AIRSPACE MODERNISATION AIRSPACE CHANGE PROPOSAL

STEP 2B
INITIAL OPTIONS APPRAISAL

APPENDIX B

PBN ARRIVALS
Runway 27L - Part 3

Heathrow

Table of Contents

All airspace design options in this document are subject to change throughout the airspace change process, as options are matured in detail and refined in accordance with safety requirements, design principles, appraisals and stakeholder engagement and consultation.

PBN Arrivals – RWY 27L Option Q

Option Description

This option was developed to address a blend of DPs 2, 4, 9 & 10. This option assumes a single PBN arrival track used for all RWY27L arrivals capable of RNP-AR during the 0430-0600 period from BEGTO.

Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA_{eq}, 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA_{eq}, 8h)	312,000	-330,300
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	493,100	-638,800

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric	Difference to Baseline
Track Miles of the routes used (nm)	-18

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	47km^2	+47km^2
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	0km^2	No change
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	3km^2	+3km^2
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	0	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	4	+4

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option may impact existing helicopter routes, further work is required to understand if there is an impact on route H3/H7.

General Aviation / Commercial Airlines – Economic impact from increased effective capacity

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

Commercial Airlines – Training costs

This option would require RNP-AR capability and approvals. This can come with significant costs for airlines, however, it is unknown at this time whether RNP-AR route options would be progressed in isolation i.e. without other arrival procedures being available. Should an RNP-AR arrival be mandatory, there may be additional costs for some operators. This will be quantified in Stage 3.

Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs

Option may require re-location and/or addition of Noise Monitoring Terminals.

Airport/ANSP – Deployment costs

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

Safety

There are no IFP design issues identified with this option however, there are no RNP-AR arrivals published in the UK at this time. Therefore, additional considerations may arise through the regulatory approval process.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

Interdependencies, Conflicts & Trade-Offs

Option may result in conflicts/interdependencies with Gatwick's options.

General Aviation / Commercial Airlines – Fuel Burn

Change in Fuel Burn (compared to the Baseline - annual - tonnes)	Not able to quantify at this time, owing to uncertainty in new stack locations

Commercial Airlines – Other costs

None identified.

Airport/ANSP – Operational costs

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

Adherence to AMS

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

Outcome of PBN Arrival RWY27L Option Q

Option Q significantly reduces the population above the Partial LOAEL (night), the population experiencing at least one N60 (night) noise event and the track miles when compared to the Baseline.

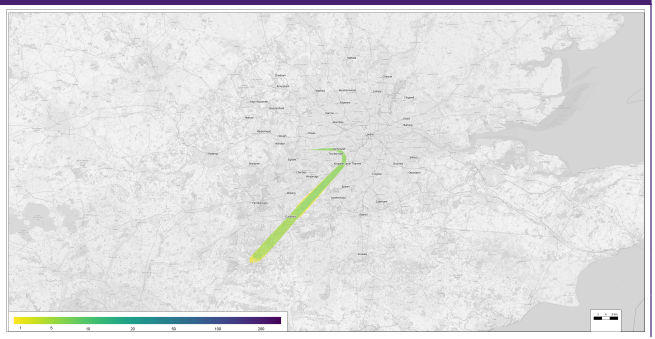
The option indicates significant increases in overflight of AONBs, NPs and Richmond Park and a significant number of biodiversity sites between 0-3000ft that may experience a change in location overflown. This option will be explored further in Stage 3.

OPTION CARRIED FORWARD TO STAGE 3

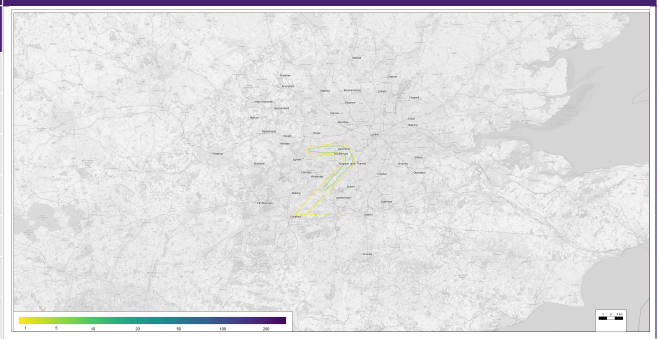
PBN Arrivals – RWY 27L Option Q (Night)

23:00 - 07:00

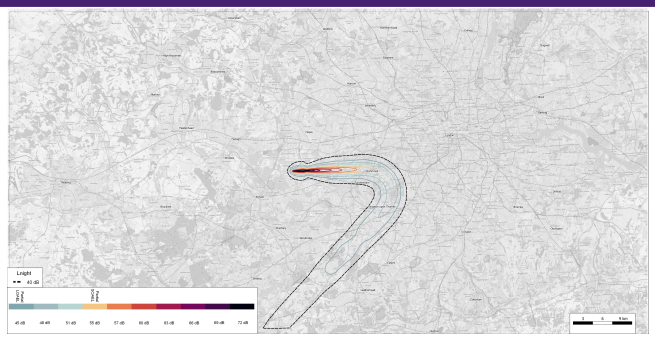
Overflight

Rate	Population Overflown		Overflight (0-7000 ft) contour map
	Baseline	Option Q	
≥ 1	873,200	223,200	
≥ 5	297,500	155,300	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day		N60 events contour map
	Baseline	Option Q	
≥ 1	1,131,900	493,100	
≥ 5	420,500	252,300	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

Noise Exposures

Population count	Baseline	Option Q	Partial LOAEL contour map
Estimated total population above 40 dB $L_{Aeq,1.5h}$	1,283,300	526,000	
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$)	642,300	312,000	

Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL	Change in noise exposure map
Partial LOAEL	254,800 (of which 234,000 brought out of Partial LOAEL by Option)	144,200	147,000 (of which 139,000 brought into Partial LOAEL by Option)	

PBN Arrivals – RWY 27L Option R

Option Description

This option was developed to address a blend of DPs 2, 4, 9 & 10. This option assumes a single PBN arrival track used for all RWY27L arrivals during the 0430-0600 period from BEDEK & BEGTO.

Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA_{eq}, 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA_{eq}, 8h)	470,800	-171,500
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	861,000	-270,900

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric	Difference to Baseline
Track Miles of the routes used (nm)	-39

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	46km^2	+46km^2
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	0km^2	No change
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	0km^2	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	0	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	0	No change

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option not expected to impact existing helicopter routes.

General Aviation / Commercial Airlines – Economic impact from increased effective capacity

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

Commercial Airlines – Training costs

Option does not require any re-equipage or upgrade costs for airlines. No training costs required for airlines.

Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs

Option may require re-location and/or addition of Noise Monitoring Terminals.

Airport/ANSP – Deployment costs

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

Safety

There are already PBN to ILS procedures in the UK. No IFP design issues are anticipated with this option.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

Interdependencies, Conflicts & Trade-Offs

Option may result in conflicts/interdependencies with Gatwick's options.

General Aviation / Commercial Airlines – Fuel Burn

Change in Fuel Burn (compared to the Baseline - annual - tonnes)	Not able to quantify at this time, owing to uncertainty in new stack locations

Commercial Airlines – Other costs

None identified.

Airport/ANSP – Operational costs

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

Adherence to AMS

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

Outcome of PBN Arrival RWY27L Option R

Option R significantly reduces the population above the Partial LOAEL (night) and the track miles when compared to the Baseline. It decreases the population experiencing at least one N60 (night) noise event. It indicates no overflight of Richmond Park and that no biodiversity sites between 0-3000ft should experience a change in location overflown.

The option indicates a significant increase in the total area of AONBs and NPs overflown. This option will be explored further in Stage 3.

OPTION CARRIED FORWARD TO STAGE 3

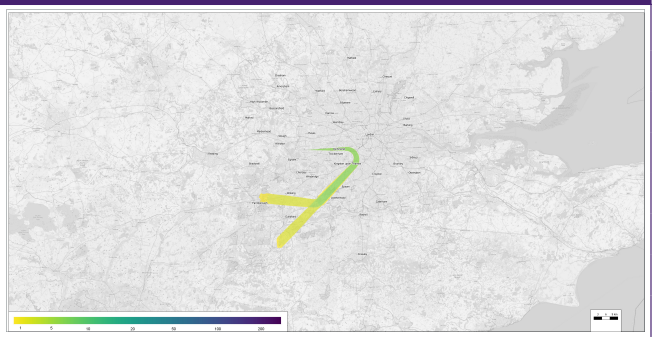
PBN Arrivals – RWY 27L Option R (Night)

23:00 - 07:00

Overflight

Rate	Population Overflown	
	Baseline	Option R
≥ 1	873,200	417,800
≥ 5	297,500	323,000
≥ 10	0	0
≥ 20	0	0
≥ 50	0	0
≥ 100	0	0
≥ 200	0	0

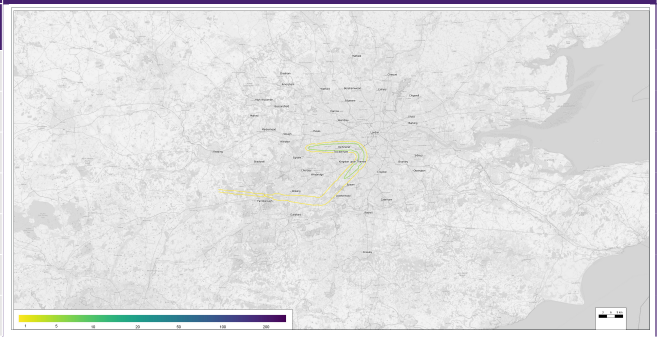
Overflight (0-7000 ft) contour map



Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day	
	Baseline	Option R
≥ 1	1,131,900	861,000
≥ 5	420,500	394,200
≥ 10	0	0
≥ 20	0	0
≥ 50	0	0
≥ 100	0	0
≥ 200	0	0

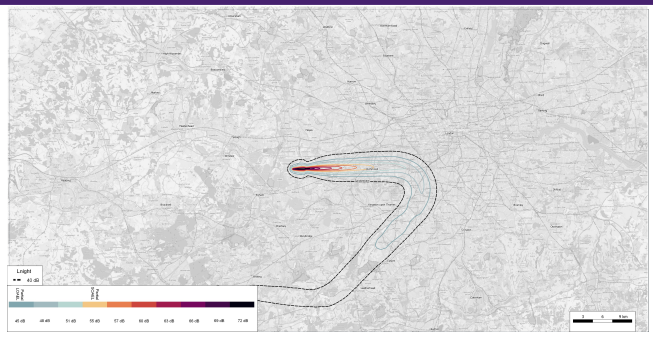
N60 events contour map



Noise Exposures

Population count	Baseline	Option R
Estimated total population above 40 dB $L_{Aeq,1.5h}$	1,283,300	893,000
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$)	642,300	470,800

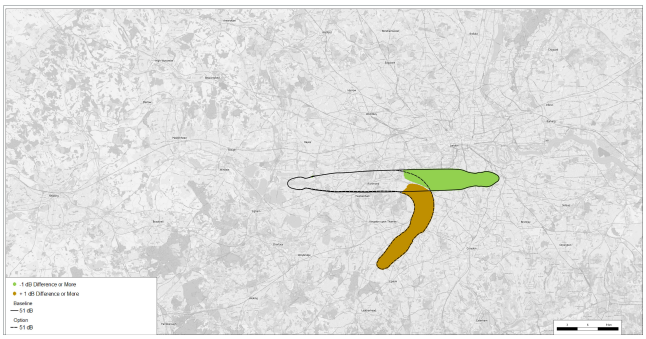
Partial LOAEL contour map



Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL
Partial LOAEL	328,000 (of which 310,500 brought out of Partial LOAEL by Option)	224,800	228,500 (of which 201,400 brought into Partial LOAEL by Option)

Change in noise exposure map



PBN Arrivals – RWY 27L Option S

Option Description

This option was developed to address a blend of DPs 2, 4, 9 & 10. This option assumes a single PBN arrival track used for all RWY27L arrivals capable of RNP-AR during the 0430-0600 period from ALESO.

Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA_{eq}, 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA_{eq}, 8h)	315,000	-327,300
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	488,500	-643,400

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric	Difference to Baseline
Track Miles of the routes used (nm)	+1

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	41km^2	+41km^2
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	6km^2	+6km^2
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	3km^2	+3km^2
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	0	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	4	+4

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option may impact existing helicopter routes, further work is required to understand if there is an impact on route H3/H7.

General Aviation / Commercial Airlines – Economic impact from increased effective capacity

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

Commercial Airlines – Training costs

This option would require RNP-AR capability and approvals. This can come with significant costs for airlines, however, it is unknown at this time whether RNP-AR route options would be progressed in isolation i.e. without other arrival procedures being available. Should an RNP-AR arrival be mandatory, there may be additional costs for some operators. This will be quantified in Stage 3.

Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs

Option may require re-location and/or addition of Noise Monitoring Terminals.

Airport/ANSP – Deployment costs

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

Safety

There are no IFP design issues identified with this option however, there are no RNP-AR arrivals published in the UK at this time. Therefore, additional considerations may arise through the regulatory approval process.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

Interdependencies, Conflicts & Trade-Offs

Option may result in conflicts/interdependencies with Gatwick's options.

General Aviation / Commercial Airlines – Fuel Burn

Change in Fuel Burn (compared to the Baseline - annual - tonnes)	Not able to quantify at this time, owing to uncertainty in new stack locations

Commercial Airlines – Other costs

None identified.

Airport/ANSP – Operational costs

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

Adherence to AMS

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

Outcome of PBN Arrival RWY27L Option S

Option S significantly reduces the population above the Partial LOAEL (night), and the population experiencing at least one N60 (night) noise event. It indicates a negligible increase in track miles when compared to the Baseline.

The option indicates significant increases in overflight of AONBs, NPs and Richmond Park and a significant number of biodiversity sites between 0-3000ft that may experience a change in location overflown. This option will be explored further in Stage 3.

OPTION CARRIED FORWARD TO STAGE 3

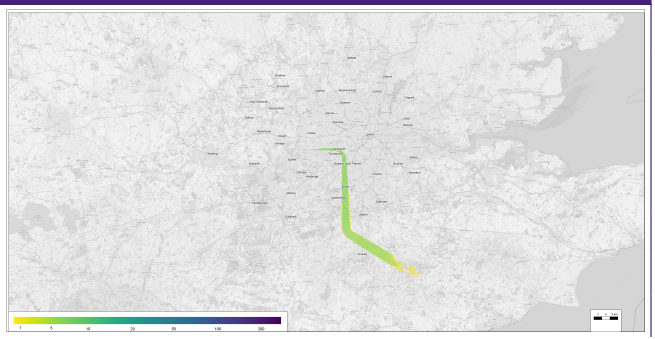
PBN Arrivals – RWY 27L Option S (Night)

23:00 - 07:00

Overflight

Rate	Population Overflown	
	Baseline	Option S
≥ 1	873,200	195,300
≥ 5	297,500	159,100
≥ 10	0	0
≥ 20	0	0
≥ 50	0	0
≥ 100	0	0
≥ 200	0	0

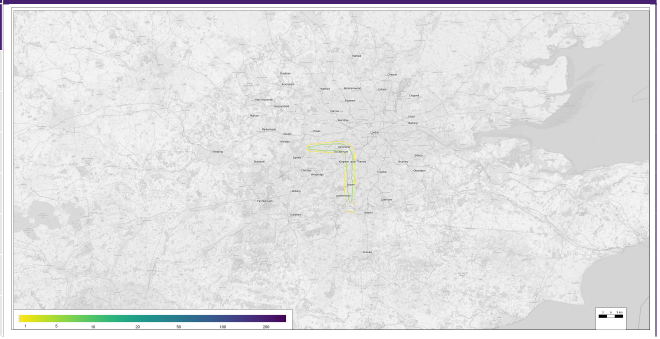
Overflight (0-7000 ft) contour map



Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day	
	Baseline	Option S
≥ 1	1,131,900	488,500
≥ 5	420,500	265,500
≥ 10	0	0
≥ 20	0	0
≥ 50	0	0
≥ 100	0	0
≥ 200	0	0

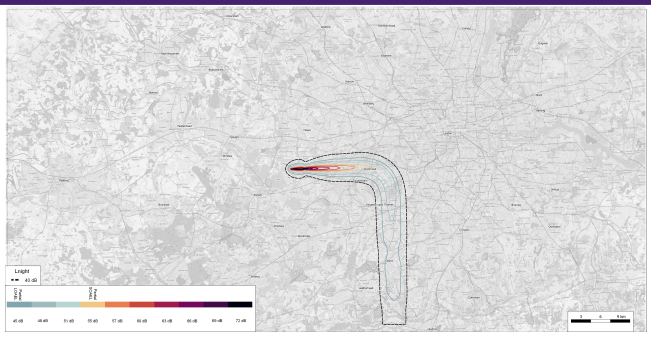
N60 events contour map



Noise Exposures

Population count	Baseline	Option S
Estimated total population above 40 dB $L_{Aeq,1.5h}$	1,283,300	533,700
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$)	642,300	315,000

Partial LOAEL contour map



Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL
Partial LOAEL	264,700 (of which 243,900 brought out of Partial LOAEL by Option)	143,700	150,500 (of which 133,000 brought into Partial LOAEL by Option)

Change in noise exposure map

PBN Arrivals – RWY 27L Option T

Option Description

This option was developed to address a blend of DPs 2, 4, 9 & 10. This option assumes a single PBN arrival track used for all RWY27L arrivals during the 0430-0600 period from ALESO & LOGAN.

Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA_{eq}, 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA_{eq}, 8h)	595,800	-46,500
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	976,700	-155,200

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric	Difference to Baseline
Track Miles of the routes used (nm)	+1

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	52km^2	+52km^2
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	6km^2	+6km^2
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	0km^2	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	0	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	0	No change

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option not expected to impact existing helicopter routes.

General Aviation / Commercial Airlines – Economic impact from increased effective capacity

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

Commercial Airlines – Training costs

Option does not require any re-equipage or upgrade costs for airlines. No training costs required for airlines.

Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs

Option may require re-location and/or addition of Noise Monitoring Terminals.

Airport/ANSP – Deployment costs

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

Safety

There are already PBN to ILS procedures in the UK. No IFP design issues are anticipated with this option.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

Interdependencies, Conflicts & Trade-Offs

Option may result in conflicts/interdependencies with Gatwick's options.

General Aviation / Commercial Airlines – Fuel Burn

Change in Fuel Burn (compared to the Baseline - annual - tonnes)	Not able to quantify at this time, owing to uncertainty in new stack locations

Commercial Airlines – Other costs

None identified.

Airport/ANSP – Operational costs

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

Adherence to AMS

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

Outcome of PBN Arrival RWY27L Option T

Option T reduces the population above the Partial LOAEL (night) and the population experiencing at least one N60 (night) noise event. It indicates no overflight of Richmond Park and that no biodiversity sites between 0-3000ft should experience a change in location overflown.

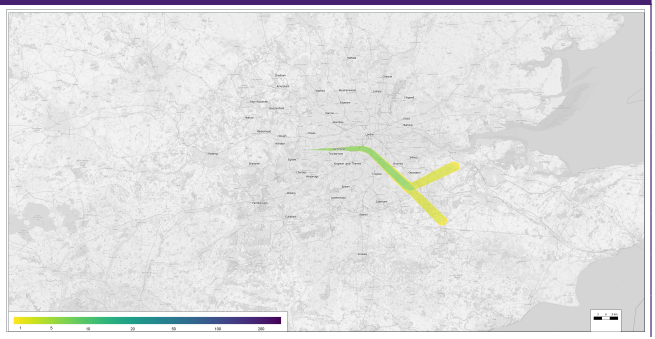
The option indicates a negligible increase in track miles and a significant increase in overflight of AONBs and NPs. This option will be explored further in Stage 3.

OPTION CARRIED FORWARD TO STAGE 3

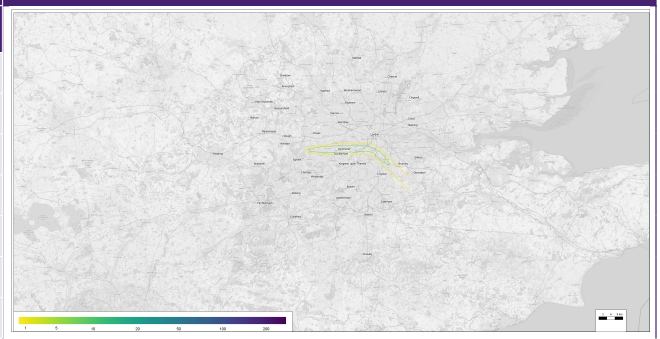
PBN Arrivals – RWY 27L Option T (Night)

23:00 - 07:00

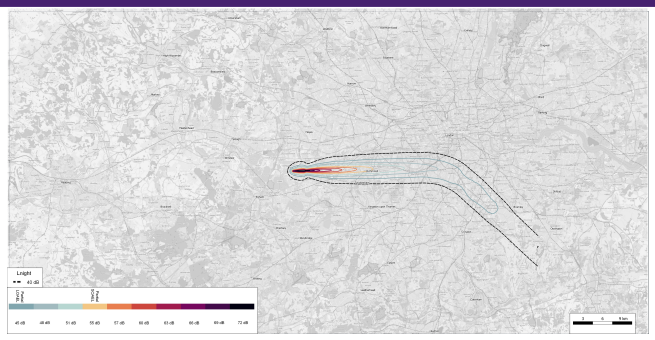
Overflight

Rate	Population Overflown		Overflight (0-7000 ft) contour map
	Baseline	Option T	
≥ 1	873,200	520,100	
≥ 5	297,500	429,600	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day		N60 events contour map
	Baseline	Option T	
≥ 1	1,131,900	976,700	
≥ 5	420,500	468,800	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

Noise Exposures

Population count	Baseline	Option T	Partial LOAEL contour map
Estimated total population above 40 dB $L_{Aeq,1.5h}$	1,283,300	1,087,800	
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$)	642,300	595,800	

Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL	Change in noise exposure map
Partial LOAEL	195,100 (of which 162,800 brought out of Partial LOAEL by Option)	436,000	127,400 (of which 116,300 brought into Partial LOAEL by Option)	

PBN Arrivals – RWY 27L Option U

Option Description

This option was developed to address a blend of DPs 2, 4, 9 & 10. This option assumes a single PBN arrival track used for all RWY27L arrivals capable of RNP-AR during the 0430-0600 period from TOBID & LOGAN.

Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA_{eq}, 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA_{eq}, 8h)	434,300	-208,000
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	680,700	-451,200

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric	Difference to Baseline
Track Miles of the routes used (nm)	+2

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	26km^2	+26km^2
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	0km^2	No change
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	0km^2	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	0	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	1	+1

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option may impact existing helicopter routes, further work is required to understand if there is an impact on route H10.

General Aviation / Commercial Airlines – Economic impact from increased effective capacity

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

Commercial Airlines – Training costs

This option would require RNP-AR capability and approvals. This can come with significant costs for airlines, however, it is unknown at this time whether RNP-AR route options would be progressed in isolation i.e. without other arrival procedures being available. Should an RNP-AR arrival be mandatory, there may be additional costs for some operators. This will be quantified in Stage 3.

Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs

Option may require re-location and/or addition of Noise Monitoring Terminals.

Airport/ANSP – Deployment costs

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

Safety

There are no IFP design issues identified with this option however, there are no RNP-AR arrivals published in the UK at this time. Therefore additional considerations may arise through the regulatory approval process.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

Interdependencies, Conflicts & Trade-Offs

Option may result in conflicts/interdependencies with Luton's options.

General Aviation / Commercial Airlines – Fuel Burn

Change in Fuel Burn (compared to the Baseline - annual - tonnes)	Not able to quantify at this time, owing to uncertainty in new stack locations

Commercial Airlines – Other costs

None identified.

Airport/ANSP – Operational costs

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

Adherence to AMS

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

Outcome of PBN Arrival RWY27L Option U

Option U significantly reduces the population above the Partial LOAEL (night) and the population experiencing at least one N60 (night) noise event when compared to the Baseline. It indicates no overflight of Richmond Park.

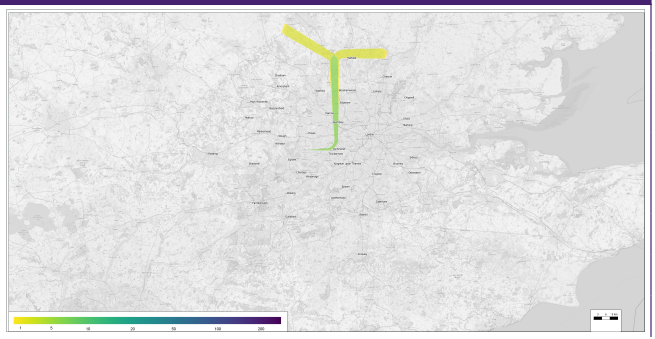
The option indicates an increase in the total area of AONBs and NPs overflown and small increases in track miles. A number of biodiversity sites between 0-3000ft may experience a change in location overflown. This option will be explored further in Stage 3.

OPTION CARRIED FORWARD TO STAGE 3

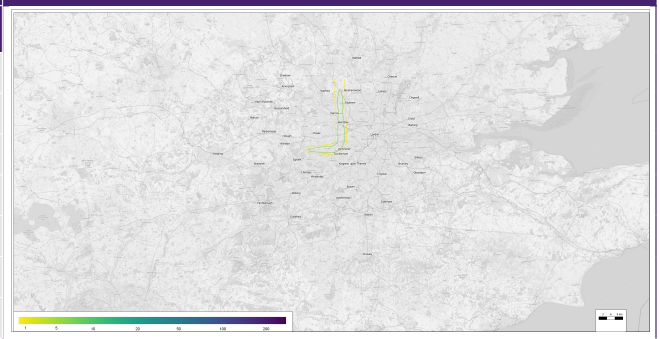
PBN Arrivals – RWY 27L Option U (Night)

23:00 - 07:00

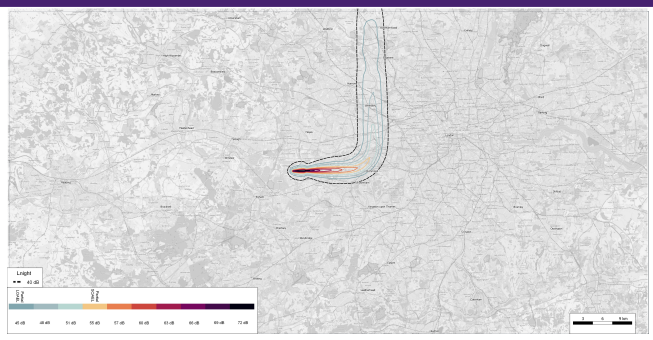
Overflight

Rate	Population Overflown		Overflight (0-7000 ft) contour map
	Baseline	Option U	
≥ 1	873,200	370,200	
≥ 5	297,500	258,500	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

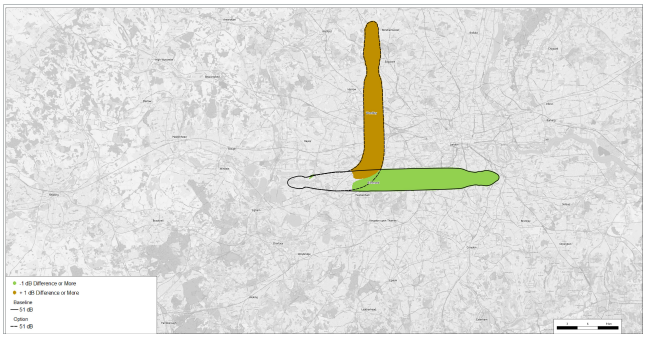
Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day		N60 events contour map
	Baseline	Option U	
≥ 1	1,131,900	680,700	
≥ 5	420,500	352,700	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

Noise Exposures

Population count	Baseline	Option U	Partial LOAEL contour map
Estimated total population above 40 dB $L_{Aeq,1.5h}$	1,283,300	740,300	
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$)	642,300	434,300	

Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL	Change in noise exposure map
Partial LOAEL	195,900 (of which 176,400 brought out of Partial LOAEL by Option)	97,100	317,800 (of which 243,300 brought into Partial LOAEL by Option)	

PBN Arrivals – RWY 27L Option V

Option Description

This option was developed to address a blend of DPs 2, 4, 9 & 10. This option assumes a single PBN arrival track used for all RWY27L arrivals capable of RNP-AR during the 0430-0600 period from BEDEK.

Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA_{eq}, 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA_{eq}, 8h)	414,000	-228,300
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	775,600	-356,300

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric	Difference to Baseline
Track Miles of the routes used (nm)	-35

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	Less than 1km^2	Less than 1km^2
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	0km^2	No change
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	0km^2	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	0	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	1	+1

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option may impact existing helicopter routes, further work is required to understand if there is an impact on route H10.

General Aviation / Commercial Airlines – Economic impact from increased effective capacity

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

Commercial Airlines – Training costs

This option would require RNP-AR capability and approvals. This can come with significant costs for airlines, however, it is unknown at this time whether RNP-AR route options would be progressed in isolation i.e. without other arrival procedures being available. Should an RNP-AR arrival be mandatory, there may be additional costs for some operators. This will be quantified in Stage 3.

Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs

Option may require re-location and/or addition of Noise Monitoring Terminals.

Airport/ANSP – Deployment costs

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

Safety

There are no IFP design issues identified with this option however, there are no RNP-AR arrivals published in the UK at this time. Therefore additional considerations may arise through the regulatory approval process.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

Interdependencies, Conflicts & Trade-Offs

Option not expected to interact with other airports' options.

General Aviation / Commercial Airlines – Fuel Burn

Change in Fuel Burn (compared to the Baseline - annual - tonnes)	Not able to quantify at this time, owing to uncertainty in new stack locations

Commercial Airlines – Other costs

None identified.

Airport/ANSP – Operational costs

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

Adherence to AMS

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

Outcome of PBN Arrival RWY27L Option V

Option V significantly reduces the population above the Partial LOAEL (night), the population experiencing at least one N60 (night) noise events and the track miles when compared to the Baseline. It indicates no AONB or NP N60 (night) noise events and no overflight of Richmond Park.

The option indicates a negligible increase in the total area of AONBs and NPs overflown and a small number of biodiversity sites between 0-3000ft that may experience a change in location overflown. This option will be explored further in Stage 3.

OPTION CARRIED FORWARD TO STAGE 3

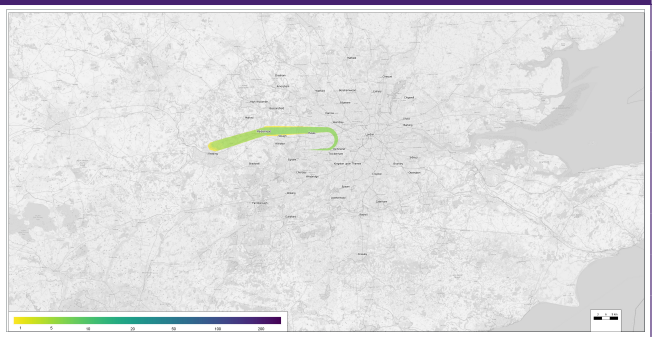
PBN Arrivals – RWY 27L Option V (Night)

23:00 - 07:00

Overflight

Rate	Population Overflown	
	Baseline	Option V
≥ 1	873,200	384,500
≥ 5	297,500	277,000
≥ 10	0	0
≥ 20	0	0
≥ 50	0	0
≥ 100	0	0
≥ 200	0	0

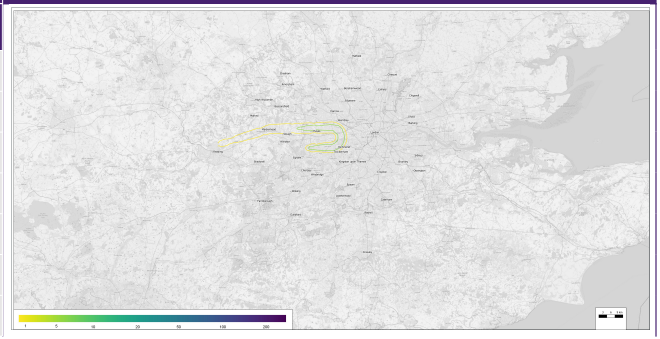
Overflight (0-7000 ft) contour map



Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day	
	Baseline	Option V
≥ 1	1,131,900	775,600
≥ 5	420,500	336,800
≥ 10	0	0
≥ 20	0	0
≥ 50	0	0
≥ 100	0	0
≥ 200	0	0

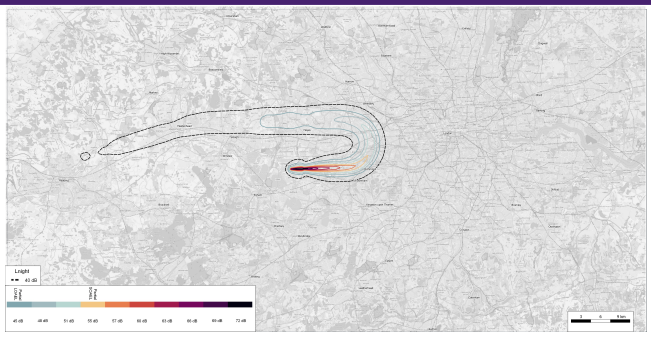
N60 events contour map



Noise Exposures

Population count	Baseline	Option V
Estimated total population above 40 dB $L_{Aeq,1.5h}$	1,283,300	821,700
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$)	642,300	414,000

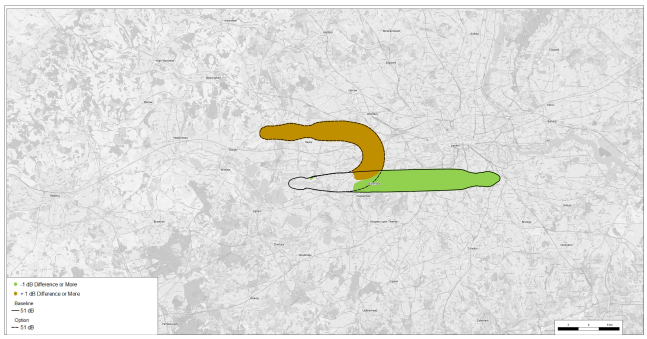
Partial LOAEL contour map



Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL
Partial LOAEL	**188,500** (of which 169,100 brought out of Partial LOAEL by Option)	**97,800**	**296,700** (of which 257,100 brought into Partial LOAEL by Option)

Change in noise exposure map



PBN Arrivals – RWY 27L Option W

Option Description

This option was developed to address a blend of DPs 2, 4, 9 & 10. This option assumes a single PBN arrival track used for all RWY27L arrivals during the 0430-0600 period from TOBID.

Communities – Noise impact on health & quality of life

Metric	Option Value	Difference to Baseline
Population above Partial LOAEL (daytime, LA_{eq}, 16h)	N/A	N/A
Population above Partial LOAEL (night-time, LA_{eq}, 8h)	531,400	-110,900
Population experiencing at least one event of N65 (daytime)	N/A	N/A
Population experiencing at least one event of N60 (night-time)	1,083,800	-48,100

Communities - Air Quality

As there is no change to track distribution below 1000ft, there is no effect on Air Quality from this option.

Wider Society – Greenhouse Gas Impact

Metric	Difference to Baseline
Track Miles of the routes used (nm)	+2

Wider Society – Tranquillity & Biodiversity

Metric	Option Value	Difference to Baseline
Total Area of AONBs/National Parks (NPs) overflown between 0-7000ft once a day on average (night-time)	0km^2	No change
Total Area of AONBs/NPs overflown experiencing at least one event of N60 on average (night-time)	12km^2	12km^2
Total Area of Richmond Park overflown between 0-7000ft at least once a day on average (night-time)	0km^2	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-1640ft which observe a potential change in location overflown	0	No change
Number of sites (RAMSAR, SAC, SPA, SSSI) overflown between 0-3000ft which observe a potential change in location overflown	0	No change

Wider Society – Capacity/Resilience

Arrival throughput not of concern 0430-0600. A single or multiple PBN route could handle the low number of arrivals in this period if required.

There is no distinguishing difference between any option regards arrival throughput. Any aircraft not RNP-AR equipped would have another PBN route to rely on.

Heathrow's capacity for this ACP is limited by the existing 480,000 movement cap.

General Aviation – Access

No additional CAS required.

Option would not facilitate the release of CAS.

Option not expected to impact existing helicopter routes.

General Aviation / Commercial Airlines – Economic impact from increased effective capacity

No economic effect expected on GA operations.

Arrival delay is not an issue during the 0430-0600 period. Use of PBN arrivals during this time would be for noise mitigation purposes only. PBN arrivals in this time will not affect delay performance. There is no distinguishing difference between any option regards arrival delay.

Commercial Airlines – Training costs

Option does not require any re-equipage or upgrade costs for airlines. No training costs required for airlines.

Airport/Air Navigation Service Provider (ANSP) – Infrastructure costs

Option may require re-location and/or addition of Noise Monitoring Terminals.

Airport/ANSP – Deployment costs

There will be considerable costs associated with deployment in terms of operational training and system upgrades which will be quantified in Stage 3. However, there is not expected to be any differences in these costs between the different options.

Safety

There are already PBN to ILS procedures in the UK. No IFP design issues are anticipated with this option.

Although new or revised safety assurances may be needed, an acceptable safety argument is envisaged to be achievable.

Interdependencies, Conflicts & Trade-Offs

Option not expected to interact with other airports' options.

General Aviation / Commercial Airlines – Fuel Burn

Change in Fuel Burn (compared to the Baseline - annual - tonnes)	Not able to quantify at this time, owing to uncertainty in new stack locations

Commercial Airlines – Other costs

None identified.

Airport/ANSP – Operational costs

This option is not anticipated to change airport nor ANSP operational costs. Heathrow will continue to require ILS and other ground based infrastructure even with the implementation of PBN arrival procedures.

Option may lead to a change in the number of properties eligible for the noise insulation scheme) which could lead to a change in operational costs for the airport.

Adherence to AMS

Supports the AMS through increased systemisation and meeting the Governments key environmental objectives by utilising PBN. The use of PBN arrivals has been appraised at this stage during periods where the landing rate is less critical. PBN arrivals in a system design might enable simplification, safety, efficiency and resilience enhancements and/or provide respite opportunities.

Outcome of PBN Arrival RWY27L Option W

Option W reduces the population above the Partial LOAEL (night) and the population experiencing at least one N60 (night) noise event when compared to the Baseline. It indicates no overflight of Richmond Park and that no biodiversity sites between 0-3000ft should experience a change in location overflown.

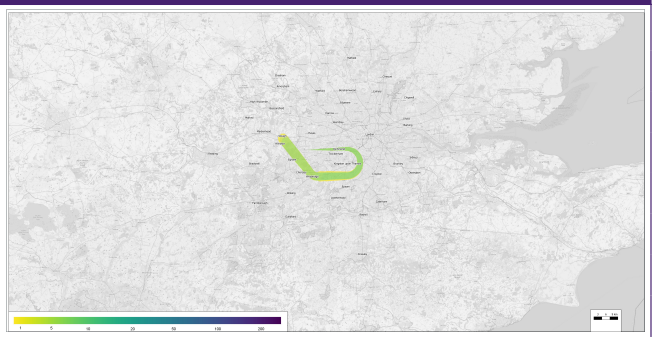
The option indicates an increase in the total area of AONBs/NPs experiencing at least one N60 (night) noise event and a small increase in track miles. This option will be explored further in Stage 3.

OPTION CARRIED FORWARD TO STAGE 3

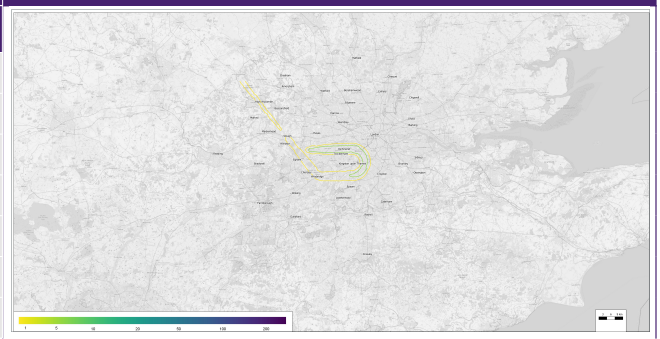
PBN Arrivals – RWY 27L Option W (Night)

23:00 - 07:00

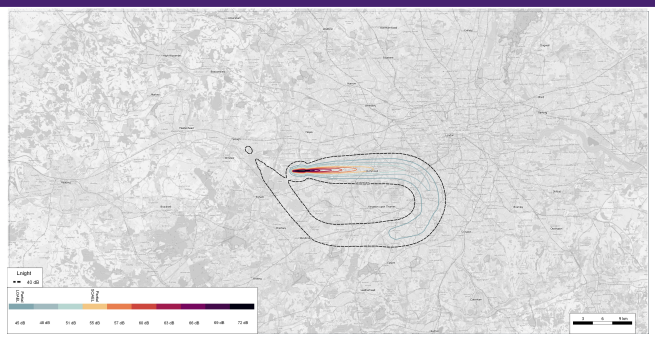
Overflight

Rate	Population Overflown		Overflight (0-7000 ft) contour map
	Baseline	Option W	
≥ 1	873,200	627,100	
≥ 5	297,500	428,700	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

Aircraft Noise Events

Rate	Population experiencing noise events above N60 each day		N60 events contour map
	Baseline	Option W	
≥ 1	1,131,900	1,083,800	
≥ 5	420,500	441,300	
≥ 10	0	0	
≥ 20	0	0	
≥ 50	0	0	
≥ 100	0	0	
≥ 200	0	0	

Noise Exposures

Population count	Baseline	Option W	Partial LOAEL contour map
Estimated total population above 40 dB $L_{Aeq,1.5h}$	1,283,300	1,090,400	
Total population within Partial LOAEL (>45 dB $L_{Aeq,1.5h}$)	642,300	531,400	

Noise Exposure Change

Change in Noise Exposure	Population experiencing at least 1 dB reduction within partial LOAEL or brought out of partial LOAEL	Population experiencing no change in noise exposure within partial LOAEL	Population experiencing at least 1 dB increase within partial LOAEL or brought into partial LOAEL	Change in noise exposure map
Partial LOAEL	348,200 (of which 320,700 brought out of Partial LOAEL by Option)	232,400	271,500 (of which 244,200 brought into Partial LOAEL by Option)