time in the queue is no more than t time units. Time (m)	0.00 s	93.0%
Utilization (traffic intensity)	r	0.205

Steady-state Distribution

n	p_n
0	0.659751
1	0.270498
2	0.055452
3	0.011368
4	0.002330
5	0.000478
6	0.000098
7	0.000020
8	0.000004
9	0.000001

M/M/s Queue

Inputs:

Arrival rate (l)	24.6	Customers per hour
	2.44	Average time (m) between arrivals
Rate per Cubicle (m)	60.0	Customers per hour per Cubicle
	1.00	Average Usage time (m)
Number of Cubicles (s)	1	

Steady-State Operating Characteristics

Probability that the system is empty	p_0	0.590
Average number of customers in line	L_q	0.285
Average time spent in line (hrs)	W_q	0.012
Average time spent in line (s)		41.695
Average time spent in the system (hrs)	**W**	0.028
Average time spent in the system (s)		101.695
Average number of customers in system	**L**	0.695
Probability that the time in the queue is 0	$W_q(0)$	0.590
Probability that the time in the queue is no more than t time units. Time (m)	72.99 s	80.0%
Utilization (traffic intensity)	r	0.410

Steady-state Distribution

n	p_n
0	0.590000
1	0.241900
2	0.099179
3	0.040663
4	0.016672
5	0.006836
6	0.002803
7	0.001149
8	0.000471
9	0.000193
10	0.000079
11	0.000032
12	0.000013
13	0.000005
14	0.000002
15	0.000001