

TECHNICAL NOTE

Project	Byron Bay – Bus Bay Capacity Assessment		
Subject	Review of Scheduled Services and Capacity Assessment		
Date	08 September 2019	Note #	4.1
Prepared	D. Innis		

1 INTRODUCTION

1.1 Technical Note Purpose

The purpose of this technical note is to undertake a review of the existing scheduled timetable at the Byron Bay bus stop and a high-level capacity assessment to identify the number of bays required for a proposed upgraded bus interchange facility. This technical note includes the following information:

- Review of scheduled timetable and identify pattern of bus and van use at the facility.
- Analyse capacity and utilisation demands of the facility.
- Identify the number of operational bays required for the proposed facility with separate bays for buses and vans.
- Analyse capacity via bus bay assignments to different operators and propose changes to operations to support capacity.
- Review of concept design relating to operations, pedestrians and safety.

1.2 Assumptions

The following assumptions have been used in review the scheduled timetable of services:

- Buses and coaches will be stopping at a separate location to airport shuttles and local vans at the upgraded facility. Buses and coaches (referred to hereafter as buses) and airport shuttles and local vans (referred to hereafter as vans) will be analysed separately.
- Buses and vans commencing at the facility will arrive three minutes prior to their scheduled departure time. This allows sufficient time for passengers to board and purchase their required fare prior to departure.
- Buses and vans servicing Byron Bay mid-trip or passing through the town, will dwell at the stop for two minutes. This provides sufficient time for passengers to alight the service then allow passengers to board and purchase their fare before departing.
- Buses and vans terminating at Byron Bay and not continuing in-service from the facility will dwell at the stop for one minute. This provides sufficient time for passengers to alight the service.
- Buses and vans terminated at Byron Bay will not layover at the facility but return to depot or another location.
- Long distance services will dwell at the facility for ten minutes providing sufficient time for passengers to break from travel to refresh before continuing with their journey.
- The SkyBus service from the Gold Coast Airport operates as a return service with five minutes scheduled between the bus arriving from the Gold Coast and departing Byron Bay. The five minutes between the arrival and departure times is assumed to be the dwell time at the bus facility.
- The integration of timetables, that is one bus arrives as one service number but departs as another, has only incorporated data provided by Blanchs. No other operator's operational data has been considered or provided in the review. This allows for the worst-case scenario to be reviewed and the recommendations to be based on the highest possible number of buses and vans utilise the facility at the same time.

2 REVIEW OF SCHEDULED TIMETABLE

2.1 Service Providers

The analysis of the scheduled timetable for services at Byron Bay has included the follow bus operators and service providers:

- NSW TrainLink.
- Various airport shuttles:
 - Brisbane airport.
 - Gold Coast airport.
 - Ballina airport.
- Greyhound Coaches.
- Local hostels.
- Nimbin Buses.
- Northern Rivers Buslines.
- Premier Coaches.
- Blancs.
- Brunswick Valley Coaches.
- Resort shuttles.
- Local tours.
- SkyBus – Byron Bay Express.

These bus operators and service providers offer travel to various local and regional destinations throughout Northern New South Wales as well as long distance locations such as Brisbane and Sydney. Overall these operators provide 217 trips per weekday, 150 trips per Saturday and 121 trips per Sunday.

2.2 Bus Services

It is important to note the data in this section is referring to the number of trips at the facility and not the number of physical vehicles operating as a vehicle can operate both a terminating and commencing trip from the facility.

2.2.1 Weekday Schedule

Table 2-1 identifies the number of trips servicing the bus facility each weekday, by hour across the day, according to their status of a commencing trip (bus starts at Byron Bay), a passing trip (bus services Byron Bay mid-trip), or a terminating trip (bus finishes service at Byron Bay).

A Friday weekday for the school period has been assessed as this provides a higher volume of bus trips compared to the operational timetable for Monday to Thursday or during school holidays. This allows the bus facility to be assessed against the day when the highest volume of buses are scheduled.

Based on the current scheduled timetable, 128 buses are servicing the facility each weekday including 46 trips commencing, 35 trips passing through and 47 trips terminating at Byron Bay. The bus facility experiences the greatest number of buses using the stop between 4:00pm and 6:00pm with ten buses scheduled per hour.

Table 2-1 Number of Weekday Trips - Buses

WEEKDAY				
Time Period	Commencing Trip	Passing Trip	Terminating Trip	Hour Total
4:00		1		1
5:00	1			1
6:00	1	1		2
7:00	3	2	1	6
8:00	2	2	4	8
9:00	3	1	2	6

WEEKDAY				
Time Period	Commencing Trip	Passing Trip	Terminating Trip	Hour Total
10:00	4	3	2	9
11:00	2	4	3	9
12:00	1	4	2	7
13:00	3	1	3	7
14:00	4	2	2	8
15:00	1	3	4	8
16:00	4	2	4	10
17:00	3	4	3	10
18:00	3	1	4	8
19:00	3	1	4	8
20:00	3	3	3	9
21:00	1		2	3
22:00	3		3	6
23:00	1		1	2
Total	46	35	47	128

2.2.2 Saturday Schedule

Table 2-2 identifies the number of trips servicing the bus facility each Saturday, by hour across the day, according to their status. The number of bus trips operating on a Saturday is almost half as many as operating on weekdays.

Based on the current scheduled timetable, 67 buses are servicing the facility each Saturday with 17 trips commencing, 34 trips passing through and 16 trips terminating at Byron Bay. The bus facility experiences the greatest number of buses using the stop between 8:00pm and 9:00pm, with nine buses scheduled.

Table 2-2 Number of Saturday Trips - Buses

SATURDAY				
Time Period	Commencing Trip	Passing Trip	Terminating Trip	Hour Total
4:00		1		1
5:00	1			1
6:00	1	1		2
7:00		2		2
8:00		3		3
9:00				0
10:00	1	4		5
11:00		2		2
12:00		4	1	5
13:00		2		2
14:00	1	2		3
15:00		2	1	3
16:00	1	1		2
17:00		5	1	6
18:00	1	1	1	3
19:00	3	1	3	7
20:00	3	3	3	9
21:00	1		2	3
22:00	3		3	6
23:00	1		1	2
Total	17	34	16	67

2.2.3 Sunday Schedule

Table 2-3 identifies the number of trips servicing the bus facility each Sunday, by hour across the day, according to their status. The number of bus trips operating on a Sunday is close to half as many as the number of trips operating on a Saturday and a quarter of trips compared to weekdays.

Based on the current scheduled timetable, 37 buses are servicing the facility each Sunday with 6 trips commencing, 27 trips passing, and 4 trips terminating at the bus facility. The bus facility experiences

the greatest number of buses using the stop between 12:00pm and 1:00pm, then again between 5:00pm to 6:00pm with five buses scheduled.

Table 2-3 Number of Sunday Trips - Buses

SUNDAY				
Time Period	Commencing Trip	Passing Trip	Terminating Trip	Hour Total
4:00		1		1
5:00	1			1
6:00	1	1		2
7:00		1		1
8:00		3		3
9:00				0
10:00	1	3		4
11:00		1		1
12:00		4	1	5
13:00		2		2
14:00	1	1		2
15:00		1	1	2
16:00	1	1		2
17:00		4	1	5
18:00		1		1
19:00	1			1
20:00		3		3
21:00			1	1
22:00				0
23:00				0
Total	5	21	4	37

2.3 Van Services

2.3.1 Weekday Schedule

The number of services operating at Byron Bay using a van remains fairly consistent across the week. Overall 89 trips are operated by van each weekday, 83 each Saturday and 84 each Sunday.

Table 2-4 identifies the number of trips servicing the bus facility by van each weekday, by hour across the day, according to their status. Based on the current scheduled timetable, 34 trips commence and terminate with an additional 28 trips passing through the facility.

The highest number of vans accessing the bus facility during the same time period is between 1:00pm and 2:00pm with 11 vans servicing the facility.

Table 2-4 Number of Weekday Trips - Vans

WEEKDAY				
Time Period	Commencing Trip	Passing Trip	Terminating Trip	Hour Total
4:00				0
5:00	1			1
6:00	1			1
7:00	3			3
8:00	2	2		4
9:00	4	1	3	8
10:00	1	2	3	6
11:00	4	2	2	8
12:00	2	2	3	7
13:00	5	2	4	11
14:00	4	1	3	8
15:00	1	2	2	5
16:00	2	2	6	10
17:00	1	2	2	5

WEEKDAY				
Time Period	Commencing Trip	Passing Trip	Terminating Trip	Hour Total
18:00	1	3	1	5
19:00	2		1	3
20:00			1	1
21:00			1	1
22:00			1	1
23:00			1	1
Total	34	21	34	89

2.3.2 Saturday Schedule

Table 2-5 identifies the number of trips servicing the bus facility by van each Saturday, by hour across the day, according to their status. Based on the current scheduled timetable, 32 trips commence from Byron Bay with an additional 20 trips passing through and 31 trips terminating.

The bus facility experiences the greatest number of vans using the stop between 1:00pm and 2:00pm, and again between 4:00pm and 5:00pm with ten vans scheduled.

Table 2-5 Number of Saturday Trips - Vans

SATURDAY				
Time Period	Commencing Trip	Passing Trip	Terminating Trip	Hour Total
4:00				0
5:00	1			1
6:00	1			1
7:00	3			3
8:00	2	2		4
9:00	4	1	3	8
10:00	1	2	3	6
11:00	4	2	2	8
12:00	2	2	3	7
13:00	5	2	3	10
14:00	3	1	3	7
15:00	1	2	2	5
16:00	2	2	6	10
17:00	1	1	2	4
18:00	1	3	1	5
19:00	1		1	2
20:00			1	1
21:00			1	1
22:00				0
23:00				0
Total	32	20	31	83

2.3.3 Sunday Schedule

Table 2-6 identifies the number of trips servicing the bus facility each Sunday, by hour across the day, according to their status. The current scheduled timetable is similar to Saturday's with the additional of an extra commencing trip.

The Sunday time period with the greatest number of vans servicing the facility at one time period is the same as Saturdays being between 1:00pm and 2:00pm, and again between 4:00pm and 5:00pm with ten vans scheduled

Table 2-6 Number of Sunday Trips - Vans

SUNDAY				
Time Period	Commencing Trip	Passing Trip	Terminating Trip	Hour Total
4:00				0
5:00	1			1
6:00	1			1
7:00	3			3
8:00	2	2		4
9:00	4	1	3	8
10:00	1	2	3	6
11:00	3	2	1	6
12:00	2	2	3	7
13:00	5	2	3	10
14:00	3	1	3	7
15:00	1	2	2	5
16:00	2	2	6	10
17:00	1	2	2	5
18:00		3	1	4
19:00	2		1	3
20:00			1	1
21:00			1	1
22:00			1	1
23:00			1	1
Total	31	21	32	84

3 CAPACITY ANALYSIS – EXISTING SERVICES

The scheduled arrival and departure times for bus and van services at Byron Bay, along with the assumed dwell times, has been assessed to provide a clear indication on the number of vehicles at the facility at a given time.

This analysis is based on the facility as a whole without stop configurations or bay assignments, to understand the overall number of bays required. Section 4 will analyse bay assignments by operator to identify any potential conflicts in capacity and proposed operating strategies to maximise usage and minimise space requirements.

Section 3.1 will address bus services and the number of bays required to support current operations.

Section 3.2 will address van services and the number of bays required to support current operations.

The information provided in this assessment is based on the scheduled timetable only and does not account for the early or late running of services which could impact operations of the bus facility.

The time of all routes scheduled to service Byron Bay is included as Attachment A, separated between bus and vans.

3.1 Bus Services

3.1.1 Weekday Service Conflicts

Figure 3-1 provides a breakdown of the volume of buses using the bus facility, taking into consideration dwell time, between 4:00am and 12:00am each weekday. From the scheduled timetable, there are four instances where three buses are identified at the facility at the same time. The times of bus conflicts are:

- 10:10am to 10:12am.
- 11:10am.
- 12:10pm to 12:12pm.
- 5:00pm.

For all other times, no more than two buses are scheduled to be at the facility.

A review of the scheduled timetable at 10:10am to 10:12am shows that four services operated by NSW TrainLink, Blanches and SkyBus use the Byron Bay facility. In reviewing their, arrival, dwell and departure times, three buses are at the facility at the same time with two of those buses departing prior to the fourth bus arriving.

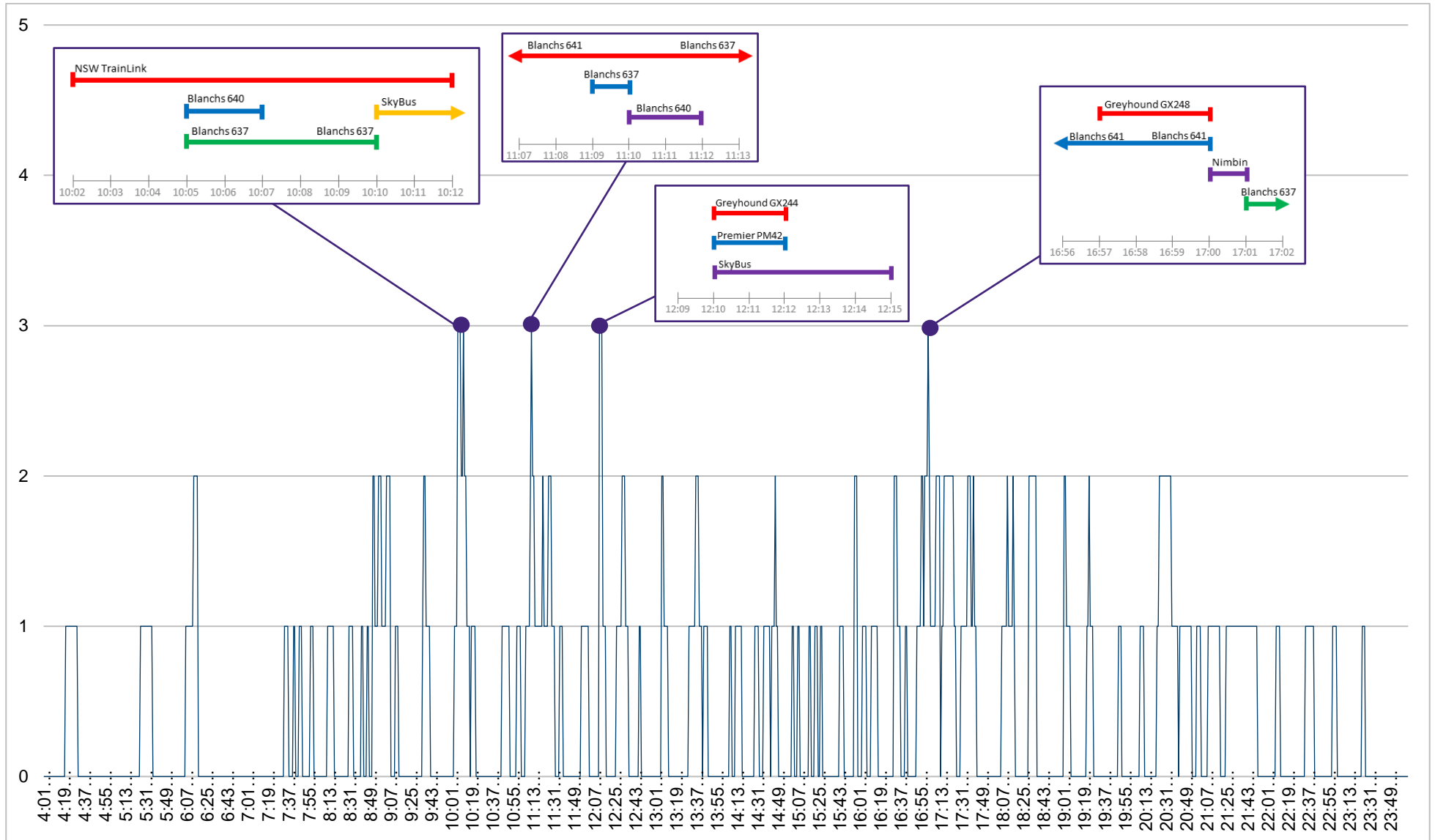
In reviewing the buses scheduled at 11:10am, three services operated by Blanches are using the facility. One bus arrives early at 11:05am and dwells for 15 minutes while the other two arrive at 11:09am and 11:10am respectively, and depart within one to two minutes.

In reviewing the buses scheduled between 12:10pm to 12:12pm, three services operated by Greyhound, Premier and Skybus are using the facility. All three buses arrive at 12:10pm with two buses departing at 12:12pm and the third departing at 12:15pm.

In reviewing the buses scheduled at 5:00pm, four services operated by Greyhound, Blanches, and Nimbin utilise the facility. One bus arrives at 4:50pm and another at 4:54pm with both of these buses departing at 5:00pm. A third bus arrives at 5:00pm and departs at 5:01pm, with the fourth bus arriving at 5:01pm.

Overall according to the schedule timetable, weekday bus services can operate sufficiently with three dedicated bus bays at the proposed Byron Bay bus facility.

Figure 3-1 Breakdown of Weekday (Friday) Bus Trips



3.1.2 Saturday Service Conflicts

Figure 3-2 provides a breakdown of the volume of buses using the bus facility, taking into consideration dwell time, between 4:00am and 12:00am each Saturday. From the scheduled timetable, there are three instances where three buses are scheduled at the facility at the same time being:

- 10:05am to 10:07am.
- 12:10pm to 12:12pm.
- 5:00pm.

For all other times, no more than two buses are scheduled to be at the facility.

A review of the scheduled timetable at 10:05am to 10:07am shows that three services operated by NSW TrainLink and Blanches use the Byron Bay facility. All three services are scheduled to be at the facility at the same time. A fourth bus operated by SkyBus arrives at the facility after two buses have departing and while the NSW TrainLink service is still at the facility.

The three buses at 12:10pm are the same services identified on weekdays and follow the same operating pattern.

In reviewing the buses scheduled around 5:00pm, a Greyhound bus is scheduled to depart as a bus from Nimbin Buses and Blanches is scheduled to arrive.

Overall according to the schedule timetable, Saturday bus services can operate sufficiently with three dedicated bus bays at the proposed Byron Bay bus facility.

3.1.3 Sunday Service Conflicts

Figure 3-3 provides a breakdown of the volume of buses using the bus facility, taking into consideration dwell time, between 4:00am and 12:00am each Sunday. From the scheduled timetable, there are two instances where three buses are identified at the facility at the same time, being 12:10pm to 12:12pm, and 5:00pm.

For both instances, the services and arrival/departure times are the same as the Saturday schedule.

For all other times, no more than two buses are scheduled to be at the facility.

Overall according to the schedule timetable, Sunday bus services can operate sufficiently with three dedicated bus bays at the proposed Byron Bay bus facility.

Figure 3-2 Breakdown of Saturday Bus Trips

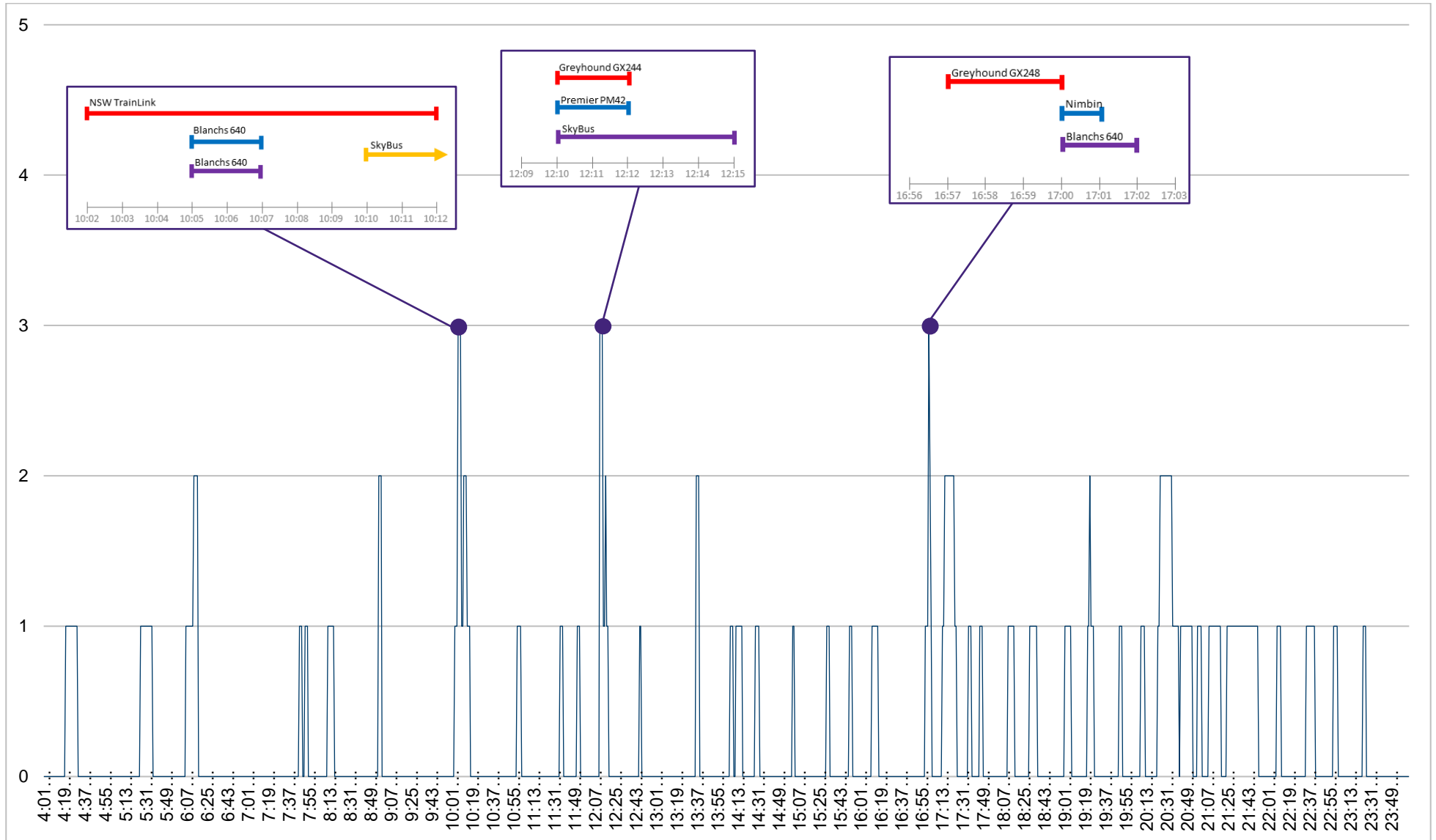
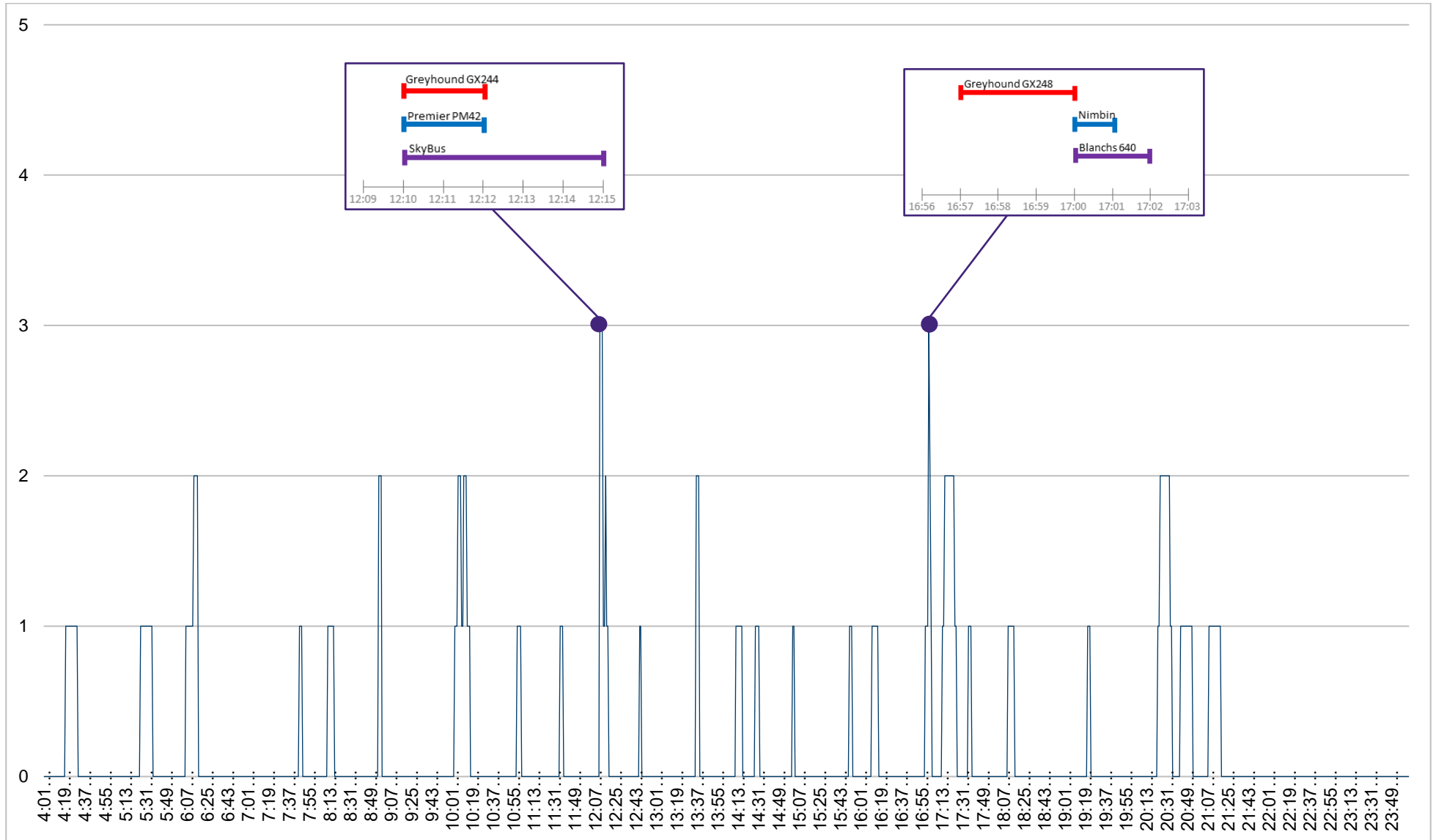


Figure 3-3 Breakdown of Sunday Bus Trips



3.2 Van Services

The capacity analysis for vans scheduled to service Byron Bus is fairly similar for all days of the week. All vans operate on weekdays with the following differences scheduled on Saturdays and Sundays when compared to weekdays:

- Saturday:
 - The 5:15pm, 7:12pm, 10:00pm and 11:45pm trips by Easybus do not operate.
 - The 1:00pm and 2:57pm trips by Bris2byr do not operate.
- Sunday:
 - The 11:00am, 11:57am, 1:00pm, 2:57pm and 6:27pm trips by Bris2byr do not operate.

Commentary on the conflict of services for Saturday and Sunday will not be included in this technical note as these conflicts are already covered in the weekday commentary. The removal of the trips identified above reduces the number of vans conflicting at the same time improving the outcome for the proposed Byron Bay bus facility.

The outcomes identified in Section 3.2.1 will apply to Saturday and Sunday, and overall van operations.

Figure 3-5 and Figure 3-6 shows the breakdown of buses accessing the facility each Saturday and Sunday respectively.

3.2.1 Weekday Service Conflicts

Figure 3-4 provides a breakdown of the volume of vans using the facility on weekdays. From the scheduled timetable for operators using vans, the following times indicated multiple vans using the facility at a similar time:

- 10:00am – four vans scheduled.
- 1:00pm – four vans scheduled.
- 2:00pm – five vans scheduled.

For all other times, no more than three vans are scheduled to be at the facility.

A review of the scheduled timetable at 10:00am indicates four vans operated by individual operators use the facility. One van is scheduled to depart at 10:00am with three other vans scheduled to arrive at that time. The arrival and departure of these vans is shown in Figure 3-4.

At 1:00pm, four vans are scheduled to arrive at the same time with two vans having Byron Bay as the last stop and the other two vans continuing beyond Byron Bay. Two of the vans are servicing local hostels and the other two are providing connectivity to airports and facilities at Brisbane and the Gold Coast. The arrival and departure of these vans is shown in Figure 3-4.

At 2:00pm, five vans are scheduled to utilise the facility. Three vans which arrived at 1:57pm are scheduled to depart at 2:00pm while two more vans are scheduled to arrive at 2:00pm. The arrival and departure of these vans is shown in Figure 3-4.

Less services operate on Saturday and Sunday however the same general timetable applies as weekdays. The conflicts that occur on Saturdays and Sundays are identified above.

Overall according to the schedule timetable, weekday van services require four bays to support existing operations at the proposed Byron Bay bus facility.

Figure 3-4 Breakdown of Weekday (Friday) Van Trips

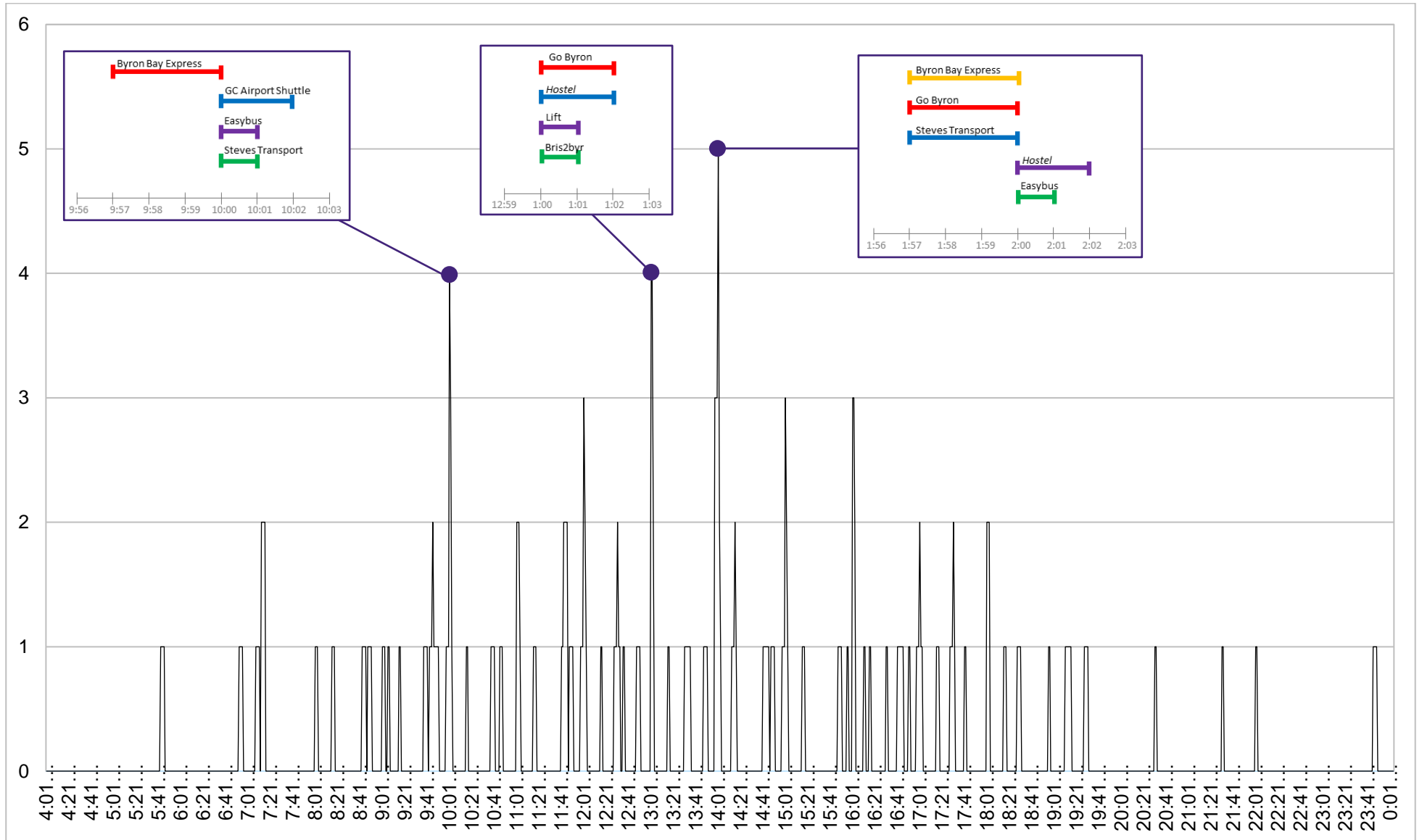


Figure 3-5 Breakdown of Saturday Van Trips

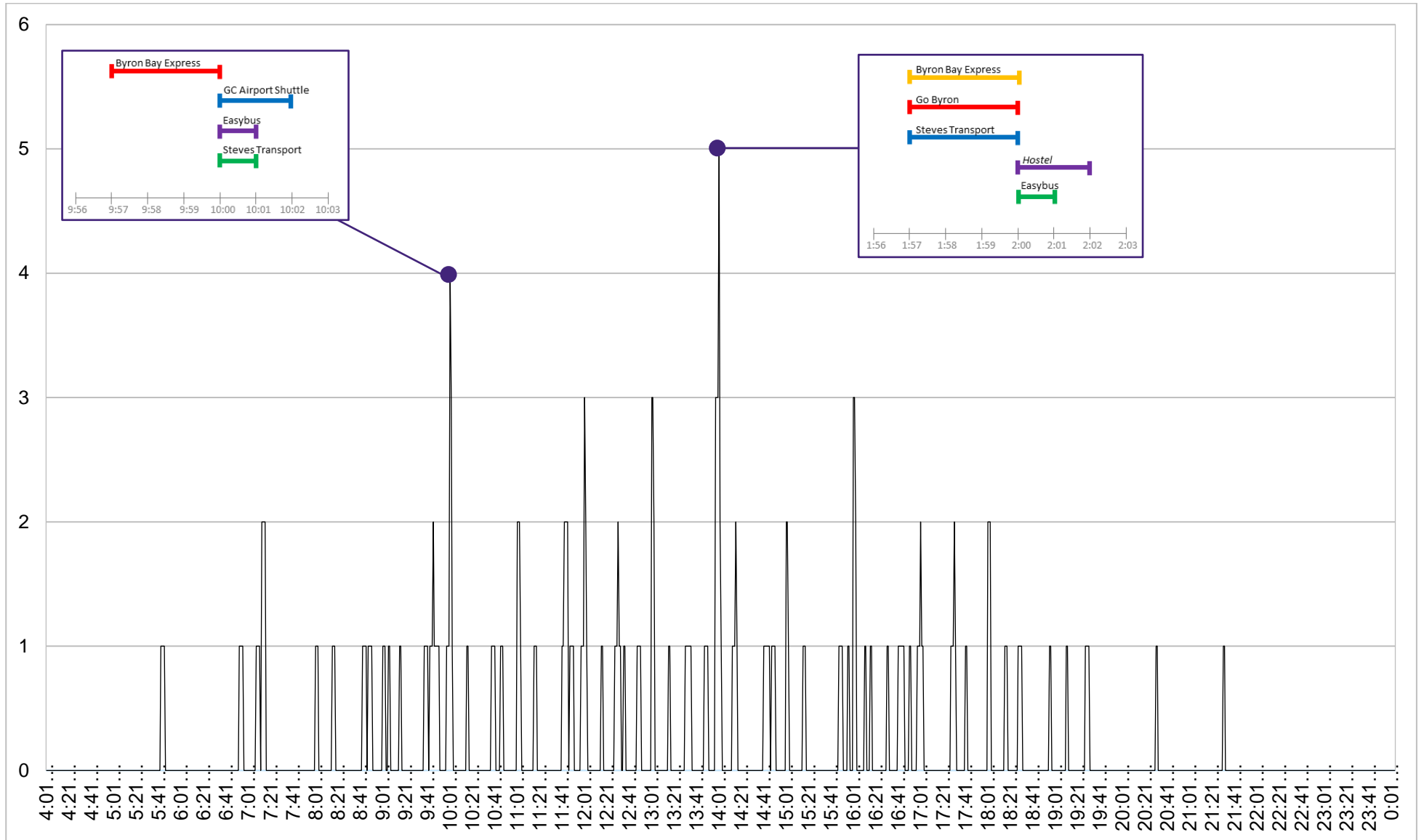
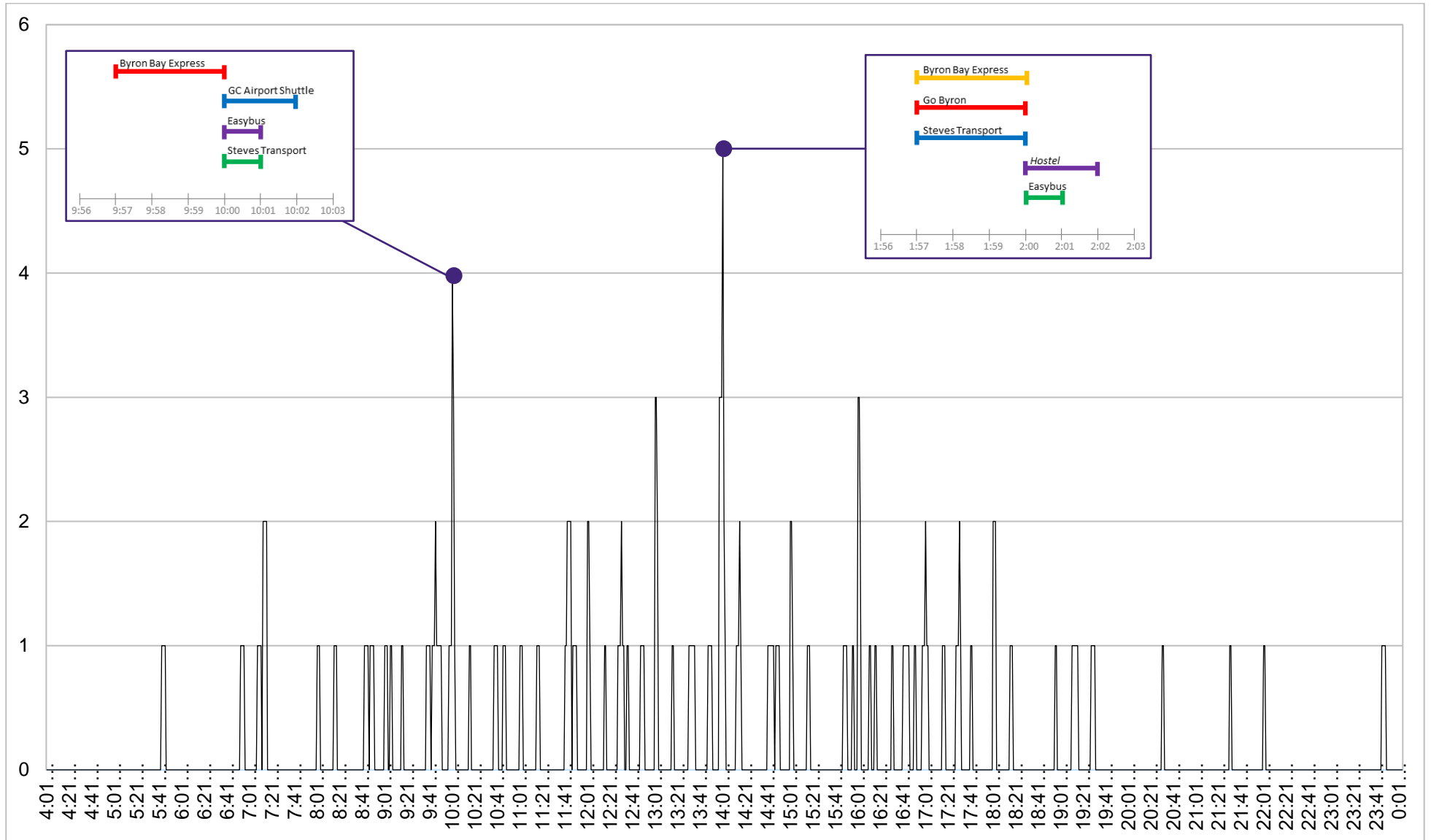


Figure 3-6 Breakdown of Sunday Van Trips



4.2 Bays 1 & 2 and Proposed Operating Strategy

4.2.1 Scheduling of Services

Figure 4-2 provides a breakdown of the volume of buses using bays 1 and 2 each weekday, with Figure 4-3 and Figure 4-4 identifying Saturday and Sunday usage respectively.

There is only one instance across a weekly timetable where three buses are scheduled to be at bays 1 and 2 at the same time; this is between 11:10am and 11:12am on weekdays involving Blanchs buses and involves the following scheduled scenario:

- Route 641 arrives at bay 1 at 11:05am and dwells/layover for 15 minutes until departing as route 637 at 11:20am.
- Route 637 arrives at 11:09am and departs out-of-service (terminating) at 11:10am.
- Route 640 arrives at 11:10am and departs at 11:12am continuing the service.

From the scheduled times, only two bus bays are required however any potential late or early running of routes 637 and 640 could create a conflict in space.

4.2.2 Proposed Operating Strategy

To remove this potential conflict, two possible strategies are proposed:

1. Route 641 could complete the dwell time away from the facility. This would require a layover bay or signed kerbside bus zone elsewhere in Byron Bay and in close proximity to the facility. This option is preferred as it frees the facility for use by in-service routes and would reduce potential customer confusion of a bus waiting at the stop but not departing.
2. Bus bay 3 has no scheduled services between 10:15am and 11:35am. The three buses could utilise the spare capacity of bus bay 3 reducing the out-of-service operations for route 641. This option is viable however to improve customer legibility of services and allow bays 1 and 2 to remain for in-service routes, route 641 would be proposed to stop and dwell/layover in bay 3 before moving to bay 1 prior to departing as route 637.

Either of these two proposed operating strategies would ensure no additional bays are required and would not require the design of the proposed facility to be modified. Utilising the spare capacity in bay 3 is the preferred option.

Figure 4-2 Breakdown of Weekday Services at Bays 1 and 2

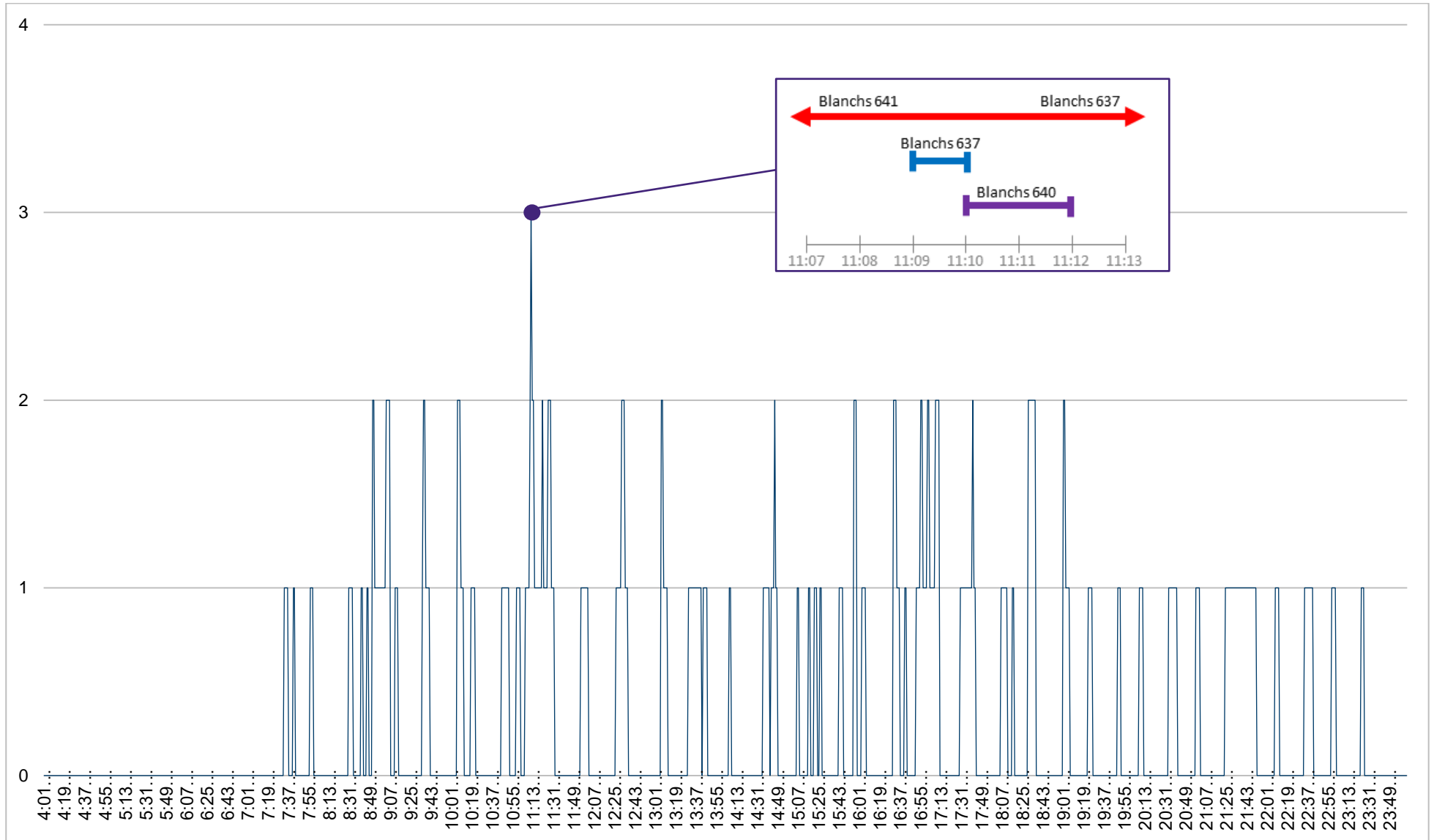


Figure 4-3 Breakdown of Saturday Services at Bays 1 and 2

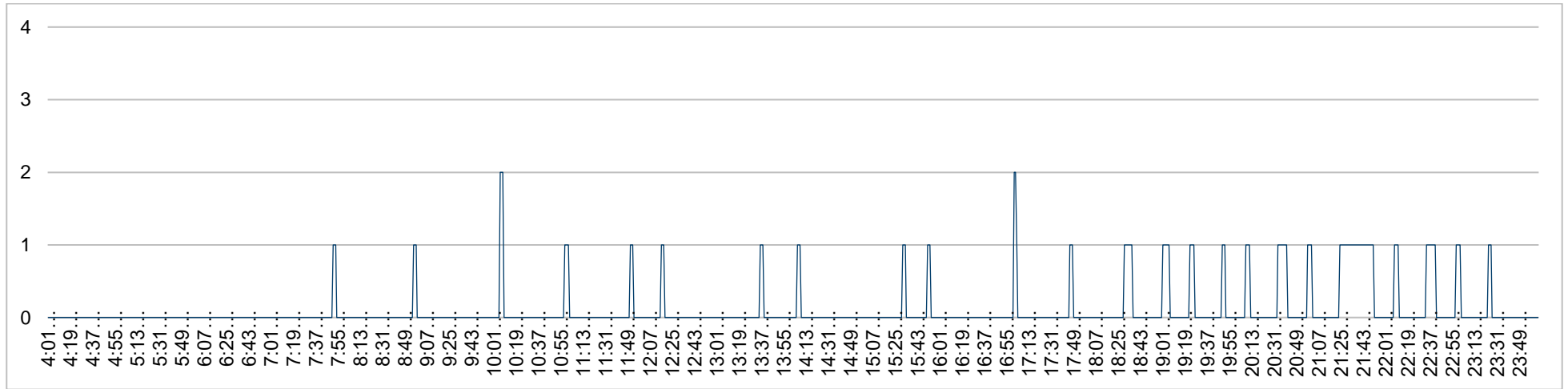
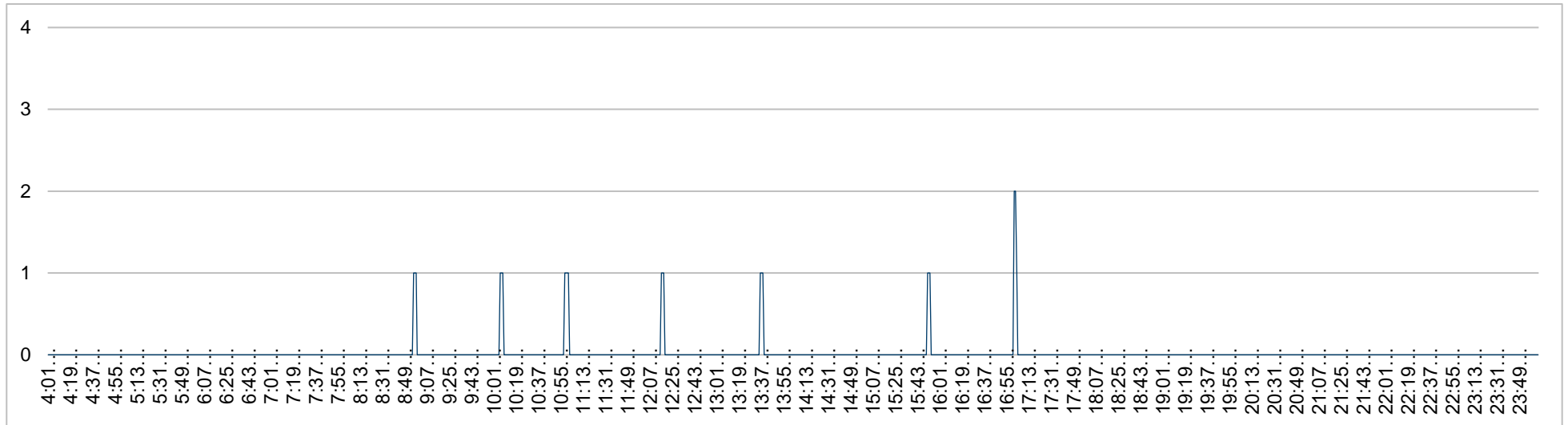


Figure 4-4 Breakdown of Sunday Services at Bays 1 and 2



4.3 Bays 3 & 4 and Proposed Operating Strategy

4.3.1 Scheduling of Services

Figure 4-5 provides a breakdown of the volume of buses using bay 3 each day. The schedule of services for NSW TrainLink and the long-distance coach services is replicate daily regardless if it is a weekday or weekend. The conflicts in the current timetable that occur are schedule each day.

There are five instances per day where there is more than one bus scheduled to utilise bay 3. These are shown in Table 4-1 with the overflow services highlighted in yellow.

Table 4-1 Bay 3 Scheduled Conflicts

Conflict #	Service	Arriving Time	Departing Time
1	NSW TrainLink service – 166	6:05 AM	6:15 AM
	SkyBus - Byron Bay Express	6:12 AM	6:15 AM
2	NSW TrainLink service – 165	10:02 AM	10:12 AM
	SkyBus - Byron Bay Express	10:10 AM	10:15 AM
3	Greyhound – GX244	12:10 PM	12:12 PM
	Premier – PM42	12:10 PM	12:12 PM
	SkyBus - Byron Bay Express	12:10 PM	12:15 PM
4	NSW TrainLink service – 172	5:12 PM	5:22 PM
	NSW TrainLink service – 168	5:14 PM	5:24 PM
5	NSW TrainLink service – 173	8:22 PM	8:32 PM
	NSW TrainLink service – 175	8:24 PM	8:34 PM

Figure 4-6 shows the utilisation of bay 4 with the overflow vehicles included in the schedule. This graph stacks each vehicle type (van and bus) and shows capacity constraints and vehicle conflicts when the overflow vehicles use bay 4.

The space of bay 4 has sufficient capacity for approximately three vans or one bus which is insufficient to support both vans and the overflow vehicles from bay 3.

4.3.2 Proposed Operating Strategy

To remove this potential conflict, three possible strategies are proposed:

1. Reallocate bay 4 as an additional bay for NSW TrainLink and long-distance coach services only. This would require vans to be relocated to another location such as on-road parking along Butler Street. This option is not preferred as it would result in bay 4 being used very irregularly and potentially considered as unused space, as well as requiring design changes to the proposed facility design to incorporate vans at an alternative location.
2. Bus bays 1 and 2 have no scheduled services at the times when the overflow vehicles are scheduled to utilise the facility. The overflow vehicles could utilise the spare capacity of bus bays 1 and 2. This option is preferred as it would not require modification to the proposed facility design or relocate the vans to an alternative location and utilises the spare capacity of the facility. How this option could potentially be implemented is identified in Table 4-2 in the column labelled 'Operating Change #2'.
3. The timetables and scheduled times of the overflow vehicles could be reviewed to schedule out any conflicts. Services could be retimed to provide a gap between services to allow for buses to clear the facility. This option is viable as it contains all the longer distance routes in the one bus bay which improves customer legibility, however this would require consultation from the facility asset owner to the service providers and consideration of the impacts external to Byron Bay for these services. How this option could potentially be implemented is identified in Table 4-2 in the column labelled 'Operating Change #3'.

Table 4-2 Bay 3 Scheduled Conflicts and Proposed Operating Changes

Conflict #	Service	Arriving Time	Departing Time	Operating Change #2	Operating Change #3
1	NSW TrainLink service – 166	6:05 AM	6:15 AM	First arrival in bay 1 or 2 – no local buses until 7:32am	6:00am departure
	SkyBus - Byron Bay Express	6:12 AM	6:15 AM		
2	NSW TrainLink service – 165	10:02 AM	10:12 AM	Use bay 3	10:15am arrival
	SkyBus - Byron Bay Express	10:10 AM	10:15 AM	Use bay 1 or 2 – local buses would have cleared and no arrivals until this bus departs	
3	Greyhound – GX244	12:10 PM	12:12 PM	Use bay 1 – no conflicts with local buses	12:15pm arrival
	Premier – PM42	12:10 PM	12:12 PM	Use bay 2 – no conflicts with local buses	
	SkyBus - Byron Bay Express	12:10 PM	12:15 PM	Use bay 3 – no conflicts with local buses and longest dwell time	
4	NSW TrainLink service – 172	5:12 PM	5:22 PM	Use bay 3	5:10pm arrival
	NSW TrainLink service – 168	5:14 PM	5:24 PM	Use bay 1 – no conflicts with local buses	5:20pm arrival
5	NSW TrainLink service – 173	8:22 PM	8:32 PM	Use bay 2 – no conflicts with local buses	8:20pm arrival
	NSW TrainLink service – 175	8:24 PM	8:34 PM	Use bay 3	8:30pm arrival

Either of option 2 or 3 of the proposed operating strategies would ensure no additional bays are required and would not require the design of the proposed facility to be modified. Utilising the spare capacity in bays 1 and 2 is the preferred option.

Figure 4-5 Breakdown of Daily Services at Bays 3

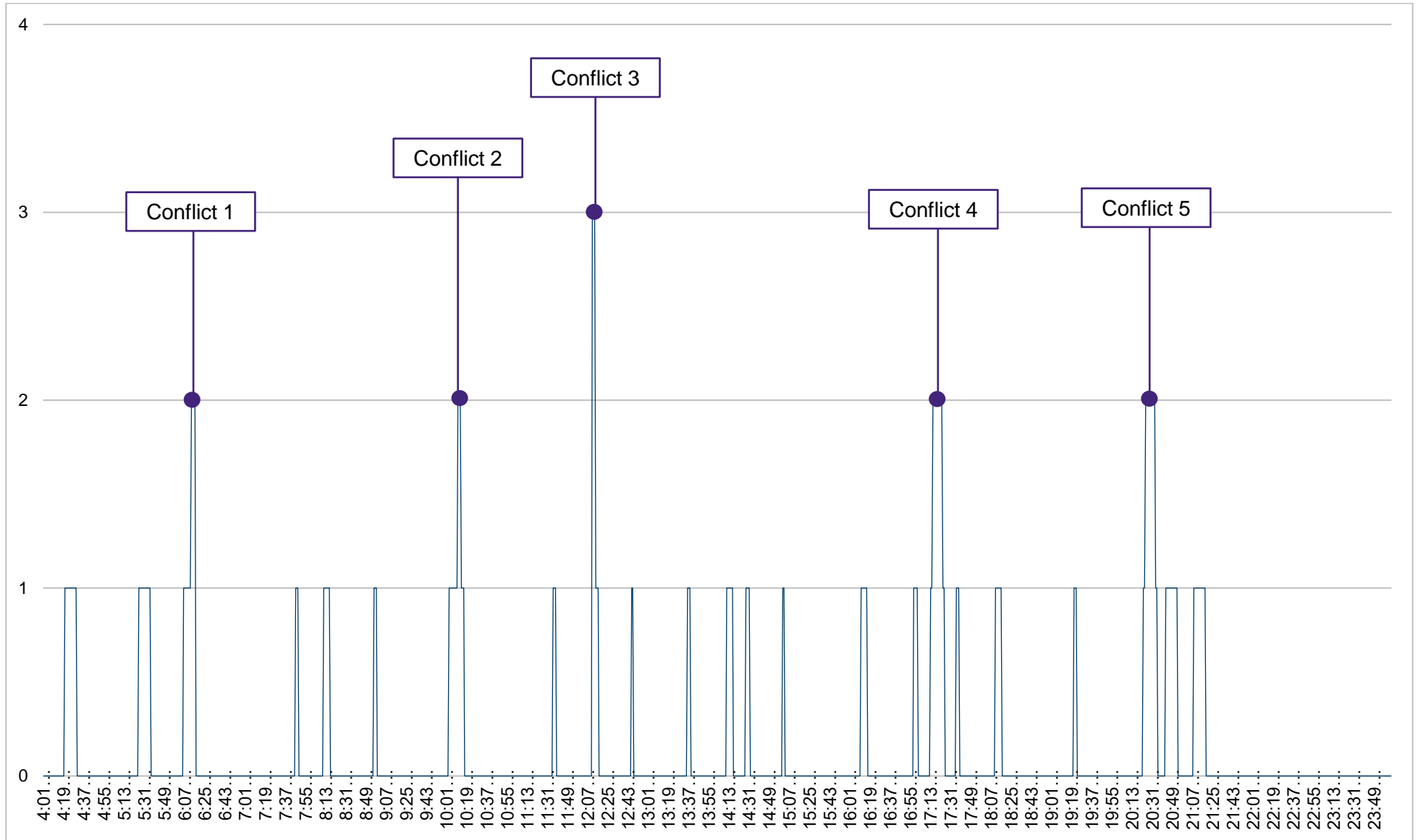
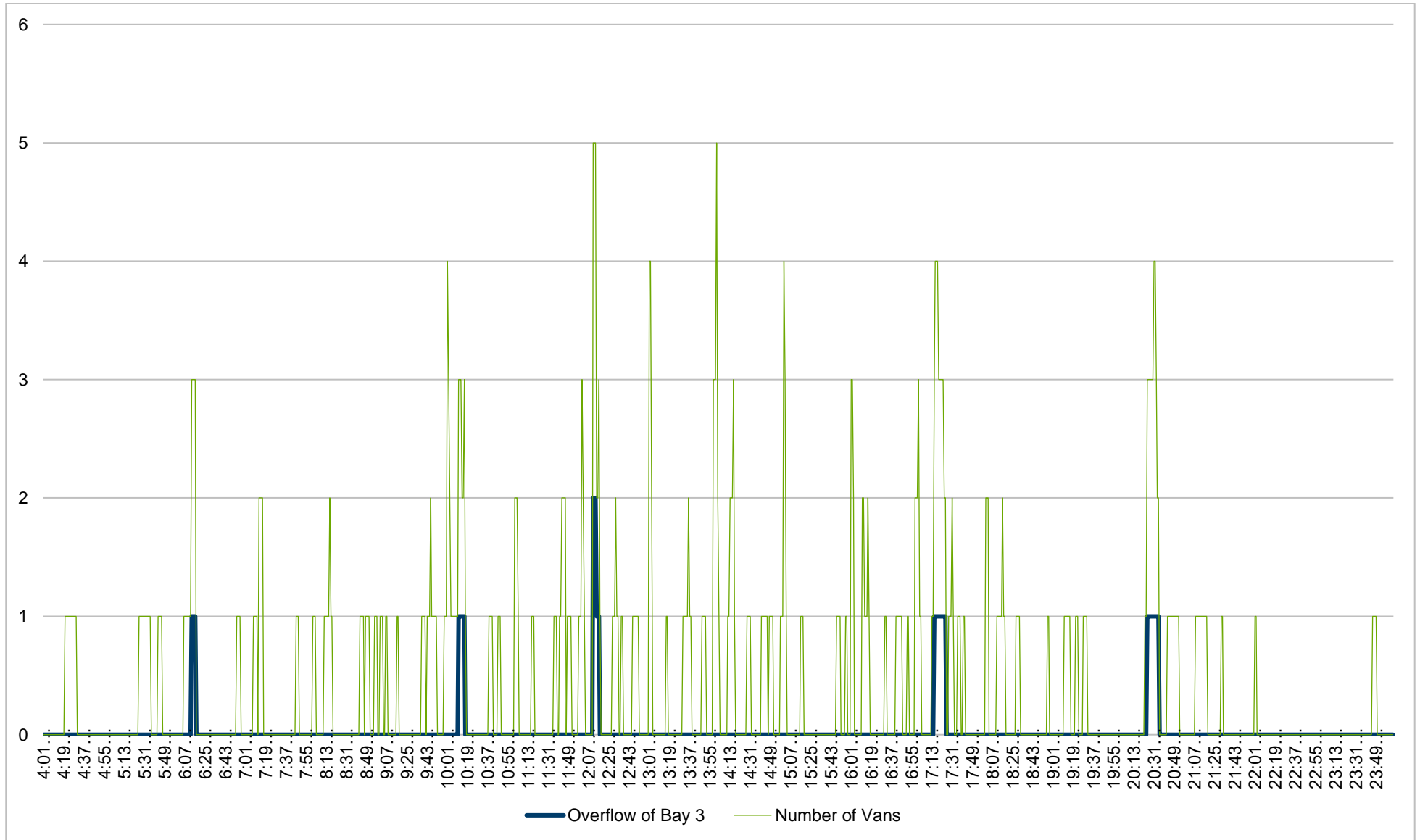


Figure 4-6 Breakdown of Daily Services of Bay 4 and Overflow Vehicles from Bay 3



5 CAPACITY ANALYSIS – FUTURE SERVICES

5.1 High Level Assessment

The Transportation Research Board (TRB) produces the *Transit Capacity and Quality of Service Manual*¹, which provides guidance on public transport services and the quantitative process for calculating transport capacity at bus stops and stations. The formula identified for calculating capacity is shown in Figure 5-1, and can be used as a provisional guide to identify the potential theoretical capacity of the Byron Bay bus facility.

This equation is useful in identifying the number of buses a facility can theoretically support per hour; however, this capacity figure depends on the timetabling and integrated nature of buses scheduled to service the facility. With numerous independent bus operators using the Byron Bay bus facility, there is the high chance of operators scheduling services to arrive at the same time, which has been demonstrated in Section 3. Therefore, this equation is used as a guide to identify the future number of services that could use the facility if timetables were integrated, revised and implemented to allow buses to arrive at different time.

Figure 5-1 Calculating Station Capacity

The capacity of a bus stop in buses per hour, B_s is:^(R36)

$$B_s = N_d B_i = \frac{3,600(g/C)}{t_c + t_d(g/C) + Zc_v t_d}$$

where:

- B_s = bus stop bus capacity (bus/h);
- B_i = individual loading area bus capacity (bus/h);
- N_d = number of effective loading areas, from Exhibit 4-12;
- 3,600 = number of seconds in 1 hour;
- g/C = green time ratio (the ratio of effective green time to total traffic signal cycle length, equals 1.0 for unsignalized streets and bus facilities);
- t_c = clearance time (s);
- t_d = average (mean) dwell time (s);
- Z = standard normal variable corresponding to a desired failure rate; and
- c_v = coefficient of variation of dwell times.

(Source: Transportation Research Board. 2014).

The assumptions used in this high-level assessment of the Byron Bay bus stop include:

- Using one to six operational bus bays at the new bus facility. This is to test the hourly capacity (buses per hour) a different of bus bays could support at Byron Bay given the varying service levels and service types.
- A green time ratio of one as the bus facility has all in-line stops, is not an on-road facility and is not influenced or affected by traffic signals.
- A clearance time of ten seconds to allow buses to close doors and depart the stop.
- An average dwell time of 280 seconds which is a combined average of ten minutes (600 seconds) dwell time for long distance coaches, three minutes (180 seconds) dwell time for shuttles, commencing and terminating services, and one minute (60 seconds) dwell time for passing buses. This is time estimated to drop-off and pick-up passengers.
- A failure rate of 15%, which represents collective delays of ten minutes per hour due to bus stop failure or queues forming behind stopped buses.
- A coefficient of variation of dwell times of 60% which is recommended by TRB for bus facilities.

Based on the assumptions above and using the TRB capacity formula, the realistic maximum capacity of the bus facility at Byron Bay, if one to six bays is implemented, is between seven and 46 buses per

¹ Transportation Research Board. 2014. *Transit Capacity and Quality of Service Manual, Third Edition*. Washington D.C.: Transportation Research Board.

hour depending on the number of bays. Table 5-1 identifies the number of buses per hour that could be supported based on the number of bays used for the bus stop.

Table 5-1 Theoretical maximum capacity based on one to six operational bus bays

	Number of Operational Bays					
	1	2	3	4	5	6
Buses per hour	7	15	23	30	38	46

A review of the scheduled timetable from Section 2 indicates that the hour with the highest volume of buses operating at the facility is ten services in total on a weekday, nine on a Saturday and five on a Sunday.

Referring to Table 5-1 and the current peak of buses per hour, the proposed bus facility with three bays has the ability to support an additional 13 buses per hour each weekday, 14 additional buses per hour on Saturdays and 18 additional buses per hour on Sundays.

The provision of three bus bays will provide for current bus operations as well as future proof the bus facility to support additional services that could be implemented as a result of development and growth in service demand.

6 BUS FACILITY CAPACITY RECOMMENDATIONS

The following are recommended as a result of this high-level desk top capacity assessment for existing bus and van operations at the proposed bus facility in Byron Bay.

- Implement three bus bays to support existing operations.
 - Three bus bays would support the current instances where multiple buses are utilising the facility at the same time.
 - A lead stop or linear bus stop arrangement would reduce space requirements for buses to stop. Having independent bus bays requires additional space so all buses can enter and exit the bays. Implementing a lead stop arrangement means buses pull up directly behind the bus in front without stopping at a dedicated flag.
 - At times throughout the day when less buses are scheduled the redundant bays can be used as layover space for long distance coaches or urban services mealing or breaking prior to becoming in-service.
 - If implementing independent bus stops and allocating bays to particularly service providers, advice should be provided that if the allocated bay is being used then service providers can use alternative bays to utilise the spare capacity and ensuring only three bus are needed for the short-term future. That is:
 - If an operator allocated bays 1 or 2 finds them full, stop in bay 3.
 - If an operator allocated bay 3 finds it full, stop in bays 1 or 2.
- Implement three to four bays for vans and shuttle services:
 - If space is not a constraint, four van bays should be provided to provide sufficient space for existing and future operations.
 - If space is a constraint, three van bays should be provided.
 - Non-scheduled or specialised vans, such as hotel/hostel and tour services, should be encouraged to use existing general parking spaces or kiss 'n' ride areas as these vans tend to be the size of a standard van and may not require a dedicated bay.
 - Bays for vans should be line-marked to ensure services are not utilising more space than required.
 - These bays could be modified in the future to provide additional bus bays for servicing passengers or for layover.

7 CONCEPT SKETCH COMMENTS

A review of the site layout (EDMS number CV0715989 and CV0716008) was undertaken to identify aspects of the concept that could influence of impact bus operations. Figure 7-1 shows the proposed facility design.

Bus Operations

- Access to the facility is separated from general traffic which will reduce delays and conflicts.
- The road space between the roundabout and the end of the bus stopping area has the potential to be used as a holding area if buses are required to wait before entering the stops.
- The provision of three independent bays caters for the current demand and scheduled capacity requirements.
- For increased future capacity, the independent configuration could be removed and reconfigured into a lead stop (nose-to-tail) arrangement. Depending on kerbside space, this could create space for a fourth bus however this may impact operations as the first bus to arrive is not always the first bus to depart.
- Separating buses and vans improves legibility and reduces potential conflicts in the bays between the different services.
- The provision of three parking bays for vans caters for current demand and scheduled capacity requirements as long as standard size van services utilise the general parking areas.

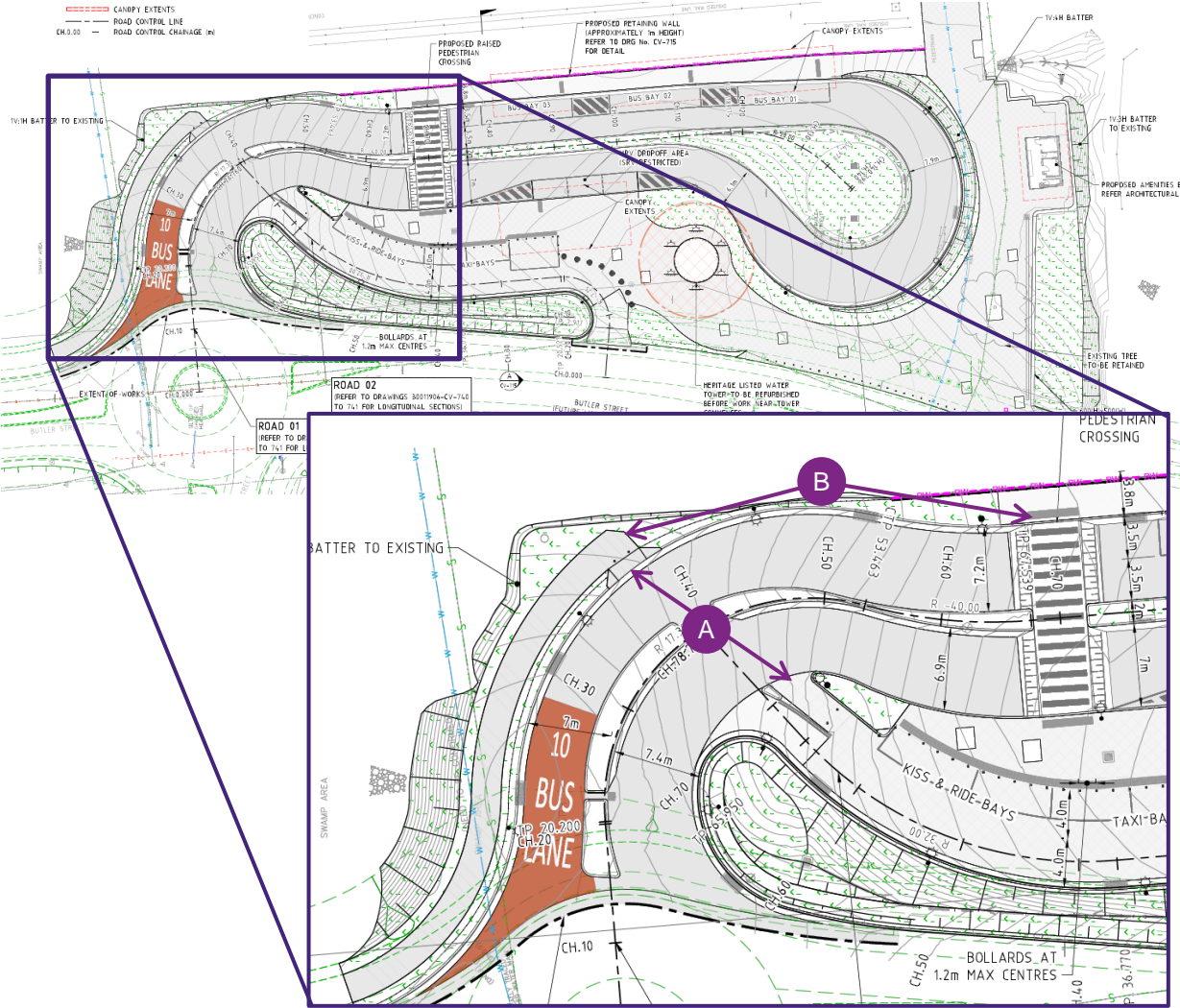
Pedestrian Movements

- A single plaza area provides a seamless connection between the bus facility, parking locations, proposed market square and surrounding land uses.
- A single platform improves legibility for passengers and provides a single waiting location for all service types.
- The proposed raised pedestrian crossing provides easy and defined access for pedestrians to the bus stops. This follows the pedestrian desire line between the kiss and ride bays and bus bays.
- Consideration might be required for a wayfinding strategy to assist with pedestrians (and cyclists) in travelling between the facility and surrounding localities and destinations.

Safety

- Bus movements are completely independent of general traffic which enhances traffic safety.
- Buses have priority when it comes to exiting the facility with general traffic having to give way before proceeding to the exit.
- There is a potential pedestrian conflict with a kerb ramp and no dedicated crossing facility between the bus lane entrance and bus bays. Sufficient space in the refuge needs to be provided for pedestrians to wait while buses depart the facility as well adequate warning signage to advise pedestrians to check for buses. Refer to point A in Figure 7-1.
 - The preferred option would be to continue the pathway to the dedicated crossing facility prior to the bus bays however there may be insufficient space for this provision between the bus lane and the property boundary. Refer to point B in Figure 7-1.
 - Pedestrian fencing along the sides and median of the facility access will further encourage pedestrians to cross at the allocated location

Figure 7-1 Site Layout



DOCUMENT CONTROL

Project Details

Project Name	Byron Bay – Bus Bay Capacity Assessment
Project Number	17-001
Client	SMEC Australia Pty Ltd

Revision History

Revision	Date of Issue	Description	Prepared
1.1	29/10/2017	Preparation of technical note outlining findings from capacity assessment	D. Innis
2.1	08/04/2018	Update of information based on new proposed bus station site and separation of buses and vans	D. Innis
3.1	24/06/2019	Update of assessment to include additional coach services operating to Byron Bay	D. Innis
4.1	08/09/2019	Update of assessment to include operational scheduling and bay assignment	D. Innis

Contact Details

Director	Daniel Innis
Address	PO Box 15161, City East, Queensland 4002
Telephone	0422 651 859
Email	Daniel.Innis@dciassociates.com.au

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