HELIOS

The aviation consultancy of Egis

HIGH-LEVEL PERFORMANCE REVIEW OF TERMINAL BUILDING CAPACITY PROJECTS

PREPARED IN SUPPORT OF CIP2020 EVALUATION PROCESS

an egis company

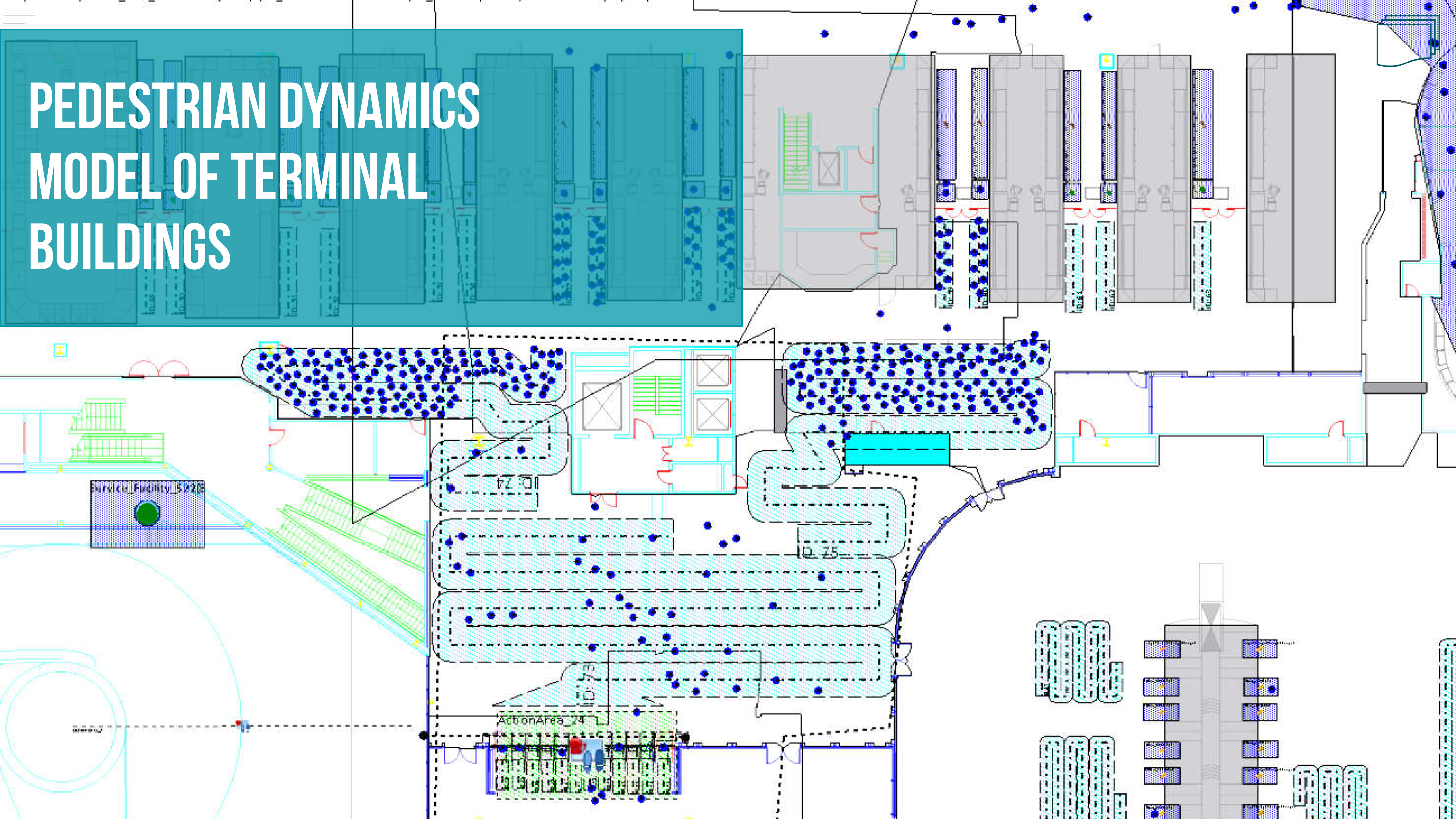
CONTEXT

- In January 2019, the Commission for Aviation Regulation (CAR) published the final version of Dublin Airport Authority (daa) Capex Investment Programme 2020+ (CIP) outlining daa’s intended airport development projects.
- CAR is the body responsible for review and approval of the CIP, in terms of deciding if and how the associated funding can be recovered from airport users in the form of Airport Charges.
- CAR requested Helios to perform a high-level feasibility and operational impact assessment of the selected CIP projects on the passenger terminal buildings (PTB) performance.
- This document represents assessment of selected PTB projects.
- Assessment of selected airside projects is provided separately.

CONTENTS

- Methodology used,
- Data and assumptions,
- Definitions of metrics measured,
- Results for individual processes,
- List of abbreviations.

PEDESTRIAN DYNAMICS MODEL OF TERMINAL BUILDINGS



THE METHODOLOGY FOLLOWED WAS:

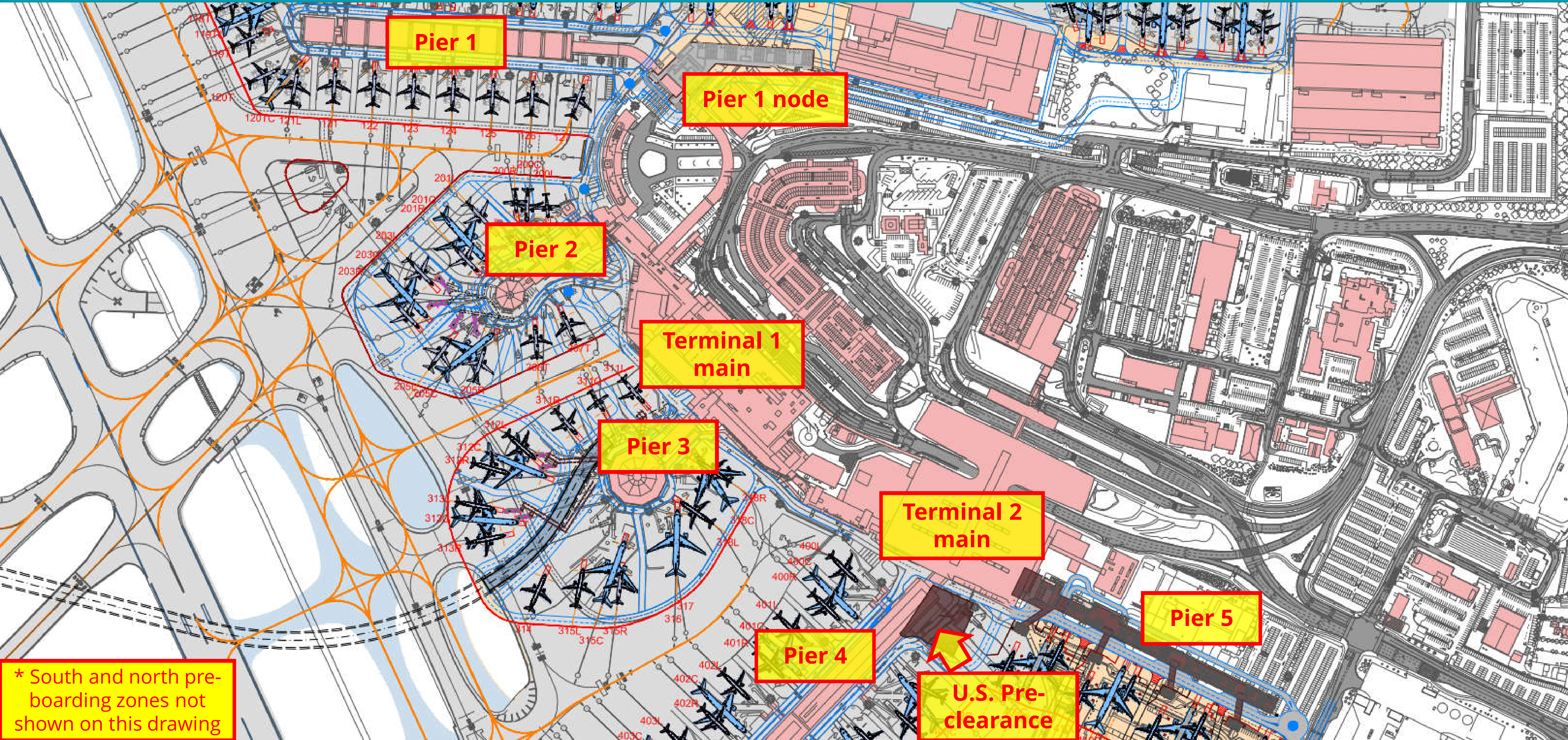
- Consultations with daa and IAA to understand the target operating concept and any potential limitations of the future layout of both Terminal 1 and Terminal 2.
- Agreement with CAR on what elements of the CIP to model.
- Data collection, validation and pre-processing.
- Update of the existing fast-time simulation model of Dublin airport's terminals*.
- Review of the updated model with representatives of CAR and daa.
- Implementation of the feedback received during the model review process.
- High-level qualitative and quantitative assessment of selected metrics.

* Helios developed a FTS model of Dublin airport terminal buildings in 2017 as part of the Capacity Assessment project. This model has now been revised and updated with the latest CIP data and assumptions before being subject to daa and CAR review.

DATA AND ASSUMPTIONS USED

- CAD drawings of the existing and future PTB layout provided by daa,
- Flight schedule representing a future ‘busy day’ provided by daa,
- Assumed operational concept for each process inside the PTB provided by daa,
- Other model-specific input data and assumptions provided by daa and in agreement with CAR.

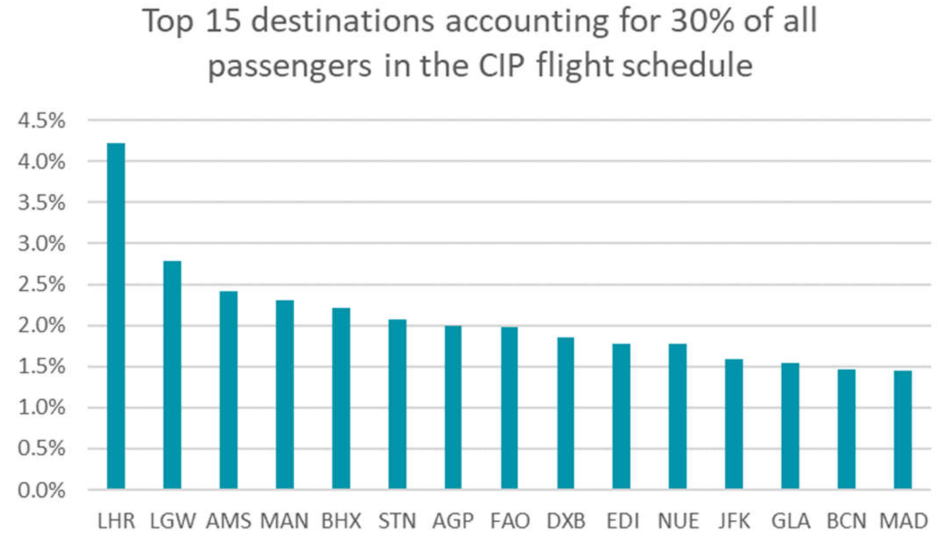
CAD DRAWING USED TO UPDATE THE PTB MODEL LAYOUT

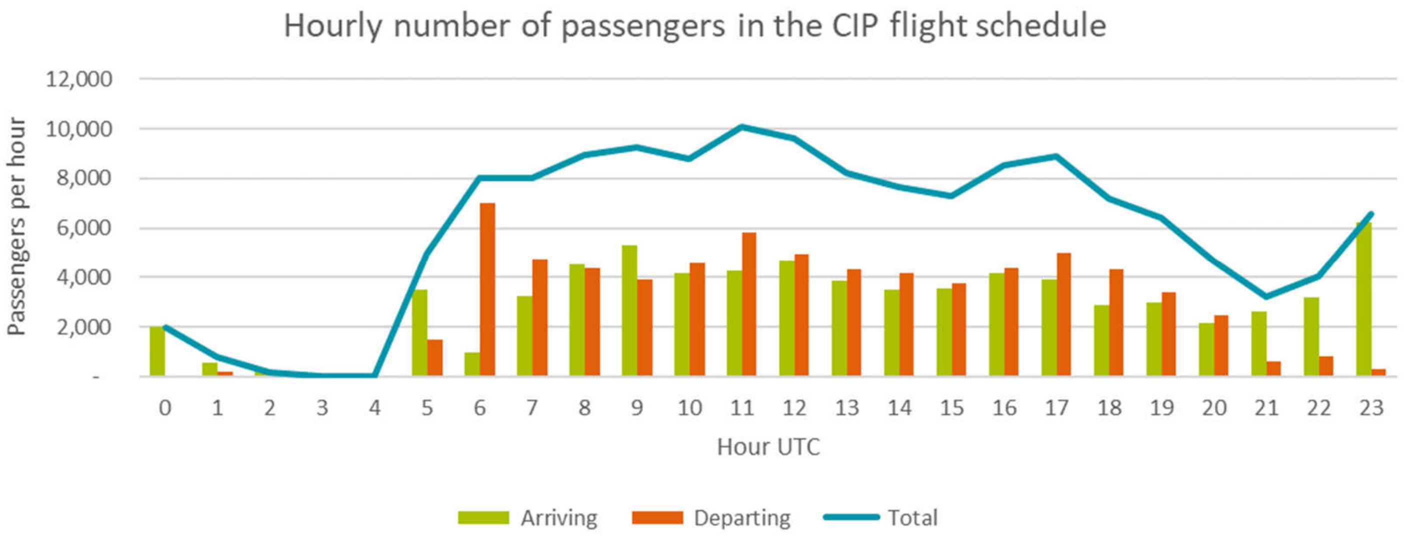


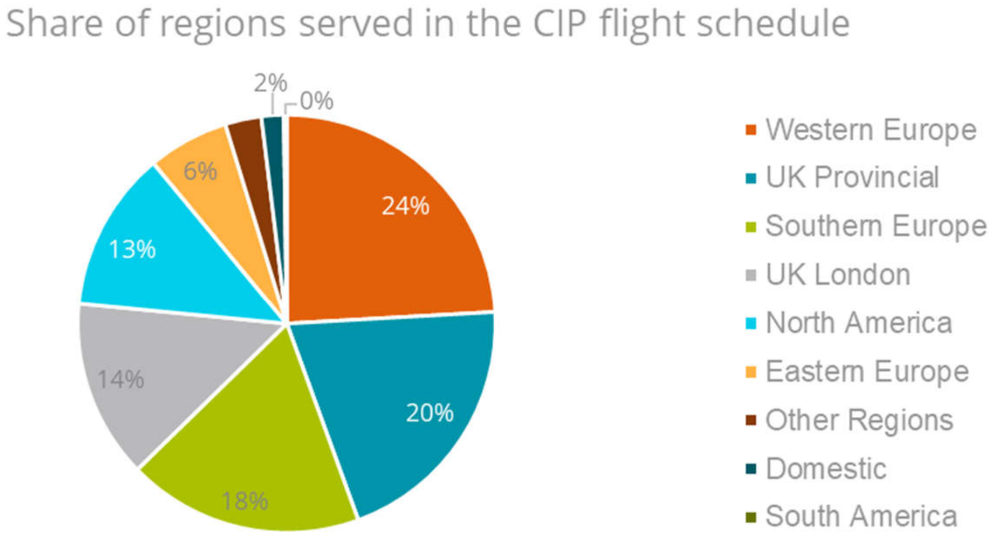
OVERVIEW OF THE FLIGHT SCHEDULE USED

The flight schedule modelled contains:

- 925 flights split into 461 arrivals and 464 departures,
- 143 long haul and 782 short haul flights,
- 861 scheduled passenger services, 37 general aviation flights, 10 cargo flights, 10 passenger charter flights, 2 technical stops, 2 air ambulance flights, 2 cargo charter flights and 1 positioning flight.







ASSUMED OPERATING CONCEPT: GENERAL ASSUMPTIONS

- This document shows how the airport is likely to perform on a busy day using all available resources – this is to test that the proposed airport design will be able to cope with any proposed traffic demand within acceptable levels of service. Therefore:
    - It is assumed all resources in all processes modelled are running at full capacity with all staff available 24/7.
    - It is assumed all resources are available 24/7 unless stated otherwise.
- The above assumption should be considered when interpreting all results presented in this document, especially in those areas which show a considerable degree of "overdesign" (as per IATA ADRM) whereas in reality, the number of staff and resources available at any point in time will be adjusted by daa to match actual demand in that period.
- Similarly, when interpreting any results showing a short period of underperformance (as per IATA ADRM) it should be considered that these results are based on a busy day that is not representative of an "average" day the airport is likely to experience.

ASSUMED OPERATING CONCEPT: CHECK-IN

- Passengers will be randomly assigned to a self-service kiosk with the shortest queue.
- Any passenger using a self-service kiosk will then go to the nearest bag drop desk.
- Passengers only dropping bags will be randomly assigned to a bag-drop desk with the shortest queue.
- Assumptions for Aer Lingus and Stobart are the same.

Terminal 1				
Ryanair:				
Bag drop only desks				-
Traditional desks				4
Self Service kiosks				-
Other arlines:				
Bag drop only desks				35
Traditional desks				59
Self Service kiosks				75
Check-in Type	**OLH**	**ME**	**FR**	**OSH**
Direct to Security	9%	5%	73%	37%
Traditional Check-in	18%	19%	5%	32%
SSK & BD	73%	76%	22%	32%
Rate (Seconds)				
Traditional Check-in	142	187	90	90
SSK	95	95	105	95
Bag Drop	30	30	20	20

Terminal 2			
Aer Lingus:			
Bag drop only desks			15
Traditional desks			16
Self Service kiosks			40
Other arlines:			
Bag drop only deks			18
Traditional desks			21
Self Service kiosks			42
Check-in Type	**EI/D8 SH**	**EI/D8 LH**	**US**
Direct to Security	29%	9%	10%
Traditional Check-in	20%	43%	30%
SSK & BD	51%	48%	60%
Rate (Seconds)			
Traditional Check-in	75	116	102
SSK	115	115	105
Bag Drop	20	30	30

ASSUMED OPERATING CONCEPT: BOARDING PASS SCAN AND SECURITY SCREENING

- 10 security lanes are operational in Terminal 1 and Terminal 2 (9 standard + 1 fast lane).
- 6% of passengers use the fast lanes.
- Passengers take 7 seconds to gather their belongings after passing through the security.
- Passengers stop being sent to Terminal 1 security at 01:15 and begin queueing again at 03:30; after 03:30 passengers wait landside for between 12 and 14 minutes before entering security screening area.
- Terminal 2 passengers begin queueing for security at 04:00, after 04:00 passengers wait landside for between 12 and 14 minutes before entering security screening area.

Boarding Pass Scan		
	Terminal 1	**Terminal 2**
Boarding pass scanners	16	10
Processing time	6 sec/pax	6 sec/pax

Security		
	Terminal 1	**Terminal 2**
Security lanes	10	10
Processing time	9.7 sec/pax	16 sec/pax

ASSUMED OPERATING CONCEPT: IMMIGRATION

- Immigration booths operate in a flexible mode for EU or non-EU passengers depending on demand - this means that the split of booths for EU and non-EU passengers is evaluated every 5 minutes based on the actual share of EU and non-EU passengers waiting to be processed. Based on this evaluation, number of EU and non-EU booths can be increased/decreased every 5 minutes as required by the demand.
- If all e-gates are in use and there is spare EU booth capacity, passengers who were assumed to use e-gates are rerouted to use traditional booths.

Terminal 1 main

Pax Type	EU	NEU	NA
Short Haul	90%	10%	-
Long Haul	50%	50%	-
North America	45%	5%	50%
E-gate Usage	90%	-	-
EU Booth Usage	10%	-	-

Number of E-gates	10
Number of booths	10
Processing time e-gates	20 sec/pax
Processing time EU citizen	10 sec/pax
Processing time non EU citizen	65 sec/pax

Terminal 1 – Pier 3

Pax Type	EU	NEU	NA
Short Haul	90%	10%	-
Long Haul	50%	50%	-
North America	45%	5%	50%
E-gate Usage	90%	-	-
EU Booth Usage	10%	-	-

Number of E-gates	4
Number of booths	12
Processing time e-gates	20 sec/pax
Processing time EU citizen	10 sec/pax
Processing time non EU citizen	65 sec/pax
Processing time Canadian citizen	30 sec/pax

Terminal 2

Pax Type	EU	NEU	NA
Short Haul	80%	20%	-
Long Haul	65%	35%	-
North America	45%	5%	50%
E-gate Usage	90%	-	-
EU Booth Usage	10%	-	-

Number of E-gates	7
Number of booths	12
Processing time e-gates	20 sec/pax
Processing time EU citizen	10 sec/pax
Processing time non EU citizen	65 sec/pax
Processing time Canadian & US	30 sec/pax

ASSUMED OPERATING CONCEPT: BAGGAGE RECLAIM

- Assumptions for baggage delivery times are broken down by terminal, airline, aircraft type and region of origin. Values for these assumptions were taken from the model developed back in 2017.
- Baggage from each incoming flight is delivered onto a belt which has the least number of flights allocated to it at that time.

Terminal 1				
	OLH	**ME**	**FR**	**OSH**
% of passengers waiting for their baggage in the baggage reclaim hall	88%	96%	57%	67%
Terminal 2				
	EI SH	**EI LH**	**US**	
% of passengers waiting for their baggage in the baggage reclaim hall	69%	96%	96%	

ASSUMED OPERATING CONCEPT: TRANSFERS

- T1 transfer passengers pass through the standard immigration process and then take stairs from T1 baggage reclaim hall to T1 security. After passing the security they go to their respective gates.
- T2 transfer passengers use either the transfer facility located in Pier 4, or they use the T2 main transfer facility.
- Due to the lack of data it was not possible to carry out a 1-on-1 mapping of arriving transferring passengers onto their respective departing flights. Therefore, the following workaround was considered sufficient for the purpose of this high-level assessment:
  - Arriving transfer passengers pass through transfer facilities and then exit the simulation in the retail area.
  - Departing transfer passengers are generated at the base of their corresponding pier according to the on-the-gate show up profile.

	Terminal 1			Terminal 2		
Pax Type	**EU**	**NEU**	**America**	**EU**	**Non EU**	**America**
Short Haul	90%	10%		80%	20%	-
Long Haul	50%	50%		65%	35%	-
North America	45%	5%	50%	45%	5%	50%
Processing rate in seconds						
Document check- Terminal 2		-		6	6	6
Document check – Pier 4		-		10	10	10
Immigration		-		10	65	30
Number of boarding pass scans		4			5	
Number of immigration booths		4			6 + 5 e-gates	

ASSUMED OPERATING CONCEPT: TSA AND CBP

- Facilities open at 06:00.
- 15% of passengers are Selectees* and queue separately.
- The number of lanes used for Selectee screening is variable and changes with demand.

US Pre clearance area	
Document Check	
Number of booths	11
Processing time	6 sec/pax
TSA search lanes	
Number of TSA lanes	11
Processing time for standard passenger	16 sec/pax
Processing time for selectee passenger	56 sec/pax
CBP	
Number of desks	30
Processing time for each passenger	55 sec/pax

* Selectee passengers undergo a more thorough screening process

ASSUMED OPERATING CONCEPT: OTHER ASSUMPTIONS

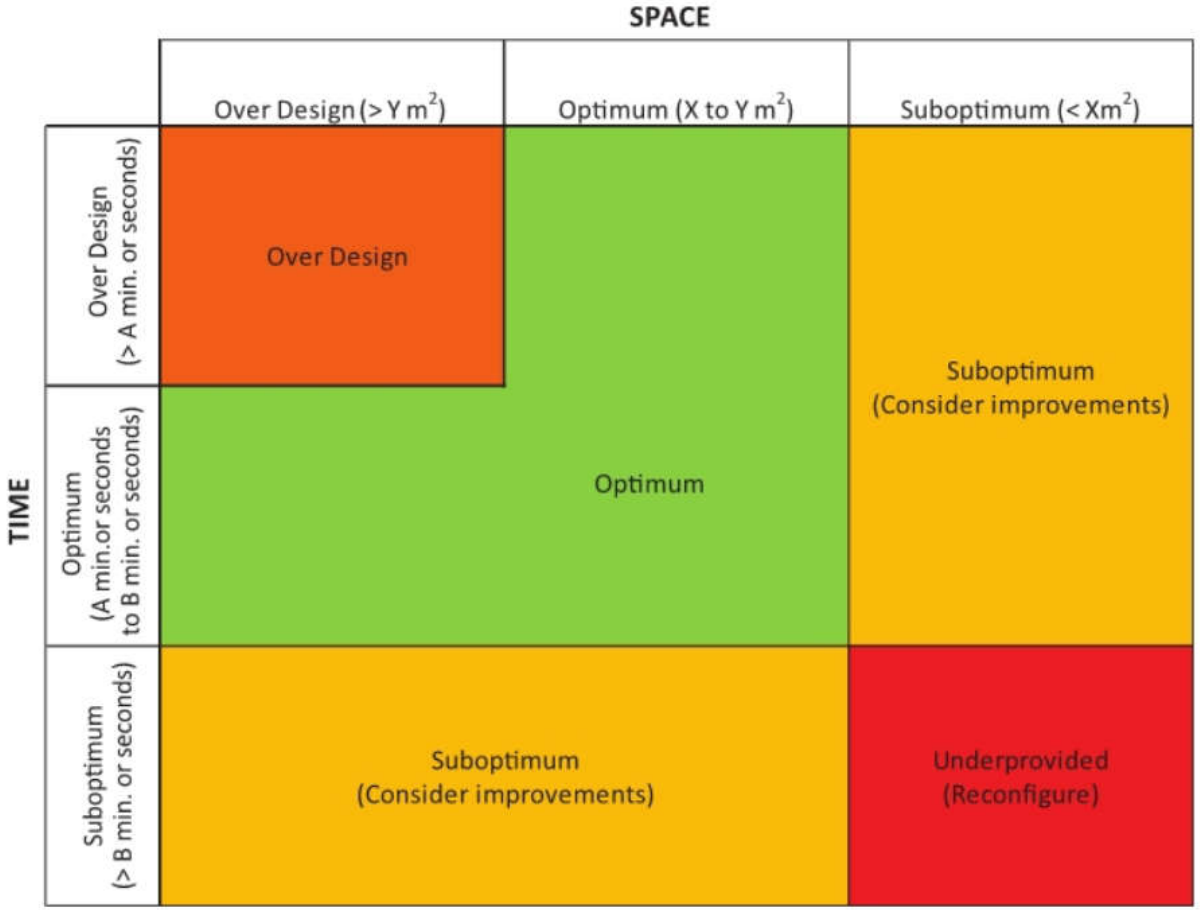
- Flights cannot depart unless all passengers are on board (flights wait for delayed passengers).
- Passengers are bussed to pre-boarding zones 30 minutes before the gate closing time.
- All bussing operations are assumed to take 10 minutes.

SERVICE STANDARD BENCHMARKS

IATA LEVEL OF SERVICE CONCEPT

- Performance of various processes inside both terminal buildings was assessed according to IATA Level of Service (LoS) concept.
- IATA LoS concept has been applied to terminal design since the 1970's when previous definitions of 'capacity' were deemed inadequate. LoS requirements have now been refined to incorporate space requirements, waiting times and perceived service quality to ensure facility planning neither under or over provides whilst maintaining a satisfactory experience for passengers. IATA ADRM (Airport Development Reference Manual) highlights the importance of managing terminal capacity and designing with Level of Service in mind for the development of competitive airports.
- IATA ADRM 10th Edition, 3rd release, effective from August 2015 was used as a reference.

WAITING TIME AND SPACE STANDARDS USED TO ASSESS PERFORMANCE OF PROCESSES INSIDE EACH TERMINAL



	SPACE STANDARDS FOR WAITING AREAS (m^2/pax)			WAITING TIME STANDARDS FOR PROCESSING FACILITIES (Minutes)			WAITING TIME STANDARDS FOR PROCESSING FACILITIES (Minutes)		
Passenger Terminal Sub-System				Economy Class			Business Class / First Class		
ADRM 9th Edition	A B	C	D E	A B	C	D E	A B	C	D E
ADRM 10th Edition	Over design	Optimum	Suboptimum	Over design	Optimum	Suboptimum	Over design	Optimum	Suboptimum
Public Departure Hall	>2.3	2.0 - 2.3	<2.0						
Check-in: Self-Service Boarding Pass / Tagging	>1.8	1.3 - 1.8	<1.3	<1	1 - 2	>2	<1	1 - 2	> 3
Check-in: Bag Drop Desk (queue width 1.4 - 1.6 m)	>1.8	1.3 - 1.8	<1.3	<1	1 - 5	>5	<1	1 - 3	>3
Check-in: Check-in Desk (queue width 1.4 - 1.6 m)							Business Class Check-in Desk		
	>1.8	1.3 - 1.8	<1.3	<10	10 - 20	>20	< 3	3 - 5	> 5
							First Class Check-in Desk		
							<1	1 - 3	>3
Security Checkpoint (queue width: 1.2 m)							Fast Track		
	>1.2	1.0 - 1.2	<1.0	<5	5-10	>10	<1	1 - 3	>3
Emigration (Passport Control) (queue width: 1.2 m)							Fast Track		
	>1.2	1.0 - 1.2	<1.0	<5	5-10	>10	<1	1 - 3	>3
Boarding Gate Lounge: Seating	>1.7	1.5 - 1.7	<1.5						
Boarding Gate Lounge: Standing	>1.2	1.0 - 1.2	<1.0						
Immigration (Passport Control) (queue width: 1.2 m)							Fast Track		
	>1.2	1.0 - 1.2	<1.0	<5	5 - 10	>10	<1	1 - 5	>5
Baggage Claim Area				First passenger to first bag			First passenger to first bag		
Narrow Body	>1.7	1.5 - 1.7	<1.5	<1	1 - 15	>15	<1	1 - 15	> 15
Wide Body	>1.7	1.5 - 1.7	<1.5	<1	1 - 25	>25			
Public Arrival Hall	>2.3	2.0 - 2.3	<2.0				*n.b. Priority bags to be delivered before Economy*		

* Source: IATA ADRM 10th Edition, 3rd release, effective from August 2015

IATA LEVEL OF SERVICE CONCEPT

- IATA ADRM states that *"... optimum space allocation and the optimum waiting time represent the limits that should not generally by exceeded in order to reach an optimum solution. In some cases, however, due to in part to very high demand peaks, an airport owner or airport operator may wish to set its own limits ... to better fit the reality prevailing at its airport(s)..."*
- It also states that "*When planning/designing a major expansion or new airport, targeted LoS may be considered for initial sizing. The target value must be within the specified LoS optimum range. Again, the target should reflect the local realities and be responsive to passenger behavior and needs.*"

METRICS MEASURED

Area	T1	T2	Space standards (pax/m2)	Waiting times (minutes)	Density maps
Check-in	✔	✔	✔	N/A	✔
Boarding pass scan	✔	✔	✔	✔	✔
Security	✔	✔	✔	✔	✔
TSA	N/A	✔	✔	✔	✔
CBP	N/A	✔	✔	✔	✔
Transfer facilities	✔	✔	✔	✔	✔
Immigration	✔	✔	✔	✔	✔
Baggage reclaim area	✔	✔	✔	N/A	✔
Departure Lounge	✔	✔	✔	N/A	N/A
Piers	✔	✔	✔	N/A	N/A

DEFINITIONS OF METRICS MEASURED

Metric	Definition
Space standards	For each area assessed, the maximum and mean number of passengers per metre squared of queueing area is shown throughout the day. Density profile throughout the day is plotted against acceptable space provision as per IATA LoS concept.
Waiting times	Graphs showing the average delay for each 15 minute interval throughout the day. Delay encompasses queuing and any slowing of pace due to crowded areas and delay is counted until the agent leaves the queue to be served by a facility. Delay profile throughout the day is plotted against acceptable waiting times as per IATA LoS concept.
Density maps	Density of each facility measured through passenger experience. Two density maps are provided for each facility we analysed: - Maximum experienced density: This is the maximum density passengers experienced across the day. The day is broken down into 5-minute periods. Then, the mean of each 5 minute interval is calculated and the maximum of all the means is displayed in the map. This is to ensure that no very short peaks distort the overall result. - Mean experienced density: This is the average density passengers experienced across the day, recorded in 15 minute intervals. The mean of each 15 minute interval is calculated and the mean of all the interval means is displayed in the map. Colour scale used in the density maps uses passenger density thresholds recommended in IATA LoS concept. To avoid skewing of results potentially caused by inclusion of night periods with no passengers in the calculation of density maps, all densities were calculated only from those periods when there were passengers present in the area being assessed.

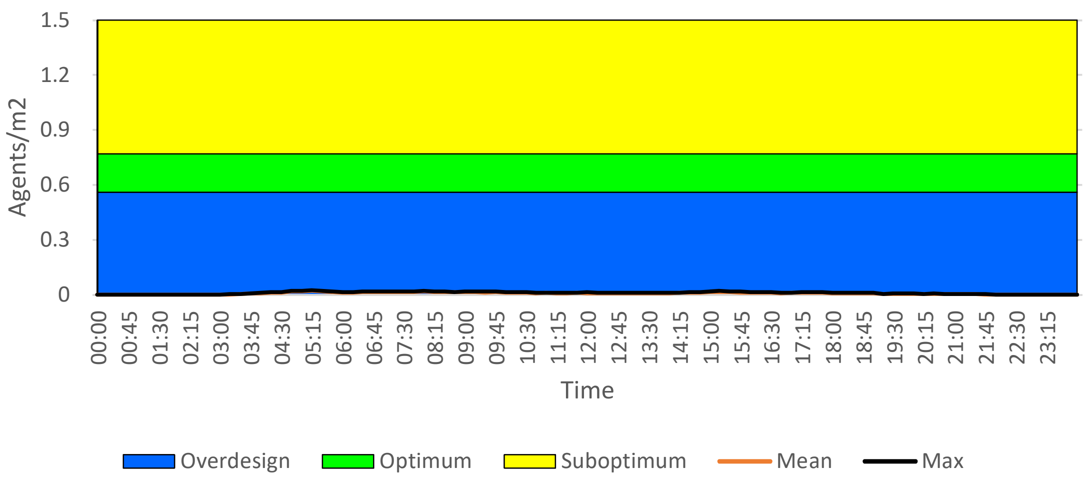
RESULTS

CHECK-IN

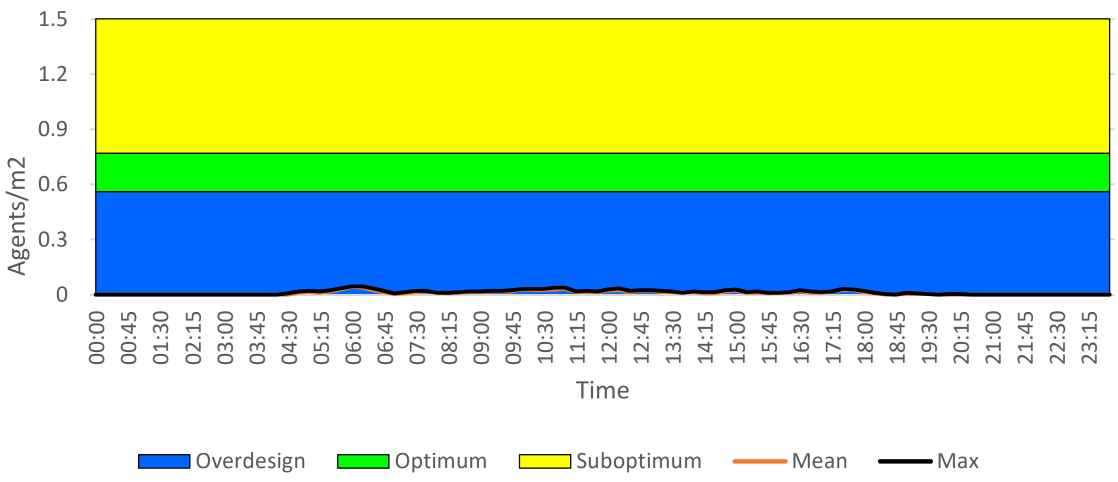
CHECK-IN AREAS: SPACE STANDARDS

The way in which the high-level models of both terminal buildings was set-up did not provide an easy way for exact measurement of check-in times in Terminal 1 and Terminal 2. However, visual inspection of the simulation run, together with assessment of the space provision indicates both check-in halls should be able to handle the expected levels of traffic within IATA LoS standards.

Terminal 1 – space standards (pax/m²)

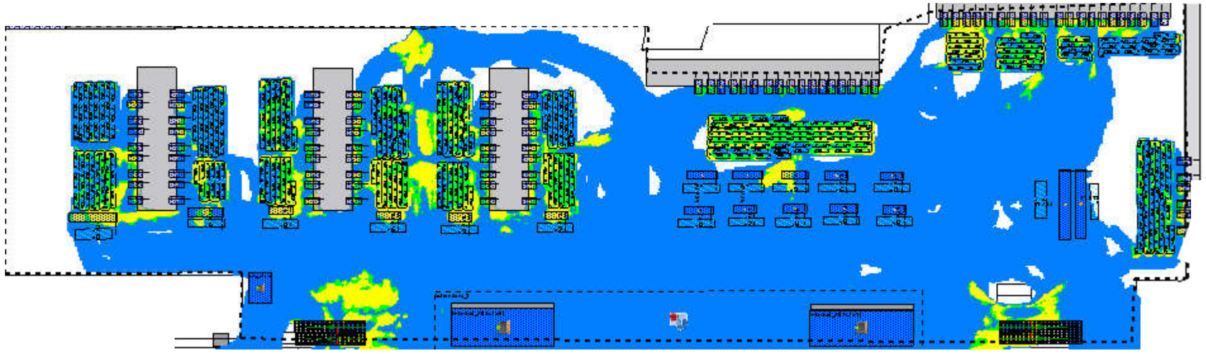


Terminal 2 – space standards (pax/m²)

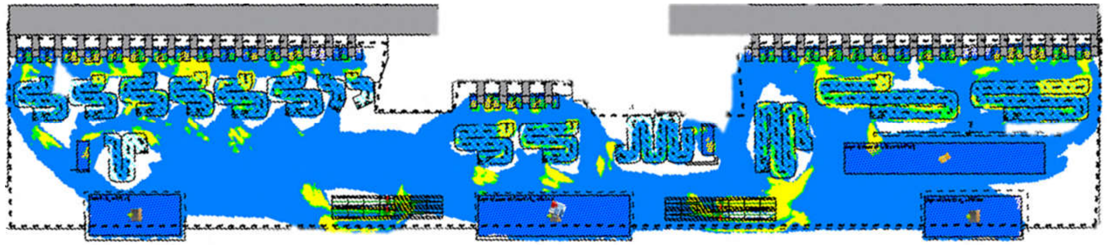


CHECK-IN AREAS: DENSITY MAPS

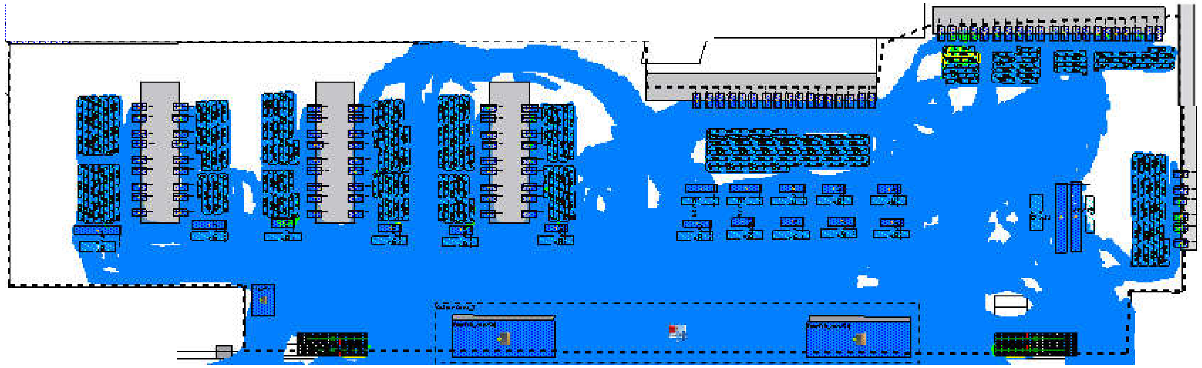
Terminal 1 - Maximum experienced density



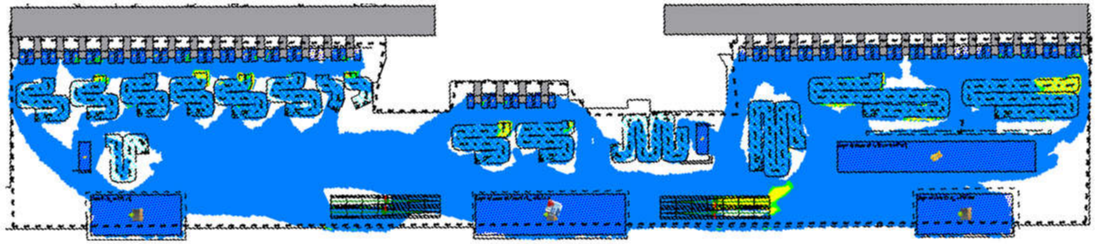
Terminal 2 - Maximum experienced density

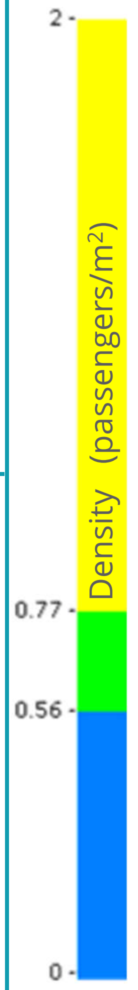


Terminal 1 - Mean experienced density



Terminal 2 - Mean experienced density



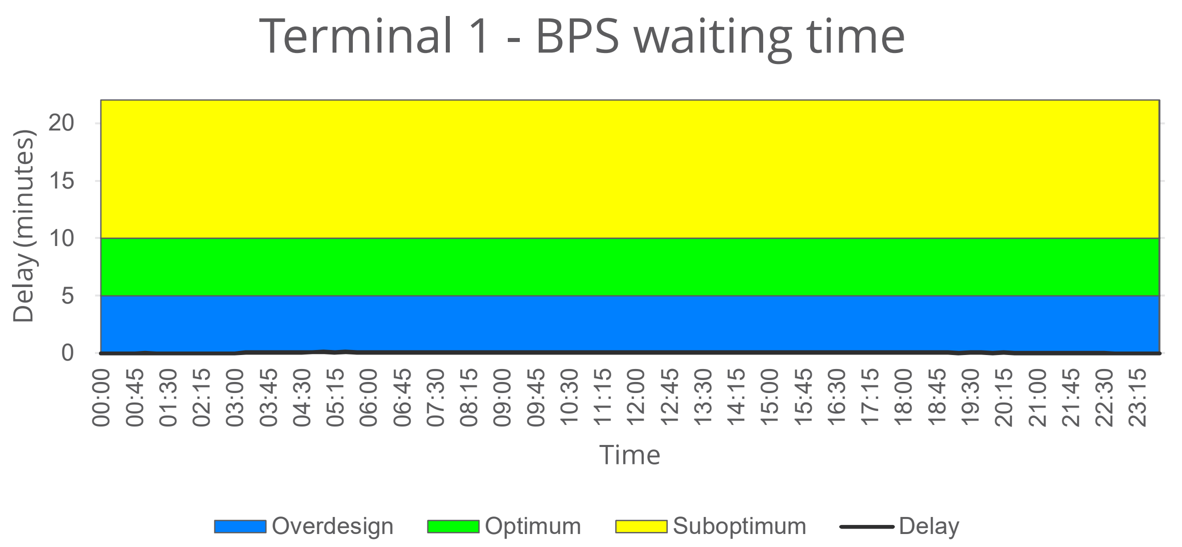


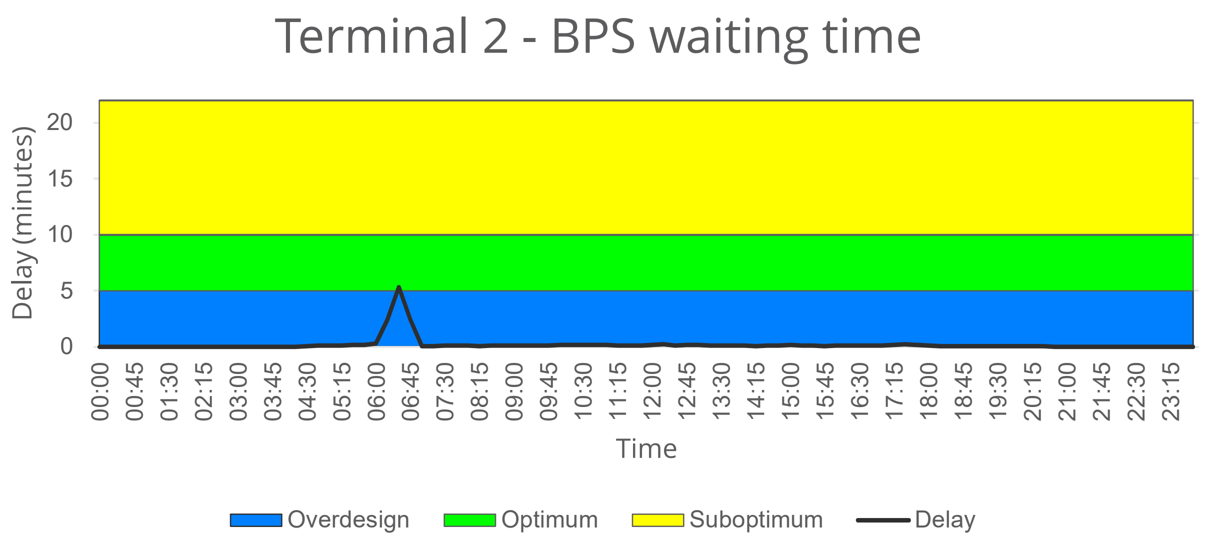
CHECK-IN: OBSERVATIONS

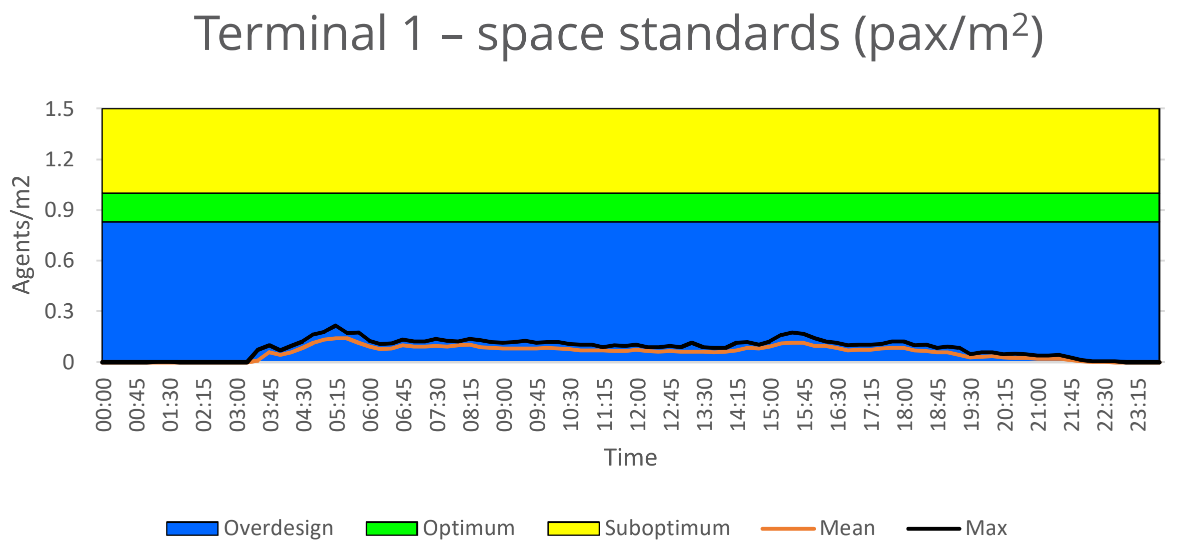
- Both check in halls have enough capacity to ensure appropriate level of service is maintained throughout the day.
- The peak density of Terminal 1 check in areas is in 04:00 - 05:30 period.
- The peak density of Terminal 2 check in areas is in 05:00 - 06:30 period.
- Queues are most prominent in Terminal 1 at the Ryanair desks and bag drop area and in Terminal 2 at the Aer Lingus traditional desks.

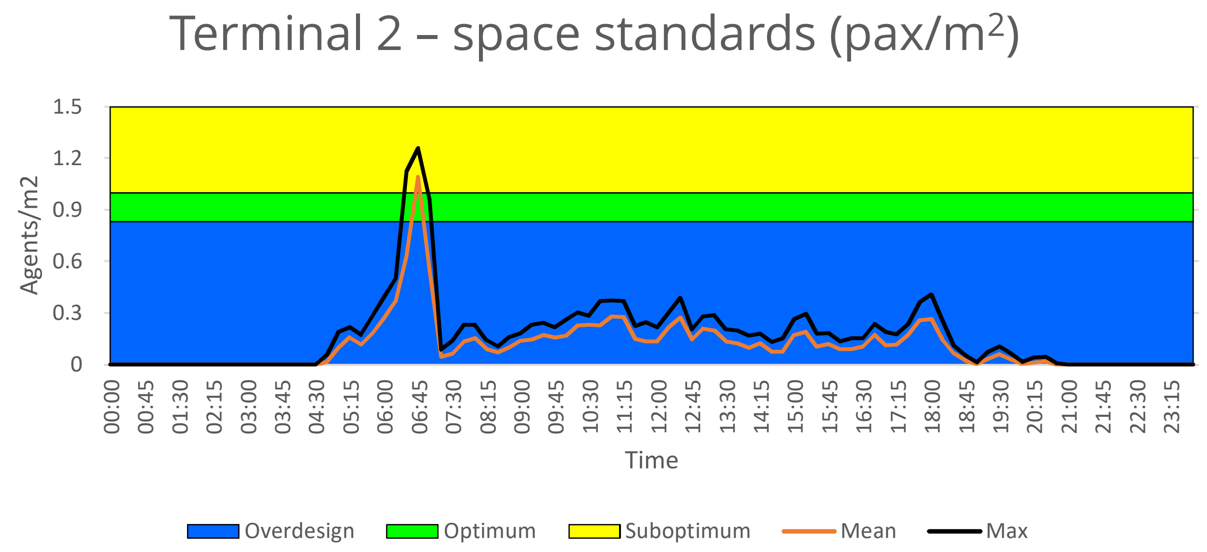
BOARDING PASS SCAN

BOARDING PASS SCAN: WAITING TIME AND SPACE STANDARDS



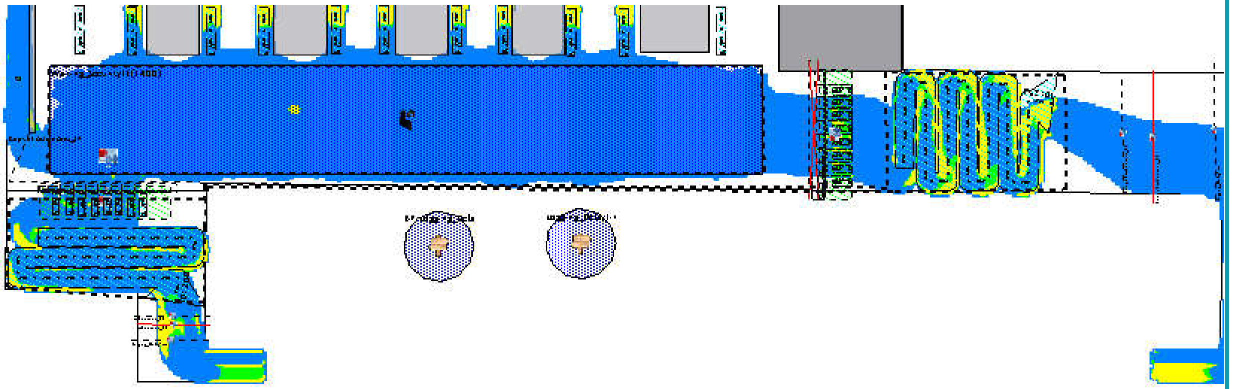




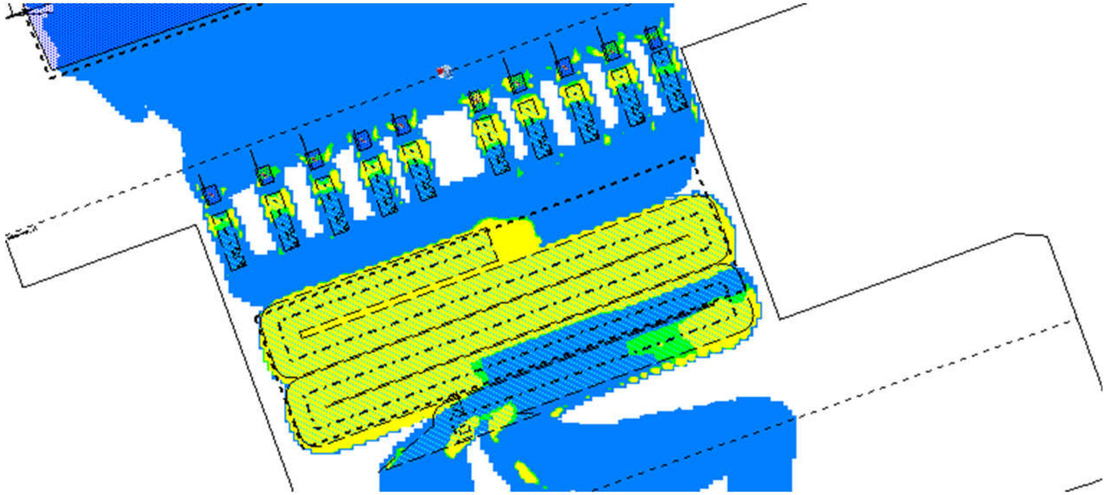


BOARDING PASS SCAN: DENSITY MAPS

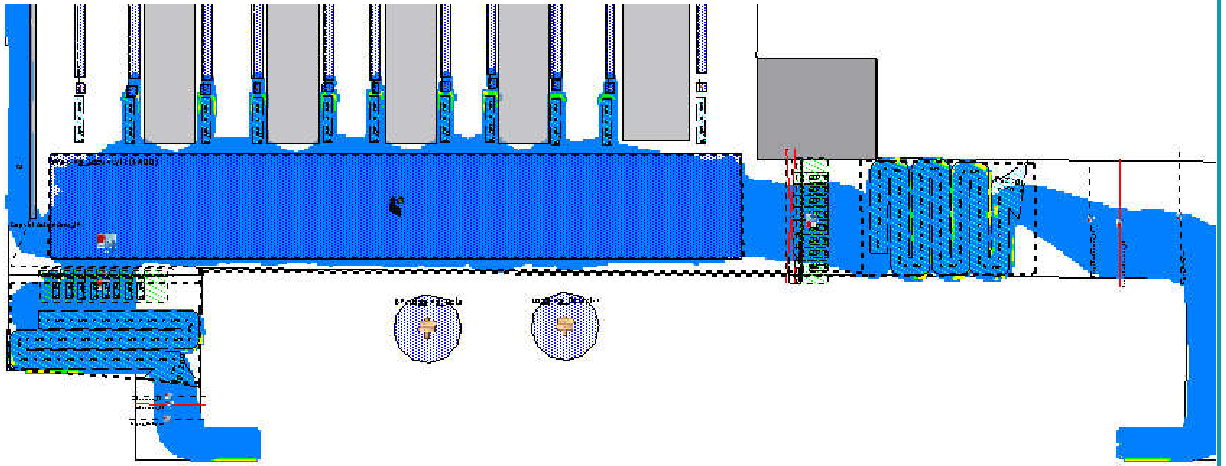
Terminal 1 - Maximum experienced density



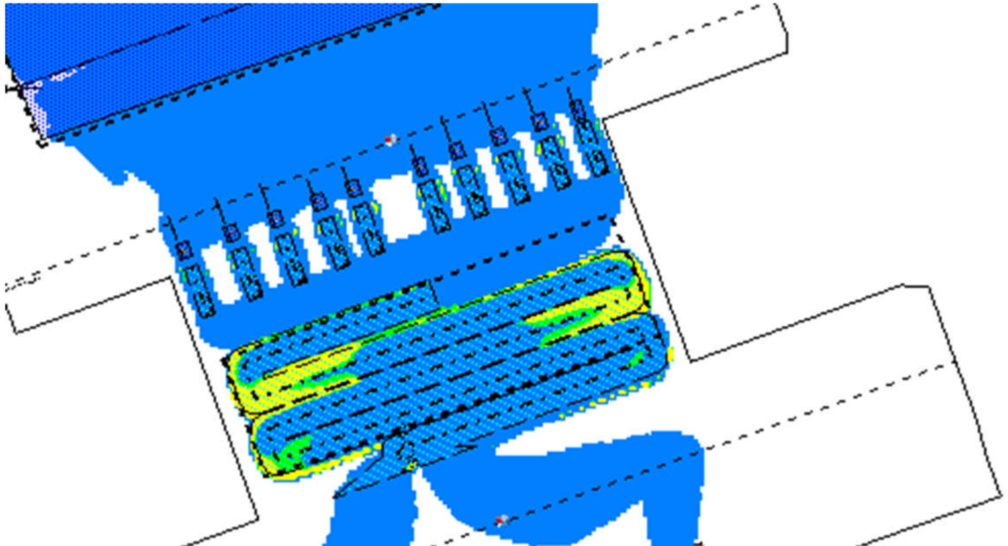
Terminal 2 - Maximum experienced density

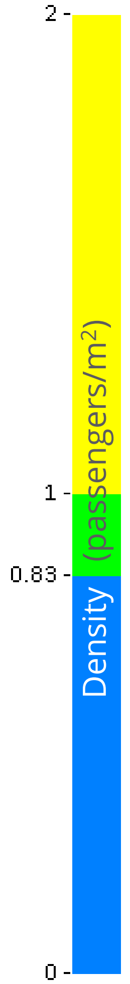


Terminal 1 - Mean experienced density



Terminal 2 - Mean experienced density

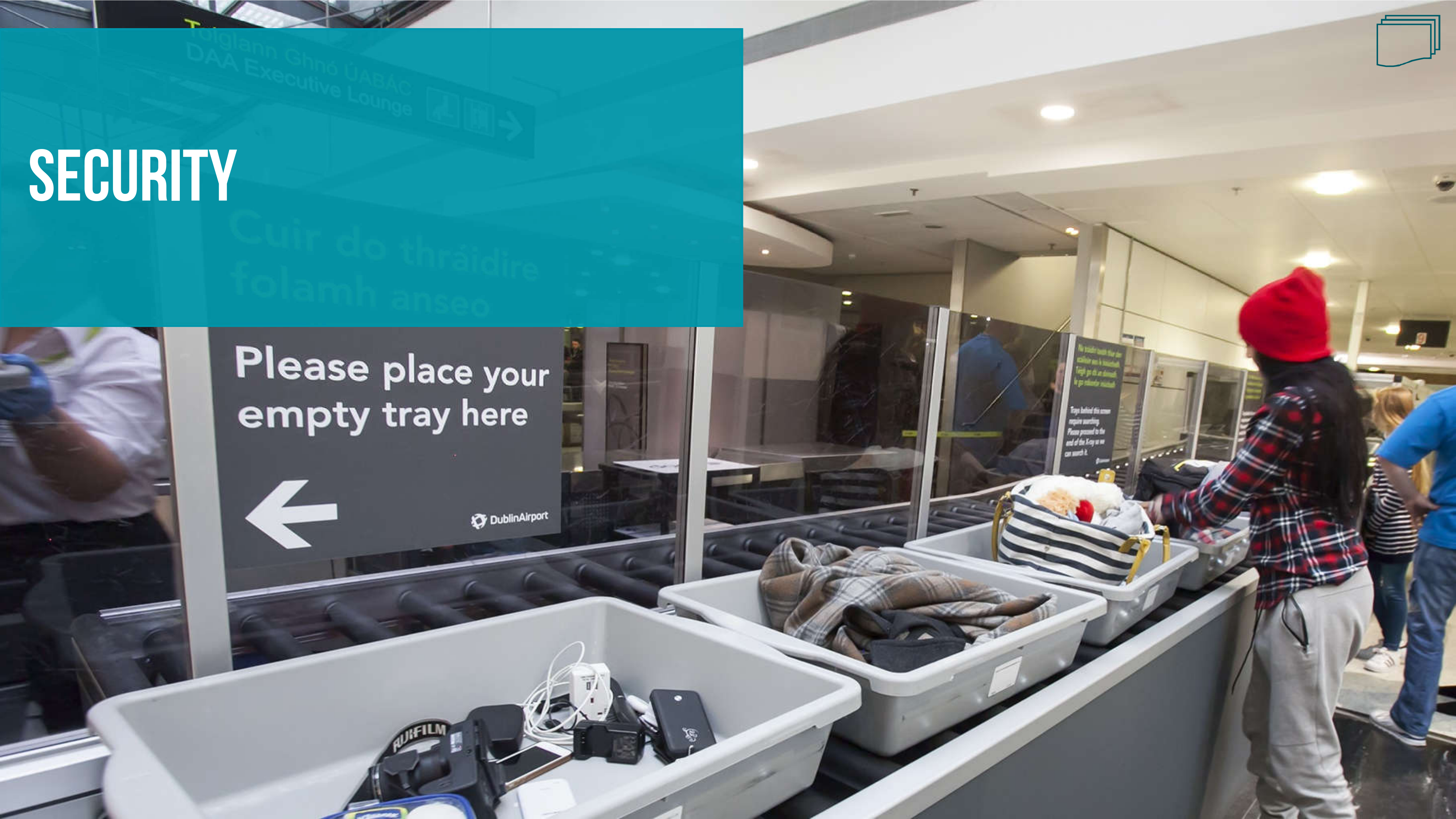




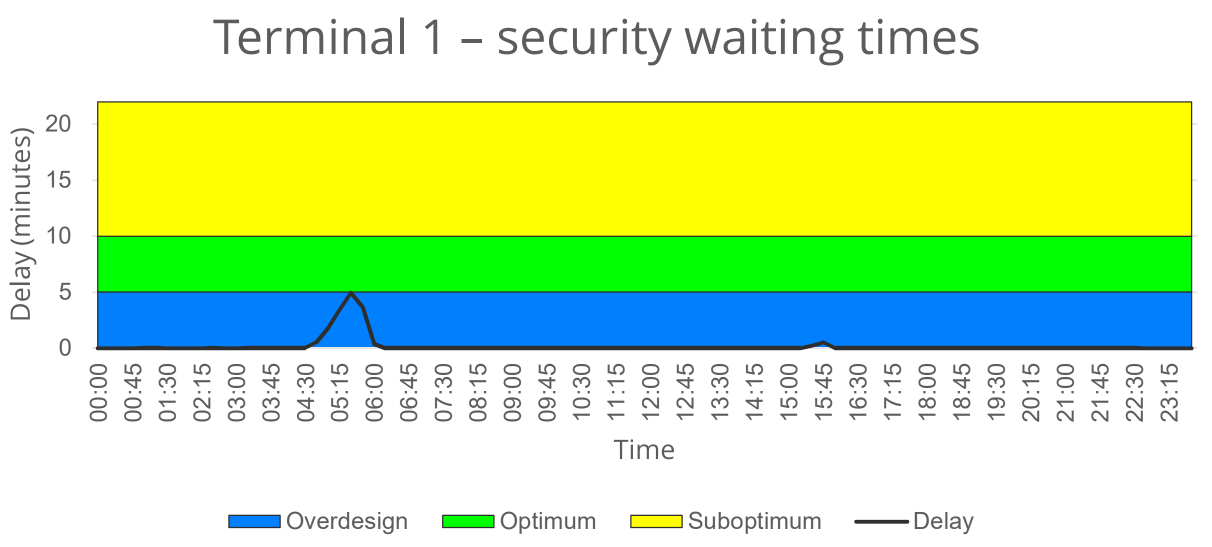
BOARDING PASS SCAN: OBSERVATIONS

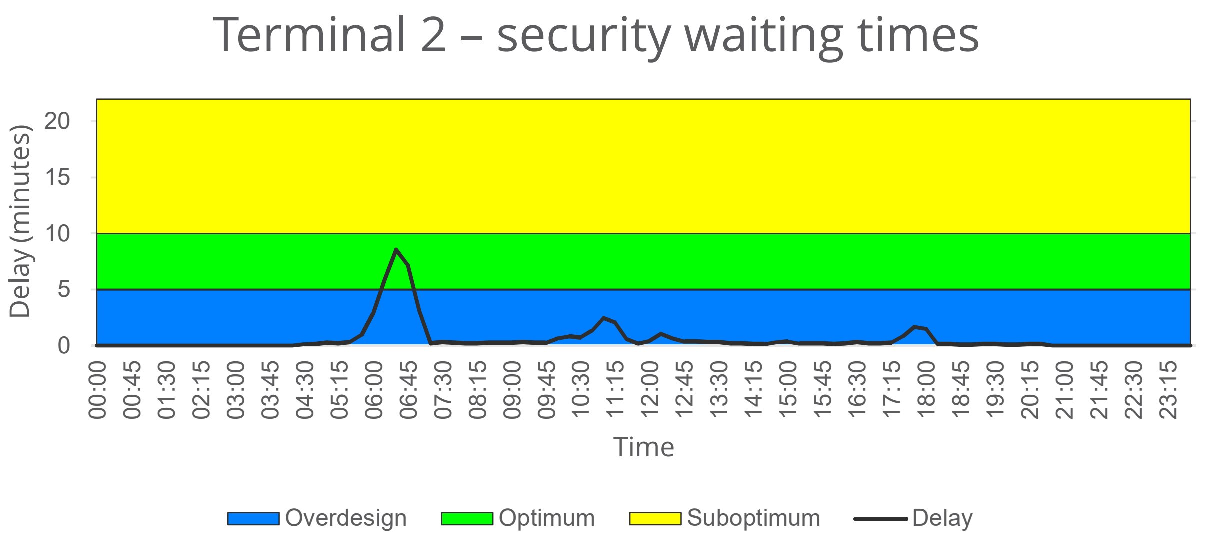
- Waiting times at the boarding pass scan process are negligible in both terminals assessed.
- Space provision at the boarding pass scan process in both terminals is sufficient throughout the day, despite a short morning peak at T2 when the space provision spikes into the suboptimum levels for a short period of time.

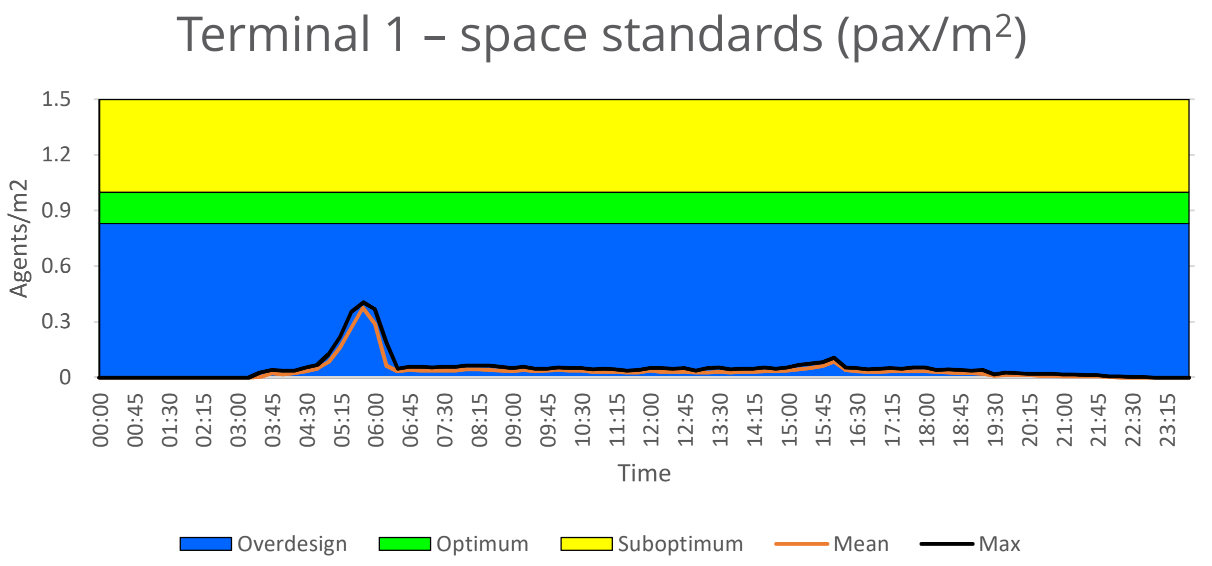
SECURITY

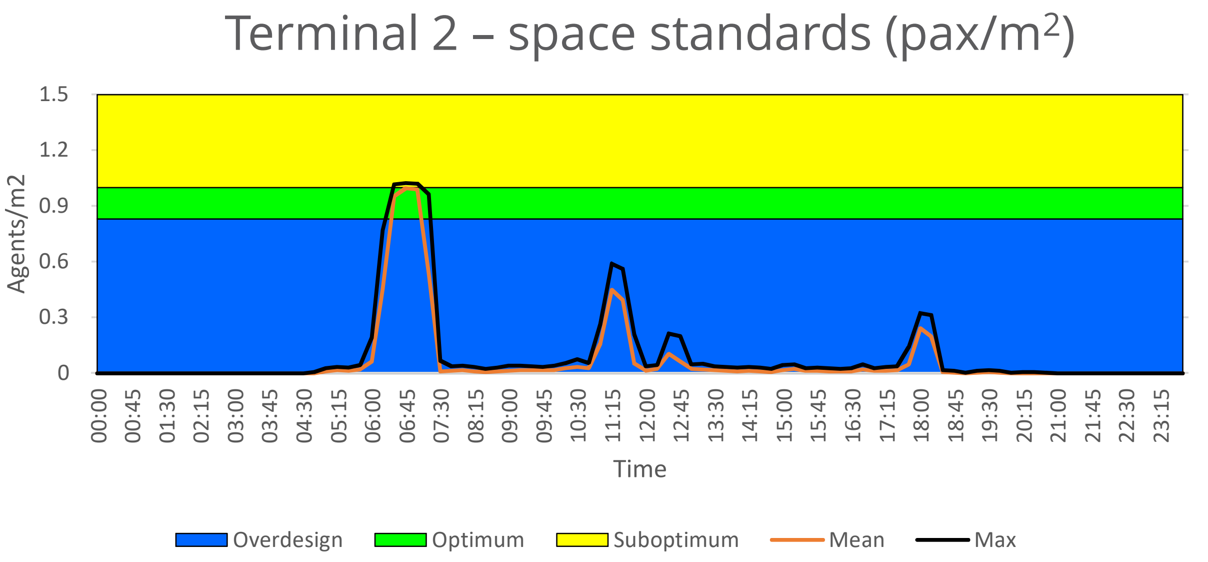

Tolglann Ghnó ÚABÁC
DAA Executive Lounge
Cuir do thráidire folamh anseo
Please place your empty tray here
DublinAirport

SECURITY SCREENING AREA: WAITING TIME AND SPACE STANDARDS



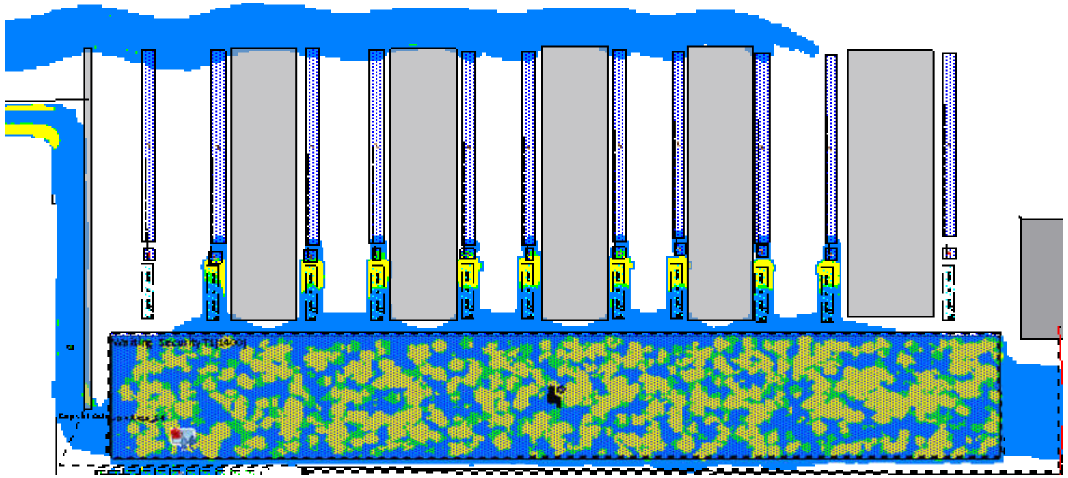




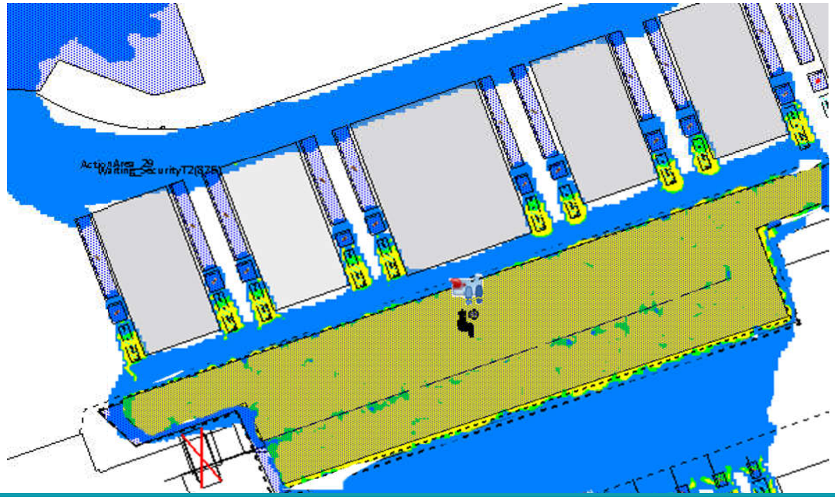


SECURITY SCREENING AREA: DENSITY MAPS

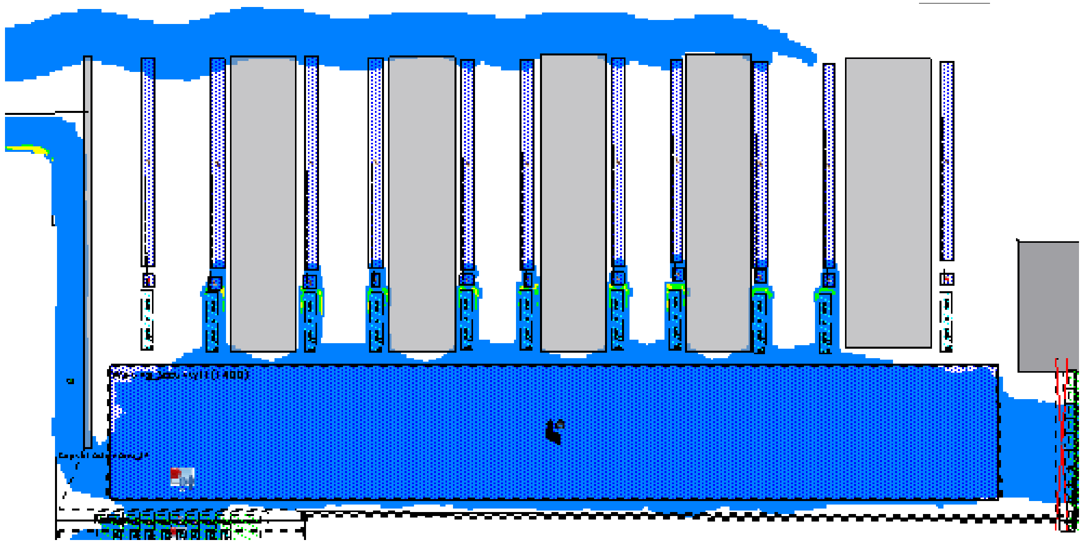
Terminal 1 - Maximum experienced density



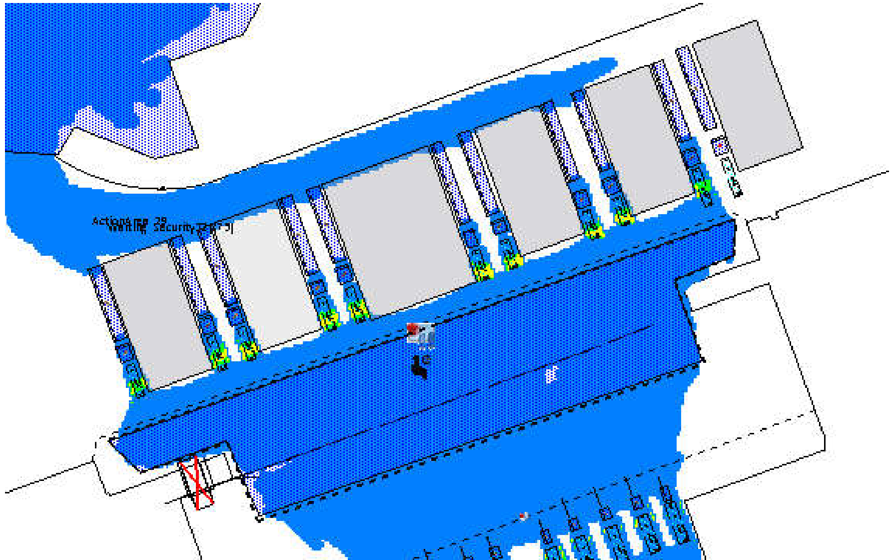
Terminal 2 - Maximum experienced density

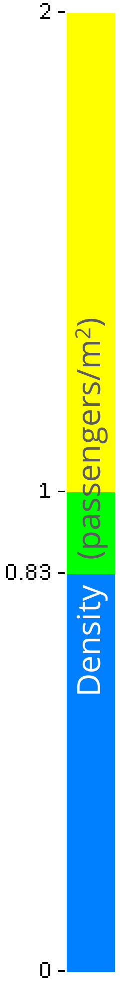


Terminal 1 - Mean experienced density



Terminal 2 - Mean experienced density



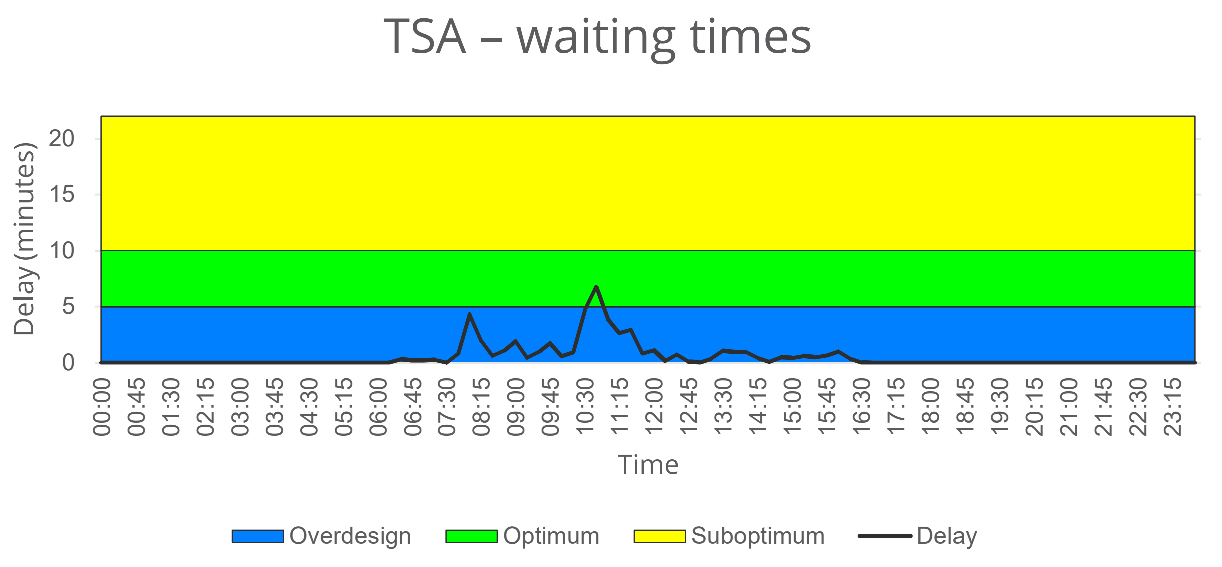


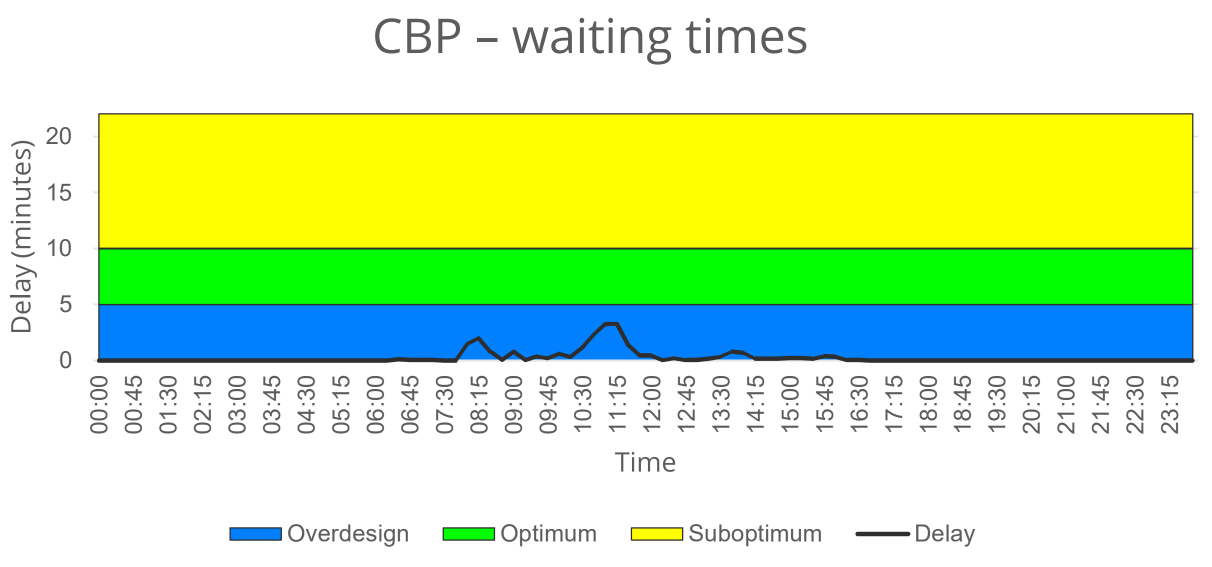
SECURITY SCREENING AREA: OBSERVATIONS

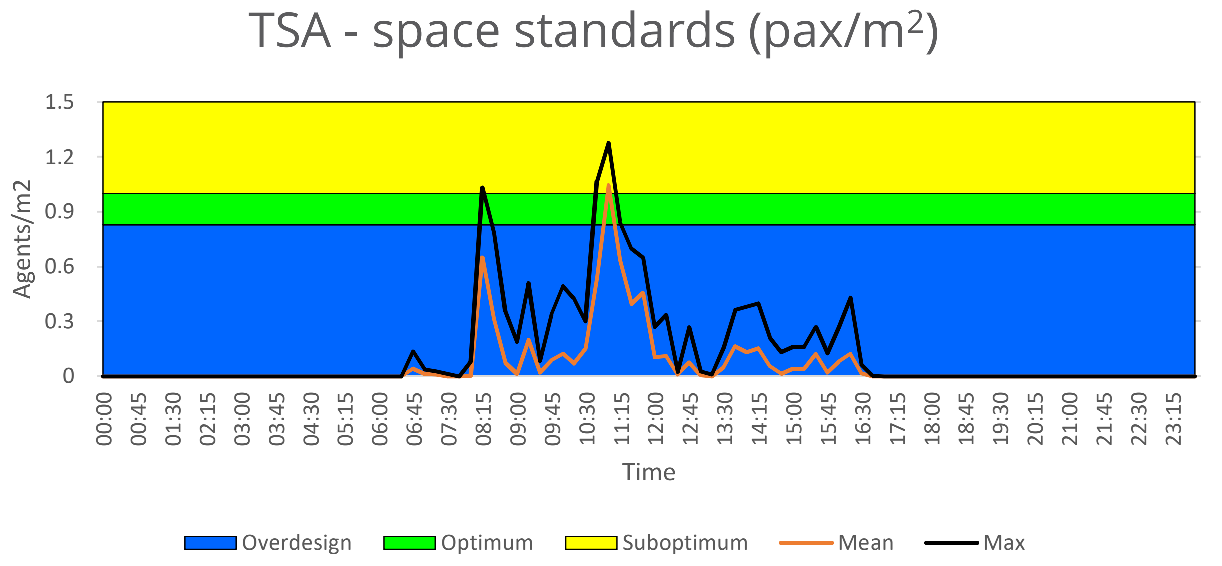
- Both T1 and T2 security areas are able to handle the traffic demand as proposed in the busy day flight schedule modelled.
- Short morning peaks can be seen in both T1 and T2 security areas.
- While Terminal 1 has ample queuing space, space provision at Terminal 2 may border on the edge of the suboptimum density range for a short period of time during the morning peak.
- Waiting times are all within acceptable limits.

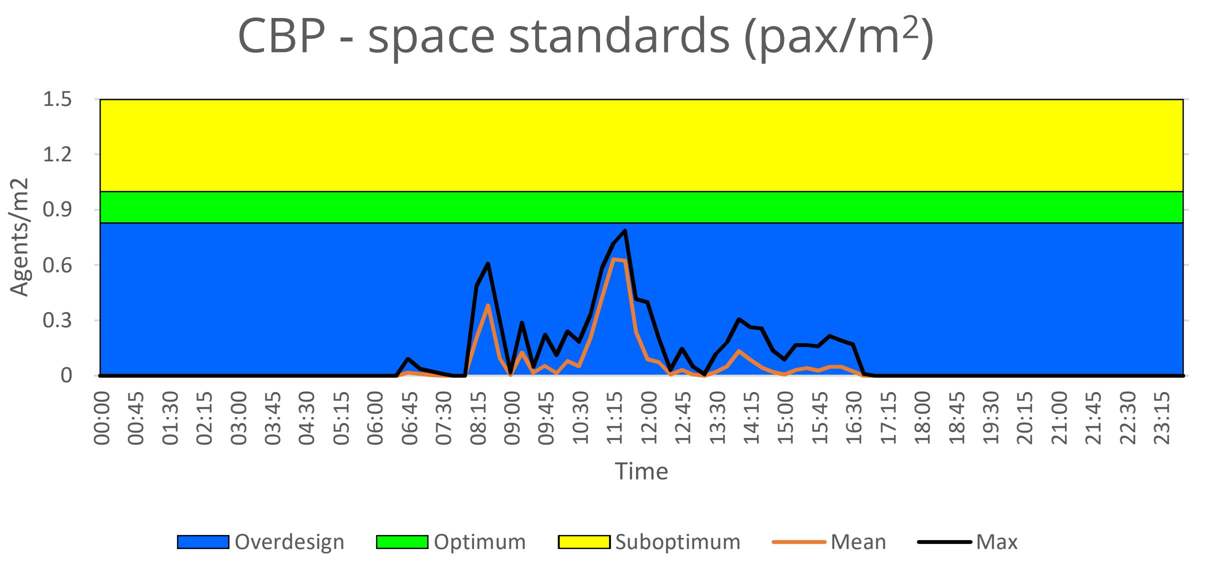
U.S. PRE-CLEARANCE

U.S. PRE-CLEARANCE AREA: WAITING TIME AND SPACE STANDARDS



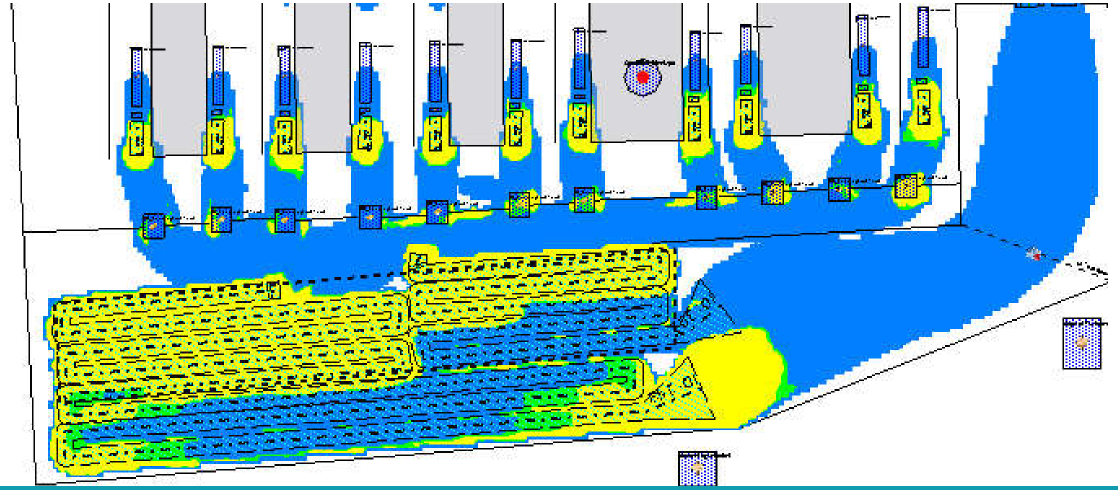






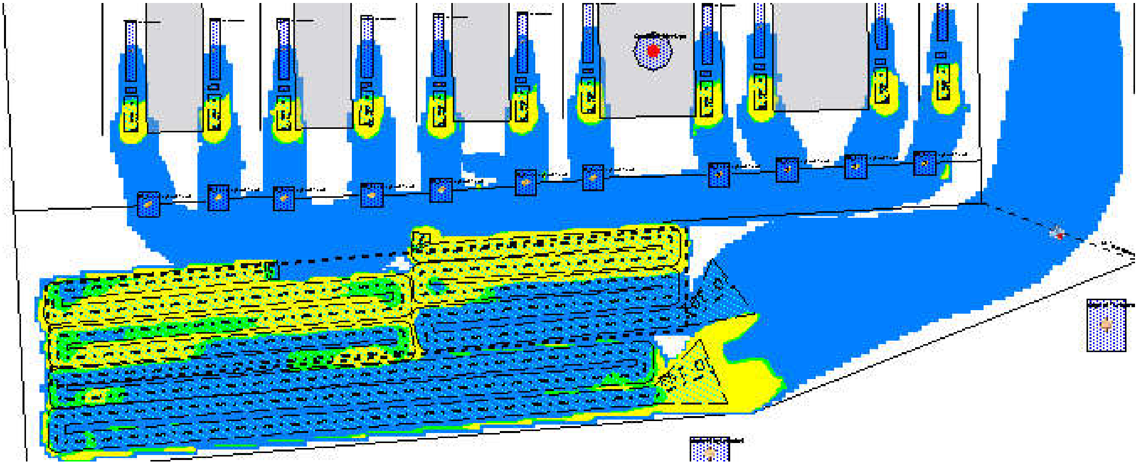
U.S. PRE-CLEARANCE AREA: DENSITY MAPS

TSA - Maximum experienced density

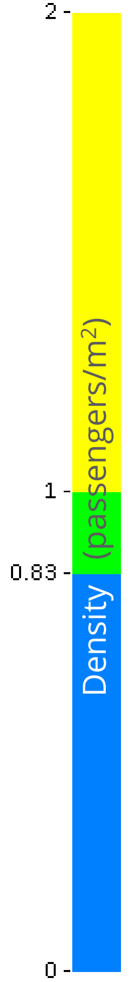


CBP - Maximum experienced density

TSA - Mean experienced density



CBP - Mean experienced density



U.S. PRE-CLEARANCE AREA: OBSERVATIONS

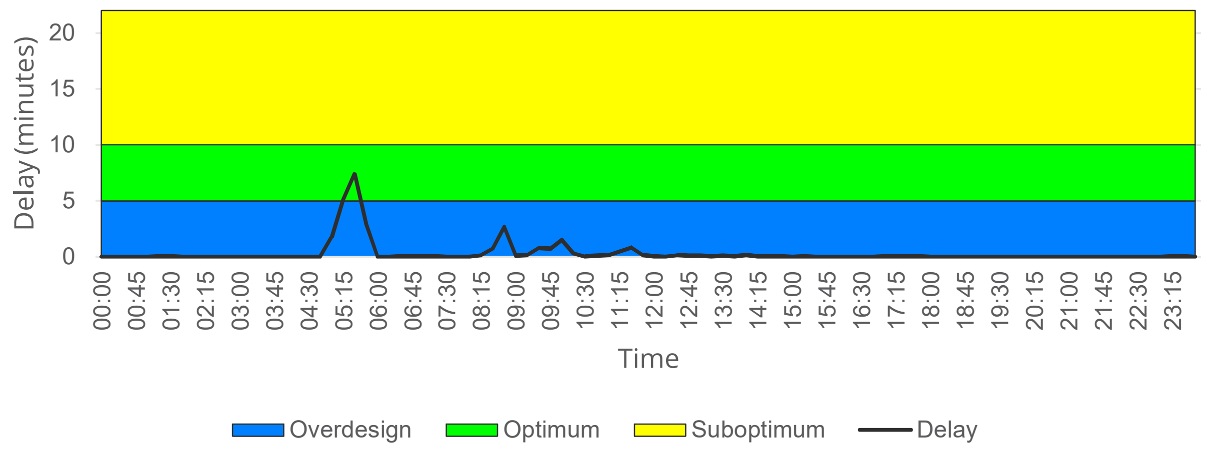
- Throughput at the TSA process influences the demand for the CBP process.
- Waiting times for both TSA and CBP processes are well within acceptable limits.
- Space provision in both TSA and CBP processes is generally within acceptable limits – there is a short peak before noon, during which the space provision drops to suboptimum levels, but the performance returns back to optimum levels after 30 minutes.

TRANSFER FACILITIES

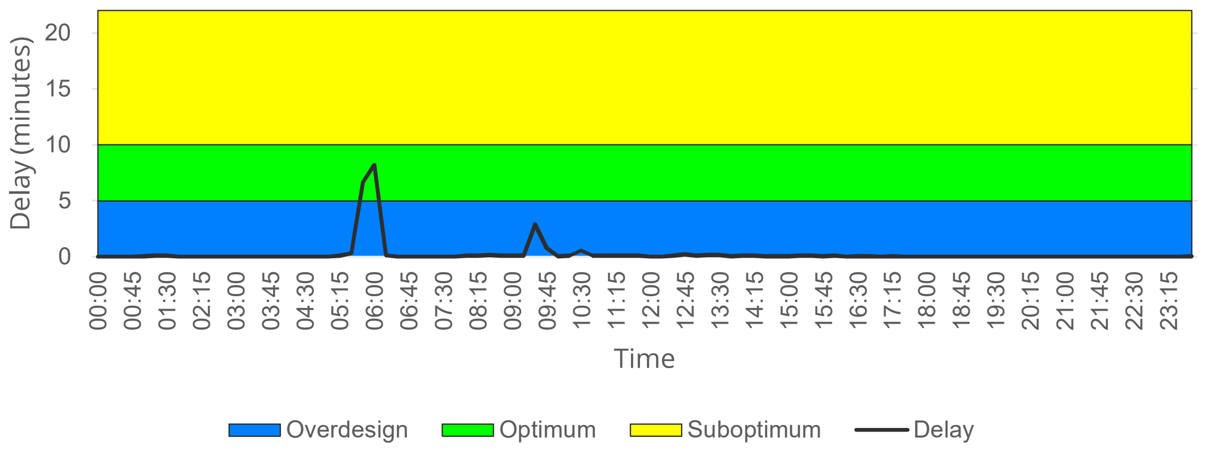
Image source: TheJournal.ie

TRANSFER FACILITIES: WAITING TIME AND SPACE STANDARDS

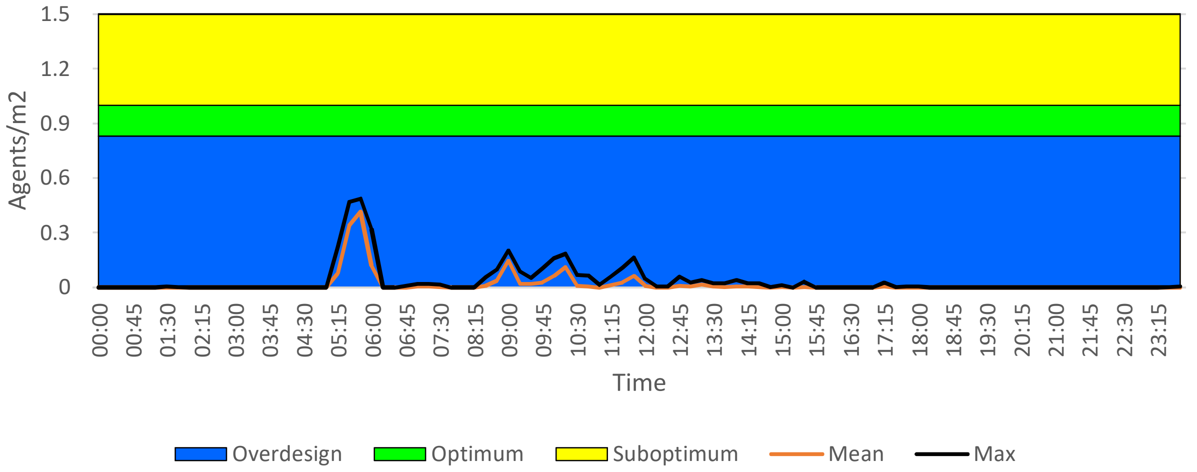
Pier 4 Transfers – waiting time



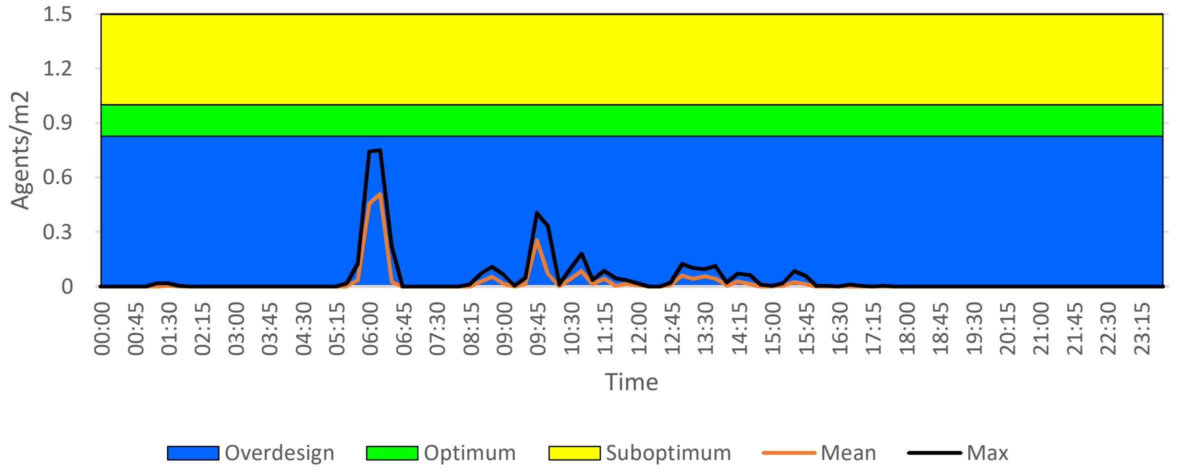
Terminal 2 Transfers – waiting time



Pier 4 Transfers - space standards (pax/m²)

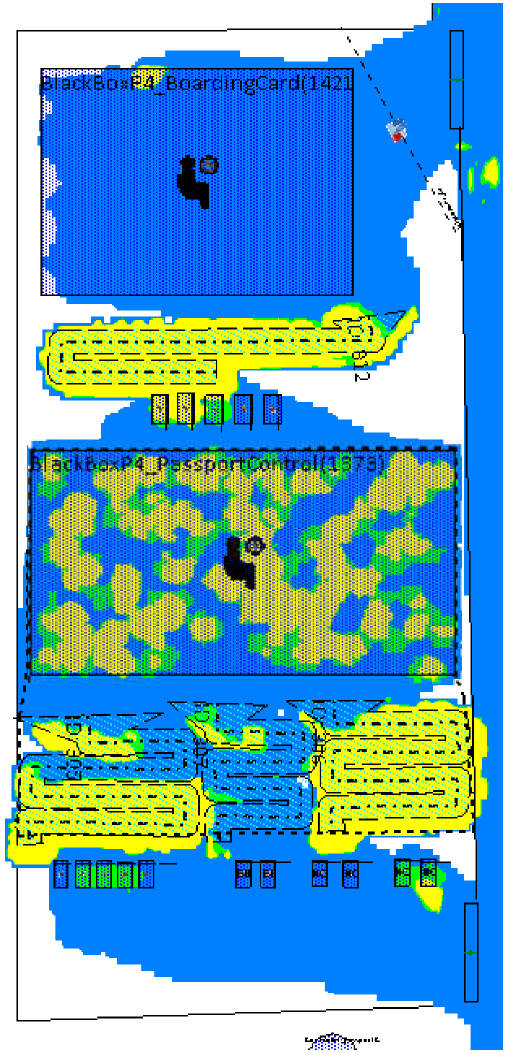


Terminal 2 Transfers - space standards (pax/m²)

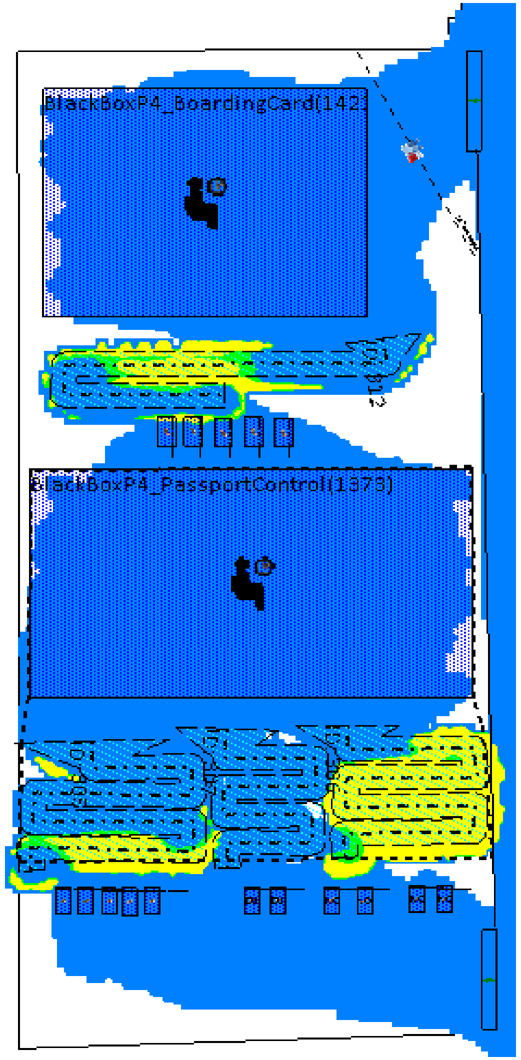


TRANSFER FACILITIES: DENSITY MAPS

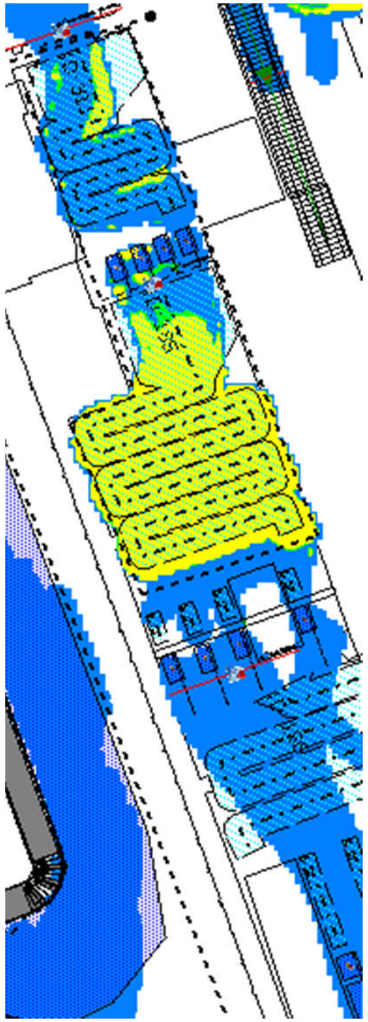
Pier 4 Transfers - Maximum experienced density



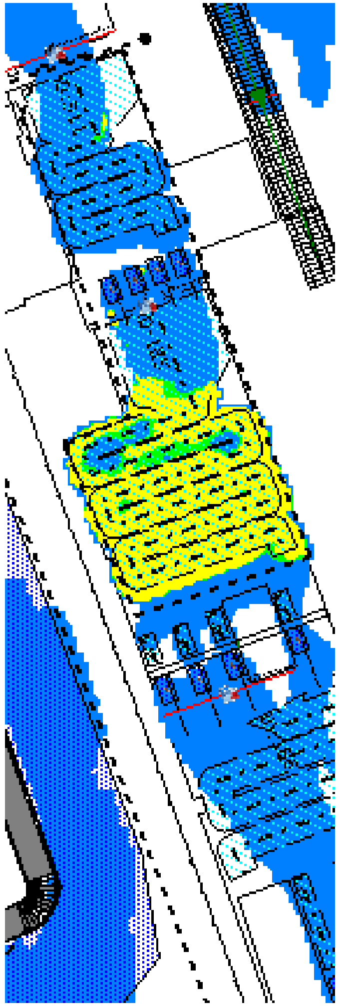
Pier 4 Transfers - Mean experienced density

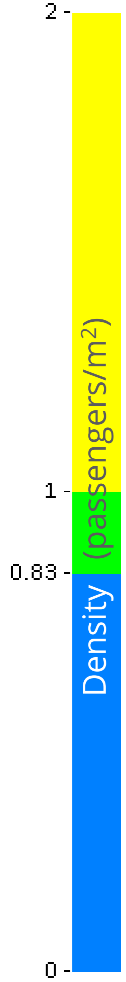


Terminal 2 Transfers - Maximum experienced density



Terminal 2 Transfers - Mean experienced density





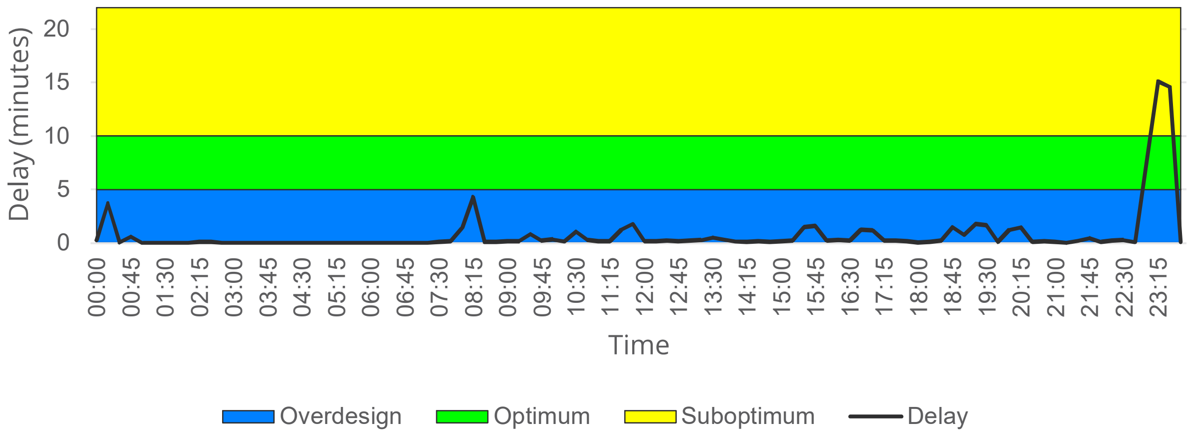
TRANSFER FACILITIES - OBSERVATIONS

- Both facilities can handle the anticipated demand.
- Both space provision and waiting times are well within the acceptable ranges even during the peak periods.

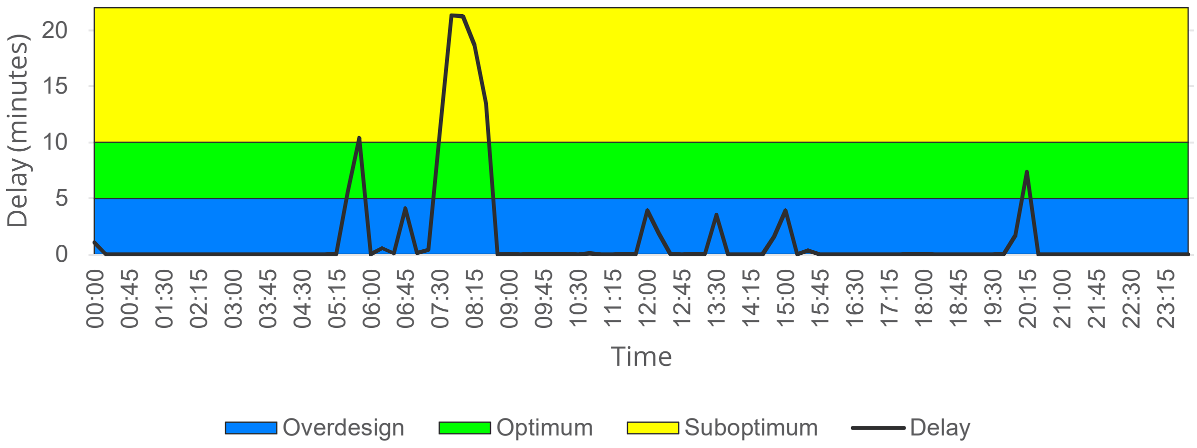
IMMIGRATION

IMMIGRATION: WAITING TIME AND SPACE STANDARDS

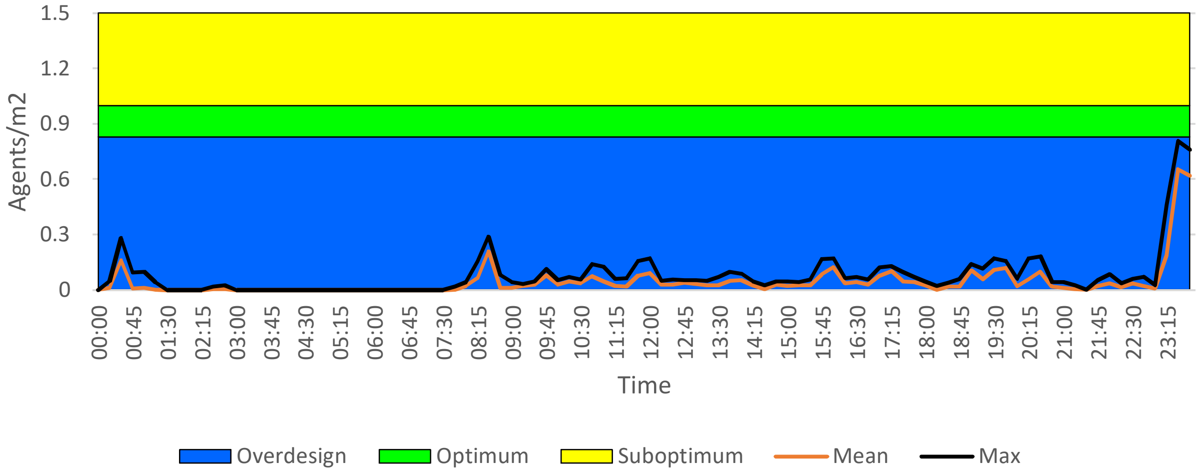
Terminal 1 - Immigration waiting time



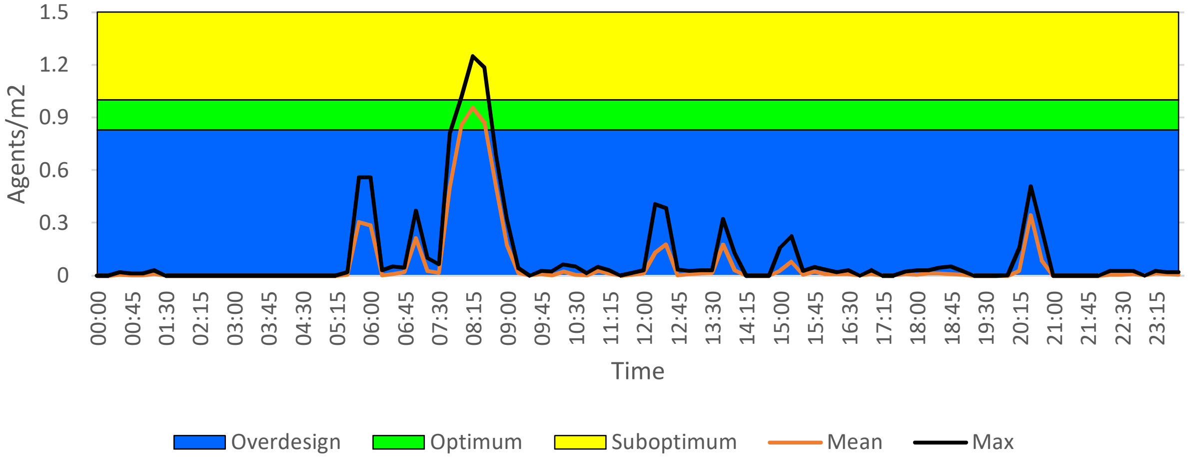
Pier 3 - Immigration waiting time



Terminal 1 - space standards (pax/m²)

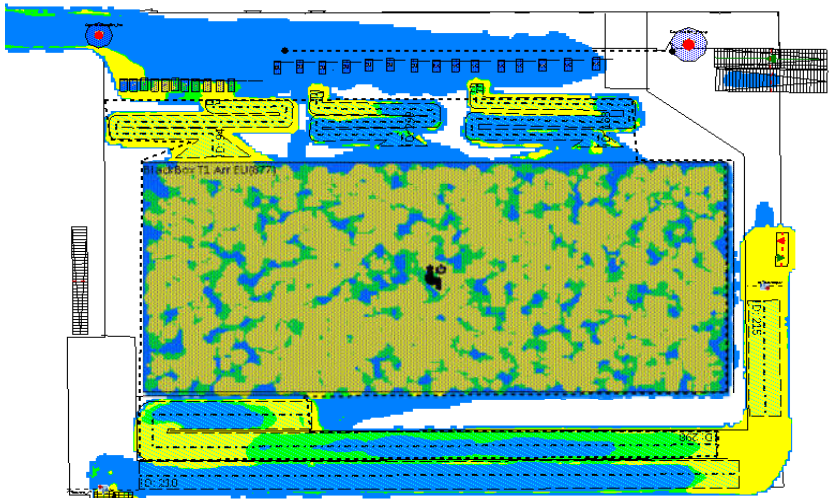


Pier 3 - space standards (pax/m²)

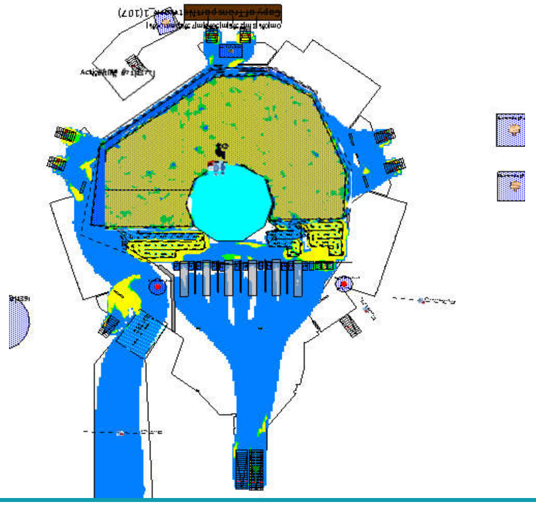


IMMIGRATION – DENSITY MAPS

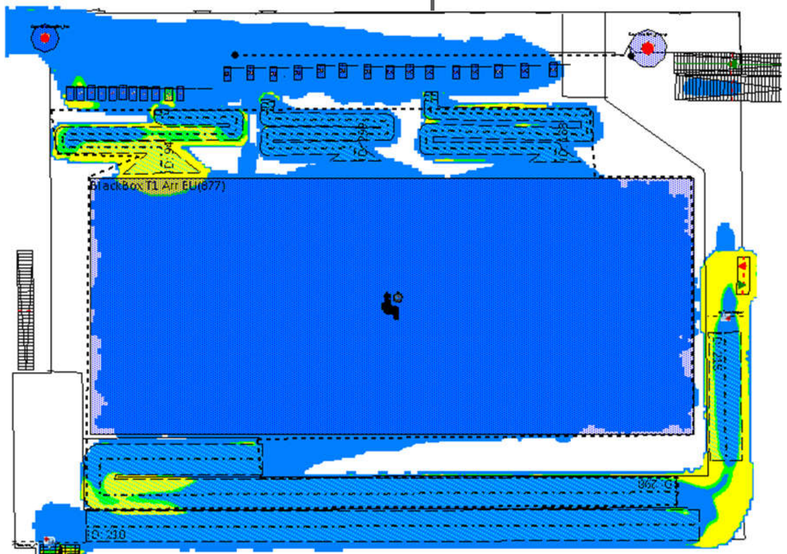
Terminal 1 - Maximum experienced density



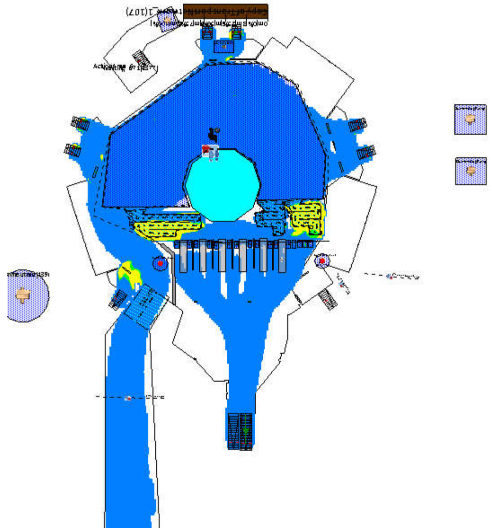
Pier 3 - Maximum experienced density

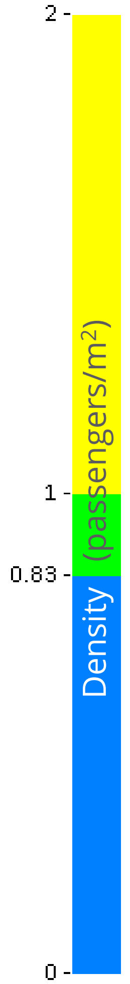


Terminal 1 - Mean experienced density



Pier 3 - Mean experienced density



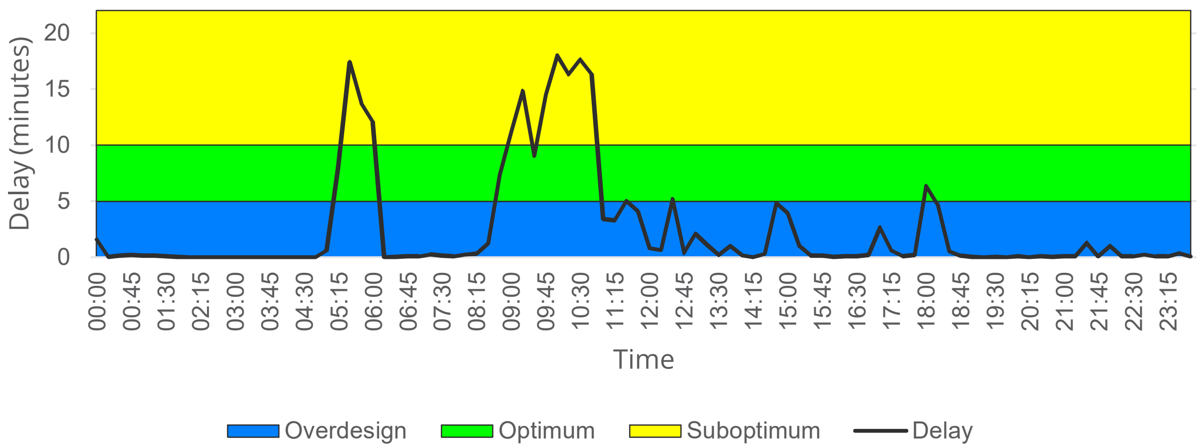


IMMIGRATION TERMINAL 1: OBSERVATIONS

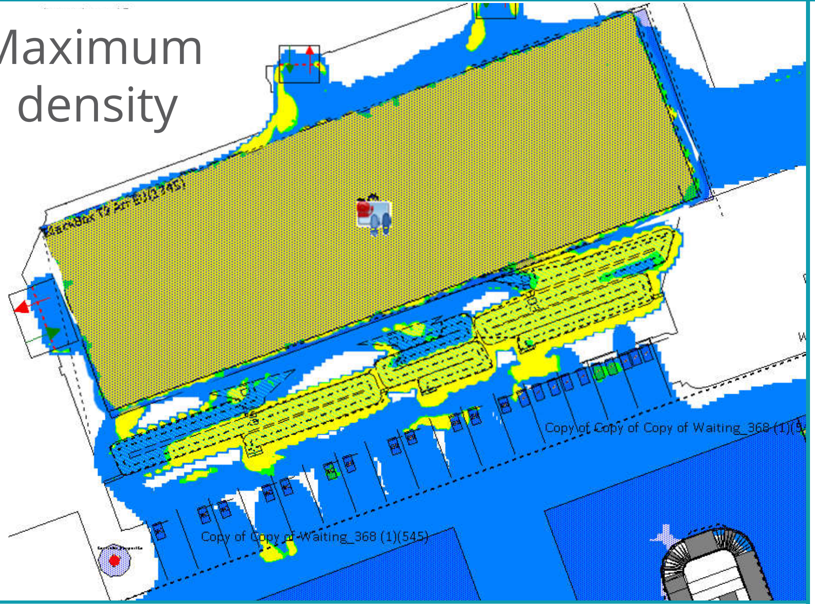
- For most of the day, Terminal 1 can handle incoming passengers within both waiting times and space provision limits. It is only the last wave of evening arrivals that brings higher numbers of passengers at once. 89% of flights using T1 immigration after 22:00 are Ryanair arrivals and 61% of passengers going through T1 immigration after 22:00 have landed in Pier 1. Although these passengers will have enough space for queuing, they will experience longer waiting times.
- Pier 3 may be capacity constrained during the morning hours. Space provision may be acceptable, given it penetrates into suboptimum levels only for a short period of time, however, waiting times during this period are clearly suboptimum and are caused by 8 wide-body arrivals from non-EU countries, bringing in potentially up to 1700 passengers between 07:25 and 08:25. Additionally, large share of these passengers will hold non-EU passports, further slowing down the immigration processing rates.

IMMIGRATION – WAITING TIME, SPACE STANDARDS AND DENSITY MAPS

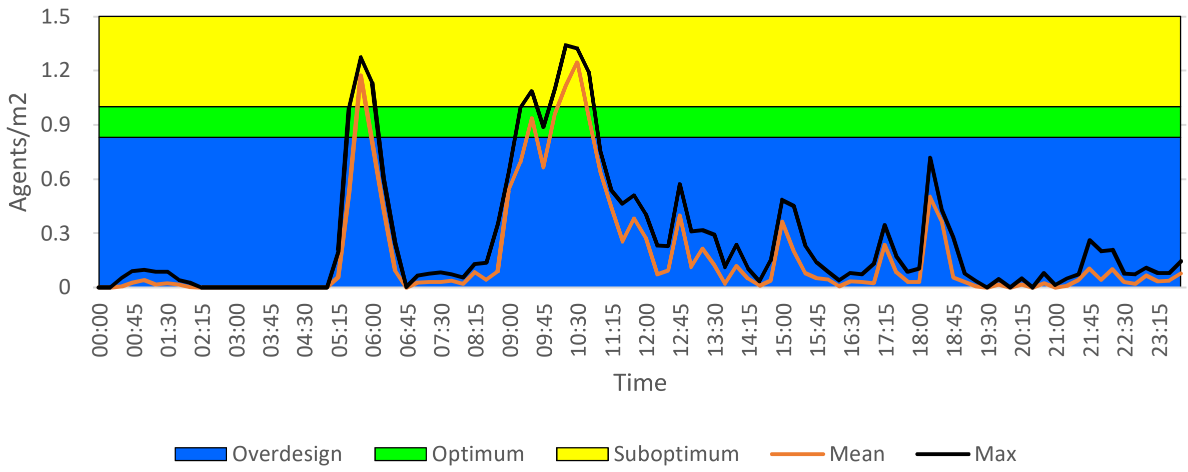
Terminal 2- Immigration waiting time



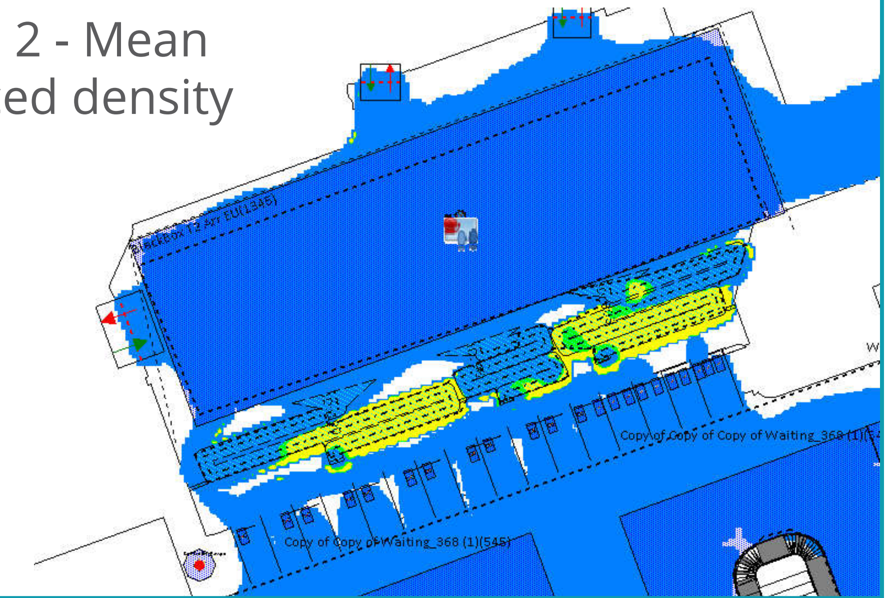
Terminal 2 - Maximum experienced density

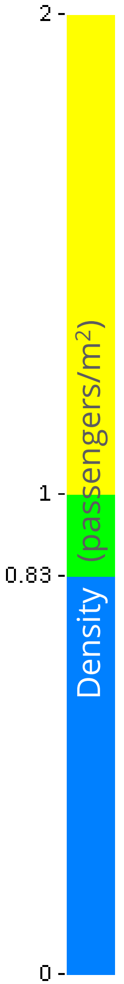


Terminal 2 - space standards (pax/m²)



Terminal 2 - Mean experienced density





IMMIGRATION TERMINAL 2: OBSERVATIONS

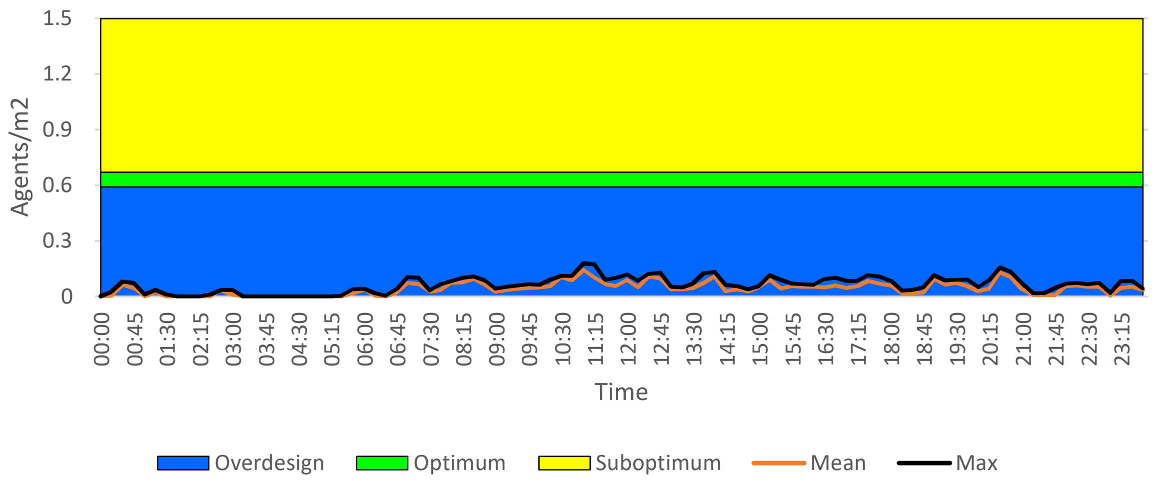
- Terminal 2 can handle passengers arriving on afternoon flights within both waiting times and space provision limits. However, both space provision and waiting time standards are suboptimal between 05:15 and 06:00 and between 09:00 and 11:00.
- Suboptimal performance during the early morning period is caused by 8 wide body arrivals from North America, potentially bringing in up to 1800 passengers between 05:15 and 05:50.
- The second peak also consists primarily of passengers arriving from the North America, but also includes two narrow-body arrivals from the EU. Altogether, there can be more than 2300 passengers delivered to Terminal 2 immigration between 09:00 and 10:30.
- After factoring in the fact that the flight schedule modelled represents an expected “busy” day, it can be concluded that the performance during an “average” day is likely to be better. We would expect the first morning peak to be within space provision and waiting times limits, however, we wouldn’t expect the late morning peak to decrease so much that it would be within the “optimum” range.

BAGGAGE RECLAIM

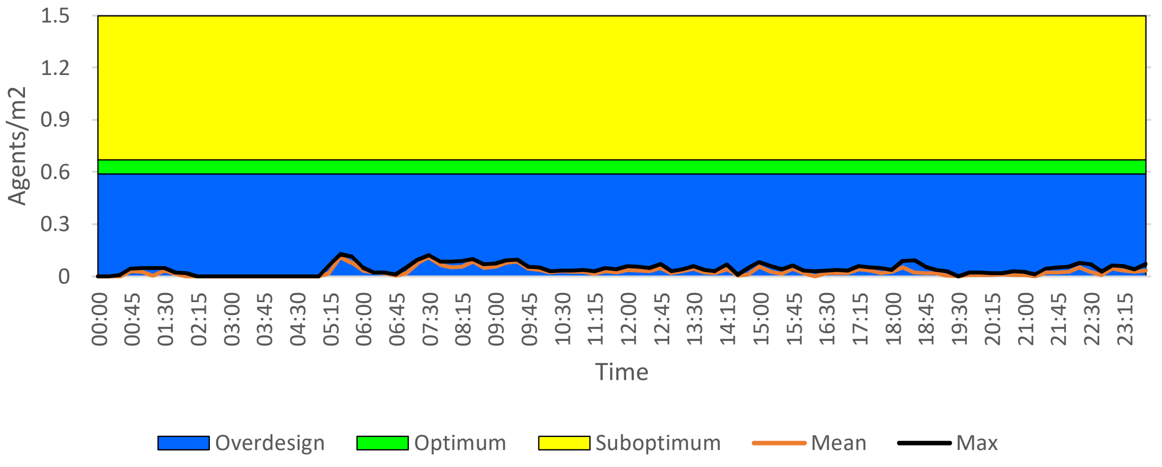
BAGGAGE RECLAIM AREAS – SPACE STANDARDS

Baggage delivery times depend on many variables. In order to calculate passenger waiting times at baggage reclaim areas we would have to model the baggage delivery process in its entirety. This would be outside of the scope of our task (a high-level assessment). Therefore, baggage delivery times were defined as inputs and served only as a tool to keep the passengers around the belts to allow us to calculate passenger densities.

Terminal 1 – space standards (pax/m²)



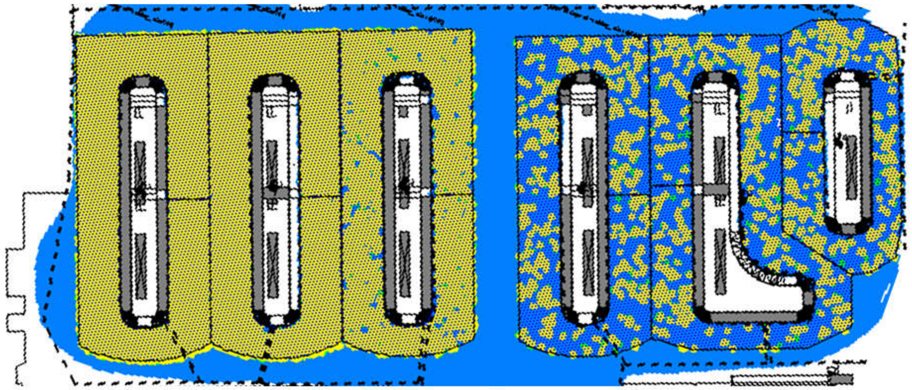
Terminal 2 – space standards (pax/m²)



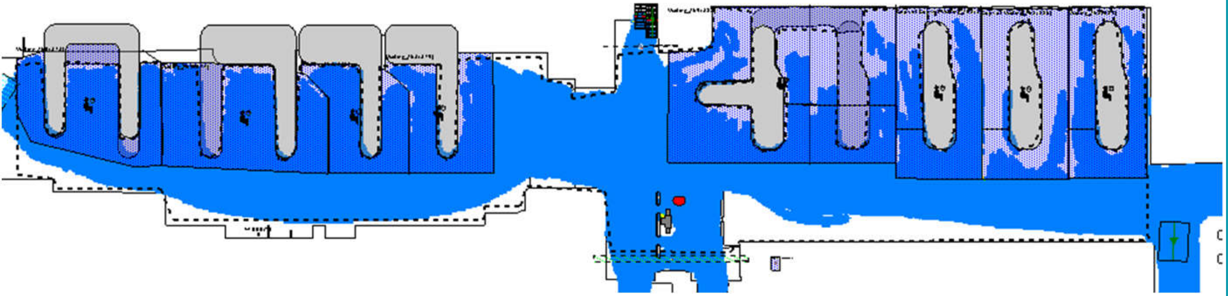
BAGGAGE RECLAIM AREAS – DENSITY MAPS

Terminal 1 - Maximum experienced density

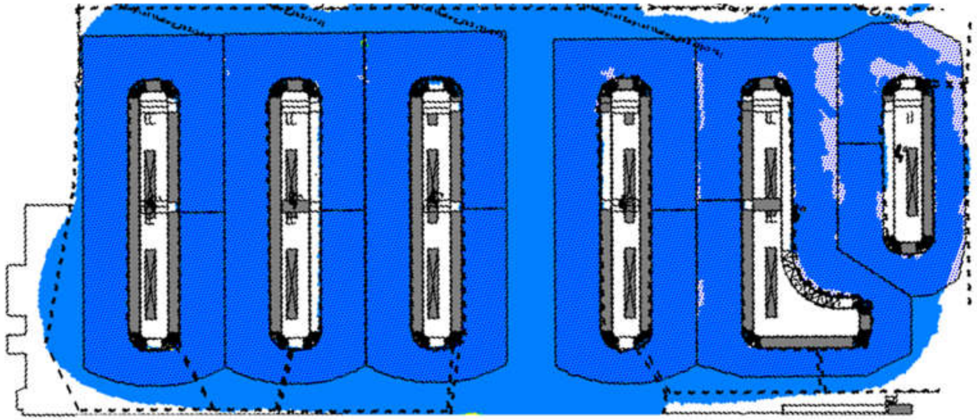
Terminal 2 - Maximum experienced density



Terminal 1 - Mean experienced density



Terminal 2 - Mean experienced density

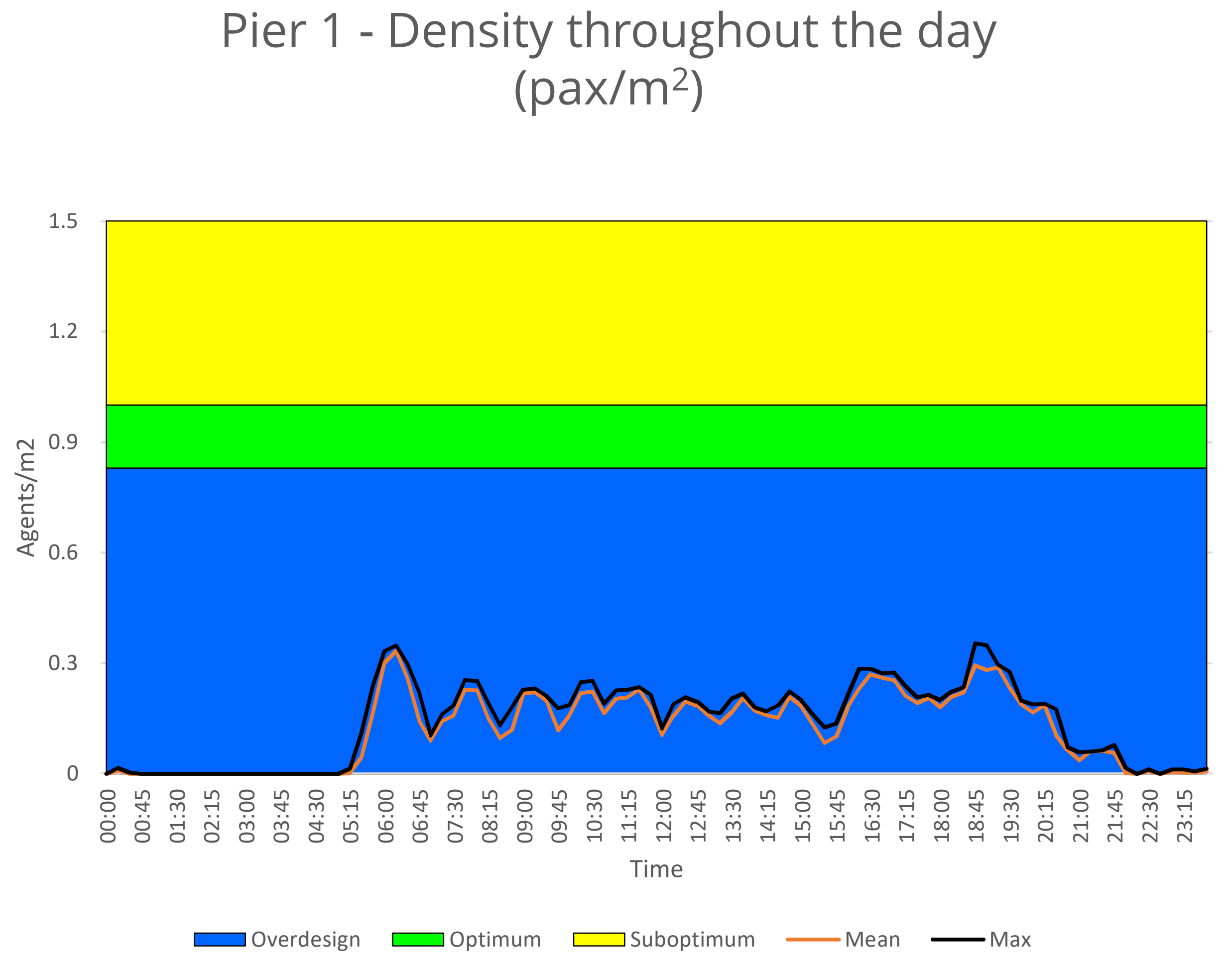


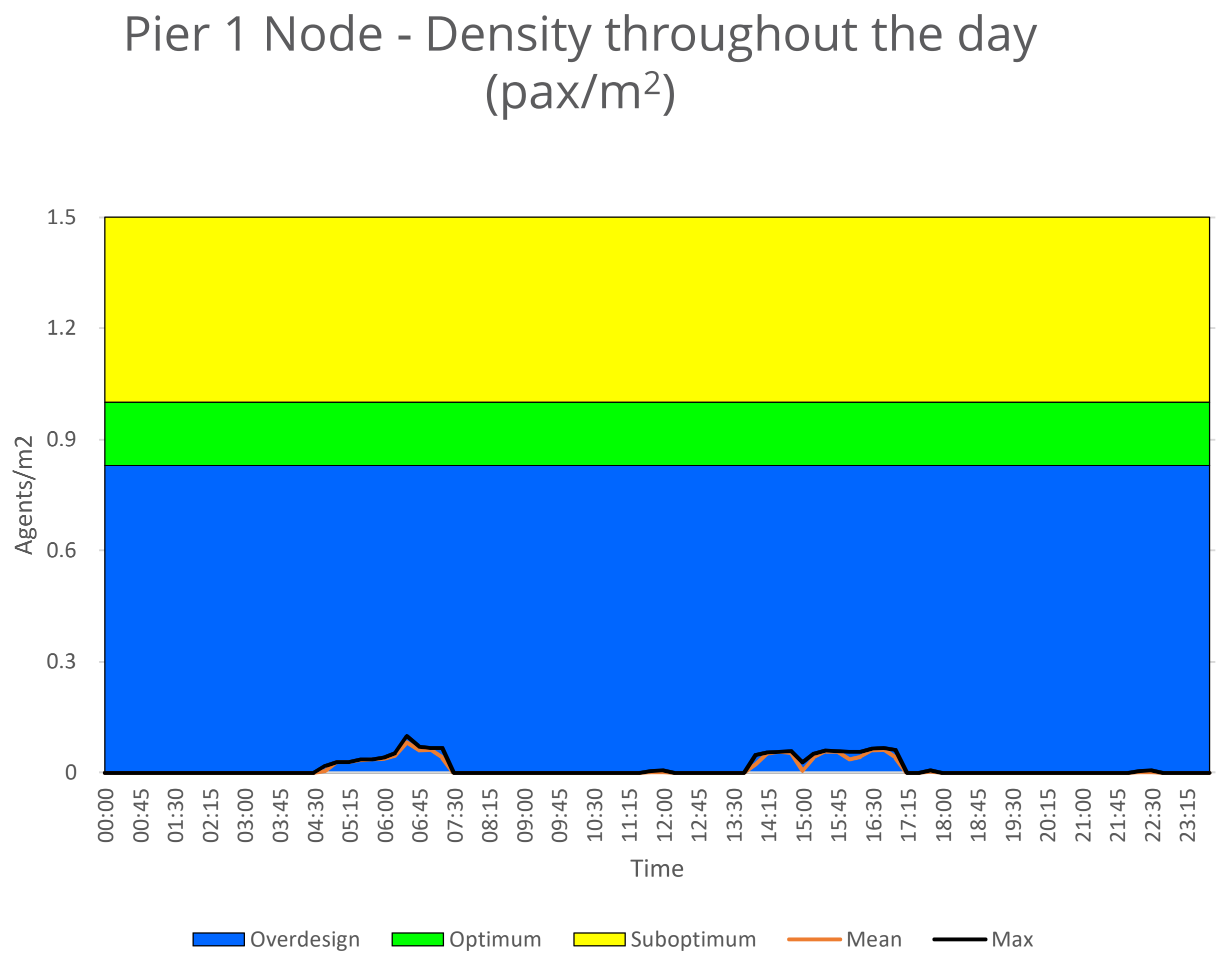
BAGGAGE RECLAIM AREAS - OBSERVATIONS

- The lack of balance in densities around each belt which can be seen on previous slide can be attributed to the assumption to assigns flights onto the belt with the least number of other flights served by that belt. However, in reality the allocation of flights to belts will be better balanced than in this simulation, leading to more even distribution of passengers around each belt.
- Although the density maps are impacted by this aspect of the modelling approach, density graphs are not impacted and clearly show that at any time of the day baggage reclaim halls in both Terminal 1 and Terminal 2 provide enough space for passengers claiming their baggage.

PIERS

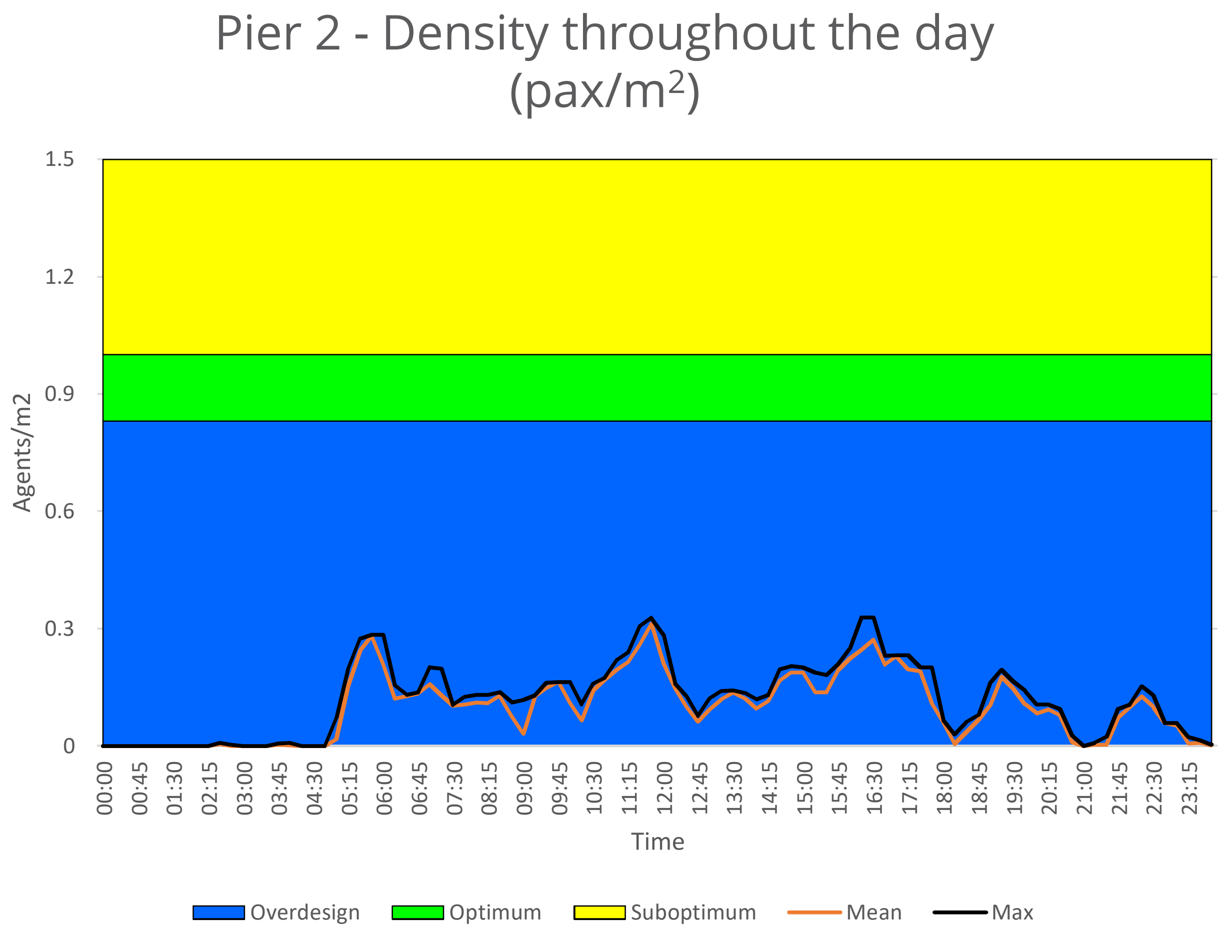
PIER DENSITY GRAPHS

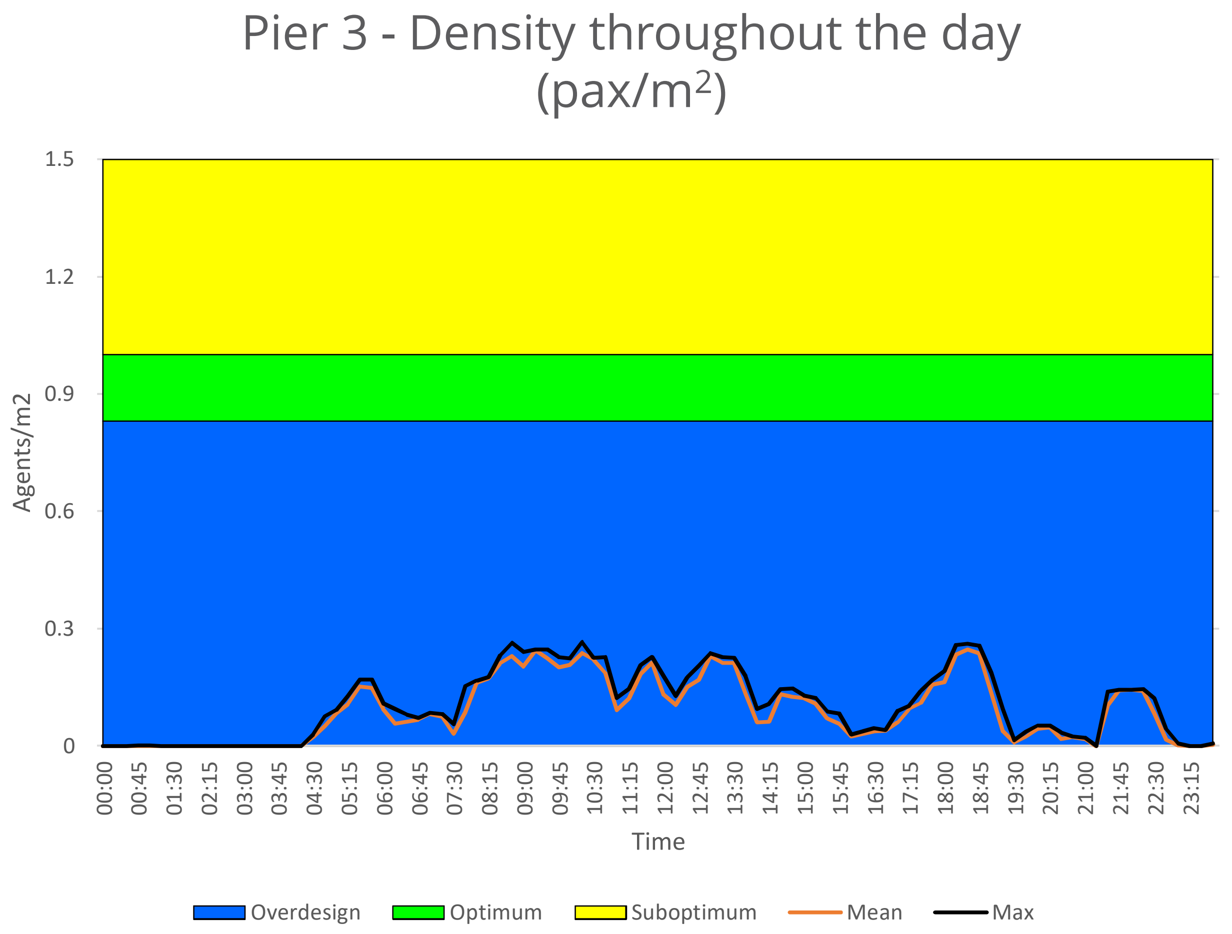




* LoS standards for standing passengers used as reference

PIER DENSITY GRAPHS





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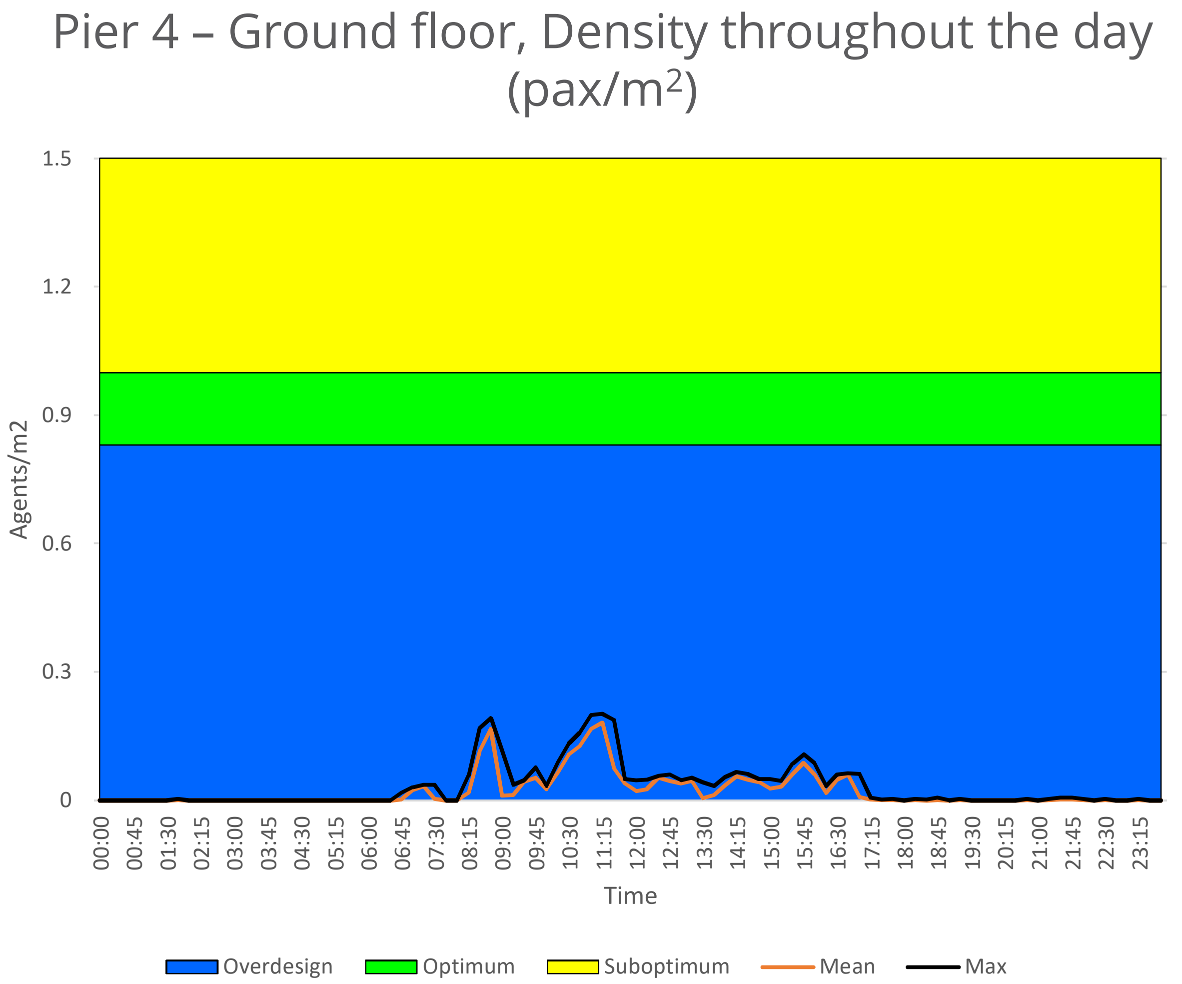
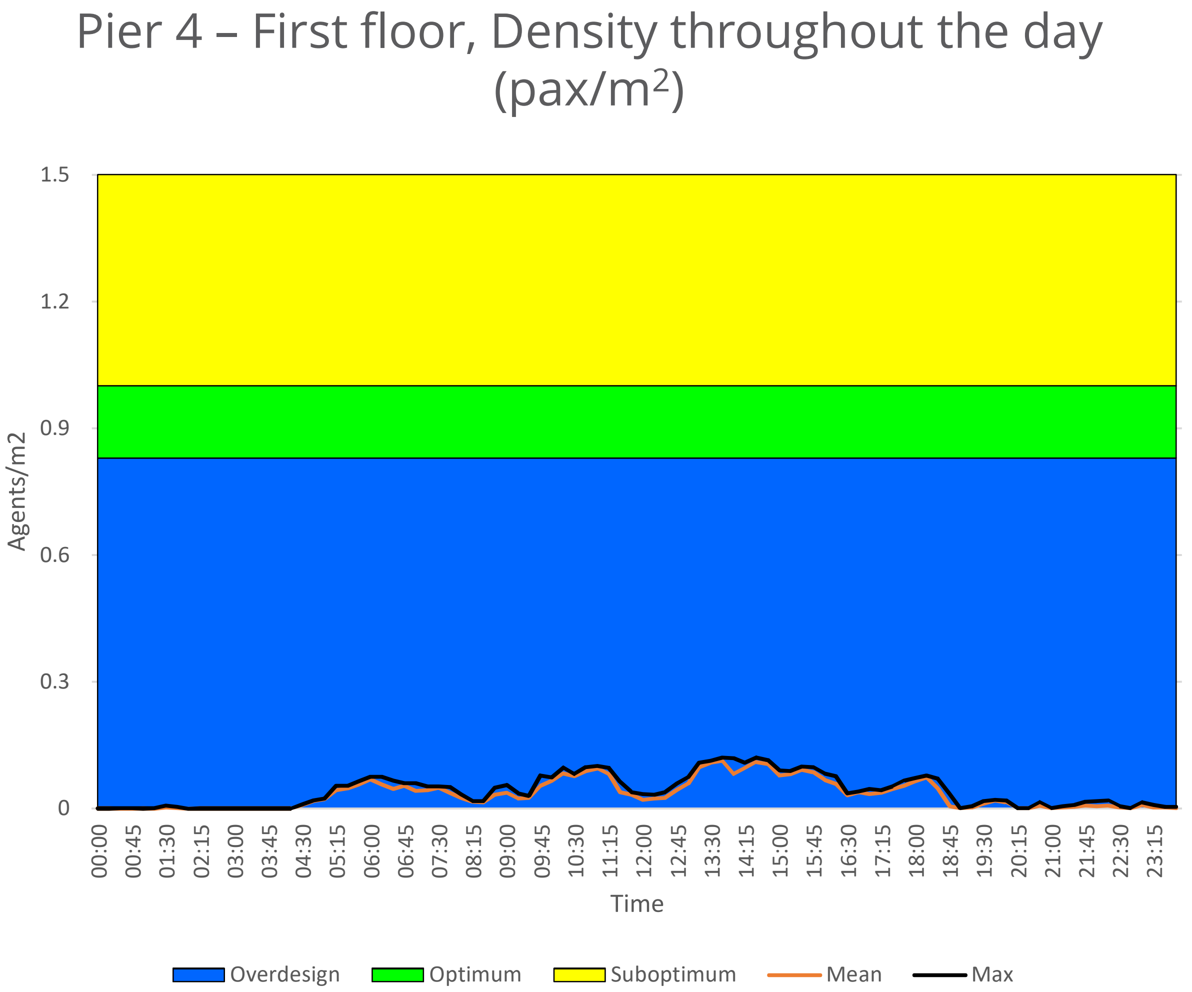
PIER DENSITY GRAPHS

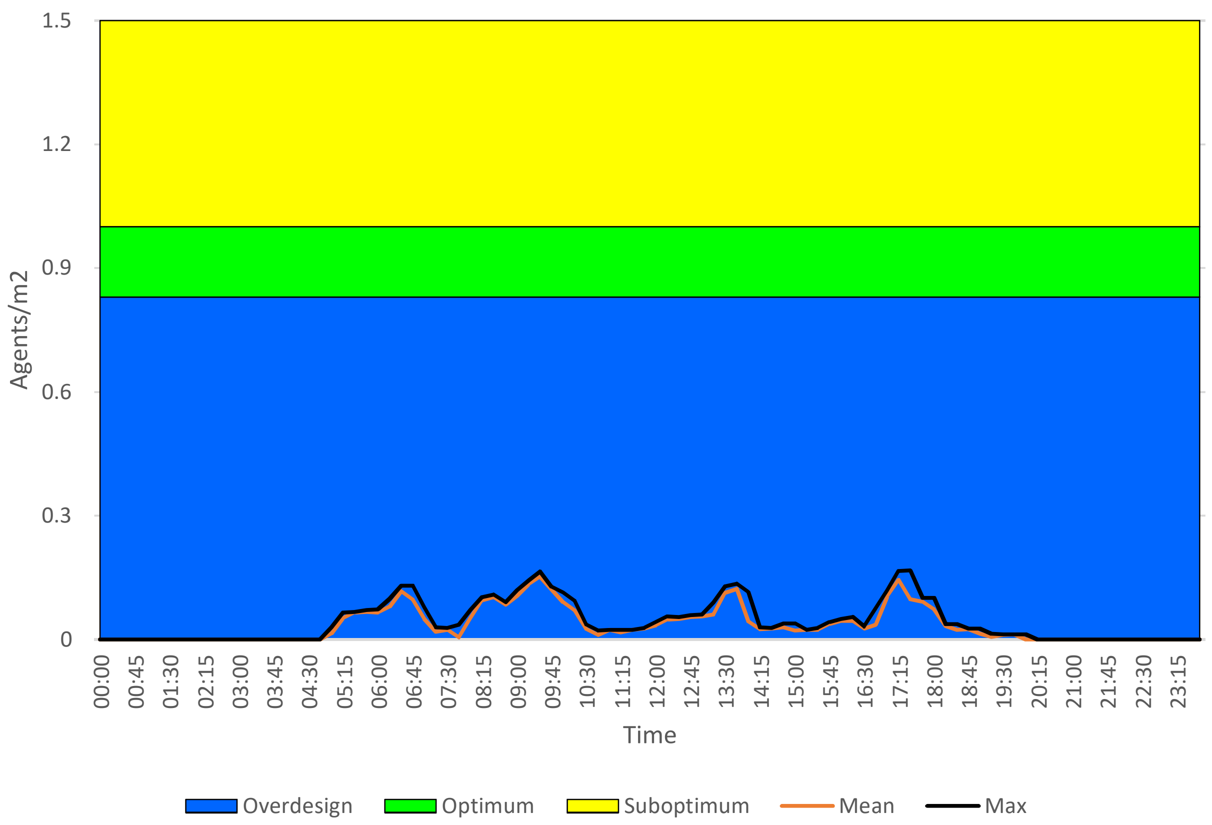




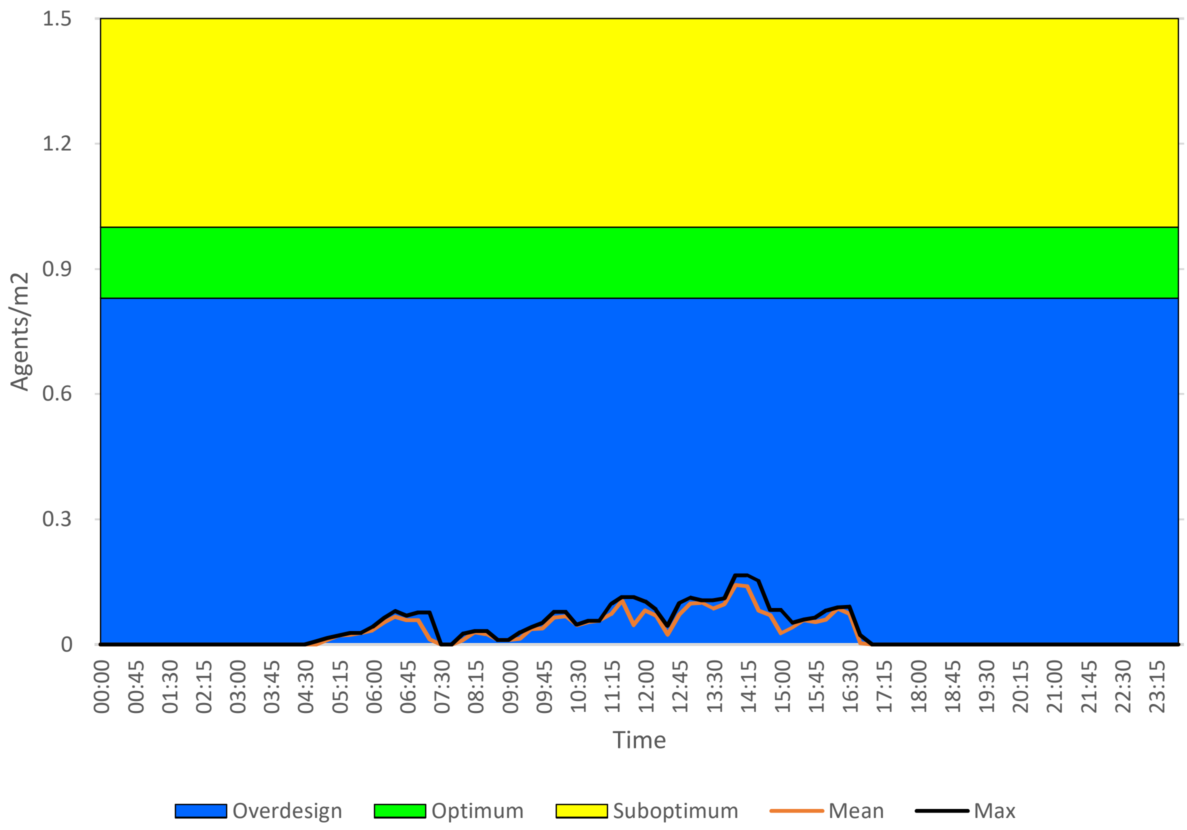
* LoS standards for standing passengers used as reference

PIER DENSITY GRAPHS

Pier 5 – Ground floor, Density throughout the day (pax/m²)

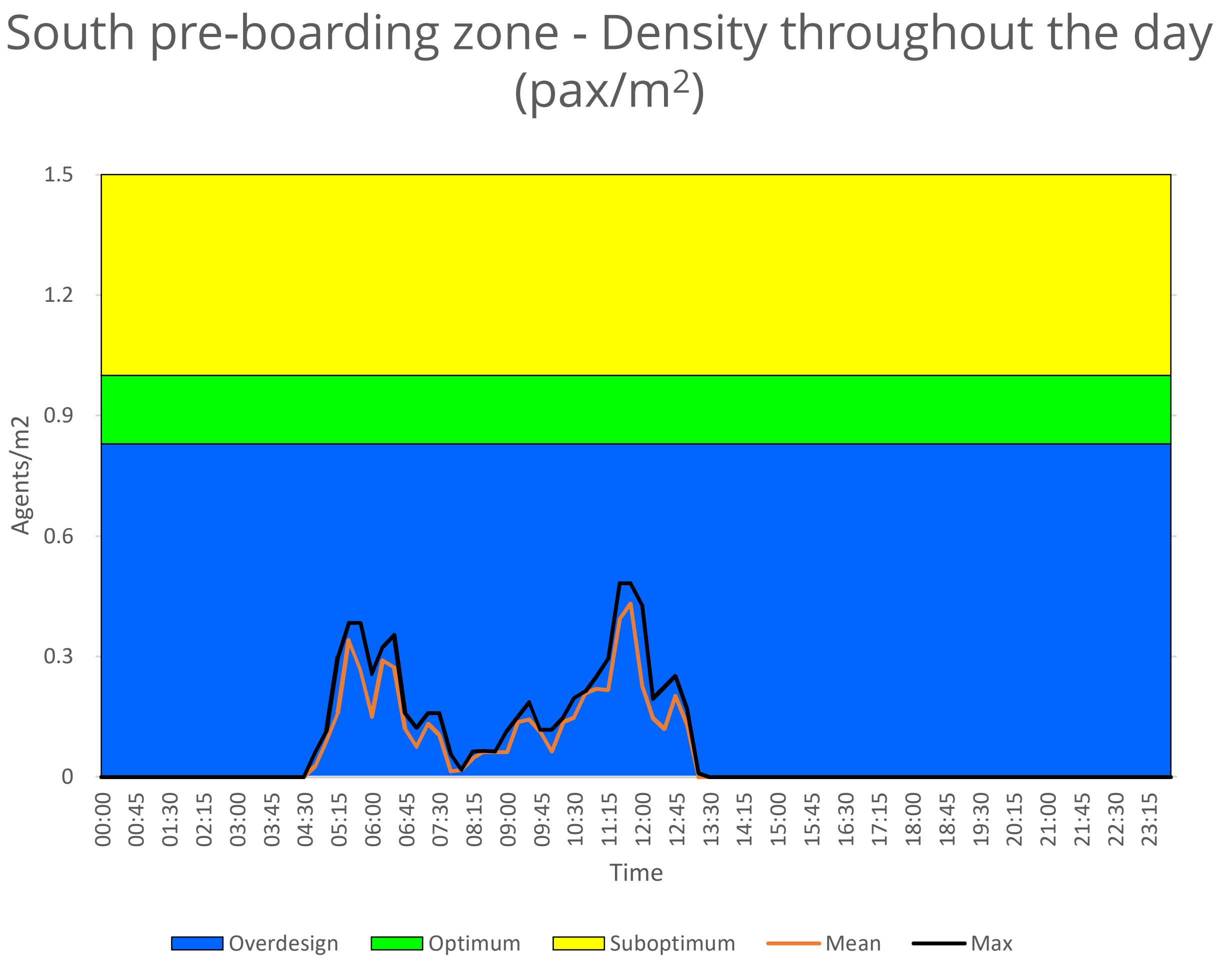


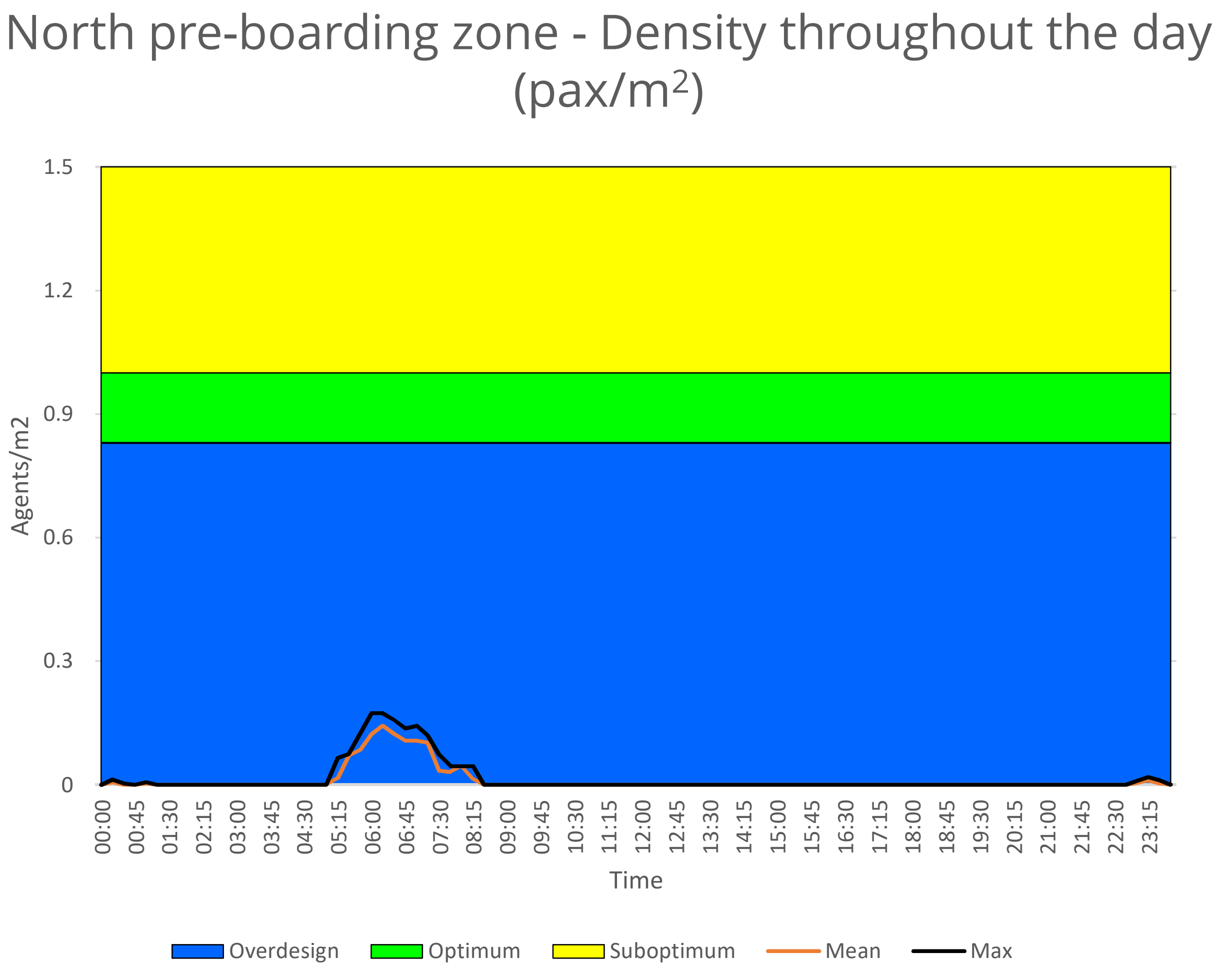
Pier 5 – First floor, Density throughout the day (pax/m²)



* LoS standards for standing passengers used as reference

PIER DENSITY GRAPHS



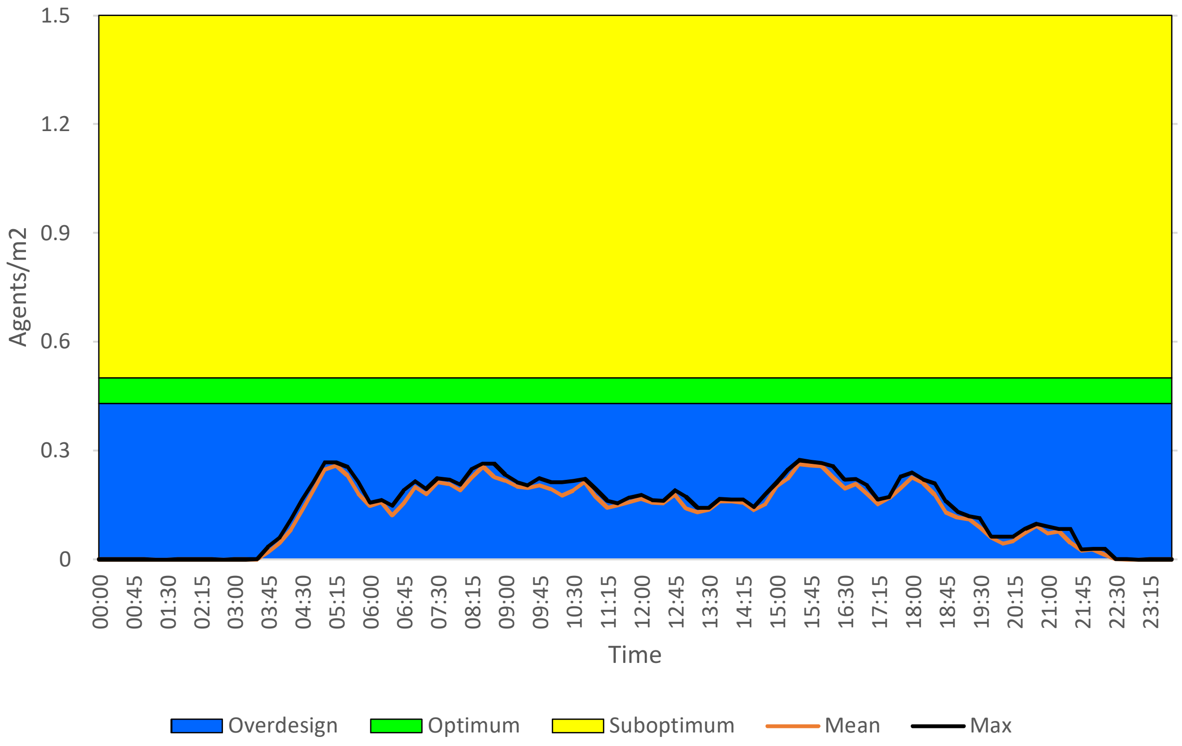


* LoS standards for standing passengers used as reference

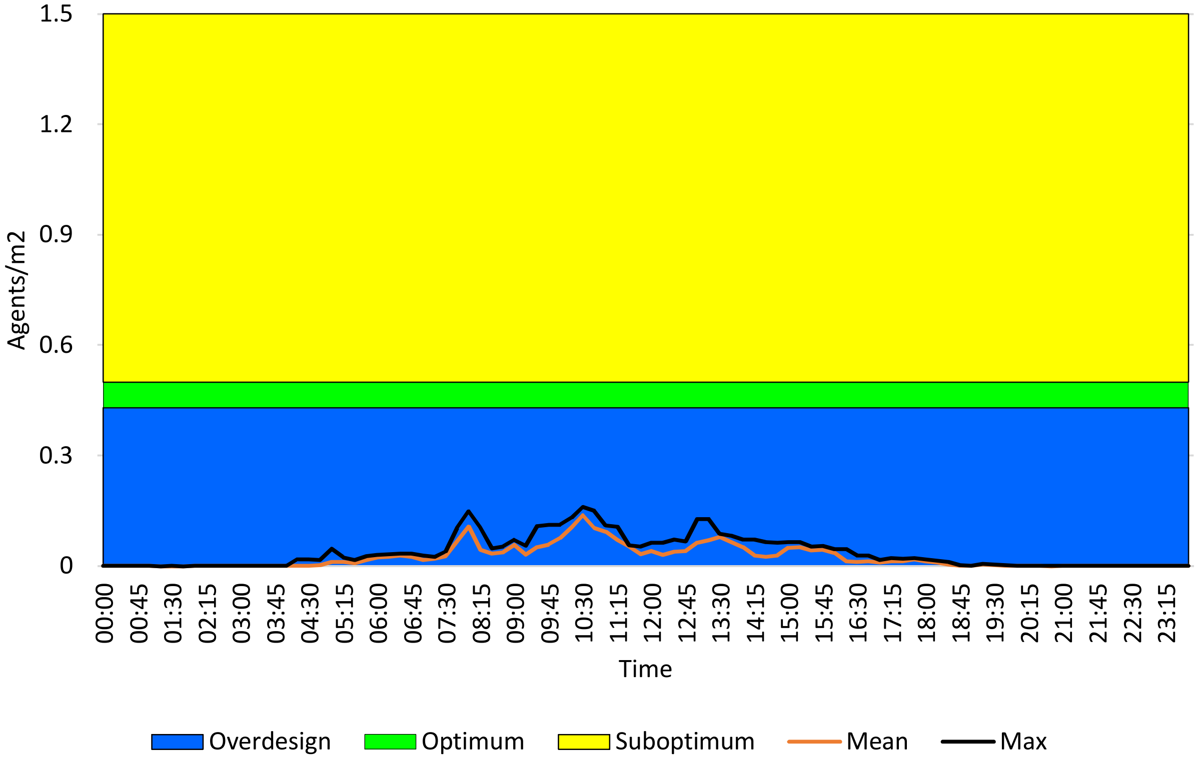
DEPARTURE LOUNGES

DEPARTURE LOUNGE: DENSITY GRAPHS FOR THE MAIN LEVELS

Terminal 1 – Density throughout the day (pax/m²)



Terminal 2 – Density throughout the day (pax/m²)



- Departure lounges in both Terminal 1 and Terminal 2 span across 2 levels. However, only the main (lower) level of each terminal was modelled.
- LoS standards for standing passengers used as reference

LIST OF ACRONYMS AND ABBREVIATIONS

ADRM	Airport Development Reference Manual	**ME**	Middle East
BD	Bag Drop	**NA**	North America
CAD	Computer-aided design	**NEU**	Non- European Union
CAR	Commission for Aviation Regulation	**OLH**	Other Long Haul (not Middle Eastern or US)
CBP	Customs and Border Protection	**OSH**	Other short haul (not RyanAir or AirLingus)
CIP	Capex Investment Programme	**pax**	Passengers
D8	Norwegian	**PTB**	Passenger Terminal Buildings
daa	Dublin Airport Authority	**SH**	Short-haul
EI	Aer Lingus	**SSK**	Self Service Kiosk
EU	European Union	**T1**	Terminal 1
FR	Ryanair	**T2**	Terminal 2
FTS	Fast-time simulation	**TSA**	Transport Security Administration
IATA	International Air Transport Association	**US**	United States
LH	Long - haul	**UTC**	Universal Time Coordinated
LoS	Level of Service		

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