Winter 2023: Assessment of the likely impact of declaring the Wishlist runway capacity

Alexandra Dudášová
April 2023

Contents

egis

01.

Context

egis

Context

The Commission for Aviation Regulation (CAR) is responsible for determining the parameters for slot allocation at Dublin Airport.

To ensure that optimal parameters are set, the Commission has instructed Egis to undertake airfield fast time simulations in preparation for the Winter 2023 (W23) season at Dublin airport.

This document provides results from two simulated scenarios:

- W23 flight schedule coordinated to the proposed W23 limits and
- W23 flight schedule coordinated to the existing W22 limits.

egis

02.

Model validation

Model description

- Based on the model developed to support the coordination committee decisions in 2017 and used since.

- Historically validated against a number of design days from previous seasonal assessments.

- Calibrated against a single day of W22 operations (08 January 2023).

- Run from actual block times to take into account all delays.

- A comparison set of airside performance metrics is provided on following slides.
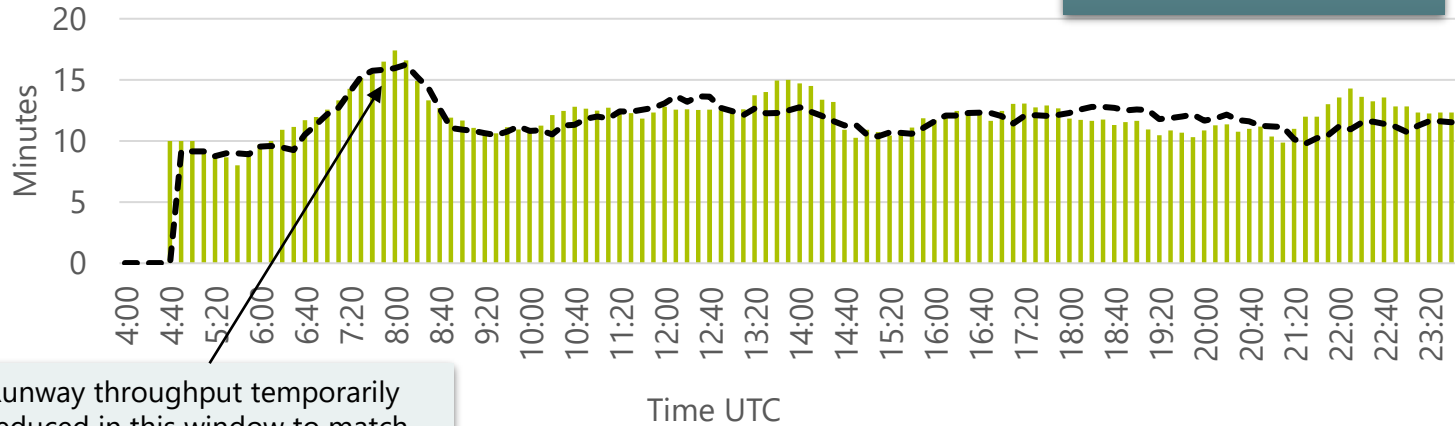
Busy day simulated for the purpose of model calibration

- **08 January 2023**
  - Westerly operations for 100% of the time;
  - Arrivals on 28L only;
  - Departures 28L 1800-0859;
  - Departures 28R 0900-1759;
- **620 flights in total, incl. GA and cargo**
  - 308 arrivals and 312 departures;
  - Helicopter operations not simulated.

Calibration of departure performance

Departure taxi-out duration

Daily averages
Actual data: 00:11:45
Simulation: 00:11:36

Minutes (y-axis: 0, 5, 10, 15, 20)

Time UTC (x-axis: 4:00, 4:40, 5:20, 6:00, 6:40, 7:20, 8:00, 8:40, 9:20, 10:00, 10:40, 11:20, 12:00, 12:40, 13:20, 14:00, 14:40, 15:20, 16:00, 16:40, 17:20, 18:00, 18:40, 19:20, 20:00, 20:40, 21:20, 22:00, 22:40, 23:20)

■ Actual data --- Simulation

Runway throughput temporarily reduced in this window to match 'on the day' throughput reduction. W23 simulations use standard agreed minimum separations

Off-blocks count

Departures (y-axis: 0, 10, 20, 30, 40)

Time UTC (x-axis: 4:00, 4:40, 5:20, 6:00, 6:40, 7:20, 8:00, 8:40, 9:20, 10:00, 10:40, 11:20, 12:00, 12:40, 13:20, 14:00, 14:40, 15:20, 16:00, 16:40, 17:20, 18:00, 18:40, 19:20, 20:00, 20:40, 21:20, 22:00, 22:40, 23:20)
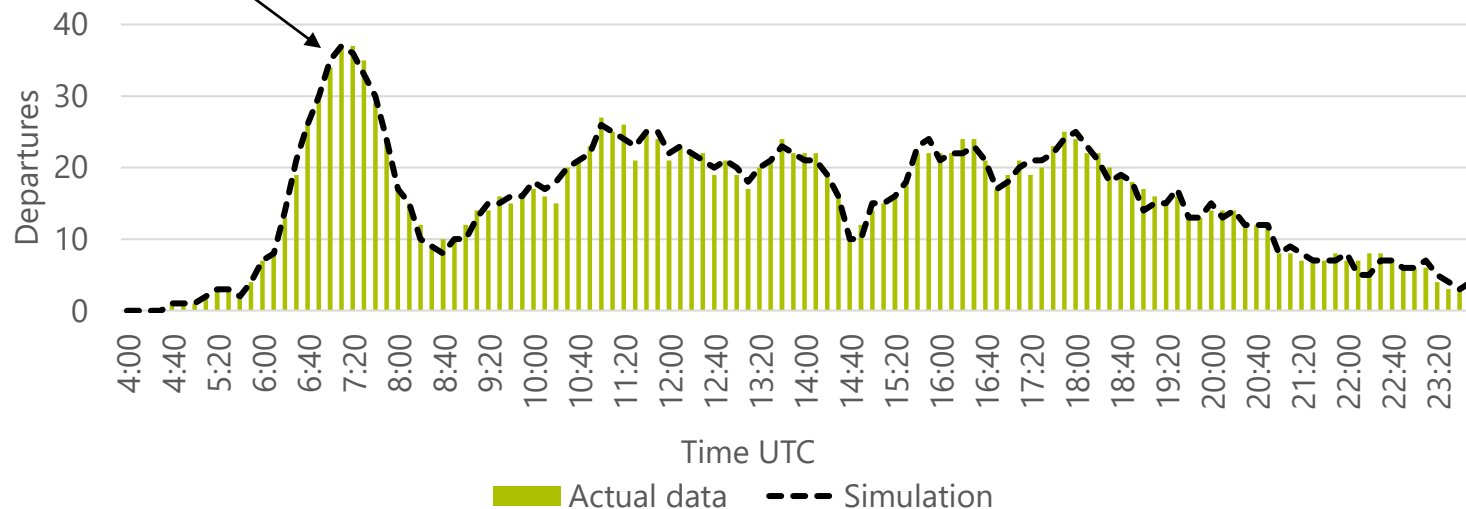
■ Actual data --- Simulation

Metric definition:

Time duration between the off-block time and aircraft lifting off.

*This graph is presented as a rolling 10-minute average (value for each time period has been calculated as average of values of all events occurring within the T-60 minutes window from the start of the measurement).
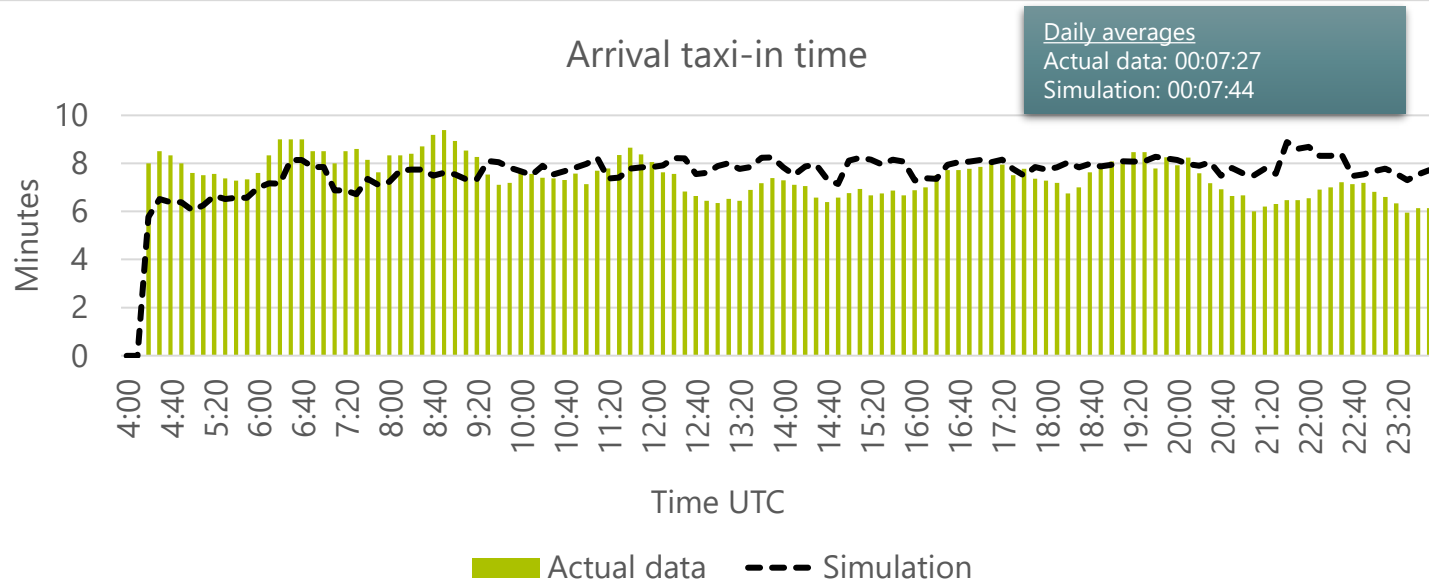
Metric definition:

The number of aircraft that have been pushed back in the last rolling period. The count is incremented when the aircraft leaves its departure parking position (either being pushed back at gate or taxiing / pulled away from a parking position).

* This graph is presented as a rolling 10-minute average (value for each time period has been calculated as average of values of all events occurring within the T-60 minutes window from the start of the measurement).

Calibration of arrival performance

Arrival taxi-in time

Daily averages
Actual data: 00:07:27
Simulation: 00:07:44

Minutes / Time UTC

Actual data --- Simulation

Metric definition:

Time duration between touch-down and aircraft parking on-blocks.

*This graph is presented as a rolling 10-minute average (value for each time period has been calculated as average of values of all events occurring within the T-60 minutes window from the start of the measurement).

On-blocks count

Arrivals / Time UTC

Actual data --- Simulation
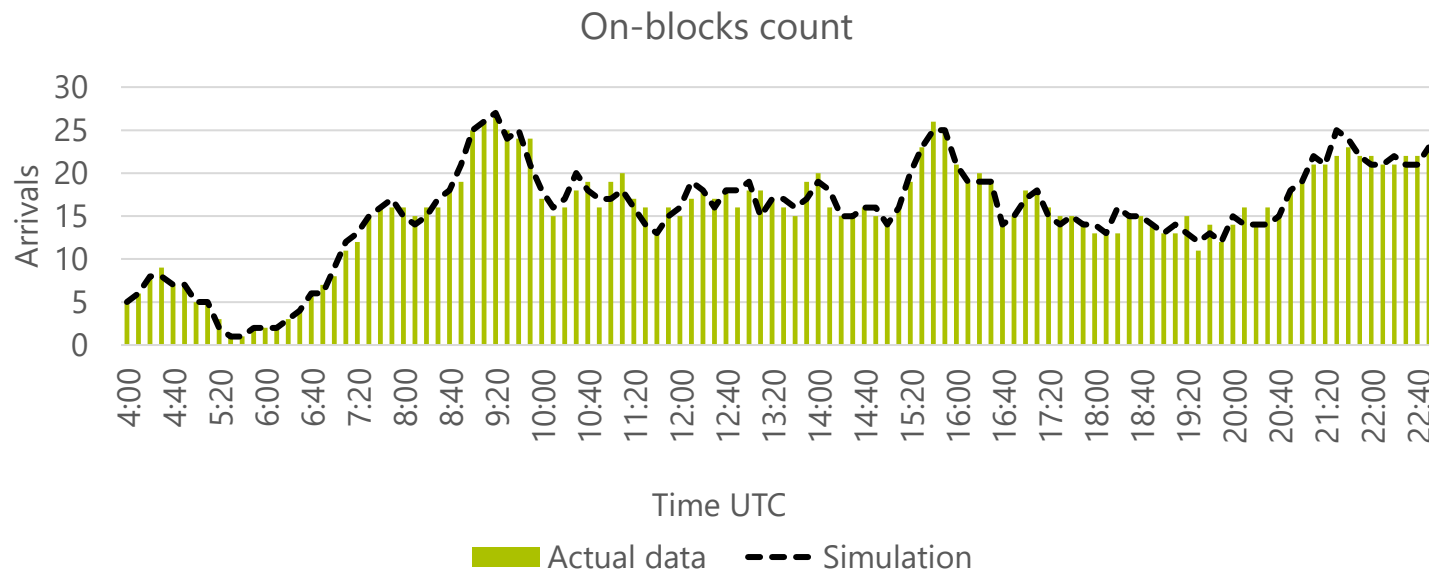
Metric definition:

The number of aircraft that have reached their arrival parking position in the last 10-minute rolling period. The count is incremented when the aircraft reaches its in-blocks position.

* This graph is presented as a rolling 10-minute average (value for each time period has been calculated as average of values of all events occurring within the T-60 minutes window from the start of the measurement).
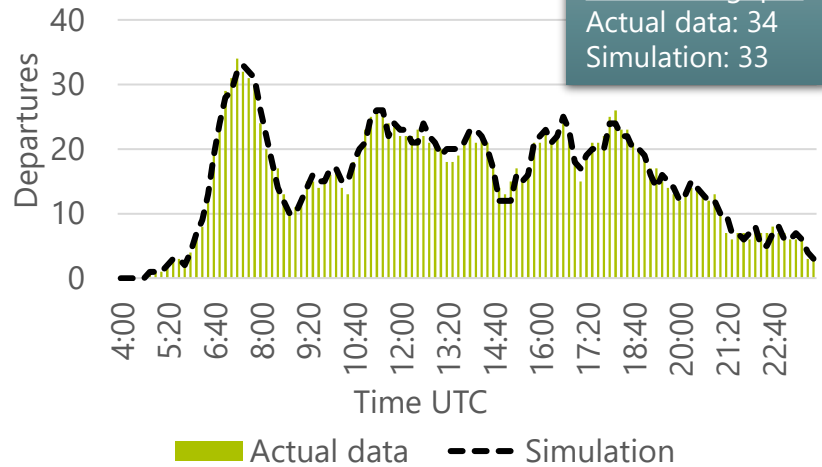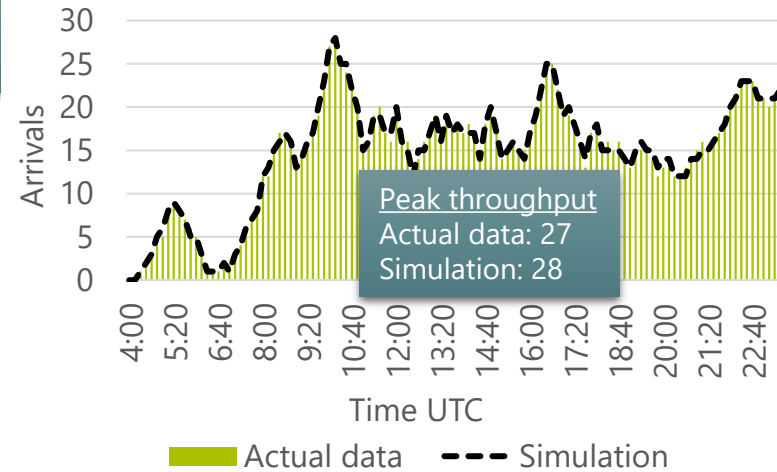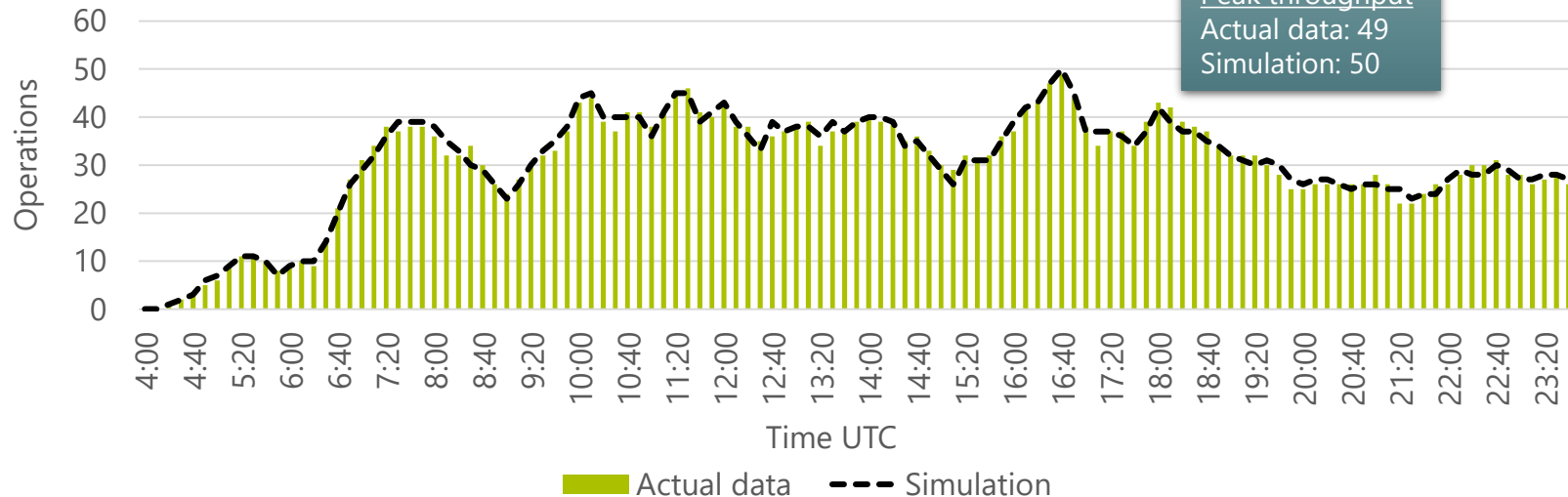
Calibration of runway performance

Lift-off count

Peak throughput
Actual data: 34
Simulation: 33

Departures axis: 0, 10, 20, 30, 40
Time UTC: 4:00, 5:20, 6:40, 8:00, 9:20, 10:40, 12:00, 13:20, 14:40, 16:00, 17:20, 18:40, 20:00, 21:20, 22:40

Legend: Actual data — Simulation

Touch-down count

Peak throughput
Actual data: 27
Simulation: 28

Arrivals axis: 0, 5, 10, 15, 20, 25, 30
Time UTC: 4:00, 5:20, 6:40, 8:00, 9:20, 10:40, 12:00, 13:20, 14:40, 16:00, 17:20, 18:40, 20:00, 21:20, 22:40

Legend: Actual data — Simulation

Runway throughput

Peak throughput
Actual data: 49
Simulation: 50

Operations axis: 0, 10, 20, 30, 40, 50, 60
Time UTC: 4:00, 4:40, 5:20, 6:00, 6:40, 7:20, 8:00, 8:40, 9:20, 10:00, 10:40, 11:20, 12:00, 12:40, 13:20, 14:00, 14:40, 15:20, 16:00, 16:40, 17:20, 18:00, 18:40, 19:20, 20:00, 20:40, 21:20, 22:00, 22:40, 23:20

Legend: Actual data — Simulation

Metric definition:

Lift-off count: The number of aircraft that have lifted off in the 60-minute rolling period. The count is incremented when the aircraft passes over the opposite end of the runway.

Touch-down count: The number of aircraft that have touched down in the 60-minute rolling period.

Runway throughput: Sum of all aircraft touching down and lifting-off in the 60-minute rolling period.

* All graphs are presented as a rolling 60-minute average (value for each time period has been calculated as average of values of all events occurring within the T-60 minutes window from the start of the measurement).

Result of model validation exercise

As the metrics calculated through the FTS model closely match the real-world data, both in terms of magnitude and profile shape, the model can be considered a satisfactory representation for the purpose of evaluating the impact of the proposed changes on flight schedules.

The model is considered to be valid if it is a sufficiently accurate representation of the corresponding real-world problem from the perspective of the intended uses of the model. "Valid" for a simulation does not mean the same as "indistinguishable from the real-world system", even though in this case there is a close match.

egis

03.

Methodology
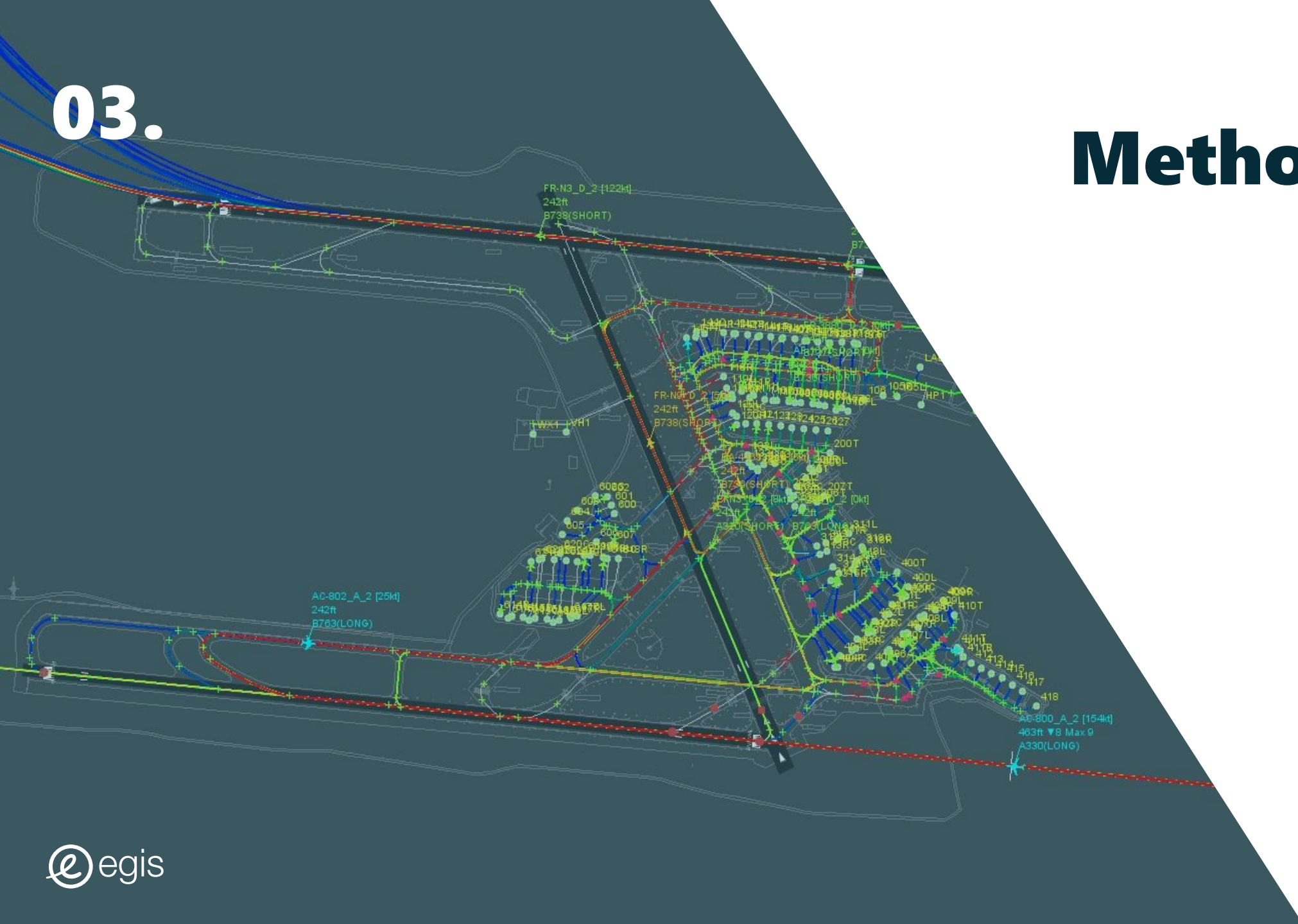
Task description

The purpose of this comparison is to assess the likely effect of either:

- **declaring an increased runway capacity, as per the Dublin Airport Wishlist proposal, or**

- **maintaining the Winter 2022 capacity declaration limits.**

The Winter 2023 schedule was designed based on expected W23 demand but also to test the proposed R60 capacity increases.

In both cases it is presumed that the Winter 2023 schedule of increased demand materialises as expected.

The same number of movements are modelled in all cases, the difference being the limits to which they are coordinated. This difference is therefore a best current information estimate of the effect of a decision to increase the runway limits on a busy Winter 2023 day.

Approach and key changes in the model
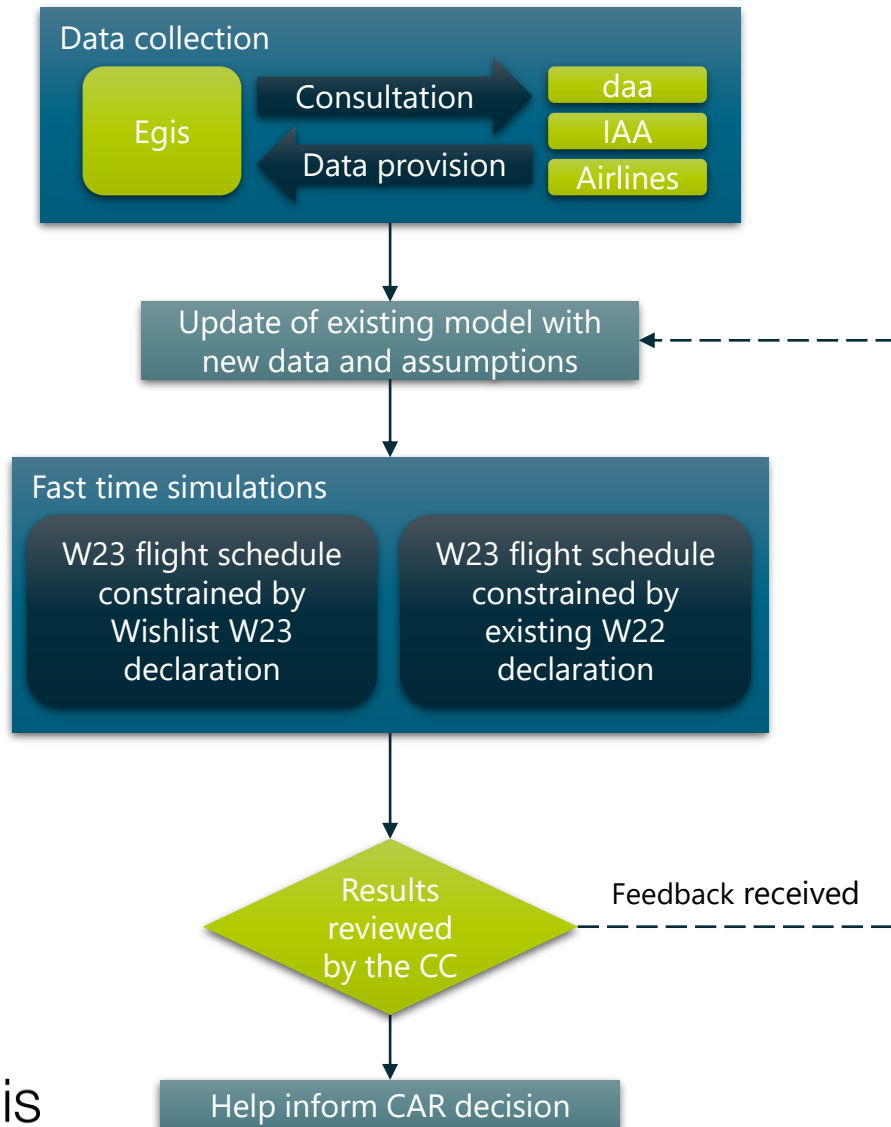
Changes to airfield model:

- Restrictions on F-INNER:
  - Closed for through traffic 24/7.
- Prerequisites for dual code E ops on Z/B1:
  - B1 closed for the duration of construction works.
- Link 5 and link 6 open in W23
- Dual runway operations:
  - Semi-mixed mode (arrive 28L, depart 28L & 28R) during the day (07:00 – 22:59 UTC) and
  - Single runway operations for both arrivals and departures from 28L for the night period (23:00 – 06:59 UTC).
  - Departures from runway 28R operating on new SIDs;
- No changes to operating procedures
  - Departure-departure separation kept at minimum of 84 seconds;
  - Arrival-arrival separation kept at minimum of 3.5 NM;
  - A-D-A separation kept at minimum of 5.5 NM.

Winter 2023 (W23) flight schedule

The flight schedule used for modelling of both scenarios:

- Based on 08th January 2023 flight schedule (an already a busy day before the new services were added);

- Contains a total of 780 flights (394 arrivals and 386 departures);

- Contains 64 new arrivals and 56 new departures;

- Does not contain helicopter, military, state or medical flights.

egis

W23 Wishlist proposed by Dublin Airport

Hour UTC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Arrivals																									
Existing W22 arrivals capacity	23	23	23	23	23	23	23	21	25	24	23	28	26	24	24	23	24	24	24	23	24	25	29	23	**575**
Proposed W23 arrivals capacity	23	23	23	23	23	23	23	21	25	24	25	28	28	25	25	23	24	26	26	24	24	25	32	23	**589**
Difference (against W22 declaration)	0	0	0	0	0	0	0	0	0	0	2	0	2	1	1	0	0	2	2	1	0	0	3	0	**14**
Departures																									
Existing W22 departures capacity	23	23	23	23	23	25	35	31	23	25	24	26	28	27	24	27	26	27	26	24	24	23	23	23	**606**
Proposed W23 departures capacity	23	23	23	23	23	25	35	35	24	25	25	28	28	28	25	27	26	28	27	25	24	23	23	23	**619**
Difference (against W22 declaration)	0	0	0	0	0	0	0	4	1	0	1	2	0	1	1	0	0	1	1	1	0	0	0	0	**13**
Totals																									
Existing W22 totals	32	32	32	32	32	32	40	40	44	42	41	48	46	43	40	43	46	47	43	38	39	39	39	32	**942**
Proposed W23 totals	32	32	32	32	32	32	40	46	45	42	43	50	49	45	42	43	46	49	46	40	39	39	42	32	**970**
Difference (against W22 declaration)	0	0	0	0	0	0	0	6	1	0	2	2	3	2	2	0	0	2	3	2	0	0	3	0	**28**

Besides adhering to hourly runway limits, flights in all modelled scenarios adhere also to 10-minute limits on number of movements – these have been assumed in line with daa proposal as follows:

Maximum number of movements per 10 minute period	
Maximum Total	13
Maximum Arrivals	6
Maximum Departures	7

W23 constrained by proposed W23 limits

| Hour UTC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Arrivals																									
Proposed W23 arrivals capacity	23	23	23	23	23	23	23	21	25	24	25	28	28	25	25	23	24	26	26	24	24	25	32	23	**589**
Arrivals in simulated W23 schedule	2	1	0	2	7	7	6	16	21	17	25	23	26	21	20	17	23	24	19	18	22	22	32	23	**394**
Historic	*2*	*1*	*0*	*1*	*7*	*5*	*6*	*13*	*19*	*16*	*18*	*22*	*21*	*19*	*15*	*16*	*19*	*20*	*12*	*11*	*19*	*22*	*25*	*21*	***330***
Additional arrivals proposed for W23	*0*	*0*	*0*	*1*	*0*	*2*	*0*	*3*	*2*	*1*	*7*	*1*	*5*	*2*	*5*	*1*	*4*	*4*	*7*	*7*	*3*	*0*	*7*	*2*	***64***
Spare capacity (against W23 wishlist)	21	22	23	21	16	16	17	5	4	7	0	5	2	4	5	6	1	2	7	6	2	3	0	0	**195**
Departures																									
Proposed W23 departures capacity	23	23	23	23	23	25	35	35	24	25	25	28	28	28	25	27	26	28	27	25	24	23	23	23	**619**
Departures in simulated W23 schedule	0	1	1	2	3	9	34	30	24	21	16	27	23	24	22	21	22	25	27	22	14	9	7	2	**386**
Historic	*0*	*1*	*1*	*2*	*2*	*8*	*34*	*27*	*21*	*19*	*12*	*24*	*20*	*22*	*13*	*20*	*20*	*20*	*22*	*12*	*12*	*9*	*7*	*2*	***330***
Additional departures proposed for W23	*0*	*0*	*0*	*0*	*1*	*1*	*0*	*3*	*3*	*2*	*4*	*3*	*3*	*2*	*9*	*1*	*2*	*5*	*5*	*10*	*2*	*0*	*0*	*0*	***56***
Spare capacity (against W23 wishlist)	23	22	22	21	20	16	1	5	0	4	9	1	5	4	3	6	4	3	0	3	10	14	16	21	**233**
Totals																									
Wishlist W23 Totals capacity	32	32	32	32	32	32	40	46	45	42	43	50	49	45	42	43	46	49	46	40	39	39	42	32	**970**
Totals in simulated W23 schedule	2	2	1	4	10	16	40	46	45	38	41	50	49	45	42	38	45	49	46	40	36	31	39	25	**780**
Historic	*2*	*2*	*1*	*3*	*9*	*13*	*40*	*40*	*40*	*35*	*30*	*46*	*41*	*41*	*28*	*36*	*39*	*40*	*34*	*23*	*31*	*31*	*32*	*23*	***660***
Additional movements proposed for W23	*0*	*0*	*0*	*1*	*1*	*3*	*0*	*6*	*5*	*3*	*11*	*4*	*8*	*4*	*14*	*2*	*6*	*9*	*12*	*17*	*5*	*0*	*7*	*2*	***120***
Spare capacity (against W23 wishlist)	30	30	31	28	22	16	0	0	0	4	2	0	0	0	0	5	1	0	0	0	3	8	3	7	**190**

Constraining the W23 schedule by the W22 limits results in spreading the flights into shoulder hours

Departures

Departures per hour (y-axis 0–50) vs Time UTC (0–23)
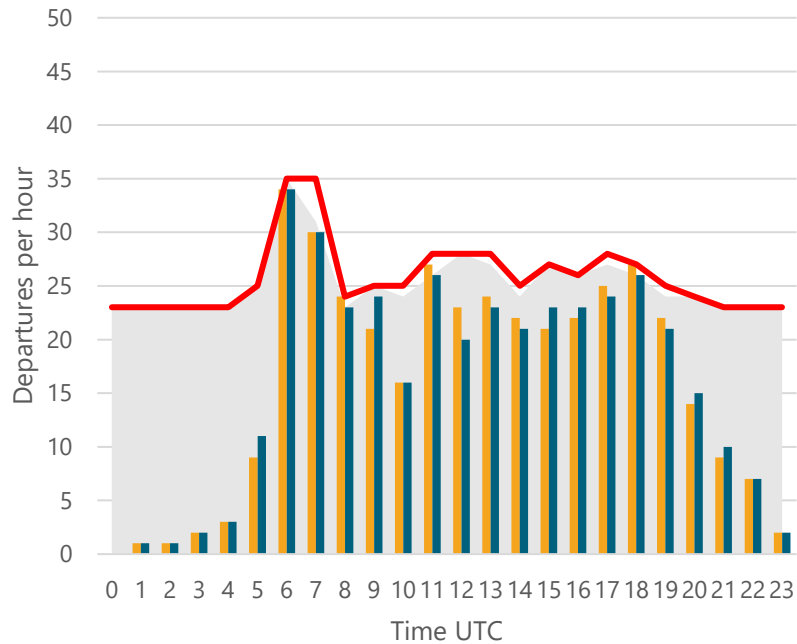
- Declared departures capacity (W22)
- Departures in simulated W23 flight schedule (W23 limits)
- Departures in simulated W23 flight schedule (W22 limits)
- Wishlist departures capacity (W23)

Arrivals

Arrivals per hour (y-axis 0–50) vs Time UTC (0–23)
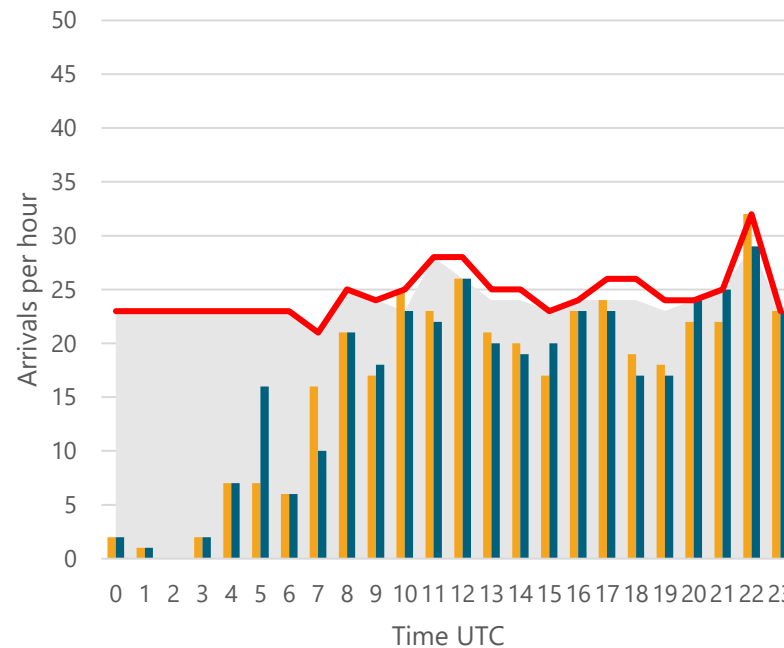
- Declared arrivals capacity (W22)
- Arrivals in simulated W23 flight schedule (W23 limits)
- Arrivals in simulated W23 flight schedule (W22 limits)
- Wishlist arrivals capacity (W23)

Totals

Movements per hour (y-axis 0–50) vs Time UTC (0–23)
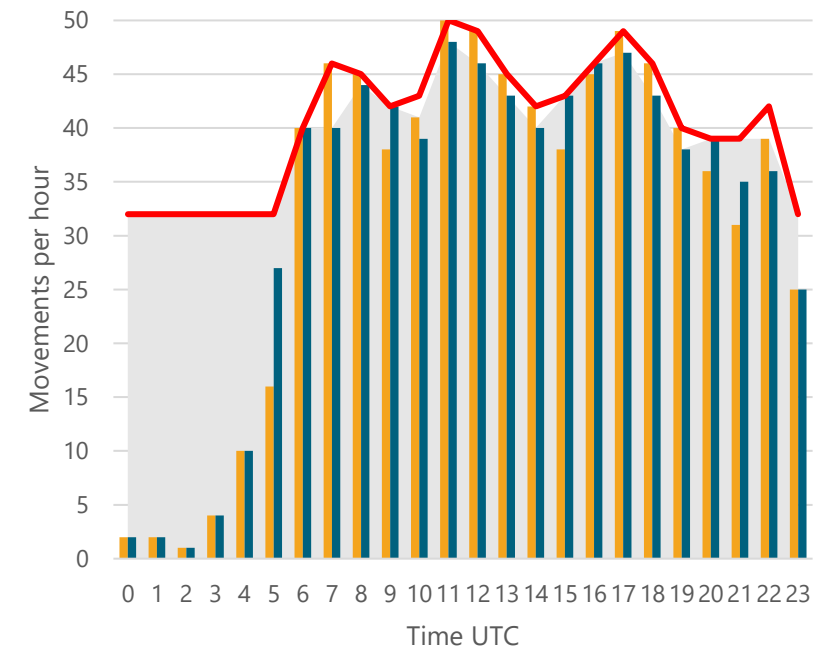
- Declared totals capacity (W22)
- Totals in simulated W23 flight schedule (W23 limits)
- Totals in simulated W23 flight schedule (W22 limits)
- Wishlist totals capacity (W23)

Some of the additional services envisaged in W23 schedule had to be re-timed to make the flight schedule compatible with the existing W22 declaration. This simulates a case where existing W22 declaration will be rolled forward to Winter 23 season but all of the new services would still operate – although not necessarily at the originally scheduled times.

W23 constrained by existing W22 limits

Hour UTC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
Arrivals																									
Existing W22 arrivals capacity	23	23	23	23	23	23	23	21	25	24	23	28	26	24	24	23	24	24	24	23	24	25	29	23	**575**
Arrivals in simulated W23 schedule	2	1	0	2	7	16	6	10	21	18	23	22	26	20	19	20	23	23	17	17	24	25	29	23	**394**
Historic	*2*	*1*	*0*	*1*	*7*	*8*	*6*	*10*	*19*	*16*	*18*	*22*	*21*	*19*	*15*	*16*	*19*	*20*	*12*	*11*	*19*	*22*	*25*	*21*	*330*
Additional arrivals proposed for W23	*0*	*0*	*0*	*1*	*0*	*8*	*0*	*0*	*2*	*2*	*5*	*0*	*5*	*1*	*4*	*4*	*4*	*3*	*5*	*6*	*5*	*3*	*4*	*2*	*64*
Spare capacity (against W23 wishlist)	21	22	23	21	16	7	17	11	4	6	0	6	0	4	5	3	1	1	7	6	0	0	0	0	**181**
Departures																									
Existing W22 departures capacity	23	23	23	23	23	25	35	31	23	25	24	26	28	27	24	27	26	27	26	24	24	23	23	23	**606**
Departures in simulated W23 schedule	0	1	1	2	3	11	34	30	23	24	16	26	20	23	21	23	23	24	26	21	15	10	7	2	**386**
Historic	*0*	*1*	*1*	*2*	*2*	*8*	*34*	*27*	*21*	*19*	*12*	*24*	*20*	*22*	*13*	*20*	*20*	*20*	*22*	*12*	*12*	*9*	*7*	*2*	*330*
Additional departures proposed for W23	*0*	*0*	*0*	*0*	*1*	*3*	*0*	*3*	*2*	*5*	*4*	*2*	*0*	*1*	*8*	*3*	*3*	*4*	*4*	*9*	*3*	*1*	*0*	*0*	*56*
Spare capacity (against W23 wishlist)	23	22	22	21	20	14	1	1	0	1	8	0	8	4	3	4	3	3	0	3	9	13	16	21	**220**
Totals																									
Existing W22 totals	32	32	32	32	32	32	40	40	44	42	41	48	46	43	40	43	46	47	43	38	39	39	39	32	**942**
Totals in simulated W23 schedule	2	2	1	4	10	27	40	40	44	42	39	48	46	43	40	43	46	47	43	38	39	35	36	25	**780**
Historic	*2*	*2*	*1*	*3*	*9*	*16*	*40*	*37*	*40*	*35*	*30*	*46*	*41*	*41*	*28*	*36*	*39*	*40*	*34*	*23*	*31*	*31*	*32*	*23*	*660*
Additional movements proposed for W23	*0*	*0*	*0*	*1*	*1*	*11*	*0*	*3*	*4*	*7*	*9*	*2*	*5*	*2*	*12*	*7*	*7*	*7*	*9*	*15*	*8*	*4*	*4*	*2*	*120*
Spare capacity (against W23 wishlist)	30	30	31	28	22	5	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	3	7	**162**

04.

Results

(westerly operations)

egis

Departure taxi out time

Definition: This metric is defined to be the time period between off-block and the time the aircraft lifts-off. This value is updated every second during the simulation when the aircraft is taxiing for departure even if the aircraft is stopped on ground.

*This graph is presented as a rolling 10-minute average (value for each time period has been calculated as average of values of all events occurring within the T-60 minutes window from the start of the measurement).
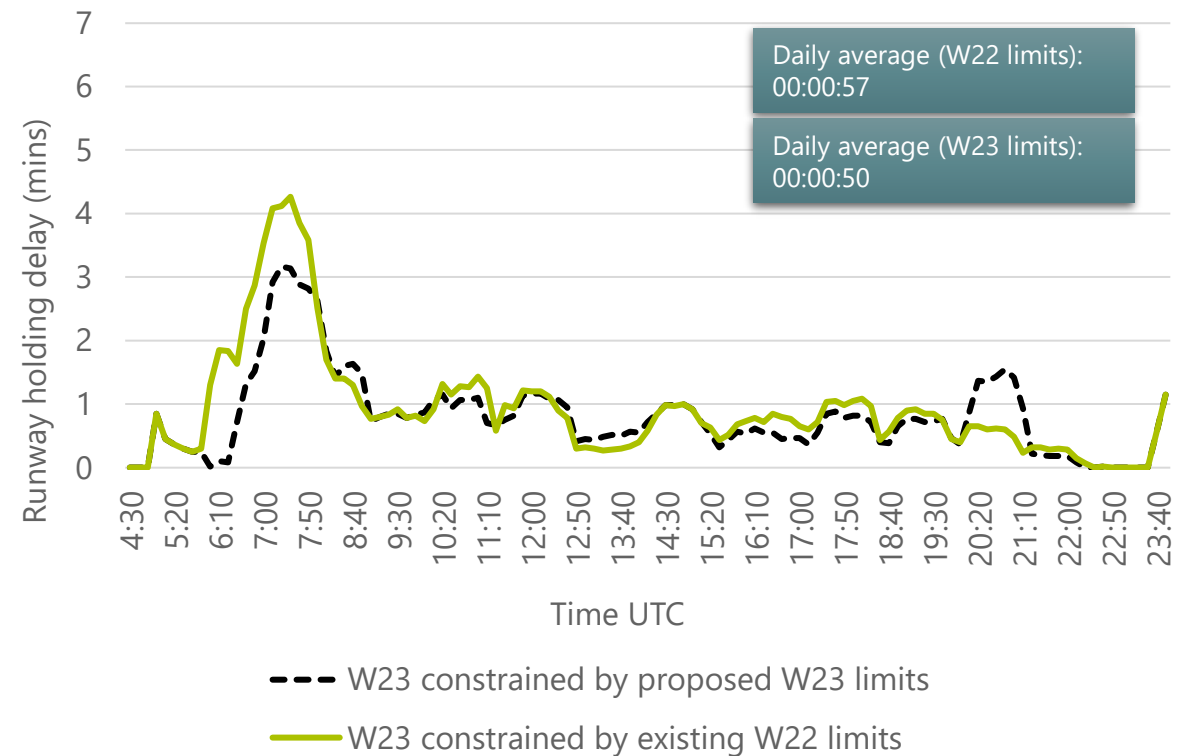
21
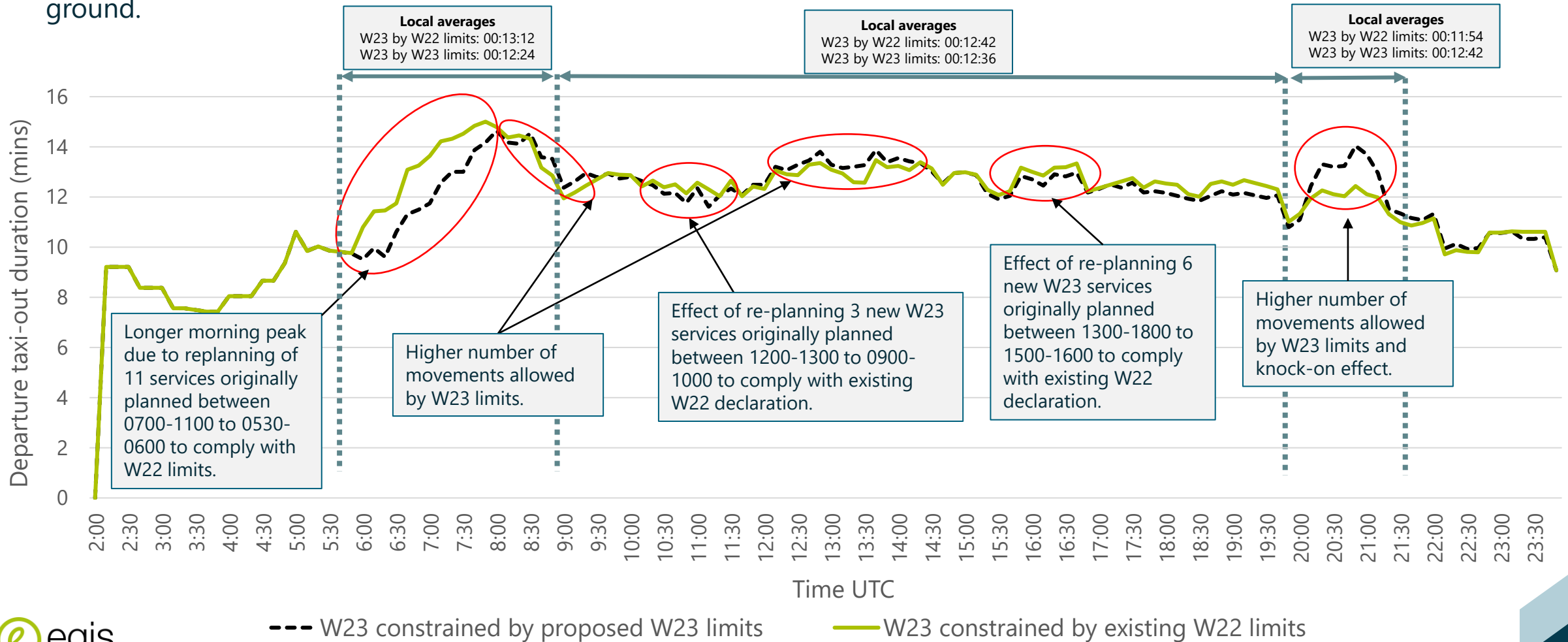
Departure ground delay and runway holding delay

Departure ground delay: Total delay of departing aircraft accumulated between off-block and entering the runway. It is effectively the sum of runway holding delay and other delays.
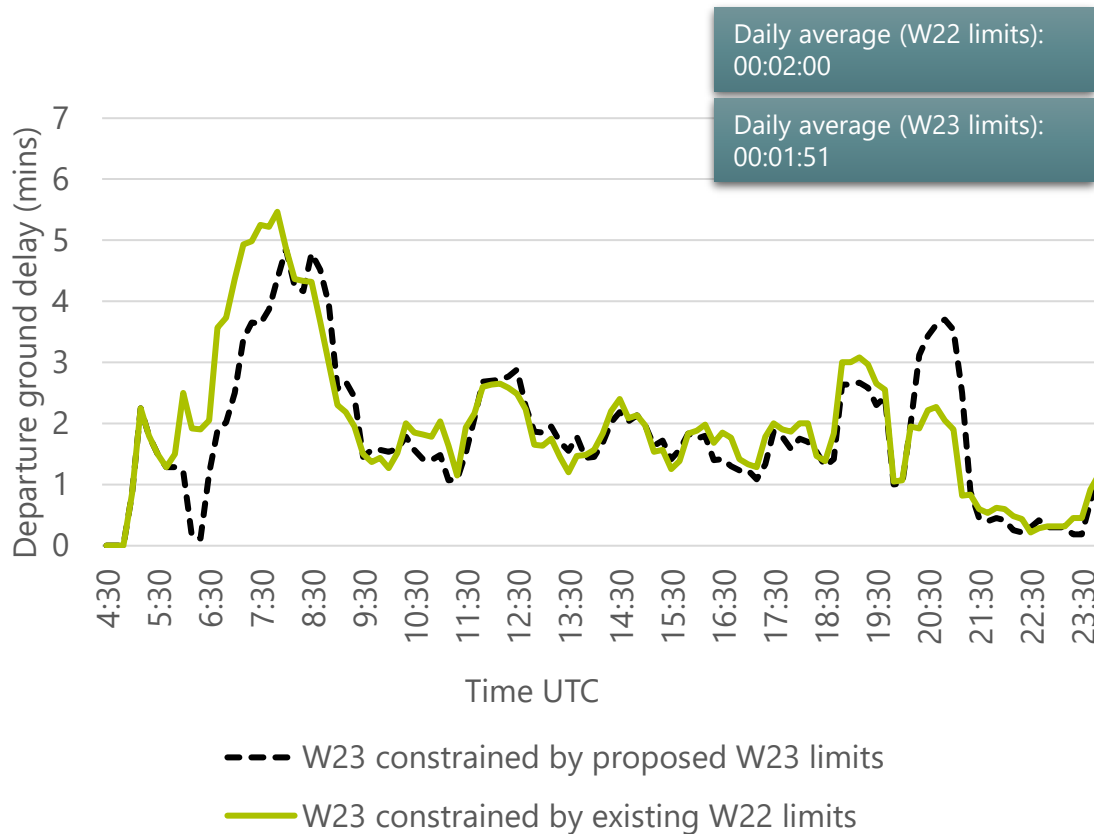
Runway holding delay: The delay experienced while the aircraft is queueing for runway entry. The delay can be caused by other aircraft (being slowed down or stopped) or when waiting at runway stop-bar (because the runway is not free for lining up). This metric is defined to be the time period between joining the back end of the queue and the time the aircraft reaches its stop bar for runway entry.
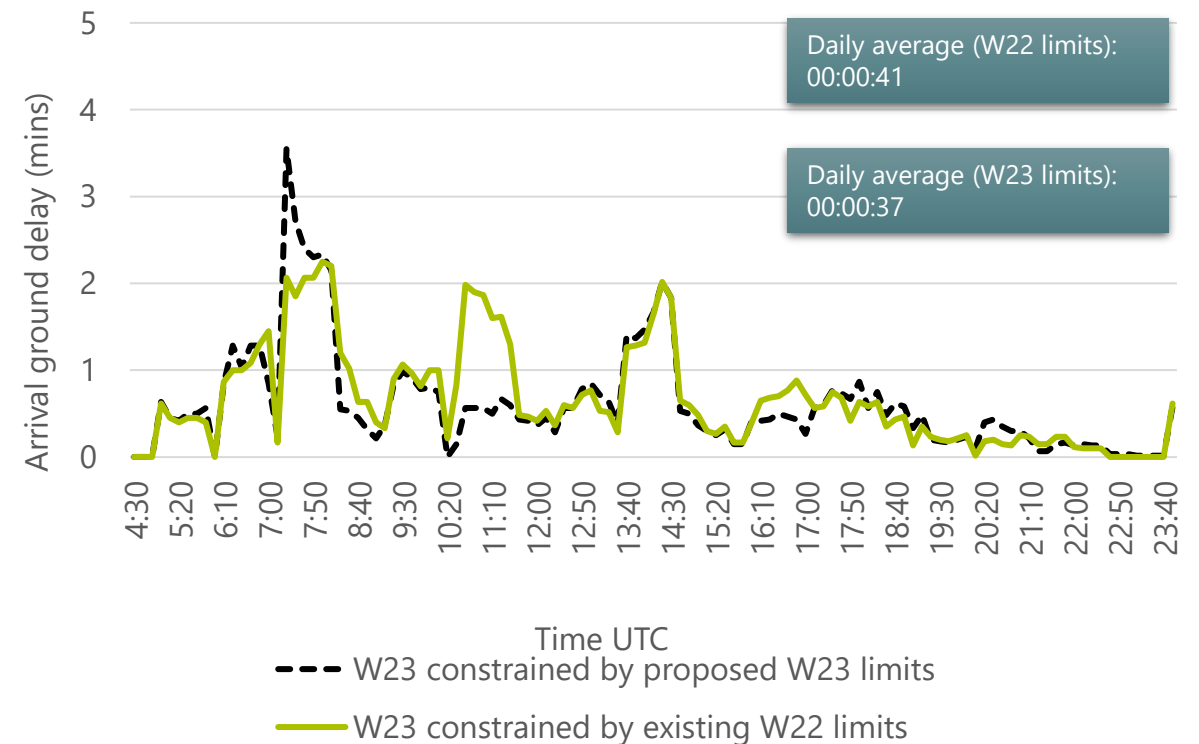
Daily average (W22 limits): 00:02:00

Daily average (W23 limits): 00:01:51

Daily average (W22 limits): 00:00:57

Daily average (W23 limits): 00:00:50

--- W23 constrained by proposed W23 limits
— W23 constrained by existing W22 limits

--- W23 constrained by proposed W23 limits
— W23 constrained by existing W22 limits

*These graphs are presented as a rolling 10-minute average (value for each time period has been calculated as average of values of all events occurring within the T-60 minutes window from the start of the measurement).

Arrival taxi in time and arrival ground delay

Arrival taxi-in time: The time duration the arriving aircraft has been taxiing on the ground of its arrival airport. This value is updated every second of simulation time when the arriving aircraft is taxiing even if the aircraft is stopped on ground.
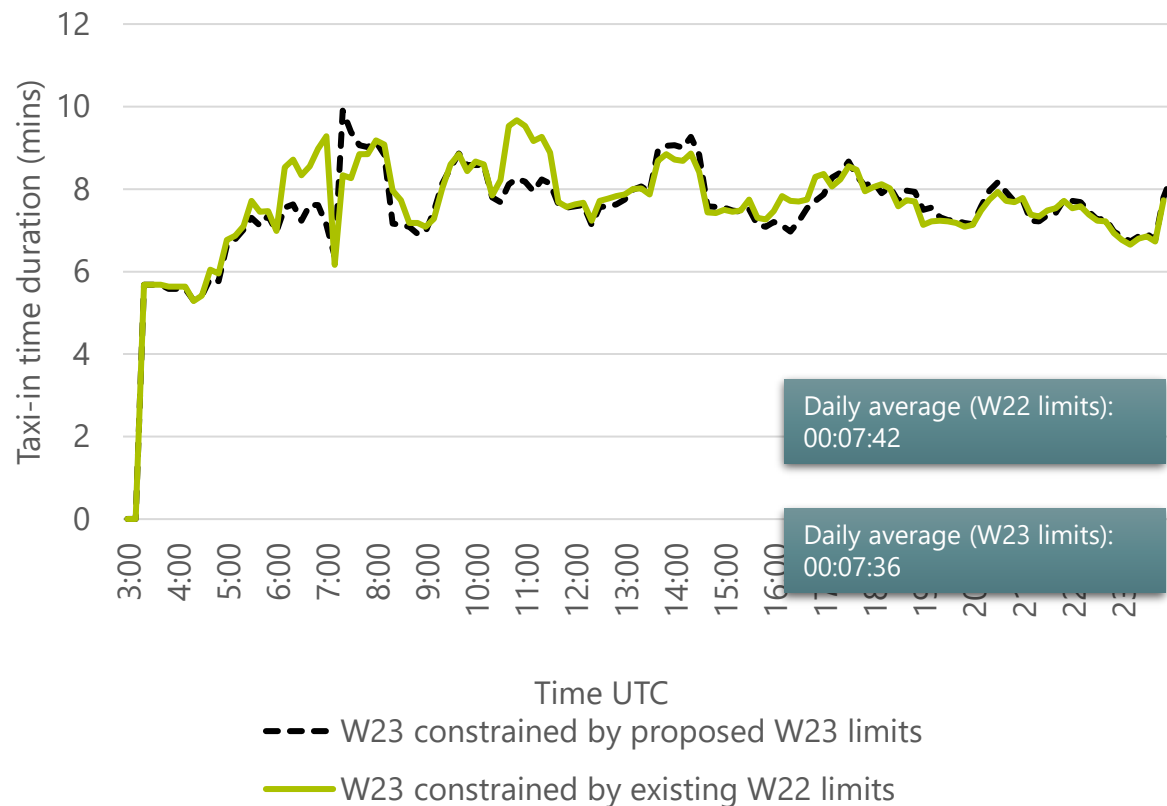
Arrival ground delay: The delay caused by traffic (slowing down or being stopped) while the aircraft is taxiing to its arrival stand. Every second of simulation time the aircraft is stopped on ground due to other traffic, the delay is increased accordingly. Additionally, if the aircraft is forced to slow-down due to other traffic, a proportional delay is calculated.

Daily average (W22 limits): 00:07:42

Daily average (W23 limits): 00:07:36

Time UTC
- - - W23 constrained by proposed W23 limits
—— W23 constrained by existing W22 limits

Daily average (W22 limits): 00:00:41

Daily average (W23 limits): 00:00:37

Time UTC
- - - W23 constrained by proposed W23 limits
—— W23 constrained by existing W22 limits

*These graphs are presented as a rolling 10-minute average (value for each time period has been calculated as average of values of all events occurring within the T-60 minutes window from the start of the measurement).

05.

Findings

Increasing the RWY limits in line with the W23 Wishlist

Assuming the W23 schedule materializes as expected, increasing the runway limits in line with the W23 Wishlist:

- The daily average and peak taxi out times are not materially impacted by declaring the additional capacity.

- Is likely to cause localized deterioration of ground delays in and around those hours where capacity increases are proposed, which is offset by less use of available capacity in adjoining hours.

  - The average departure taxi time in the first morning wave peaks between 0750-0830 with average departure taxi time of around 14 minutes and 30 seconds per flight.

  - Additional services proposed between 1000-1459 show negligible impact on taxi time performance - this period is constrained primarily by limits on total number of movements rather than arrivals or departures limits.

  - Additional services between 1700-1959 pose additional demand on departure runway and are likely to cause increase of up to 2 minutes of additional departure taxi-out time per flight.

  - Additional arrivals between 2300-2359 are not likely to cause additional taxi time, even though the arrivals are scheduled up to the proposed limits, but there is spare capacity in total movements.

- Is likely to lead to scheduled capacity limits being reached during the morning period (0600-0859 UTC), mid-day (1000-1459 UTC), evening (1700-1959 UTC) and night (2200-2359 UTC). However, when both runways are operational, taxi time is not materially impacted by additional services.

- Firebreaks will be preserved in the morning at 0900 UTC and at in the afternoon at 1500 UTC.

  Simulated schedule is restricted primarily by limits on total movements. Only 5 hours in a day are limited by either arrival or departure limits.

ⓔegis

Maintaining the RWY limits in line with the W22 declaration

Assuming the W23 schedule materializes as expected, maintaining the runway limits in line with the W22 capacity declaration:

- Is likely to cause re-distribution of newly planned services to hours with any remaining available capacity.
  - The highest impact is likely to be in the morning period 0530-0730, where 11 flight were re-scheduled to comply with W22 limits. This causes the departure taxi-out peak to start an hour earlier in comparison to W23 schedule constrained by proposed W23 limits.
  - Re-planning the new services to comply with W22 limits will:
    - Cause local reduction in taxi time performance (compared against W23 wishlist schedule) in those hours where the additional services were initially proposed.
    - Cause local increase in taxi time performance (compared against W23 wishlist schedule) in those hours where the propose new services for W23 have been accommodated in line with W22 capacity limits.

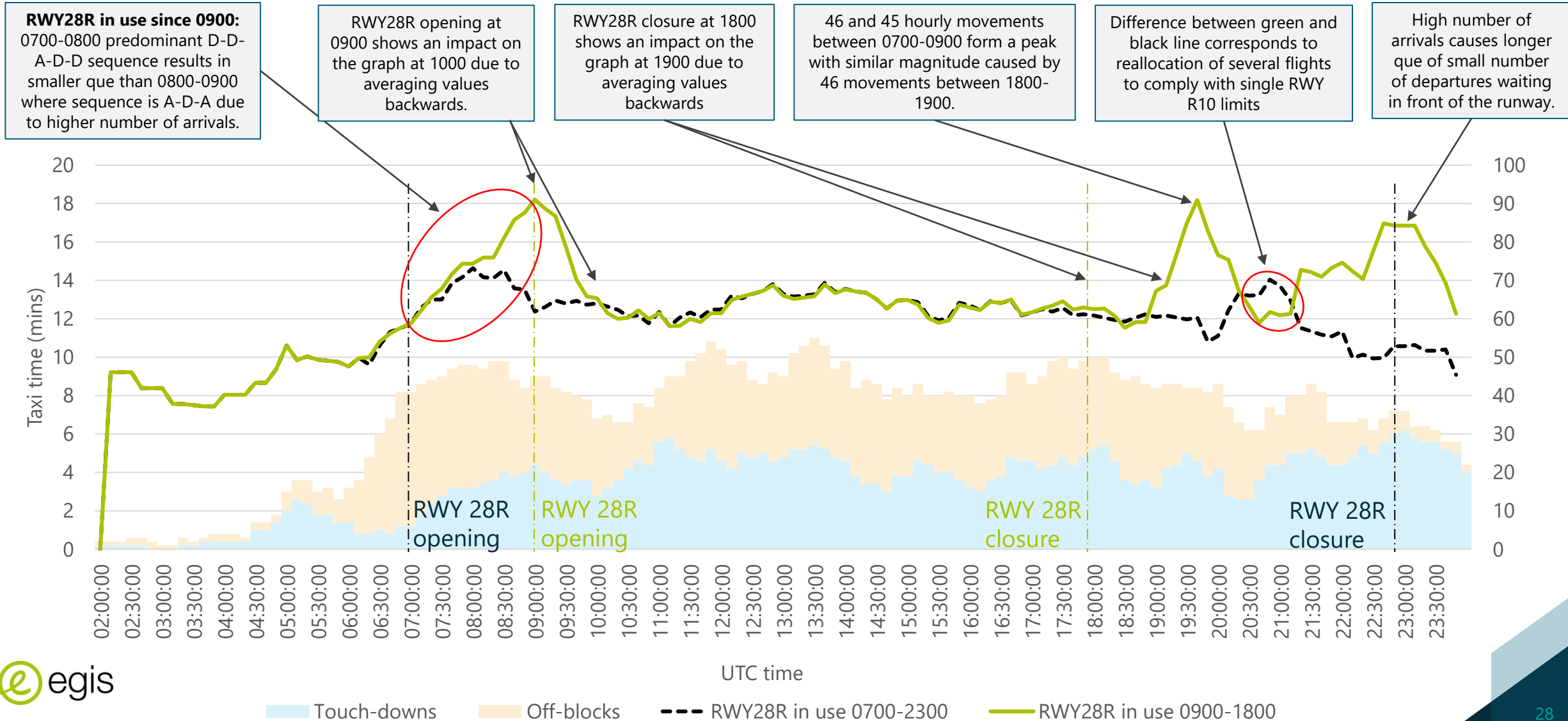- Is likely to lead to scheduled capacity limits being reached between 0600-2359.

06.

Additional simulation

North runway operational between 0900-1800

Departure taxi out time
Comparison of RWY28R operation times under W23 proposed limits

All values for each time window have been calculated as average of values of all events occurring within the T-60 minutes window from the start of the measurement.

RWY28R in use since 0900: 0700-0800 predominant D-D-A-D-D sequence results in smaller que than 0800-0900 where sequence is A-D-A due to higher number of arrivals.

RWY28R opening at 0900 shows an impact on the graph at 1000 due to averaging values backwards.

RWY28R closure at 1800 shows an impact on the graph at 1900 due to averaging values backwards

46 and 45 hourly movements between 0700-0900 form a peak with similar magnitude caused by 46 movements between 1800-1900.

Difference between green and black line corresponds to reallocation of several flights to comply with single RWY R10 limits

High number of arrivals causes longer que of small number of departures waiting in front of the runway.

RWY 28R opening

RWY 28R opening

RWY 28R closure

RWY 28R closure

UTC time

Touch-downs Off-blocks RWY28R in use 0700-2300 RWY28R in use 0900-1800

egis

28

Arrival taxi in time
Comparison of RWY28R operation times under W23 proposed limits
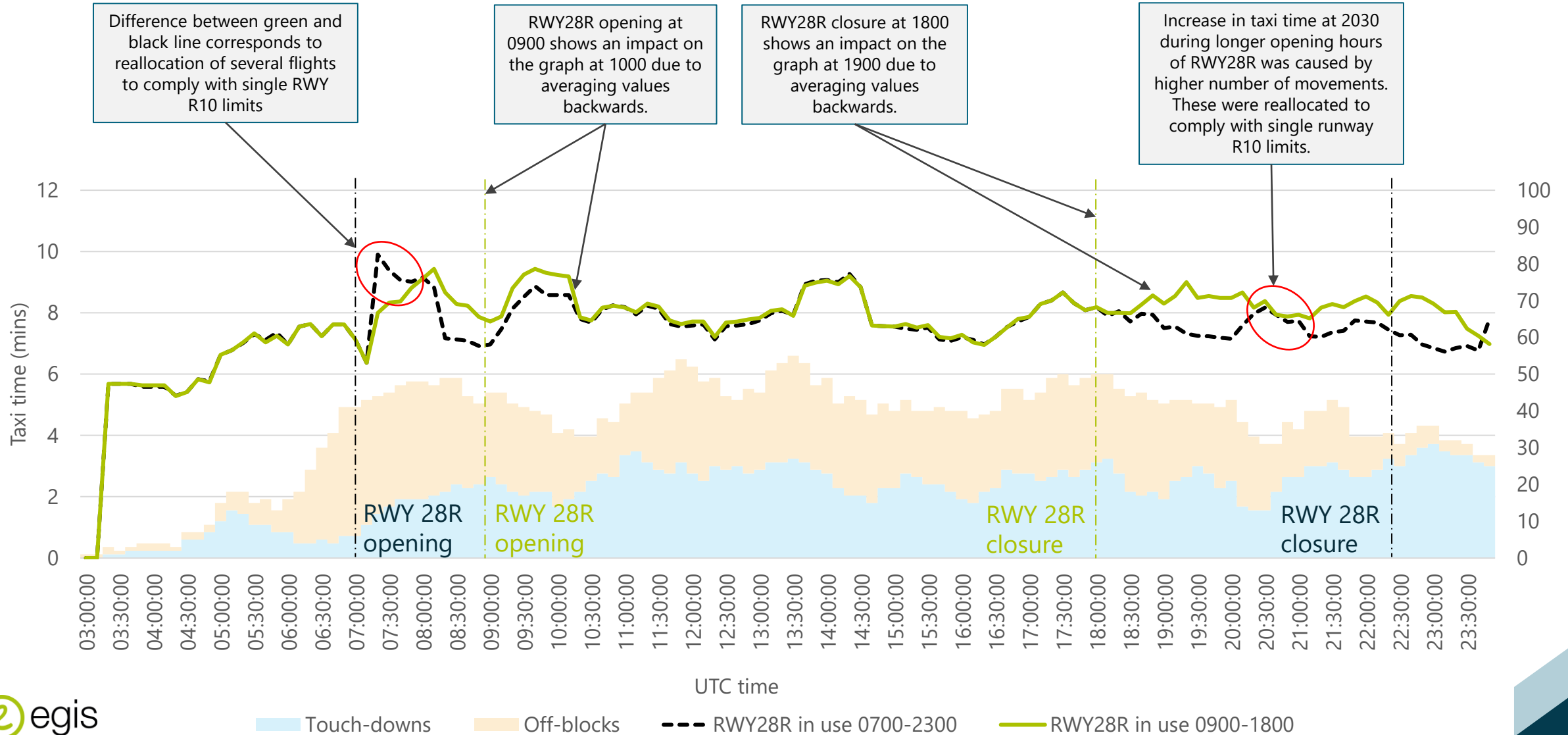
All values for each time window have been calculated as average of values of all events occurring within the T-60 minutes window from the start of the measurement.

Alexandra Dudášová

Egis

15 avenue du Centre
CS 20538 Guyancourt
Saint Quentin-en-Yvelines
France

www.egis-group.com