Airspace Change Proposal:

RNAV1 Procedures on the Runway 26 Brookmans Park Departure Routes

Formal Submission

August 2014

LONDON LUTON AIRPORT

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1. Operational Requirements

1.1 Justification

For over 10 years the Airport has been working with airlines, NATS, our Air Traffic Control provider (ATC) and the Civil Aviation Authority (CAA) to look at ways track-keeping can be improved on the Runway 26 Brookmans Park (BPK) departure route. Aircraft currently using the Runway 26 Clacton and Detling standard instrument departures (SIDs) from London Luton Airport often fly outside of the current Noise Preferential Route (NPR), overflying densely populated areas such as Hemel Hempstead and St. Albans. A plot density has been provided in Figure 1.1 to illustrate this. Figure 1.2 has also been provided to illustrate the position of the current SID and NPR along with sample flight tracks.

The introduction of area navigation (RNAV1) technology would enable a route to be designed (within the tolerances of RNAV1 criteria) that avoids centres of population. The objective of this proposal is therefore to implement new RNAV1 SIDs along the Runway 26 BPK departure route towards Clacton and Detling, for which the nominal route tracks between Markyate and Flamstead, Redbourn and Hemel Hempstead, as well as St. Albans and Harpenden but still remains within the current NPR corridor.

The proposed RNAV1 SID was initially tested in a flight simulator to prove flyability. It was then agreed with the CAA and ATC that a short live flight trial could be undertaken. The aim of this trial was to find out if noise impacts lessened or increased, and if track-keeping improved or deteriorated.

Two RNAV1 options were trialled, one with a speed restriction along the second turn of 210 knots[1], and the other with a speed restriction of 220 knots. Following feedback received throughout the trial and during the consultation period, it was determined that at 210 knots aircraft fly with the flaps extended which causes an increase in airframe noise, fuel usage and wear on the flaps. At this speed aircraft are put in an awkward configuration that constitutes a non-standard procedure, which increases crew workload at a critical time of flight in busy airspace.

Following analysis of data collected during the trial and an extensive consultation, the proposed change is to introduce RNAV1 SIDs along the Runway 26 BPK departure route towards Clacton and Detling with an initial speed restriction of 220 knots.

Environmental analysis using data collected during the trial (Section 2) indicates that this option would:

- Reduce the number of people overflown along this departure route
- Reduce the level of noise from aircraft that is currently experienced in areas of high population density, particularly Hemel Hempstead, and
- Reduce the amount of fuel burnt by aircraft using this departure route thereby minimising carbon emission.

Track-keeping significantly improved during the trial, demonstrating that RNAV1 procedures would enable aircraft to successfully navigate within the proposed NPR and away from areas of high population density. A plot density and sample tracks from the 220 knots RNAV1 trial have been provided in Figures 1.3 and 1.4 to illustrate this. The plot density has been calculated using flight data from the duration of the trial, whereas sample flight tracks are provided from a week-long period during the trial.

1. Please note that where 'knots has been used throughout this document, this refers to 'Knots Indicated Air Speed' (KIAS)

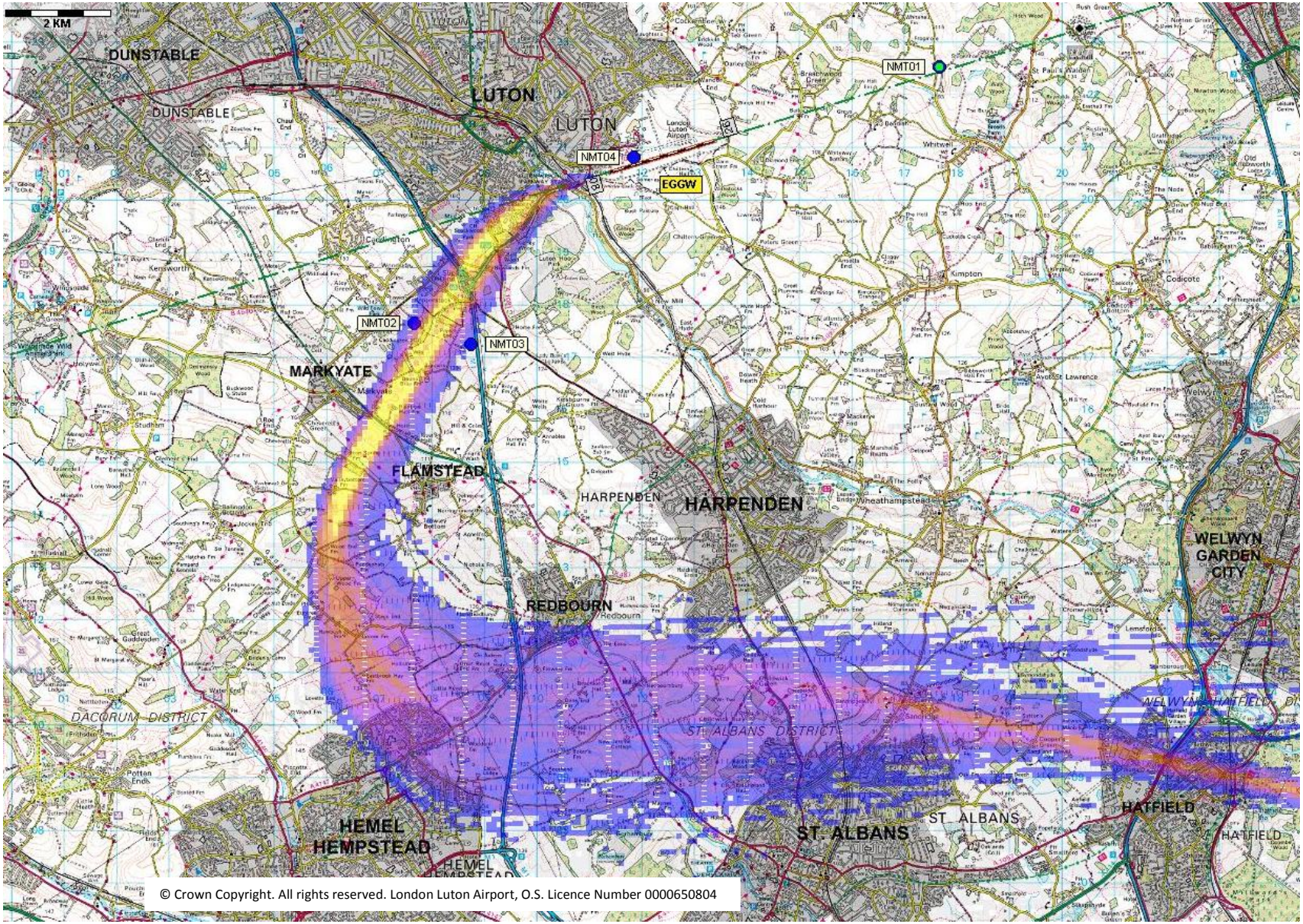


Figure 1.1 Plot density diagram for the existing conventional Brookmans Park SID

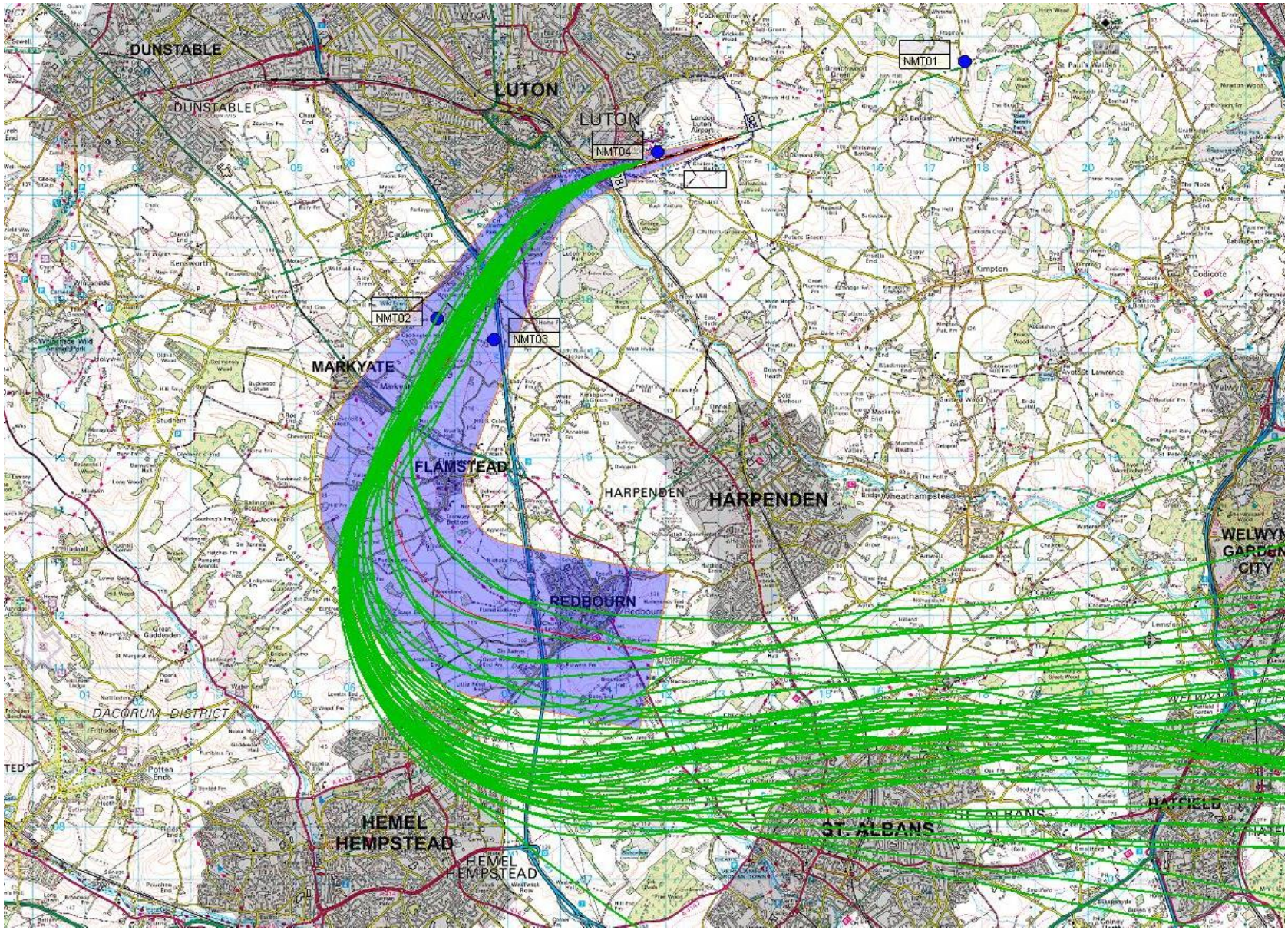


Figure 1.2. Sample flight tracks for the current Brookmans Park SID

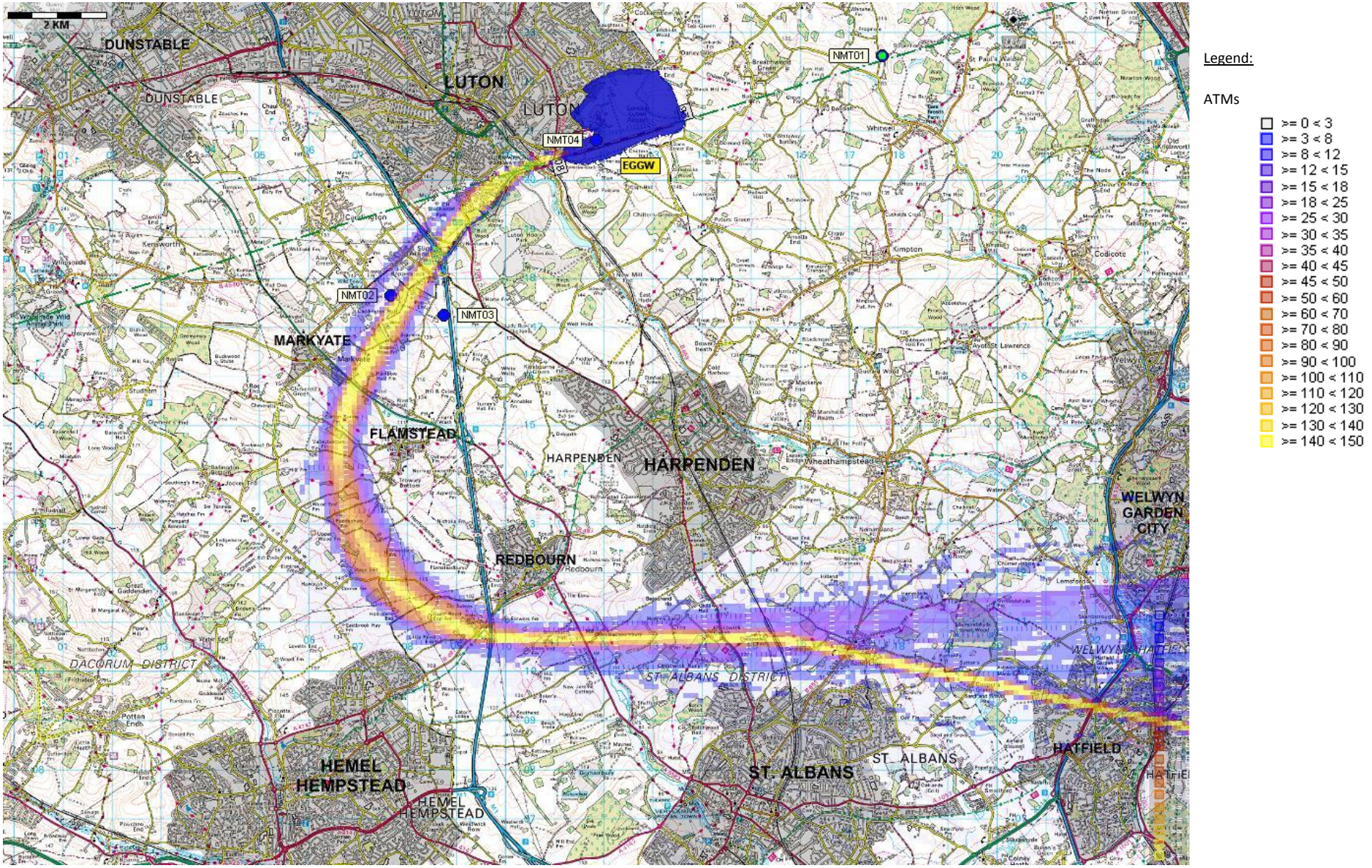


Figure 1.3 Plot density diagram for the proposed Brookmans Park 220 knots RNAV1 SID

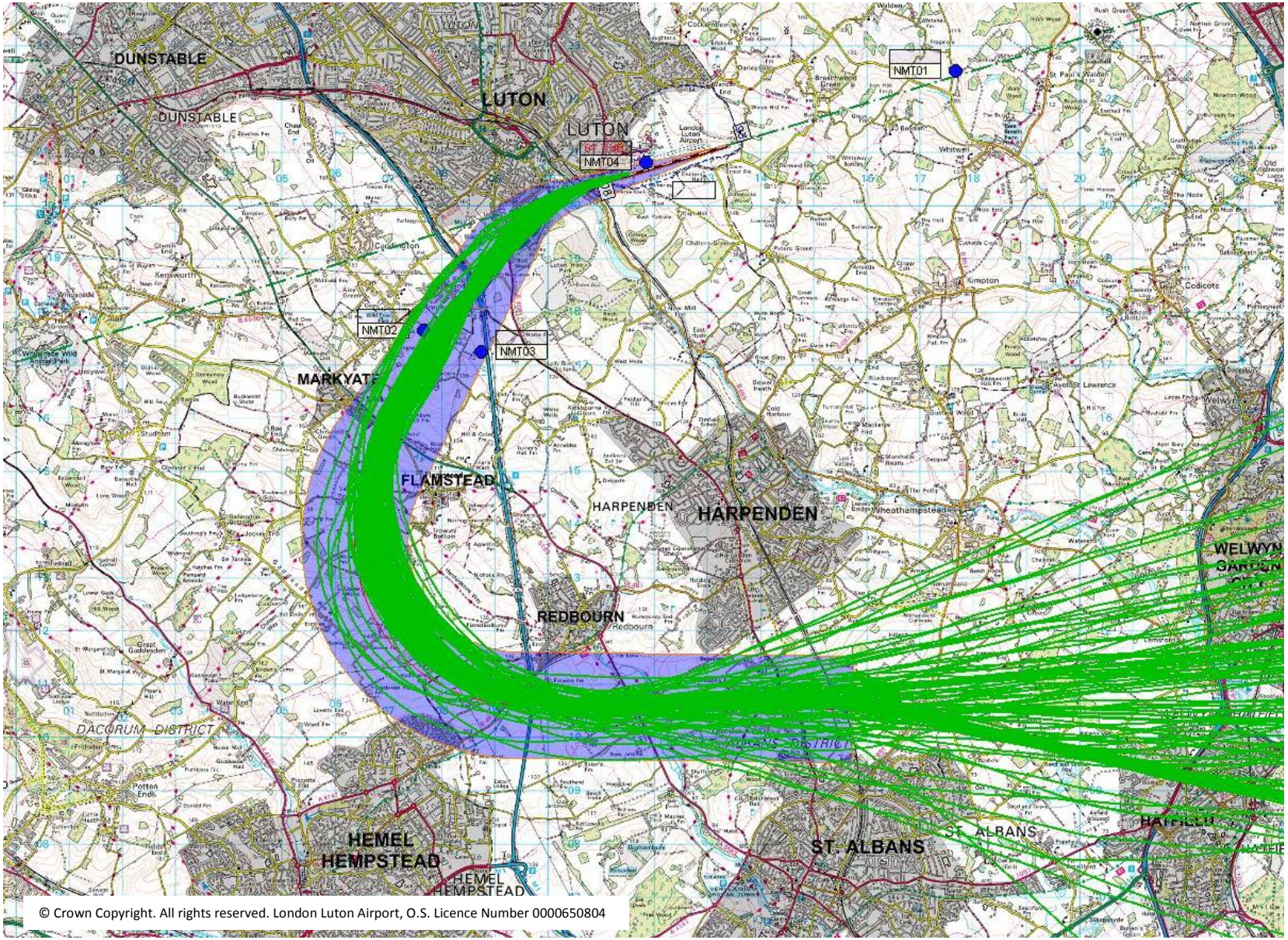
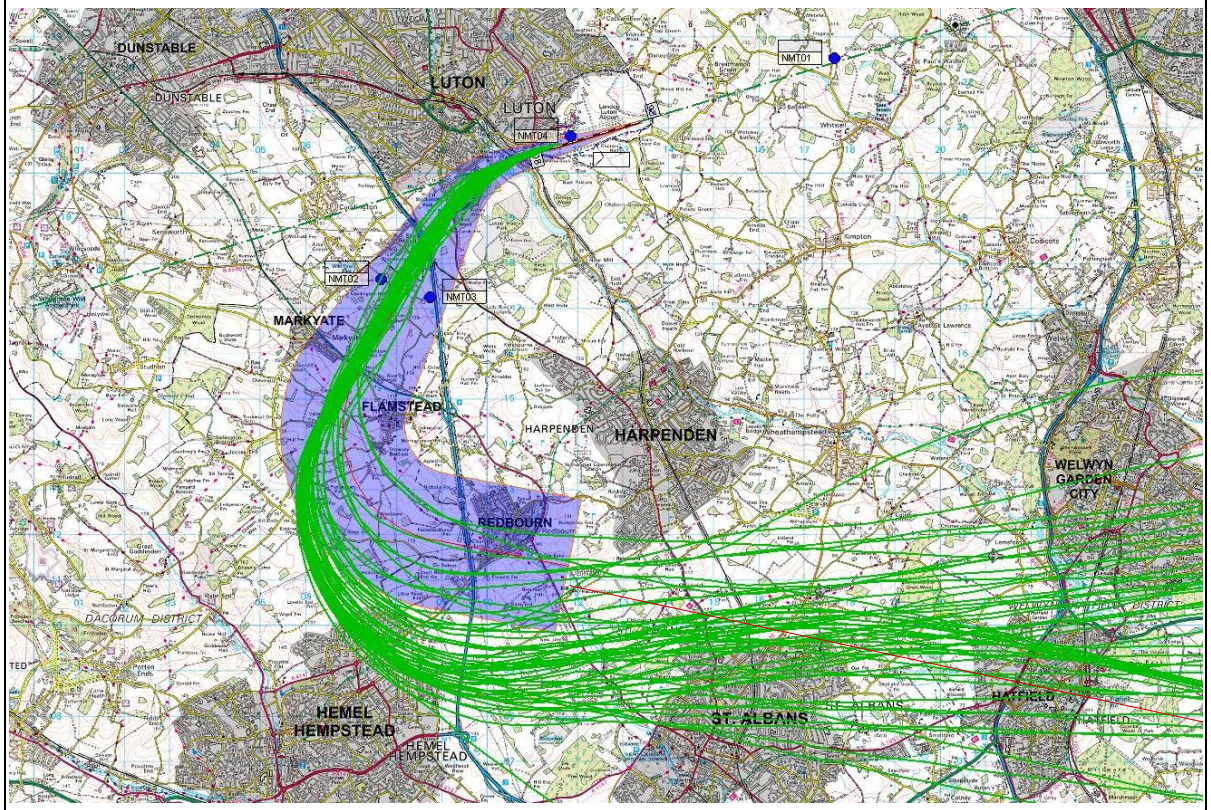
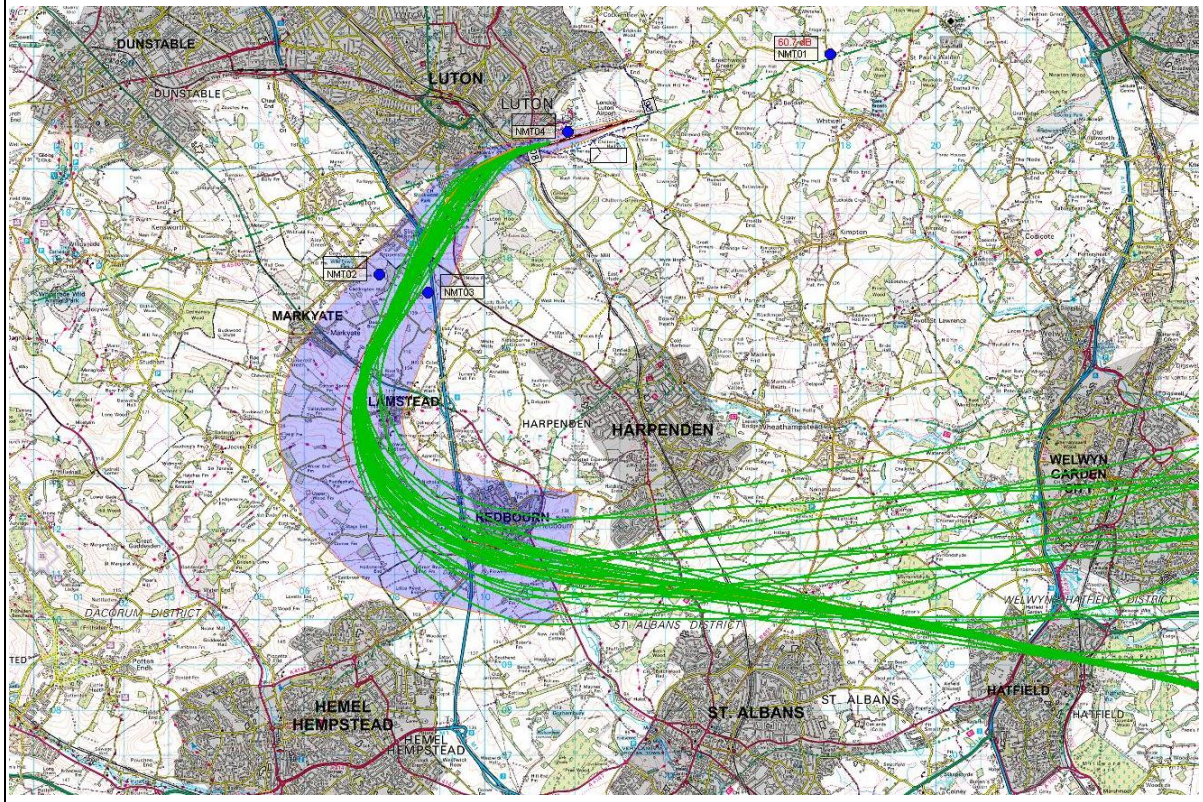


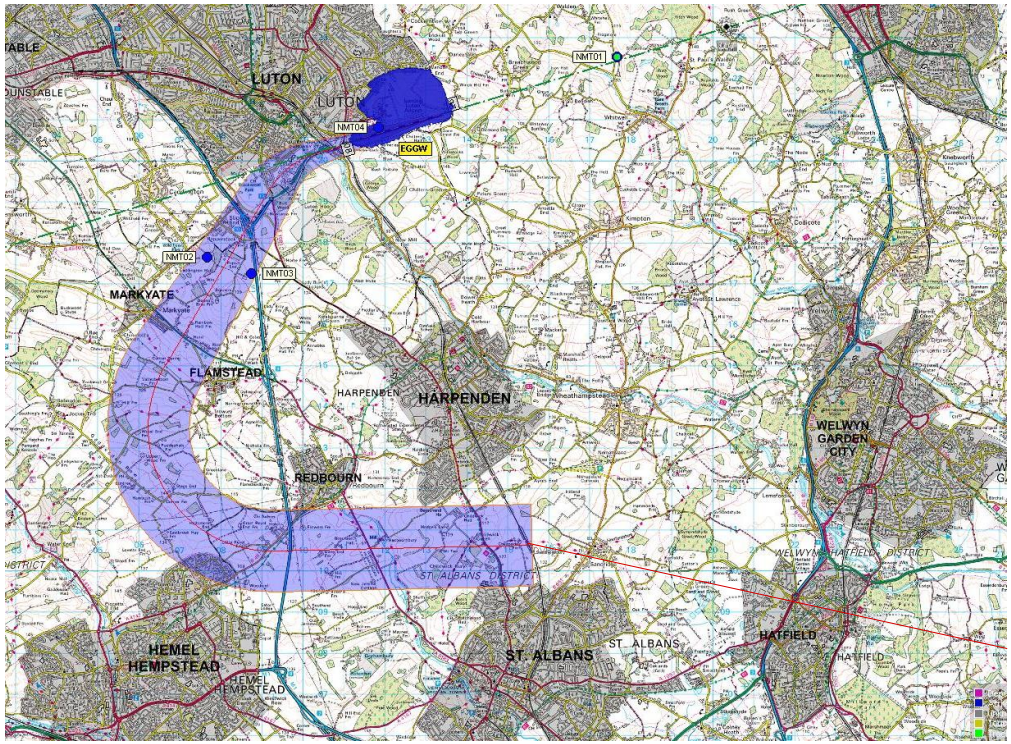
Figure 1.4 Sample flight tracks for the proposed Brookmans Park 220 knots RNAV1 SID

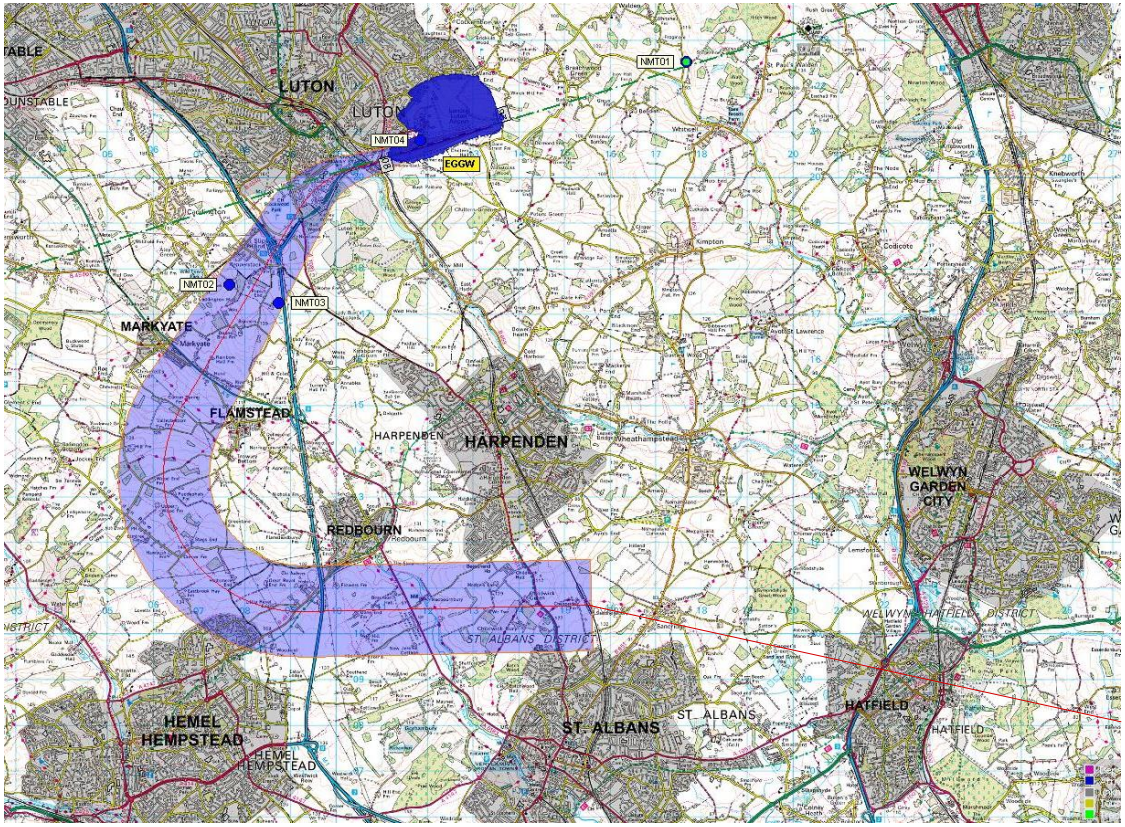
1.2 Change Options

The following matrix displays all of the options that were considered, listing benefits and disbenefits for each. Each option has been trialled, and the data collected during those trials analysed. The implications of each change are therefore well understood.

Option	Description and Diagram	Pros	Cons	Decision
Option 1: Do nothing	This option is to keep to the current route procedures being undertaken at London Luton Airport which have been flown for a number of years using conventional navigation technology. As can be seen in the diagram below, aircraft deviate from the nominal track which results in aircraft overflying north Hemel Hempstead and St Albans resulting in track dispersion beyond the existing NPR corridor. 	This option would require no change in procedure.	This option results in aircraft overflying densely populated areas such as north Hemel Hempstead and St. Albans, resulting in noise disturbance. This option also results in greater fuel burn compared to the RNAV1 options.	Not supported on environmental grounds.

Option	Description and Diagram	Pros	Cons	Decision
Option 2: Reduce aircraft speed and make a minor adjustment to aircraft turn point	Option 2 is based upon a trial conducted by London Luton Airport in conjunction with easyJet, between 5th May 2011 and 6th November 2011 on the Runway 26 BPK departure route. Following feedback from communities over a number of years concerning aircraft deviating outside of the NPR corridor in the vicinity of Hemel Hempstead/St. Albans the Airport worked closely with airlines, the CAA and ATC to look at ways to help improve track-keeping on this route. It was determined that by reducing the speed of aircraft from 230-250 knots to 220 knots on the second turn to the east and initiating the turn point around 1 nautical mile (NM) earlier, aircraft followed the nominal track much closer. 	The trial demonstrated that this option would result in aircraft flying within the NPR corridor, with the majority of aircraft flying closer to the nominal track.	Extensive community feedback during the trial suggested that communities in Flamstead and Redbourn were adversely affected by this change. With conventional navigation techniques, very little could be done to change the route further.	Not supported on environmental grounds.

Option	Description and Diagram	Pros	Cons	Decision
Option 3: Adopt a new RNAV1 SID with initial speed restrictions of 210 knots	In order to mitigate the negative effects of the trial held in 2011 (option 2) it was clear that a more precise form of track-keeping was required to get aircraft to fly closer to the nominal track and to enable modification of the nominal track so that it avoids the most densely populated areas along the route. An RNAV1 based version of the SID departure routes for Runway 26 BPK departures has therefore been considered, with an initial speed restriction of 210 knots. The NPR width would be reduced from 3km to 2km under this option. The daytime vectoring altitude would also be raised from 3,000 ft to 4,000 ft to ensure aircraft fly within the swathe for longer, bringing it in line with the night-time vectoring altitude. Furthermore above 4,000 ft aircraft would be routinely kept within the NPR corridor until crossing the railway line between St. Albans and Harpenden, however this would be at the discretion of ATC for operational/safety reasons. 	This option would reduce the number of people directly overflown, thereby minimising noise impacts. The amount of fuel burnt would also be less than option 1, resulting in less CO_2 emissions and an economic benefit.	At 210 knots aircraft fly with the flaps extended which causes an increase in airframe noise, fuel usage and wear on the flaps. At this speed aircraft are put in an awkward configuration that constitutes a non-standard procedure, which increases crew workload at a critical time of flight in busy airspace.	Following the trials and responses from the consultation, this option is no longer supported due to the operational and environmental implications compared to option 4.

Option	Description and Diagram	Pros	Cons	Decision
Option 4: Adopt a new RNAV1 SID with an initial speed restriction of 220 knots	Option 4 is a RNAV1-based SID, similar to Option 3 but with a slight refinement on the speed of the second turn to bring it up to 220 knots. The NPR width would again be reduced from 3km to 2km under this option. The daytime vectoring altitude would also be raised from 3,000 ft to 4,000 ft to ensure aircraft fly within the swathe for longer, bringing it in line with the night-time vectoring altitude. Above 4,000 ft aircraft would also be routinely kept within the NPR corridor until crossing the railway line between St. Albans and Harpenden, however this would again be at the discretion of ATC for operational/safety reasons. 	This option would reduce the number of people directly overflown, thereby minimising noise impacts. The amount of fuel burnt would also be less than option 1, resulting in less CO_2 emissions and an economic benefit. This option would also reduce the use of flaps compared to Option 3.		This is the supported option based on environmental and operational grounds.

1.3 Airspace Description

In the event that RNAV1 SIDs are adopted, they would be SIDs within existing Class D controlled airspace for Runway 26 Clacton and Detling departures. The SIDs would broadly be a replication of the existing SIDs and wholly contained within the existing NPR corridor up to the point at which aircraft may be vectored. Minor adjustments have been made to turn points and speeds flown to attempt to ensure aircraft adhere to tracks which minimise environmental noise impact to overflown areas. Therefore, no additional airspace is required and there is no alteration to the existing dimensions of Luton's airspace.

Both the Runway 26 Clacton and Detling SIDs are identical until the Brookmans Park reporting beacon, and the environmental assessments have therefore been undertaken in parallel. NATS removed the Dover SID on 29th May 2014, and replaced this with the existing Detling SID to enable more accurate fuel planning. Whilst the details regarding this change are outside the scope of this document, it is important to note that this change will not alter aircraft flight tracks over the ground either vertically or laterally in the vicinity of London Luton Airport, and does not affect the validity of the results from the trials.

An initial speed restriction of 220 knots will be in place for both the Clacton and Detling SIDs until the second turn has been completed (GWE12) The RNAV1 SIDs will extend to Clacton and Detling beacons, however the route coordinates will remain unchanged after the end of the NPR. The current SIDs and NPR are provided in Figure 1.5, and the proposed RNAV1 SIDs are provided in Figure 1.6.

These routes would be used 24 hours a day, 7 days a week at the discretion of Air Traffic Control (ATC) and would not be subject to any seasonal variation. The hours of operation will therefore remain unchanged, and if RNAV1 is introduced this will not increase or decrease aircraft capacity along this route or any other route.

The width of the current NPR swathe is 3 km (1.5km either side of the SID centreline) and it is proposed that following a period of familiarisation, the swathe width would be reduced from 3 km to 2 km for aircraft flying the new RNAV1 SIDs. The familiarisation period will be a maximum of 6 months. The RNAV1 NPR would pass slightly further west at the second turn than currently, and pass between Redbourn and Hemel Hempstead. It was identified during the trial that whilst the majority of aircraft maintain a much tighter track swathe than using current navigation techniques, high winds can cause slight deviations particularly through the second turn. A 2km swathe is therefore considered appropriate at this time, but will be reviewed and possibly reduced further when required navigation performance radius to fix (RNP1 RF) is considered following the approval of the new design criteria.

The daytime vectoring altitude would also be raised from 3,000 ft to 4,000 ft to ensure aircraft fly within the swathe for longer. Whilst ATC will still be permitted to tactically vector aircraft (i.e. given a specific heading towards their final destination) for operational or safety reasons, aircraft will generally track within the swathe until crossing the railway line between St. Albans and Harpenden (GWE16). The RNAV1 NPR is therefore illustrated as stretching further east than the current NPR that currently terminates soon after passing Redbourn. The night time vectoring altitude will be maintained at 4,000 ft, and similarly aircraft will only be tactically vectored at night once they have passed the railway line.

During the trials there was an unanticipated increase in noise levels recorded in south Luton, and this increase was attributed to aircraft making a later first turn during the trial as an unintended consequence of the trialled RNAV1 route design. The proposed RNAV1 SIDs address this to ensure the first turn is initiated as per the current route design, at approximately 1,000ft depending on weather conditions (i.e. at 1030ft QNH), ensuring that noise levels remain unaltered in south Luton.

Apart from this small alteration, the proposed SIDs are identical to that flown during the 220 knots RNAV1 trial, and this alteration is not anticipated to affect the route flown passed the first turn.

In the event that RNAV1 procedures are adopted along the Runway 26 BPK departure routes, and following a period of familiarisation, where clear track-keeping infringements occur (i.e. not safety or weather related) then a penalty system would be introduced in conjunction with our Flight Operations Committee and London Luton Airport Consultative Committee (LLACC).

During westerly operations, aircraft also depart London Luton Airport from Runway 26 along the Compton and Olney SIDS. The SIDs and NPRs for these along with the proposed RNAV1 SIDs and NPR along the Brookmans Park departure route are provided in Figure 1.7 below.

The RNAV1 SIDs have been designed by the Directorate of Airspace Policy, and are compliant with ICAO Standards and Recommended Practices (SARPs). The SIDs have also been designed taking into consideration the London Airspace Management Programme (LAMP).

The proposed change shall have no impact on flights using Controlled Airspace in the vicinity, and there will not be any impact on existing STARs and SIDs. Interactions with other domestic and international en-route structures, Terminal Manoeuvring Areas (TMAs) and holds including the Bovingdon and LOREL reporting point are unaffected by the proposed change.

When London Luton Airport is using Runway 26, permission to transit shall normally be granted subject to capacity. Airspace users are currently granted equitable access to the airspace and the proposals will not alter or affect this.

The proposed AIP charts and supplementary text has been provided in Appendix 1.1. The co-ordinates describing the proposed SIDs have also been provided in Appendix 1.2.

1.4 Timescales

The provisional implementation date for the proposed RNAV1 procedures is 30th April 2015 (AIRAC cycle 5). This accommodates the following stages:

- 16 weeks review period of this ACP submission by the CAA
- Operational procedure submission to the aeronautical information publications
- Two AIRAC cycles for promulgation.

If this deadline is missed, the next implementation date (AIRAC cycle 6) would be 28th May 2015. If the review doesn't take a full 16 weeks then the procedure will be submitted into an earlier cycle if possible.

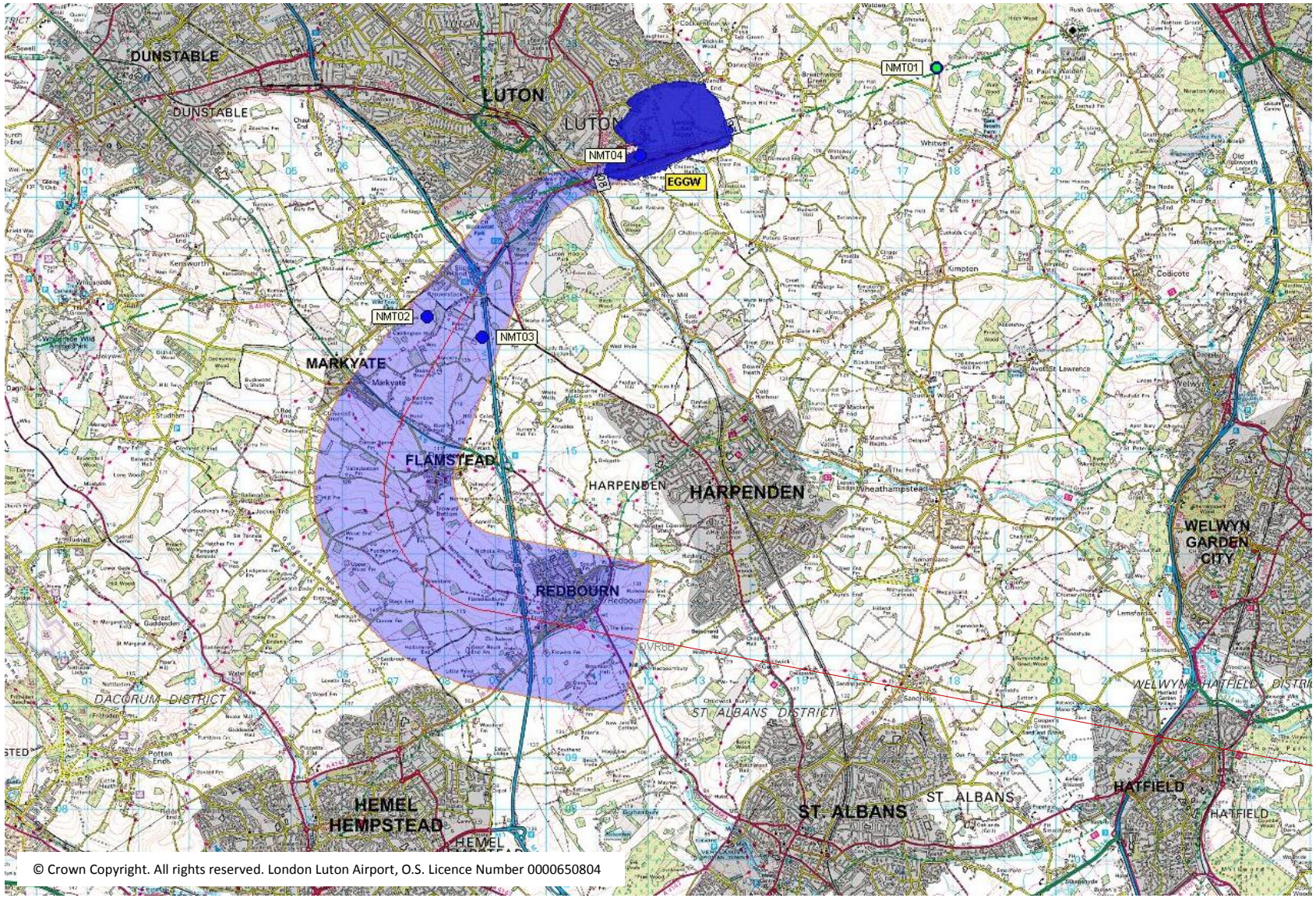
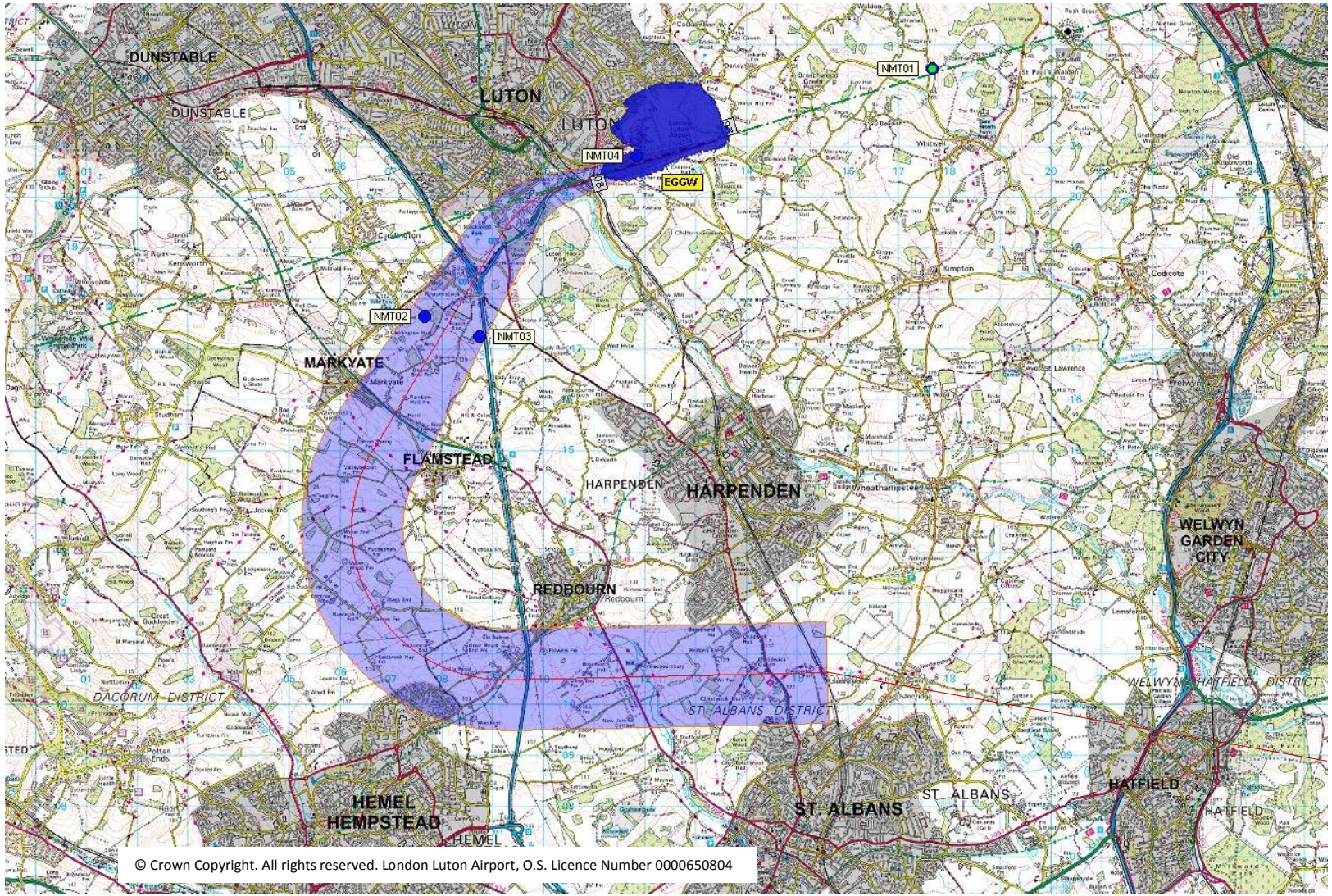


Figure 1.5 Current SID centreline and NPR with 3km swathe



Legend:

RNAV1 SID centreline

RNAV1 NPR

Figure 1.6. RNAV1 SID and NPR corridor with a 2km swathe

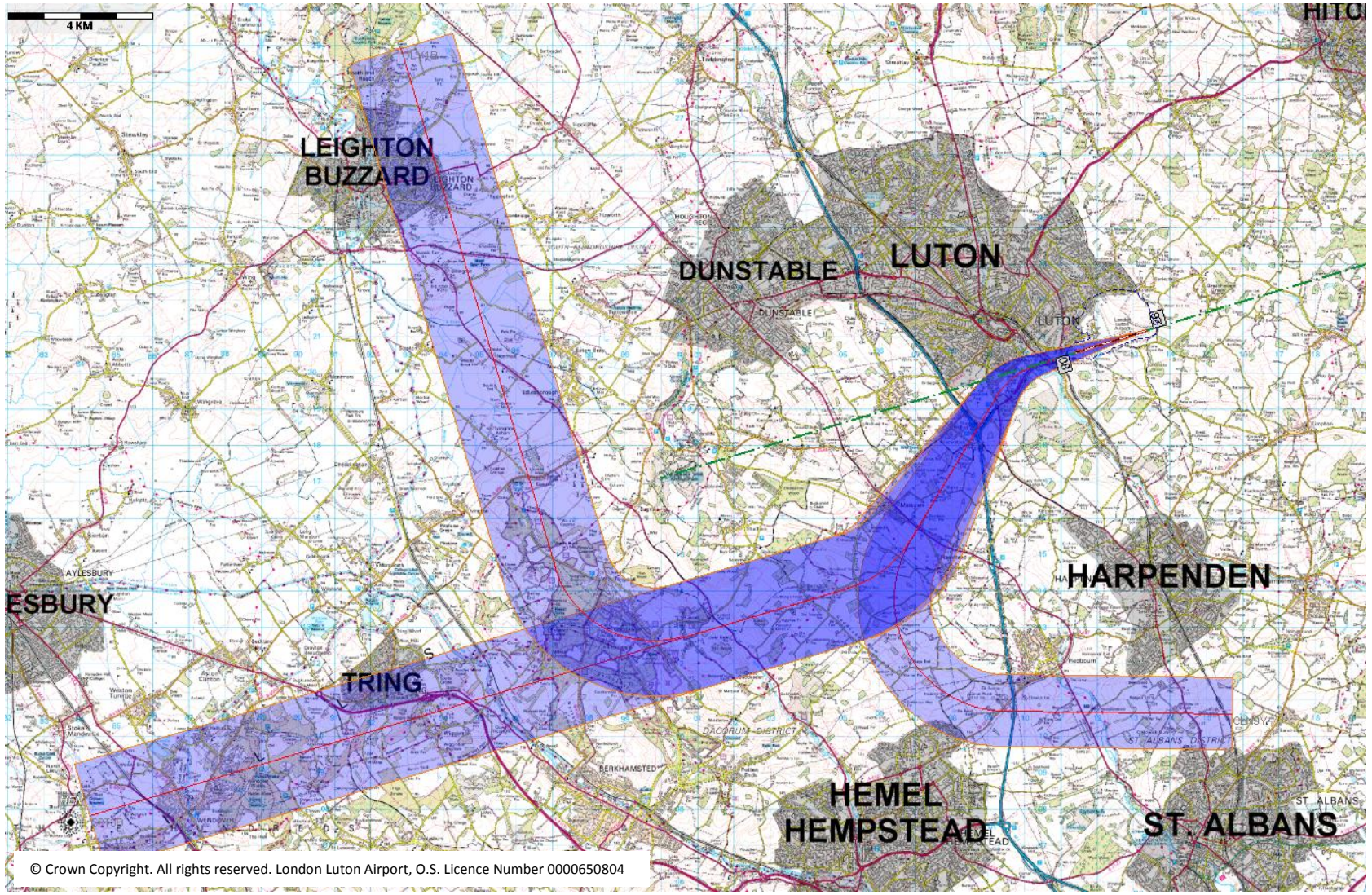


Figure 1.7. SIDs during westerly operations, including the proposed RNAV1 SID along the BPK departure route

1.5 Supporting Infrastructure and Resources

Following the RNAV1 trial, ATC and airlines have demonstrated that the processes, procedures and infrastructure are already in place to introduce the RNAV1 SIDs on a permanent basis. As RNAV1 is aircraft based navigation rather than ground based there is no impact on ATC equipment.

RNAV1 requires that any proposed route shall have excellent VOR and DME coverage. Luton has several of these facilities within close range; thus allowing for contingency should any ground based facility fail. A VOR with co-located DME is located at Brookmans Park, with operational coverage of 40 nm.

The NATS system would initially recognise a VOR or DME failure via their monitoring equipment. They would then inform Luton Radar and this failure would then be subject to promulgation via NOTAM. Information relating to a local failure would be broadcast via the Luton airport ATIS. The Luton area is within good satellite coverage for Global Navigation purposes.

Any RNAV1 departure would be strictly monitored by Luton radar using both primary and secondary radar as an additional safeguard. Standard radar separation would apply at all times, 1000 feet vertically and/or 3 nm laterally, regardless of whether the departure was conducted via RNAV1 or radar vectors.

The RNAV1 SIDs will only be available to aircraft which are equipped and operated in accordance with the requirements of JAA TGL-10 or equivalent, and approved by their State of Registry for RNAV1 (formally P-RNAV) operations. This requires aircraft to be GNSS equipped or to have DME/DME and INS/IRU with an automatic runway update capability. Additionally flight crews have to complete appropriate RNAV1 training and be approved by the appropriate state authorities to conduct RNAV1 operations. Over 90% of aircraft currently using London Luton Airport are anticipated to be able to utilise the RNAV1 SIDs if they come into operation, and this percentage is expected to rise over the coming years.

RNAV SIDs will be differentiated from the conventional by the designator and will have separate charts in the AIP. During the trial this was CLN 9Y and DVR 9Y. Crews of approved operators requesting a RNAV1 SID will request this when obtaining their clearance from ATC Luton (NATS).

Aircraft which do not have approval from ATC to fly the procedure will be issued with the conventional SID clearances even if suitably equipped in accordance with JAA TGL-10. Conventional navigation SIDs for Clacton and Detling will therefore remain in force, and these will be used for those aircraft/airlines that are not equipped to fly RNAV1 procedures, or for when an ATC clearance cannot be issued for the use of the RNAV1 SIDs. If for any reason operators are unable to use the SIDs, then the existing CLN and DET SIDs as published in the UK AIP will be utilised.

Therefore, in the event that RNAV1 is adopted along this route, two NPR swathes will be in operation: One for the conventional SIDs, and one for the RNAV1 SIDs.

1.6 Operational Impact

The proposed RNAV1 SIDs are fully contained within the existing NPR, and therefore have no impact on any other traffic in or through the area other than aircraft that wish to use RNAV1 procedures along the Brookmans Park departure route. Similarly, there will be no impact on Visual Flight Rules (VFR) operations. There are no consequential effects on procedures, capacity, neighbouring aerodromes or other activities within or adjacent to the airspace.

1.7 Economic Impact

Track data from both the 210 and 220 knots trials have been used to determine the impact on fuel burn and associate CO_2 emissions, and this assessment has been provided in Section 2.3. This assessment was undertaken using KERMIT, NATS bespoke fuel burn model, and provides an estimate based on the aircraft's height, speed, type and phase of flight (cruise/climb/descent) up until the point at which the route crosses the railway line from Harpenden to St. Albans.

The results demonstrate that both RNAV1 routes reduce the amount of fuel burnt and CO_2 emitted compared to the current route due to a small reduction in track miles and savings are greatest on the RNAV1 220 knots route. Based on total aircraft movements in 2013 (Table 2), if the RNAV1 220 knots route is adopted, 290 tonnes of fuel and 885 tonnes of CO_2 would be saved annually. This equates to over £250,000 saved on fuel per year.

1.8 Safety Management

No changes are proposed to safety management in the airspace.

1.8.1 Airspace and Infrastructure Requirements

A key element of any change proposal is the need to demonstrate that the proposed airspace change complies with the DAP Regulatory Requirements. The Regulatory requirements are derived from International Civil Aviation Organisation (ICAO) standards and recommended practices (SARPS) and European Civil Aviation Conference (ECAC)/Eurocontrol requirements and any additional requirements to satisfy UK Policy as notified and are detailed below:

a) *The airspace structure must be of sufficient dimensions with regard to expected aircraft navigation performance and manoeuvrability to fully contain horizontal and vertical flight activity in both RADAR and non-RADAR environments.*

Prior to consultation and submission of this airspace change proposal (ACP), London Luton Airport Operations Ltd in conjunction with NATS completed operational trials of the RNAV1 SIDs. All aircraft on the trial were contained within current airspace as the RNAV1 SIDs replicate the current conventional SIDs.

b) *Where an additional airspace structure is required for RADAR control purposes, the dimensions shall be such that RADAR control manoeuvres can be contained within the structure, allowing a safety buffer. This safety buffer shall be in accordance with agreed parameters as set down in DAP Policy Statement, 'Safety Buffer Policy for Airspace Design Purposes Segregated Airspace.'*

Not applicable to this ACP.

c) *The Air Traffic Management (ATM) system must be adequate to ensure that prescribed separation can be maintained between aircraft within the airspace structure and safe management of interfaces with other airspace structures.*

Primary and Secondary RADAR will be used. Flights flying along the RNAV1 SIDs will remain inside controlled airspace. Minimum RADAR separation shall be observed at all times (1000 feet vertically, 3 nm laterally and 2 nm inside the boundaries of controlled airspace).

d) *ATC procedures are to ensure required separation between traffic inside a new airspace structure and traffic within existing adjacent or other new airspace structures.*

ATC shall at all times maintain standard separation between all instrument flight rules (IFR) flights operating within the confines of the current unchanged airspace (3 nm laterally and/or 1000 feet vertically) by the use of primary and secondary RADAR.

As now, visual flight rules (VFR) and IFR flights shall be authorised to transit the proposed RNAV1 SID route subject to unit capacity and issued tactically, but their passage shall not delay or compromise separation against Luton departure flights.

e) Within the constraints of safety and efficiency, the airspace classification should permit access to as many classes of user as practicable.

The proposed RNAV1 SIDs shall continue to be class D. This shall allow regulated access to any potential user provided they have a means of direct communication with Luton RADAR. The pilot in advance of any transit shall make a request via the R/T. Approval shall be given on a tactical basis, subject to unit capacity.

f) There must be assurance as far as practicable against unauthorised incursions. This is usually done through the classification and promulgation.

Current arrangements to prevent incursions through education and detect through RADAR tools and controller vigilance remain in place. The proposed introduction of RNAV1 SIDs would not alter the current infringement risk

g) Pilots shall be notified of any failure of navigational facilities and of any suitable alternative facilities available and the method of identifying failure and notification should be specified.

Any failure of a navigational aid shall be promulgated via a 'notice to airmen' (NOTAM), and to ensure all potential users are aware of an unplanned failure a message shall be broadcast via the Luton Airport automatic terminal information service (ATIS). Should any particular RADAR fail, another approved for use by Luton RADAR can be manually selected swiftly by the controller. Swanick systems monitor navigational aids and notify ATC units of any failure.

h) The notification of the implementation of new airspace structures or withdrawal of redundant airspace structures shall be adequate to allow interested parties sufficient time to comply with user requirements. This is normally done through the AIRAC cycle.

Promulgation of the introduction of the RNAV1 SIDs shall be via an Aeronautical Information Circular, then included within the relevant aeronautical information regulation and control (AIRAC) cycle. This will be completed in sufficient time to allow aircraft flight management system (FMS) to be updated. Consultation with local users has already occurred, so there will be some familiarity with the proposals already.

i) There must be sufficient R/T coverage to support the ATM system within the totality of proposed controlled airspace.

There is no change to dimensions of controlled airspace therefore current radio coverage remains adequate.

j) If the new structure lies close to another airspace structure or overlaps an associated airspace structure, the need for operating agreements shall be considered.

Not relevant to this application.

k) Should there be any other aviation activity (low flying, gliding, parachuting, microlight site etc.) in the vicinity of the new airspace structure and no suitable operating agreements or ATC Procedures can be devised, the sponsor shall act to resolve any conflicting interests. The Directorate may offer to act as arbitrator if required.

Not relevant to this application

l) Airspace changes in respect of ATS Routes and Terminal Airspace structures are subject to additional requirements as specified in the paragraphs below.

ATS Routes

a) There must be sufficient accurate navigational guidance based on in-line VOR/DME or NDB or by approved RNAV derived sources to contain the aircraft within the route to the published RNP value in accordance with ICAO/Eurocontrol Standards.

RNAV1 requires that any proposed route shall have excellent VOR and DME coverage. Luton has several of these facilities within close range. Such VOR's with co-located DME include Barkway (BKY), Bovingdon (BNN), Brookmans Park (BPK) London (LON) and Daventry (DTY).

Operational coverage of these VORs is as follows:

- BPK 40 nm
- BNN 60 nm
- DTY 60 nm
- BKY 40 nm
- LON 80 nm

The Luton area has good satellite coverage.

b) Where ATS routes adjoin Terminal Airspace there shall be suitable link routes as necessary for the ATM task.

Not relevant to this application.

Terminal Airspace

a) The airspace structure shall be of sufficient dimensions to contain appropriate procedures, holding patterns and their associated protected areas.

Not applicable to this application.

b) There shall be effective integration of departure and arrival routes associated with the airspace structure and linking to designated runways and published IAPs.

Not applicable to this application.

c) Where possible, there shall be suitable linking routes between the proposed terminal airspace and existing en-route airspace structure.

Not applicable to this application.

d) The airspace structure shall be designed to ensure that adequate and appropriate terrain clearance can be readily applied within and adjacent to the proposed airspace.

Terrain clearance provision is unchanged as the vertical profile of the SIDs are unaltered.

e) *Suitable arrangements for the control of all classes of aircraft operating within (including transits) or adjacent to the airspace in question in all meteorological conditions and flight rules are in place or will be put into effect by change sponsors upon implementation of the change in question (if these do not already exist).*

These arrangements are already in place and are as follows:-

Access for potential users shall be granted on a tactical basis depending upon traffic levels and unit workload.

Aircraft requesting access must carry a two-way radio and have the means of communicating with Luton RADAR. Standard separation between IFR flights shall be maintained. Flights may not continue to operate freely below the vertical base of the proposed airspace. Notification of the impending airspace change shall be via an aeronautical information circular (AIC), and then published via the AIRAC. Navigational maps and charts will also be updated in good time. Local airspace users have already been consulted about the proposal.

f) *Change sponsors shall ensure that sufficient visual reference points (VRPs) are established within or adjacent to the subject airspace to facilitate the effective integration of VFR arrivals, departures and transits of the airspace with IFR traffic.*

Luton already has VRP's strategically located to afford access for VFR arrivals, departures and zone transits.

g) *There shall be suitable availability of RADAR control facilities.*

Primary and Secondary RADAR data from the Stansted 10cm shall be the preferred choice; the alternative source would come from Debden. The airspace that forms part of the proposal has good proven primary and secondary RADAR coverage.

h) *Change sponsors shall, upon implementation of any airspace change, devise the means of gathering (if these do not exist) and of maintaining statistics on the number of aircraft transiting the airspace in question. Similarly, change sponsors shall maintain records on the numbers of aircraft refused permission to transit the airspace in questions, and the reasons why. Change sponsors should note that such records will enable ATS Managers to plan staffing requirements necessary to effectively manage the airspace under their control.*

London Luton Airport operates a Topsonic Noise & Track Monitoring System, which records the RADAR tracks of all commercial aircraft activity in the vicinity of the proposed SIDs. Reports of movements within the proposed airspace will be provided to NATS & to the London Luton Airport Consultative Committee on a quarterly basis.

Off-Route Airspace Structures

a) *If the new structure lies close to another airspace structure or overlaps an associated airspace structure, the need for operating agreements shall be considered.*

No additional operating agreements are required.

b) *Should there be any other aviation activity (low flying, gliding, parachuting, microlight site etc.) in the vicinity of the new airspace structure and no suitable operating agreements or ATC Procedures can be devised, the sponsor shall act to resolve any conflicting interests. The directorate may offer to act as arbitrator if required.*

No additional operating agreements are required.

2. Environmental Assessment

Data collected during the trial has been used to analyse the environmental implications of the proposal.

2.1 Lateral Dispersion

Lateral dispersion of aircraft throughout the trial was monitored through the Airport's Noise and Track Monitoring System. Figures 2.3 to 2.5 display the lateral dispersion of aircraft navigating using current procedures, and also during the 210 knots and 220 knots RNAV1 trials for comparison. On the plot density diagrams yellow indicates the highest density of tracks, followed by red, pink then blue. Plot densities have been calculated using flight data from the duration of the 210 knots and 220 knots trial.

2.2 Vertical Dispersion

Vertical dispersion of aircraft throughout the trial was also monitored through the Airport's Noise and Track Monitoring System. The proposed RNAV1 route design is not anticipated to alter or affect the rate at which aircraft climb. To demonstrate this, gates have been set up along the route to analyse the altitude at which aircraft pass through. The procedure for flying the first turn will remain unchanged, therefore the first gate has been set up immediately after the first turn at Slip End. Five locations have been set up:

- Slip End
- Markyate
- Second Turn
- Motorway
- Railway

Data has been provided for the most common aircraft to fly the BPK departure route (A320s) and also the slowest climbing aircraft that uses the route (A306).

The gates for aircraft flying the RNAV1 procedures (both 210 knots and 220 knots) have been set-up to span the NPR and therefore illustrates the lateral spread of aircraft within the NPR as well as the altitude. The data provided is taken from the full duration of the trials. The locations of the gates have been provided in Figure 2.6.

The gates for aircraft flying current procedures (non-RNAV) have been set up to span the current NPR at Slip End and Markyate, however the gates have been extended at the last three locations to capture those aircraft that are flying outside of the NPR. The locations of these gates have been provided in Figure 2.7. Therefore whilst these results graphically represent vertical dispersion, they are not a clear representation of lateral dispersion when comparing them to the results from aircraft flying the RNAV1 routes. The data provided is taken from aircraft flying current procedures during the RNAV1 210 and 220 knots trials.

The results have been provided in Appendix 2.1 along with the underlying data.

The results illustrate that the rate at which aircraft climb is no different when using RNAV1 procedures compared to current procedures.

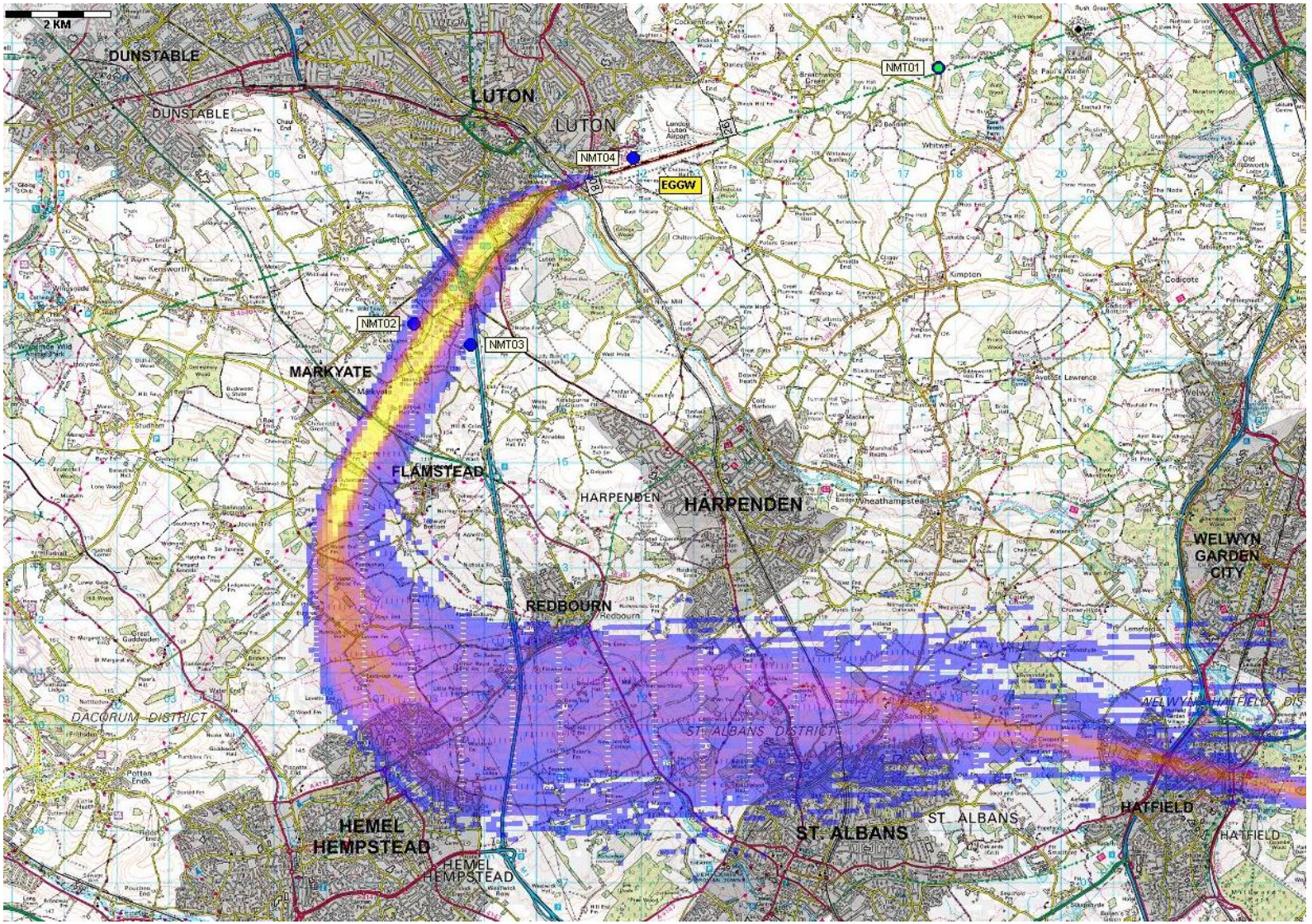


Figure 2.3. Existing Conventional Brookmans Park SID Plot Density Diagram

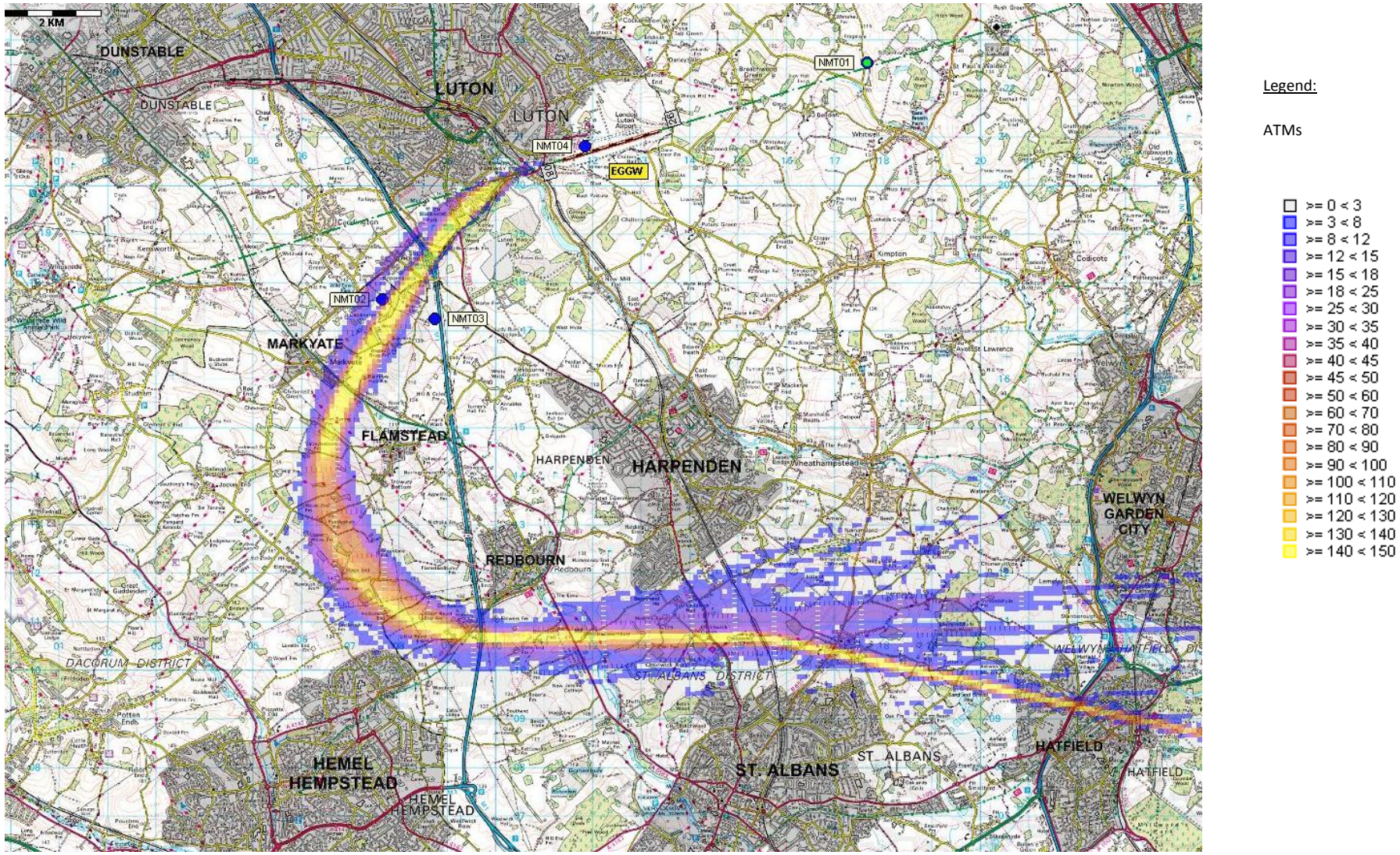


Figure 2.4. RNAV 1 Trial SID with Initial Speed Restriction of 210 knots – Plot Density Diagram

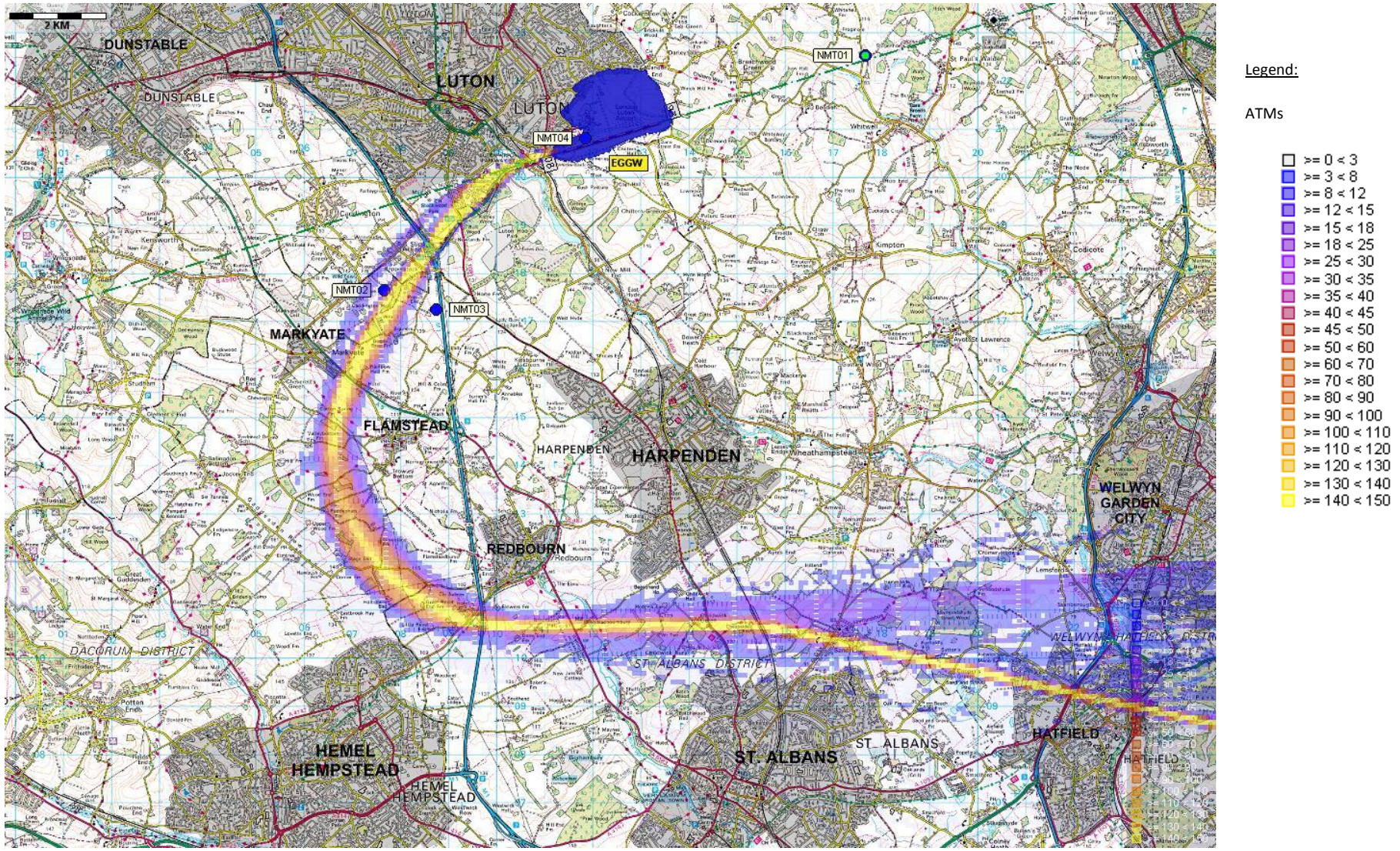


Figure 2.4. RNAV 1 Trial SID with Initial Speed Restriction of 220 knots – Plot Density Diagram

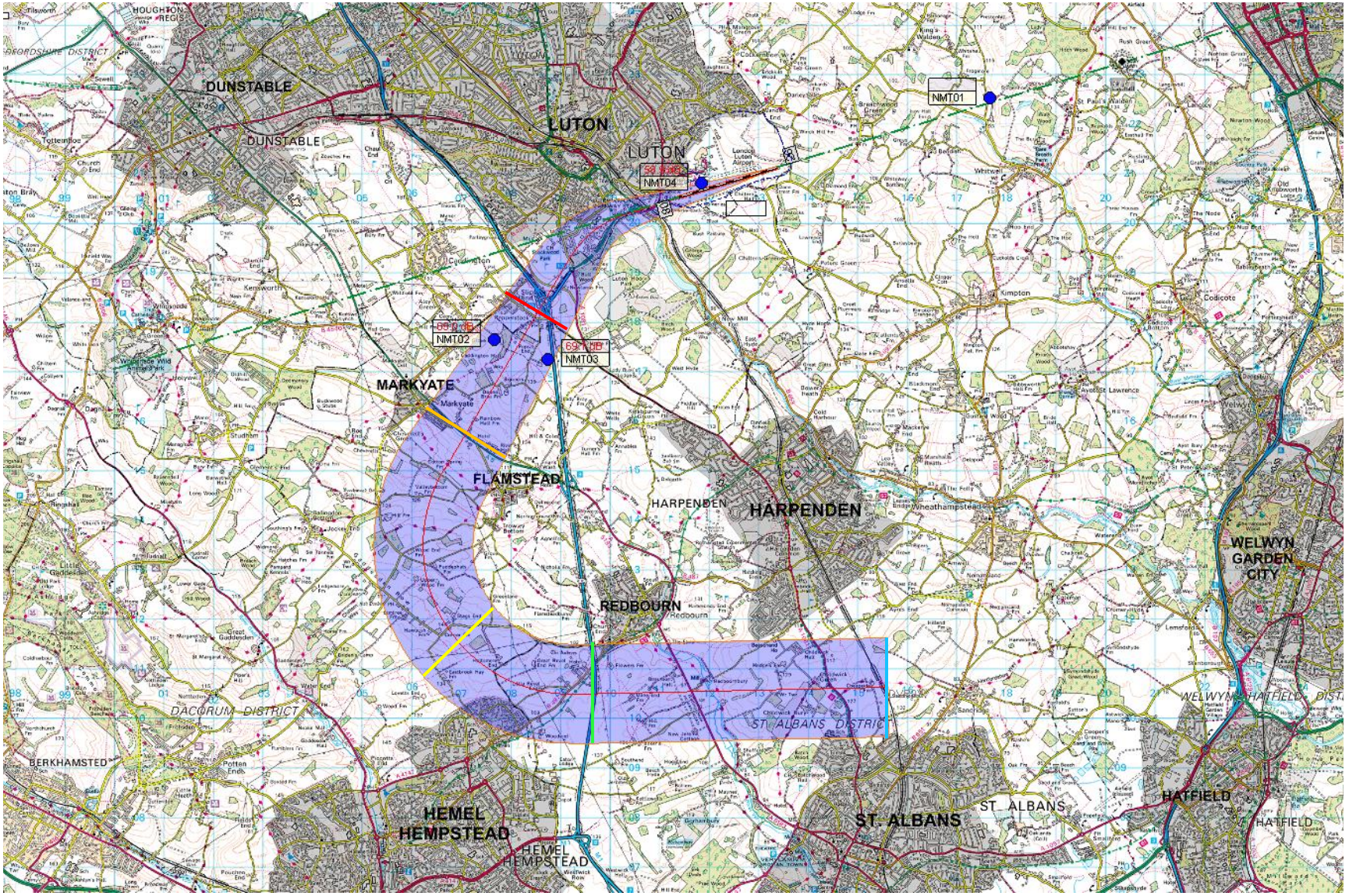


Figure 2.5. Penetration gates used for aircraft flying RNAV1 procedures

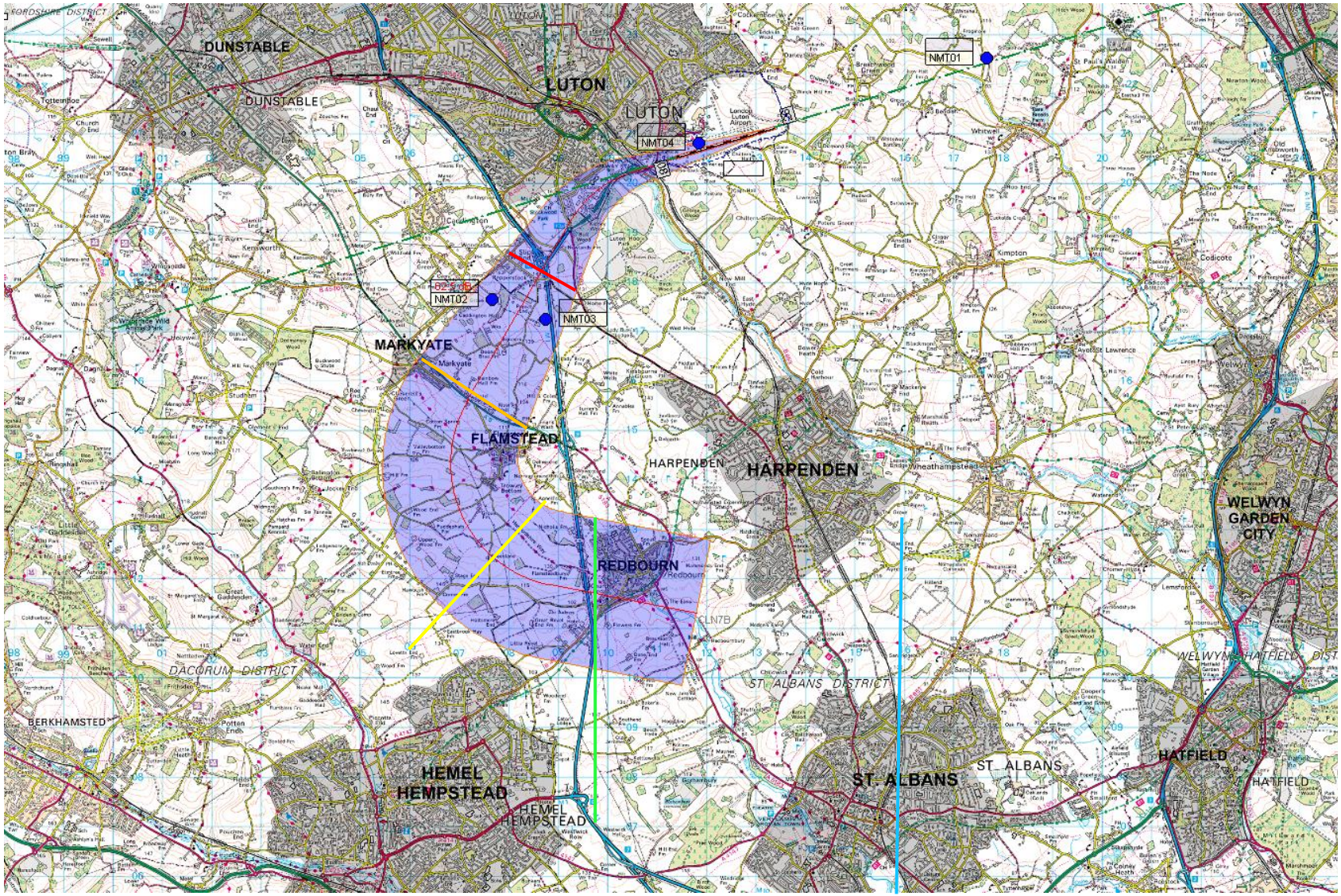


Figure 2.6. Penetration gates used for aircraft flying current procedures

2.3 Traffic Forecasts

Runway 26 BPK departure routes are in use during westerly operations which occur approximately 70% of the time, and facilitate approximately 40% of all departing aircraft when in operation. These percentages are based on an average of the last five years, and equates to approximately 60-70 flights per day for 70% of the year based on 2013 total aircraft movements. During 2013, 14,488 movements were recorded on the Runway 26 BPK departure route, 609 of which were at night. Night movements are defined as those that departed between 23:00 – 06:00, Mon-Sat and until 07:00 on Sunday.

Table 2.1 details the 10 most frequent types of aircraft in operation along this route, and the percentage of traffic that is attributed to that aircraft. Anticipated passenger and traffic forecasts along the Runway 26 BPK departure routes up until 2030 are provided in Table 2.2, along with data from the last four years.

The adoption of RNAV1 along the Runway 26 BPK departure route will not have any impact on traffic forecasts, and does not affect the number or type of aircraft able to use the route or the Airport. It also does not affect the route flown once aircraft have passed St. Albans.

Table 2.1 Aircraft type on Runway 26 Brookmans Park departures

Aircraft Type	Percentage
A320	46%
A319	15%
B738	5%
B734	3%
C56X	2%
GLF5	2%
CL60	2%
GLF4	2%
GLEX	2%
A306	2%

Table 2.2 Air traffic movements – Totals and BPK departures

Year	Million passengers per annum	Total Air Traffic Movements (ATMs) per annum – 000s	Runway 26 Departures per annum (in use for 70% of the time) – 000s	Runway 26 Departures on BPK route per annum (40% of R26 departures) – 000s	Average number of departures on BPK route per day when in use
2010	8.8	96	31	12	53
2011	9.5	99	36	15	57
2012	9.6	99	36	16	61
2013	9.7	98	31	15	62
2014	10.8	116	41	16	65
2015	11.2	118	41	17	66
2016	11.7	121	42	17	68
2017	12.1	124	43	17	70
2018	12.6	128	45	18	72
2019	12.9	130	46	18	73
2020	13.4	132	46	19	74
2021	14.3	137	48	19	77
2022	14.8	141	49	20	79
2023	15.4	144	50	20	81
2024	15.8	146	51	20	82
2025	16.6	150	53	21	84
2026	17.3	154	54	22	87
2027	17.7	156	55	22	88
2028	17.8	157	55	22	88
2029	17.8	157	55	22	88
2030	17.8	157	55	22	88

N.B. 2010-2013 are based on actual movement data, whereas 2014-2030 is a forecast based on upper end, unconstrained demand, assuming the development proceeds as planned (based on London Luton Airport Operations Limited Revised Masterplan document (http://www.london-luton.co.uk/en/about/).

2.4 Noise

A noise assessment of the proposal was carried out by noise consultants Bickerdike Allen Partners using noise monitoring data obtained during the trials. This assessment includes noise contours, and an estimate of the number of people overflown currently and in the event that RNAV1 procedures are adopted. This report has been provided in Appendix 2.2.

The noise assessment showed no significantly greater impacts from the RNAV1 routes as opposed to the current route. In the event that RNAV1 procedures are adopted the greatest change would be a reduction in noise levels in Hemel Hempstead.

A population assessment was also carried out to determine the number of people currently impacted by aircraft along this route, and the number that would be impacted if RNAV1 procedures were adopted. Full details are in Appendix 2.2, however the assessment concluded that the number of people would be greatly reduced if RNAV1 procedures were adopted.

2.5 Climate Change

Track data from both trials has been used to determine the impact on fuel burn and associate CO_2 emissions. This assessment was undertaken using KERMIT, NATS bespoke fuel burn model, and provides an estimate based on the aircraft's height, speed, type and phase of flight (cruise/climb/descent) up until the point at which the route crosses the railway line from Harpenden to St. Albans. This endpoint was chosen because if an RNAV1 procedure is adopted it will be ensured that aircraft track within the swathe until crossing this point (subject to ATC vectoring earlier due to

safety or operational reasons). KERMIT refers to the BADA (Base of Aircraft Data) database (version 3.10) to determine aircraft performance (e.g. mean fuel flow) for an aircraft type at a particular flight level, phase and speed.

KERMIT estimations of fuel burn and CO_2 emissions are very much dependent on the various assumptions used for the constants and formulae in the design, as well as the accuracy of inputs to the model. Ultimately, the study of aircraft fuel burn and CO_2 emissions is a complex science and, as such, the model itself requires these assumptions.

Full details of the assessment are provided in Appendix 2.3 along with the underlying data. The table below summarises the results.

Table 2.3. Fuel Burn Analysis

	Average fuel burn per flight (kg)	Average CO_2 per flight (kg)	Average track extension per flight (NM)	Sample size
Current route	312	990	4.41	1,823
RNAV1 210 knots	298	948	4.12	820
RNAV1 220 knots	292	929	3.92	845

NB. Track extension is calculated by comparing the distance flown and the great-circle distance from first to last radar point for each flight.

Applying this to the number of aircraft that used the BPK departure route in 2013, as well as traffic forecasts for 2018 and 2030 (provided in Section 2.3) the following fuel savings are estimated.

Table 2.4. Annual fuel and CO_2 savings

	2013		2018		2030	
	Fuel savings per annum (tonnes)	CO_2 savings per annum (tonnes)	Fuel savings per annum (tonnes)	CO_2 savings per annum (tonnes)	Fuel savings per annum (tonnes)	CO_2 savings per annum (tonnes)
RNAV1 210 knots	210	630	252	756	308	924
RNAV1 220 knots	300	915	360	1,098	440	1,342

The results demonstrate that both RNAV1 routes reduce the amount of fuel burnt and CO_2 emitted compared to the current route due to a small reduction in track miles and savings are greatest on the RNAV1 220 knots route. The RNAV 210 knots route uses more fuel because this speed restriction makes it necessary to increase the use of flaps through the initial turns. Based on total aircraft movements in 2013 (Table 2), if the RNAV1 220 knots route is adopted, 290 tonnes of fuel and 885 tonnes of CO_2 would be saved annually. This equates to over £250,000 saved on fuel per year. Similarly if the RNAV1 210 knots route is adopted 203 tonnes of fuel and 609 tonnes of CO_2 would be saved annually.

These results are supported by a separate analysis that was undertaken by WizzAir, the results of which were supplied in response to their consultation response in Appendix 3.6.

2.6 Local Air Quality

Local air quality is not anticipated to be affected by the adoption of RNAV1 along the Runway 26 Brookmans Park (BPK) departure routes. The adoption of RNAV1 procedures would reduce the quantity of fuel burnt, however the benefits are unlikely to be significant enough to be detectable through air quality monitoring at ground level.

Air quality, including NO_2 and PM10 is monitored across and around the airport. This data is published at the following link: http://www.ukairquality.net/

2.7 Tranquility and Visual Intrusion

The Chilterns is a designated Area of Outstanding Natural Beauty (AONB) stretching from the Thames north of Reading some 70km to Hitchin. The area skirts the south-west of Luton, and both the current and proposed Runway 26 BPK departure routes fall slightly within the boundary for a short stretch between Markyate and Flamstead heading into the second turn. The adoption of neither RNAV1 options along this route is anticipated to alter the tranquillity of the Chilterns compared to the current situation. Maps illustrating the AONB in relation to the current and proposed NPRs are provided in the figures below.

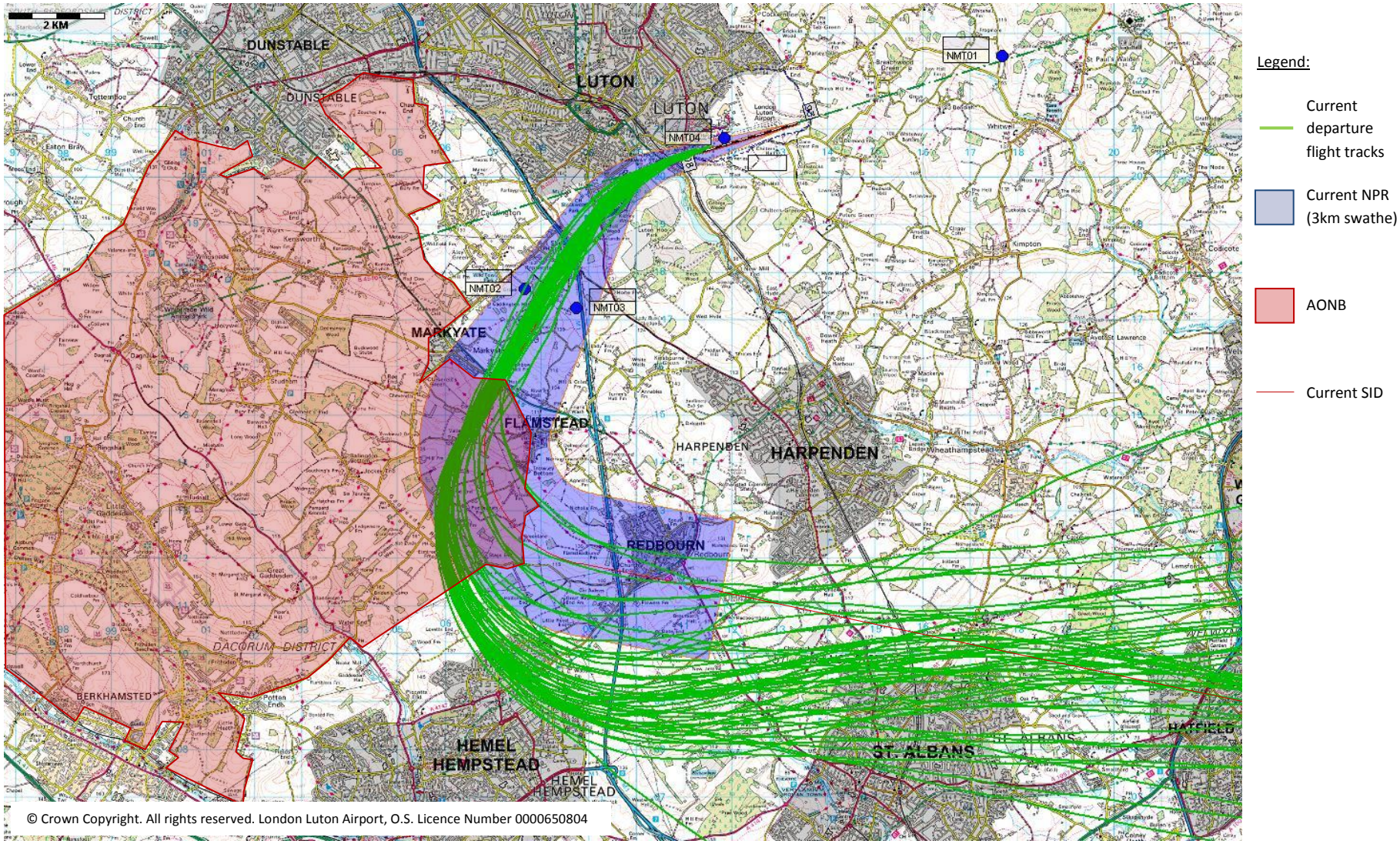


Figure 2.7. AONB and current NPR corridor and example flight tracks

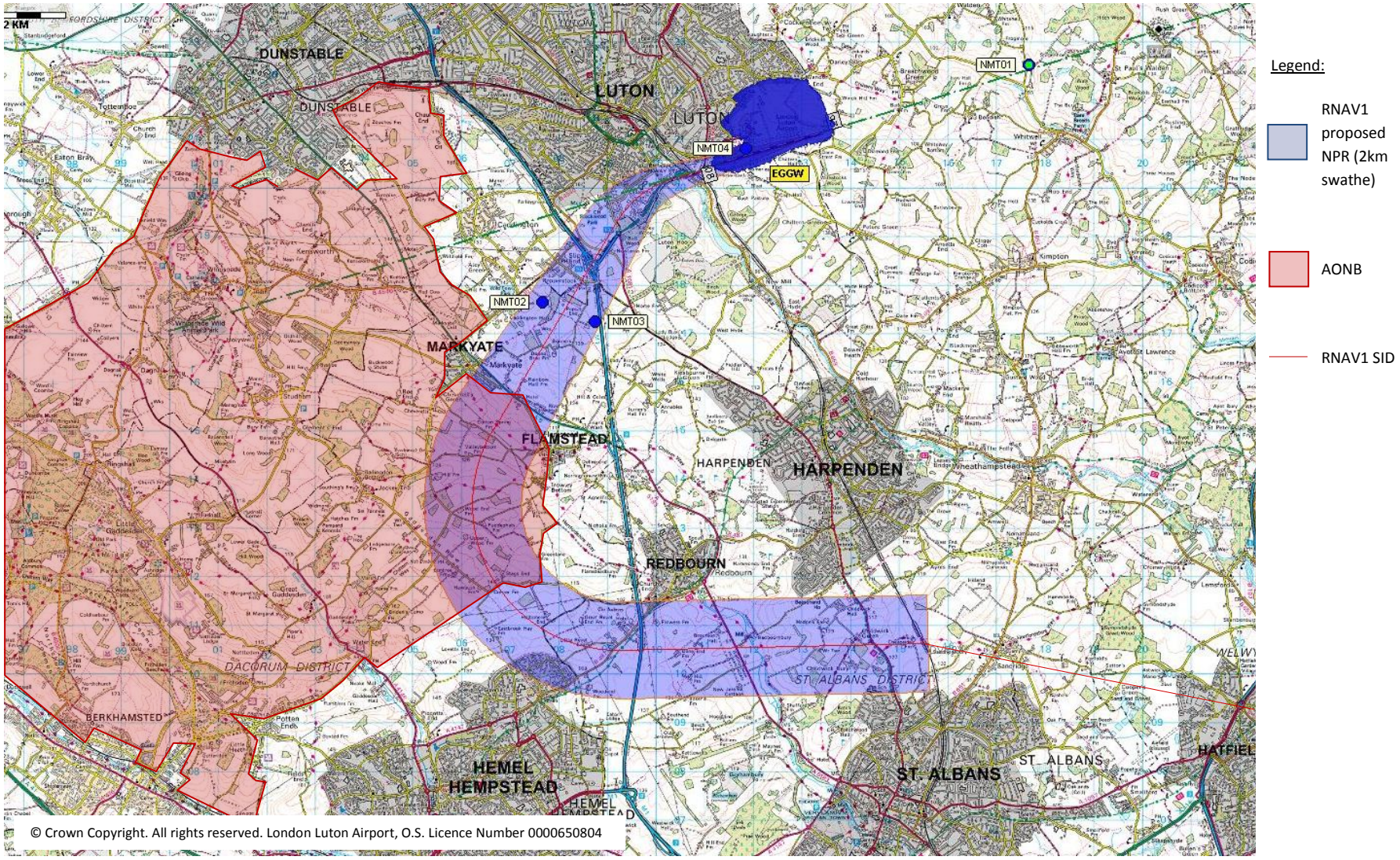


Figure 2.8. AONB and proposed RNAV1 NPR corridor

3. Consultation Report

3.1 Executive Summary

The consultation exercise received a high response rate from stakeholders, particularly from local residents.

3.2 Overview of Responses

3.2.1 Response Rate

A total of 1,453 responses were received during the consultation period, with the majority coming from local residents. This high response rate indicates that awareness of the consultation was high.

Of the 102 organisations identified as targeted stakeholders 29 responded.

3.2.2 Consultation Outcome

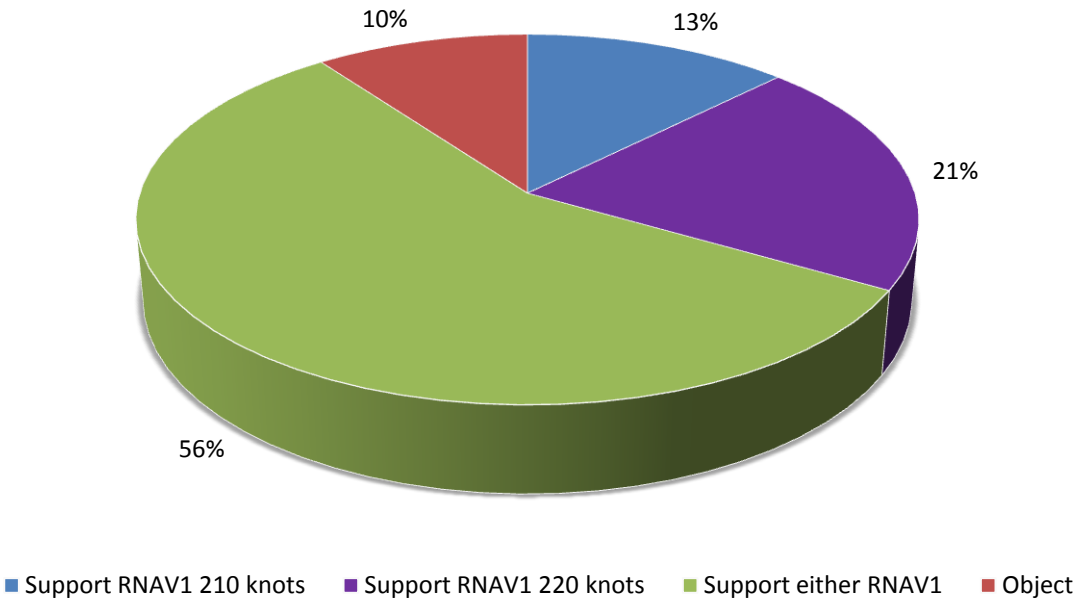
Responses from the targeted stakeholders indicated preference for RNAV1 with a 220 knots initial speed restrictions, and all of the airlines that responded to the consultation also favoured this option.

A spreadsheet containing all the responses received has been provided in Appendix 3.1. Where it was requested that personal details were not passed on, only the postcode has been provided. The responses were split as follows.

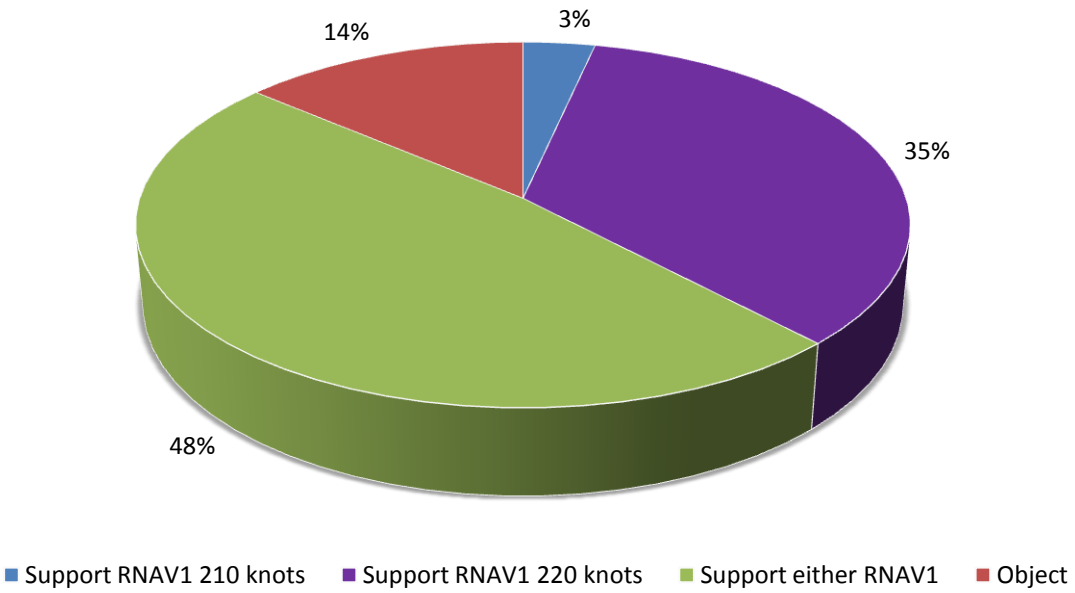
Table 3.1 A summary of responses received.

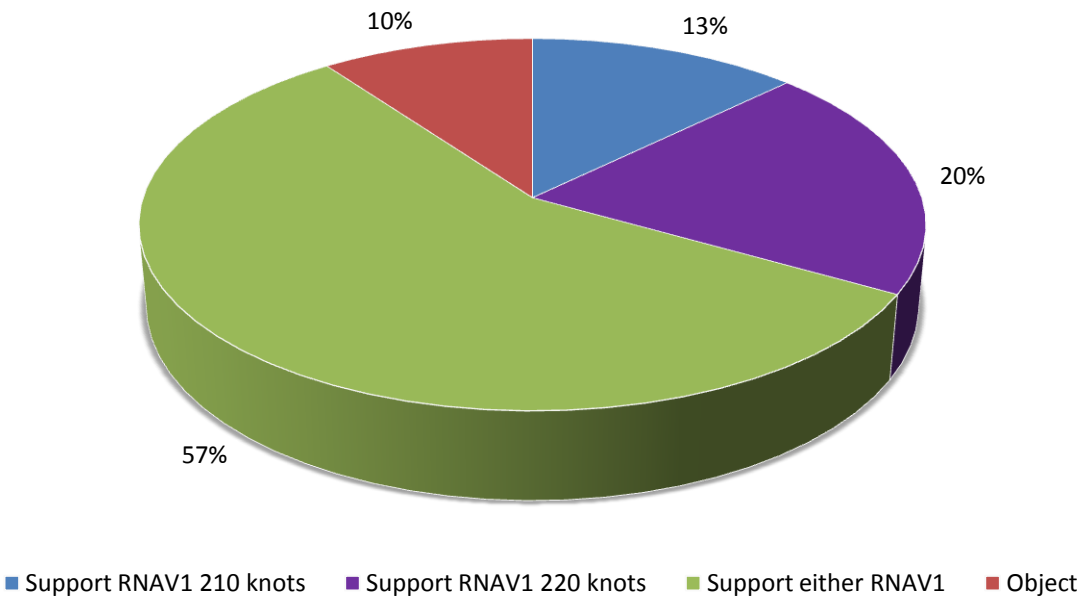
		Number of targeted stakeholders	Number of Committees/ People responded	Support RNAV1 210 knots	Support RNAV1 220 knots	Support either RNAV1	Objection
Targeted Stakeholders	LLACC incl. NTSC	23	7	0	3	3	1
	FLOPC	26	4	0	4	0	0
	NATMAC	37	5	0	1	4	0
	Additional Stakeholders (e.g. parish councils)	16	13	1	2	7	3
	Sub-total	**102**	**29**	**1**	**10**	**14**	**4**
General Public	Individuals	N/A	1,411	182	288	800	141
	Organisations	N/A	13	0	3	8	2
	Sub-total	N/A	**1,424**	**182**	**291**	**808**	**143**
	TOTAL		**1,453**	**183**	**301**	**822**	**147**

Total Responses



Targeted Stakeholders





Objections to the adoption of any RNAV1 procedures were received from Flamstead Parish Council, the Chiltern Countryside Group and London Luton Airport Town & Villages Communities Committee (LLATVCC). 143 objections were also received from members of the public, the locations of which are provided in Table 3.2 and Figure 3.1 (with the exception of the objection from Oxfordshire).

Table 3.1. The location of members of the public that objected to the proposal

Location	Number of Objections
South Luton LU1	7
Markyate AL3 8	1
Flamstead AL3 8	1
Hemel Hempstead HP	8
Harpenden - AL5	6
St Albans AL1 and AL3	39
Sandridge and Jersey Farm AL4 9	78
Wheathampstead AL4 8	1
Welwyn Garden City AL7	1
Chinnor, Oxfordshire OX39	1
Total	**143**

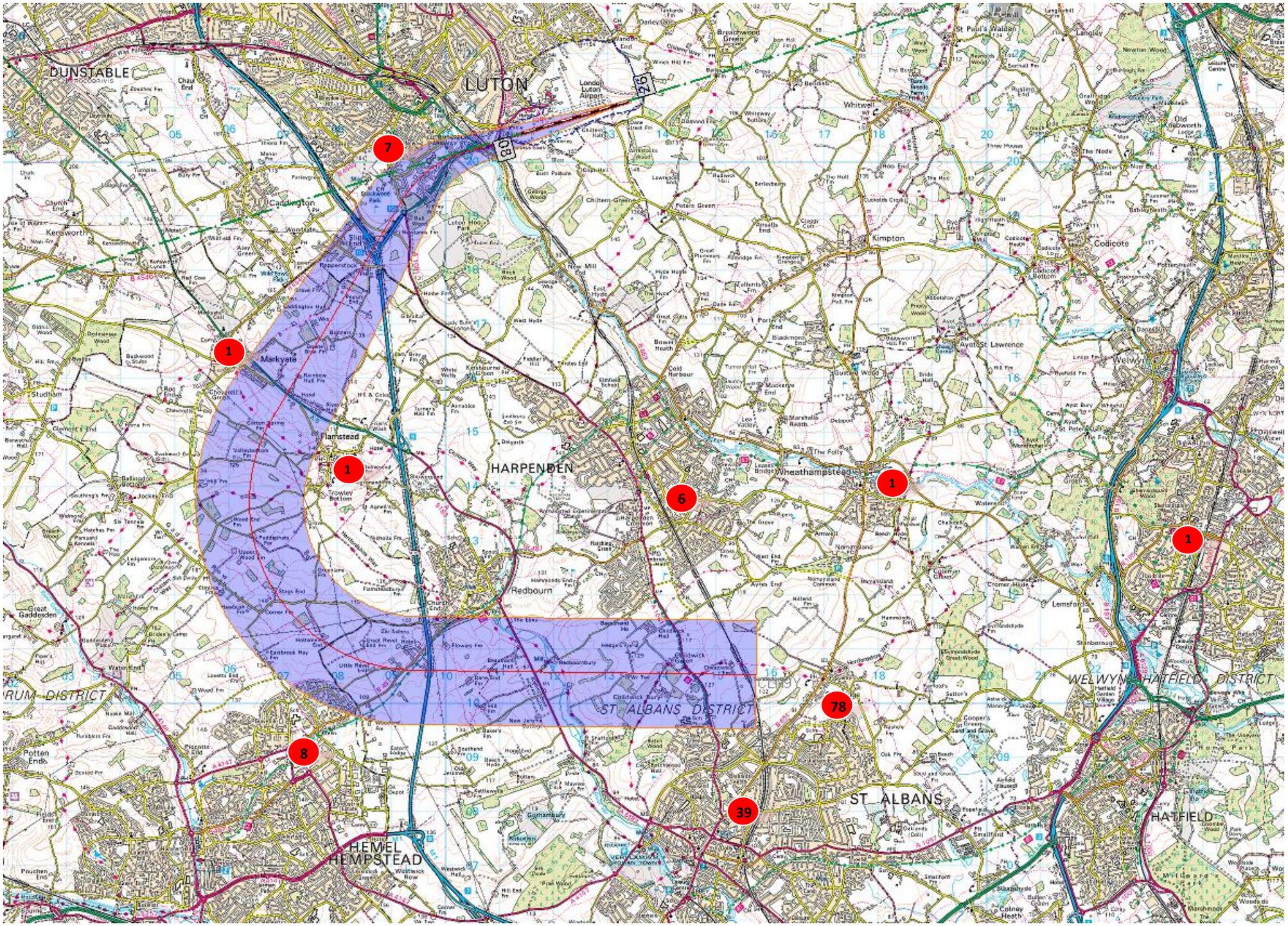


Figure 3.1. Locations of members of the public who objected to the proposal

3.2.3 Recurring Themes

A number of recurring themes have been identified from the responses received.

Support for the proposals

Support for the proposal was received from Air Traffic Control, and all airlines and NATMAC (National Air Traffic Management Advisory Committee) members that responded to the consultation. This indicates that the adoption of RNAV1 procedures is beneficial from an operational perspective.

Airlines specifically supported the adoption of the RNAV1 proposals with a speed restriction of 220 knots, stating that this would reduce fuel-burn, and enable the aircraft to fly in a more efficient configuration. The RNAV 210 knots route would require greater use of flaps which would increase air frame noise, increase flap wear and would constitute a 'non-standard' procedure which would increase crew workload.

LLACC members were also largely in favour of adopting RNAV1 procedures due to a reduction in the number of people overflown, with some specifically supporting the RNAV1 220 knots route due to the greater reduction in fuel burn.

Members of the public that responded also largely supported the adoption of RNAV1 procedures, again with preference for RNAV1 220 knots route over the RNAV1 210 knots route due to lower fuel burn.

Objections to the proposals

Through analysis of the responses in objection to the proposals, the following themes have been identified as key concerns. These responses have also been written in the Stakeholder Consultation Report.

> ***Whilst the proposals will offer respite to some, a reduction in the swathe of the NPR has the potential disadvantage of imposing a greater noise burden on those communities which remain within the swathe. This seems to be an unfair balance.***

The proposals are consistent with the Government's Aviation Policy Framework commitment to limit and where possible reduce the number of people in the UK significantly affected by aircraft noise.

> ***The noise results from the trial were inconclusive, and no monitoring was undertaken in the location I live in. A further trial is therefore requested to obtain more data.***

The length of the trial was agreed with the CAA prior to the launch, and the duration limited in case of any unanticipated adverse impacts encountered. Monitoring was focussed on areas believed to have the highest potential for change in noise levels as a result of the trialled procedures. If this Airspace Change Proposal is accepted by the CAA, the effectiveness of the change will be further monitored and assessed over the following 12 months, and a review held at the end of this period.

> ***The proposed route flies directly over Sandridge. Why can the route not be directed slightly north at this point to avoid this village and fly between Sandridge and Wheathampstead.***

There is no change proposed in the location of the SIDs past Sandridge, and aircraft are often in excess of 6,000 feet along this section of the route. Should RNAV1 procedures be adopted however, noise monitoring will be undertaken in Sandridge to determine whether the concentration of aircraft passed this location is perceivable, and the data provided as part of the review process with the CAA.

A further enhancement of performance-based navigation capabilities is due later this year when new SID design criteria is expected to be approved by the International Civil Aviation Organisation (ICAO), and by the CAA for use in the UK. This will involve the introduction of a new design criterion for Required Navigation Performance (RNP1) SIDs which will further improve track keeping. When this technology has been made available for use at London Luton Airport, this technology will be considered for use along the Runway 26 Brookmans Park departure route, and re-routing of the SIDs north of Sandridge will be considered as part of this. If this re-routing was to be incorporated into this current proposal, this would cause significant delay in implementing RNAV1 procedures along this route and therefore cause a delay in providing significant benefits to a large number of people.

> ***Noise levels rose during the trials in south Luton, attributed to aircraft making a later first turn during the trial as an unintended consequence of the RNAV1 trial route design. Whilst it has been stated that this will be addressed to ensure the first turn is initiated as per the current route design, how can you be sure noise levels won't still be higher, or that this won't affect the routing of aircraft further down the SID.***

There will be no change to the procedure by which aircraft navigate the first turn over South Luton if RNAV1 procedures are adopted. Noise levels over south Luton will therefore be unaltered. Track adherence will again be monitored and analysed as part of the review process with the CAA.

> ***I live in the northern part of Hemel Hempstead and I am concerned that we will be overflown more often if RNAV1 procedures are introduced because the NPR would pass over my house whereas it currently doesn't.***

Under current procedures aircraft are not able to fly within the NPR, and therefore routinely overfly north Hemel Hempstead. During the RNAV1 trials aircraft were able to pass between Hemel Hempstead and Redbourn, and the noise monitoring results indicated that Hemel Hempstead would experience significant benefits in the event that RNAV1 procedures are adopted.

> ***We are concerned that adopting RNAV1 may not be appropriate for all routes from Luton.***

This Airspace Change Proposal solely concerns the Runway 26 Brookmans Park Departure Route. Whilst we intend to consider RNAV1 procedures for all other routes, each will be considered on their own merit.

3.2.4 Incomplete Responses

Six responses received were not included in the analysis because they did not specify which option they supported. All other responses received have been considered usable and have therefore been incorporated into the analysis, although some responses are lacking in detail. For example, some individuals did not include their name and/or address on the online survey, which prevents them being incorporated into any postcode analysis. The majority of individuals did however provide sufficient information.

To ensure one individual did not submit multiple responses, the online survey did not accept multiple responses from one IP address. The majority of responses received by post contained a name which enabled cross-checking to ensure a response from that individual had not already been received.

3.3 Modification to the Proposal

The RNAV1 option with an initial speed restriction of 220 knots received greater support than the option with an initial speed restriction of 210 knots, and therefore this is the option that has been put forward for approval. No modification to the RNAV1 220 knots SID as defined in the consultation is proposed, however a modification to the procedures used during the trial is proposed.

Noise levels in south Luton during the 210 knots trial rose unexpectedly compared to outside the trial period, and a small increase was also measured during the 220 knots trial in Slip End. These increases were attributed to aircraft making a later first turn during the trial as an unintended consequence of the RNAV1 trial route design. The RNAV1 SIDs put forward for adoption addresses this to ensure the first turn is initiated as per the current route design, at approximately 1,000ft depending on weather conditions (i.e. at 1030ft QNH), ensuring that noise levels remain unaltered in south Luton.

3.4 Supporting Documentation

3.4.1 Consultation Process

The formal consultation took place over a 13 week period from 10th April 2014 until 9th July 2014. Feedback was encouraged by post, email or through an online survey.

The consultation material was made available on the London Luton Airport website for download, including a non-technical summary. A copy of these consultation documents have been provided in Appendix 3.2, along with the distribution list.

A press release was also distributed on 23rd April 2014. This press release has been provided in Appendix 3.3, along with the distribution list.

The table below contains a timetable for the consultation period.

Table 3.2. RNAV1 consultation timetable

Date	Action	Comments
10th April 2014	Start of consultation period	An email was sent to all consultees providing notification of the launch of the consultation. The webpage and online survey were made live.
14th April 2014	South Luton Area Board Meeting	Meeting held following an invitation to present the RNAV1 proposals at Luton Borough Council's Chambers. Interested parties including local residents from South Luton attended.
23rd April 2014	Press Release	A press release on the RNAV1 consultation was sent out.
15th May 2014	Flight Operations Committee (FLOPC)	FLOPC members were reminded of the consultation and encouraged to submit feedback before 9th July.
27th May 2014	Save Our Skies meeting	Two members from Save our Skies requested a meeting to discuss the RNAV1 proposals. A meeting was therefore held at

		London Luton Airport.
10th June 2014	Reminder email sent to consultees	An email was circulated to consultees who were yet to respond to the consultation, reminding them that responses were required before 9th July.
27th June 2014	Noise and Track Sub-Committee (NTSC)	NTSC members were reminded of the consultation, and encouraged to submit feedback before 9th July.
7th July 2014	London Luton Airport Consultative Committee (LLACC)	LLACC members were reminded of the consultation and encouraged to submit feedback before 9th July.
9th July 2014	End of consultation period	Webpage and online survey were taken down from the website, and the webpage was replaced with a notice indicating the consultation period had ended.

Awareness of the RNAV1 trials and airspace change proposal was however repeatedly discussed in detail prior to the formal consultation period with LLACC, NTSC and FLOPC as well as at additional stakeholder meetings such as with parish councils and the DAP. Meeting minutes and presentations have been provided in Appendix 3.4 to illustrate this, including attendance lists with the relevant sections of the meeting minutes highlighted in yellow. A timetable for these meetings has been provided below. Meeting minutes from the most recent committees have not yet been approved and therefore have not been included.

Table 3. Meetings at which the RNAV1 proposals had been discussed prior to the formal consultation period

Date	Nature of Meeting
8th October 2012	Framework Briefing with DAP
10th October 2012	Flight Operations Committee
19th December 2012	Noise and Track Sub Committee
21st January 2013	London Luton Airport Consultative Committee
Jan-Feb 2013	Stakeholder Engagement Meetings (Pre-trial)
13th March 2013	Noise and Track Sub Committee
22nd April 2013	London Luton Airport Consultative Committee
15th May 2013	Flight Operations Committee
27th June 2013	Noise and Track Sub Committee
8th July 2013	London Luton Airport Consultative Committee
4th September 2013	Noise and Track Sub Committee
17th September 2013	RNAV1 trial update with DAP
14th October 2013	London Luton Airport Consultative Committee
16th October 2013	Flight Operations Committee
26th November 2013	RNAV1 Stakeholder Meeting
18th December 2013	Noise and Track Sub Committee
13th January 2014	London Luton Airport Consultative Committee
7th April 2014	London Luton Airport Consultative Committee

An RNAV1 briefing sheet was also uploaded to the London Luton Airport website in February 2013 before the trials. This has been provided in Appendix 3.5.

3.4.2 Full consultation responses

A spreadsheet containing a summary of all the consultation responses is provided in Appendix 3.1. Those with the names and email addresses blanked out and/or the full address not visible requested that personal details were not shared with the CAA.

Responses from targeted stakeholders have also been provided in Appendix 3.6 along with the responses received electronically from members of the public. Due to the high number of paper responses received by post, these have not all been provided electronically, but those paper copies from responders who did not specify that their personal details should remain confidential have been provided to the CAA.

3.4.3 Stakeholder Consultation Report

Following the conclusion of the consultation period, the feedback was analysed and a Stakeholder Consultation Report produced. The report was published on London Luton Airport's website, and distributed among targeted stakeholders. A copy of this report is available in Appendix 3.7.