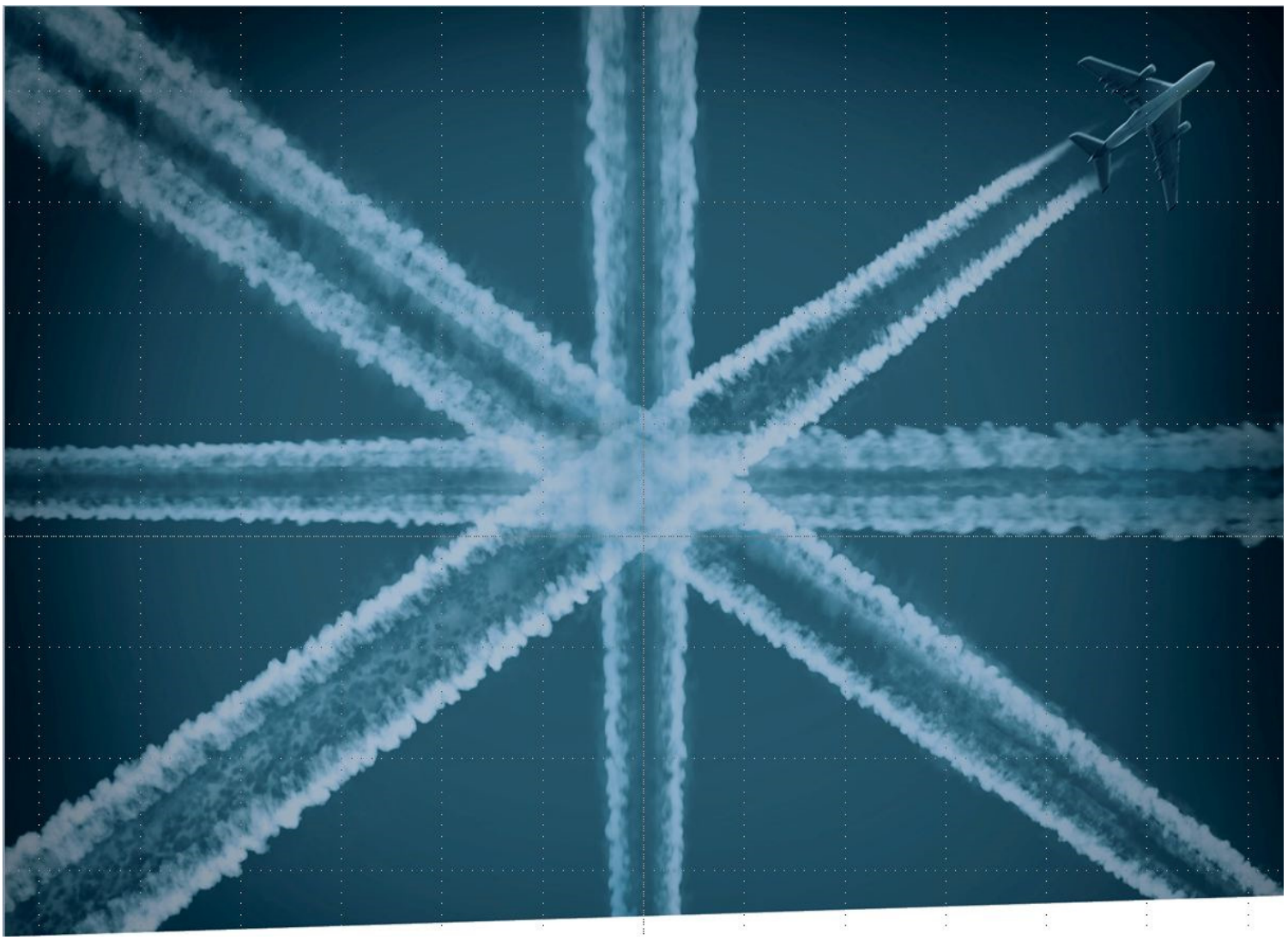
Introducing RNP1 (RF) SIDs

Airspace Change Proposal

London Stansted Airport – February 2016



Executive Summary

For over two years London Stansted Airport ('Stansted') has been trialling RNP1 technology in collaboration with the local community and our industry partners. The purpose of the trial was to reduce the number of people directly overflown by departing aircraft through improving the accuracy that these departing aircraft can navigate immediately after departure.

The two trial SIDs are a replication of our conventional SIDs and the results represent significant benefits for the local area. The procedures are wholly contained within the existing Noise Preferential Routes and offer many of our local communities the benefit of no longer being directly overflown by departing aircraft at low level.

The extensive consultation process undertaken between September to November 2015 was to demonstrate the trial data we have so far and understand local community feeling towards implementing this RNP1 technology permanently.

The feedback received through the consultation exercise was very positive, particularly with those comments received from parish, district and county councils suggesting the airport should expand this technology to our other departures routes.

In light of this positive feedback and support shown during the consultation exercise, London Stansted is submitting this Airspace Change Proposal in order to formally adopt the two RNP1 SIDs, CLN1E and DET1D as trialled, as a permanent option to complement our existing SIDs.

John Farrow

Operations Director

Contents

1. Background

This Airspace Change Proposal (ACP) has been developed to meet the requirements of the CAA publication 'Guidance on PBN SID Replication for Conventional SID Replacement'.

The intention of this ACP is to implement two trial SIDs that were designed to RNP1 with RF turns specification. The SIDs were originally designed to help improve departure track keeping and avoid the overflight of some areas within the NPRs by following the conventional SID as closely as possible through replication. The concentration of departure tracks, evident from our trial data, supports the government policy as stated in the Aviation Policy Framework

> *'Consistent with its overall policy to limit and where possible reduce the number of people adversely affected by aircraft noise, the Government believes that, in most circumstances, it is desirable to concentrate aircraft along the fewest possible number of specified routes in the vicinity of airports and that these routes should avoid densely populated areas as far as possible*[1]*.'*

Stansted believes that this government policy objective has been fully realised through the PBN trial undertaken at Stansted, which commenced on 7 May 2013.

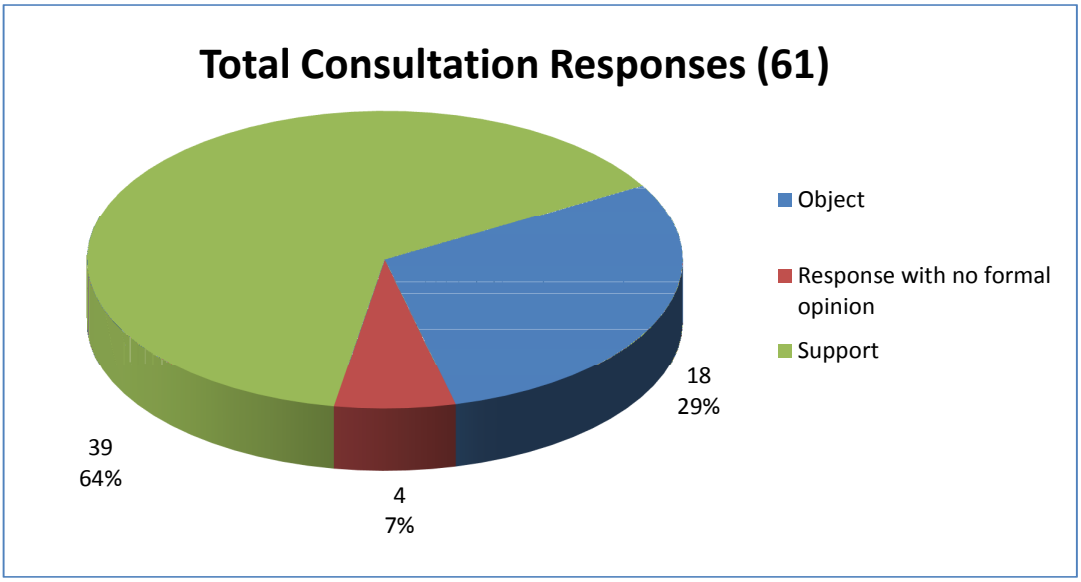
The first 18 months of track data since the commencement of the trial was analysed and a technical report[2] published in May 2015 followed. This was submitted to the CAA. The trial continued for a further year. Stansted then launched a public consultation sharing data from the trial, demonstrating its results and gathering feedback from local communities and stakeholders before seeking to adopt the procedures permanently through this ACP.

A full suite of consultation materials can be found online at:
http://www.stanstedairport.com/community/local-environmental-impacts/performance-based-navigation/

The consultation feedback was widely in support of the trial procedures, as demonstrated on the graph on page 4. Following a comprehensive review of all feedback received (demonstrated through the publication of our Consultation Feedback Report) Stansted has now progressed to submit this ACP.

---

[1] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/153776/aviation-policy-framework.pdf
[2] 'Trial Technical Report':http://www.stanstedairport.com/community/local-environmental-impacts/noise/



Introducing PBN also forms part of the regulatory requirements for Stansted. The Airport is mandated by the EU to introduce PBN, by way of RNP1 with RF SIDs as part of the SESAR - Pilot Common Project. [3]

All departure track evidence in this ACP is data recorded as gathered by the Airport's Noise and Track Keeping System – ANOMS. Having already trialled these procedures extensively, there exists a strong evidence base of data rather than theoretical / anticipated results.

Whilst most of the regulatory requirements for this ACP have already been evidenced in the RNP1 Trial report, all additional requirements will be covered in the remainder of this document. This ACP does not include any additional images to those available during the public consultation.

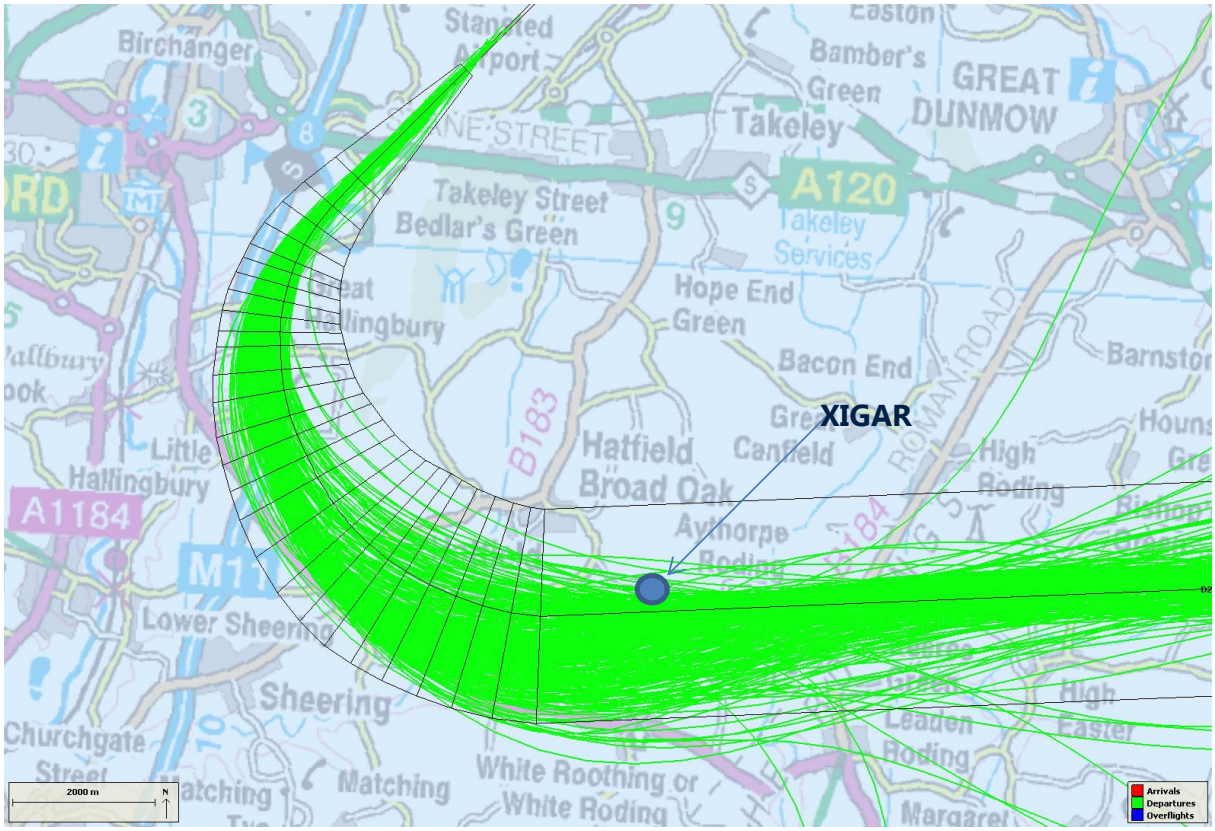
[3] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0716&from=EN

2. Concerns with existing SIDs and NPRs

CLN8R – conventional SID vs. (trialled) CLN1E - RNP1 (RF) SID

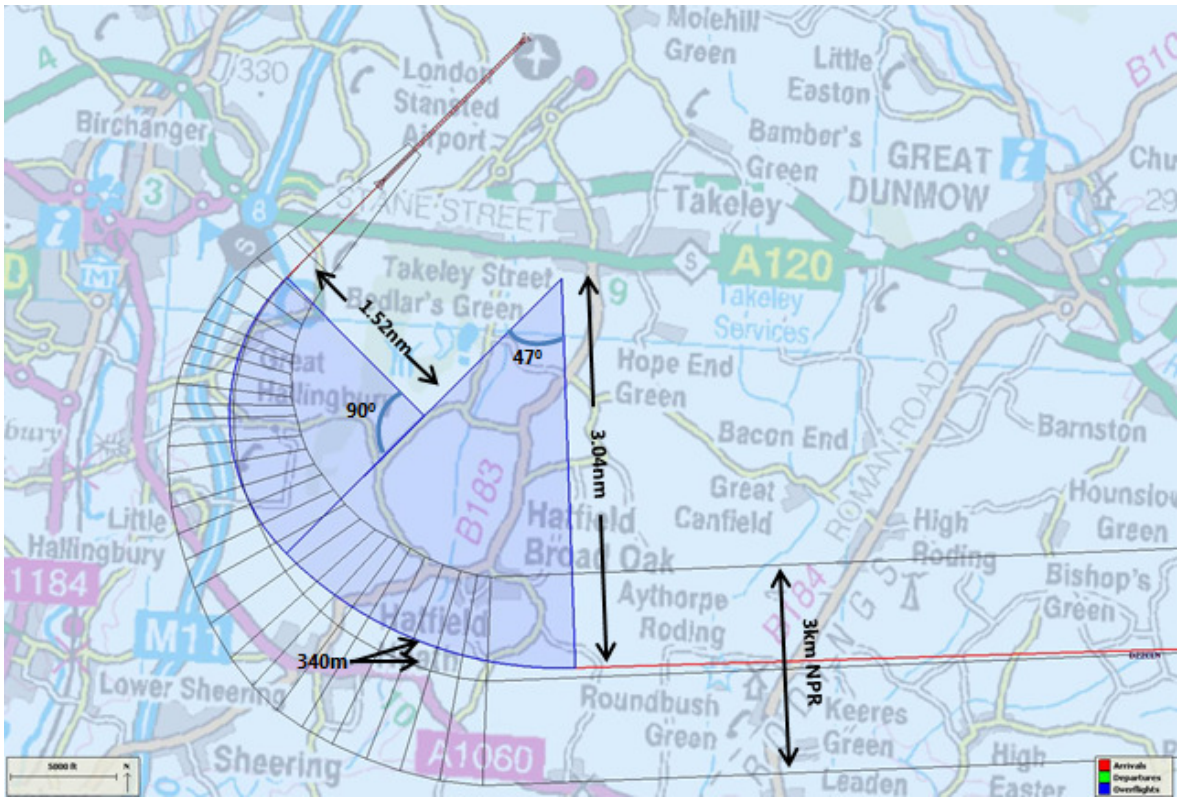
The CLN8R SID is in use when operating on runway 22. The initial turn commences at 1.2DME and routes the SID slightly to the north of Hatfield Heath, outbound towards the Clacton VOR. Traditionally, most aircraft overshoot the turn and as a result directly overfly the communities of Little Hallingbury and Hatfield Heath. This impact is magnified for these areas due to another SID (DET1R) also being in very close proximity during the initial turn, before straightening down to the Detling VOR.

The Hatfield Broad Oak community to the northern edge of the NPR is often also overflown by aircraft that turn direct to the XIGAR waypoint rather than following the curve of the conventional SID.



By replicating the conventional SID with RNP1 RF design, concentrating aircraft as closely to the conventional SID as possible, many of the communities mentioned would experience a significant reduction in the direct overflight of departing aircraft.

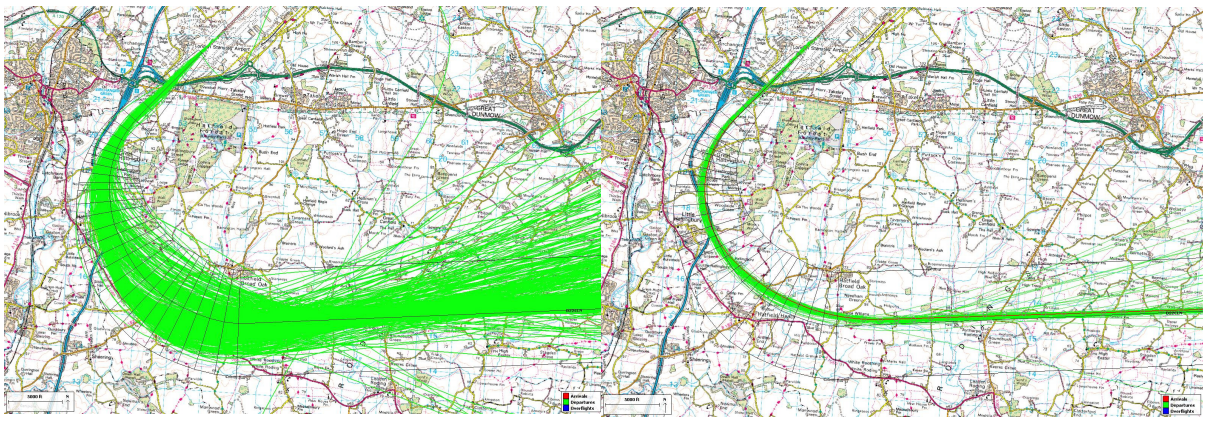
The CLN1E SID replicates the CLN8R SID with a maximum design deviation of 340m, as shown in the image below.



The results from the CLN1E trial clearly show the improvement in adherence to this RNP1 SID, a tight concentration of tracks and the reduction in overflight for local communities.

Standard SID encoding track distribution 22Clacton

CLN1E RNP1 (RF) Departures



The CLN1E RNP1 SID plate and encoding table is shown in Annex A

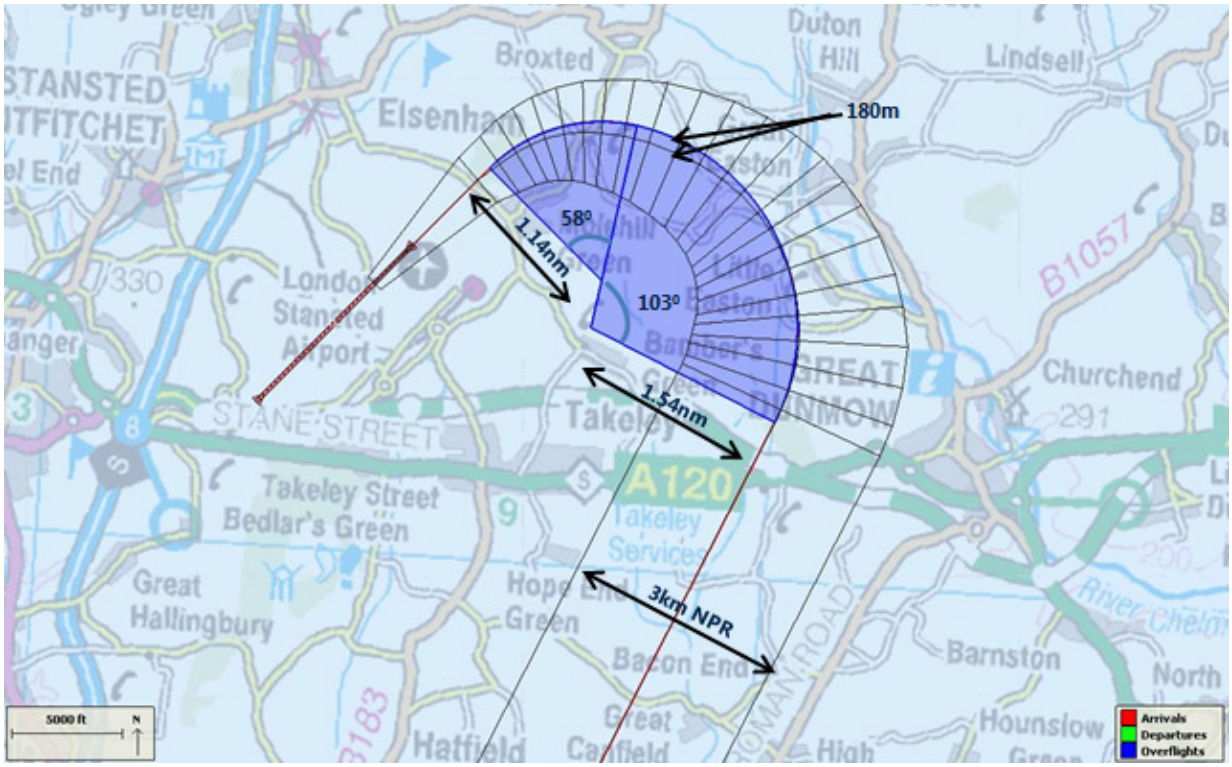
DET1S – conventional SID vs. (trialled) DET1D - RNP1 (RF) SID

The DET1S SID is in use when operating on runway 04, with a very tight turn initiated shortly after take-off at 0.8DME. The DET1S SID has always proved a problematic SID to fly with conventional SID encodings, with many aircraft overshooting the turn and overflying Great Dunmow.

The departure track keeping statistics for this SID have always been considerably lower than any other SID at Stansted, due to the tight wrap around turn at 0.8DME. The 2015 statistics for all Stansted SIDs are shown in the table below.

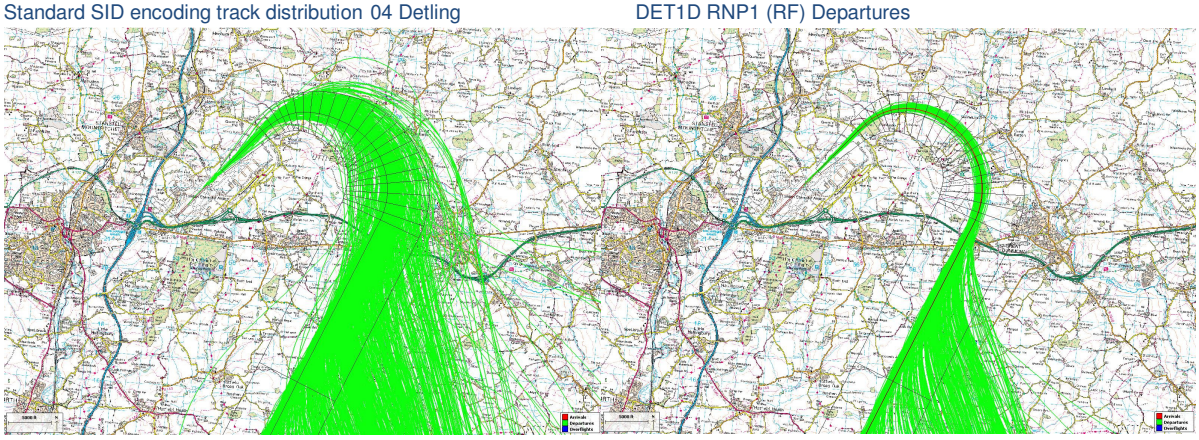
	Runway 22			Runway 04		
	BZD-R	CLN-R	DET - R	BZD-S	CLN-S	DET-S
Jan-15	99.87%	99.80%	99.11%	100.00%	99.53%	98.39%
Feb-15	99.81%	99.57%	99.03%	99.15%	99.64%	97.16%
Mar-15	99.78%	99.70%	98.34%	99.62%	100.00%	98.79%
Apr-15	99.88%	99.41%	98.68%	99.81%	99.64%	97.46%
May-15	99.89%	99.29%	98.49%	99.86%	99.41%	97.58%
Jun-15	99.96%	99.33%	98.81%	99.74%	99.09%	96.94%
Jul-15	99.93%	99.42%	98.47%	99.21%	100.00%	98.18%
Aug-15	99.89%	98.87%	98.51%	99.63%	99.35%	97.59%
Sep-15	99.82%	99.15%	97.47%	99.60%	98.58%	98.28%
Oct-15	99.89%	99.15%	98.78%	99.64%	99.49%	98.24%
Nov-15	99.69%	99.66%	99.23%	99.63%	100.00%	95.85%
Dec-15	99.93%	99.71%	99.34%	100.00%	100.00%	93.55%
Average	**99.86%**	**99.42%**	**98.69%**	**99.66%**	**99.56%**	**97.33%**

The DET1D RNP1 designed SID replicates the DET1S conventional SID with a maximum design deviation of 180m, as shown in the image below.



The results from the DET1D trial also clearly show the improvement in adherence to this RNP1 SID, a tight concentration of tracks and the reduction in overflight for local communities, particularly Great Dunmow.

Standard SID encoding track distribution 04 Detling



DET1D RNP1 (RF) Departures

The DET1D RNP1 SID plate and encoding table is shown in Annex B

Noise Preferential Routes

The NPRs surrounding the CLN8R, CLN1E, DET1S and DET1D SIDs extend from 2000m SOR from the runway centreline, diverging each side by 10^{o} until they represent a distance 1.5km either side of the SID.

There are no variations to the existing 22CLN and 04DET conventional or RNP1 SIDs and associated NPRs for daytime or night time operations.

There are no variations to the NPRs required to contain the RNP1 SIDs as they closely replicate the existing SIDs through the entirety of the NPR.

3. Operational Impacts and Operator Feedback

Operational Impacts

There are no operational impacts for our airspace users as a result of introducing these two RNP1 SIDs. For those operators that are not RNP1 approved by their state aviation regulator we intend to maintain our existing conventional SIDs until such a time exists where it is operationally feasible to remove conventional SIDs with minimal impact to our operators.

Throughout the trial, it has proved difficult on some occasions to obtain RNP1 operational approval due to a number of reasons including fleet equipage.
RNP1 SIDs are uncommon in the EU but we would expect the number of aircraft able to operate RNP1 with RF SIDs to steadily increase as will the number of RNP1 SIDs available to fly over the next three to four years. This increase in RNP1 operations will be as a result of fleet changes and upgrades to meet the requirements of the SESAR PCP and the collective industry desire to improve operational safety and efficiency through the development of PBN solutions within the EU and particularly in the LTMA.

Operator Feedback

Feedback from our operators who have flown the RNP1 procedures has been very encouraging, all indicating support for adopting the procedures permanently.

> *'easyJet has invested heavily in the most modern and technologically advanced aircraft fleet. These new aircraft are equipped with the latest avionics and navigation and the RNP1 trial has enabled us to fully utilise and benefit from this investment.*
> *The track keeping accuracy achieved through the RNP1 trial shows clearly where the Aviation Industry can significantly reduce the impact of its operations. Having departures designed with the latest technology available should be embraced and easyJet are delighted to lead and assist in bringing this trial to an operational level through working collaboratively with the UK Regulator, NATS and Stansted Airport. We fully support the use of RNP1 procedures which share benefits with local communities and the aviation industry alike. easyJet supports making these trial RNP1 procedures permanent.'*

Captain George Hutton
easyJet Base Captain and Pilot Manager - London Stansted Airport

'We look forward to permanent RNP SID(s). Our 747 -8 aircraft use the RNP SID to the fullest extent. It has greatly enhanced track compliance; it is simple and transparent to the crews and it has mitigated tracking issues with earlier versions of our 747 -8 Flight Management Computer (FMC) software, which was problematic. The FMC issues have since been corrected. Our 747-400 aircraft will eventually have Next Generation FMC's installed whereby we will be able to take full advantage of RNP SIDs.'

Atlas Air
Captain of the B 747-400/-8F fleet

'My feedback is RF is great, aircraft was very stable throughout the RF legs; we had no issues & please keep trial in place!!'

Captain Jonathan Bonds
Manager, Flight Safety, UPS

'We at Fayair are encouraged by the time given to us by NATS to evaluate the RNP1 departures from London Stansted. When the opportunity has existed, we have found the RNP1 departures to be extremely accurate and this is borne out by the track depictions passed on to us each month. More RNAV/RNP1 arrivals and departures would enhance the safety and efficiency of aircraft operating within the Stansted airspace.'

Laurence Printie
Fayair (Jersey) Co Limited

'For the RNP1 ops: We didn't get to try a lot of repetitions due to the routes we fly not being the ones that were issued the trial departures. However, feedback from those events that we did use was very positive. The RNP1 Ops worked extremely well for FedEx MD11s. These procedures are easy to load from the database which cuts down on pilot error, the airplane can maintain the designated track, and in the end that ensures compliance with the desired routing. We enthusiastically support the use of RNP1 procedures.'

Captain Cynthia H. Berwyn
Manager, MD-11/10 Flight Training, FedEx.

4. Air Navigation Service Provider Feedback

Airport ANSP

Since the inception of the RNP1 trial, the Airport ANSP (NATS) has fully supported the introduction of the two RNP1 SIDs. To facilitate more RNP1 departures, NATS have adapted their systems to provide Datalink clearances for easyJet by default as the RNP1 SID. easyJet requested this development and are a single airframe type operator which has state regulatory RNP1 approval. This has greatly enhanced the numbers of departures operating the RNP1 SIDs and helped proved a more robust dataset. The Airport ANSP fully supports the RNP1 implementation as detailed in this ACP.

En-route ANSP

The following response was received during the consultation from the En-route ANSP:

> *'Thank you for providing NATS with the opportunity to respond to your consultation and we have reviewed the consultation material with interest. NATS' supports the introduction of PBN routes and procedures as enabling improvements in the efficiency of UK airspace under FAS and so we welcome Stansted's proposal to permanently implement two RNP1 (RF) SIDs.*
> *The proposals do not appear to change the geographical and vertical extent of the NPRs of the two new SIDs and therefore NATS' assumes that there is no change to the current procedures for the ATC management of departures.'*

Confirmation that there were no procedure changes associated with the introduction of the two RNP1 SIDs was provided to NATS En-route.

5. Environmental Impacts

Track, Fleet and NPR

The trial data, as presented in the Trial Technical Report[4], demonstrates the track analysis and how this has been correlated between the centrelines of the conventional SID and the RNP1 SID. The maximum offset between the conventional and designed RNP1 SIDs, CLN1E and DET1D, are 340m and 180m respectively.

Since the trial report was published, participating operators have continued to fly the RNP1 SIDs. Thomas Cook has also recently joined the trial and successfully operated its A321s. UPS has also flown the RNP1 SIDs in its Boeing 757 freighters very successfully.

Stansted anticipates, as regulatory compliance continues for RNP1 operations, that utilisation of the RNP1 procedures will increase. This will also be complimented by upgrades to current fleets to newer modern aircraft as we have seen at Stansted over the last 10 - 15 years[5].

The RNP1 SIDs are contained wholly within the existing spread of current aircraft tracks operating the conventional SID and wholly contained within the NPR profile.
The vertical and lateral profile of the RNP1 SIDs is a replication of the conventional SID. However, the degree of accuracy and adherence to the designed procedure for aircraft flying the RNP1 SIDs and subsequent concentration of the departure track reduces the overall area of noise exposure. When considered in terms of direct overflight of local communities, our population exposed to low level (below 4,000ft) reduces from 3,800 down to 500 for the CLN1E SID and 1,200 down to 200 on the DET1D SID.

Summary Population Counts (using 2014 CACI Ltd population data)

	Households	Populations	Change
22 CLN NPR Swathe	1,550	3,800	-
22 CLN RNP 400m wide corridor	200	500	-87%
04 DET NPR Swathe	500	1,200	-
04 DET RNP 400m wide corridor	100	200	-83%

4 http://www.stanstedairport.com/community/local-environmental-impacts/noise/
5 E.g. easyJet moving from Boeing 737-300 / 700 and Ryanair 737-200, to Airbus A319/320 and Boeing 737-800NG respectively.

ATC vectoring is permitted above 4,000ft. Our consultation material clearly demonstrates at which point this occurs and is consistent with either RNP1 or conventional procedures. We do not anticipate any changes to current vectoring practices.

There are no new individuals or households exposed to aircraft noise or overflight by low level aircraft as a result of implementing the two RNP1 SIDs.

London Stansted is not proposing any changes to the existing NPRs.

Air Quality

The RNP1 SIDs, being a replication of the conventional SIDs do not attribute any increase in fuel burn or associated emissions. The procedures are wholly contained within the track dispersion of the conventional SID and NPR and therefore there is no increase in track miles flown as a result of RNP1 implementation.

6. The Airspace Change Proposal

London Stansted has successfully trialled two RNP1 designed SID with RF path terminators.

Following the publication of a trial report, the continuation and success of the trial has been endorsed by our local communities through feedback sought during our public consultation.

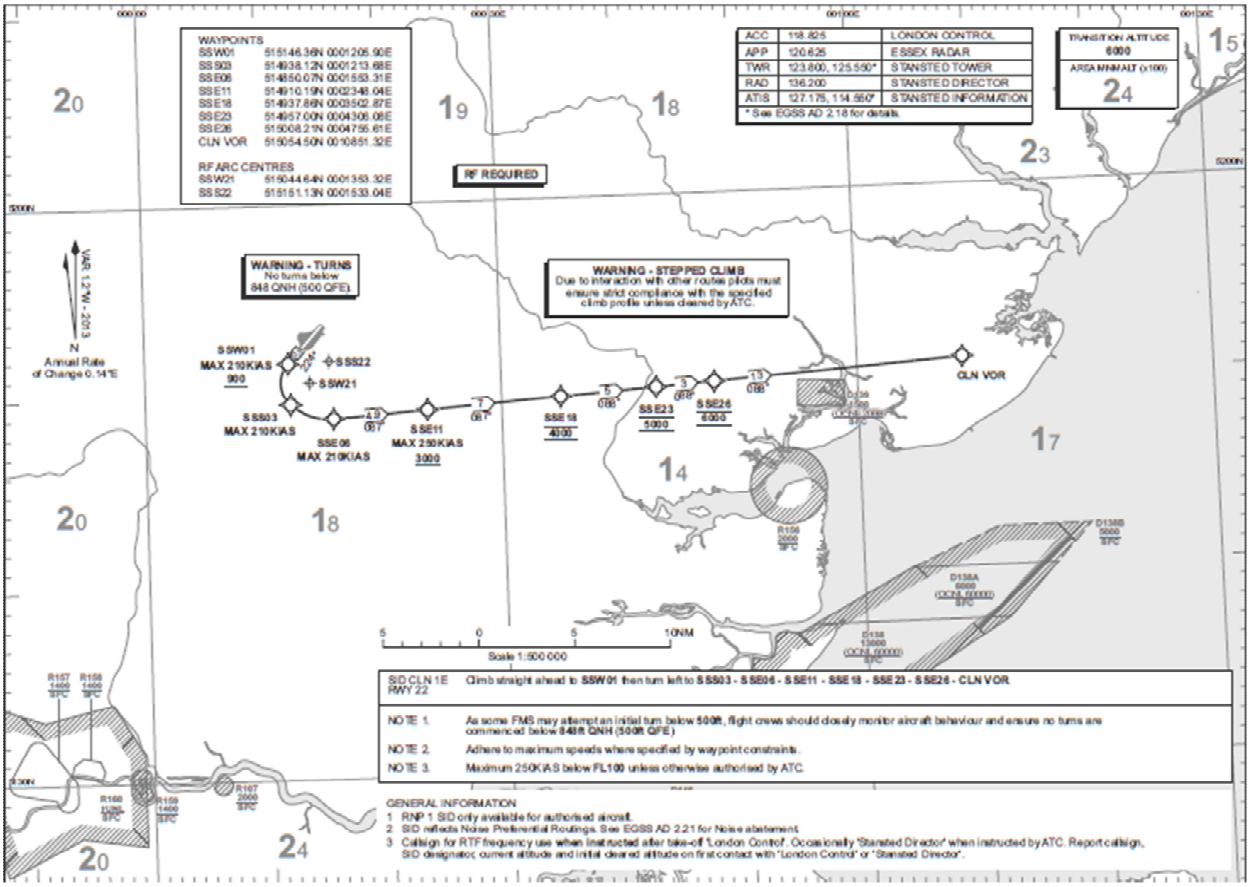
It is now proposed that:

- The CLN1E RNP1 SID is adopted as a permanent option
- The DET1D RNP1 SID is adopted as a permanent option
- The CLN8R and DET1S conventional SIDs remain
- There is no change the current NPRs
- There are no changes to any associated local and En-route ANSP procedures

7. Glossary of Terms

ANOMS	Airport Noise and Operations Monitoring System
ANSP	Air Navigation Services Provider
ATC	Air Traffic Control
CAA	Civil Aviation Authority
CLN1E	Clacton 1 Echo – Clacton Trial Departure SID
CLN8R	Clacton 8 Romeo – conventional runway 22 Clacton SID
DET1D	Detling 1 Delta – Detling Trial Departure SID
DET1S	Detling 1 Sierra – conventional runway 04 Detling SID
DME	Distance Measuring Equipment
LTMA	London Terminal Manoeuvring Area
NATS	NATS Services Limited (air navigation services provider)
NERL	NATS En Route Limited
NM	Nautical Mile
NPR	Noise Preferential route
PBN	Performance Based Navigation
PCP	Pilot Common Project
RF	Radius to Fix
RNP1	Required Navigational Performance of 1nm
SESAR	Single European Sky ATM Research
SID	Standard Instrument Departure
SOR	Start of Roll
STAL	Stansted Airport Limited

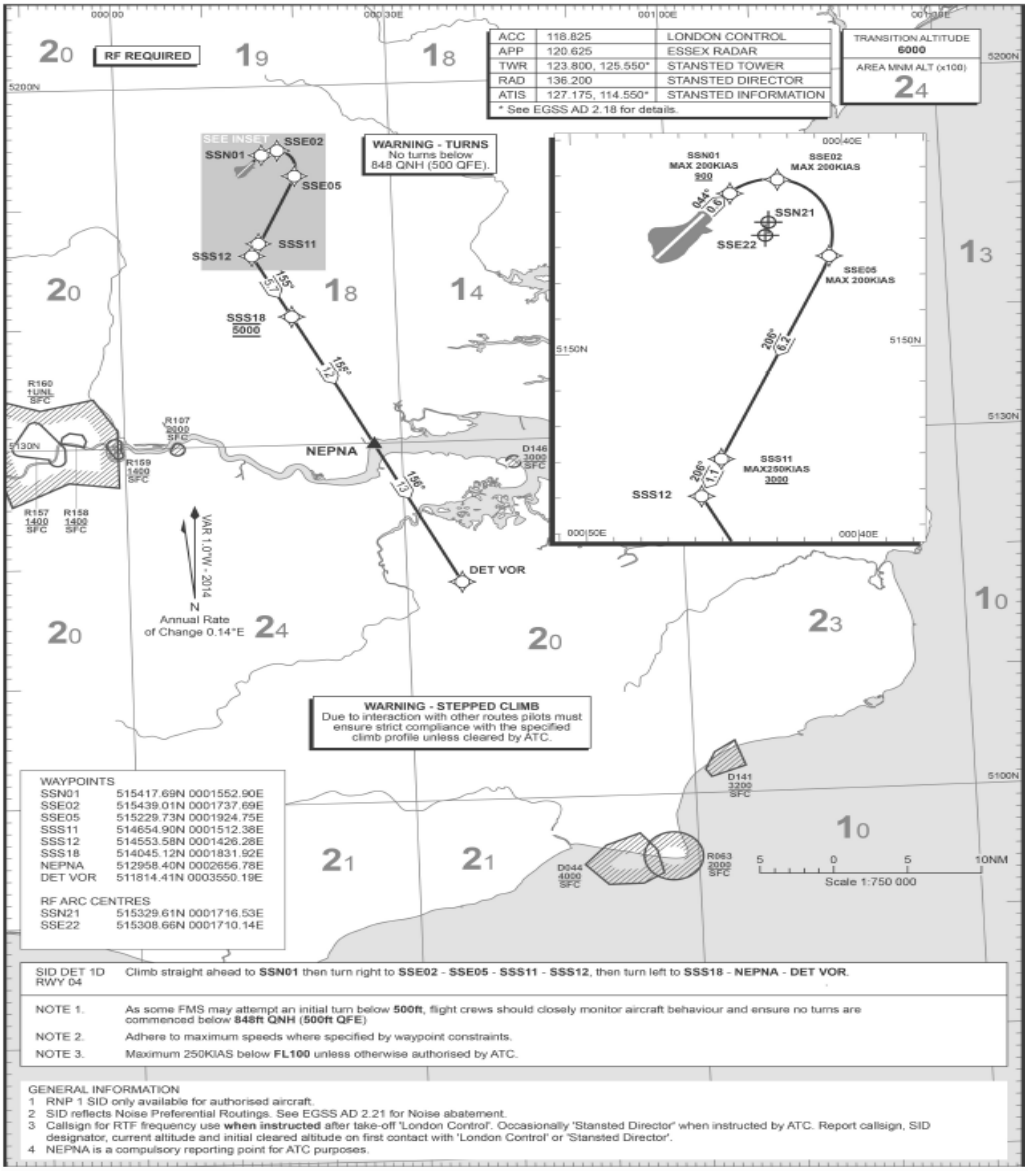
Annex A – CLN1E RNP1 (RF) SID plate and coding table



London Stansted Runway 22 CLN 1E

Designator	Sequence Number	Path Terminator	Waypoint Name	Waypoint Co-ordinates	Arc Centre Name	Arc Centre Co-ordinates	Flyover	Course/ Track °M (°T)	Magnetic Variation	Distance (NM)	Turn Direction	Level Constraint	Speed Constraint (KT)	Navigation Performance
CLN 1E	001	CF	SSW01	515146.36N 0001205.90E	-	-	N	224° (222.9°)	1.2	0.9	-	+900	210	RNP 1
CLN 1E	002	RF	SSS03	514938.12N 0001213.68E	SSW21	515044.64N 0001353.32E	N	-	1.2	-	Left	-	210	RNP 1
CLN 1E	003	RF	SSE06	514850.07N 0001553.31E	SSS22	515151.13N 0001533.04E	N	-	1.2	-	Left	-	210	RNP 1
CLN 1E	004	TF	SSE11	514910.19N 0002348.04E	-	-	N	087° (086.0°)	1.2	4.9	-	+3000	250	RNP 1
CLN 1E	005	TF	SSE18	514937.86N 0003502.87E	-	-	N	087° (086.1°)	1.2	7.0	-	4000	250	RNP 1
CLN 1E	006	TF	SSE23	514957.00N 0004306.08E	-	-	N	088° (086.3°)	1.2	5.0	-	5000	250	RNP 1
CLN 1E	007	TF	SSE26	515008.21N 0004755.61E	-	-	N	088° (086.4°)	1.2	3.0	-	6000	250	RNP 1
CLN 1E	008	TF	CLN	515054.50N 0010851.32E	-	-	N	088° (086.5°)	1.2	13.0	-	-	250	RNP 1

Annex B – DET1D RNP1 (RF) SID plate and coding table



London Stansted Runway 04 DET 1D

Designator	Sequence Number	Path Terminator	Waypoint Name	Waypoint Co-ordinates	Arc Centre Name	Arc Centre Co-ordinates	Flyover	Course/ Track °M (°T)	Magnetic Variation	Distance (NM)	Turn Direction	Level Constraint	Speed Constraint (KT)	Navigation Performance
DET 1D	001	CF	SSN01	515417.69N 0001552.90E	-	-	N	044° (042.9°)	1.0	0.6	-	+900	200	RNP 1
DET 1D	002	RF	SSE02	515439.01N 0001737.69E	SSN21	515329.61N 0001716.53E	N	-	1.0	-	Right	-	200	RNP 1
DET 1D	003	RF	SSE05	515229.73N 0001924.75E	SSE22	515308.66N 0001710.14E	N	-	1.0	-	Right	-	200	RNP 1
DET 1D	004	TF	SSS11	514654.90N 0001512.38E	-	-	N	206° (205.1°)	1.0	6.2	-	+3000	250	RNP 1
DET 1D	005	TF	SSS12	514553.58N 0001426.28E	-	-	N	206° (205.0°)	1.0	1.1	Left	-	250	RNP 1
DET 1D	006	TF	SSS18	514045.12N 0001831.92E	-	-	N	155° (153.7°)	1.0	5.7	-	5000	250	RNP 1
DET 1D	007	TF	NEPNA	512958.40N 0002656.78E	-	-	N	155° (153.7°)	1.0	12.0	-	-	250	RNP 1
DET 1D	008	TF	DET	511814.41N 0003550.19E	-	-	N	156° (154.5°)	1.0	13.0	-	-	250	RNP 1