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FAREHAM
BOROUGH COUNCIL

AGENDA FOR THE EXECUTIVE

Date: Monday, 4 December 2017

Time: 6.00 pm

Venue: Collingwood Room - Civic Offices

Executive Members:

Councillor S D T Woodward, Policy and Resources (Executive Leader)

Councillor T M Cartwright, MBE, Health and Public Protection (Deputy Executive Leader)

Councillor Mrs K Mandry, Housing

Councillor Miss S M Bell, Leisure and Community

Councillor K D Evans, Planning and Development

Councillor Miss T G Harper, Streetscene

1. Apologies for Absence

2. Minutes (Pages 5 - 8)

To confirm as a correct record the minutes of the meeting of Executive held on 06 November 2017.

3. Executive Leader's Announcements

4. Declarations of Interest

To receive any declarations of interest from members in accordance with Standing Orders and the Council's Code of Conduct.

5. Petitions

6. Deputations

To receive any deputations, of which notice has been lodged.

7. Minutes / References from Other Committees

To receive any reference from the committees or panels held.

Matters for Decision in Public

Note: Where an urgent item of business is raised in accordance with Part 3 of the Constitution, it will be considered with the relevant service decisions as appropriate.

8. Leisure and Community

Key Decision

(1) Crofton Community Centre Hall Repairs (Pages 9 - 12)

A report by the Head of Leisure and Corporate Services.

9. Policy and Resources

Key Decision

(1) Land at Station Road Portchester (Pages 13 - 20)

A report by the Director of Finance and Resources.

(2) IFA2 Technical Feasibility Update (Pages 21 - 464)

A report by the Director of Finance and Resources.

Non-Key Decision

(3) Corporate Strategy 2017-23 (Pages 465 - 504)

A report by the Director of Finance and Resources.

P GRIMWOOD
Chief Executive Officer
www.fareham.gov.uk
24 November 2017

For further information please contact:
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democraticservices@fareham.gov.uk

FAREHAM
BOROUGH COUNCIL

Minutes of the Executive

(to be confirmed at the next meeting)

Date: Monday, 6 November 2017

Venue: Collingwood Room - Civic Offices

Present:

S D T Woodward, Policy and Resources (Executive Leader)
T M Cartwright, MBE, Health and Public Protection (Deputy Executive Leader)
Mrs K Mandry, Housing
Miss S M Bell, Leisure and Community
K D Evans, Planning and Development
Miss T G Harper, Streetscene

Also in attendance:

Mrs S M Bayford, Chairman of Scrutiny Board
F Birkett, Chairman of Housing Policy, Development & Review Panel
Mrs P M Bryant, Chairman of Licensing and Regulatory Affairs Committee
M J Ford, JP, Chairman of Health & Public Protection Policy Development and Review Panel
Mrs C L A Hockley, Chairman of Leisure and Community Poilcy, Development and Review Panel
A Mandry, Chairman of Planning and Development Policy Development & Review Panel

1. APOLOGIES FOR ABSENCE

There were no apologies given for this meeting.

2. MINUTES

RESOLVED that the minutes of the Executive held on 09 October 2017 be confirmed and signed as a correct record.

3. EXECUTIVE LEADER'S ANNOUNCEMENTS

There were no Leader's Announcements given at this meeting.

4. DECLARATIONS OF INTEREST

There were no Declarations of Interest made at this meeting.

5. PETITIONS

There were no petitions submitted at this meeting.

6. DEPUTATIONS

The Executive received a deputation from Mr Toby King in relation to item 8(1) - 1st Sarisbury Scout Group.

7. MINUTES / REFERENCES FROM OTHER COMMITTEES

Licensing and Regulatory Affairs Committee – 19 September 2017
Minute 6 – Review of Hackney Carriage Fares

The Committee considered a report by the Head of Environmental Health on the Review of Hackney Carriage Fares.

RESOLVED that the Committee:-

(a) considered the responses from the individuals who responded and the Hackney Carriage and Private Hire Association in respect of the changes to the tariff;

(b) considered if a change is appropriate; and

(c) recommends to the Executive that no increase to charges be made at the present time.

A report on this matter is at item 9(1) of the agenda.

8. LEISURE AND COMMUNITY

(1) 1st Sarisbury Scout Group

A deputation on this item was received from Mr Toby King from 1st Sarisbury Scout Group.

The Executive Leader agreed to bring this item forward on the agenda.

RESOLVED that the Executive:

(a) agrees a matched funding grant of up to £25,000, to 1st Sarisbury Scout Group, to install a purpose-built scout hut at Burridge Recreation Ground; and

(b) agrees the award of funding, subject to 1st Sarisbury Scout Group agreeing terms for community use as set out in the Community Fund Agreement in Appendix B and Community Fund Award Letter as set out in Appendix C.

9. HEALTH AND PUBLIC PROTECTION

(1) Review of Hackney Carriage Fares

RESOLVED that the Executive agrees that no increase be made to the level of taxi tariff for the 2018/19 financial year.

10. PLANNING AND DEVELOPMENT

(1) Planning for the right homes in the right places: Response to Government Consultation

A tabled amendment was submitted to clarify the wording of paragraph 10 of Appendix B, as appended to these minutes.

RESOLVED that the Executive agrees that Fareham Borough Council's Consultation Response as outlined in this report is submitted to the Government for their consideration.

11. POLICY AND RESOURCES

(1) Fareham Borough Council Apprenticeship Scheme

RESOLVED that the Executive agrees to adopt a 3-way approach to grow its Apprenticeship scheme incrementally over a five-year period as set out in paragraph 15 of the report.

(2) World War 1 Commemorative Mural

RESOLVED that the Executive agrees to defer the decision on a commemorative mural to allow further research to be carried out by officers on design and materials before bringing a report to a future meeting of the Executive.

(3) Finance Monitoring Report 2017-18

RESOLVED that the Executive notes the Revenue and Capital Budget Monitoring Report for 2017/18.

(4) Treasury Management Monitoring Report 2017-18

RESOLVED that the Executive notes the Treasury Management Monitoring Report for 2017/18.

(The meeting started at 6.00 pm
and ended at 6.40 pm).

FAREHAM
BOROUGH COUNCIL

Report to the Executive for Decision
04 December 2017

Portfolio:	Leisure and Community
Subject:	**Crofton Community Centre Sports Hall Repairs**
Report of:	Director of Finance and Resources
Strategy/Policy:	Leisure Strategy
Corporate Objective:	Leisure for Health and For Fun

Purpose:
To approve funding for urgent works to the external facade and roof of the Crofton Community Centre sports hall.

Executive summary:
The Crofton Community Centre Sports Hall was built in 1988 and leased to the Crofton Community Centre. The lease for the sports hall element of the building is a full repairing lease, with the Council responsible for all the repair and maintenance liabilities.

Urgent repairs are required to the sports hall facade which is now irreparably damaged on the western elevation. The roof, guttering and ventilation have also failed resulting in water ingress.

The estimated cost of the works is £125,000 and the Crofton Community Association has made a generous offer to provide £20,000 towards the cost of these works.

The Community Association has also agreed to fund and carry out works to replace the sports hall lights with new LED lighting and refurbish the sports hall. The cost of these works is estimated to be £24,000.

Given the urgent need to complete the works, the proposal is to allocate the remaining revenue budget for 2017/18 and to bring forward the required amount from 2018/19 to complete these works as a priority.

Recommendation/Recommended Option:
It is recommended that the Executive agrees that:

(a) the remaining capital budget for 2017/18 is allocated to undertake the repairs;

(b) the balance of funding required is brought forward from 2018/19 revenue budget: and

(c) the decision to appoint the successful contractor be delegated to the Director of Finance and Resources and the Executive Member for Leisure and Community.

Reason:
To fulfil the Council's obligation under the terms of the lease to undertake repairs to the Crofton Community Centre Sports Hall.

Cost of proposals:
The estimated cost of the works is £125,000 and the Crofton Community Association has offered to pay £20,000 towards the cost which means a budget of £105,000 is required from capital.

Appendices: **None**

Background papers: File of correspondences

FAREHAM
BOROUGH COUNCIL

Executive Briefing Paper

Date:	04 December 2017
Subject:	Crofton Community Centre Sports Hall Repairs
Briefing by:	Director of Finance and Resources
Portfolio:	Leisure and Community

INTRODUCTION

1. The Crofton Community Centre Sports Hall was built in 1988 and leased to the Crofton Community Centre. The lease for the sports hall element of the building is a full repairing lease with the Council responsible for all the repair and maintenance liabilities.

URGENT REPAIRS

2. There are several major problems with the sports hall that require urgent attention and these are set out in the following paragraphs.

3. The exterior of the building has a metal façade and the western elevation is in very poor condition. Remedial works to secure loose and damaged panels have been regularly undertaken. However, this elevation is exposed to the playing field and is subject to balls being kicked up against the façade which has caused irreparable damage. This now presents a risk of the panels falling from the building and therefore urgent works are required to replace the cladding with a more durable material to prevent this from happening again.

4. The existing internal box guttering has reached the end of its life and despite regular repairs, there is frequent water ingress into the building which can result in the cancellation of bookings.

5. The existing internal gutters need replacing with an external system to reduce the likelihood of a leaks occurring and to ensure that if a leak does occur it will be external and therefore not an immediate risk to the use of the building.

6. The existing roof covering has been in place for 20 years and is showing signs of delamination of the decorative coating. Whilst upgrading the guttering system there is a need to extend the profile of the roof, therefore it is recommended that a new covering be applied in conjunction with the works to the rain water goods.

7. The existing ventilation system comprises four high level wall mounted fans. Currently only one of these is operational and there is water ingress from the damaged fans.

PROJECT FUNDING & PROCUREMENT

8. There is an annual capital budget of £120,000 allocated for the repair and maintenance of community buildings.

9. The current estimated cost of completing the works is £125,000.

10. Crofton Community Association has made a generous offer to provide £20,000 towards the cost of these works. It has also agreed to fund and carry out works to replace the sports hall lights with new LED lighting and refurbish the sports hall floor. The cost of these works is estimated to be £24,000.

11. To date in 2017/18, £17,908 has been spent, and £39,000 has been committed leaving a balance of £79,000 remaining. Given the urgent need to complete the works the proposal is to allocate the remaining budget for 2017/18 and to bring forward the required amount of £26,000 from 2018/19 to complete these works as a priority. This will mean that there will be no remaining budget available to fund major works on community buildings in 2017/18 and a limited amount of funding in 2018/19.

12. Given the urgent need to complete the works, the Executive is asked to agree that the decision to appoint the successful contractor is delegated to the Director of Finance and Resources and the Executive Member for Leisure and Community.

CONCLUSION

13. The Crofton Sports Hall roof and external facade have failed and, despite numerous attempts to fix the problem, it has not been possible to prevent water ingress into the building. Urgent repairs are required to the metal facade which is now irreparably damaged on the western elevation because of footballs being repeatedly kicked against the cladding.

14. The estimated cost of the works is £125,000 and the Crofton Community Association has made a generous offer to provide £20,000 towards the cost of these works. It has also agreed to fund and carry out works to replace the sports hall lights with new LED lighting and refurbish the sports hall. The cost of these works is estimated to be £24,000.

15. Given the urgent need to complete the works, the proposal is to allocate the remaining available revenue budget for maintenance of community buildings for 2017/18 and to bring forward the required amount from 2018/19 to complete these works as a priority.

16. Considering the urgency of the works, the Executive is asked to agree that the decision to appoint the successful contractor is delegated to the Director of Finance and Resources and the Executive Member for Leisure and Community.

Enquiries:

For further information on this report please contact Emma Watts. (Ext 4440)

FAREHAM
BOROUGH COUNCIL

Report to the Executive for Decision
04 December 2017

Portfolio:	Policy and Resources
Subject:	Land at Station Road Portchester
Report of:	Director of Policy and Resources
Strategy/Policy:	Asset Management
Corporate Objective:	To be a dynamic, prudent and progressive Council To build strong and inclusive communities To maintain and extend prosperity

Purpose:
To report the terms agreed with the owner of the former Merjen Engineering site and premises at Station Road Portchester.

Executive summary:
Discussions have been held with the owner to acquire the site and premises formerly occupied by Merjen Engineering at Station Road Portchester to progress a residential scheme in conjunction with the adjoining Council owned land.

Recommendation/Recommended Option:
It is recommended that the Executive approves the terms agreed with the owner for the acquisition of the land at Station Road Portchester as given in the Confidential Appendix A.

Reason:
To obtain approval to the terms agreed with the owner of the site and premises at Station Road Portchester.

Cost of proposals:
The acquisition price is set out in the confidential Appendix A

Appendices:	**Appendix A:** Confidential appendix setting out the terms agreed (Exempt by Virtue of paragraph (3) of Part 1 of Schedule 12 A of the Local Government Act 1972). **Appendix B:** Site Plan
Background papers:	Confidential
Reference papers:	P/16/0142/FP Planning application – Proposed redevelopment by the erection of a 2/2.5 storey block of seventeen aged-persons apartments

FAREHAM
BOROUGH COUNCIL

Executive Briefing Paper

Date:	04 December 2017
Subject:	Land at Station Road Portchester
Briefing by:	Director of Policy and Resources
Portfolio:	Policy and Resources

INTRODUCTION

1. The Executive at their meeting on 16 February 2004, received a confidential report on proposals for a residential development by Swaythling Housing Association of the Council's and Merjen Engineering land ownerships at Station Road, Portchester, which were subject to planning consent being obtained, with preference given to the provision of social rented housing. The Director of Finance and Resources was authorised to agree terms for the sale of the Council land with the terms agreed being reported back to the Executive for information.

2. No further report was submitted to the Executive as terms were not agreed and no planning consent obtained for a residential development.

PROPOSAL

3. The Merjen premises adjoin land owned by the Council and the site as a whole is allocated for around 15 older persons units (site H20) under Policy DSP42 (New Housing for Older Persons) within the Local Plan Part 2 as adopted on 08.06.2015.

4. In 2016 Merjen Engineering applied for planning permission (P/16/0142/FP) for seventeen aged- person apartments including 6 affordable housing units on site H20 (including the Council owned land) and the resolution of the Planning Committee was to grant planning permission subject to conditions including the applicant /owner entering into a legal agreement in respect of off-site provision of 0.8 of a unit of affordable housing plus a financial contribution towards the Solent Recreation Mitigation Project.

5. The Council was not party to the planning application however following contact from the agent acting for the owner, negotiations in respect of the acquisition of the Merjen site have recently been concluded. The provisionally agreed terms are set out in the confidential Appendix A. and the site to be acquired is shown for identification purposes on the plan attached as Appendix B

FINANCIAL IMPLICATIONS

6. The cost of the acquisition will be funded from HRA reserves and 1:4:1 receipts.

CONCLUSION

7. Terms have been provisionally agreed with the owner for the acquisition of the former Merjen Engineering site. The terms are set out in the Confidential Appendix A and are recommended for approval by the Executive.

Enquiries:

For further information on this report please contact Karen Boothroyd (Ext 4319)

By virtue of paragraph(s) 3 of Part 1 of Schedule 12A
of the Local Government Act 1972.

Document is Restricted

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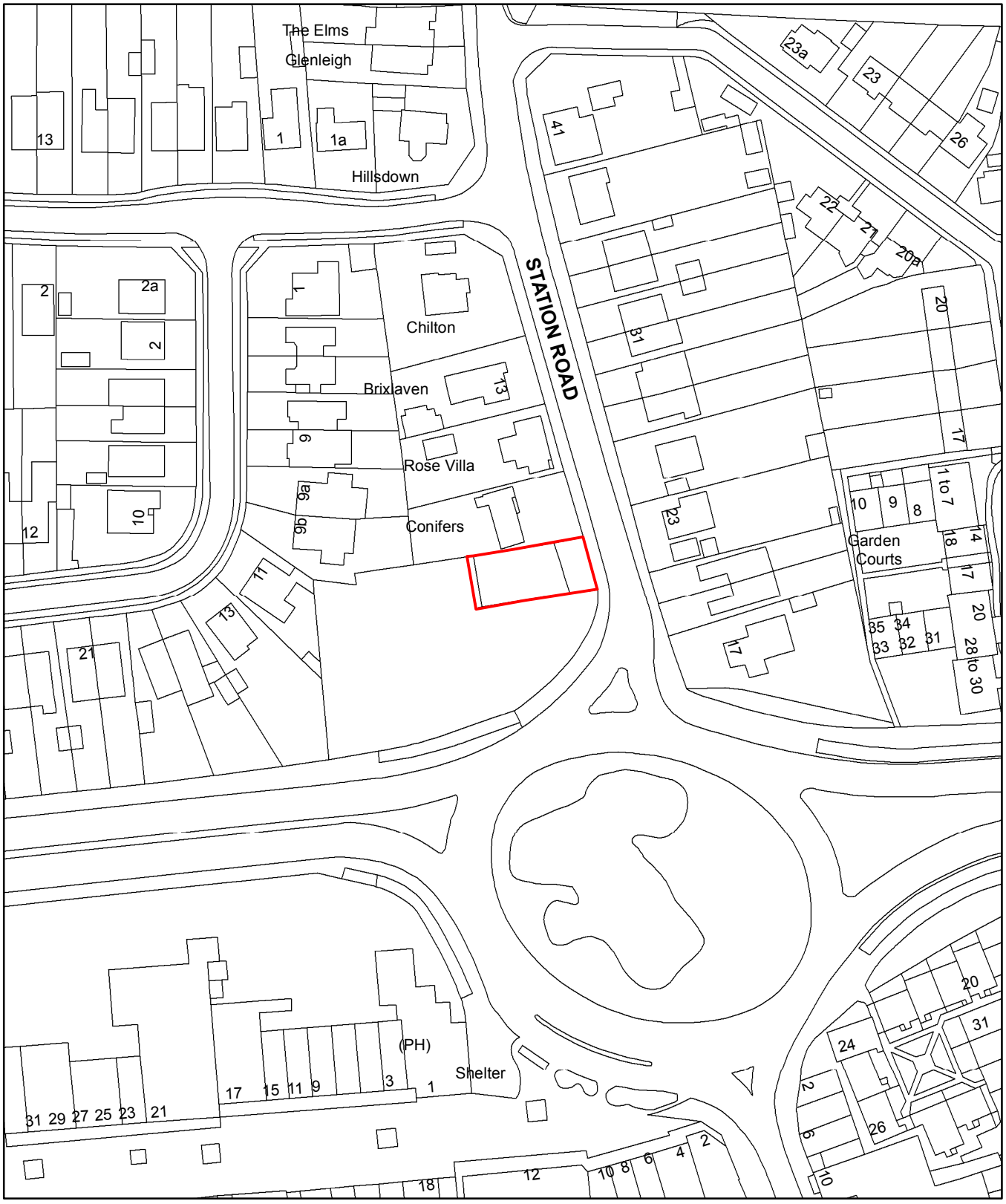
BOROUGH COUNCIL

Appendix B



Land at Station Road
Portchester
Scale 1:1250

FAREHAM
BOROUGH COUNCIL

Report to the Executive for Decision
04 December 2017

Portfolio:	Policy and Resources
Subject:	**IFA2 Technical Feasibility Update**
Report of:	Director of Finance and Resources
Strategy/Policy:	Corporate Strategy
Corporate Objective:	To Maintain and Extend Prosperity

Purpose:
To present the outcome of technical assessments in relation to the National Grid IFA2 development, and to consider whether the development should proceed to the next stage.

Executive summary:
In December 2015, the Executive resolved to agree terms for the lease of land at Daedalus to National Grid, to enable the construction of the IFA2 Interconnector. An update was further considered in April 2017, which identified the measures that were being put in place to provide assurance that the Interconnector development would be compatible with the wider uses at the Airport, and the Council's Vision for Daedalus.

Over the course of 2017, a range of independent technical assessments and tests have been undertaken to provide the necessary assurance to the Council, and to help inform National Grid's proposals as the detailed design and construction methods are developed. These studies focussed on a wide range of potential impacts including the impact of electromagnetic fields (EMF's) and Radio Frequency Interference (RFI's) emanating from the building and cables, and the potential commercial impact of the IFA2 for prospective businesses wishing to locate on the Enterprise Zone.

To support the Technical Assessments, a range of detailed reviews were commissioned by National Grid, and "real world" field tests were carried out to validate to results of the assessments.

The Assessments have been completed and the key reports form Arcadis and LSH are appended to this report. In summary, both reports provide sufficient assurance to the Council, that IFA2 would not be detrimental in technical or commercial terms to the wider Airport uses and the Council's Vision for Daedalus, provided that certain mitigating measures are put in place, and further detailed design work is carried out.

To this end, while the Airport Condition (within the land agreement between the council and National Grid), has largely been satisfied, the Council will want to be assured that appropriate mitigations are put in place, tests are undertaken to ensure that they perform as expected and that the detailed design work does not undermine the assurance achieved to date.

To do this, it is proposed that the Airport Condition is recognised as satisfied sufficiently to allow National Grid to proceed to the next stage and be able to enter into a Construction Lease with the Council. The lease will, however, be revised to carry the remaining obligations into the construction phase, enabling the Council to oversee progress and impose changes where they are necessary to mitigate against impacts on the Airport and the wider Daedalus site.

Recommendation:

It is recommended that the Executive;

a) notes the progress made in relation to the technical assessment and design of the IFA2 project, and the conclusions of the independent technical assessments undertaken;

b) agrees in principle that the necessary technical assurance has been obtained to enable National Grid to proceed to the next stage of construction, provided that extended arrangements are put in place to provide ongoing safeguards to the Council during and following the construction stage;

c) confirms that the Option can be exercised by National Grid, once legally binding amendments to the legal documentation are in place and the construction lease granted, to enable IFA2 to proceed to the construction stage in accordance with the target programme; and

d) delegates authority to the Director of Finance and Resources, following consultation with the Executive Leader, to conclude the revisions to the legal documentation;

Reason:
To enable the IFA2 development to proceed to the construction stage and secure all necessary assurances on the technical compatibility of the development.

Cost of proposals:
There are no new financial implications arising from the report.

Appendices:

A: Arcadis report Part 1 “Interim Safety Justification Report for the IFA2 Interconnector on the Solent Airport, Daedalus”

Arcadis report Part 2 “Hazard Log Report for the IFA2 Interconnector at Solent Airport”

Arcadis report Part 3 “Technical Assessment Report for the IFA2 Interconnector at Solent Airport”

B: List of Key Supporting Documents to the technical studies

C: Lambert Smith Hampton report “Proposed IFA2 Facility Daedalus: Occupier Impact Assessment”

D: IFA2 Summary Delivery Programme

E: Draft Deed of Variation (CONFIDENTIAL)

Background papers:

File of correspondence and technical reports

Reference papers:

Report to the Executive 7th December 2015 – Disposal of Land at Daedalus

Report to the Executive 3rd April 2017 – National Grid IFA2 Project Update

FAREHAM
BOROUGH COUNCIL

Executive Briefing Paper

Date:	04 December 2017
Subject:	IFA2 Technical Feasibility Update
Briefing by:	Director of Finance and Resources
Portfolio:	Policy and Resources

INTRODUCTION

1. At its meeting in December 2015, the Executive considered proposals for the lease of land at Daedalus to National Grid, to enable the construction of the IFA2 Interconnector.

2. Having considered the proposal and resolved to approve draft heads of terms for the land agreements, the Executive delegated authority to the Director of Finance and Resources in consultation with the Executive Member for Policy and Resources to agree the detailed terms. It further resolved to reinvest the proceeds of the disposal of land into the delivery of actions that support the Vision for Daedalus, including the airport, the business parks and the open space.

3. A further report was considered by the Executive in April 2017, which provided an update on progress with the land agreements, including the steps that were put in place to provide assurance that the Interconnector use was compatible with the wider uses and vision for Daedalus.

4. This report provides details of the outcome of the work undertaken to date, and proposals to enable the project to proceed to the next stage of construction.

PROGRESS OF THE PROJECT

5. At its meeting in April 2017, the Executive resolved to:

   (a) note the progress with the IFA2 project, including the conclusion of the detailed land agreement documents; and

   (b) endorse the scope of work for two technical studies.

6. In accordance with the terms of the land agreement, the two technical studies were procured with a duty of care to both the Borough Council and to National Grid, ensuring that they were conducted objectively and without preferential bias towards one party or another.

7. Arcadis were engaged to undertake a "Technical Assessment of the Co-Existence of the IFA2 Electricity Interconnector and Daedalus Airfield Operations (Future Airport Development)", and the scope of work published in April 2017 can be found at http://moderngov.fareham.gov.uk/documents/s18432/Appendix%20A.pdf).

8. Lambert Smith Hampton were engaged to "Provide a Market Compatibility Assessment and Occupier Consultation on the Proposed IFA2 Enterprise Zone Development", and the scope of work published in April 2017 can be found at http://moderngov.fareham.gov.uk/documents/s18433/Appendix%20B.pdf).

9. Since April, National Grid has also carried out further site investigations and detailed design work for both the Converter Station and the cables, in accordance with the outline planning consent that was granted in January 2017 for the converter buildings and mitigating open space, and detailed consent for the cabling. This has enabled National Grid to submit further planning applications for the detailed design of the Converter station and Open Space, and this was approved by the Planning Committee on 17th November 2017.

TECHNICAL ASSESSMENTS

10. The purpose of the technical assessment undertaken by Arcadis was to provide the Council as landowner with assurance over the compatibility of IFA2 with the broader uses at Daedalus. This report was completed in November 2017 and is attached as Appendix A. In order to fulfil the scope of work, Arcadis drew from the conclusions of a host of supplementary assessments into specific areas, and the suite of supporting documents is set out in Appendix B of this report.

11. The report is in three main parts;

    i. Interim Safety Justification Report. This details the body of evidence that, once complete, will provide a demonstrable argument that IFA2 is adequately safe. It is referred to as 'Interim' because it requires ongoing monitoring and the resolution of conditions on the airfield. It concludes: "the current state of the evidence available provides a high level of confidence that potential safety risks posed by IFA2 should not adversely impact the airport's current operations or the known planned developments."

    ii. Hazard Log Report. This shows how potential hazards have been identified and addressed. It is an evolving document that records hazards which have been identified to date, and will be updated during commissioning and testing. The log identifies 28 possible hazards. 12 of these have already been addressed. The log details what needs to be done to address the remaining possible hazards. This includes firm actions for each. As a result, it concludes: "the safety effect of IFA2 on Solent Airport's operations can be successfully managed."

    iii. Technical Assessment Report. This report considers the possible affects that the Interconnector may have on the Airport's operations and development plans, and is a supporting document to the Safety Justification report. It builds on initial work prepared by Arcadis in support of the IFA2 outline planning application and concludes that correct management will ensure that IFA2 does not increase risks in any of the areas assessed.

12. In summary, the Arcadis report indicates that there are no hazards identified to date, which would lead to incompatibility between IFA2 and both existing and planned future

airport developments, subject to mitigation measures and testing to be carried out before, during and post-construction. Where mitigation measures are required, these are being recorded formally in a “Hazard Log and Schedule”, to ensure they are tracked throughout the project. Inevitably, this is an evolving document which will be updated as work progresses.

13. In addition to the independent assessment by Arcadis, National Grid agreed to carry out a series of “real-world” validation tests, to simulate the proposed cable installations for IFA2, with the purpose of being able to validate the desk-top assessment of EMF and RFI effects, particularly in relation to aircraft moving in the vicinity of the cables. The tests included measurements taken at existing Interconnector sites, at the cable contractor lab site and concluding with a cable installed at Daedalus for a variety of aircraft to pass over. The results of these trials can be found in Appendix C.

14. The commercial assessment carried out by Lambert Smith Hampton was to consider whether the IFA2 facility is likely to have any detrimental impact on the commercial viability of the Faraday and Swordfish business parks. This report is shown in Appendix C and also indicates that potential businesses are unlikely to be deterred from relocating to Daedalus, solely due to the presence of the IFA2 development.

15. In overall terms, the outcome of the technical work is positive, and provides a good basis of assurance on which the Council can consider allowing the project to progress to the next stage of delivery. As stated above, however, there are a number of areas where further detailed design is required and where mitigation measures are needed in order to satisfy the Council. While these should not delay the progression of the IFA2 project, they are of sufficient importance that the Council would need to be reassured that all necessary measures have been put in place prior to full operation of the facility.

16. In order to formalise this arrangement, a legal agreement will be entered into, which updates the existing land agreements as explained below.

LAND AGREEMENTS

17. There are four documents in the suite that make up the land agreement with National Grid. These are:

    a) The Option Agreement, which gives National Grid an option to secure the land where the converter station is proposed to be built, and the land where the cables would be installed.

       The Option sets out several pre-conditions that must be satisfied before the Option can be exercised. These requirements are captured in an “Airport Condition” which is intended to ensure that the development can co-exist with the Airport and surrounding business parks as outlined in the Council’s Vision for Daedalus. The Option also includes covenants on both parties during the Option term and the commercial arrangements for the land agreement.

    b) A construction lease, which is granted to National Grid if it has satisfied the pre-conditions in the Option Agreement and chooses to exercise their option. This sets out the rights and restrictions for National Grid during the construction of the project.

c) A converter station lease, which is granted when the project has been completed and which sets out the rights and restrictions on the National Grid during the operational period, as well as the arrangements at the end of the operational life of the converter.

d) A Deed of Easement, which is similar to the converter lease but grants specific rights and restrictions over the cable operations.

PROPOSED AMENDMENTS TO THE AIRPORT CONDITION

18. The Airport Condition included in the Option agreement requires both the Council and IFA2 to jointly procure the specialist technical studies to assess whether the proposed cable installation and converter station development has any negative impact on the operation of the airport, both now and as envisaged in the future, or on the delivery of the Council's vision for Daedalus. It also requires National Grid IFA2 to provide the Council with construction methodologies and specifications which demonstrate how the development will meet the safeguarding requirements in both its design and during construction. The process of monitoring performance against the Airport Condition is through a joint Technical Working Group.

19. Both parties are required to have regard to the conclusions and recommendations of the studies.

20. The operation of the Airport Condition in the document anticipates that it will be capable of satisfaction ahead of Start on Site. To date, the studies and tests carried out have identified a requirement for ongoing testing/additional assessments and monitoring that post-dates Start on Site. This can only be carried after the development is complete, and in some cases once the facility becomes operational. The purpose of these tests is to check that actual performance of IFA2 concurs with the findings of the technical studies.

21. The Airport Condition also anticipates that all details of the Construction Methodology and Specification will be available ahead of start on site. As the construction contracts are being let on a design and build basis, some of the details of the design will not be finalised until initial works have been carried out.

22. The findings of the technical studies and the ongoing development of the detailed design and construction methods means that this is not possible for the airport condition to be fully addressed before the development proceeds. Officers are, however, satisfied that all the findings of the technical studies and work IFA 2 and their contractors have done to date indicate that impacts can be mitigated satisfactorily. This provides sufficient certainty for the Council to allow the development to proceed to the next stage, provided that the Council is able to impose additional safeguards to secure the original requirements of the airport condition in full.

23. By proceeding on this basis, National Grid has agreed to carry out all mitigations and measures within the Hazard Log and Schedule, and will be obliged to do so, to the Council's satisfaction. National Grid also agree to maintain the Technical Working Group until such time as all testing and mitigation has been finalised. If, in the unlikely event that satisfactory mitigations cannot be put in place, National Grid would be in breach of the lease and unable to operate the IFA2 Interconnector.

WAY FORWARD

24. If the Executive agree to the proposed way forward, the safeguarding obligations in the Option Agreement will be extended into the Construction Lease. This would allow the project to proceed in line with National Grid's delivery programme, whilst also ensuring that the Council is in a position to oversee and approve any ongoing technical details that are still being finalised, and record any new legal obligations that may be required to protect the Council's land.

25. The draft document is attached as Appendix E.

FINANCIAL IMPLICATIONS

26. Upon entering into the Construction Lease, National Grid is due to pay to the Council an initial lease premium. It was resolved by the Executive in December 2015 that any proceeds from the disposal of land are to be reinvested into the delivery of actions that support the Vision for Daedalus, including the airport, the business parks and the open space.

27. Funding was also previously secured to cover costs associated with Council supporting the Technical Working Group. As a result of the Council's continuing input being required throughout the project, additional financial support is being sought from National Grid to cover the Council's reasonable costs.

CONCLUSIONS

28. The technical studies relating to the proposed development have been completed, and indicate that there will be no material impact on the operation of the airport or the vision for Daedalus.

29. The Construction Methodology and Specification is being developed, and reflects the operational requirements of the airport and mitigation measures identified by the technical studies. This development will continue in full liaison with FBC officers, advisers and the Airport Manager through the Technical Working Group.

30. The Airport Condition cannot however be fully satisfied until the tests and ongoing monitoring requirements identified in the technical studies have been completed.

31. Given the comfort that has been provided by the comprehensive technical work done to date, this report recommends that the IFA2 is able to proceed to the next stage, subject to extended arrangements are secured to provide ongoing safeguards to the Council during and following the construction stage.

Enquiries: For further information on this report please contact Andrew Wannell (Ext 4620)

APPENDIX A1

ARCADIS Design & Consultancy for natural and built assets

SAFETY JUSTIFICATION REPORT

for the IFA2 Interconnector on the Solent Airport, Daedalus

35588103/RP/080917/3

NOVEMBER 2017

Incorporating

EC HARRIS BUILT ASSET CONSULTANCY

Hyder

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VERSION CONTROL

Issue	Revision No.	Date Issued	Description of Revision: Page No.	Description of Revision: Comment	Reviewed By:
1	1	08/09/2017	Draft Report issued for comment.		S Scannali T Rowe
	2	06/10/2017	Incorporating comments from National Grid and Fareham Borough Council	Addressing various comments on Rev 1	S Scannali
	3	10/11/2017	Section 9.3.1 includes findings from cable trials. Also updated following hazard review and comments	Incorporates Findings on cable trials, update on hazard review and addresses comments from FBC on Rev 2	S Scannali

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EXECUTIVE SUMMARY

National Grid Interconnector Holdings (NG) is in the process of developing and implementing a new electricity interconnector facility, the Interconnexion France-Angleterre 2 (IFA 2). The facility is being developed jointly with Réseau de Transport d'Electricité (RTE), the French transmission system owner and operator. It will link the United Kingdom's electricity transmission network with France's, and will enhance the security, affordability, and sustainability of energy supply to both countries.

The facility consists of two converter stations, one sited in each country. The UK converter station is to be sited to the north-east of Solent Airport at Daedalus ("Solent Airport"). National Grid proposes to route high-voltage direct current and high-voltage alternating current cables in a shared cable corridor to the west and north of the Solent Airport main runway.

During the planning application and land acquisition processes, NG, together with Fareham Borough Council (FBC) and Regional and City Airports Management (RCAM); the airport operator, commissioned a number of assessments as part of best practice development and design to determine whether the siting of the converter station and proposed routing of cables at Solent Airport could affect the airport's existing operations. This work included both technical and environmental assessment to examine effects focussed around the main potential hazards, which are:

- Hazards related to aerodrome safeguarding as identified in CAP 738 [1], these include any potential impacts on airport operations from obstacle limitation surfaces, building lighting, and bird hazard management.
- Electromagnetic field (EMF) and radio-frequency interference (RFI) emissions from the converter station, the equipment and HV cables with potential impact on airport and aircraft operation.
- Wind flow effects caused by the IFA 2 building and potential safety impact on flying operations.

This work was also intended to help address stakeholder concerns about the proposals to site the converter station at Solent Airport, and has provided supporting information to the public consultation and planning application processes.

Over 2016 and 2017, further, more detailed technical assessment has been undertaken; this work has progressively developed the initial body of evidence. As part of this work, Arcadis was commissioned to undertake independent peer review of the body of evidence as well as further technical assessment of the converter station to assess whether the IFA2 facility can co-exist safely with the existing airport and its operations. This work, presented in [2], [3] and [6] includes a hazard identification and risk assessment study, and as a result of this a Hazard Log has been developed in accordance with the standard CAP 760 [4].

The project is now progressing through the detailed design process and some initial trials have been completed. This document provides an interim safety justification for the IFA2 facility at Solent Airport, and is intended to support the application to the FBC Executive Committee as planning authority for the full planning acceptance and consent to progress to the next stage in the Project. As for any major project, the full safety justification will be complete post construction, when all the validation evidence from testing and commissioning is available.

A safety justification is a documented body of evidence that provides a demonstrable and valid argument that a system is adequately safe for a given application and environment over its lifetime. This safety justification considers only IFA 2 at Solent Airport. It does not consider other hazards to the airport or provide a safety case for the airport itself. The information in this safety justification may be used by RCAM as Airport Operator to update the airport safety management system [11] and to support a submission to the Civil Aviation Authority (CAA) under CAP 791 [5] which is the process to notify the CAA of changes at an aerodrome, covering both the infrastructure and management system changes related to the introduction of IFA 2.

This safety justification document is supported by two addenda. Addendum 1 presents the current hazard log which details the status of the hazards and the assurance evidence at this point in time. Addendum 2 provides additional analysis and assessment to address some specific hazards in the hazard log and forms part of the assurance evidence referenced within the hazard log, and includes:

- A revised assessment of airfield safeguarding taking account of the IFA 2 design and updating the assessment in [2].
- additional wind flow analysis carried out to supplement that in [2], [3] and [6]. This models interaction effects between the IFA2 converter station and the Faraday Business Park.
- Further independent peer review of some additional documents related to Radio Frequency Interference (RFI) and Electromagnetic Field [EMF] and consideration of EMF / RFI effects. This confirms some assumptions made in the assessments in [2] and [3] and considers some specific hazards within the hazard log that were not explicitly or fully covered by the body of evidence available.
- Consideration of some Maritime & Coastguard Agency (MCA) equipment in the context of effects related to IFA 2,
- Additional assessment of potential future options that may be available to improve the navigation environment (including an instrument landing capability). This considers any potential impacts related to the IFA 2 facility as well as general considerations that will need to be progressed by the airport operator should there be a decision to introduce such equipment at Solent Airport in the future.
- Assessment of Unmanned Aerial Vehicles (UAVs), considering any potential impacts related to the IFA 2 facility as well as general considerations that will need to be progressed by the airport operator.

Some of the key safety requirements and objectives for the IFA 2 facility are formalised as constraints through planning conditions and the legal covenants in the Converter Station Lease, and formal agreement of these conditions is a vital part of the assurance evidence.

At this stage in the project (part way through the detailed design process), the body of evidence which forms the safety justification for IFA 2 is progressively evolving. As for any major project, the assurance evidence will continue to develop over the project lifecycle. Consistent with the stage in the project lifecycle, a robust base of analysis, calculations and assessment exists which establishes a high level of confidence that safety objectives and safety requirements will be met and that risks related to IFA 2 are acceptable as defined in the CAA guidelines CAP 760 [4]. Initial testing has been completed simulating the maximum electromagnetic fields that would be generated by the HV DC and AC cables. This has successfully demonstrated the accuracy of the calculations used to generate the EMF analysis and gives confidence that the requirements of planning condition 48 (concerning EMF emissions) will be met. The testing has also validated predictions that effects on aircraft systems are negligible.

The focus of the assurance evidence from this point will be the issue of the detailed design and the extensive programme of testing planned to validate the computer analysis and calculations and ultimately to provide the demonstration of compliance with planning conditions and requirements from legal agreements.

The main conclusions of the safety justification at this stage are as follows:

- Overall, the current state of the evidence available provides a high level of confidence that potential safety risks posed by IFA2 should not adversely impact the airport's current operations or the known planned developments. Once all the dependencies stated in this report are complete, the demonstration that risks posed by IFA2 are acceptable and ALARP as defined in CAP 760 [4] will be complete.
- There are no hazards, risks or issues identified which may place unreasonable or impractical constraints on the design of the IFA 2 Facility.
- The body of assurance evidence available and planned is thorough and diverse, including analysis, calculations and assessment, testing, and simulation. Once complete the extent of the evidence will exceed the minimum requirements in CAP 760 [4] for the confidence level required for validation evidence, based on risk.
- The actions to establish the remaining assurance and thus to complete the body of evidence are recorded in the Hazard Log and captured as "dependencies" in this safety justification.

REFERENCES

Ref No	Reference Identifier	Title
1	CAP 738 Version 2	Safeguarding of Aerodromes
2	35588100/NT/300916/1	Technical Assessment (Main Report) of the possible impact of the IFA2 Interconnector at Solent Airport Daedalus.
3	35588102/RP/270617	Technical Assessment (Main Report) of the possible impact of the IFA2 Interconnector at Solent Airport Daedalus.
4	CAP 760 Version 1	Civil Aviation Procedure (CAP 760) Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases.
5	CAP 791 Version 2	Notification of Changes to Aerodrome Infrastructure
6	35588100/NT/300916-3 - Addendum 1	Technical assessment Wind Flow Analysis
7		Draft Daedalus Masterplan – 12 October 2016
8	35588100/NT/300916/2	Technical Assessment (Hazard Log) of the possible impact of the IFA2 Interconnector at Solent Airport Daedalus.
9	35588102/RP/080517	HAZARD LOG REPORT Technical Assessment of the Effects of IFA2 interconnector at Solent Airport
10		Daedalus: A Vision and Outline Strategy
11	CIMS/RCA/DA/GT11.0 & 12.0	RCAM Daedalus SMS Incorporating the Aerodrome Manual.
12	LSAEM/2015/019/TR/01	RFI Assessment Report for IFA2 and Daedalus Airfield - LSA Electromagnetics Report.
13		National Grid – Compass Deviation Calculator for DC cable 270716 and magnetic field calculations
14		Verification of calculations of deviations to magnetic compasses from HVDC cables.
15	LSAEM/2015/019/TR/01- Issue 2	RFI Assessment Report for IFA2 and Daedalus Airfield - LSA Electromagnetics Report. - Addition of Annex 1 with summary of airfield systems - Addition of RTCA/D)160 radiated emission analysis for aircraft radios – Addition of notes on general RFI
16	LSAEM/2015/019/TR/002 Issue 1	Aircraft Magnetic Field Susceptibility Assessment Report for IFA2 – LSA Electromagnetics Assessment of magnetic field effects on aircraft
17	AR/NG/17102016 Issue 1	Islander and Defender Magnetic Field Susceptibility Assessment Report for IFA2 Aviation Requirements Assessment of magnetic field effects on Islander and Defender aircraft
18	QINETIQ/MS/AD/LR1604249/1	Magnetic effect -impact on UK MoD Islander and Defender Aircraft QinetiQ Assessment of magnetic field effects on Islander and Defender aircraft

Ref No	Reference Identifier	Title
19	QINETIQ/MS/AD/LET1604895/1	Magnetic effect -impact on UK MoD Islander and Defender Aircraft Assessment QinetiQ Calibration opinion 23 November 2016
20	OVE-IFA2-REP-001 Issue 1	National Grid, IFA2 Converter TV and Radio Reception Study Issue 1 | 14 September 2016
21	OVE-IFA2-REP-001 Issue 2	National Grid, IFA2 Converter TV and Radio Reception Study Issue 2 | 27 June 2017
22	LSAEM/2015/019/TR/005	RF Survey Test Report for the IFA2 Development at Solent Airport. March 2017.
23	239216-02 Issue 2 May 2016	National Grid Interconnector IFA2 - Assessment of Possible Wind Effects on Flying Operations of HMS Daedalus – Ove Arup Report.
24	CIGRE TB391	Guide for measurement of radio frequency interference from HV and MV substations.
25	1JNL575900 (Draft)	Audible Noise - Assessment for Planning Application
26	75936551 Issue 1	TUV-SUD document for FBC - IFA2 Interconnector Project – Review of EMC / EMF Assessment Reports.
27	IDE 00034 version P3	IFA2 Converter Station External Flood Lighting (for FBC approval)
28	IKA-0508 version P3	Converter Station Reactor Hall 5 Degree Pitch Option Elevations
29	1JNL439067, C	Fire Systems Description
30	500-001 Revision B	AGL Duct Installation Arrangement and Detail
31	PPL15142-SE-RA-001-v00	Preliminary impressed voltage assessment for cables at Daedalus
32	BS 5489 -1:2013	'Code of Practice for the Design of Road Lighting
33	AOA Advice Note 2	Safeguarding of Aerodromes
34	International Commission on Non-Ionizing Radiation Protection	ICNRP guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 ghz)
35	1JNL568775 Rev C	Radio and Telecomms Interference and EMF assessment, ABB
36	1JNL549328 Dated 27-5-16	Potential New Solution with Layout Rotation in Daedalus
37	FM-5267	3D Masterplan 2017 update
38	G3221.181I	Drawing: IFA2 Overview Map Daedalus New Boundary, NG
39	35588103/RP/260917 (Draft)	Wind Flow Analysis for the IFA2 Facility
40	RWDI #1703422 (Draft)	Airport Runway Wind Study
41	1JNL553364 Rev A	HF Performance Report
42	1JNL590610 (2017-10-09)	Preliminary assessment for touch and step voltage
43	GTech Surveys Limited 2017 09/10/2017	Pre-Construction 2G, 3G and 4G Mobile Telephone Network Signal Survey IFA2
44	GTech Surveys Limited 2017 03/10/2017	Pre-construction Airwave Radio Network / TETRA Signal Survey

Ref No	Reference Identifier	Title
45	IFA2-IJV-CAB-TTR-0003 (Nov 17)	Technical Note: Tests to Verify Ability to Comply with Planning Conditions on Electric and Magnetic Fields for IFA2 Cables at Daedalus Airfield
46	IFA2-IJV-CAB-TTR-0004 (Nov 17)	Technical Note: Tests of Aircraft in Electric and Magnetic Fields from IFA2 Cables at Daedalus Airfield.

TERMS AND DEFINITIONS

Term / Abbreviation	Definition
Airport	Solent Airport at Daedalus
AAIB	Air Accident Investigation Branch
AC	Alternating Current
AGL	Aeronautical Ground Light
AIP	Aerodrome Information Package
ALARP	As Low as Reasonably Practicable
AOA	Airport Operators Association
APAPI	Airport Precision Approach Path Indicator
ARP	Aerodrome Reference Point
ATC	Air Traffic Control
ATS	Air Traffic System / Air Traffic Services
BHMP	Bird Hazard Management Plan
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CEMAST	Centre of Excellence in Engineering and Manufacturing Advanced Skills Training
CFD	Computational Fluid Dynamics
CIGRE	Conseil International des Grands Réseaux Électriques
DC	Direct Current
EMC	Electromagnetic Compatibility
EMF	Electromotive Field
FIS / FISO	Flight Information Service / Officer
FBC	Fareham Borough Council
FHA	Functional Hazard Assessment
GB	Great Britain
HV	High Voltage
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
ICNIRP	International Commission on Non-Ionizing Radiation Protection

Term / Abbreviation	Definition
IFA2	The IFA2 Interconnector, being developed by National Grid jointly with Réseau de Transport d'Électricité
ILS	Instrument Landing Systems
LED	Light-Emitting Diode
LV	Low Voltage
MEOSAR	Medium Earth Orbit Search and Rescue
MW	Megawatt
National Grid	National Grid Interconnector Holdings
NATS	National Air Traffic Services
NDB	Non-Directional Beacon
NG	National Grid Interconnector Holdings
NOTAM	Notice to Airmen
OFZ	Obstacle Free Zone
OLS	Obstacle Limitation Surfaces
RAF	Royal Air Force
RCAM	Regional and City Airports Management
RFI	Radio frequency interference
SMS	Safety Management System
Solent Airport	Solent Airport at Daedalus
The (Control) Tower	The Control Tower at Solent Airport
VFR	Visual Flight Rules

1 INTRODUCTION

National Grid Interconnector Holdings (NG) is developing a new electricity interconnector facility, the Interconnexion France-Angleterre 2 (IFA2). The facility is being developed jointly with Réseau de Transport d'Electricité (RTE), the French transmission system owner and operator. It will link the United Kingdom's electricity transmission network with France's, and is expected to help enhance the security, affordability, and sustainability of energy supply to both countries.

The facility consists of two converter stations, one sited in each country. The UK converter station is to be sited to the north-east of Solent Airport at Daedalus ("Solent Airport"). National Grid proposes to route high-voltage direct current and high-voltage alternating current cables in a shared cable corridor to the west and north of the Solent Airport main runway.

The project is currently progressing through the detailed design stage and a large body of assurance evidence has evolved to examine whether the siting of the converter station and proposed routing of cables at Solent Airport could affect the airport's existing operations or future plans for the airport. This has considered in detail radio frequency interference (RFI) and electromagnetic field (EMF) effects, analysis of wind effects and airport safeguarding. In addition to this hazard identification and risk assessment has been undertaken and a hazard log developed, which records all risks, mitigation measures and the requirements / actions that need to be completed, in order to provide a robust safety justification that risks are acceptable as defined in CAP 760 [4].

This is an interim safety justification for the IFA 2 facility at Solent Airport that has developed through the project and details the body of evidence that, once complete, will provide a demonstrable and valid argument that potential safety risks posed by IFA2 should not adversely impact the airport's current operations or the known planned developments. It does not provide a safety case for the airport itself, however the information, documentation and references here may be used by RCAM to support a submission to the CAA under CAP 791 [5] demonstrating that the change to the airport by introducing IFA2 will be tolerably safe and will meet its specified safety objectives and requirements.

This safety justification document is supported by two addenda. Addendum 1 presents the current hazard log which details the status of the hazards and the assurance evidence at this point in time. Addendum 2 provides additional analysis and assessment to address some specific hazards in the hazard log and forms part of the assurance evidence referenced within the hazard log; this includes:

- A revised assessment of airfield safeguarding taking account of the IFA 2 design and updating the assessment in [2].
- Additional wind flow analysis carried out to supplement that in [2], [3] and [6]. This models interaction effects between the IFA2 converter station and the Faraday Business Park.
- Further technical assessment of EMF / RFI effects to confirm some assumptions made in the assessments in [2] and [3] and to consider some specific hazards within the hazard log that were not explicitly or fully covered by the body of evidence available.
- Assessment of UAVs and possible options for future improvements to the navigation environment at Solent Airport (including an instrument landing capability) which explore any potential hazards, risks or issues in the context of IFA 2 at Solent Airport. Currently there are no plans to introduce Instrument Landing Systems (ILS) or other navigation systems at the airport.

This safety justification document details the outcome of the hazard identification and risk assessment process, the safety objectives and requirements and the evidence providing the safety and technical assurance demonstrating that risks are acceptable. CAP 760 [4] has been used as the overarching standard and guidance concerning tolerability of risk, and the safety justification is structured in the format advised in this standard.

2 SCOPE

The scope of this safety justification is confined to considering possible hazards associated with the introduction of the IFA2 facility and how this may affect the Solent Airport (within the boundaries stated below), including the airport and airborne systems as well as the known future developments. Other potential causes of hazards which could affect airport operations (i.e. those arising from sources other than IFA 2) are not considered. This safety justification therefore may be used to support a safety justification for the airport but will not in itself provide an airport safety case, as this would need to address all hazards arising from all relevant equipment and operations.

The boundaries of the airport are shown in the most recent version of the Masterplan [7], which is reproduced in Appendix A. The scope of the safety justification covers the existing airport and airport operations within the boundaries shown on the Masterplan, together with the future planned changes to the airport described in Section 4.

The hazard identification and risk assessment supporting the safety justification has considered all aircraft in communication with, or attempting to be in communication with the Solent Airport control tower. Other aircraft using the Class G (uncontrolled) airspace in the vicinity of Solent Airport have been excluded because the effect of buildings under Class G airspace is addressed by compliance with general regulations.

The scope excludes hazards and issues related to the construction phase of the project. These hazards are the responsibility of the main contractor appointed to construct the IFA2 facility and the cables, and control of hazards will be demonstrated through construction method statements and safety management plans put in place for the construction work. The main contractor will also implement a separate risk register in accordance with the Construction (Design and Management) Regulations to manage construction risks. Any interfacing hazards or issues between the construction phase and the operational IFA2 facility have been considered through the participation of the main contractor in the hazard identification workshops and hazard review meetings.

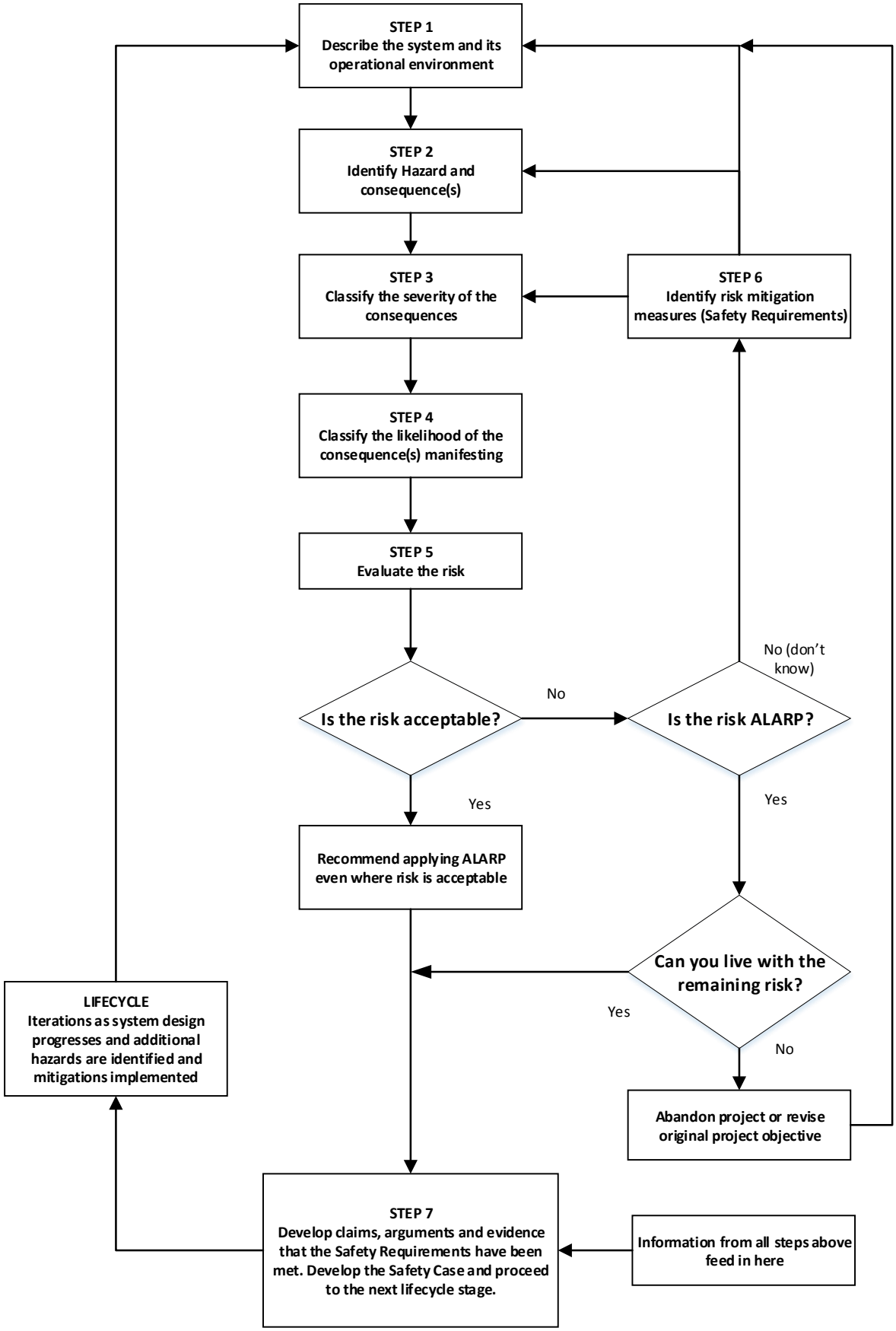
3 OVERVIEW OF HAZARD IDENTIFICATION AND RISK ASSESSMENT PROCESS

International regulations and standards require that any change being introduced that may have an impact on the safety of aerodrome operations or air traffic services (ATS) is subject to a hazard identification and risk assessment / risk mitigation process to support its safe introduction and operation.

For any engineering project, the hazard identification and risk assessment process is an iterative process undertaken at the same time as, and supplementary to, the design process. This process starts at the concept stage with preliminary hazard analysis and develops through the design and implementation phases. Risk mitigation evidence is identified by more detailed hazard analysis in the hazard management phase, with any residual risks managed in the operational phase. Ultimately, the completion of this process demonstrates that hazards are eliminated where practicable, with residual risks acceptable and As Low As Reasonably Practicable (ALARP).

The hazard identification and risk assessment process adopted here follows a systematic Functional Hazard Analysis (FHA) approach that covers the Seven Steps for risk assessment in CAP 760 [4] as applicable in the project. This process is illustrated in Figure 1 below, which is extracted from CAP 760 [4]. Step 7 of CAP 760 [4], “claims, arguments and evidence that the safety requirements have been met and documenting this in a safety case”, can only be fulfilled within the constraints of this justification, (i.e. only in respect of the IFA2 facility and within the limits of the equipment and infrastructure stated on the agreed Masterplan).

Figure 1 – The Seven Step to Risk Assessment Approach (Extract from CAP 760 [4])



The purpose of the FHA is to:

- identify ways in which the proposed IFA2 installation might impair the safety of air traffic operations at Solent Airport (hazards) or have other adverse safety effects;
- identify how severe such impairment might credibly be;
- estimate the approximate likelihood of such impairment where possible.

The means of managing risk has developed progressively through the risk management process. Possible ways to manage risks identified during the FHA workshop are recorded in the hazard log, and have been developed through regular reviews of hazards aimed at managing the risks to closure.

An initial FHA workshop was held on the 24th August 2016 as part of the preliminary technical assessment [2] and a hazard log developed [8]. This work concluded that, based on the evidence available at the time, the risks posed by IFA2 were not expected to impact the airport's current operations adversely, and any hazards should be straightforward to manage.

A further hazard identification and risk assessment workshop was held on the 11th and 12th April 2017, described in [9], which developed the initial assessment and extended the hazards to include the plans for the development of the airport as known and specified at the time of the study. Additionally, the design specifications for the IFA2 facility had progressed at this stage, enabling the ranking of risks. This work also developed a plan for delivery of the risk mitigation evidence, which is given in [3] and is being maintained as a "live document" within the hazard log.

Since the 2017 workshop, the hazard log in [9] and the risk mitigation plan have developed; mitigation evidence has evolved with the detailed design. Although the assurance evidence is not yet complete, most of the analysis, calculations and assessments have been completed that support the detailed design and enable this interim safety justification to be completed. The issue of the interim safety justification at this stage is aimed at providing the necessary assurance to the FBC Executive Committee as planning authority, for full planning acceptance for the IFA 2 facility, obtaining the legal agreements and consent to progress to the next stage in the Project. Ultimately, as for any major project, the safety justification presented here will be fully complete, post construction when all the validation evidence from testing and commissioning is complete.

4 SYSTEM DESCRIPTION

This safety justification considers the possible effects that the proposed IFA2 facility could have upon Solent Airport's operations including the airport's airborne systems and operational functions, and equipment at the airport owned or operated by third-parties. The scope of the safety justification considers the airport's current operations and future changes to the airport and its operations, where details are known at this stage. Future changes considered here are based on the most recent version of the Masterplan [7], together with some additional known changes described (but not shown on the Masterplan).

4.1 The Airport and Airborne Systems

Solent Airport, located on the Solent shoreline between the villages of Stubbington and Lee-on-the-Solent, has been identified as a key development site for creating skilled employment in the boroughs of Fareham and Gosport. Outline planning permission was secured for a comprehensive investment package across the whole airport and surrounding area, which includes over 50 000 m^2 of commercial development in the Fareham Borough, together with a range of community benefits (e.g. public open space, a park and comprehensive landscaping).

Solent Airport is owned by Fareham Borough Council and operated by Regional and City Airports Management Ltd (RCAM). The IFA 2 converter station is to be sited to the North East of Solent Airport.

Fareham Borough Council describes how it sees the future for its own land interest at Solent Airport in [10] as follows:

"For Daedalus to become a premier location for aviation, aerospace engineering and advanced manufacturing businesses, creating many skilled employment opportunities for local people, which is under-pinned by a vibrant and sustainable airport."

The Solent Airport site is zoned into a number of development opportunities and is currently being promoted for a variety of uses.

Characteristics of Solent Airport itself are given in the airport manual [11]. The airport currently operates between 09:00AM and 16:30PM local time, seven days a week (or as published on the Airport website). For operations out of hours, agreements and prior permission is required for visiting aircraft. Future developments may extend the current operating hours.

The airport is currently used by a variety of organisations, including flying / gliding clubs, aircraft maintenance organisations, storage of aircraft and private owners. The Maritime Coastguard Agency (MCA) also operates from the Airport. The airport was granted a CAA Licence in January 2015.

Developments completed to date at Solent Airport include:

- CEMAST College (a Centre of Excellence in Engineering and Manufacturing Advanced Skills Training, opened in August 2014);
- Fareham Innovation Centre, completed in March 2015, providing quality, affordable office/workshop facilities in a supported environment for small businesses;
- Construction of roads and services for development plots on Daedalus East, as the first phase of the commercial development.

The future plans for the airport include hangars, facilities, services to attract more corporate, and commercial aviation activities, allowing it to be self-sustaining in the medium term and contribute positively to the local community. Many of these future buildings will be located in the Faraday Business Park, which is located to the NE of the airport in the vicinity of the IFA 2 building as shown in Appendix A.

4.1.1 Safety Justification Boundaries

As stated above, the boundaries of the airport considered in this safety justification are shown in the most recent version of the Masterplan [7] and Appendix A. Existing airport operations are considered together with the known planned future changes affecting the airport and third-party equipment as summarised below.

Operational Changes

The current operational regime at the airport is to be upgraded to Flight Information Service (FIS). Whilst not full Air Traffic Control (ATC), FIS is an information system and can influence the onset or development of an incident.

Airfield Ground Lighting

Currently there is no Airfield Ground Lighting (AGL) at the airport. Incorporation of AGL on the main runway, as well as the future runway extension and other taxiways and aprons will be:

- Runway edge lighting.
- Airport Precision Approach Path Indicator (APAPI).
- Approach lighting.
- Upgrading of the Maritime Coastguard Agency (MCA) lighting.

Ducting for the AGL wiring has already been installed.

Navigational Aids

There are no plans at Solent Airport to implement Instrument Landing Systems (ILS) and Non-Directional Beacons (NDB). However, potential future options that may be available for the airfield to improve the navigation environment (including an instrument landing capability) have been considered within the scope in Addendum 2 to the safety justification in the event that such a system is installed in the future.

Fuel Installations and mobile fuel bowsers

The fuel installation consists of the following:

- The fixed fuel installation tank to be located at the bottom of the taxi way as shown on the Masterplan [7].
- The self-service tanks which will remain at the current location (the fuel farm) as shown on the Masterplan [7].
- Mobile bowsers that operate across the airport.

Compass Base and Pre- Flight Check Area Proposal

Compass Base:

The implementation of a compass base is a planned development and will be the defined area in which the compass will be calibrated for all aircraft. The location of the compass base is shown in the Master Plan [7].

Pre-flight check area:

The location of the planned pre-flight check area is yet to be decided, this is likely to be on the western side of the west taxiway. Once the location is decided, any potential impacts of IFA 2 need to be considered and confirmed to be acceptable. This is recorded as a dependency in Section 5.2.

Engine Testing Area

The location of the engine testing area has not been decided yet. However, it is likely to be near to or at the compass base. Potential hazards from IFA 2 related to the engine testing area were considered in the FHA, however no hazards were identified.

Runway extension and Taxiway extension

The planned runway extension is at the north end of the runway. It will be up to 100m length and to Code 3 status. Runway lighting will be extended.

The new taxiway is as shown on the Master Plan [7] and runs the full length of the current taxiway but may be moved slightly west by about 4 to 5m.

Weather Forecasting and Measurement Equipment

Weather forecasting and measurement equipment to be implemented in the future are:

- Visio meters; (Measurement).
- Cloud base recorder;
- AFTN lines (Airfield Fixed Telecoms Network), a messaging system to be introduced as part of the plan to introduce FIS.

Buildings

The buildings to be introduced as part of the IFA2 facility have been considered this assessment in terms of the potential effects on wind flow and airport operations.

The converter station building profile assumed for the assessment is Option B in [36], with the boundaries defined in [38].

Other buildings to be introduced in the vicinity of The IFA2 facility at the Faraday Business Park are shown on the Masterplan [7]. A “Sketch up” of these buildings in [36] was provided by FBC giving dimensions of the building. These buildings could potentially interact with the IFA 2 building to impact wind flow and this has been considered in Addendum 2 to this safety justification.

Drainage & Services and Ancillary Structures

Drainage and services relating to the IFA2 facility will be part of the installation and any additional fencing which is subject to Airport restrictions.

Aircraft Types

Aircraft types that could potentially be introduced in the future include:

- Civilian: up to 19-seater passenger jet, helicopters;
- MCA: helicopters;
- Military: Hercules, Apache, Chinook;
- Commercial UAVs (drones);
- Historic aircraft.

The current airport licence allows 40k movements per year. It has been assumed that this could rise to a maximum of 120k movements per year.

4.1.2 Airport Stakeholders

Stakeholders considered in the safety justification include existing and future known occupiers / users of airside facilities at Solent Airport as follows:

- Maritime and Coastguard Agency (MCA)
- Aerotech Solent
- Atlas Helicopters
- Bournemouth Avionics
- Britten Norman
- Hampshire Aeroplane Club
- Lee Bees Model Aircraft Flying Club
- Lee Flying Association
- Nason Energy
- Phoenix Aviation
- Portsmouth Naval Gliding Club
- Solent Microlights
- Deltair
- Malcom Paul
- Tiger Motorcycle Display Team
- TUV
- NATS
- MAST
- UTP

Potential future tenants considered are:

- Tekever

Future Third Party Equipment in Planning Process

Plans for third party equipment currently in the planning process are:

- NATS radar – this is used for training purposes only and there are no plans to convert it for operational purposes.
- An MCA satellite Local User Terminal (LUT) as part of the MEOSAR development.

4.2 IFA2 Interconnector Facility

National Grid is the British promoter of the IFA2 1000MW high voltage direct current (HVDC) electrical interconnector linking the French and British transmission systems. The IFA2 facility will consist of two HVDC converter stations of similar construction, one sited in each country. The converters are connected by two HVDC cables – underground and subsea – in a defined cable route. There are also HVAC cables connecting the converter stations to the existing electricity transmission grid infrastructure.

Within Great Britain, the converter station will be sited to the north-east of Solent Airport as shown in Appendix A.

HVDC and HVAC cables are to be routed in the same cable corridor to the west and north of the main runway to avoid existing development areas of the Enterprise Zone, and to avoid foreseeable development areas, as shown in Appendix B.

The alternating current (AC) electricity of the sending country is converted to direct current (DC) electricity at the converter station and then transmitted to the receiving country's converter station, where it is converted back to AC and supplied to the receiving transmission system. The interconnector can import and export electricity depending on requirements at any given time.

The link in its entirety will consist of:

1. a converter station including HVAC connection, adjacent to Tourbe sub-station, near Caen, Normandy in France;
2. HVDC land cables from Tourbe to Merville, France;
3. HVDC submarine cables from Merville, France to Monks Hill Beach, Daedalus;
4. HVDC land cables from Daedalus coast to the converter station at Solent Airport;
5. a converter station at Solent Airport;
6. HVAC connections (both submarine and underground) from the converter station at Daedalus to a National Grid Electricity Transmission (NGET) Substation at Chilling, Hampshire.

The nominal DC voltage is 320 kV. The nominal AC voltage is 400 kV.

The Voltage Source Converter (VSC) will be housed indoors in separate buildings. The main buildings are the AC Hall, transformer enclosures, DC Hall and the Valve Hall.

5 ASSUMPTIONS AND DEPENDENCIES

A safety justification must state clearly the hazards from and dependencies on other facilities or external services or activities and related claims or assumptions that should be substantiated, in order to complete the safety justification. These are stated in Section 5.1 below. The list of dependencies in Section 5.2 include all the actions and activities identified in the Hazard Log and the risk mitigation plan shown in Appendix C.

Some of the dependencies listed in Section 5.2 are related to this safety justification as they ensure control of risks but are subject to a separate safety management programme and are not a constraint on the IFA 2 programme. This occurs for example, where a third-party system which interfaces with IFA 2 is planned, and testing for compatibility or a procedure will be required before the third-party system is brought into operation. The table in Section 5.2 therefore states which dependencies are a constraint on IFA 2 i.e. must be completed within the safety management programme for IFA2, and those which are not, i.e. those related to the programme for third-party systems. The table also provides a status against each of the dependencies which is current as at the date of issue of this safety justification.

5.1 Assumptions

Table 1 – Assumptions

No	Assumption
A01	Wiring for AGL will be routed in the ducting already installed.
A02	AGL lighting implemented will be compliant with airport standards.
A03	IFA2 facility as built will be as per the specifications which form the basis of this safety justification. Any changes will require review / re-assessment.
A04	The wind flow assessment is based on the masterplan [7] as provided by FBC, and the dimensions and layout of the buildings on this development have been used
A05	Not used.
A06	The planned runway extension will be up to 100m and to Code 3 status.
A07	Future aircraft movements at Solent Airport could rise to a maximum of 120k movements per year.
A08	Drainage systems at Solent Airport are of non-metallic / conductible materials.

5.2 Dependencies

The status of dependencies assigned below uses the following definitions, for further detail of the actions remaining to fulfil each dependency refer to the risk mitigation plan in Appendix C:

- “Design” – there remain actions relating to the design or the design still needs to be finalised.
- “Testing” – all actions relating to the design are complete and testing is required once the facility is operational.
- “Management” – there are no design or testing actions remaining, ongoing management or a procedure is required.
- “Closed” – all actions to fulfil the dependency are closed.

Table 2 – Dependencies

No	Dependency	Constraint on IFA2	Status
M01.1	Confirmation of the final IFA 2 external flood lighting design.	Yes	Closed
M01.2	External security lighting design details to be finalised with confirmation that this meets guidelines for lighting near airports in AOA advice note 2 [32] and BS 5489 'Code of Practice for the Design of Road Lighting [30] as appropriate.	Yes	Closed
M01.3	Final confirmation / agreement that Planning Condition No 10 concerning building external lighting is met.	Yes	Design
M02.1	Confirmation that there are no road / highway lighting changes related to IFA 2 at final detailed design.	Yes	Closed
M03.1	Confirmation that the final converter station building cladding design is as per the design specifications.	Yes	Design
M04.1	The final version of the noise report -1JNL575900 "Audible Noise - Assessment for Planning Application" [25] to be issued.	Yes	Closed
M04.2	Confirmation that the noise emissions from the IFA 2 facility during operation meet predictions in the noise report [25].	Yes	Testing
M04.3	Final confirmation / agreement that Planning Condition No 11 and legal agreements concerning noise emissions are met.	Yes	Testing
M05.1	RCAM to notify updates on IFA 2 site activities to airport users and tenants through NOTAMs over the construction and operational periods.	Yes	Management
M05.2	NG has a process in place to provide regular updates on IFA 2 site activities to RCAM over the construction and operational periods.	Yes	Management
M08.1	Confirmation that choice of trees for landscaping is in accordance with RCAM tree schedule.	Yes	Closed
M08.2	FBC has a process in place to manage vegetation growth.	Yes	Management
M11.1	RCAM has a Bird Hazard Management process in place updated for IFA 2.	Yes	Management
M11.2	RCAM, wildlife experts and planning team agree on plans for water features in the landscaping design in the context of bird hazard management.	Yes	Closed
M12.1	Safe means of access to building roof and guttering for clearing bird nests.	Yes	Design
M13.1	Detail of roof, including any bird deterrent measures, to be confirmed in the detailed design.	Yes	Design
M16A.1	FISO radios to be tested prior to IFA 2 and when IFA 2 energised to identify any dead spots.	Yes	Testing
M16A.2	RCAM has procedures in place to manage any radio dead spots identified.	Yes	Management
M16B.1	Survey carried out prior to IFA 2 and when IFA 2 energised to identify any dead spots affecting emergency services radios.	Yes	Testing
M18.1	Start of operations advised by RCAM to airfield users through email.	Yes	Management

No	Dependency	Constraint on IFA2	Status
M19A.1	Testing completed that demonstrates compliance with electro-magnetic field and compass deviation limits.	Yes	Testing
M19A.2	Final confirmation / agreement that Planning Condition No 48 and legal agreements concerning electro-magnetic fields are met.	Yes	Testing
M19A.3	Compass base confirmed as implemented with all signage, airfield markings and instructions in place before IFA 2 is energised.	Yes	Testing
M20.1	Pre-flight check area confirmed as implemented with all signage, airfield markings and instructions in place before IFA 2 is energised.	Yes	Design
M24.1	Procedure implemented before FISO introduced that retains the existing rule regarding only authorised vehicles allowed airside.	No	Management
M26.1	Testing completed that demonstrates acceptable RFI emissions.	Yes	Testing
M26.2	Final confirmation / agreement that Planning Condition No 14 and legal agreements concerning RFI emissions are met.	Yes	Testing
M27.1	FBC impose the requirements for testing by MCA under the legal agreements for MEOSAR and compliance confirmed.	No	Testing
M28.1	Detailed construction method statement and detailed scheme with cable arrangements in place.	Yes	Management
M28.2	Monitoring of electro-magnetic fields once operational to confirm that planning conditions are met.	Yes	Testing
M28.3	RCAM submission under CAP 791 “Procedures for Changes to Aerodromes” incorporating IFA 2 and CAA endorsement in place.	Yes	Management
M29.1	FBC impose the requirements for testing by NATS under the legal agreements for radar and compliance confirmed.	No	Testing
M30.1	Preliminary impressed voltage assessment for cables at Daedalus finalised and plans implemented.	Yes	Design
M31. 1	RCAM has procedures and controls in place for UAVs, before UAVs permitted to fly at Solent Airport.	No	Management
M32.1	Detailed design for the fire protection / suppression systems complete and as per the system description.	Yes	Closed
M32.2	Confirmation that fire protection / suppression system in place is as per the detailed design.	Yes	Testing
M34.1	RCAM has procedures for FISO in place.	No	Management
M37.1	Threat assessment for the Airport updated for IFA2 and measures in place to manage threats as required.	Yes	Management
M40.1	The interface between the AGL wiring layout and the HV cable design to be checked for touch potential / impressed voltage hazards and suitable mitigation implemented as necessary.	No	Design
M43.1	Safety step and touch voltage study for the converter building issued and plans implemented.	Yes	Design

6 SAFETY OBJECTIVES

CAP 760 [4] defines Safety Objectives as "the definition of a hazard together with its target maximum rate of occurrence. A goal or target that, where achieved, demonstrates that a tolerable level of safety is being, or will be achieved for the hazard concerned."

This safety justification is considering the change being introduced to Solent Airport through the introduction of IFA 2 and identifies the potential hazards and risks that may have an impact on the safety of aerodrome operations or air traffic services (ATS). The hazard identification and risk assessment process has followed a systematic FHA approach that covers the Seven Steps for risk assessment in CAP 760 [4] as described in Section 2.

Risk is a combination of the likelihood of occurrence and the severity of the consequences of a hazard. Severity and likelihood classifications from Solent Airport's SMS [11] were used, which are identical to those of CAP 760 [4], but also include Solent Airport's processes for managing safety risk. Both severity and likelihoods have been assigned to most of the hazards in the Hazard Log. At the time of the FHA the mitigation measures were evolving, hence the likelihood set for most hazards is a target and the mitigation evidence is the means of demonstrating that this target is met.

The hazards identified from the FHA that has been carried out together with the likelihood targets to be demonstrated are summarised below, listing hazards from highest to lowest consequence severity.

Severity Classification (CAP 760)	Definition	Hazards in this Category	Target Likelihood
"Accident"	Accident - as defined in Council Directive 94/56/EC1 for air traffic services. Also includes loss of or substantial damage to major aerodrome facilities. Serious injury or death of multiple staff/ members of public at the aerodrome.	None	N/A
"Serious Incident"	Serious Incident - as defined in Council Directive 94/56/EC1 for air traffic services. For the aerodrome, an event where an accident nearly occurs. No safety barriers remaining. The outcome is not under control and could very likely lead to an accident. Damage to major aerodrome facilities. Serious injury to staff/members of public at the aerodrome.	HAZ20 - High 50Hz impressed voltages or touch potentials due to LV cabling or fencing.	To be eliminated by the design.
"Major Incident"	A major incident associated with the operation of an aircraft, in which safety of aircraft may have been compromised, having led to a near collision between aircraft, with ground or obstacles. A large reduction in safety margins. The outcome is controllable by use of existing	None	N/A

Severity Classification (CAP 760)	Definition	Hazards in this Category	Target Likelihood
	emergency or non-normal procedures and/or emergency equipment. The safety barriers are very few approaching none. Minor injury to occupants of the aircraft or staff/members of public at the aerodrome. Minor damage to aircraft or major aerodrome facilities may occur.		
"Significant Incident"	Significant incident involving circumstances indicating that an accident, a serious or major incident could have occurred, if the risk had not been managed within safety margins, or if another aircraft had been in the vicinity. A significant reduction in safety margins but several safety barriers remain to prevent an accident. Reduced ability of the flight crew or air traffic control to cope with the increase in workload as a result of the conditions impairing their efficiency. Only on rare occasions can the occurrence develop into an accident. Nuisance to occupants of the aircraft or staff/members of public at the aerodrome.	HAZ01: Distraction of aircrew; HAZ02: Wind impact, caused by building (turbulence and unexpected changes in wind patterns, wind shear and so on); HAZ03: Bird strike; HAZ10: Distraction of control tower staff; HAZ11: Impaired ground to ground communications; HAZ17: Terrorist attack on IFA2; HAZ18: Exposure of public and workers to excessive magnetic fields; HAZ19: Incorrect magnetic compass reading; HAZ21: Loss of control of Unmanned Aerial Vehicle (UAV); HAZ22: Fire and smoke; HAZ24: Incorrect ground lighting intensity; and HAZ25: Wrong or no altimeter reading.	Remote: Unlikely to occur during the total operational life of the system. 10^{-5} to 10^{-7} per hour. Once in 10 years to once in 1000 years. (or better)
Not Assigned		HAZ26: Unknown effect on MCA operations; HAZ27: Unknown effects on Britten-Norman operations; and HAZ28: Unknown effect of NATS operations.	These hazards concern the interface of IFA 2 with third partly systems. Risks are subject to the third-party safety management system and are not ranked here. The objective here is to demonstrate with the highest level of confidence that there are no adverse impacts that would impact

Severity Classification (CAP 760)	Definition	Hazards in this Category	Target Likelihood
			the third-party system from introducing the IFA 2 facility.

7 SAFETY REQUIREMENT DERIVATION

Step 6 of the CAP 760 Seven Steps to Risk Assessment covers derivation of safety requirements. The risk mitigation measures that are necessary for the system to meet the safety criteria are referred to as Safety Requirements, and must be clearly documented. These safety requirements must be met before putting the system into operational service.

Step 7 of the CAP 760 process "claims, arguments and evidence that the safety requirements have been met and documenting this in a safety case" then addresses the arguments and evidence required to show that each safety requirement has been satisfied. However, this step can only be fulfilled in respect of the IFA2 facility and within the limits of the equipment and infrastructure stated on the agreed Masterplan [7].

The criticality of a safety requirement and the confidence level of assurance necessary, depends on the risk. The more likely and more severe the consequences then a higher level of assurance is required to provide confidence that the safety requirement is met.

Safety requirements have been derived through the FHA in the form of the mitigation measures required to close out the hazards. The hazard log tracks all the hazards, the risk assessment and the risk mitigation measures for which assurance is necessary. The evidence providing the assurance is being collated through the risk mitigation plan as described in [3].

Some of the key safety requirements are formalised as constraints through planning conditions and the legal covenants in the Converter Station Lease. Two of the key planning conditions which concern radio frequency interference and electromagnetic field emissions are highlighted below. Other relevant conditions and the legal covenants concern noise emissions and external lighting.

- "Planning Condition 14 - No development relating to the erection of the converter station buildings shall take place until details setting out how the converter station buildings will be designed and implemented to ensure that any electromagnetic disturbance arising from the use of the site does not prevent radio and telecommunications equipment or other equipment outside the site from operating as intended, has been submitted to and approved in writing by the local planning authority. The development shall be undertaken strictly in accordance with the approved details. REASON: To prevent radio frequency interference to users of surrounding land and buildings".
- "Planning Condition 48 - No development in relation to the Installation of cables on Daedalus Airfield shall take place until details of the way in which the cables will be arranged below ground along with the depth at which the cables will be laid has been submitted to and approved by the local planning authority in writing to the achieve the following: - a)Alternating Current magnetic fields directly above the cables not more than 10 micro tesla when measured at ground level at each taxi-way crossing of the cables; b) Direct Current magnetic fields directly above the cables not more than 10 micro tesla when measured 1.5 metres above ground level at each taxi-way crossing of the cables; c) compass deviation not more than 1 degree when 12 metres or more away from Direct current cables, measured at 1.5 m above ground level at each taxi-way crossing of the cables. The installation of the cables on Daedalus Airfield shall be undertaken in accordance with the approved details. REASON - To ensure Alternating and Direct Current cables at the site will not materially impact upon aviation use and safety at the site".

8 SAFETY REQUIREMENTS

As explained above, safety requirements are generated from the hazard identification and risk assessment process. CAP 760 [4] defines a safety requirement as a:

"*Specified criteria of a system that is necessary in order to reduce the risk of an accident or incident to an acceptable level. Also a requirement that helps achieve a Safety Objective.*"

For example a safety requirement may be set for an engineered design item to be compliant with a standard or to have certain properties or design features in order to ensure that the risks are acceptable, as assessed through hazard identification and risk assessment.

Through the FHA, mitigation measures have been set which once validated, will ensure that risks associated with the IFA 2 facility at Solent Airport are acceptable. These mitigation measures therefore form safety requirements.

CAP 760 [4] also sets guidelines for the minimum confidence levels for the validation evidence showing compliance with the safety requirements. This is based on the risk associated with the corresponding hazard.

8.1 Guidelines on Acceptable Levels of Evidence (CAP 760)

CAP 760 [4] includes guidance on the level of evidence required, which for convenience is summarised below:

High confidence evidence:

- uncertainties or assumptions are minimised, erring on the side of pessimism i.e. the worst is assumed;
- substantial and diverse forms of evidence should be used e.g. testing, field service and analytical evidence;
- for equipment and systems supplied by third parties, the cooperation of the supplier is essential because design specifications, manufacturing specifications, design test results and quality assurance data is typically required to support claims and arguments;
- where possible evidence should be subjected to independent scrutiny through, rigorous internal or external quality assurance inspection or audit.

Medium confidence evidence

- uncertainties or assumptions are minimised or err on the side of optimism i.e. the worst may not be assumed.
- the quantity of evidence should be balanced to the risk.
- at least two diverse forms of evidence should be used e.g. testing, field service and analytical evidence;
- for equipment and systems supplied by third parties, the cooperation of the supplier may be required because design specifications, manufacturing specifications, design test results and quality assurance data may be required to support claims and arguments.
- where possible, evidence should be subjected to independent scrutiny through internal or external quality assurance inspection or audit, however a sampling approach to the audit may be used.

Low confidence evidence

- uncertainties or assumptions are minimised or err on the side of optimism i.e. the worst may not be assumed.
- the quantity of evidence may be low.
- only one form of evidence may be required, however it is recommended to use more than one form of evidence.
- for equipment and systems supplied by third parties, design and manufacturing evidence may not be required, unless it can be provided cost effectively. However good working practice will still need to be demonstrated so some information from the supplier organizations may be required.
- the evidence should be subjected to scrutiny through inspection or audit, however a sampling approach may be used.

8.2 Risk Mitigation Measures and Confidence Level of Assurance

Appendix C lists the safety requirements which are derived from the hazard log (Addendum 1 to this report) and the risk mitigation measures required to control risks. The safety requirements are numbered based on the mitigation measures defined in the hazard log (Addendum 1 to this report). The table in Appendix C also defines the minimum confidence level required from the mitigation evidence demonstrating compliance, which is generally based on the risk categories assigned to the relevant hazards in the hazard log.

Appendix C also shows the traceability to the dependencies listed in Section 5. Dependencies are stated where all the evidence to demonstrate compliance with the requirement is not currently available.

Liaison has taken place with third party agencies to fully understand any potential hazards and risks (both business and safety risks) related to the interfaces with IFA 2 and the mitigation measures required. Risk rankings however have not been assigned to these hazards. This is because these hazards are subject to the safety management system of the third-party organisation as well as the Airport SMS, including their criteria for tolerable risk (both business and safety risks). It is thus not considered to be appropriate to assign risk rankings to them. For these hazards, a pessimistic approach has been adopted in defining the evidence required, with the objective of demonstrating with the highest level of confidence (based on CAP 760 guidelines), that there are no adverse impacts that would impact the third-party system from introducing the IFA 2 facility at Solent Airport.

9 SYSTEM ASSURANCE

This section of the report describes the process followed and analysis carried out within the defined scope to provide assurance that the potential safety risks posed by the IFA2 facility upon Solent Airport's operations, systems and equipment can be appropriately managed and are acceptable as defined in CAP 760 [4].

The core hazards associated with IFA 2 were identified very early during the planning stage for IFA 2. These are.

- Hazards to be considered as part of aerodrome safeguarding as identified in CAP 738 [1] include any potential impacts on airport operations (e.g. obstacle limitation surfaces, lighting, and bird hazard management).
- Electromagnetic field (EMF) and radio-frequency interference (RFI) emissions from the converter station, the equipment and HV cables with potential impact on airport and aircraft operation.
- Wind flow effects caused by the IFA 2 building and potential safety impact on flying operations.

As described in Section 3, following this initial assessment, formal FHA was completed to identify all hazards associated with IFA 2 that could cause an increase in risk on airport and aircraft operations as well any other foreseeable hazards / risks. Hazards and risks resulting from these studies are recorded in the hazard log.

The development of the assurance evidence also commenced at a very early stage in the project. This focussed initially on high level analysis and generic calculations and technical assessment which have now significantly developed as the project has progressed. The detail design of IFA 2 is now well under way and a large body of assurance evidence has evolved. There are plans in place to implement an extensive programme testing to validate the analysis and calculations and to demonstrate that safety requirements, planning conditions and legal requirements are met. The body of assurance evidence discussed below falls into the following categories:

- Analysis, calculations and assessment.
- Wind tunnel testing.
- Testing and trials.
- Independent Scrutiny.

Hazard review meetings have taken place as the project lifecycle has progressed to collate the evidence, as follows:

- Hazard Review Meeting on the 25/5/17 (attended by RCAM, NG, FBC, Arcadis).
- Hazard Review Meeting 27/6/17 (attended by NG, Arcadis).
- Review of mitigation plan 21/7/17 (attended by FBC, Arcadis).
- Review of MCA hazards 21/7/17 (attended by MCA, RCA, Arcadis).
- Hazard Review Meeting 10/8/17 (attended by RCAM, NG, FBC, Arcadis).
- Review of Hazard Log Actions 23/8/17 (attended by FBC, NG, Arcadis).
- Hazard Review Meeting 1/11/17 (attended by FBC, NG, Arcadis)

Liaison with the converter station Main Contractor (ABB) and HV cable contractor (Prysmian) has taken place through conference calls and NG/contractor liaison meetings as the design has developed.

There is a regular working group meeting held involving FBC and NG and NG has set up a weekly progress meeting to monitor progress in implementing the risk control measures that provide safety assurance evidence.

9.1 Analysis Assessment and Calculations.

The following sections provide an overview of the analysis, technical assessment and calculations that have been completed focussing on the main potential hazards associated with IFA 2 i.e. EMF/RFI emissions, aerodrome safeguarding and wind flow effects.

9.1.1 Electrical Hazards, including EMF / RFI Emissions

During 2016, analysis in [12], [13] and [14] was commissioned by National Grid to investigate the possible effects of EMF and RFI that the converter station and cabling might present at Solent Airport. These preliminary studies were undertaken at the planning stage, when a detailed design of the converter station was not available, hence they included assumptions relating to the design and specifications of the converter station.

This work concluded that there is a very low probability of interference to airport communication systems, potential future navigation systems (e.g. ILS) and no credible safety risk to aircraft equipment. The preliminary analysis of EMF / RFI effects that supported this view, predicted that the overall impact is negligible, the potential exists however for some small localised effects which could be mitigated as follows:

- A possible risk of interference to aircraft receivers operating in areas of the airport close to the converter station had been predicted. However, the strength of the main signal compared to any electromagnetic radiation from the converter station is such that it is not expected to be disturbed.
- Some possible localised deviation of heading indications on compass systems and magnetometers due to DC and magnetic fields, mainly for aircraft on the ground close to the HV cables. However, the deviation predicted was small and indications quickly returned to the correct indications once a short distance away from the localised area;
- Some potential for interference to local high-frequency, medium-frequency and low-frequency radios, but with limited effects and only for radios very close to the converter station.
- Whilst not presenting any safety hazard, an initial assessment of possible shadowing of terrestrial television transmissions for the Rowridge transmitter on the Isle of Wight in [12] was undertaken. This concluded that the risk of any shadowing effects causing interference is low.

Since this initial analysis further, more detailed assessment of EMF / RFI effects has been undertaken which has refined the initial findings and substantiated that effects (if any) would be very small and localised. This includes:

- Further RFI assessment for IFA2 [15];
- Aircraft Magnetic Field Susceptibility Assessment [16];
- Islander and Defender Magnetic Field Susceptibility [17], [18] and [19];
- Further TV and Radio Reception Studies [20] and [21];
- An RF Survey Test Report for the IFA2 Development at Solent Airport [22];
- A Radio and Telecomms Interference and EMF assessment [35],
- A High Frequency (HF) filter performance study [41].
- Surveys assessing potential impact to mobile phone networks and emergency services radios [43] and [44].

The assessments in [22], [35] and [41] have considered the limits for the level of RFI emissions that can be tolerated from the converter station, based on a report by the Council on Large Electric Systems (Cigré), Report 391 [24]. The most recent assessments undertaken by the designer of the converter station (ABB) document [41] expect RFI emission levels to be at or below background radiation levels at 30 m from the converter station for frequencies < 10 MHz. For frequencies >10MHz, the emission levels are expected to be even lower.

The Arcadis technical assessment in [3] carried out an independent peer review of the analysis available in February 2017 and also identified a few areas where further technical assessment may be necessary to supplement the evidence required by the hazard log. Addendum 2 to this safety justification document provides further technical assessment to complete this evidence including:

- Independent peer review of the more recent analysis in [21], [22] and [35].
- Further consideration of potential risks related to EMF / RFI effects on the MCA equipment and operations.

- Further consideration of potential risks related to EMF / RFI effects should UAV operations or possible improvements to the navigation environment (including an instrument landing capability) be introduced to Solent Airport in the future.

With the detail design now developing, the Main Contractors are planning further analysis and calculations to demonstrate that some of the potential hazards relating to impressed voltages and touch potentials are eliminated. ABB has completed a preliminary assessment of touch voltages [42] for the converter station and Prysmian (the HV cable contractor) has undertaken a "preliminary impressed voltage assessment for cables at Daedalus" [31], stating their intentions for further assessment of earth potential rise during fault conditions and impressed voltages due to magnetic coupling.

9.1.2 Aerodrome Safeguarding

In 2016, Arcadis carried out an assessment of aerodrome safeguarding in relation to the IFA2 Interconnector Facility in [2] based on the assumptions at that time concerning the converter station design. The primary purpose of aerodrome safeguarding is to protect aircraft from obstacles and obstructions whilst operating in the vicinity of airports. With regard to airports the purpose is to take measures to ensure the safety of aircraft, and thereby the passengers and crews aboard them, while taking-off or landing, or while flying in the vicinity of an aerodrome. Thus, measures are taken to prevent aircraft colliding with each other, or with fixed and mobile objects, while manoeuvring on the ground, while taking-off or landing, or while flying in the vicinity of the aerodrome. Measures are also taken to prevent interference with, or distortion of the guidance given, or indications from visual aids, radio aids to air navigation and meteorological instruments. It also includes the measures taken to reduce the risk of aircraft experiencing a bird strike, particularly during take-off and landing.

Overall, the plans for the IFA2 converter station were found not to conflict with aerodrome safeguarding criteria. A few minor issues were identified to consider when developing the final plans and detailed design, but the general principle of the development to date was considered to be acceptable and any safety risks were expected to be acceptable in accordance with CAP 760 [4].

- A flat or low-pitched roof on the converter station could attract birds; however, the site is within the Airport boundary and will be well maintained and inspected with a bird hazard management plan in place. The roof design is now confirmed as pitched and dependency M12.1 captures the need to specify the access arrangements for maintenance.
- Lighting at the converter station should follow the Airport Operators Association advice to ensure that the operation of the airfield is not adversely impacted at night. This is captured in dependency M01.2.

The safeguarding assessment in [2] has been updated in Addendum 2 to this report with the detailed design information now available and it is confirmed that there are no conflicts with aerodrome safeguarding. Recommendations from the safeguarding assessment are captured as dependencies.

9.1.3 Wind flow effects

A preliminary qualitative assessment of the likely impact of the IFA 2 converter station on wind flow encountered at Solent Airport was commissioned by National Grid in [21]. This predicted that any effects on wind flow from the converter station were small and risks to aircraft taking off or landing at Solent Airport is acceptable. Arcadis carried out a peer review of this work and performed independent analysis using computational fluid dynamic analysis in [2] and [6]. This work was repeated in [4] for the revised profile of the IFA2 converter station and modelled the landscaping.

The analysis in [4] modelled the converter station buildings and included details of the landscaping in the immediate vicinity of the of the building. This work concluded that effects of the buildings on the wind flow were small; the highest relative increase in wind speed onto the main runway caused by the building being a maximum of 39% at a height of 10m above the ground in the wind speed cases of 10m/s. At low wind speeds like 5m/s, the building has little to no impact on the main runway at the wind direction of 70º EoN. Similarly, at wind speeds more than 5m/s that are coming from the direction of the building onto the main runway, there is no significant building wake impact at 20m or more above the ground.

Analysis in Addendum 2 to this report, includes the converter station together with more of the immediate surroundings, in particular, the Faraday Business Park. This assumed estimated dimensions of the building

based on the expected profiles of the future building. The purpose of this analysis is to examine any possible interaction effects between the converter station and other buildings that could impact the wind flow on the runway. This analysis concludes that the future faraday business park buildings both act as a shield to the converter station and have the overriding impact on the runway. The worst-case angle changes from 70^0 to 90^0 EoN. At this angle, the buildings nearest the runway produce three tails of faster winds, which covers the biggest area on the main runway compared to the other angles. The highest relative increase in wind speed onto the main runway caused is a maximum of 29% at a height of 5m above the ground.

It is recommended that the configuration of these “frontline” buildings nearest the runway is reviewed to minimise any wind flow effects.

It was confirmed at the hazard identification and risk assessment study reported in [8] and [9] that localised changes in wind patterns are easily managed and that pilots quickly become familiar with any changes in wind patterns and adapt their flying accordingly through good airmanship.

9.2 Wind Tunnel Testing

Since the completion of the wind flow analysis in Addendum 2, NG has commissioned additional work to simulate the wind flow around the converter station within a wind tunnel. This work is reported in [40]. The wind tunnel testing considered the converter station and the surrounding landscape together with the some of the adjacent hangars which are part of the Faraday Business Park currently under construction.

The wind tunnel testing provides an opportunity to compare the results with the CFD wind flow modelling and to give reassurance of the reliability and accuracy of the wind analysis results, as well as providing further confidence in the proposed design. A further CFD wind flow analysis has therefore been carried out to model the same building configuration within the Faraday Business Park as in the wind tunnel, and the results have been compared.

Both the wind tunnel testing and the CFD wind flow analysis confirm all previous predictions that the wind flow effects are small and localised.

The comparison of the detailed results shows that:

- the wind speeds predicted by the CFD wind flow analysis are generally higher compared to the wind tunnel testing. This could be due to a number of reasons, such as the turbulence model used, or the surface roughness in the model;
- there is a strong correlation between the two sets of results where the discrepancy is within a 15% margin, the CFD wind flow analysis being generally on the pessimistic side;
- the general trends of the CFD wind flow analysis results are in line with wind tunnel results, in respect of wind speed increases in relation to the height from ground level.

9.3 Testing and Trials

9.3.1 EMF Testing for the HV AC and HVDC Cables

Testing is planned both during the pre-construction phase and during the testing and commissioning of IFA 2 post-construction. This is aimed at valdating computer models and ultimately at demonstrating compliance with the relevant planning conditions and legal agreements concerning EMF emissions.

The analysis described in Section 9.1.1 uses computer software models to predict the electro-magnetic fields (produced by the HVAC cables) and compass deviation (produced by the HVDC cables) based on the configurations and currents proposed for the AC and DC circuits. This predicts that any EMF effects from the HV cables (both AC and DC) are very small and localised. Initial testing, reported in [45] has now been completed to provide confidence to all stakeholders that the calculations do indeed yield the correct results for the fields produced by cables, that the planning conditions and legal agreements concerning EMF emissions will be met and therefore that it is appropriate for IFA2 to proceed with the installation of the cables. Additionally, testing reported in [46] has given confidence regarding the calculations predicting that there are no adverse impacts from EMF emissions on aircraft and aircraft systems.

The cable tests described in [45] were performed in three stages as follows:

1. **Seven tests on five existing National Grid cables**. These are designed to validate the general principle that the calculations are capable of predicting measured fields in a range of circumstances.
2. **A test on the design of cables proposed at Solent Airport**, conducted on samples of these cables laid out at ground level at Prysmian's test facility at Bishopstoke. These are designed to validate that the calculations predict the correct field for the design of cables proposed for Daedalus, but do not reproduce the correct depth of burial, as the cables are laid on the surface.
3. **A test on a length of the cables buried in the proposed configuration at Solent Airport**. These are designed to validate calculations of field for the full geometry of the actual cables, including the approximate depth of burial.

The tests in 2 and 3 above simulated the maximum electro-magnetic field that that would be generated by the final cables. IFA2 is likely to include screening of the magnetic fields where the cables cross the taxiways, partly to ensure that the planning conditions are met with a comfortable margin. None of the existing National Grid cables have any screening of the magnetic field. The test at Prysmian included both screened and unscreened cables. The test at Daedalus was for screened cables.

The main findings regarding the calculation of electromagnetic fields and screening are summarised below:

- Calculations of AC and DC magnetic fields and of compass deviation do indeed predict the actual fields that are produced with considerable accuracy.
- IFA2 will be designed with a specified depth of burial such that, even allowing for any potential variations in the placing of the HV cables, the electromagnetic fields produced will be compliant with the planning conditions.
- AC screening of the type and specific design proposed ("passive loop screening") reduces the magnetic fields by a factor of about two.
- DC screening of the type proposed (a ferromagnetic screening tube) reduces the magnetic fields and the compass deviation by a factor of at least two and possibly more.
- For the final IFA2 cables, the screening material for the DC screening will have been developed further, and it is anticipated that the screening factor will be greater than was observed in these tests.

The testing reported in [46] used the length of cable buried at Solent Airport to assess the impact on actual aircraft and aircraft systems provided by third party organisations for use in the tests. The aircraft tested, which included a helicopter and a drone (UAV), were located directly above the buried cable and effects were measured through the instrumentation readings. All representatives from the organisations involved reported that the aircraft systems tested during the trial functioned as normal and no anomalies were observed on any of the aircraft avionics during the trials. Compass deviation on magnetic compasses was noted to be between 2 and 3 degrees. Fluxgate compasses exhibited negligible deviation".

Further EMF testing of the cables is planned post-construction, during the testing and commissioning period for IFA 2 in order to demonstrate compliance with the planning conditions and legal agreements for the as-built facility.

9.3.2 RFI Testing for the Converter Station.

During the IFA 2 testing and commissioning phase, when the station is ready to be energised, measurements of disturbance levels around the station will be performed in order to verify compliance with requirements regarding emissions and in particular the relevant planning conditions and legal agreements.

Measurements of background RF will be taken at specified locations with IFA 2 de-energised and energised with full load respectively. These measurements will be compared with limits based on the standard CIGRE TB391 [24] in order to validate the predictions in [35] and [44] and to demonstrate compliance with the planning conditions and the legal agreements.

9.3.3 Other testing

Other testing planned to complete the mitigation evidence is as follows:

- Noise measurements during testing and commissioning of the converter station to confirm predictions in the noise report [23] and to comply with planning and landlord requirements.
- Testing of FISO radios before and after IFA 2 is energised. This is subject to RCAM's programme for introducing the radios and is not a constraint on the IFA 2 programme.
- Testing of third party installations i.e. the MCA MEOSAR satellite station and the NATS radio as part of the legal agreements for the MCA / NATS planning process. This process is managed by FBC as planning authority in accordance to their programme and is not a constraint on the IFA 2 programme.

9.4 Independent Scrutiny

As discussed above, in 2016 and 207, Arcadis were commissioned by NG together with FBC to carry out an independent peer review of the analysis for EMI and RFI effects, also the initial analysis of wind effects in [21]. These peer reviews are reported in [2] and [3]. Recommendations were raised in these reports to develop the analysis as the design of IFA 2 progressed in order to provide a robust safety and technical justification for EMF and RFI effects and these recommendations have either been addressed or are planned to be addressed, all safety related actions still to be complete being recorded as dependencies.

FBC as planning authority commissioned their own peer review of the EMF / RFI analysis discussed in 9.1 above. The TÜV-SÜD report [24] is a peer review of documents relating to EMF and RFI effects arising from the IFA2 facility, including a peer - review of a draft version of the Arcadis report that was eventually issued in [2].

10 LIMITATIONS AND SHORTCOMINGS

In accordance with CAP 760 [4] guidelines, a safety justification should state clearly:

- any deficiencies found with the system;
- any safety objectives or requirements that have only partially been proven, have failed to be proven or have insufficient evidence to provide the required level of confidence (except those requirements where further validation work is already planned);
- any counter evidence for the system i.e. any evidence that demonstrates that a requirement is not met.
- any assumptions for the system for which there is no, or insufficient validation or rationale.

This document demonstrates that in the context of providing a safety justification for The IFA2 facility at Solent Airport there are no limitations or shortcomings. All further validation work that is required to demonstrate safety requirements is recorded as dependencies and is planned in the project programme. All assumptions made require confirmation however they all have a strong rationale behind them.

11 ONGOING MONITORING

This section identifies those safety requirements that require ongoing monitoring.

Assumptions in Section 5.1 require confirmatory checks to ensure they remain valid.

The closure of the dependencies in Section 5.2 require ongoing monitoring over the project lifecycle in order to complete the safety justification. Some of these simply requiring confirmatory checks on the final detail design, others require validation evidence through testing. Some of the dependencies are subject to other safety management programmes and are not constraints on the IFA 2 programme.

Safety requirements related to operational controls will require ongoing monitoring beyond the IFA 2 design and construction programme. These controls are normal airport procedures; hence it is expected that this will be managed through the RCAM safety management system [11]. The RCAM safety management system may require update to include IFA 2 however actions are raised for this where necessary as dependencies in 5.2.

12 CONCLUSIONS

This safety justification presents the body of evidence which collectively, once all evidence is available, will demonstrate the safety of the IFA 2 facility within the boundaries of Solent Airport. The scope considers hazards related to IFA 2 at Solent Airport; there is no consideration of other hazards to the airport. This safety justification does not provide a safety case for the airport itself, however the information in this safety justification may be used by RCAM as Airport Operator to update the airport safety management system [11] and to support a submission to the CAA under CAP 791 [5]. CAP 791 is the process to notify the CAA of changes at an aerodrome, covering both infrastructure and management system changes.

Some of the key safety requirements and objectives for the IFA 2 facility are formalised as constraints through planning conditions and the legal covenants in the Converter Station Lease and formal agreement of these conditions is a vital part of the assurance evidence.

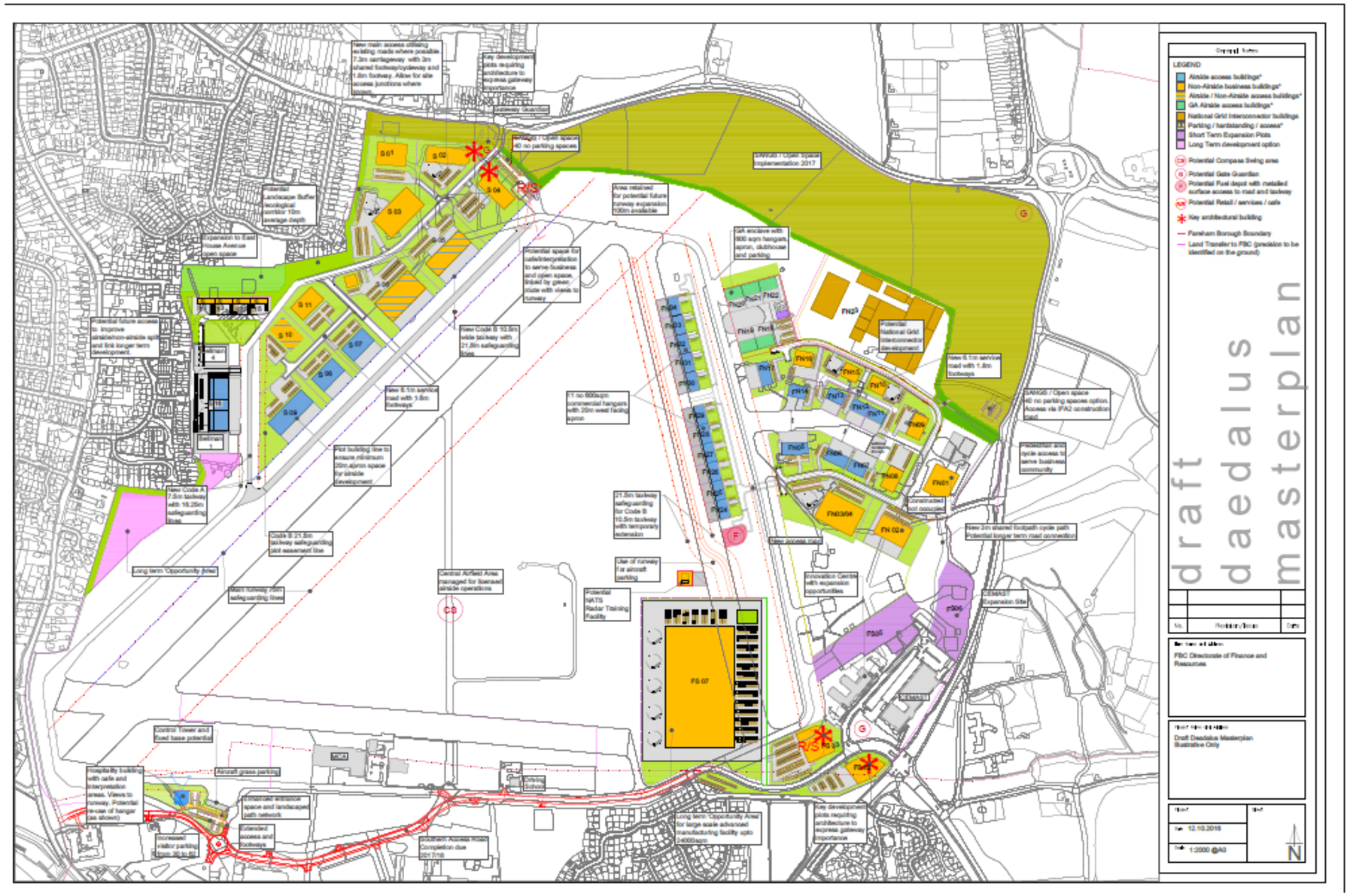
At this stage in the project (part way through the detailed design process), the body of evidence which forms the safety justification for IFA 2 is progressively evolving. As for any major project, the assurance evidence will continue to develop over the project lifecycle. Consistent with the stage in the project lifecycle, a robust base of analysis, calculations and assessment exists which establishes a high level of confidence that safety objectives and safety requirements will be met and that risks related to IFA 2 are acceptable as defined in CAP 760 [4]. Initial testing has been completed simulating the maximum electromagnetic fields that would be generated by the HV DC and AC cables. This has successfully demonstrated the accuracy of the calculations used to generate the EMF analysis and gives confidence that the requirements of planning condition 48 (concerning EMF emissions) will be met. The testing has also validated predictions that effects on aircraft systems are negligible.

The focus of the assurance evidence from this point will be the extensive programme of testing following energisation of the facility to provide the validation evidence for the as-built facility and to demonstrate compliance with planning conditions and requirements from legal agreements.

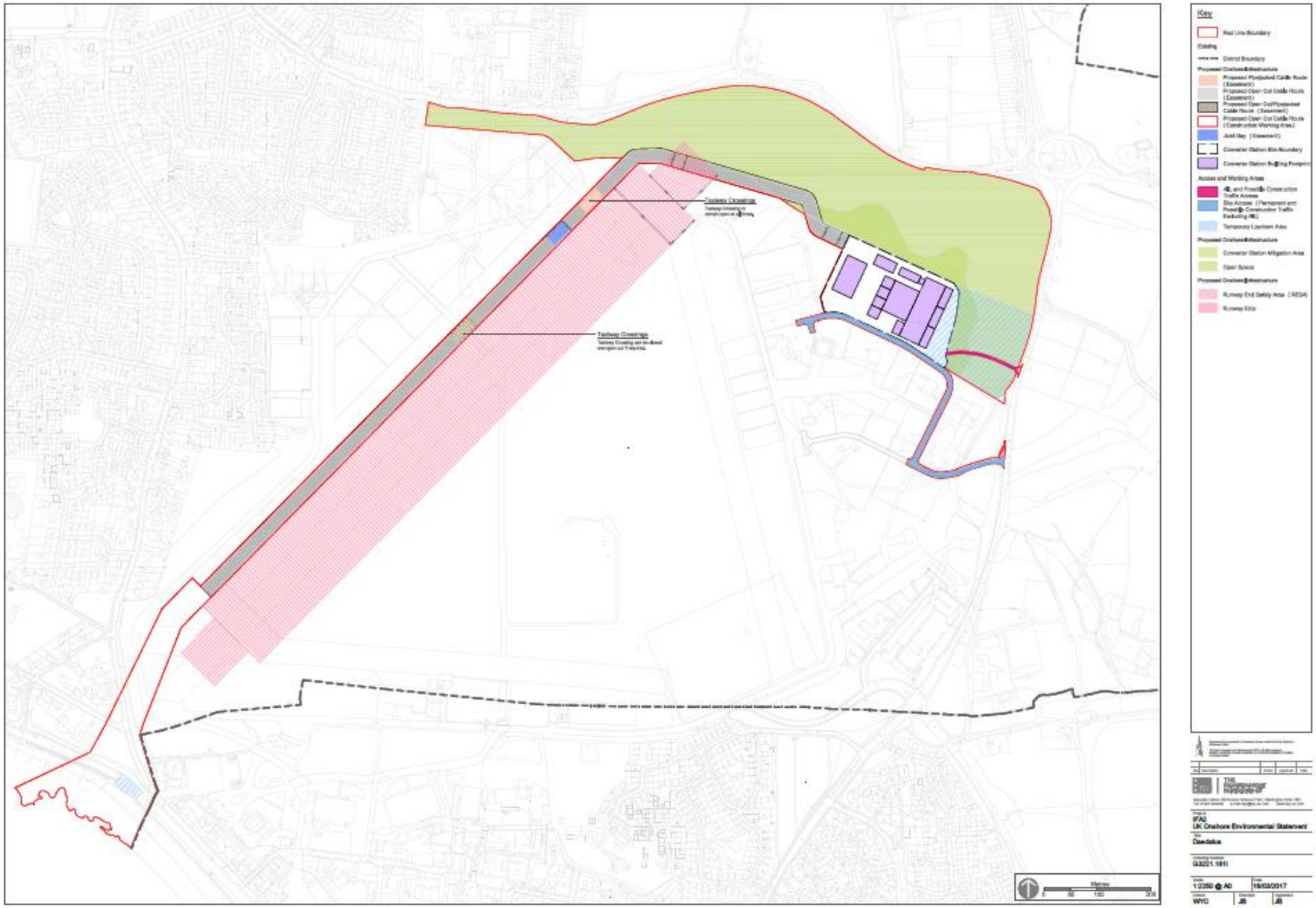
The main conclusions of the safety justification at this stage are as follows:

- Overall, the current state of the evidence available provides a high level of confidence that potential safety risks posed by IFA2 should not adversely impact the airport's current operations or the known planned developments. Once all the dependencies stated in this report are complete, the demonstration that risks posed by IFA2 are acceptable and ALARP as defined in CAP 760 [4] will be complete.
- There are no hazards, risks or issues identified which may place unreasonable or impractical constraints on the design of the IFA 2 Facility.
- The body of assurance evidence available and planned is thorough and diverse, including analysis, calculations and assessment, testing, and simulation. Once complete the extent of the evidence will exceed the minimum requirements in CAP 760 [4] for the confidence level required for validation evidence, based on risk.
- The actions to establish the remaining assurance and thus to complete the body of evidence are recorded in the Hazard Log and captured as "dependencies" in this safety justification.

APPENDIX A SOLENT AIRPORT AND SURROUNDING AREA (THE MASTER PLAN)



APPENDIX B CABLE ROUTE



APPENDIX C SAFETY REQUIREMENTS AND EVIDENCE

ID	Safety Requirement	Minimum Confidence level (for evidence)	Assurance Evidence Available	Dependencies (Further Evidence Required)	Status at issue of this safety justification.
M01	Building lighting to be directed downwards, away from flight paths and control tower, and not towards the runway. This requirement is to be included in the design specifications.	Low	IDE 00034 – IFA2 Converter Station External Flood Lighting (for FBC approval) [25] provides details of external flood lighting, including Lux levels.	M01.1 Confirmation of the final IFA 2 external flood lighting design. M01.2 External security lighting design details to be finalised with confirmation that this meets guidelines for lighting near airports in AOA advice note 2 [32] and BS 5489 'Code of Practice for the Design of Road Lighting [30] as appropriate. M01.3 Final confirmation / agreement that Planning Condition No 10 concerning building external lighting is met.	M01.1 and M01.2 is closed M01.3 Subject to minor documentation clarification then this will be closed.
M02	The design of all road lighting to be compliant with BS 5489 [6] Section 12.2: Lighting in the vicinity of aerodromes.	Low	There are no permanent changes to road / highway lighting around the airport due to IFA2. There will be a temporary roadway constructed for construction traffic, but this will be removed and the area landscaped post construction.	M02.1 Confirmation that there are no road / highway lighting changes related to IFA 2 at final detailed design.	No changes to road lighting so closed.
M03	External surfaces of building to be designed not to present a distraction to aircrew.	Low	IKA-0508- Converter Station Reactor Hall 5 Degree Pitch Option Elevations [26] shows details of building cladding colour (blue / grey) with RAL numbers.	M03.1 Confirmation that the final converter station building cladding design is as per the design specifications.	Cladding specification requires planning approval.
M04	Noise levels to be managed to ensure they are not distracting to pilots, particularly glider pilots.	Low	The noise report (1JNL575900 - Audible Noise - Assessment for Planning Application) [23] has been issued in draft	M04.1 The final version of the noise report -1JNL575900 "Audible Noise - Assessment for Planning Application" [25] to be issued. M04.2 Confirmation that the noise emissions from the IFA 2 facility during operation meet predictions in the noise report [25]. M04.3 Final confirmation / agreement that Planning Condition No 11 and legal agreements concerning noise emissions are met	M04.1 – closed for design. M04.2 and M04.3 - closed for design, requires testing / measurement in operation.
M05	Aircrew and airport ground operators to be kept up-to-date with changes and likely effects.	Low	NOTAMs is standard existing process.	M05.1 RCAM to notify updates on IFA 2 site activities to airport users and tenants through NOTAMs over the construction and operational periods. M05.2 NG has a process in place to provide regular updates on IFA 2 site activities to RCAM over the construction and operational periods.	M05.1, M05.2 – requires ongoing management.
M06	Wind assessment to determine the impact of the building on the wind patterns (including consideration of light aircraft and UAVs).	Low	Wind flow assessment completed confirms no significant impact from IFA 2 on the runway. As now, good airmanship is the means of dealing with localised gusts of wind. Addendum 2 includes further wind assessment including other buildings that may interface with IFA2 i.e, the Faraday Business Park). IKA-0508- Converter Station Reactor Hall 5 Degree Pitch Option Elevations has confirmed the pitched roof design. Addendum 2 to this safety justification concludes that there appear to be no gaps in the analysis and no reasons why IFA2 should be unsafe to UAVs. Wind tunnel testing complete in [40] and results used to provide confidence in the CFD analysis is [39]	None	
M07	Publicity and training to include awareness of changes in landscape in relation to wind effects.	Low	NOTAMs is standard existing process.	M05.1 RCAM to notify updates on IFA 2 site activities to airport users and tenants through NOTAMs over the construction and operational periods. M05.2 NG has a process in place to provide regular updates on IFA 2 site activities to RCAM over the construction and operational periods.	M05.1, M05.2 – requires ongoing management.

ID	Safety Requirement	Minimum Confidence level (for evidence)	Assurance Evidence Available	Dependencies (Further Evidence Required)	Status at issue of this safety justification.
M08	Obstacle clearance surfaces to be protected.	Low	Initial and final airport safeguarding assessment completed in the context of IFA 2 finds not significant issues: Schedule of trees appropriate to the airport issued to landscaping team.	M08.1 Confirmation that choice of trees for landscaping is in accordance with RCAM tree schedule. M08.2 FBC has a process in place to manage vegetation growth	
M09	Effects of wind to be kept under review in the case of increased traffic.	Low	Agreed at FHA that increased traffic has no impact on wind effects.	None	
M10	Airmanship provides mitigation.	Low	As now, good airmanship is the means of dealing with localised gusts of wind.	None	
M11	RCAM to ensure an effective bird management strategy.	Low	Existing bird hazard management process in place and reviewed for IFA 2. Schedule of trees appropriate to the airport issued to landscaping team.	M11.1 RCAM has a Bird Hazard Management process in place updated for IFA 2. M08.1 Confirmation that choice of trees for landscaping is in accordance with RCAM tree schedule. M11.2 RCAM, wildlife experts and planning team agree on plans for water features in the landscaping design in the context of bird hazard management. M08.2 FBC has a process to manage vegetation growth.	M11.1, M08.2 – requires ongoing management. M08.1, M011.2 closed.
M12	Building to provide appropriate access for bird management strategy.	Low	IKA-0508- Converter Station Reactor Hall 5 Degree Pitch Option Elevations [26] has confirmed roof the pitched roof design.	M12.1 Safe means of access to building roof and guttering for clearing bird nests.	To be confirmed in the final design.
M13	The building design to discourage a significant increase in the bird activities or detrimental changes in bird behaviour in this area.	Low	IKA-0508- Converter Station Reactor Hall 5 Degree Pitch Option Elevations [26] has confirmed roof the pitched roof design.	M13.1 Detail of roof, including any bird deterrent / management measures, to be confirmed in the detailed design.	To be confirmed in the final design.
M14	RCAM to discuss bird strikes with a wildlife expert and to seek the expert's advice on how to manage the bird activities in this area.	Low	This is part of M11	None	
M15	FBC to consider the risk of bird strike in future landscaping and choice of trees, and so on.	Low	This is part of M11	None	
M16A	If communication (airport comms) dead spots are found, appropriate procedures are to be put in place to manage the resulting risk.	Low	Confirmed that currently there are no communication blackspots.	M16A.1 FISO radios to be tested prior to IFA 2 and when IFA 2 energised to identify any dead spots. M16A.2 RCAM has procedures in place to manage any radio dead spots identified.	M16A.1 – requires testing. M16A.2 – ongoing management.
M16B	If communication (including TV and digital networks) dead spots are found, appropriate procedures are to be put in place to manage the resulting risk.	Low	Assessments of TV and digital networks to evaluate shadowing effects [18] and [19] has found no significant issues.	M16B.1 Survey carried out prior to IFA 2 and when IFA 2 energised to identify any dead spots affecting emergency services radios.	M16B.1 requires testing in operation.
M17	Planning Constraints to limit permitted noise from IFA2 (taking the proposed runway extension into account).	Low	The planning condition is in place – Planning Condition 10	None	
M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.	Low	Standard existing process for communications.	M18.1 Start of operations advised by RCAM to airfield users through email. M05.2 NG has a process to provide regular updates on site activities to RCAM.	M018.1, M05.2 – requires ongoing management.
M19A	RCAM, in collaboration with NG, to confirm that the magnetic fields at the compass base could not credibly lead	Low	Area defined on the Masterplan [7] and compass survey completed.	M19A.1 Testing completed that demonstrates compliance with electro-magnetic field and compass deviation limits.	M19A.1, M19A.2, M19A.3 require testing in operation.

ID	Safety Requirement	Minimum Confidence level (for evidence)	Assurance Evidence Available	Dependencies (Further Evidence Required)	Status at issue of this safety justification.
	to incorrect calibration of magnetic compasses.			M19A.2 Final confirmation / agreement that Planning Condition No 48 and legal agreements concerning electro-magnetic fields are met. M19A.3 Compass base confirmed as implemented with all signage, airfield markings and instructions in place before IFA 2 is energised.	
M19B	RCAM, in collaboration with NG, to confirm that the magnetic fields at the compass base could not credibly lead to incorrect calibration of magnetic compasses.	Low	As M19A.	None	
M20	Pre-flight check area to be assessed for effect of magnetic fields on the setting of aircraft direction indicators.	Low	The pre-flight check area is a B2 Hold Point currently under consideration.	M19A.1 Testing completed that demonstrates compliance with electro-magnetic field and compass deviation limits. M19A.2 Final confirmation / agreement that Planning Condition No 48 and legal agreements concerning electro-magnetic fields are met. M20.1 Pre-flight check area confirmed as implemented with all signage, airfield markings and instructions in place before IFA 2 is energised.	M19A.1, M19A.2 require testing in operation. M20.1 ongoing – pre-flight check area to be defined.
M21	RCAM to promulgate instruction to calibrate magnetic compasses only at compass base.	Low	As M19A.3 and M20.1	None	
M22	General airmanship provides a mitigation because aircrew should quickly identify incorrect calibration by reference to visual landmarks.	Low	Good airmanship is an existing mitigation employed.	None	
M23	RCAM to promulgate instruction to set DIs against magnetic compasses in designated pre-flight check area.	Low	As M19A.3 and M20.1	None	
M24	FIS procedures to take into account the possibility of impairment of ground-ground communications.	Low	Current procedure in place to phone / radio the tower. Only authorised vehicles are allowed airside.	M24.1 Procedure implemented before FISO introduced that retains the existing rule regarding only authorised vehicles allowed airside.	M018.1, M05.2 – requires ongoing management.
M25	If aircraft using radio altimetry are likely to use the airport, the effect of the IFA2 on radio altimetry is to be assessed.	Low	No aircraft with radio altimetry likely as the equipment is being phased out. General assessments and analysis demonstrating no significant effects from RFI and EMF emissions.	None	
M26	LSA RFI assessment concluded that this is not a credible effect.	Low	Analysis of RFI effects on airport and aircraft systems completed demonstrates no significant effects. No plans to introduce ILS, however generic assessment complete.	M26.1 Testing completed that demonstrates acceptable RFI emissions. M26.2 Final confirmation / agreement that Planning Condition No 14 and legal agreements concerning RFI emissions are met.	M26.1, M26.2 require testing in operation.
M27	Liaise with MCA to identify possible hazards specific to its operation arising from IFA2.	As this relates to a third-party organisation the confidence level is set as high.	Liaison on hazards has taken place with MCA. Assessment of MCA SAR helicopter navigation and flight management systems complete. Agreement reached between NG and MCA concerning MEOSAR / IFA 2 compatibility in the proposed location. Potential adverse effects related to RFI assessed with no significant issues.	M26.1 Testing completed that demonstrates acceptable RFI emissions. M26.2 Final confirmation / agreement that Planning Condition No 14 and legal agreements concerning RFI emissions are met. M19A.1 Testing completed that demonstrates compliance with electro-magnetic field and compass deviation limits. M19A.2 Final confirmation / agreement that Planning Condition No 48 and legal agreements concerning electro-magnetic fields are met.	M26.1, M26.2 require testing in operation. M19A.1, M19A.2 require testing in operation. M27.1 – requires testing.

ID	Safety Requirement	Minimum Confidence level (for evidence)	Assurance Evidence Available	Dependencies (Further Evidence Required)	Status at issue of this safety justification.
				M27.1 FBC impose the requirements for testing by MCA under the legal agreements for MEOSAR and compliance confirmed. This is subject to the FBC and MCA programme and not a constraint on the IFA2 facility.	
M28	Liaison with Britten-Norman to identify possible hazards specific to its operation arising from IFA2.	As this relates to a third-party organisation a pessimistic approach is taken and the confidence level is set as high.	Liaison on hazards has taken place with Britten Norman and representation made to the Planning Committee. Assessment of Islander and Defender aircraft systems electro-magnetic field susceptibility completed, and recommendations raised which are captured in the planning representation.	M28.1 Detailed construction method statement and detailed scheme with cable arrangements in place. M28.2 Monitoring of electro-magnetic fields once operational to confirm that planning conditions are met. M28.3 RCAM submission under CAP 791 "Procedures for Changes to Aerodromes" incorporating IFA 2 and CAA endorsement in place. M19A.1 Testing completed that demonstrates compliance with electro-magnetic field and compass deviation limits. M19A.2 Final confirmation / agreement that Planning Condition No 48 and legal agreements concerning electro-magnetic fields are met.	M28.1, M28.3 – require ongoing management. M28.2, M19A.1, M19A.2 – requires testing in operation.
M29	Liaise with NATS to identify possible hazards specific to its operation arising from IFA2.	As this relates to a third-party organisation a pessimistic approach is taken and the confidence level is set as high.	Liaison on hazards has taken place with NATS. NATS Radar is a training facility and there are no safety risks identified concerning the interface with IFA 2. Agreement reached between NG and NATS concerning radar / IFA 2 compatibility in the proposed location. Potential adverse effects related to RFI assessed with no significant issues.	M26.1 Testing completed that demonstrates acceptable RFI emissions. M26.1 Final confirmation / agreement that Planning Condition No 14 and legal agreements concerning RFI emissions are met. M29.1 FBC impose the requirements for testing by NATS under the legal agreements for radar and compliance confirmed. This is subject to the FBC and NATS programme and not a constraint on the IFA2 facility.	M26.1, M26.2, M29.1 – requires testing in operation.
M30	Detailed surveys for existing services are to be undertaken before excavation of a trench to lay the cables, any existing cables will either be revealed by the survey or exposed on excavation and moved/dealt with appropriately. Thus, subject to this being completed, the risk of electric shock from impressed voltages and touch potentials will be eliminated by design.	High as this risk will be eliminated.	Draft preliminary impressed voltage assessment for cables at Daedalus [29] assesses the risks of impressed voltages on metallic objects and states plans for the mitigation of these risks.	M30.1 Preliminary impressed voltage assessment for cables at Daedalus [29] finalised and plans implemented.	M30.1– detailed design to be finalised.
M31	The communication strategy in place for flying UAVs to be studied further to determine possible risk.	Low	Addendum 2 to this safety justification concludes that there appear to be no gaps in the analysis and no reasons why IFA2 should be unsafe to UAVs.	M31. 1 RCAM has procedures and controls in place for UAVs, before UAVs permitted to fly at Solent Airport. This is not a constraint on IFA2.	M31.1 – requires ongoing management.
M32	Design specifications to require fire protection systems to ensure that fire is controllable.	Low	1JNL439067, C Fire Systems Description [27] provides a description of the fire protection / systems and includes a water deluge system Building cladding confirmed to be non-combustible.	M32.1 Detailed design for the fire protection / suppression systems complete and as per the system description. M32.2 Confirmation that fire protection / suppression system in place is as per the detailed design.	M32.1 – closed for design. M32.2 – requires testing in operation.
M33	Not used				
M34	Lighting signals can be used if RF levels are exceptionally sufficiently high to cause interruption to radio communications systems.	Low	Lighting signals already available for use as they are required by FISO.	M34.1 RCAM has procedures for FISO in place. This is not a constraint on IFA2.	M34.1 – requires ongoing management

ID	Safety Requirement	Minimum Confidence level (for evidence)	Assurance Evidence Available	Dependencies (Further Evidence Required)	Status at issue of this safety justification.
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference.	Low	Analysis of RFI effects on airport and aircraft systems completed demonstrates no significant effects.	M26.1 Testing completed that demonstrates acceptable RFI emissions. M26.1 Final confirmation / agreement that Planning Condition No 14 and legal agreements concerning RFI emissions are met.	M26.1, M26.2 require testing in operation.
M36	Not used.				
M37	A threat assessment to be conducted to determine the threat levels, using input from NG and FBC.	Low	IFA2 assessed as NOT critical infrastructure by NG process.	M37.1 Threat assessment for the Airport updated for IFA2 and measures in place to manage threats as required.	M37.1 – requires ongoing management.
M38	Project documentation to show that AC and direct current (DC) fields comply with requirements.	Low	Analysis of EMF effects completed demonstrates no significant effects.	M19A.1 Testing completed that demonstrates compliance with electro-magnetic field and compass deviation limits. M19A.2 Final confirmation / agreement that Planning Condition No 48 and legal agreements concerning electro-magnetic fields are met.	M19.1, M19.2 require testing in operation.
M39	Review RFI impact on UAVs.	Low	Analysis of RFI effects on airport and aircraft systems completed demonstrates no significant effects. Addendum 2 to this safety justification concludes that there appear to be no gaps in the analysis and no reasons why IFA2 should be unsafe to UAVs.	M26.1 Testing completed that demonstrates acceptable RFI emissions. M26.1 Final confirmation / agreement that Planning Condition No 14 and legal agreements concerning RFI emissions are met.	M26.1, M26.2 require testing in operation.
M40	Any future AGL system to be designed to ensure interference from HV cables cannot credibly affect the lighting.	Low	500-001 - AGL Duct Installation Arrangement and Detail [28] shows ducting installed.	M40.1 The interface between the AGL wiring layout and the HV cable design to be checked for touch potential / impressed voltage hazards and suitable mitigation implemented as necessary.	M40.1 – Design to be checked once available.
M41	The risk of public exposure to electromagnetic fields is eliminated provided the planning constraint for emissions is met.	Low	The Planning constraint limit is ~10uT The accepted limits in UK are the ICNIRP's reference levels [32] which are 500 µT and 10 kV m^{-1} for workers and 100 µT and 5 kV m^{-1} for the public.	M19A.1 Testing completed that demonstrates compliance with electro-magnetic field and compass deviation limits. M19A.2 Final confirmation / agreement that Planning Condition No 48 and legal agreements concerning electro-magnetic fields are met.	M19.1, M19.2 require testing in operation.
M42	The possible effects of heat from the facility on UAVs are to be reviewed.	Low	Addendum 2 to this safety justification concludes that there appear to be no gaps in the analysis and no reasons why IFA2 should be unsafe to UAVs.	None	
M43	Cable protection system to ensure power is promptly removed in the event of an insulation failure.	Low	Draft preliminary impressed voltage assessment for cables at Daedalus [29] assesses the risks of earth potential rises and states plans for the consideration of fault conditions as an interface with the converter station. ABB has plans to produce a safety step and touch voltage study for the converter station.	M30.1. Preliminary impressed voltage assessment for cables at Daedalus [29] finalised and plans implemented. M43.1 Safety step and touch voltage study for the converter building issued and plans implemented.	M30.1, M43.1 – detailed design to be finalised.
M44	The location of the fixed fuel installation and filling points for mobile bowsers is not near the HV cables.	Low	The Masterplan [7] shows the fixed fuel installation is far from the HV cable route. Any changes to the cable route are restricted within red line boundary.	None	

ID	Safety Requirement	Minimum Confidence level (for evidence)	Assurance Evidence Available	Dependencies (Further Evidence Required)	Status at issue of this safety justification.
M45	If any high-power AC cables run parallel or near-parallel to any metal fences or similar structures and run alongside for a significant distance, those structures are to be sufficiently earthed, and that earthing maintained sufficiently, to eliminate the risk of dangerous impressed voltages and touch potentials.	Low	Draft preliminary impressed voltage assessment for cables at Daedalus assesses the risks of earth potential rises and states plans for the consideration of fault conditions as an interface with the converter station. ABB has plans to produce a safety step and touch voltage study for the converter station.	M30.1. Preliminary impressed voltage assessment for cables at Daedalus [29] finalised and plans implemented. M43.1 Safety step and touch voltage study for the converter building issued and plans implemented.	M30.1, M43.1 – detailed design to be finalised.

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APPENDIX A2

ARCADIS Design & Consultancy for natural and built assets

HAZARD LOG REPORT

for the IFA2 Interconnector at Solent Airport

35588103/RP/080917/3 Addendum 1

NOVEMBER 2017

Incorporating

EC HARRIS BUILT ASSET CONSULTANCY

Hyder

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VERSION CONTROL

Issue	Revision No.	Date Issued	Description of Revision: Page No.	Description of Revision: Comment	Reviewed By:
1	1	04/09/2017	Draft Report issued for comment.		S Scannali
1	2	06/10/2107	Comments provided on Revision 1 addressed	Various comments throughout	S Scannali
	3	10/11/2017	Comments provided by FBC on Revision 2 addressed	Various comments throughout	S Scannali

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EXECUTIVE SUMMARY

National Grid Interconnector Holdings (NG) is developing and implementing an electricity interconnector facility. The facility (referred to as IFA2) is being developed jointly with Reseau de Transport d'Electricite (RTE), the French transmission system owner and operator. It links the United Kingdom's electricity transmission network with France's, and helps to enhance the security, affordability and sustainability of energy supply to both countries.

The facility consists of two converter stations, one sited in each country. It is to be sited to the north-east of Solent Airport, with high-voltage direct current (HVDC) and high-voltage alternating current (HVAC) cables proposed to be routed in the same cable corridor to the west and north of the main runway.

Over 2016 and 2017, NG, in agreement with Fareham Borough Council (FBC) and Regional and City Airports Management (RCAM); the airport operator, commissioned analysis and assessment to determine whether the siting of the converter station at Solent Airport could impact the airport's operations. These assessments also help to address local concerns over the proposals to site the converter station at Solent Airport and have been provided as supporting information to the planning and public consultation process being led by FBC.

As part of this work, NG jointly with FBC commissioned Arcadis to undertake technical assessment of the converter station to support the planning and land acquisition process. The assessment includes a functional hazard assessment (FHA), in accordance with Civil Aviation Authority (CAA) standard CAP 760 [1] and the development of a hazard log. The hazard log is used as a tool to track the risk management process as the project lifecycle progresses.

This addendum documents in detail the results of the FHA and the status of the hazard log at this point in time when the project is a significant way through the detailed design process. This document, therefore supports the interim safety justification for the IFA2 facility at Solent Airport [2].

The hazard log continues to be used to track hazards as the project progresses. For ease of ongoing management, all the risk mitigation measures in Appendix C of this hazard log are being tracked as dependencies required to be fulfilled to meet safety requirements, together with a risk mitigation plan which is presented in the safety justification document [2]. The risk mitigation plan is being updated regularly throughout the hazard management phase. At the end of the testing and commissioning phase and prior to the commencement of operation, all the dependencies will be confirmed as complete and hazards confirmed as closed with risks acceptable and ALARP.

The scope of the safety assessment and the hazard log considers the effects of the IFA2 facility upon Solent Airport's operations, and has identified 28 hazards arising from 36 causal factors. Some of the hazards identified initially have been merged or closed; 16 hazards remain open. However, completion of the dependencies as discussed above will close these and ensure that any potential safety risks presented by the IFA2 facility upon Solent Airport's operations are considered acceptable. With the robust body of evidence in place so far as described in the safety justification document [2], there is a high level of confidence that the potential safety effects presented by the IFA2 facility on Solent Airport's operations can all be successfully managed to closure.

REFERENCES

Ref No	Reference Identifier	Title
1	CAP 760	Civil Aviation Procedure (CAP 760) Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases.
2	35588103/RP/080917	Safety Justification for the IFA2 Interconnector at Solent Airport Daedalus.
3	35588100/NT/300916/2	Technical Assessment (Hazard Log) of the possible impact of the IFA2 Interconnector at Solent Airport Daedalus.
4	CIMS/RCA/DA/GT 11.0 & CIMS/RCA/DA/GT 12.0	Regional & City Airports Management: Daedalus: Safety Management System (SMS) Incorporating the Aerodrome Manual/
5	-	IFA2 Interconnector: Daedalus FHA Briefing Note, Arcadis, August 2016.
6	BS 5489-1:1203	Code of practice for the design of road lighting: lighting of roads and public amenity areas Part 1 Lighting of roads and public amenity areas.
7	-	Draft Daedalus Masterplan – 12 October 2016
8	25-7-17 MoM	Minutes of meeting on 25 July 2017 at Lee-on-Solent Airport to discuss IFA2 – MCA Interface and Equipment.
9	35588102/RP/080517/2	Hazard Log Report Technical Assessment of the possible impact of the IFA2 Interconnector at Solent Airport Daedalus.

TERMS AND DEFINITIONS

Term/Abbreviation	Definition
AC	Alternating Current
AFTN	Aeronautical Fixed Telecommunications Network
AGL	Airfield Ground Lighting
Airport, the	Solent Airport at Daedalus
CAA	(UK) Civil Aviation Authority
CAP	Civil Aviation Publication
CDM	Construction (Design and Management)
Control Tower	The Daedalus control tower
DC	Direct Current
DI	Direction Indicator
EMI	Electromagnetic Interference
FBC	Fareham Borough Council
FHA	Functional Hazard Assessment
FIS	Flight Information Service
FISO	Flight Information Service Officer
HIRA	Hazard Identification and Risk Assessment
HV	High Voltage
IFA2	Interconnexion France-Angleterre 2
ILS	Instrument Landing System
kV	Kilovolt
LED	Light-Emitting Diode
LSH	Lambert Smith Hampton
LV	Low Voltage
MCA	Maritime and Coastguard Agency
NATS	National Air Traffic Services
NG	National Grid Interconnector Holdings Limited
RCAM	Regional and City Airports Management
RF	Radio Frequency
RFI	Radio Frequency Interference

Term/Abbreviation	Definition
SMS	Safety Management System
Solent Airport	Solent Airport at Daedalus
UAV	Unmanned Aerial Vehicle
UHF	Ultra-High Frequency
VHF	Very High Frequency

1 INTRODUCTION

National Grid Interconnector Holdings (NG) is proposing to develop and implement a new electricity interconnector facility, the Interconnexion France-Angleterre 2 (IFA2). The facility is being developed jointly with Réseau de Transport d'Electricité (RTE), the French transmission system owner and operator. It will link the United Kingdom's electricity transmission network with France's, and is expected to help enhance the security, affordability, and sustainability of energy supply to both countries.

The facility consists of two converter stations, one sited in each country. The UK converter station is to be sited to the north-east of Solent Airport at Daedalus ("Solent Airport"). National Grid proposes to route high-voltage direct current and high-voltage alternating current cables in a shared cable corridor to the west and north of the Solent Airport main runway.

This is a report of the hazard identification and risk assessment process, including an update of the hazard log at this point in time when the project is a significant way through the detailed design process. The hazard log will be used to track hazards as the project progresses and hazards confirmed as closed when all of the risk mitigation is complete and prior to operation.

All hazards identified are shown on the hazard log forms in Appendix A of this report. The causal factors giving rise to those hazards are shown in the causal factor record sheets in Appendix B. The controls, mitigations, and actions identified in the FHA meetings are shown in Appendix C

2 FUNCTIONAL HAZARD ANALYSIS PROCESS

The Functional Hazard Analysis (FHA) is part of a systematic a process to:

- identify ways in which the proposed IFA2 installation might impair the safety of air traffic operations at Solent Airport (hazards);
- identify how severe such impairment might credibly be;
- estimate the approximate likelihood of such impairment where possible.

FHA has been carried out to consider any possible adverse effects of the proposed IFA2 facility upon the Airport, taking into consideration the likely future airport developments and the surrounding businesses as defined in the Masterplan [7].

The means of managing risk is identified through the overall risk management process as the design progresses through the project lifecycle, however, possible ways to manage risks identified during the FHA are recorded in the hazard log, which can be used to help manage the risks downstream.

Two FHA workshops were held as follows, both were coordinated by Arcadis and facilitated by TGR Safety Management Ltd:

- The first FHA workshop [3] was carried out on the 24th August 2016 and subject matter experts from National Grid, FBC, RCAM and Arcadis participated. This considered possible effects of the IFA2 facility on existing Airport operations.
- The second FHA workshop [9] was held on the 11th and 12th April 2017 to review the first assessment in the light of the likely future airport developments as well as developments in the control measures for hazards. This was attended by experts from National Grid, FBC, RCAM and Arcadis, the main IFA2 contractors and Lambert Smith Hampton (LSH) (the Commercial Agents) as listed in Appendix D. This ensured comprehensive coverage and representation from all the specialist areas necessary to identify hazards and assess risks.

A briefing note [5], describing the FHA process, was issued to participants before both workshops.

Subsequent to the workshops, a number of hazard review meetings have been held to develop the risk mitigation evidence as follows:

- Hazard Review Meeting on the 25/5/17 (attended by RCAM, NG, FBC, Arcadis)
- Hazard Review Meeting 27/6/17 (attended by NG, Arcadis)
- Review of mitigation plan 21/7/17 (attended by FBC, Arcadis).
- Review of MCA hazards 21/7/17 (attended by MCA, RCA, Arcadis).
- Hazard Review Meeting 10/8/17 (attended by RCAM, NG, FBC, Arcadis)
- Review of Hazard Log Actions 23/8/17 (attended by FBC, NG, Arcadis).

Liaison with the converter station Main Contractor (ABB) and HV cable contractor (Prysmian) has taken place through conference calls and NG/contractor liaison meetings as the design has developed.

The meeting held with MCA [8] on the 21/7/17 considered the possible effects of the IFA2 facility on that agency, and the hazard log has been updated to include the results of that meeting.

Risk is a combination of the likelihood and severity of hazards. At the time of the first workshop, lifecycle hazard mitigation measures were not fully defined, so in most cases the first FHA meeting identified only the severity and not the likelihood of hazards. As the mitigation measures were more firmly specified at the time of the second workshop, in most cases likelihoods have now been assigned.

Severity and likelihood classifications from Solent Airport's SMS [4] were used, which are identical to those of CAP760 (Section 4.7) but also include Solent Airport's processes for managing safety risk.

In cases where a need for further research or investigation is identified, the likelihood given is a worst-case estimate by the participants at FHA meeting, and the actions can be closed provided the research or investigation concludes that the likelihood is no worse than that identified. In cases where further design work is required, or controls and mitigations are still to be implemented, the likelihood given is the maximum

target likelihood that would ensure that the risks will be acceptable. The likelihood categories may be reviewed at the end of the design process by those who have responsibility for mitigating the risks.

This study is focussed on assessing the effects of the IFA2 facility upon airport operations only. It does not consider potential causes of hazards which could affect airport operations arising from sources within the Airport. Step 7 of CAP 760, “Claims, arguments and evidence that the safety requirements have been met and documenting this in a safety case” can only be fulfilled so far as the assumptions and boundaries of this study allow, that is, only in respect of the IFA2 facility and within the limits of the equipment and infrastructure on the agreed Masterplan [7]. The work reported in this document can be used to support, but will not itself provide, a safety case for the airport, as the safety case for the airport will need to address all hazards arising from all relevant equipment and operations

Within this document, all likelihoods assigned are those due to the effects of IFA2 only. It should be noted that the hazards might also be caused in ways that are independent of IFA2. All credible causes of hazards should be considered when assessing the overall airport risk. CAP760 Chapter 3 Section 5.8 describes the process by which allowance can be made for multiple possible causes of hazards.

Hazard record sheets developed to record all hazard related information are included in Appendix A and have assigned actions for the risk controls and mitigations to “owners”, whom the participants in the FHA considered to be the organisations best placed to progress the actions. These assignments are:

- NG;
- FBC; and
- RCAM.

Owners of actions and mitigation measures have changed as the project progresses, the risk mitigation plan has been used to define the latest action and owner at any point in time. The airport operator, RCAM, retains ultimate responsibility for ensuring risk control and mitigation measures relating to airport operations are adequately implemented.

3 SUMMARY OF RESULTS

This section of the report summarises the results of the FHA, listing hazards from highest to lowest consequence severity.

3.1 “Accident” Severity

No hazards were identified as having the severity of Accident.

3.2 “Serious Incident” Severity

The definition of “Serious Incident” in CAP760 [1] and the Solent Airport SMS [4] is:

Serious Incident - as defined in Council Directive 94/56/EC1 for air traffic services.

For the aerodrome, an event where an accident nearly occurs. No safety barriers remaining. The outcome is not under control and could very likely lead to an accident. Damage to major aerodrome facilities. Serious injury to staff/members of public at the aerodrome.

One hazard HAZ20 (High 50Hz impressed voltages or touch potentials due to LV cabling or fencing) falls into this severity category. However, through the mitigation measures identified during the FHA, including detailed surveys being undertaken and any LV cables identified during excavations, the hazard and hence the risk is to be eliminated by design.

3.3 “Major Incident” Severity

No hazards were identified as having the severity Major Incident.

3.4 “Significant Incident” Severity

The definition of “Significant Incident” in CAP760 [1] and the Solent Airport SMS [4] is:
Significant incident involving circumstances indicating that an accident, a serious or major incident could have occurred, if the risk had not been managed within safety margins, or if another aircraft had been in the vicinity.

A significant reduction in safety margins but several safety barriers remain to prevent an accident.

Reduced ability of the flight crew or air traffic control to cope with the increase in workload as a result of the conditions impairing their efficiency.

Only on rare occasions can the occurrence develop into an accident.

Nuisance to occupants of the aircraft or staff/members of public at the aerodrome.

The FHA identified the severity of the following open hazards to be Significant Incident:

- HAZ01: Distraction of aircrew;
- HAZ02: Wind impact, caused by building (turbulence and unexpected changes in wind patterns, wind shear and so on);
- HAZ03: Bird strike;
- HAZ10: Distraction of control tower staff;
- HAZ11: Impaired ground to ground communications;
- HAZ17: Terrorist attack on IFA2;
- HAZ18: Exposure of public and workers to excessive magnetic fields;
- HAZ19: Incorrect magnetic compass reading;
- HAZ21: Loss of control of Unmanned Aerial Vehicle (UAV);
- HAZ22: Fire and smoke;
- HAZ24: Incorrect ground lighting intensity; and
- HAZ25: Wrong or no altimeter reading.

The acceptable likelihood for hazards with severity Significant Incident is Remote, defined in CAP760 and the Solent Airport SMS as:

Unlikely to occur during the total operational life of the system.

10^{-5} to 10^{-7} per hour.

Once in 10 years to once in 1000 years.

The FHA meetings did not anticipate any difficulties meeting a likelihood of Remote or better for any of these hazards. However, the meetings did not assign a likelihood to HAZ17 because that hazard is subject to a separate threat assessment.

3.5 Severity not Assigned

The FHA meetings did not assign severities to the following hazards, which relate to the interface of IFA 2 with third party systems:

- HAZ26 Unknown effect on MCA;
- HAZ27: Unknown effects on Britten-Norman operations; and
- HAZ28: Unknown effect of NATS operations.

Liaison has taken place with all these agencies to understand any potential hazards related to IFA 2. These hazards are subject to the third-party safety management system, including their criteria for tolerable risk, hence they have not been ranked. For these hazards, the objective is to demonstrate with the highest level of confidence, based on CAP 760 guidelines, that there are no adverse impacts that would impact the third-party system from introducing the IFA 2 facility at Solent Airport.

4 CONCLUSIONS

The safety assessment of the effect of the IFA2 facility on Solent Airport's operations identified 28 hazards arising from 36 causal factors. Some of the hazards have been merged or closed; 16 remain open. The hazard log continues to be used to track hazards as the project progresses. For ease of ongoing management, all the risk mitigation measures in Appendix C of this hazard log are being tracked as dependencies required to be fulfilled to meet safety requirements, together with a risk mitigation plan which is presented in the safety justification document [2]. The risk mitigation plan is being updated regularly throughout the hazard management phase. At the end of the testing and commissioning phase and prior to operation, all the dependencies will be confirmed as complete and hazards confirmed as closed with risks acceptable and ALARP.

The scope of the safety assessment and the hazard log considers the effects presented by the IFA2 facility upon Solent Airport's operations, and has identified 28 hazards arising from 36 causal factors. Some of the hazards identified initially have been merged or closed; 16 hazards remain open. However, completion of the dependencies as discussed above will close these and ensure that any potential safety effects presented by the IFA2 facility upon Solent Airport's operations is acceptable. With the robust body of evidence in place so far as described in the safety justification [2], there is a high level of confidence that the potential safety effects presented by the IFA2 facility on Solent Airport's operations can all be successfully managed to closure.

APPENDIX A HAZARD RECORD SHEETS

A.1 HAZ01

Identified By		Date Created	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Revised based on second FHA meeting.		12-Apr-17	
Description			
Distraction of aircrew			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF01	Distraction of aircrew at night caused by lighting from the facility - building and security lighting	Human Factors	Extremely Improbable
CF02	Distraction of aircrew at night caused by reflection from building structure and cladding	Human Factors	Extremely Improbable
CF04	Communication interference, impacting the workload of the staff in control tower or aircrew (e.g. dealing with instrumentation and radio problems).	Human Factors	Extremely Improbable
CF05	Noise from IFA2 facility causes a distraction.	Human Factors	Extremely Improbable
CF06	Pilots under training who are not accustomed to any impacts from converter station - e.g. as they have undergone training before the converter station is operational.	Human Factors	Extremely Improbable
CF08	Air-ground communications impacted by interference caused by emissions from HV cables/facility.	Technical Factors	Remote
Consequences			
ID	**Description**	**Severity**	
C01	Aircraft unintentionally deviates from normal in-flight parameters.	Significant Incident	
C04	Aircraft does not accelerate or take off as expected.	No Immediate Effect	
C07	Aircraft in close proximity with another aircraft such that their safety is or may be compromised.	Significant Incident	
C14	Runway overrun	No Immediate Effect	
Probability		**Severity**	
Remote		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M01	Building lighting to be directed downwards, away from flight paths and control tower, and not towards the runway. This requirement is to be included in the design specifications.	Open	NG
M02	The design of all road lighting to be compliant with BS 5489 [6] Section 12.2: Lighting in the vicinity of aerodromes.	Closed	NG
M03	External surfaces of building to be designed not to present a distraction to aircrew.	Open	NG
M16	If communications dead spots are found, appropriate procedures are to be put in place to manage the resulting risk.	Open	RCAM

M17	Planning Constraints to limit permitted noise from IFA2 (taking the proposed runway extension into account).	Closed	FBC
M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.	Open	RCAM
M35	All electrical systems to be designed to ensure radio frequency (RF) levels are too low for significant interference	Open	NG
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	
Open			
Comment			
LSA RFI assessment showed that emissions are below the levels at which interference would occur, and the probability of interference to radios is very low for current airfield operations. There is no credible risk of equipment damage.			

A.2 HAZ02

Identified By		Date Created	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Revised based on second FHA meeting.		12-Apr-17	
Description			
Wind impact.			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF21	Heat generated from converter station - air density changes immediately above the facility impacts aircraft or gliders.	Technical Factors	Extremely Improbable
CF24	Wind impact, caused by building or landscaping (turbulence and unexpected changes in wind patterns, wind shear, and so on).	Environmental Factors	Extremely Improbable
CF32	Tall trees	Environmental Factors	Remote
Consequences			
ID	**Description**	**Severity**	
C01	Aircraft unintentionally deviates from normal in-flight parameters.	Significant Incident	
C02	Inability to make a stop within the expected distance requirements.	Significant Incident	
C03	Loss of directional control on the runway.	Significant Incident	
C05	Terrain separation deteriorating below normal requirements	Significant Incident	
Probability		**Severity**	
Remote		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M06	Wind assessment to determine the impact of the building on the wind patterns (including consideration of light aircraft and UAVs).	Closed	NG
M07	Publicity and training to include awareness of possible wind effects.	Open	RCAM
M09	Effects of wind to be kept under review in case of increased traffic	Closed	FBC
M10	Airmanship provides mitigation.	Closed	
M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.	Open	RCAM
M42	The possible effects of heat from the facility on UAVs are to be reviewed,	Closed	RCAM
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			

Date of Action	
Status of this Hazard Log Entry	**Date Closed**
Open	
Comment	
Note that no direct impact of the IFA2 on the landing has been identified. This hazard is related to wind phenomenon.	

A.3 HAZ03

Identified By		**Date Created**	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Revised based on second FHA meeting.		12-Apr-17	
Description			
Bird strike			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF29	Future planning of landscaping - attracts birds near to airfield	Environmental Factors	Remote
CF30	Converter station warms air immediately above the converter station and attracts birds.	Environmental Factors	Remote
CF31	Building design - flat roof - attracts birds	Environmental Factors	Remote
Consequences			
ID	**Description**	**Severity**	
C01	Aircraft unintentionally deviates from normal in-flight parameters.	Significant Incident	
Probability		**Severity**	
Remote		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M12	Building to provide appropriate access for bird management strategy.	Open	NG
M14	RCAM to discuss bird strikes with a wildlife expert and to seek the expert's advice on how to manage the bird activities in this area.	Closed	RCAM
M15	FBC to consider the risk of bird strike in future landscaping and choice of trees, and so on.	Closed	FBC
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	
Open			
Comment			

16

A.4 HAZ04

Identified By		Date Created	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Closed		12-Apr-17	
Description			
Wind impact, caused by building (turbulence and unexpected changes in wind patterns, wind shear and so on). Note that the worst case at the airport is wind from north-east.			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF21	Heat generated from converter station - air density changes immediately above the facility impacts aircraft or gliders.	Technical Factors	Extremely Improbable
CF24	Wind impact, caused by building or landscaping (turbulence and unexpected changes in wind patterns, wind shear, and so on).	Environmental Factors	Extremely Improbable
Consequences			
ID	**Description**	**Severity**	
C02	Inability to make a stop within the expected distance requirements.	Significant Incident	
Probability		**Severity**	
Extremely Improbable		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M06	Wind assessment to determine the impact of the building on the wind patterns (including consideration of light aircraft and UAVs).	Closed	NG
M07	Publicity and training to include awareness of possible wind effects.	Open	RCAM
M09	Effects of wind to be kept under review in case of increased traffic	Closed	FBC
M10	Airmanship provides mitigation.	Closed	
M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.	Open	RCAM
M42	The possible effects of heat from the facility on UAVs is to be reviewed,	Closed	RCAM
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Hazard merged with HAZ02			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	

Closed 24-Apr-17	
Comment	

18

A.5 HAZ05

Identified By		Date Created	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Revised based on second FHA meeting.		12-Apr-17	
Description			
Wind impact, caused by building (turbulence and unexpected changes in wind patterns, wind shear and so on). Note that the worst case at the airport is wind from north-east.			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF21	Heat generated from converter station - air density changes immediately above the facility impacts aircraft or gliders.	Technical Factors	Extremely Improbable
CF24	Wind impact, caused by building or landscaping (turbulence and unexpected changes in wind patterns, wind shear, and so on).	Environmental Factors	Extremely Improbable
Consequences			
ID	**Description**	**Severity**	
C03	Loss of directional control on the runway.	Significant Incident	
Probability		**Severity**	
Extremely Improbable		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M06	Wind assessment to determine the impact of the building on the wind patterns (including consideration of light aircraft and UAVs).	Closed	NG
M07	Publicity and training to include awareness of possible wind effects.	Open	RCAM
M09	Effects of wind to be kept under review in case of increased traffic	Closed	FBC
M10	Airmanship provides mitigation.	Closed	
M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.	Open	RCAM
M42	The possible effects of heat from the facility on UAVs are to be reviewed.	Open	RCAM
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Merged with HAZ02			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	
Closed		24-Apr-17	

Comment

20

A.6 HAZ06

Identified By		Date Created	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Revised based on second FHA meeting.		12-Apr-17	
Description			
Distraction of aircrew or control tower staff.			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF01	Distraction of aircrew at night caused by lighting from the facility - building and security lighting	Human Factors	Extremely Improbable
CF02	Distraction of aircrew at night caused by reflection from building structure and cladding	Human Factors	Extremely Improbable
CF04	Communication interference, impacting the workload of the staff in control tower or aircrew (e.g. dealing with instrumentation and radio problems).	Human Factors	Extremely Improbable
CF05	Noise from IFA2 facility causes a distraction.	Human Factors	Extremely Improbable
CF06	Pilots under training who are not accustomed to any impacts from converter station - e.g. as they have undergone training before the converter station is operational.	Human Factors	Extremely Improbable
CF08	Air-ground communications impacted by interference caused by emissions from HV cables/facility.	Technical Factors	Remote
Consequences			
ID	**Description**	**Severity**	
C04	Aircraft does not accelerate or take off as expected.	No Immediate Effect	
Probability		**Severity**	
Remote		No Immediate Effect	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M01	Building lighting to be directed downwards, away from flight paths and control tower, and not towards the runway. This requirement is to be included in the design specifications.	Open	NG
M02	The design of all road lighting to be compliant with BS 5489 [6] Section 12.2: Lighting in the vicinity of aerodromes.	Open	NG
M03	External surfaces of building to be designed not to present a distraction to aircrew.	Open	NG
M16	If communications dead spots are found, appropriate procedures are to be put in place to manage the resulting risk.	Open	RCAM
M17	Planning Constraints to limit permitted noise from IFA2 (taking the proposed runway extension into account).	Closed	FBC

M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.	Open	RCAM
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference	Open	NG
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Merged with HAZ01			
Date of Action			
24-Apr-17			
Status of this Hazard Log Entry		**Date Closed**	
Closed		24-Apr-17	
Comment			

A.7 HAZ07

Identified By		Date Created	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Closed 24-Apr-17			
Description			
Wind impact, caused by building (turbulence and unexpected changes in wind patterns, wind shear and so on). Note that the worst case at the airport is wind from north-east.			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF21	Heat generated from converter station - air density changes immediately above the facility impacts aircraft or gliders.	Technical Factors	Extremely Improbable
CF24	Wind impact, caused by building or landscaping (turbulence and unexpected changes in wind patterns, wind shear, and so on).	Environmental Factors	Extremely Improbable
Consequences			
ID	**Description**	**Severity**	
C05	Terrain separation deteriorating below normal requirements	Significant Incident	
Probability		**Severity**	
Extremely Improbable		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M06	Wind assessment to determine the impact of the building on the wind patterns (including consideration of light aircraft and UAVs).	Closed	NG
M07	Publicity and training to include awareness of possible wind effects.	Open	RCAM
M09	Effects of wind to be kept under review in case of increased traffic	Closed	FBC
M10	Airmanship provides mitigation.	Closed	
M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.	Open	RCAM
M42	The possible effects of heat from the facility on UAVs is to be reviewed.	Closed	RCAM
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Merged with HAZ02			
Date of Action			
24-Apr-17			
Status of this Hazard Log Entry		**Date Closed**	

Closed	24-Apr-17
Comment	

A.8 HAZ08

Identified By		Date Created	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Closed		12-Apr-17	
Description			
Distraction of aircrew or control tower staff.			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF01	Distraction of aircrew at night caused by lighting from the facility - building and security lighting	Human Factors	Extremely Improbable
CF02	Distraction of aircrew at night caused by reflection from building structure and cladding	Human Factors	Extremely Improbable
CF04	Communication interference, impacting the workload of the staff in control tower or aircrew (e.g. dealing with instrumentation and radio problems).	Human Factors	Extremely Improbable
CF05	Noise from IFA2 facility causes a distraction.	Human Factors	Extremely Improbable
CF06	Pilots under training who are not accustomed to any impacts from converter station - e.g. as they have undergone training before the converter station is operational.	Human Factors	Extremely Improbable
CF08	Air-ground communications impacted by interference caused by emissions from HV cables/facility.	Technical Factors	Remote
Consequences			
ID	**Description**	**Severity**	
C05	Terrain separation deteriorating below normal requirements	Significant Incident	
Probability		**Severity**	
Remote		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M01	Building lighting to be directed downwards, away from flight paths and control tower, and not towards the runway. This requirement is to be included in the design specifications.	Open	NG
M02	The design of all road lighting to be compliant with BS 5489 [6] Section 12.2: Lighting in the vicinity of aerodromes.	Open	NG
M03	External surfaces of building to be designed not to present a distraction to aircrew.	Open	NG
M16	If communications dead spots are found, appropriate procedures are to be put in place to manage the resulting risk.	Open	RCAM
M17	Planning Constraints to limit permitted noise from IFA2 (taking the proposed runway extension into account).	Closed	FBC

M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.	Open	RCAM
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference	Open	NG
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Merged with HAZ01			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	
Closed		24-Apr-17	
Comment			

A.9 HAZ09

Intentionally blank.

A.10 HAZ10

Identified By		Date Created	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Revised based on second FHA meeting.		12-Apr-17	
Description			
Distraction of control tower staff.			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF01	Distraction of aircrew at night caused by lighting from the facility - building and security lighting	Human Factors	Extremely Improbable
CF02	Distraction of aircrew at night caused by reflection from building structure and cladding	Human Factors	Extremely Improbable
CF04	Communication interference, impacting the workload of the staff in control tower or aircrew (e.g. dealing with instrumentation and radio problems).		
CF05	Noise from IFA2 facility causes a distraction.	Human Factors	Extremely Improbable
CF06	Pilots under training who are not accustomed to any impacts from converter station - e.g. as they have undergone training before the converter station is operational.	Human Factors	Extremely Improbable
CF08	Air-ground communications impacted by interference caused by emissions from HV cables/facility.	Technical Factors	Remote
Consequences			
ID	**Description**	**Severity**	
C06	Incorrect presence of aircraft, people, or vehicles in the protected area.	Significant Incident	
C07	Aircraft in close proximity with another aircraft such that their safety is or may be compromised.	Significant Incident	
C14	Runway overrun	No Immediate Effect	
Probability		**Severity**	
Remote		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M01	Building lighting to be directed downwards, away from flight paths and control tower, and not towards the runway. This requirement is to be included in the design specifications.	Open	NG
M02	The design of all road lighting to be compliant with BS 5489 [6] 12.2: Lighting in the vicinity of aerodromes. Section	Open	NG
M03	External surfaces of building to be designed not to present a distraction to aircrew.	Open	NG
M16	If communications dead spots are found, appropriate procedures are to be put in place to manage the resulting risk.	Open	RCAM

M17	Planning Constraints to limit permitted noise from IFA2 (taking the proposed runway extension into account).	Closed	FBC
M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.	Open	RCAM
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference	Open	NG
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	
Open			
Comment			

A.11 HAZ11

Identified By		Date Created	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Revised based on second FHA meeting.		12-Apr-17	
Description			
Impaired ground to ground communications.			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF09	Ground-ground communications (UHF) impacted by interference caused by emissions from HV cables/facility.	Technical Factors	Extremely Improbable
CF10	Interference caused by emissions from HV cables/facility delays Emergency Services communication	Technical Factors	Extremely Improbable
Consequences			
ID	**Description**	**Severity**	
C09	Delay to emergency services response	No Immediate Effect	
C06	Incorrect presence of aircraft, people, or vehicles in the protected area.	Significant Incident	
Probability		**Severity**	
Extremely Improbable		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M24	FIS procedures to take into account the possibility of impairment to ground- ground communications.	Open	RCAM
M34	Lighting signals can be used if RF levels are exceptionally sufficiently high to cause interruption to radio communications systems	Open	RCAM
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference	Open	NG
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	
Open			
Comment			

A.12 HAZ12

Identified By		**Date Created**	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Closed			
Description			
Impaired ground to ground communications.			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF09	Ground-ground communications (UHF) impacted by interference caused by emissions from HV cables/facility.	Technical Factors	Extremely Improbable
Consequences			
ID	**Description**	**Severity**	
C06	Incorrect presence of aircraft, people, or vehicles in the protected area.	Significant Incident	
Probability		**Severity**	
Extremely Improbable		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M34	Lighting signals can be used if RF levels are exceptionally sufficiently high to cause interruption to radio communications systems	Open	RCAM
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference	Open	NG
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Merged with HAZ11			
Date of Action			
12-Apr-17			
Status of this Hazard Log Entry		**Date Closed**	
Closed		24-Apr-17	
Comment			

A.13 HAZ13

Identified By		Date Created	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Closed		12-Apr-17	
Description			
Distraction of aircrew or control tower staff (class G airspace operations)			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF01	Distraction of aircrew at night caused by lighting from the facility - building and security lighting	Human Factors	Extremely Improbable
CF02	Distraction of aircrew at night caused by reflection from building structure and cladding	Human Factors	Extremely Improbable
CF04	Communication interference, impacting the workload of the staff in control tower or aircrew (e.g. dealing with instrumentation and radio problems).	Human Factors	Extremely Improbable
CF05	Noise from IFA2 facility causes a distraction.	Human Factors	Extremely Improbable
CF06	Pilots under training who are not accustomed to any impacts from converter station - e.g. as they have undergone training before the converter station is operational.	Human Factors	Extremely Improbable
CF08	Air-ground communications impacted by interference caused by emissions from HV cables/facility.	Technical Factors	Remote
Consequences			
ID	**Description**	**Severity**	
C07	Aircraft in close proximity with another aircraft such that their safety is or may be compromised.	Significant Incident	
Probability		**Severity**	
Remote		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M01	Building lighting to be directed downwards, away from flight paths and control tower, and not towards the runway. This requirement is to be included in the design specifications.	Open	NG
M02	The design of all road lighting to be compliant with BS 5489 [6] Section12.2: Lighting in the vicinity of aerodromes.	Open	NG
M03	External surfaces of building to be designed not to present a distraction to aircrew.	Open	NG
M16	If communications dead spots are found, appropriate procedures are to be put in place to manage the resulting risk.	Open	RCAM
M17	Planning Constraints to limit permitted noise from IFA2 (taking the proposed runway extension into account).	Closed	FBC

M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.	Open	RCAM
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference	Open	NG
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Merged with HAZ01			
Date of Action			
24-Apr-17			
Status of this Hazard Log Entry		**Date Closed**	
Closed		24-Apr-17	
Comment			

A.14 HAZ14

Identified By		**Date Created**	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Closed		12-Apr-17	
Description			
Distraction of aircrew caused by reflection from building structure and cladding (procedural non-radar operations)			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF02	Distraction of aircrew at night caused by reflection from building structure and cladding	Human Factors	Extremely Improbable
Consequences			
ID	**Description**	**Severity**	
C07	Aircraft in close proximity with another aircraft such that their safety is or may be compromised.	Significant Incident	
Probability		**Severity**	
Extremely Improbable		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M03	External surfaces of building to be designed not to present a distraction to aircrew.	Open	NG
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Merged with HAZ01			
Date of Action			
12-Apr-17			
Status of this Hazard Log Entry		**Date Closed**	
Closed		24-Apr-17	
Comment			

A.15 HAZ15

Identified By		Date Created	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Closed		12-Apr-2017	
Description			
Distraction of aircrew or control tower staff, other than by distraction of aircrew caused by reflection from building structure and cladding (procedural non-radar operations)			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF01	Distraction of aircrew at night caused by lighting from the facility - building and security lighting	Human Factors	Extremely Improbable
CF04	Communication interference, impacting the workload of the staff in control tower or aircrew (e.g. dealing with instrumentation and radio problems).	Human Factors	Extremely Improbable
CF05	Noise from IFA2 facility causes a distraction.	Human Factors	Extremely Improbable
CF06	Pilots under training who are not accustomed to any impacts from converter station - e.g. as they have undergone training before the converter station is operational.	Human Factors	Extremely Improbable
CF08	Air-ground communications impacted by interference caused by emissions from HV cables/facility.	Technical Factors	Remote
Consequences			
ID	**Description**	**Severity**	
C07	Aircraft in close proximity with another aircraft such that their safety is or may be compromised.	Significant Incident	
Probability		**Severity**	
Remote		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M01	Building lighting to be directed downwards, away from flight paths and control tower, and not towards the runway. This requirement is to be included in the design specifications.	Open	NG
M02	The design of all road lighting to be compliant with BS 5489 [6] Section12.2: Lighting in the vicinity of aerodromes.	Open	NG
M16	If communications dead spots are found, appropriate procedures are to be put in place to manage the resulting risk.	Open	RCAM
M17	Planning Constraints to limit permitted noise from IFA2 (taking the proposed runway extension into account).	Closed	FBC

M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.	Open	RCAM
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference	Open	NG
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Merged with hazards HAZ01 and HAZ10			
Date of Action			
12-Apr-17			
Status of this Hazard Log Entry		**Date Closed**	
Closed		24-Apr-17	
Comment			

A.16 HAZ16

Identified By		Date Created	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Closed		24-Apr-17	
Description			
Distraction of aircrew or control tower staff			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF01	Distraction of aircrew at night caused by lighting from the facility - building and security lighting	Human Factors	Extremely Improbable
CF02	Distraction of aircrew at night caused by reflection from building structure and cladding	Human Factors	Extremely Improbable
CF04	Communication interference, impacting the workload of the staff in control tower or aircrew (e.g. dealing with instrumentation and radio problems).	Human Factors	Extremely Improbable
CF05	Noise from IFA2 facility causes a distraction.	Human Factors	Extremely Improbable
CF06	Pilots under training who are not accustomed to any impacts from converter station - e.g. as they have undergone training before the converter station is operational.	Human Factors	Extremely Improbable
CF08	Air-ground communications impacted by interference caused by emissions from HV cables/facility.	Technical Factors	Remote
Consequences			
ID	**Description**	**Severity**	
C14	Runway overrun	No Immediate Effect	
Probability		**Severity**	
Remote		No Immediate Effect	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M01	Building lighting to be directed downwards, away from flight paths and control tower, and not towards the runway. This requirement is to be included in the design specifications.	Open	NG
M02	The design of all road lighting to be compliant with BS 5489 [6] Section12.2: Lighting in the vicinity of aerodromes.	Open	NG
M03	External surfaces of building to be designed not to present a distraction to aircrew.	Open	NG

M16	If communications dead spots are found, appropriate procedures are to be put in place to manage the resulting risk.	Open	RCAM
M17	Planning Constraints to limit permitted noise from IFA2 (taking the proposed runway extension into account).	Closed	FBC
M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.	Open	RCAM
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference	Open	NG
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Merged with HAZ01 and HAZ10			
Date of Action			
24-Apr-17			
Status of this Hazard Log Entry		**Date Closed**	
Closed		24-Apr-17	
Comment			

A.17 HAZ17

Identified By		Date Created	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Revised based on second FHA meeting.		12-Apr-17	
Description			
Terrorist attack on IFA2			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF36	Terrorist attack on IFA2	Terrorist Incident	
Consequences			
ID	**Description**	**Severity**	
C01	Aircraft unintentionally deviates from normal in-flight parameters.	Significant Incident	
Probability		**Severity**	
Significant		Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M37	A threat assessment to be conducted to determine the threat levels, using input from NG and FBC.	Open	RCAM
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action Taken			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	
Open			
Comment			

A.18 HAZ18

Identified By		**Date Created**	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Revised based on second FHA meeting.		12-Apr-17	
Description			
Exposure of public and workers to excessive magnetic fields			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF03	Human (public and workers) exposure to excessive magnetic fields (see 8.2 for impact on equipment)	Human Factors	Extremely Improbable
Consequences			
ID	**Description**	**Severity**	
C08	Harm to health	Significant Incident	
Probability		**Severity**	
Extremely Improbable		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M38	Project documentation to show that alternating current (AC) and direct current (DC) fields comply with requirements.	Open	NG
M41	This risk of public exposure to electromagnetic fields is eliminated provided the planning constraint for emissions is met.	Closed	NG
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	
Open			
Comment			
This hazard is to be designed out. The current limit required by planning constraints is ~10µT which is significantly lower than the maximum limit specified by the regulations (~100µT for public and 500µT for workers).			

A.19 HAZ19

Identified By		Date Created	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Revised based on second FHA meeting.		12-Apr-17	
Description			
Incorrect magnetic compass reading			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF07	Magnetic compass/magnetometer deviation caused by magnetic fields from HV cables.	Technical Factors	Remote
Consequences			
ID	**Description**	**Severity**	
C05	Terrain separation deteriorating below normal requirements	Significant Incident	
Probability		**Severity**	
Remote		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M10	Airmanship provides mitigation.	Closed	
M19	RCAM, in collaboration with NG, to confirm that the magnetic fields at the compass base could not credibly lead to incorrect calibration of magnetic compasses.	Open	RCAM, NG
M20	Pre-flight check area to be assessed for effect of magnetic fields on the setting of aircraft direction indicators.	Open	RCAM
M21	RCAM to promulgate instruction to calibrate magnetic compasses only at compass base.	Open	RCAM
M22	General airmanship provides a mitigation because aircrew should quickly identify incorrect calibration by reference to visual landmarks.	Closed	
M23	RCAM to promulgate instruction not to set direction indicators against magnetic compasses in zones likely to be subject to magnetic interference.	Open	RCAM
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Date of Action			

Status of this Hazard Log Entry	Date Closed
Open	
Comment	

A.20 HAZ20

Identified By		**Date Created**	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Revised based on second FHA meeting.		12-Apr-2017	
Description			
High 50Hz impressed voltage or touch potentials due to fences or LV cabling.			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF19	Touch potential from HV cable layout or impressed potential in fences (planned or existing) and existing LV cables with the risk of impressed voltages.	Technical Factors	
Consequences			
ID	**Description**	**Severity**	
C11	Electric shock / electrocution	Serious Incident	
Probability		**Severity**	
		Serious Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M30	Detailed surveys for existing services are to be undertaken before excavation of a trench to lay the cables. Any existing cables will either be revealed by the survey or exposed on excavation and moved/dealt with appropriately. Thus, subject to this being completed, the risk of electric shock from impressed voltage and touch potentials will be eliminated by design.	Open	NG
M43	Cable protection system to ensure power is promptly removed in the event of an insulation failure.	Open	NG
M45	If any high-power AC cables run parallel or near-parallel to any metal fences or similar structures and run alongside for a significant distance, those structures are to be sufficiently earthed, and that earthing maintained sufficiently, to eliminate the risk of dangerous impressed and touch potentials.	Open	
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action taken			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	

Open	
Comment	

A.21 HAZ21

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Revised based on second FHA meeting.	12-Apr-17

Description

Loss of control of UAV.

Causal Factors

ID	Description	Category	Likelihood
CF20	Emissions/RFI from HV cables/facility cause malfunctioning of UAV (e.g. drones).	Technical Factors	Remote
CF21	Heat generated from converter station - air density changes immediately above the facility impacts aircraft or gliders.	Technical Factors	Extremely Improbable

Consequences

ID	Description	Severity
C07	Aircraft in close proximity with another aircraft such that their safety is or may be compromised.	Significant Incident

Probability	Severity
Remote	Significant Incident

Controls, Mitigations and Actions

ID	Description	Status	Assigned
M07	Publicity and training to include awareness of possible wind effects.	Open	RCAM
M10	Airmanship provides mitigation.	Closed	
M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.	Open	RCAM
M31	The communication strategy in place for flying UAVs to be studied further to determine possible risk.	Open	RCAM, FBC
M39	NG to Review RFI impact on UAVs.	Open	NG
M42	The possible effects of heat from the facility on UAVs are to be reviewed.	Closed	RCAM

Proposed By	Planned Date
HIRA 24-8-16	

Action taken

Date of Action

Status of this Hazard Log Entry	Date Closed
Open	

Comment

A.22 HAZ22

Identified By		**Date Created**	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Revised based on second FHA meeting.		22-Apr-17	
Description			
Smoke impeding vision of aircrew.			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF23	Equipment within the converter station catches fire and generates smoke impeding vision of aircrew	Fire and Smoke	Extremely Remote
Consequences			
ID	**Description**	**Severity**	
C05	Terrain separation deteriorating below normal requirements	Significant Incident	
C07	Aircraft in close proximity with another aircraft such that their safety is or may be compromised.	Significant Incident	
Probability		**Severity**	
Extremely Remote		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M32	Design specifications to require fire protection systems to ensure that fire is controllable.	Open	NG
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action Taken			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	
Open			
Comment			
The risk is unlikely to be significantly worse than any other building near the airport because advanced fire management systems such as the proposed fire deluge system are expected to offset any increased fire risk due to the location of the IFA2 and the materials present.			

A.23 HAZ23

Identified By		**Date Created**	
HIRA 24-8-16		24-Aug-16	
Last Update Action		**Date of Last Update**	
Closed.		22-Apr-17	
Description			
Smoke impeding vision of aircrew			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF23	Equipment within the converter station catches fire and generates smoke impeding vision of aircrew	Fire and Smoke	Extremely Remote
Consequences			
ID	**Description**	**Severity**	
C07	Aircraft in close proximity with another aircraft such that their safety is or may be compromised.	Significant Incident	
Probability		**Severity**	
Extremely Remote		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M32	Design specifications to require fire protection systems to ensure that fire is controllable. Open	NG	
Proposed By		**Planned Date**	
HIRA 24-8-16			
Action Taken			
Merged with HAZ22			
Date of Action			
24-Apr-17			
Status of this Hazard Log Entry		**Date Closed**	
Closed		24-Apr-17	
Comment			
The risk is unlikely to be significantly worse than any other building near the airport because advanced fire management systems such as the proposed fire deluge system are expected to offset any increased fire risk due to the location of the IFA2 and the materials present.			

A.24 HAZ24

Identified By		**Date Created**	
HIRA 12-4-17		12-Apr-17	
Last Update Action		**Date of Last Update**	
Created		12-Apr-17	
Description			
Incorrect ground lighting intensity			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF26	Interference from high-voltage cables affects ground lighting.	Technical Factors	Remote
Consequences			
ID	**Description**	**Severity**	
C01	Aircraft unintentionally deviates from normal in-flight parameters.	Significant Incident	
Probability		**Severity**	
Remote		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M40	Any future Airfield Ground Lighting (AGL) system to be designed to ensure interference from HV cables cannot credibly affect the lighting.	Open	RCAM
Proposed By		**Planned Date**	
HIRA 12-4-17			
Action Taken			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	
Open			
Comment			
There is no AGL system at the airport. This hazard relates to possible future development.			

A.25 HAZ25

Identified By		**Date Created**	
HIRA 12-4-17		12-Apr-17	
Last Update Action		**Date of Last Update**	
Created		12-Apr-17	
Description			
Wrong or no altimeter reading			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF11	Altimeters (UHF) impacted by emissions from HV cables/facility.	Technical Factors	Extremely Improbable
Consequences			
ID	**Description**	**Severity**	
C05	Terrain separation deteriorating below normal requirements	Significant Incident	
Probability		**Severity**	
Extremely Improbable		Significant Incident	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M25	If aircraft using radio altimetry are likely to use the airport, the effect of the IFA2 on radio altimetry is to be assessed.	Open	RCAM
Proposed By		**Planned Date**	
HIRA 12-4-17			
Action Taken			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	
Open			
Comment For MCA Equipment altimetry is part of the flight management / terrain awareness system which uses a GPS interface (no ground based systems). Pilots are particularly reliant on this equipment during bad-weather approaches. Impact to be assessed to ensure the likelihood of the hazard is extremely improbable.			

A.26 HAZ26

Identified By		**Date Created**	
HIRA 12-4-17		12-Apr-17	
Last Update Action		**Date of Last Update**	
Reviewed and updated following meeting with MCA on 25 July 2017.		23-Aug-17	
Description			
Unknown effect on MCA operations			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF15	Interference with Maritime Coastguard Agency communications caused by RFI /emissions from/HV cables/facility.	Technical Factors	
CF25	Emissions from HV cables/facility interfere with meteorological instruments.	Technical Factors	
Consequences			
ID	**Description**	**Severity**	
C12	Unknown effect on MCA		
Probability		**Severity**	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M27	Liaise with MCA to identify possible hazards specific to its operation arising from IFA2.	Closed	FBC, RCAM
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference	Open	NG
Proposed By		**Planned Date**	
HIRA 12-4-17			
Action taken			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	
Open			
Comment			
Merged with HAZ01, HAZ06, HAZ08, HAZ10, HAZ13, HAZ15, and HAZ16 after discussion with MCA.			

A.27 HAZ27

Identified By		**Date Created**	
HIRA 12-4-17		12-Apr-17	
Last Update Action		**Date of Last Update**	
Created		12-Apr-17	
Description			
Unknown effects on Britten-Norman operations			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF16	Emissions from HV cables and facilities impacts Britten-Norman activities involving complex avionics and military aircraft.	Technical Factors	
Consequences			
ID	**Description**	**Severity**	
C10	Unknown effect on Britten-Norman operations		
Probability		**Severity**	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M28	Liaise with Britten-Norman to identify possible hazards specific to its operation arising from IFA2.	Closed	RCAM, FBC
Proposed By		**Planned Date**	
HIRA 12-4-17			
Action Taken			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	
Open			
Comment			

A.28 HAZ28

Identified By		**Date Created**	
HIRA 12-4-17		12-Apr-17	
Last Update Action		**Date of Last Update**	
Created		12-Apr-17	
Description			
Unknown effect of NATS operations			
Causal Factors			
ID	**Description**	**Category**	**Likelihood**
CF17	Impact on Radar due to emissions from HV cables/facility	Technical Factors	
Consequences			
ID	**Description**	**Severity**	
C13	Unknown effect on NATS		
Probability		**Severity**	
Controls, Mitigations and Actions			
ID	**Description**	**Status**	**Assigned**
M29	Liaise with NATS to identify possible hazards specific to its operation arising from IFA2.	Closed	RCAM, FBC
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference	Open	NG
Proposed By		**Planned Date**	
HIRA 12-4-17			
Action taken			
Date of Action			
Status of this Hazard Log Entry		**Date Closed**	
Open			
Comment			

APPENDIX B CAUSAL FACTOR FORMS

B.1 CF01

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description

Distraction of aircrew at night caused by lighting from the facility - building and security lighting

Category

Human Factors

Consequence

Temporary reduction in vision caused by glare

Probability

Extremely Improbable

Controls, Mitigations and Actions

ID	Mitigation
M01	Building lighting to be directed downwards, away from flight paths and control tower, and not towards the runway. This requirement is to be included in the design specifications.
M02	The design of all road lighting to be compliant with BS 5489 [6] Section 12.2: Lighting in the vicinity of aerodromes.

Associated Hazards

ID	Description
HAZ01	Distraction of aircrew.
HAZ06	Distraction of aircrew or control tower staff.
HAZ08	Distraction of aircrew or control tower staff.
HAZ10	Distraction of control tower staff.
HAZ13	Distraction of aircrew or control tower staff (class G airspace operations).
HAZ15	Distraction of aircrew or control tower staff, other than by distraction of aircrew caused by reflection from building structure and cladding (procedural non-radar operations).
HAZ16	Distraction of aircrew or control tower staff.

Comments

B.2 CF02

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description

Distraction of aircrew at night caused by reflection from building structure and cladding

Category

Human Factors

Consequence

Temporary reduction in vision caused by glare

Probability

Extremely Improbable

Controls, Mitigations and Actions

ID	Mitigation
M03	External surfaces of building to be designed not to present a distraction to aircrew.

Associated Hazards

ID	Description
HAZ01	Distraction of aircrew.
HAZ06	Distraction of aircrew or control tower staff.
HAZ08	Distraction of aircrew or control tower staff.
HAZ10	Distraction of control tower staff.
HAZ13	Distraction of aircrew or control tower staff (class G airspace operations).
HAZ14	Distraction of aircrew caused by reflection from building structure and cladding (procedural non-radar operations).
HAZ16	Distraction of aircrew or control tower staff.

Comments

B.3 CF03

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description

Human (public and workers) exposure to excessive magnetic fields (see 8.2 for impact on equipment)

Category

Human Factors

Consequence

Health hazard.

Probability

Extremely Improbable

Controls, Mitigations and Actions

ID	Mitigation
M38	Project documentation to show that AC and direct current (DC) fields comply with requirements.
M41	This risk of public exposure to electromagnetic fields is eliminated provided the planning constraint for emissions is met.

Associated Hazards

ID	Description
HAZ18	Exposure of public and workers to excessive magnetic fields

Comments

No specific effect at the airport, relative to the general background magnetic fields.

B.4 CF04

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description

Communication interference, impacting the workload of the staff in control tower or aircrew (e.g. dealing with instrumentation and radio problems).

Category

Human Factors

Consequence

Interference impacts radio or causes damage to communication or navigation equipment. Increased workload dealing with this causes distraction of tower personnel or aircrew.

Probability

Extremely Improbable

Controls, Mitigations and Actions

ID	Mitigation
M16	If communications dead spots are found, appropriate procedures are to be put in place to manage the resulting risk.

Associated Hazards

ID	Description
HAZ01	Distraction of aircrew.
HAZ06	Distraction of aircrew or control tower staff.
HAZ08	Distraction of aircrew or control tower staff.
HAZ10	Distraction of control tower staff.
HAZ13	Distraction of aircrew or control tower staff (class G airspace operations).
HAZ15	Distraction of aircrew or control tower staff, other than by distraction of aircrew caused by reflection from building structure and cladding (procedural non-radar operations).
HAZ16	Distraction of aircrew or control tower staff.

Comments

There may be a localised impact on communication, but this can be identified and managed.

The likelihood and significance could increase with the introduction of new equipment (such as visiometers and cloud base recorders) and introduction of FIS, but the second HIRA 24-8-16 did not consider such changes would be sufficient to change the risk categories of the associated hazards.

If communications fail during the final phase of approach, it is extremely unlikely that the aircrew would be sufficiently distracted by the failure to affect their handling of the landing.

B.5 CF05

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description
Noise from IFA2 facility causes a distraction.
Category
Human Factors
Consequence
Distraction to aircrew due to noise from the facility.
Probability
Extremely Improbable

Controls, Mitigations and Actions

ID	Mitigation
M17	Planning Constraints to limit permitted noise from IFA2 (taking the proposed runway extension into account).

Associated Hazards

ID	Description
HAZ01	Distraction of aircrew.
HAZ06	Distraction of aircrew or control tower staff.
HAZ08	Distraction of aircrew or control tower staff.
HAZ10	Distraction of control tower staff.
HAZ13	Distraction of aircrew or control tower staff (class G airspace operations).
HAZ15	Distraction of aircrew or control tower staff, other than by distraction of aircrew caused by reflection from building structure and cladding (procedural non-radar operations).
HAZ16	Distraction of aircrew or control tower staff.

Comments
Noise levels from the IFA2 facility are low. Unlikely to be heard by aircraft, possibly could be heard by glider pilots. Noise levels unlikely to be higher than the background noise. To be considered as part of the design specifications.

B.6 CF06

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description

Pilots under training who are not accustomed to any impacts from converter station - e.g. as they have undergone training before the converter station is operational.

Category

Human Factors

Consequence

Distraction to aircrew

Probability

Extremely Improbable

Controls, Mitigations and Actions

ID	Mitigation
M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.

Associated Hazards

ID	Description
HAZ01	Distraction of aircrew.
HAZ06	Distraction of aircrew or control tower staff.
HAZ08	Distraction of aircrew or control tower staff.
HAZ10	Distraction of control tower staff.
HAZ13	Distraction of aircrew or control tower staff (class G airspace operations).
HAZ15	Distraction of aircrew or control tower staff, other than by distraction of aircrew caused by reflection from building structure and cladding (procedural non-radar operations).
HAZ16	Distraction of aircrew or control tower staff.

Comments

For Pilots under training, the onus is on the instructor. It is expected to take 4 years to build the facility, with plenty of publicity, so trainees have time to adjust. Communications required on switching on of the facility.

B.7 CF07

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description
Magnetic compass/magnetometer deviation caused by magnetic fields from HV cables.
Category
Technical Factors
Consequence
Wrong compass reading or heading indication.
Probability
Remote
Controls, Mitigations and Actions

ID	Mitigation
M10	Airmanship provides mitigation.
M19	RCAM, in collaboration with NG, to confirm that the magnetic fields at the compass base could not credibly lead to incorrect calibration of magnetic compasses.
M20	Pre-flight check area to be assessed for effect of magnetic fields on the setting of aircraft direction indicators.
M21	RCAM to promulgate instruction to calibrate magnetic compasses only at compass base.
M22	General airmanship provides a mitigation because aircrew should quickly identify incorrect calibration by reference to visual landmarks.
M23	RCAM to promulgate instruction not to set direction indicators against magnetic compasses in zones likely to be subject to magnetic interference.

Associated Hazards

ID	Description
HAZ19	Incorrect magnetic compass reading.

Comments
More information was available at the second HIRA 24-8-16 than at the first HIRA 24-8-16.
HAZ19 has been expanded to cover all magnetic compass deviation caused by fields from HV cables
LSA RFI assessment demonstrated only a localised impact on magnetic fields for compass and magnetometers on the ground in certain locations.
Provided the compass is calibrated correctly, reading will revert to correct reading once outside the zone.

The compass base is an area allocated for compass calibration, away from the cable routes. The distance between the compass base and the cable routes should reduce the probability of IFA2 affecting compass calibration to Remote or better.
Within the pre-flight checks, the compass will be used to set direction indicators, which introduces a potential risk because the area might be close to the cables.
Magnetic checks shall be conducted after the cables are installed under the ground to identify whether it will be a suitable area for pre-flight checks including compass calibration.
It is anticipated that in the worst case, there may belocalised deflection within ±12m of the cables.
Compass checks shall not take place in the vicinity of the cables.
The direction indicator is not directly affected by EMI. The direction indicator should be reset in flight every 10-15min by the aircrew, which should correct any incorrect Direction Indicator (DI) setting.
Multiple failures would be needed for this hazard to be realised: • The aircrew conducts the pre-flight checks in a location in which the magnetic compass is misaligned; • The aircrew fails to notice that the DI does not align with the runway direction; • The aircrew fails to reset the DI as required by normal procedures; • The aircrew fails to notice (by reference to ground features) that the aircraft is deviating from the intended course.

B.8 CF08

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description
Air-ground communications impacted by interference caused by emissions from HV cables/facility.
Category
Technical Factors
Consequence
Delayed air-ground communication.
Probability
Remote
Controls, Mitigations and Actions

ID	Mitigation
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference.

Associated Hazards

ID	Description
HAZ01	Distraction of aircrew.
HAZ06	Distraction of aircrew or control tower staff.
HAZ08	Distraction of aircrew or control tower staff.
HAZ10	Distraction of control tower staff.
HAZ13	Distraction of aircrew or control tower staff (class G airspace operations).
HAZ15	Distraction of aircrew or control tower staff, other than by distraction of aircrew caused by reflection from building structure and cladding (procedural non-radar operations).
HAZ16	Distraction of aircrew or control tower staff.

Comments
LSA RFI assessment concludes low probability of interference for current operations.
Risk of interference for additional equipment introduced for future operations would be assessed as part of the safety management of the introduction of that equipment.
With the introduction of an FIS, there is the potential for safety impact in the event of interference/disruption in air - ground communications.
In events when main radio communication is lost FISO will make a decision to change radio and communicate with the

pilot. Furthermore, Air traffic control may use light signals to communicate with the pilots.

B.9 CF09

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description

Ground-ground communications (UHF) impacted by interference caused by emissions from HV cables/facility.

Category

Technical Factors

Consequence

None

Probability

Extremely Improbable

Controls, Mitigations and Actions

ID	Mitigation
M34	Lighting signals can be used if RF levels are exceptionally sufficiently high to cause interruption to radio communications systems.
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference.

Associated Hazards

ID	Description
HAZ11	Impaired ground to ground communications.
HAZ12	Impaired ground to ground communications.

Comments

No mechanism has been Identified By which ground-ground communication problems can impair the safety of operations.

No mechanism has been Identified By which ground-ground communication problems can impair the safety of operations.

Equipment introduced for future operations will be subject to its own risk management.

Trained staff stop at a safe place when the communication fails. If main radio communication is lost FISO can make a decision to change radio and communicate with the pilot or can use light signals to communicate with the pilots/ people on the ground/ vehicles on the ground.

Trained staff stop at a safe place when the communication fails. If main radio communication is lost FISO can make a decision to change radio and communicate with the pilot or can use light signals to communicate with the pilots/ people on the ground/ vehicles on the ground.

B.10 CF10

Identified By	**Date Created**
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description
Interference caused by emissions from HV cables/facility delays Emergency Services communication
Category
Technical Factors
Consequence
Delay in response from Emergency Services
Probability
Extremely Improbable
Controls, Mitigations and Actions

ID	**Mitigation**
M24	FIS procedures to take into account the possibility of impairment of ground-ground communications.
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference

Associated Hazards	
ID	**Description**
HAZ11	Impaired ground to ground communications.

Comments
Amended for the introduction of an FIS.
Equipment introduced for future operations will be subject to its own risk management.
Emergency services have agreed response procedures with fire zones defined.
In the event of a fire/emergency, all air traffic would be directed to an alternative airport until it is safe to land.
Several communication channels as options under FISO. Emergency communications prioritised (radio silence). If necessary, emergency services can be directed to the incident by other means.

B.11 CF11

Identified By	**Date Created**
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17
Description	
Altimeters (UHF) impacted by emissions from HV cables/facility.	
Category	
Technical Factors	
Consequence	
Wrong or no altimeter reading	
Probability	
Extremely Improbable	
Controls, Mitigations and Actions	
ID	**Mitigation**
M25	If aircraft using radio altimetry are likely to use the airport, the effect of the IFA2 on radio altimetry is to be assessed.
Associated Hazards	
ID	**Description**
HAZ25	Wrong or no altimeter reading
Comments	

B.12 CF12

Identified By	**Date Created**
HIRA 24-8-16.	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17
Description	
Instrument Landing System (ILS) impacted by emissions from HV cables/facility	
Category	
Technical Factors	
Consequence	
Incorrect ILS guidance.	
Probability	
Controls, Mitigations and Actions	
Associated Hazards	
Comments	
No ILS currently.	
Confirmed as no longer applicable.	

B.13 CF13

Identified By	**Date Created**
HIRA 24-8-16.	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17
Description	
GPS impacted by emissions from HV cables/facility (note current aircraft have their own GPS).	
Category	
Consequence	
Wrong or no position information from GPS.	
Probability	
Controls, Mitigations and Actions	
Associated Hazards	
Comments	
MCA Helicopter Pilots rely on a GPS based flight management system for navigation and depend on this at low altitudes for bad weather approaches.	
The MCA GPS based system is augmented and is subject to its own safety management.	
Pilots of other aircraft do not depend on GPS for navigation; At low altitude (below 600ft) aircrew perform a visual approach.	
The landing area is a flat area. It does not affect minimum safe altitude.	
GPS is always vulnerable to multipath and dropouts, which are dealt with the in the existing procedures.	
If GPS augmentation is introduced, it will be subject to its own safety management.	

B.14 CF14

Identified By	**Date Created**
HIRA 24-8-16.	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17
Description	
Impact from RFI/emissions on power supply system in aircraft.	
Category	
Technical Factors	
Consequence	
Damage to or loss of power supply in aircraft.	
Probability	
Controls, Mitigations and Actions	
ID	**Mitigation**
M26	LSA RFI assessment concluded that this is not a credible effect.
Associated Hazards	
Comments	

B.15 CF15

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated following meeting with MCA on 25 July 2017.	23-Aug-17

Description	
Interference with Maritime Coastguard Agency communications caused by RFI /emissions from/HV cables/facility.	
Category	
Technical Factors	
Consequence	
Probability	
Controls, Mitigations and Actions	
ID	**Mitigation**
M27	Liaise with MCA to identify possible hazards specific to its operation arising from IFA2.
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference
Associated Hazards	
ID	**Description**
HAZ01	Distraction of aircrew
HAZ06	Distraction of aircrew or control tower staff.
HAZ08	Distraction of aircrew or control tower staff.
HAZ13	Distraction of aircrew or control tower staff (class G airspace operations)
HAZ15	Distraction of aircrew or control tower staff, other than by distraction of aircrew caused by reflection from building structure and cladding (procedural non-radar operations)
HAZ16	Distraction of aircrew or control tower staff
HAZ25	Wrong or no altimeter reading
HAZ26	Unknown effect on MCA operations
Comments	
The station, mast and tower are on the airfield.	
MCA plans to install a MEOSAR satellite system (Medium Earth Orbit Search and Rescue), for search and rescue (SAR) distress alerting, have been assessed for EMC.	

B.16 CF16

Identified By	**Date Created**
HIRA 24-8-16	12-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description
Emissions from HV cables and facilities impacts Britten-Norman activities involving complex avionics and military aircraft.
Category
Technical Factors
Consequence
Unknown effect on Britten-Norman activities.
Probability
Controls, Mitigations and Actions

ID	**Mitigation**
M28	Liaise with Britten-Norman to identify possible hazards specific to its operation arising from IFA2.

Associated Hazards	
ID	**Description**
HAZ27	Unknown effects on Britten-Norman operations

Comments
Status of actions updated.
A detailed study has been conducted to evaluate the potential impact on Britten-Norman activities.
This study is being reviewed as part of the Phase 1 technical assessment to determine whether there are any gaps.

B.17 CF17

Identified By	**Date Created**
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description
Impact on Radar due to emissions from HV cables/facility
Category
Technical Factors
Consequence
Temporary loss of radar.
Probability
Controls, Mitigations and Actions

ID	**Mitigation**
M29	Liaise with NATS to identify possible hazards specific to its operation arising from IFA2.
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference

Associated Hazards	
ID	**Description**
HAZ28	Unknown effect of NATS operations

Comments
Status of actions updated.
No impact at the airport. The radar service is provided by Solent Radar.
LSA RFI assessment concludes that it is unlikely that the facility would cause RFI to future radar.
Needs to be confirmed that the NATS Radar system is only used for training purposes. A related hazard is retained until that is determined.

B.18 CF18

Identified By	**Date Created**
HIRA 24-8-16.	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17
Description	
Ionising radiation from HV cables.	
Category	
Technical Factors	
Consequence	
Fire	
Probability	
Controls, Mitigations and Actions	
Associated Hazards	
Comments	
No credible mechanism for this causal factor has been identified.	

B.19 CF19

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description

Touch potential from HV cable layout or impressed voltage in fences (planned or existing) or existing LV cables.

Category

Technical Factors

Consequence

Electric shock/electrocution from touch potential.

Probability

Controls, Mitigations and Actions

ID	Mitigation
M30	Detailed surveys for existing services are to be undertaken before excavation of a trench to lay the cables. Any existing cables will either be revealed by the survey or exposed on excavation and moved/dealt with appropriately. Thus, subject to this being completed, the risk of electric shock from impressed and touch potentials will be eliminated by design.
M43	Cable protection system to ensure power is promptly removed in the event of an insulation failure.
M45	If any high-power AC cables run parallel or near-parallel to any metal fences or similar structures and run alongside for a significant distance, those structures are to be sufficiently earthed, and that earthing maintained sufficiently, to eliminate the risk of dangerous impressed and touch potentials.

Associated Hazards

ID	Description
HAZ20	High 50Hz impressed and touch potentials in fences or LV cabling.

Comments

The power should be designed to trip out within 80ms if there is earth leakage. There should also be a backup system to force a power trip out within 500ms.

There are no fences that runs parallel and near to the cable route. There is no effect if cables cross the conductor at 90º. Note this is an AC not a DC issue so only relates to the AC circuits.

To be checked that is the southwest corner where the cables cross under the fencing whether the fencing is non-conductible. However, the fencing is earthed locally to ensure there is no step or touch potential problem.

B.20 CF20

Identified By	**Date Created**
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description
Emissions/RFI from KV cables/facility cause malfunctioning of UAV (e.g. drones).
Category
Technical Factors
Consequence
Loss of control of UAV.
Probability
Remote

Controls, Mitigations and Actions	
ID	**Mitigation**
M31	The communication strategy in place for flying UAVs to be studied further to determine possible risk.
M39	NG to Review RFI impact on UAVs.

Associated Hazards	
ID	**Description**
HAZ21	Loss of control of UAV.

Comments
Note that the risk might be dependent on the location UAVs are permitted to fly in and controls on their operation.

B.21 CF21

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description

Heat generated from converter station - air density changes immediately above the facility impacts aircraft or gliders.

Category

Technical Factors

Consequence

Loss of control of aircraft/glider.

Probability

Extremely Improbable

Controls, Mitigations and Actions

ID	Mitigation
M07	Publicity and training to include awareness of possible wind effects.
M10	Airmanship provides mitigation.
M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.
M42	The possible effects of heat from the facility on UAVs are to be reviewed.

Associated Hazards

ID	Description
HAZ02	Wind impact.
HAZ04	Wind impact, caused by building (turbulence and unexpected changes in wind patterns, wind shear and so on). Note that the worst case at the airport is wind from north-east.
HAZ05	Wind impact, caused by building (turbulence and unexpected changes in wind patterns, wind shear and so on). Note that the worst case at the airport is wind from north-east.
HAZ07	Wind impact, caused by building (turbulence and unexpected changes in wind patterns, wind shear and so on). Note that the worst case at the airport is wind from north-east.
HAZ21	Loss of control of UAV.

Comments

Any change in temperature should be slight change (a few degrees) and is a localised. Aircraft/gliders will fly over the converter station on take-off but there should, therefore, be no material impact.

Potential for this to be notified to glider pilots, so they are aware of possible slight effects

B.22 CF22

Identified By	**Date Created**
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Merged with CF07	12-Apr-17
Description	
Compass miscalibrated due to calibration taking place in zone impacted by magnetic fields.	
Category	
Technical Factors	
Consequence	
Probability	
Controls, Mitigations and Actions	
Associated Hazards	
Comments	

B.23 CF23

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description
Equipment within the converter station catches fire and generates smoke impeding vision of aircrew
Category
Fire and Smoke
Consequence
Aircrew vision impeded.
Probability
Extremely Remote
Controls, Mitigations and Actions

ID	Mitigation
M32	Design specifications to require fire protection systems to ensure that fire is controllable.

Associated Hazards	
ID	**Description**
HAZ22	Smoke impeding vision of aircrew.
HAZ23	Smoke impeding vision of aircrew

Comments
Powered aircraft can divert from smoke; gliders would need to avoid or land.
The proposed runway extension could mean that aircraft are at a lower altitude than at present when passing over the IFA2 site.

B.24 CF24

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	24-Aug-16

Description

Wind impact, caused by building or landscaping (turbulence and unexpected changes in wind patterns, wind shear, and so on).

Category

Environmental Factors

Consequence

Loss of control of aircraft/glider.

Probability

Extremely Improbable

Controls, Mitigations and Actions

ID	Mitigation
M06	Wind assessment to determine the impact of the building on the wind patterns (including consideration of light aircraft and UAVs).
M07	Publicity and training to include awareness of possible wind effects.
M09	Effects of wind to be kept under review in the case of increased traffic.
M10	Airmanship provides mitigation.

Associated Hazards

ID	Description
HAZ02	Wind impact.
HAZ04	Wind impact, caused by building (turbulence and unexpected changes in wind patterns, wind shear and so on). Note that the worst case at the airport is wind from north-east.
HAZ05	Wind impact, caused by building (turbulence and unexpected changes in wind patterns, wind shear and so on). Note that the worst case at the airport is wind from north-east.
HAZ07	Wind impact, caused by building (turbulence and unexpected changes in wind patterns, wind shear and so on). Note that the worst case at the airport is wind from north-east.

Comments

Note that changes in wind could cause distraction initially for glider pilots in particular, i.e. until they become familiar with the changed wind patterns.

B.25 CF25

Deleted after discussion with MCA. The “Unknown effect on MCA operations” is now known, and the effects addressed by other causal factors.

B.26 CF26

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description
Interference from high-voltage cables affects ground lighting.
Category
Technical Factors
Consequence
Malfunction of lighting (AGL) impacts aircraft landing at night.
Probability
Remote
Controls, Mitigations and Actions

ID	Mitigation
M40	Any future AGL system to be designed to ensure interference from HV cables cannot credibly affect the lighting.

Associated Hazards	
ID	**Description**
HAZ24	Incorrect ground lighting intensity

Comments

B.27 CF27

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description
Insulation failure of HV cables - impacts another system (e.g. AGL)
Category
Environmental Factors
Consequence
Damage / malfunction of equipment.
Probability
Controls, Mitigations and Actions

ID	Mitigation
M43	Cable protection system to ensure power is promptly removed in the event of an insulation failure.

Associated Hazards
Comments
Updated for cable protection system assumptions as recorded at the workshop on the 11&12th April 2017.
Based on the discussion at the workshop on the 11&12th April 2017, the power will trip out quickly (~80ms). There is also a backup system which would force a full power trip out in 500ms. The assumption to be verified by design specifications.

B.28 CF28

Identified By	Date Created
HIRA 24-8-16.	24-Aug-16
Last Update Action	**Date of Last Update**
Closed based on the conclusion of that meeting that the risk is not specific to IFA2.	12-Apr-17
Description	
Future construction works (once converter station in operation) - digging in the vicinity of HV cables.	
Category	
Environmental Factors	
Consequence	
Electrocution / electric shock to future construction workers	
Probability	
Controls, Mitigations and Actions	
Associated Hazards	
Comments	
Managed by a separate process not relevant to this assessment.	
Cable location records to be retained within the Health and Safety File as required by Construction (Design and Management) (CDM) Regulations.	
A safe digging procedure shall be in place. All operation and future activities are subject to aerodrome regulations.	
No longer considered relevant to IFA2.	

B.29 CF29

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description
Future planning of landscaping - attracts birds near to airfield
Category
Environmental Factors
Consequence
Bird strike
Probability
Remote

Controls, Mitigations and Actions

ID	Mitigation
M14	RCAM to discuss bird strikes with a wildlife expert and to seek the expert's advice on how to manage the bird activities in this area.
M15	FBC to consider the risk of bird strike in future landscaping and choice of trees, and so on.

Associated Hazards

ID	Description
HAZ03	Bird strike

Comments
The airport is close to the sea and green spaces that already attract birds.

B.30 CF30

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description
Converter station warms air immediately above the converter station and attracts birds.
Category
Environmental Factors
Consequence
Probability
Remote
Controls, Mitigations and Actions

ID	Mitigation
M14	RCAM to discuss bird strikes with a wildlife expert and to seek the expert's advice on how to manage the bird activities in this area.

Associated Hazards	
ID	**Description**
HAZ03	Bird strike
Comments	

B.31 CF31

Identified By	**Date Created**
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17
Description	
Building design -flat roof - attracts birds	
Category	
Environmental Factors	
Consequence	
Bird strike.	
Probability	
Remote	
Controls, Mitigations and Actions	
ID	**Mitigation**
M12	Building to provide appropriate access for bird management strategy.
Associated Hazards	
ID	**Description**
HAZ03	Bird strike
Comments	

B.32 CF32

Identified By	Date Created
HIRA 24-8-16	24-Aug-16
Last Update Action	**Date of Last Update**
Reviewed and updated at HIRA workshop 11&12th April 2017.	12-Apr-17

Description
Tall trees
Category
Environmental Factors
Consequence
Tree growth impacts the obstacle limitation surface.
Probability
Remote

Controls, Mitigations and Actions	
ID	**Mitigation**
M07	Publicity and training to include awareness of possible wind effects.
M09	Effects of wind to be kept under review in the case of increased traffic.
M10	Airmanship provides mitigation.

Associated Hazards	
ID	**Description**
HAZ02	Wind impact.

Comments

B.33 CF33

Identified By	Date Created
HIRA 12-4-17.	12-Apr-17
Last Update Action	**Date of Last Update**
Closed because not considered a credible hazard.	12-Apr-17
Description	
Fire as a result of fuel installation facility or fuel mobile bowsers being near the cable routes.	
Category	
Environmental Factors	
Consequence	
Fire on the airfield, smoke affects visibility for pilots.	
Probability	
Extremely Remote	
Controls, Mitigations and Actions	
ID	**Mitigation**
M44	The location of the fixed fuel installation and filling points for mobile bowsers is not near the HV cables.
Associated Hazards	
Comments	
The cabling cannot credibly cause ionising levels of radiation.	

B.34 CF34

Identified By	**Date Created**
HIRA 12-4-17	12-Apr-17
Last Update Action	**Date of Last Update**
Closed because no credible hazard was identified.	12-Apr-17
Description	
RFI / interference with Aeronautical Fixed Telecommunication Network (AFTN) causing loss of data.	
Category	
Technical Factors	
Consequence	
AFTN is not currently used. However AFTN is related to FIS, might be used in future. AFTN is not mandatory. No significant effect.	
Probability	
Controls, Mitigations and Actions	
Associated Hazards	
Comments	
New causal factor - not considered to result in a credible hazard.	

B.35 CF35

Identified By	**Date Created**
HIRA 12-4-17	12-Apr-17
Last Update Action	**Date of Last Update**
Closed because no credible hazard identified	12-Apr-17
Description	
Insufficient drainage causing water ingress and flooding.	
Category	
Consequence	
No safety impact identified; operational issues only.	
Probability	
Controls, Mitigations and Actions	
Associated Hazards	
Comments	

B.36 CF36

Identified By	Date Created
HIRA 24-8-16	12-Apr-17
Last Update Action	**Date of Last Update**
Created	12-Apr-17

Description
Terrorist attack on IFA2
Category
Terrorist Incident
Consequence
Unknown effect - needs results of threat assessment.
Probability
Controls, Mitigations and Actions

ID	Mitigation
M37	A threat assessment to be conducted to determine the threat levels, using input from NG and FBC.

Associated Hazards	
ID	**Description**
HAZ17	Terrorist attack on IFA2
Comments	

APPENDIX C CONTROLS, MITIGATIONS AND ACTIONS

The “Assigned to” column is intentionally blank. Those mitigations that are not complete are taken through as dependencies in the safety justification [2] and tracked through the risk management plan.

ID	Description	Status	Comments	Assigned To
M01	Building lighting to be directed downwards, away from flight paths and control tower, and not towards the runway. This requirement is to be included in the design specifications.	Open		
M02	The design of all road lighting to be compliant with BS 5489 [6] Section 12.2: Lighting in the vicinity of aerodromes.	Closed		
M03	External surfaces of building to be designed not to present a distraction to aircrew.	Open		
M04	Noise levels to be managed to ensure they are not distracting to pilots, particularly glider pilots.	Open		
M05	Aircrew and airport ground operators to be kept up-to-date with changes and likely effects.	Open		
M06	Wind assessment to determine the impact of the building on the wind patterns (including consideration of light aircraft and UAVs).	Closed		
M07	Publicity and training to include awareness of possible wind effects.	Open		
M08	Obstacle clearance surfaces to be protected.	Open		
M09	Effects of wind to be kept under review in the case of increased traffic.	Closed		
M10	Airmanship provides mitigation.	Closed		
M11	RCAM to ensure an effective bird management strategy.	Open		
M12	Building to provide appropriate access for bird management strategy.	Open		
M13	The building design to discourage a significant increase in the bird activities or detrimental changes in bird behaviour in this area.	Open		
M14	RCAM to discuss bird strikes with a wildlife expert and to seek the expert’s advice on how to manage the bird activities in this area.	Closed		
M15	FBC to consider the risk of bird strike in future landscaping and choice of trees, and so on.	Closed		
M16	If communications dead spots are found, appropriate procedures are to be put in place to manage the resulting risk.	Open		

ID	Description	Status	Comments	Assigned To
M17	Planning Constraints to limit permitted noise from IFA2 (taking the proposed runway extension into account).	Closed		
M18	Airport authority to publicise the start of operations of the IFA2 in advance to airfield users.	Open		
M19	RCAM, in collaboration with NG, to confirm that the magnetic fields at the compass base could not credibly lead to incorrect calibration of magnetic compasses.	Open		
M20	Pre-flight check area to be assessed for effect of magnetic fields on the setting of aircraft direction indicators.	Open		
M21	RCAM to promulgate instruction to calibrate magnetic compasses only at compass base.	Open		
M22	General airmanship provides a mitigation because aircrew should quickly identify incorrect calibration by reference to visual landmarks.	Closed		
M23	RCAM to promulgate instruction not to set DIs against magnetic compasses in zones likely to be subject to magnetic interference.	Open		
M24	FIS procedures to take into account the possibility of impairment of ground-ground communications.	Open		
M25	If aircraft using radio altimetry are likely to use the airport, the effect of the IFA2 on radio altimetry is to be assessed.	Open		
M26	LSA RFI assessment concluded that this is not a credible effect.	Closed		
M27	Liaise with MCA to identify possible hazards specific to its operation arising from IFA2.	Closed		
M27	Liaise with MCA to identify possible hazards specific to its operation arising from IFA2.	Closed		
M28	Liaise with Britten-Norman to identify possible hazards specific to its operation arising from IFA2.	Closed		
M28	Liaise with Britten-Norman to identify possible hazards specific to its operation arising from IFA2.	Closed		
M29	Liaise with NATS to identify possible hazards specific to its operation arising from IFA2.	Closed		
M29	Liaise with NATS to identify possible hazards specific to its operation arising from IFA2.	Closed		

ID	Description	Status	Comments	Assigned To
M30	Detailed surveys for existing services are to be undertaken before excavation of a trench to lay the cables, any existing cables will either be revealed by the survey or exposed on excavation and moved/dealt with appropriately. Thus, subject to this being completed, the risk of electric shock from impressed and touch potentials will be eliminated by design.	Open		
M31	The communication strategy in place for flying UAVs to be studied further to determine possible risk.	Open		
M31	The communication strategy in place for flying UAVs to be studied further to determine possible risk.	Open		
M32	Design specifications to require fire protection systems to ensure that fire is controllable.	Open		
M34	Lighting signals can be used if RF levels are exceptionally sufficiently high to cause interruption to radio communications systems.	Open		
M35	All electrical systems to be designed to ensure RF levels are too low for significant interference.	Open	LSA RFI assessment showed that emissions are below the levels at which interference would occur, and the probability of inference to radios is very low for current airfield operations. There is no credible risk of equipment damage.	
M36	Intentionally blank.			
M37	A threat assessment to be conducted to determine the threat levels, using input from NG and FBC.	Open		
M38	Project documentation to show that AC and direct current (DC) fields comply with requirements.	Open		
M39	NG to Review RFI impact on UAVs.	Open		
M40	Any future AGL system to be designed to ensure interference from HV cables cannot credibly affect the lighting.	Open		
M41	This risk of public exposure to electromagnetic fields is eliminated provided the planning constraint for emissions is met.	Closed	The limit is ~10uT which is sufficiently below the regulations limit for the public (~100uT) and workers (~500uT).	
M42	The possible effects of heat from the facility on UAVs are to be reviewed.	Open		

ID	Description	Status	Comments	Assigned To
M43	Cable protection system to ensure power is promptly removed in the event of an insulation failure.	Open		
M44	The location of the fixed fuel installation and filling points for mobile bowsers is not near the HV cables.	Open		
M45	If any high-power AC cables run parallel or near-parallel to any metal fences or similar structures and run alongside for a significant distance, those structures are to be sufficiently earthed, and that earthing maintained sufficiently, to eliminate the risk of dangerous impressed and touch potentials.	Open		

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APPENDIX A3

ARCADIS Design & Consultancy for natural and built assets

TECHNICAL ASSESSMENT REPORT

For the IFA2 Interconnector at Solent Airport

35588103/RP/080917/3 Addendum 2

NOVEMBER 2017

Incorporating

EC HARRIS BUILT ASSET CONSULTANCY

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VERSION CONTROL

Issue	Revision No.	Date Issued	Description of Revision: Page No.	Description of Revision: Comment	Reviewed By:
1	1	08/09/2017	Draft Report issued for comment.		I Coutts J Wilson S Scannali
	2	06/10/2017	Comments provided on Revision 1 addressed		S Scannali
	3	10/11/2017	Comments from FBC on Revision 2 addressed	Various comments throughout	S Scannali

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EXECUTIVE SUMMARY

National Grid Interconnector Holdings (NG) is proposing to develop and implement a new electricity interconnector facility, the Interconnexion France-Angleterre 2 (IFA2). The facility is being developed jointly with Réseau de Transport d'Electricité (RTE), the French transmission system owner and operator. It will link the United Kingdom's electricity transmission network with France's, and is expected to help enhance the security, affordability, and sustainability of energy supply to both countries.

The facility consists of two converter stations, one sited in each country. The UK converter station is to be sited to the north-east of Solent Airport at Daedalus ("Solent Airport"). National Grid proposes to route high-voltage direct current and high-voltage alternating current cables in a shared cable corridor to the west and north of the Solent Airport main runway.

As part of the planning application and land acquisition processes, NG, in agreement with Fareham Borough Council (FBC) and Regional and City Airports Management (RCAM), the airport operator, commissioned a number of initial assessments as part of best practice development and design to determine whether the siting of the converter station and routing of cables at Solent Airport could affect the airport's existing operations. These assessments were also intended to help address stakeholder concerns about the proposals to site the converter station at Solent Airport. Additionally, they were also provided as supporting information to the public consultation and planning application processes.

Over 2016 and 2017 a further, more detailed technical assessment was undertaken to progressively develop the initial work. As part of this, Arcadis was commissioned to undertake an independent peer review as well as a further technical assessment of the converter station to assess whether the IFA2 Facility can co-exist safely with the existing airport and its operations. This work, presented in [1], [2], [36] and [37] includes a hazard identification and risk assessment study, and as a result of this a *Hazard Log* [37] has been developed in accordance with the standard *CAP 760* [15]. The project is now part way through the detailed design process.

This document supports the interim Safety Justification [38] for the IFA2 Facility at Solent Airport and is part of the work intended to support the application to the Fareham Borough Council (FBC) Executive Committee for the full planning acceptance and consent to progress to the next stage in the project.

Specifically, this report which forms part of the assurance evidence referenced within the *Hazard Log* [37], includes additional review and technical assessment to address some specific hazards in the *Hazard Log* [37]:

- a revised assessment of airfield safeguarding taking account of the IFA2 design and updating the assessment in [2];
- additional wind flow analysis carried out to supplement that in [1], [2] and [16]. The additional analysis covers the interaction effects between the IFA2 Converter Station and the Faraday Business Park;
- further independent peer review of some additional documents related to Radio Frequency Interference (RFI) and Electromagnetic Frequency (EMF) documents and consideration of EMF/RFI effects to confirm some assumptions made in the assessments in [1] and [36] and to consider some specific hazards within the hazard log that were not explicitly covered by the body of evidence available;
- consideration of the possible effects upon Maritime & Coastguard Agency (MCA) equipment arising from the IFA2 Facility;
- an assessment of Instrument Landing Systems (ILS), both generically and in the context of the IFA2 Facility at Solent Airport. Currently there are no plans to introduce ILS to the airport;
- an assessment of Unmanned Aerial Vehicles (UAVs), considering the risks that non-commercial UAVs could pose to Solent Airport and whether the IFA2 Facility could exacerbate these risks.

A summary of the conclusions associated with each of the above topics is given below.

Aerodrome Safeguarding Analysis

The aerodrome safeguarding analysis aims to ensure that the existing proposed development will have no impact on the safe operation of the airport. The proposed design of the buildings within the development are not infringing any of the obstacle limitation surfaces (OLS) and are compliant with the associated legislation and standards. The design of the IFA 2 building roof is pitched, which is less attractive to birds than a flat roof. A bird hazard management plan will be needed. Lighting within the development should follow the Airport Operators Association (AOA) advice [11] to ensure that the operation of the airport is not adversely impacted. The use of cranes during construction may present a temporary risk, but the type of crane used should be considered and agreed with the airport at the earliest opportunity, in order to assure that any risk is mitigated and is acceptable, particularly as the site is in such close proximity to the runway.

Wind Assessment

The wind effects analysis has considered the impact of the updated design of the IFA2 Converter Station combined with the future proposed Faraday Business Park buildings on the main runway and covers a realistic range of wind directions and wind speeds. One main effect observed is that the future proposed Faraday Business Park buildings act as a shield to the IFA2 Facility and have the overriding impact on the runway. This also explains the worst-case wind direction now being at the angle of 90^0 EoN, compared to 70^0 EoN from the earlier analysis when only the IFA2 Building is considered. This is because at this angle the future buildings produce three tails of faster winds, which covers the biggest area on the main runway compared to the other angles. The highest relative increase wind speed onto the main runway caused is a maximum of 29% at a height of 5m above the ground.

The wind impacts indicated above can be mitigated by extending the “frontline” buildings nearest the runways and closing the gaps.

Additionally, it was confirmed at the hazard identification and risk assessment [2, 37] studies report that localised changes in wind patterns are easily managed and that pilots quickly become familiar with any changes in wind patterns and adapt their flying accordingly through good airmanship.

Technical Assessment of EMF/RFI Effects

The work included in Arcadis’ *Technical Assessments* [1, 36] completed the main review of the analysis available concerning EMF and RFI effects. Due to additional information being made available very recently, a further review regarding EMF and RFI has been conducted. Additionally, some areas where there were perceived to be gaps in the existing hazard mitigation evidence have also been considered.

Based on the evidence reviewed so far, whilst further testing evidence is required, there are no issues concerning EMF/RFI emissions due to the IFA2 facility and the expectation remains that risks concerning RFI and EMF will be acceptable as defined in *CAP 760* [15]. Work is in progress to complete the testing and measurement activities that are planned to verify that the requirements and the planning conditions are met. All verification required to demonstrate that safety requirements are met is recorded as a dependency in the Safety Justification [38]. Some points requiring clarification are raised by the assessment, these should be addressed as the design documentation develops.

Avionics Impacts of Emissions from IFA2

The impact upon avionics equipment from emissions originating from IFA2 has been analysed. The analysis includes assessment of the impacts on Flight Management Systems (FMS) and other specific aircraft navigation systems. The analysis also assessed the impact of wideband noise on aircraft sensors.

It has been determined that any emissions from the IFA2 Facility will rapidly diminish with distance and will have no discernible impact on aircraft that are operating within the normal bounds of the airfield using the systems assessed within this assessment.

Instrument Landing Systems

The assessment has identified no specific risks related to IFA 2 in introducing a future ILS system or similar system at Solent Airport. Whilst there are no current plans to introduce ILS, the assessment has considered possible options for future systems and issues that will need to be progressed by the airport operator should the decision be taken to introduce an instrument landing capability or similar in the future.

It should be noted that the international standards for an Instrument Approach Procedure (IAP) require the existence of an instrument runway and an approach control service. Within the UK, an IAP implemented in accordance with the CAA's *CAP 1122* [39] framework will be limited to a minimum descent height of 500 feet above the runway threshold. This regulatory limitation determines that all of the options for the provision of an instrument approach at Solent Airport will provide the same operational performance capability in respect of cloud base and visibility. The operational benefits for all of the instrument approach types that may be considered by Solent Airport in the future are identical. This leads to a strong business case for GNSS based approaches as they do not require investment in the installation and ongoing maintenance costs of ground based navigation aid infrastructure.

Unmanned Aerial Vehicles

Unmanned Aerial Vehicles (UAVs) had previously been considered at a fairly high level. At this stage of the project, a more detailed assessment has now been carried out, whereby the potential impact (risks and effects) that UAVs could have on the IFA2 Facility and vice versa has been assessed in more detail, and is now included as part of the Hazard Identification and Risk Assessment [2 & 37].

This latest assessment has not identified any additional risks and mitigation measures that were not previously known, and there are currently no recommendations to add further controls, mitigations and actions not otherwise identified.

It is concluded that the proposed IFA2 Facility would not exacerbate the possible risks posed by UAVs themselves upon Solent Airport.

There is a potential for non-commercial, third party UAVs from external sources to enter the airport and IFA2 Facility boundaries, potentially causing damage or injury / death (depending on the type and size of UAV) to personnel. This is a generic external risk affecting all airports. Appropriate measures to prevent this need to be considered by the Airport Operator. There is no reason to believe why suitable measures should not be achieved within the programme for introducing UAVs to Solent Airport.

REFERENCES

Ref No	Reference Identifier	Title
1	35588100/NT/300916/1	Technical Assessment (Main Report) of the possible impact of the IFA2 Interconnector at Solent Airport Daedalus.
2	35588100/NT/300916/2	Technical Assessment (Hazard Log) of the possible impact of the IFA2 Interconnector at Solent Airport Daedalus.
3	-	Draft Daedalus Masterplan – 12 October 2016
4	CAP 738	Civil Aviation Publication - CAP 738 Safeguarding of Aerodromes, CAA
5	-	The Town and Country Planning (Safeguarded Aerodromes, Technical Sites and Military Explosives Storage areas) Direction 2002
6	-	Air Navigation Order made under Section 60 of the Civil Aviation Act 1982
7	-	Lee-on-Solent Airport AIP
8	CAP 168	Civil Aviation Publication - CAP 168 Licensing of Aerodromes, CAA
9	CS-ADR-DSN – Aerodrome Design	CS-ADR-DSN, Certification Specifications and Guidance Material for Aerodrome Design, EASA
10	CAP 772	Civil Aviation Publication - CAP 772 Wildlife Hazard Management at Aerodromes, CAA
11	-	Safeguarding of Aerodromes: Advice Note 2 – Lighting near Aerodromes
12	BS 5489-1:1203	British Standard Institution's BS 5489 Code of Practice for the design of road lighting
13	BS EN 13201-2:2015	British Standard Institution's BS EN 13201 Road lighting
14	BS 7121-3:2017	British Standard Institution's BS 7121 Code of practice for safe use of cranes
15	CAP 760	Civil Aviation Publication - CAP 760 Guidance on the Conduct of Hazard Identification, Risk Assessment and the Production of Safety Cases, CAA
16	35588100/NT/300916 Addendum 1	Technical Assessment - Wind Flow Analysis
17	35588102/RP/010617	Wind Flow Analysis for the IFA2 Facility
18	G3221.181I	IFA2 UK Onshore Environmental Statement, NG
19	G-003-0219	IFA2 Open Cut Trench Cross Section Under Taxiway, NG
20	500-001	IFA2 AGL Ducting, Issue B, NG
21	LSAEM/2015/019/TR/005	RF Survey Test Report for IFA2 Development at Solent Airport, NG
22	OVE-IFA2-REP-001	IFA2 Converter TV and Radio Reception Study, NG
23	935-11-600	Operation Manual for the 935-11 DF System, Cobham
24	G3221.181I	Drawing: IFA2 Overview Map Daedalus New Boundary, NG
25	1JNL568775	Radio and Telecomms Interference and EMF assessment, ABB
26	CIGRE TB391	TB 391 – Guide for measurement of radio frequency interference from HV and MV substations, Cigré
27	25-7-17 MoM	Minutes of meeting on 25 July 2017 at Lee-on-Solent Airport to discuss IFA2 – MCA Interface and Equipment
28	PPL15142-SE-RA-001-v00	Preliminary impressed voltage assessment for cables at Daedalus
29	NEN 3654:2012	NEN 3654:2012, Mutual Influence of Pipelines And High-Voltage Circuits

Ref No	Reference Identifier	Title
30	IEC 61000	IEC 61000 Electromagnetic compatibility (EMC), International Electrotechnical Commission
31	CAP 722	Civil Aviation Publication - CAP 722 Unmanned Aircraft System Operations in UK Airspace – Guidance, CAA
32	EASA NPA 2017-05	EASA NPA 2017-05 (A) and (B) - Introduction of a regulatory framework for the operation of drones
33	CAP 382	Civil Aviation Publication - CAP 382 Mandatory Occurrence Reporting Scheme, CAA
34	EU 376/2014	Regulation (EU) No 376/2014 on the reporting, analysis and follow-up of occurrences in civil aviation
35	IR 2015/1018	Implementing Regulation (EU) 2015/1018 laying down a list classifying occurrences in civil aviation to be mandatorily reported
36	35588102/RP/270617	Technical Assessment (Main Report) of the possible impact of the IFA2 Interconnector at Solent Airport Daedalus
37	35588102/RP/080517	HAZARD LOG REPORT Technical Assessment of the Effects of IFA2 interconnector at Solent Airport
38	35588103/RP/080917	Safety Justification for the IFA2 Interconnector at Solent Airport Daedalus.
39	CAP 1122	Application for Instrument Approach Procedures to Aerodromes without an Instrument Runway and/or Approach Control
40	ICNIRP	International Commission on Non-Ionizing Radiation Protection
41	Solent Aerodrome Chart	AD 2-EGHF-2-1, Lee-on-Solent Aerodrome Chart
42	TSO 145 / ETSO 145	TSO-C145, Airborne Navigation Sensors Using the GPS Augmented by the WAAS, FAA; ETSO-C145, Airborne Navigation Sensors Using the GPS Augmented by the WAAS, EASA
43	TSO 146 / ETSO 146	TSO-C146, Stand-Alone Airborne Navigation Equipment Using the GPS Augmented by the (WAAS), FAA; ETSO-C146, Stand-Alone Airborne Navigation Equipment Using the GPS Augmented by the (WAAS), EASA
44	TSO 129 / ETSO 129	TSO-C129, Airborne Supplemental Navigation Equipment Using GPS, FAA; ETSO-C129, Airborne Supplemental Navigation Equipment Using GPS, EASA
41	1JNL553364 Rev A	HF Performance Report

TERMS AND DEFINITIONS

Term/Abbreviation	Definition
AAIB	Air Accidents Investigation Branch
ADF	Automatic Direction Finding
ADS-B	Automatic Dependent Surveillance-Broadcast
AGL	Airfield Ground Lighting
AHRS	Attitude and Heading Reference Systems
AIP	Aerodrome Information Publication/Package
Airport, The	Solent Airport at Daedalus
ANPS	Air Navigation Service Provider
AOA	Airport Operators Association
ARP	Aerodrome Reference Point
ATC	Air Traffic Control (Tower)
ATM	Air Traffic Movements/Management
ATS	Air Traffic Service
BHMP	Bird hazard management plan
BS	British Standards
BSI	British Standard Institution
CAA	(UK) Civil Aviation Authority
CAP	Civil Aviation Publication
CFD	Computational Fluid Dynamics
CFIT	Controlled Flight into Terrain
CNS	Communication Navigation Surveillance
DC	Direct Current
DF	Direction Finder
DME	Distance Measuring Equipment
EASA	European Aviation Safety Agency
EASA NPA	European Aviation Safety Agency – Notices of Proposed Amendment
EFIS	Electronic Flight Instrument System
EGHF	The ICAO Code for Solent Airport

Term/Abbreviation	Definition
EGNOS	European Geostationary Overlay Service
EGPWS	Enhanced Ground Proximity Warning System
EMC	Electromagnetic Compatibility
EMF	Electromagnetic Frequency
EMI	Electromagnetic Interference
EoN	East of North
FBC	Fareham Borough Council
FHA	Functional Hazard Assessment
FLIR	Forward Looking Infrared (Cameras)
FM	Frequency Modulation
FMCW	Frequency Modulated Continuous Wave
FMS	Flight Management System
GA	General Aviation
GAT	General Air Traffic
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
HV	High Voltage
IAP	Instrument Approach Procedure
ICAO	International Civil Aviation Organization
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEC	International Electrotechnical Commission
IFA2	Interconnexion France-Angleterre 2
IHS	Inner Horizontal Surface of an aerodrome's OLS
ILS	Instrument Landing System
IRS	Inertial Reference System
LNAV	Lateral Navigation
LPA	Local Planning Authority
LPV	Localiser Performance Vertical

Term/Abbreviation	Definition
LV	Low Voltage
MCA	Maritime and Coastguard Agency
MOR	Mandatory Occurrence Reporting
NATS	National Air Traffic Services
NDBs	Non-Directional Beacons
NEN	Nederlands Normalisatie Instituut
NG	National Grid Interconnector Holdings Limited
NOTAM	Notice to Airmen
OAT	Operational Air Traffic
OCH	Obstacle Clearance Height
OFZ	Obstacle Free Zone
OLS	Obstacle Limitation Surfaces
PNT	Position Navigation or Time
RAIM	Receiver Autonomous Integrity Monitoring
RCAM	Regional and City Airports Management
RF	Radio Frequency
RFI	Radio Frequency Interference
RNAV	Area Navigation
RTE	Réseau de Transport d'Electricité
SBAS	Satellite Based Augmentation System
Solent Airport	Solent Airport at Daedalus
TAWS	Terrain Awareness and Warning System
TSO	Technical Standards Orders
TV	Television
UAV	Unmanned Aerial Vehicle
UCFIT	Un-Controlled Flight into Terrain
UHF	Ultra High Frequency
UK	United Kingdom
VFR	Visual Flight Rules

Term/Abbreviation	Definition
VHF	Very High Frequency
VOR	VHF Omni Range
WAAS	Wide Area Augmentation System
WHMP	Wildlife Hazard Management Plan

1 INTRODUCTION

National Grid Interconnector Holdings (NG) is proposing to develop and implement a new electricity interconnector facility, the Interconnexion France-Angleterre 2 (IFA2). The facility is being developed jointly with Réseau de Transport d'Electricité (RTE), the French transmission system owner and operator. It will link the United Kingdom's electricity transmission network with France's, and is expected to help enhance the security, affordability, and sustainability of energy supply to both countries.

The facility consists of two converter stations, one sited in each country. The UK converter station is to be sited to the north-east of Solent Airport at Daedalus ("Solent Airport"). National Grid proposes to route high-voltage direct current and high-voltage alternating current cables in a shared cable corridor to the west and north of the Solent Airport main runway.

This addendum supports the interim Safety Justification for the IFA2 Facility at Solent Airport [38] and is part of the work intended to support the application to the Fareham Borough Council (FBC) Executive Committee for the full planning acceptance and consent to progress to the next stage in the project. Specifically, this report which forms part of the assurance evidence referenced within the *Hazard Log* [37], includes additional review and technical assessment to address some specific hazards in the *Hazard Log* [37], including:

- a revised assessment of airfield safeguarding taking account of the IFA2 design and updating the assessment in [2];
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- an assessment of Unmanned Aerial Vehicles (UAVs), considering the risks that non-commercial UAVs could pose to Solent Airport and whether the IFA2 Facility could exacerbate these risks.

2 AERODROME SAFEGUARDING

This section of the report analyses the IFA2 Interconnector Facility, focusing on the associated buildings of the converter station, against aerodrome safeguarding criteria. This section introduces the concept of aerodrome safeguarding, its context in relation to the IFA2 Interconnector Facility and any recommendations or mitigation measures required arising from the assessment.

This is an update to the initial Aerodrome Safeguarding Assessment completed in 2016 [1]. The design of the facility has progressed since the initial assessment and therefore this revised assessment takes the latest design into account.

2.1 Purpose of Aerodrome Safeguarding

The primary purpose of aerodrome safeguarding is to protect aircraft from obstacles and obstructions whilst operating in the vicinity of airports. With regards to airports the purpose is to take measures to ensure the safety of aircraft, and thereby the passengers and crews aboard them, while taking-off or landing, or while flying in the vicinity of an aerodrome. Thus, measures are taken to prevent aircraft colliding with each other, or with fixed and mobile objects, while manoeuvring on the ground, while taking-off or landing, or while flying in the vicinity of the aerodrome. Measures are also taken to prevent interference with, or distortion of the guidance given, or indications from visual aids, radio aids to air navigation and meteorological instruments. It also includes the measures taken to reduce the risk of aircraft experiencing a bird strike, particularly during take-off and landing.

This is achieved by a process of analysing proposed developments to:

- protect the blocks of air through which aircraft fly, by preventing penetration of surfaces created to identify their lower limits;
- protect the integrity of radar and other electronic aids to air navigation, by preventing reflections and diffractions of the radio signals involved;
- protect visual aids, such as approach and runway lighting, by preventing them from being obscured, or other lights being confused for them;
- reduce the hazard to aircraft from bird strikes, by preventing the increase of bird numbers in the vicinity of the aerodrome.

Safeguarding is included in UK legislation as an integral part of the planning procedure. It is set out in Directions contained in circulars issued under the Town and Country Planning Acts. Local Planning Authorities (LPAs) are advised, usually by issue of maps, of the safeguarded area around an aerodrome. Normally these extend to some 15 km from the aerodrome. The LPAs are required to approach the Safeguarding Consultee named on the map (usually the aerodrome concerned) about any Planning Application within this area, should it meet certain criteria relating to the height and location of the proposed development to the aerodrome. In addition, any proposed developments with bird attractant properties within 13 km of the aerodrome will also be referred for consultation. The reason for the 13 km area is explained in Section 2.7 of this report.

An explanation of the legislation in relation to Solent Airport is provided in Section 2.5.

2.2 CAP 738 – Safeguarding of Aerodromes

Civil Aviation Publication – CAP 738 [4] is a guidance document produced by the CAA for airports and those responsible for the safe operation of an aerodrome or a technical site. It describes the processes and procedures that should be followed when assessing the impacts on aerodrome and aircraft operations against new development proposals. There are a range of factors that must be considered when planning developments in the vicinity of an airport or aerodrome and *CAP 738* [4] is the main point of reference in the UK for these issues. *CAP 738* [4] includes a Safeguarding Process Flowchart (*Figure 1, Chapter 1, CAP 738*) as a guide for ensuring the correct procedures are followed when assessing developments.

CAP 738 [4] contains the relevant information within which the IFA2 Interconnector Facility at Solent Airport is assessed against aerodrome safeguarding criteria. The main aspects of the assessment cover the following broad areas:

- Obstacle Limitation Surfaces (OLS);

- Bird Strike Hazard;
- Lighting;
- Cranes.

To provide overall context to *CAP 738* [4] there are several other measures to analyse, as follows:

- Technical Site Safeguarding;
- Wind Turbines;
- Roads & Railways.

Technical Site Safeguarding analyses the impact of development on aeronautical systems. This assessment is described in the following sections. Wind turbines can interfere with air navigation systems by appearing as aircraft on radar screens. No wind turbines are proposed in this application and this is not relevant as part of the study. Vehicles on roads and railways are considered as potential obstructions to aircraft and are classed as mobile obstacles. However, due to the nature of the proposed development the IFA2 Interconnector will have no impact on adjacent roads or railways, therefore no further analysis is necessary.

2.3 The Town and Country Planning (Safeguarded Aerodromes, Technical Sites and Military Explosives Storage Areas) Direction 2002

The Town and Country Planning (Safeguarded Aerodromes, Technical Sites and Military Explosives Storage areas) Direction 2002 [5] is the UK Government guidance on the management and implementation of the aerodrome safeguarding process through the planning system. It sets out the main processes that must be followed to ensure that appropriate consultation is undertaken for developments in the vicinity of aerodromes and other technical sites related to aviation, such as radar installations.

Civil aerodromes in the UK are licensed under an Air Navigation Order made under *Section 60* of the *Civil Aviation Act 1982* [6]. The CAA is responsible under the Air Navigation Order for being satisfied that a licensed aerodrome is safe for use by aircraft. Part of this provision includes being satisfied that the physical characteristics of the aerodrome and its surroundings are safe to use by aircraft. Once satisfied, the CAA will issue an Aerodrome Licence with a named individual stated as the Aerodrome Licence Holder.

Some of the main aspects of *The Town and Country Planning (Safeguarded Aerodromes, Technical Sites and Military Explosives Storage Areas) Direction 2002* [5] which will need to be considered for the IFA2 interconnector at Daedalus include the Safeguarding Map, Officially Safeguarded Aerodromes, Other Aerodromes, and the Aerodrome Information Package. These are described in more detail in Subsections 2.3.1 to 2.3.3 below.

2.3.1 Safeguarding Map

The need for and purpose of the safeguarding map is described in *The Town and Country Planning* legislation [5]. A safeguarding map for individual aerodromes is lodged with relevant local planning authorities to indicate the type of development they must consult on. The safeguarding map is centred on the aerodrome and contains colour-coded areas showing the extent of the safeguarded area to indicate the appropriate developments to refer for consultation. The colour coding within the map largely refers to the height of proposed buildings and structures that will trigger the requirement for a consultation.

2.3.2 Officially Safeguarded Aerodromes

There are a number of officially safeguarded aerodromes in the UK, largely due to their importance to the aviation industry and overall transport system.

All major airports in the UK are officially safeguarded and this is to ensure that they can continue to operate safely and efficiently without being inhibited by buildings, structures, physical objects and any other feature that may obscure runway lights or impair the performance of navigational aids.

Generally, all development within the safeguarded area, which is broadly the extent of the Obstacle Limitation Surfaces (OLS), must be referred for consultation with the relevant airport. Officially safeguarded aerodromes are included in the list of statutory consultees within the planning system.

Local planning authorities will refer to the safeguarding map when deciding whether or not to consult on a particular development.

2.3.3 Other Aerodromes

In addition to the officially safeguarded aerodromes, there are many other aerodromes in operation around the UK. These are typically small to medium sized airports and airfields. They do not experience the same level of protection under planning legislation as officially safeguarded aerodromes.

However, best practice advice for these aerodromes is to establish a process to protect the safe and efficient operation of the aerodrome against new developments. Measures should be taken to agree on consultation procedures between the aerodrome and local planning authorities.

These aerodromes do not have official safeguarding maps but the CAA recommends that an unofficial safeguarding map be lodged with the relevant local planning authorities and that local authorities act reasonably towards non-officially safeguarded aerodromes when assessing new development.

2.4 Aerodrome Information Package

The Aerodrome Information Package (AIP) contains relevant aeronautical information and general airport information on a particular airport or aerodrome. The AIP for Solent Airport [7] is published as Lee-on-Solent under the International Civil Aviation Organization (ICAO) Code EGHF. With regards to safeguarding, the information in the AIP is used as background data for completing the safeguarding assessment. The AIP contains important data on the position and height above mean sea level of the Aerodrome Reference Point (ARP). The ARP is the main point of reference for the geographical location of the airport. The ARP is usually situated on the mid-point of the main operational runway.

The AIP also states the important lengths and dimensions of all operational runways.

Using this data from the AIP enables us to obtain the relevant information required to input into the safeguarding assessment, particularly when assessing the building heights against the obstacle limitation surfaces, which is discussed in Section 2.6.

2.5 Solent Airport

Solent Airport is not currently an officially safeguarded aerodrome and the legislation explained in previous sections is not strictly applicable to the airport. Therefore, developments are not automatically required to be referred for a formal consultation.

Solent Airport is categorised under the definition provided in Section 2.3.3 Other Aerodromes. As such, no official safeguarding map is required, nor is there an obligation to consult on local planning applications. Any safeguarding process is advisory. However, it is clear that due to the management and ownership status of the aerodrome that there is an effective process in place for safeguarding to ensure development in the surrounding area and within the aerodrome boundary itself is analysed against safeguarding criteria.

It is evident that an aerodrome safeguarding process is in place which will ensure that the new development will not adversely impact the operation of the airport. Therefore, the assessment completed in this study follows the principles described above.

2.6 Obstacle Limitation Surfaces

Obstacle Limitation Surfaces (OLS) form a complex series of three-dimensional surfaces, which vary depending on the characteristics of the runway and are fully defined in *ICAO Annex 14, Chapter 4* of *CAP 168* [8] and *Chapters H & J of EASA document CS-ADR-DSN Certification Specifications and Guidance Material for Aerodromes Design* [9].

They extend upwards and outwards from the edges of the Runway Strip and/or Runway Clearway and comprise the following:

- Take-Off Climb Surfaces;
- Approach Surfaces;
- Transitional Surfaces (sometimes called “side slope”);

- Inner Horizontal Surface;
- Conical Surface;
- Outer Horizontal Surface.

The surfaces are shown in Figure 1 below.

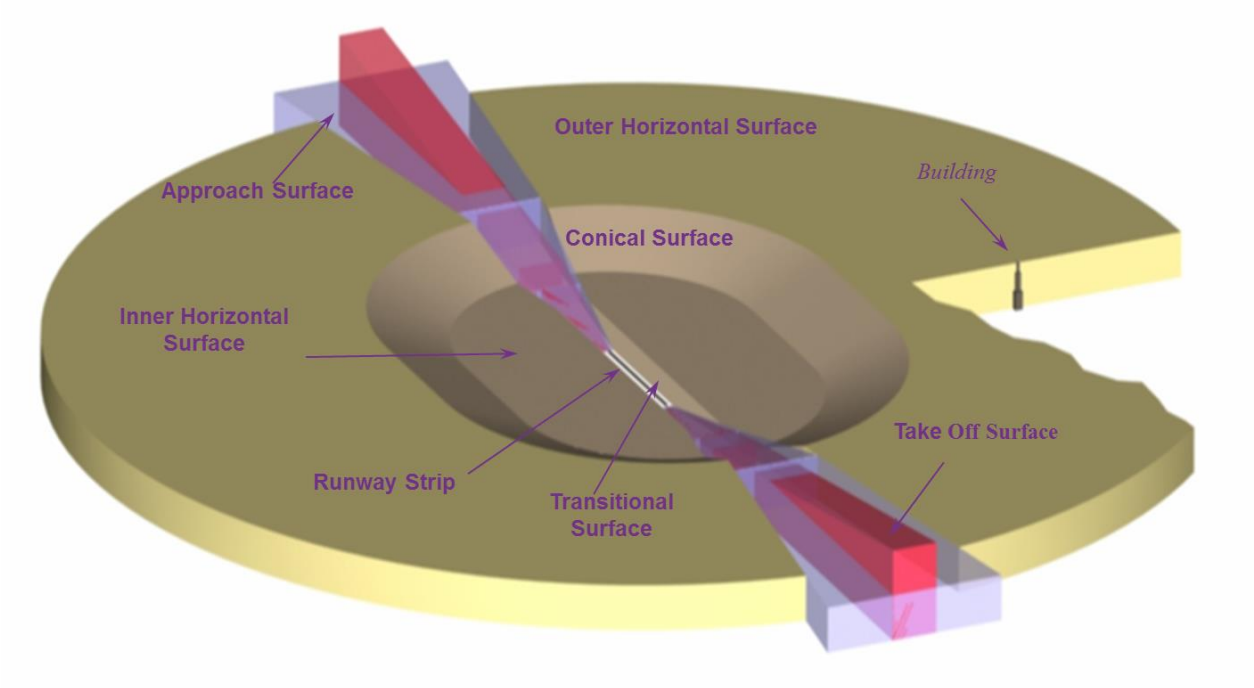


Figure 1 Obstacle Limitation Surfaces

The requirement is that no new objects penetrate these surfaces, unless shielded by an existing immovable object. These surfaces apply to aircraft parked on aprons, but not to those taxiing.

Additionally, there is a set of inner obstacle limitation surfaces, which together make up the Obstacle Free Zone (OFZ). The objective of the OFZ is to protect aircraft making a precision instrument approach and during any subsequent missed approach from both fixed and mobile obstacles. The OFZ comprises the following:

- Inner Approach Surface (a portion of the Approach Surface);
- A portion of the Runway Strip;
- Inner Transitional Surface;
- Baulked Landing Surface.

No object, whether fixed or mobile, is allowed to penetrate the OFZ, unless it is frangible and its presence is essential to air navigation. However, if the main Obstacle Limitation Surfaces, listed above, are not penetrated by a fixed object, then there will also be no impact on the OFZ. Therefore, these surfaces mainly apply to mobile objects, such as aircraft using the taxiway system and aircraft at the runway holds awaiting entry to the runway.

Solent Airport does not currently have any Instrument Landing Systems (ILS) installed and as the primary objective of the OFZ is to protect aircraft making a precision approach, this does not strictly apply to the airport at this time. However, the understanding is that whilst there are no foreseeable plans to introduce ILS at Solent Airport, the possibility cannot be discounted. Nevertheless, the OFZ is less onerous than the other surfaces and if these are protected and free from obstacles then the OFZ will be protected by default.

Finally, the Plane of Approach Lights is a surface, or more commonly, a series of surfaces, based on the heights of the individual lights in the approach light system. It is established to ensure that objects do not obscure or distort the lighting pattern observed from aircraft on the approach. The plane extends from the threshold to 1.5 times the length of the system at a width of 120m equally disposed about the extended

centreline of the runway. The gradient of the section beyond the outermost end of the system is an extension of the surface joining the threshold lights and the outermost light.

Solent Airport does not currently have approach or runway lighting installed so this does not apply to the airport. However, these may be installed in future upgrades and this must be considered within the context of developing the wider site.

2.6.1 Assessment

The closest point of the proposed National Grid development at Solent Airport is located just under 1km from the ARP and therefore is situated within the OLS. The AIP states that the ARP is 9.95m above mean sea level. Figure 2 (also included in Appendix A) illustrates the position of the buildings in relation to the airport and the OLS.

Figure 2 Position of buildings in relation to Solent Airport and OLS

Figures 3 and 4 (also included in Appendix A) illustrates the location of the buildings in relation to the OLS in further detail.

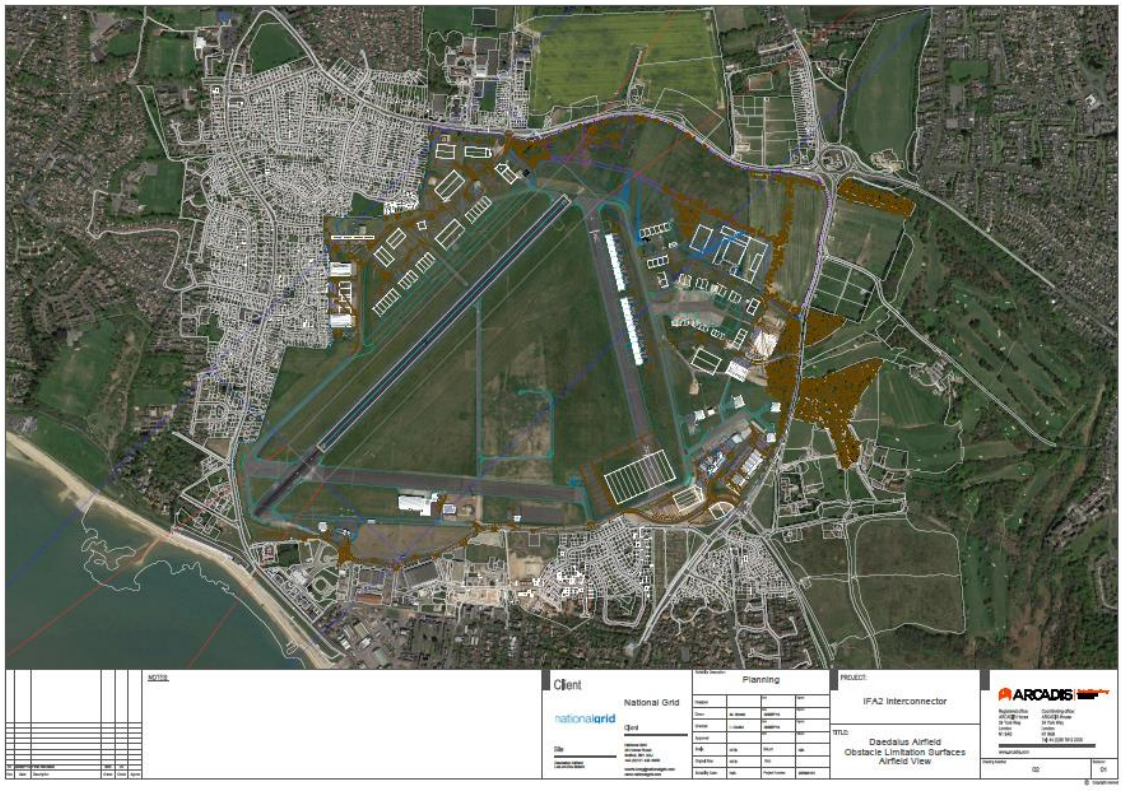


Figure 3 Position of buildings in relation to OLS with background image

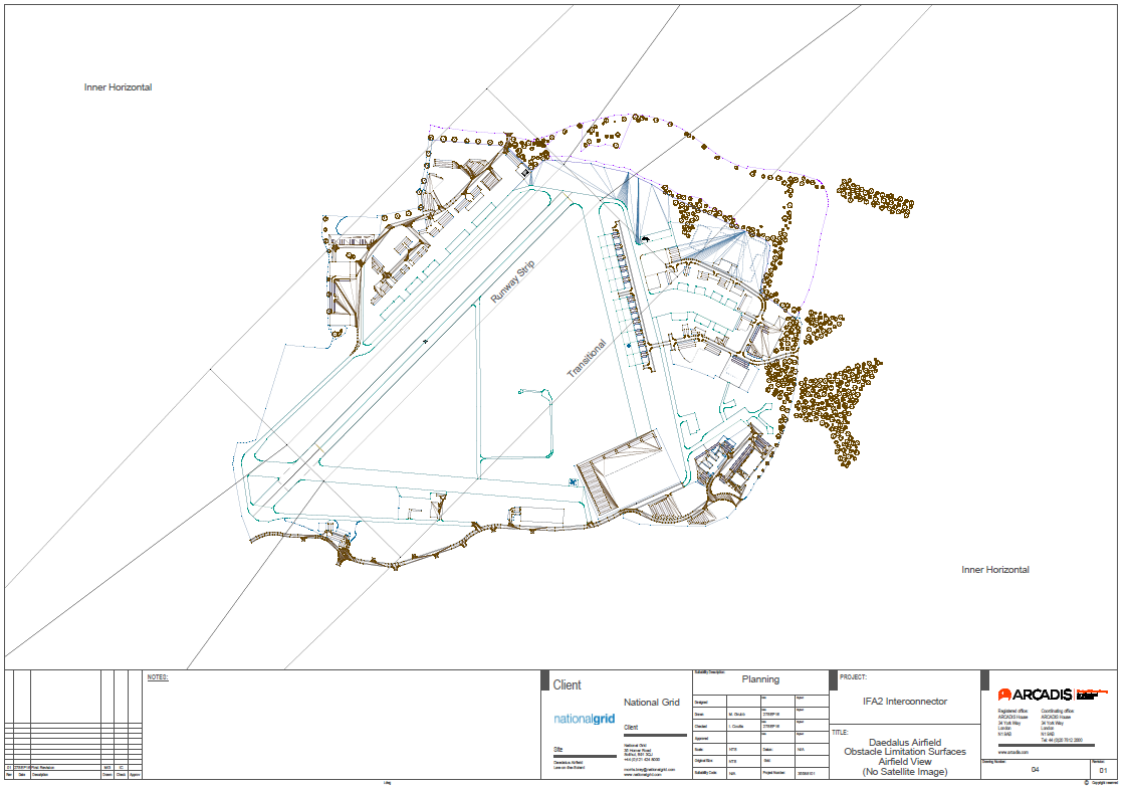


Figure 4 Position of buildings in relation to OLS without background image

Figure 5 shows the location of the Transitional and Inner Horizontal Surfaces in relation to the runway. The IFA2 Interconnector buildings are situated within both the Transitional Surface and the Inner Horizontal Surface. The buildings are not situated underneath any of the other surfaces.

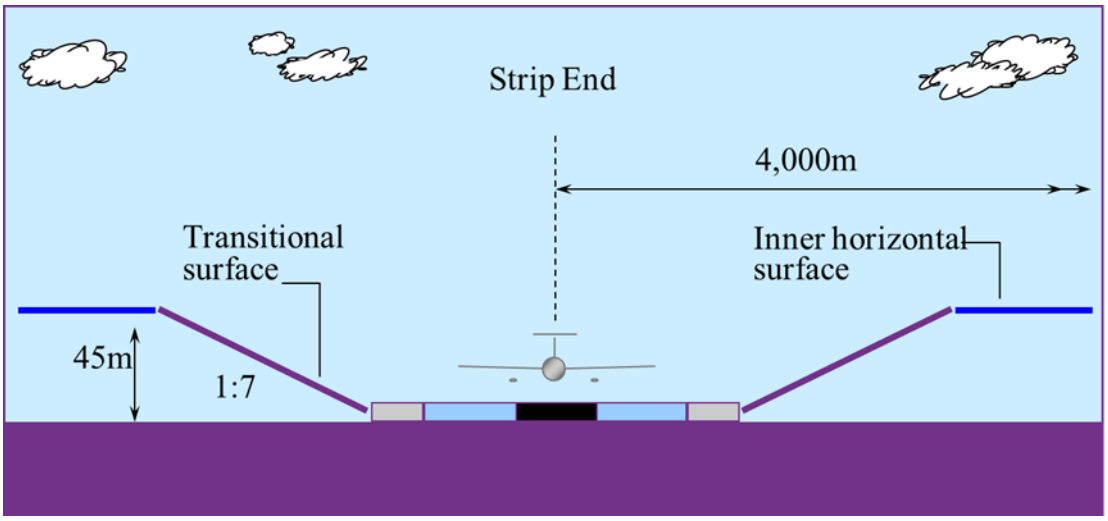


Figure 5 Transitional and inner horizontal surfaces

The Transitional Surface is a sloped surface rising 1:7 from the edge of the runway strip. It slopes up until it meets the Inner Horizontal Surface (IHS). The IHS is a horizontal surface located 45m above the surface of the ARP.

There are various different independent and connected buildings proposed within the site. However, the maximum height of any of the buildings within the development is 19.94m above ground level. This is the height of the vent stacks on the AC Filter Hall.

2.6.1.1 Transitional Surface

A portion of the development site is situated within the Transitional Surface and as described in the previous section, this is a sloping surface (slope of 1:7) beginning at the edge of the runway strip and ending where it meets the Inner Horizontal Surface 45m above ground level. The assessment has analysed the building closest to the most onerous section of the Transitional Surface and determined that it is situated under the maximum height that would create an infringement.

The height of the Transitional Surface at the most onerous section of the building is 36m.This clearance increases for the buildings situated further away from the runway. The maximum building height within the development site is 19.94m, therefore the development will not create an infringement of the Transitional Surface.

2.6.1.2 Inner Horizontal Surface

All new developments including buildings, vegetation and other obstacles must not exceed 45m above ground level. Anything higher than this would create an infringement of the OLS. The maximum height of the buildings are 19.94m, therefore the new buildings will not create an infringement of the OLS.

The location of the converter station in relation to the relevant OLS described above is illustrated in Figure 6 (also included in Appendix A). This demonstrates that the buildings will not infringe the surfaces and will therefore have no impact on the OLS.

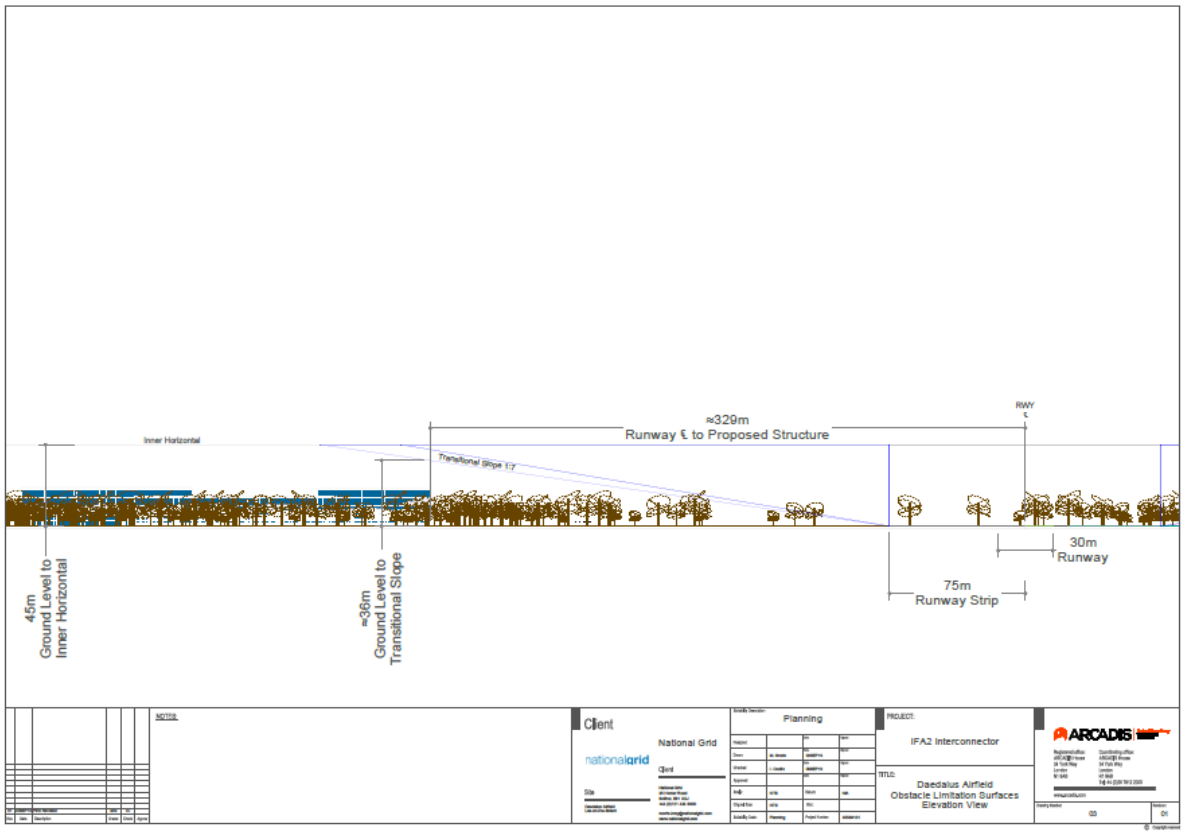


Figure 6 Location of the IFA2 Facility in relation to the relevant OLS

2.6.1.3 Landscaping

The plans indicate that landscaping and trees are proposed within the development. It is extremely unlikely that the trees will be taller than the buildings so no infringement is likely. Once established, the trees will continue to grow but they would need to be 45m in height before creating an infringement.

It is likely that other vegetation in the surrounding area that is more established will be an issue before the new trees on this site so they are not considered to be an issue from the perspective of the OLS. Regular pruning should be undertaken on surrounding vegetation if it is considered a risk to a potential infringement of the OLS. This is recorded as a contributory factor and action for ongoing management in the *Hazard Log* [2].

2.7 Bird Strike Hazard

Bird strikes – collisions between birds and aircraft – have been around since the dawn of aviation. The first bird strike fatality was recorded in 1912 when Cal Rogers, the first man to fly across America, lost his life after a gull became jammed in the controls of his aircraft. Since then more than 190 deaths have resulted from over 50 crashes of civil aircraft and over 300 military aeroplanes have been lost following bird strikes. The cost to the civil aviation industry worldwide is estimated to be over £750 million per year in damage and delays.

Aircraft are particularly vulnerable to collisions with large birds such as waterfowl and flocks of small and medium sized birds such as starlings and gulls. Most bird strikes take place when aircraft are below 2,000 ft., thus they are most susceptible when approaching to land at an aerodrome or shortly after take-off. Aircraft up to 13 km from an airport may be at this altitude; therefore, the aerodrome safeguarding process at airports will assess all developments within a radius of 13 km against the risk of bird strikes. It is essential that features attractive to birds are not introduced to the aerodrome or the surrounding environment unless they are proactively managed and monitored.

Provided certain bird attractant features are avoided, it is possible for landscaping proposals, including water features, to be acceptable to the aerodrome safeguarding process. Similarly, there are certain bird attractant

properties in building design that should not form part of the design for buildings on or near an aerodrome. This applies to all developments at Solent Airport.

The main issue in building designs are flat or low-pitched roofs. These provide an ideal environment for loafing, roosting and nesting. The best way to mitigate this risk is to avoid flat or low-pitched roofs in the design of the building. However, this can be unavoidable in certain circumstances due to the nature of the development and the operational requirements of the building. Advice from the airport Operators Association (AOA) states that flat or shallow pitched roofs should not be greater than 10m x 10m. If this cannot be avoided in the design then all parts of the roof should be accessible by foot to ensure that any hazards arising from birds loafing, roosting and nesting can be dispersed and any eggs or nests can be removed.

As regards the IFA 2 facility the roof design is pitched, and all actions related to bird hazard management are captured in the safety justification and the hazard log.

2.7.1 Assessment

The first point of reference for airports regarding the management of wildlife on and surrounding the airport is *CAP 772 – Wildlife Hazard Management at Aerodromes* [10].

The proposed development includes various buildings of different sizes, some of which are connected to each other. Some of the buildings within the site are designed with a flat roof, others have pitched roofs. The largest buildings with flat roofs are the Control Building and the Service Building.

The design of the converter station has developed with consideration for bird hazard management. It includes a pitched roof with appropriate roof access for maintenance and clearing of birds' nests as required

A Bird Hazard Management Plan (BHMP) will be required to cover the management activities required in relation to the IFA 2 converter station buildings. There are several buildings proposed for this development and they are located in close proximity to each other. Therefore, one consolidated BHMP would be sufficient to manage all of the buildings. The BHMP will detail the inspection regime and activities undertaken to manage the risk of birds loafing, roosting and nesting on the roofs of the building. Given the nature of the development, it is assumed that there will be a permanent or regular on-site presence and that the buildings will be well maintained. A nominated person should be responsible for the plan.

Solent Airport already has an active Wildlife Hazard Management Plan (WHMP) in place. Therefore, an alternative to a standalone BHMP would be to integrate and update the WHMP reflecting the addition of the IFA2 Facility. The goals of the Solent Airport WHMP are:

- Reduce infringements of critical airspace by high and moderate risk wildlife species;
- Ensure that adequate systems are in place to define roles, responsibilities and procedures for managing wildlife risks at Solent Airport;
- Define the methods by which wildlife hazards are managed at Solent Airport;
- Develop performance goals and targets for adaptive management of wildlife issues and outline how these will be assessed and reviewed.

Solent Airport's WHMP states that the Airport Manager is responsible for the "*overall coordination, supervision and management of the WHMP"*. The airport Operations Wildlife Officer is responsible for implementing the WHMP. The WHMP is a comprehensive document detailing the overall aims and objectives of the process. It includes the operational methodology of mitigating the bird strike risk and outlines the roles and responsibilities for airport personnel.

To the put the bird strike risk at Solent Airport in perspective, for the last full year of available information, 2016, there were no reports of bird strikes at the airport. In 2015 there were also no reported bird strikes.

The IFA2 Facility is to be constructed within the boundary of the airport and will therefore be situated within the area covered by the WHMP.

The plans indicate that landscaping and trees are proposed within the development. However, the purpose of the landscaping is mainly to provide amenity. The proposals are not a significant part of the development. As particular varieties of trees and vegetation can attract birds, it is recommended that these are omitted from the landscaping plans to reduce the bird strike risk. However, if this is not feasible or desirable then the

species should not be berry bearing, as berries are an attractant to birds. Regular inspection of the landscaping should be undertaken to ensure that no nesting is taking place.

2.8 Lighting

The approach and runway lights are protected by provisions in the *Air Navigation Order* [6] which states that other lights shall not be installed which are liable to endanger aircraft taking-off or landing, or which are liable to be mistaken for an aeronautical light. Situations that may endanger aircraft operations are:

- Where intensity causes glare in the direction of an approaching aircraft;
- Where the colour could cause it to be mistaken for an Aeronautical Ground Light (AGL);
- Where, when viewed from the air, they make a discernible pattern similar to AGL;
- Where the overall amount of illumination detracts from the conspicuousness of the AGL.

It is outside of the scope of work for this project but it should be noted that outdoor light displays, particularly those involving lasers, searchlights or fireworks, are also of concern if in the immediate vicinity of an aerodrome, or under one of the approaches, and should be notified to the CAA. Advice is available from, and notification of displays should be sent to, the Airspace Utilisation Section, Directorate of Airspace Policy / CAA.

2.8.1 Assessment

The main consideration regarding lighting for the IFA2 Interconnector is the location and positioning of lights on the buildings and immediate surroundings, such as car parks. Airport lighting is not currently installed at Solent Airport, however, night flying is permitted but only by resident aircraft. The only night flying permitted for visiting aircraft is for departures only. It is acknowledged that extension of night-time flying operations may be a possibility in the future. Consideration must be given to possible lighting of the airport in the future and it would be prudent to ensure that any lighting proposed on the development site must not obscure potential future airport lighting. Therefore, whilst lighting within the converter station compound would not obscure future runway lighting it could potentially distract pilots operating at the airport.

The final lighting detail and design for the site is currently being developed. However, the most effective method of ensuring that the lighting does not create operational issues for the airport is to use downward pointing lights with no or very limited light spillage. The AOA recommends [11] that flat glass full cut-off lanterns mounted horizontally be used. This will ensure that no light is emitted above the horizontal.

The AOA also reference the British Standard Institution's *BS 5489, Code of Practice for the design of road lighting* [12]. This recommends the use of lighting conforming to the maximum luminous intensity of lighting. Each class in Table 1 below is compliant with the flat glass full cut-off lighting principle. Ensuring the lighting design complies with this standard will protect potential future runway lighting and minimise pilot distraction from ground lighting.

It should also be noted that the same requirements apply to all buildings within proximity of the airfield and this is not unique to the buildings in the converter station compound.

Angle from the downward vertical	Maximum Luminous Intensity (cd / klm)		
	Class G4	Class G5	Class G6
70°	500	350	350
80°	100	100	100
90°	10	10	0
>95°	0	0	0

Table 1 Source: BS EN 13201 Road lighting, Part 2 Performance requirements, Table A.1 [13]

As the converter station buildings will not penetrate the Obstacle Limitation Surfaces there is no requirement to install aviation-warning lights on the structures.

2.9 Cranes

Normally cranes, and other items of construction equipment, are not subject to the planning application process, unless this aspect is made a condition of the planning permission for the development. In addition, cranes may be required for other purposes not involving new developments, such as maintenance and repair of existing structures. The BSI's *BS 7121, Code of practice for the safe use of cranes* [14] contains the following paragraph:

"*9.3.3 Crane control in the vicinity of aerodromes/airports*

The appointed person should consult the aerodrome/airport manager for permission to work if a crane is to be used within 6km of the aerodrome/airport and its height exceeds 10m or that of the surrounding structures or trees."

Note: The Air Navigation Order [6] makes it an offence to act recklessly or negligently in a manner likely to endanger aircraft.

Most airports in the UK have a crane authorisation process involving the issue of permits, covering both cranes on the airport and in the area covered by the British Standard. It is essential to consider this at an early stage of the development if it is anticipated that a crane will be required during construction. This is particularly important for the use of fixed cranes that cannot be removed or lowered quickly at the request of the airport.

2.9.1 Assessment

The issue of cranes is more of a construction issue than a planning issue at this stage but it should be considered as early as possible as it may impact on the construction method and programme. Cranes may be a particular issue in the vicinity of the main runway where temporary cranes may be necessary as part of the construction phase. Early consideration must be given to the type of crane anticipated.

Within the 6 km crane circle, it is usually best practice to operate cranes that are capable of being lowered on request within a reasonable period of time. Fixed cranes not capable of being lowered, particularly within or near the approach and take-off areas should generally be avoided. Fixed cranes within the 6 km circle but outside of the main approach and take-off areas can be acceptable provided close cooperation and coordination is in place between the airport and the crane operator.

Air traffic movements at Solent Airport are dominated by Visual Flight Rules (VFR) so in periods of low visibility airport movements are suspended, particularly as precision approaches are not currently possible. Therefore, any cranes situated in the vicinity of the airport should be visible to aircraft operating in the area.

The height of cranes may infringe the OLS and in this case, cranes over 45 m in AGL would result in an infringement of the IHS. However, as this is a temporary object this is generally accepted provided the appropriate information is promulgated via standard aviation communications, notably through the issuing of a Notice to Airmen (NOTAM) and the provision of obstacle lighting on the crane.

2.10 Conclusion

The IFA2 Converter Station has been assessed against aerodrome safeguarding criteria. The aim has been to ensure that the proposals do not currently impact on the safe and efficient operation of the airport and as far as is practical, ensure that future developments on the airport itself will not be impacted by the proposals.

The assessment analysed the new buildings against the OLS. The buildings are situated within the Transitional Surface and the Inner Horizontal Surface but at a maximum of 19.94 m in height, the buildings will not create an infringement.

The design of the IFA 2 converter station includes a pitched roof which reduces the potential to introduce bird hazards. The site will be well managed and there is a good relationship between the airport and surrounding operators, so the measures outlined in the report will be sufficient to ensure that the risk is at an acceptable level as defined by *CAP 760* [15]. This is recorded as an action in the *Hazard Log* [37] for the management of the converter station.

Lighting within the development should follow the AOA advice [11] to ensure that the operation of the airport is not adversely impacted.

The use of cranes during construction may present a temporary risk, but the type of crane used should be considered and agreed with the Airport at the earliest opportunity particularly as the site is in such close proximity to the runway, in order to assure that any risk is mitigated and is acceptable.

The development is considered acceptable from an aerodrome safeguarding perspective and will not adversely impact on the operations of the airport. Therefore, the plans for the IFA2 Converter Station will not conflict with aerodrome safeguarding criteria.

3 WIND ASSESSMENT

This section presents wind analysis to assess the potential impact of the IFA2 Converter Building, coupled with the future proposal of the Faraday Business Park buildings, on trailing winds on the main runway at Solent Airport.

Technical Assessment (Main Report) [1], *Technical Assessment – Wind Flow Analysis* [16] and the *Wind Flow Analysis for the IFA2 Facility* [36] reports have presented preliminary analysis of the wind flow around the Converter Building, based on outline proposals for the building structure. This work was undertaken in support of the planning application process for the IFA2 Facility, together with Hazard Identification and Risk Assessment [2, 37] and other Technical Assessments.

The preliminary analysis concluded that the highest relative increase in wind speed onto the main runway caused by the building is a maximum of 30%, at a height of 5m above the ground (for wind speeds of 10, 15, and 20m/s respectively). At low wind speeds like 5m/s, the building has little to no impact on the main runway in the wind direction coming from the direction of the building onto the main runway. Similarly, at wind speeds more than 5m/s in the same direction, there is no significant building wake impact above 30m above the ground.

It was confirmed within the Hazard Identification and Risk Assessment studies [2, 37] that localised changes in wind patterns are easily managed and that pilots quickly become familiar with any changes in wind patterns and adapt their flying accordingly through good airmanship.

A recommendation was raised in the *Technical Assessment* [36] that the analysis should be repeated when the final design of the converter station and future development plans for the area are known.

Since completion of the preliminary analysis, the design of the Converter Station has been revised, the height has been reduced and the building is more compact. Additionally, some further details are known regarding the landscaping in the immediate vicinity of the of the building. These changes have the potential to affect the previous results in terms of wind turbulence, which is likely to be reduced since the span of the geometrical extent has reduced.

More detailed wind analysis has now been completed where the model used to simulate the wind flow has been developed in more detail with the revised building profile and to take into account more of the immediate surroundings such as the upstream earth mounds planned (to relocate earth displaced by the construction).

As previously, the analysis assesses the potential impact of the IFA2 Converter Station on trailing winds on the main runway, considering both pessimistic and more realistic wind conditions.

Figure 7 below shows the extent of the domain (i.e. the area modelled) that is to be analysed using Computational Fluid Dynamics (CFD). CFD is a tool that uses numerical analysis and data structures to solve and analyse problems that involve fluid flows.

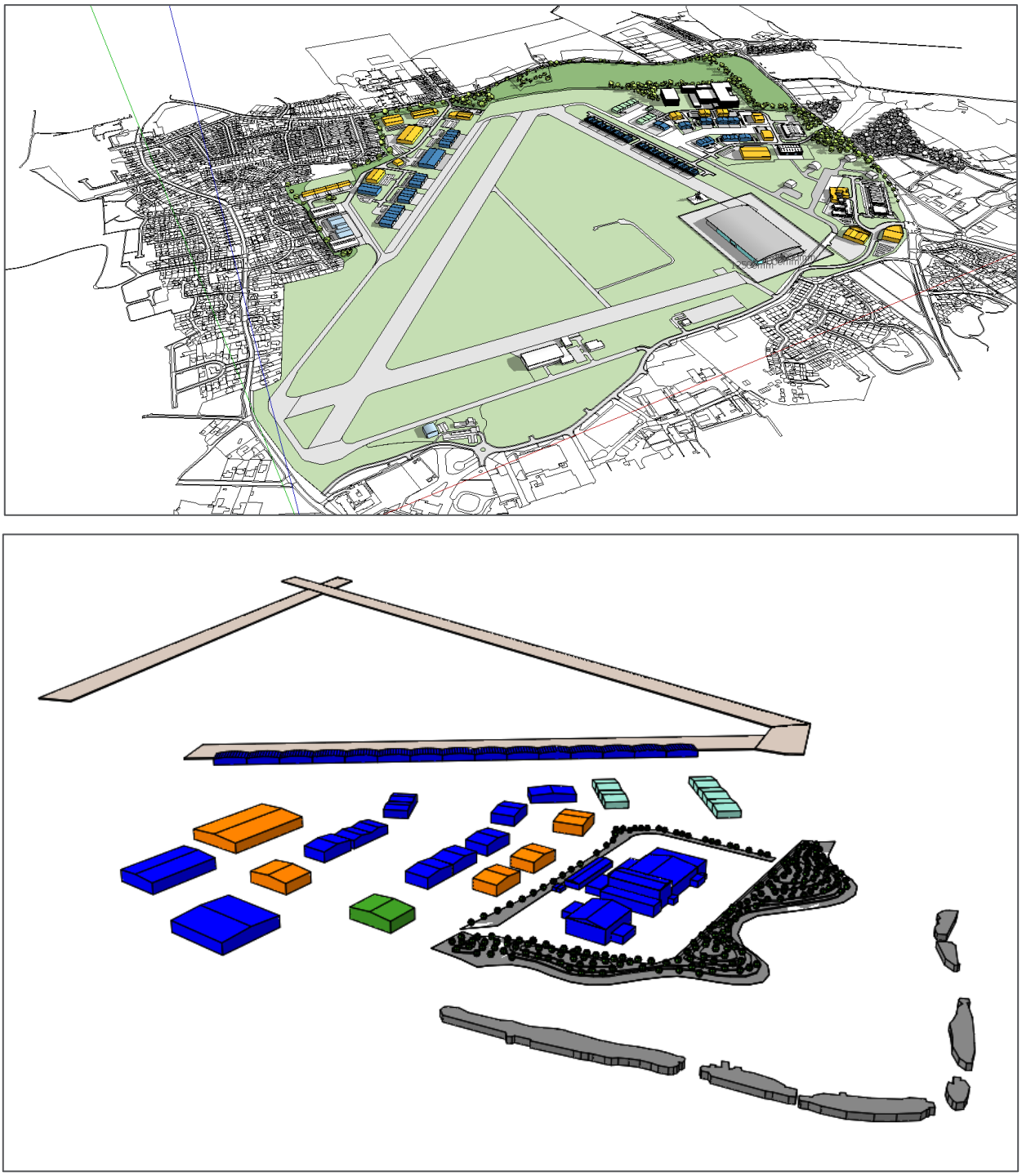


Figure 7 CFD Domain of Analysis

3.1 Analysis

3.1.1 Investigation of the Worst-Case Wind Direction

In order to determine the worst-case wind direction in terms of impact on the runway, a CFD analysis has been carried out. The method of CFD analysis has been chosen as the most appropriate tool to model the turbulence effects in the wind patterns.

The CFD analysis is based on a wind velocity of 20m/s since wind rose data indicates that this is likely to be the maximum wind speed. This input represents the meteorological wind speed which is measured at a

height of 10m above ground. The details of this has been justified in the previous wind assessment reports [16].

Figure 8 below shows the analysis of a range of wind angles between 60^0 to 100^0 EoN (at 20m/s) to determine worst-case wind direction in terms of impact of the combination of buildings on the main runway (also see Appendix B for magnified images of the results).

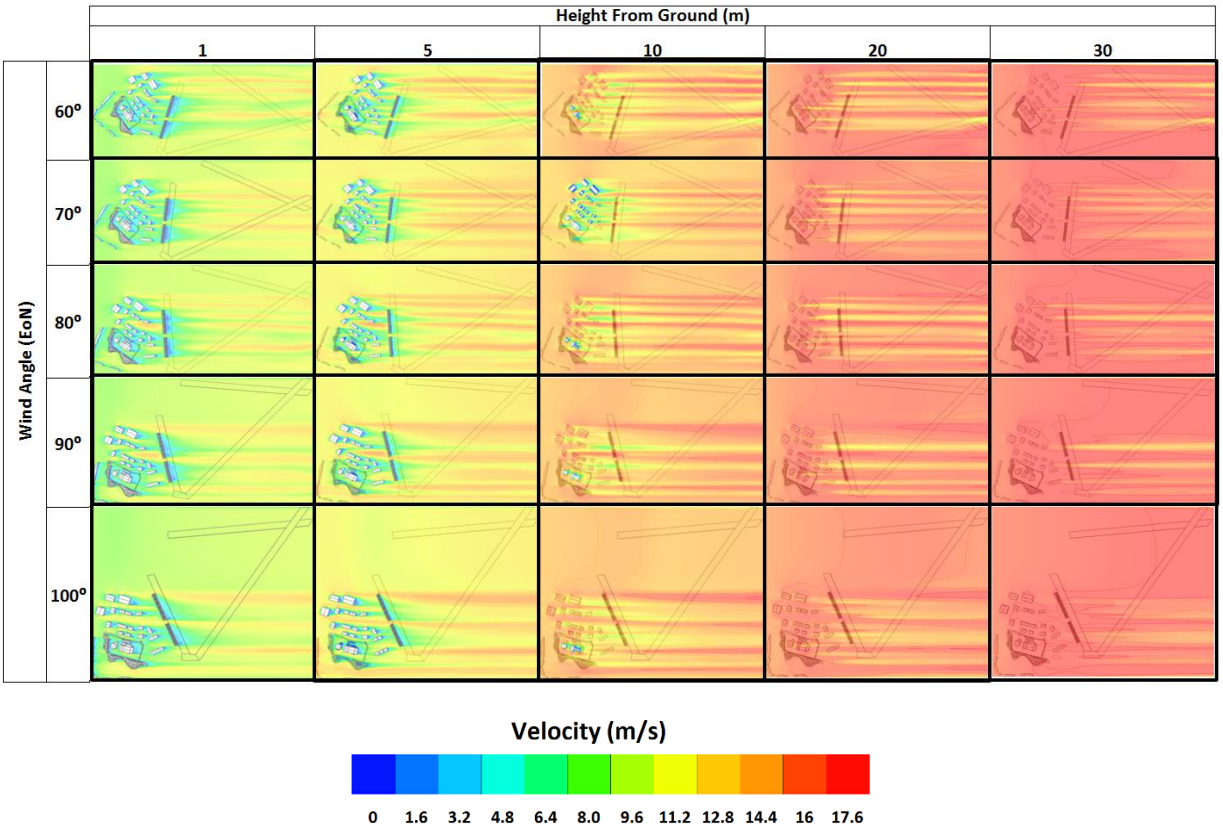


Figure 8 Results of wind flow for a range of directions and heights (flow direction from left to right).

In order to determine the worst-case direction in terms of impact on the runway, it is necessary to consider both wind speed and the zone of impact, a higher wind speed over a larger area being the worst case. From the results illustrated in Figure 8 above, it is concluded that the worst-case wind direction is at the angle of 90^0 EoN (East of North). Whilst the highest wind speed reached is similar for all angles, at 90^0 EoN the buildings produce the faster winds over a larger area on the main runway compared to the other angles. It is also worth noting that generally over a height of 20m above the ground, the building acts a windshield where the tails are slower than the prevailing wind direction.

Comparing the above results to the previous analysis in the *Technical Assessment* [36], repeated below in Figure 9, we find that the future proposed Faraday Business Park buildings both act as a shield to the IFA2 and have the overriding impact on the runway. This also explains the worst case changing from 70^0 to 90^0 EoN. The evaluation of the worst case is detailed in the next section.

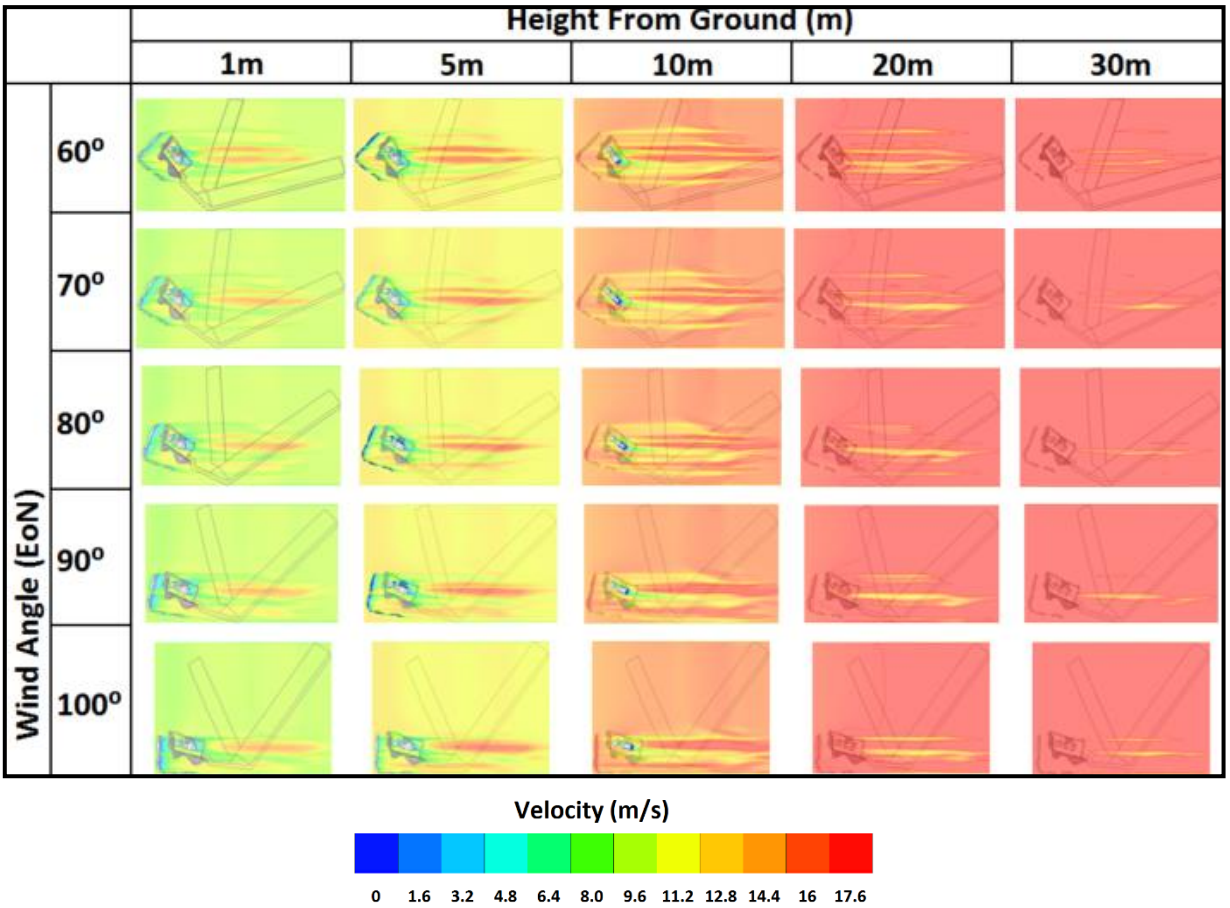


Figure 9 Results of wind flow for a range of directions and heights (flow direction from left to right) excluding the Faraday Business Park buildings [36].

3.2 Evaluation of Results

The 90^0 EoN is considered as the worst case angle for the new configuration that includes the Faraday Business Park buildings. Figure 10 below shows the results for 20m/s at 5m from the ground. The two red circles indicate that the main wind speed increase is due to the “frontline” buildings. The highest relative increase in wind speed onto the main runway in this case is a maximum of 29%. It is recommended that such buildings should be designed in a more continuous manner as illustrated in Figure 11.

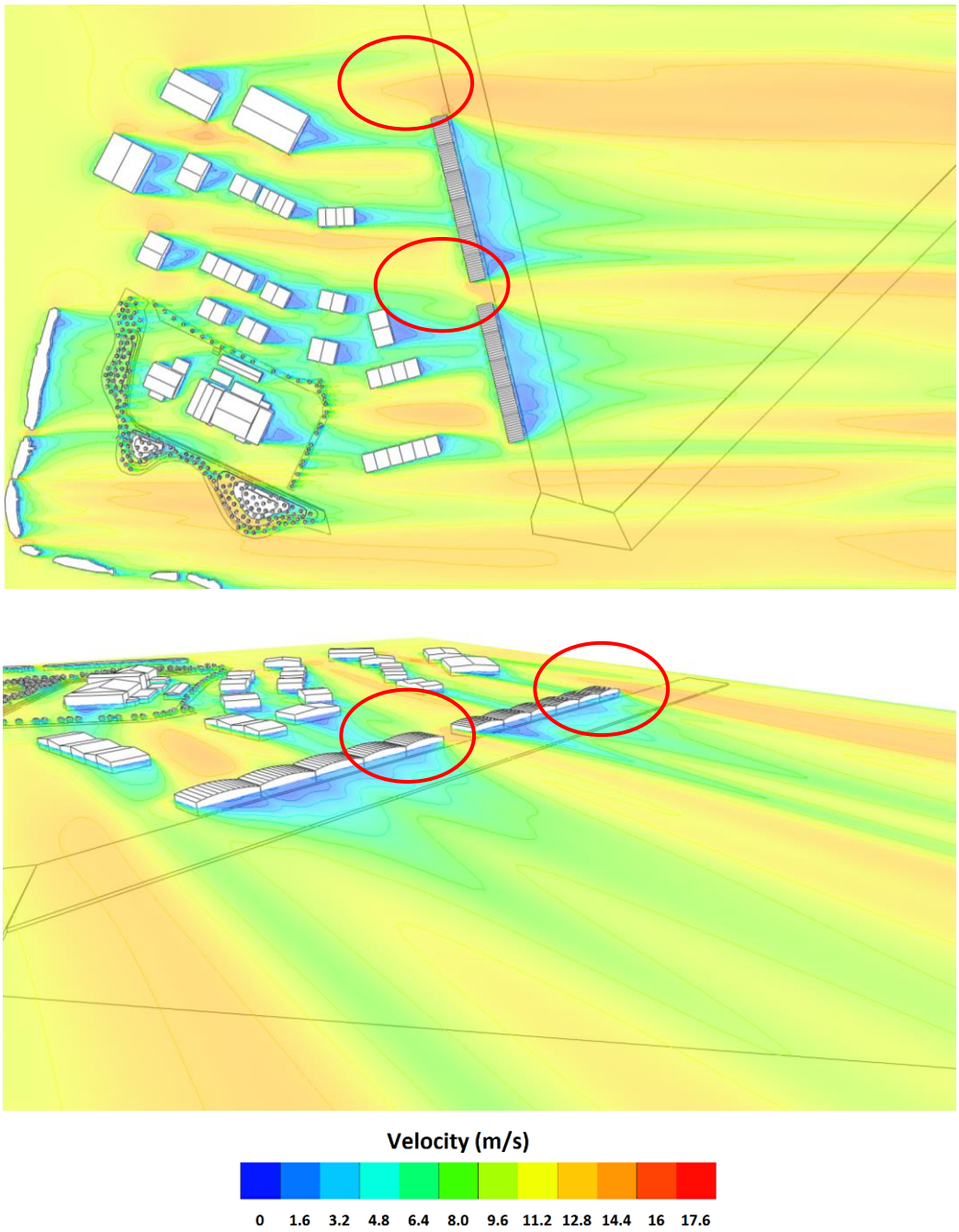


Figure 10 Angle=90 ^{0}, 20m/s at 5m from ground.

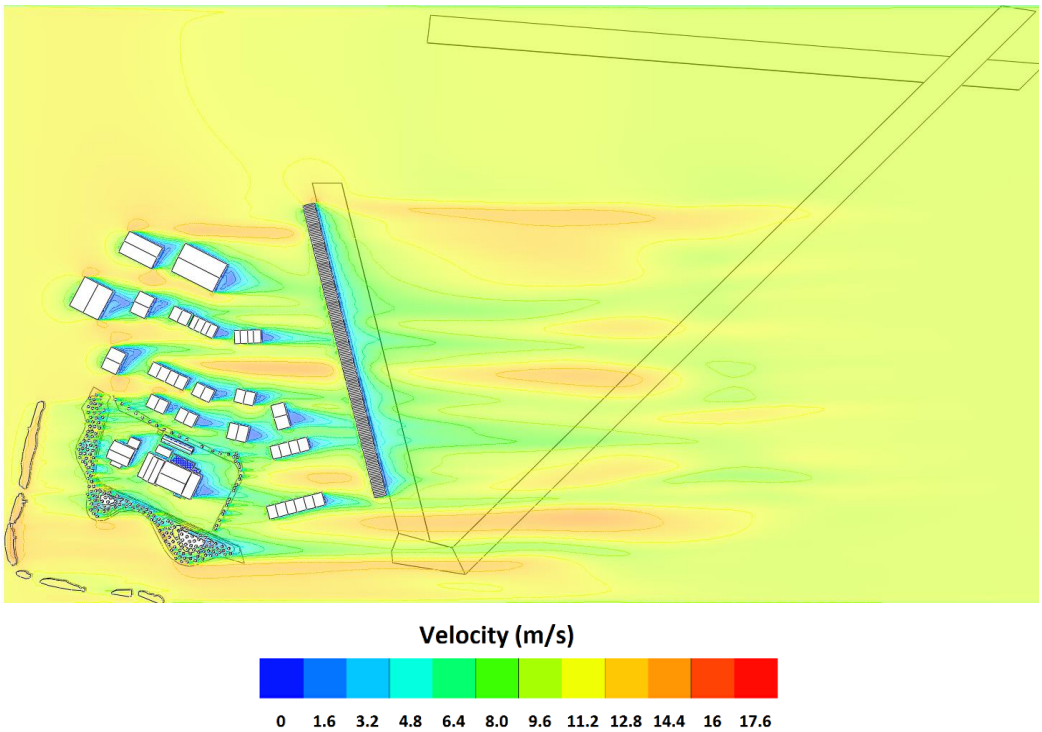


Figure 11 Angle=90^0, 20m/s at 5m from ground with buildings nearest the runways extended.

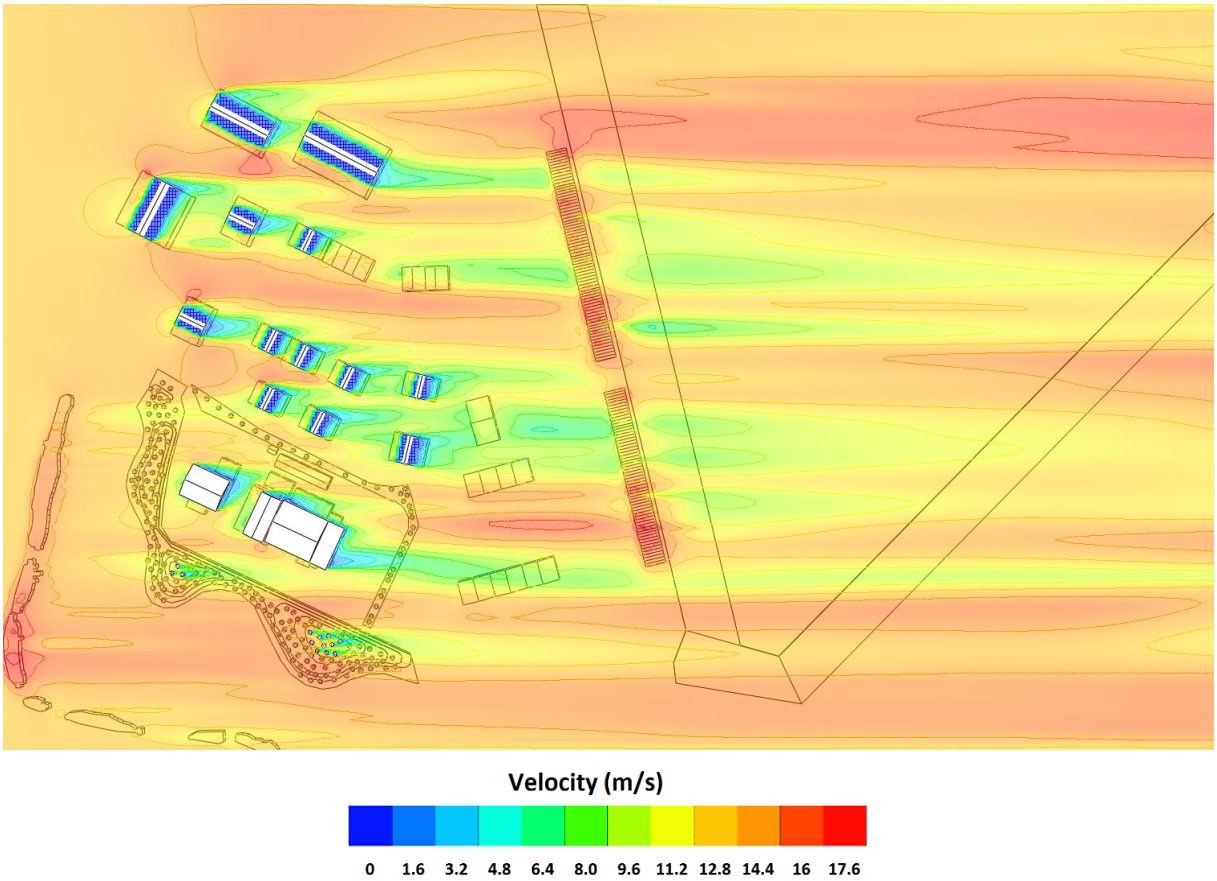


Figure 12 Angle=90^0, 20m/s at 10m from ground.

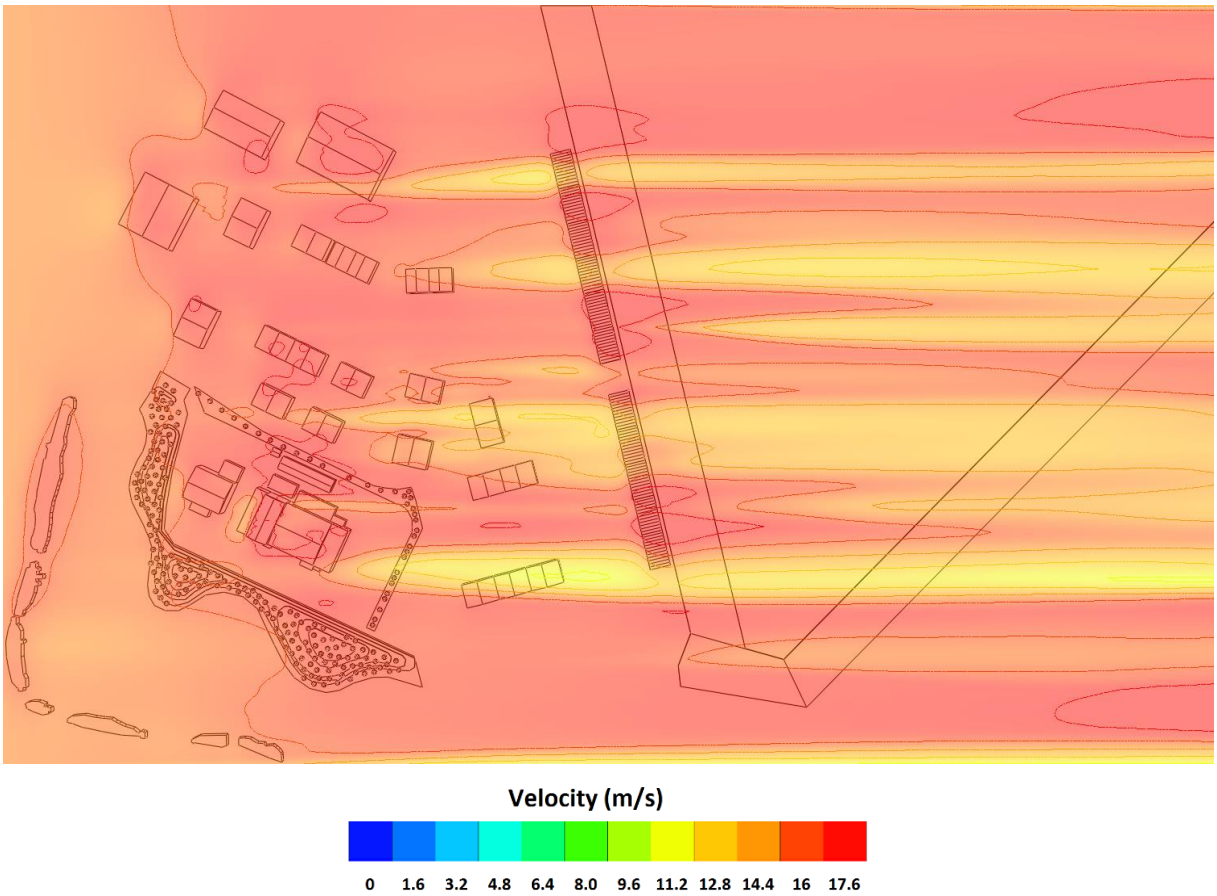


Figure 13 Angle=90^0, 20m/s at 20m from ground.

The main observations from Figures 12 and 13 is that above the height of 20m, the impact of the site on the runway generally diminishes.

It was confirmed within the Hazard Identification and Risk Assessment [2, 37] studies reported in the *Technical Assessment* [1] that localised changes in wind patterns are easily managed by good airmanship and reports issued to airport management through Notice to Airmen (NOTAMs) if necessary. It was also confirmed that pilots will quickly become familiar with any changes in wind patterns and adapt their flying accordingly.

3.3 Conclusion

The detailed wind effects analyses that have been carried out consider the impact of the updated design of the IFA2 Converter Station combined with the future proposed Faraday Business Park buildings on the main runway, and cover a realistic range of wind directions and wind speeds. One main effect observed is that the future proposed Faraday Business Park buildings act as a shield to the IFA2 Facility and have the overriding impact on the runway. This also explains the worst-case wind direction now being at the angle of 90^0 EoN, compared to 70^0 EoN from the earlier analysis when only the IFA2 Building is considered on its own. This is because at this angle, the future buildings produce three tails of faster winds, which covers the biggest area on the main runway compared to the other angles. The highest relative increase wind speed onto the main runway caused is a maximum of 29% at a height of 5m above the ground.

The wind impacts indicated above can be mitigated by extending the “frontline” buildings nearest the runways and closing the gaps between the buildings to form a complete wind shield to the runway from the 90^0 EoN direction.

Additionally, it was confirmed within the Hazard Identification and Risk Assessment studies [2, 37] that localised changes in wind patterns are easily managed and that pilots quickly become familiar with any changes in wind patterns and adapt their flying accordingly through good airmanship.

4 ELECTROMAGNETIC FIELD (EMF) AND RADIO FREQUENCY INTERFERENCE (RFI)

4.1 Introduction

The Arcadis work undertaken during 2016 and 2017 to date, reported in *The Technical Assessments* [1, 36], included an independent peer review of the analysis carried out by other parties concerning the EMF and RFI effects of the IFA2 Facility. Since then further analysis has been carried out by other parties on behalf of NG which now also requires an independent peer review by Arcadis. Additionally, some areas where perceived "gaps" existed in the hazard mitigation evidence were identified in the *Technical Assessment* [36], based on the *Hazard Log* [37]. These "gaps" were thought unlikely to result in any significant safety impact, but further consideration is given to these here in order to confirm this.

Since the initial analysis, detailed in the *Technical Assessments* [1, 36], further analysis reports, listed below, have been issued to Arcadis, which we have reviewed and is reported in this section:

- RF Survey Test Report for IFA2, Development at Solent Airport [21];
- TV and Radio Reception Study [22];
- Radio and Telecoms interface and EMF assessment [25].

Arcadis has also been provided with and has reviewed the following draft document:

- Preliminary impressed voltage assessment for cables at Daedalus [28].

Other information concerning the IFA2 Facility design has become available which has been used for information as follows.

- Drawing: IFA2 Overview Map Daedalus New Boundary [24];
- Airfield Ground Lighting AGL ducting layout [20];
- More recent drawings on the cable cross section (*G3221.181I* [18] and *G-003-0219* [19]).

Specific areas identified in the *Technical Assessment* [36] that are given further consideration here are as follows:

- MCA equipment: Specifically, further information has been sought and checks made on certain MCA equipment to confirm that no adverse effects are expected from IFA2 due to EMF or RFI. The document *Operation Manual for the 935-11 DF System,* [23] has been provided for information;
- Some of the conclusions in the *Technical Assessment* [36] are confirmed, now further detailed design information is available concerning cable route and cross section [18, 19] and the Airfield Ground Lighting (AGL) [20];
- The model aircraft radio controlled equipment was identified for consideration in [36]. However, this was not identified at the FHA as being related to safety. Furthermore the model aircraft club stated that they intend to relocate from Solent Airport before the end of 2017 and saw no need to consider this equipment.

4.2 High Frequency Electromagnetic Interference (RFI)

4.2.1 TV and Radio Reception Study

The *TV and Radio Reception Study* [22] is a more recent issue of the detailed assessment of television shadowing effects, which was previously reviewed by Arcadis in the *Technical Assessment* [1]. As before, the analysis concludes that whilst there is a potential theoretical shadowing effect, the impact is not significant. The shadowing area predicted is smaller than in the previous version of this document, but the reason for this is not explained in the *TV and Radio Reception Study* [22]. It is understood that this is because the analysis is based on the revised profile of the IFA2 Building, which is more compact than assumed in the previous analyses.

It was suggested by Arcadis in the *Technical Assessment* [1] that where an electromagnetic signal is reflected and a receiver may receive two or more signals from the same source, the use of a multi-pad could improve coverage generally and reduce any risk of disruption to signals behind the convertor station even further. This had not been considered in the analysis. The use of a multi-pad is also not considered in this re-issued version of the document; hence this suggestion is re-iterated.

As advised in the *Technical Assessment* [36], the *TV and Radio Reception Study* [22] would benefit by being more transparent regarding underlying assumptions, calculation tools, criteria and methodologies used, etc. Additionally, it is suggested that a conclusion on digital audio broadcasting should be added.

In the *Technical Assessment* [36] Arcadis advised that consideration should be given to communication methods used by the emergency services (*Recommendation R8*) and that carrying out a survey in the potential shadowing areas, both before and after IFA2 would be beneficial to manage business risks (Recommendation R14). Both of these recommendations are re-iterated here. It is understood that there are plans in place to complete these recommendations.

4.2.2 RF Survey Test Report for IFA2 Development at Solent Airport

The *RF Survey Test Report* [21] reports on measurements taken of the ambient Radio Frequency (RF) environment at Solent Airport and compares them to the standard limit proposed by Cigré in *TB 391 – Guide for measurement of radio frequency interference from HV and MV substations* [26] which permits a higher level of emissions, measured 200 m from the installation. Based on this comparison, the report indicates that the use of the Cigré at-receiver limit will provide an appropriate level of protection against EMI to the reception of lower level signals.

Arcadis generally agrees with the conclusion as presented, however, as advised in the *Technical Assessment* [1], the *RF Survey Test Report* [21] would benefit from more transparency concerning underlying information that could potentially impact the results. In particular, information on sensitive parameters that can affect the results would be beneficial such as:

- Date and time each of the measurements were taken;
- The environment when the measurements were taken, e.g. fog or heavy rain, that can influence the measurements;
- Reasons why the selected locations were chosen and whether the three measurements were taken at the same time as the signal can change;
- The basis behind the radio signal frequency range selected in the context of IFA2;
- The basis behind the selected method of measurements and justification that this provides sufficient accuracy.

Since the issue of this report, further clarification has been provided on the conditions at the time the measurements were taken. It is recognised that the measurements were intended to provide an indication in a typical environment.

4.2.3 Radio and Telecoms Interface and EMF Assessment

The report *Radio and Telecomms interference and EMF assessment* [25], produced by the Main Contractor for the IFA2 Converter Station (ABB), discusses the sources of electromagnetic disturbance due to the converter station at Solent Airport and describes steps to mitigate this disturbance and limit exposure to EMFs. Overall, it is considered that the calculation methods described in the report are appropriate and correct in theory. Testing and measurements will be required as the project progresses to confirm that the requirements concerning exposure limits are met and this is recognised in ABB's report [25] as a conclusion. The need for testing and measurement to verify that safety requirements are met is recorded as a dependency in the Safety Justification [38].

The report [25] assumes that all equipment will be placed in metallic enclosures or buildings. However, it should be noted that the cables will have to leave the IFA2 Building, where they could function as antennas and cause electromagnetic radiation. This needs to be considered as further mitigation may be required to prevent electromagnetic disturbance.

Table 2 in the report [25] details measures for extended mitigation specific to the converter station at Solent Airport as outlined in the *RF Survey Test Report* [21] and the design measures that are being implemented. The general design measures are believed to be suitable, but the use of materials may present an issue regarding the longevity of the design. The use of several metal types can lead to electrical corrosion and reduce the life time of the 'box' surrounding the converter equipment. The corrosion process may be accelerated due to the proximity of the development to the sea. It is also suggested in Table 2 of the report

[25] that a thinner steel can be utilised without losing shielding efficiency, although no clarification is given why this is the case.

4.2.4 MCA Equipment

It is possible that some MCA equipment could potentially be susceptible to EMF or RFI effects from the IFA2 Facility. A meeting was held on the 25th July 2017 with MCA to establish the equipment that is important to MCA's operations, the meeting minutes [27] highlight MCA interfaces and equipment. This concluded that the equipment that needed to be considered in the context of IFA2 are:

- a GPS based flight management / terrain awareness system;
- a homing device;
- a weather radar system;
- remote controlled lights on the runway.

Very little documentary information was available for this review; the only document provided being the *Operational Manual for the 935-11 DF System* [23] referred to by MCA as the "homer". This gives limited technical information. It is understood from this however that this is a GPS location system with a few radio communication and Search and Rescue facilities. MCA has advised that they set the equipment up on the apron outside the MCA facilities at Solent Airport. Following arrival at the rescue area they use the equipment to locate precisely the casualty.

Regarding the GPS based systems, it is considered highly unlikely that GPS will be subject to disturbance from the IFA2 Facility due to the frequencies used and the way that GPS make uses of several satellites for positioning.

The *DF Operation Manual* [23] details six receivers for the homer which are working in the 30 to 470 MHz band. There is no potential for disturbance due to IFA2 during flight. The only area where disturbance cannot be ruled out is within 200m of the converter station (based on the Cigré standard [26]), which could only occur in the event of very low flight above the IFA2 convertor station. With the recent work in [26], this limit may be changed to 60m. Due to the flight speed the helicopter would only be within a range of 200 meters from the convertor station for a very short duration.

Based on the *DF Operation Manual* [23] the homer also uses a beacon system. It is understood that this is mostly used during flight and for search and rescue and no disturbance would be expected from the convertor station.

There is no information available concerning the weather radar system and the remote control of the runway lighting. If these are far away from the cables (other site of the runway and taxiway and more than 200 meters from the convertor station) no disturbance would be expected. Further information would be necessary to confirm this as distances cannot be established from the information available.

4.2.5 Other Comments

Considering the revised building layout and locations and comparing this with the Cigré specifications [26], one new building is now situated within the 200 meters distance of the convertor station. The 200 meters is the distance in Cigré within which there is no guarantee that the RFI/EMC limits are below the European specifications. However the more recent work (References [21], [25 and [41]) is recognised, which once the work is completed, is likely to demonstrate negligible emissions 30m from the converter station and beyond.

Note that this comparison has taken the measurements locations in the *RF Survey Test Report* [21] and Figure 14 below shows the south-west corner of the IFA2 Converter Building (taken from Google Earth). The approximate location of the corner of the convertor building is based on the drawing *G3221.184I Overview map Daedalus New Boundary* [24].

Figure 14 Location of the south-west corner of the IFA2 Converter Building (Source: Google Earth).

4.3 DC and Low-Frequency Interference

4.3.1 Radio and Telecoms Interface and EMF Assessment

Arcadis has reviewed the calculations in the *Radio and Telecomms Interference and EMF Assessment* [25], with regards to DC and low frequency interference, and we are in general agreement that the values for power frequency electric and power frequency magnetic fields do not exceed the indicated norm at the station fence. Therefore, there is no violation of exposure to field levels expected at this location.

However, a few important questions are raised which require clarification:

1. What sources / source currents have the simulations used and whether the values used are in accordance with the expected operational currents? The field strengths are proportional to the sources and are therefore of paramount importance to the integrity of the results.
2. It is reported in Section 2.2 of the report [25] that "*the EMF requirements stated in "E2.1-a.i Converter System Basis of Design", together with the revision in "TB233 EMF requirements*"" applies for electric and magnetic field levels. It needs to be clarified what standards these levels / test values are compatible with e.g. European standard. It is noted that in the standard *ICNIRP* [40] the power frequency electric field indicates 5 kV / m (rather than 9 kV / m) and the power frequency magnetic field 100 µT (rather than 360 µT). Even so, these values are not exceeded by the currently reported simulation results.

4.4 Preliminary Impressed Voltage Assessment

A draft document, *Preliminary impressed voltage assessment for cables at Daedalus* [28], has been provided which states the cable contractor's intentions regarding assessing the risks of induced voltage by the cables on the following objects:

- The fence line around Daedalus airfield;
- The fence line around the converter station;
- Existing metal objects installed underground (i.e. metal pipes and drains);
- New drains (if metal);
- Existing/New LV cables installed in the airfield to provide lighting to the runway.

Arcadis has reviewed this document and no significant issues have been identified, however the following comments have been sent to NG for the development of the plans stated in the *Preliminary impressed voltage assessment* [28].

Chapter 4 of the *Preliminary impressed voltage assessment* [28] considers induced voltage and earth potential rise of the ground near the facility and the fact that cables grounded near the facility could transfer this voltage to elsewhere. This phenomenon of transfer potential can also occur the other way around: Cables (cable shields), coated metal pipelines or other long conductors grounded elsewhere bring zero voltage to an environment which in case of an earth fault has been risen to a high voltage, again creating potential large voltage differences.

Large gradients may occur across the soil immediately next to the facility, in case of an earth fault. Chapter 4 concludes that this will have to be assessed when full details are known. This is agreed, Arcadis advises that the assessment of Earth Potential Rise is kept under review.

Chapter 5 of *Preliminary impressed voltage assessment* [28] considers voltage induced due to magnetic coupling. Arcadis generally agrees with the statements made in the *Preliminary impressed voltage assessment* [28], in particular:

"The distance between the fence line and the power cables is considerable for the majority of route (i.e. over 50 metres) and therefore induced voltage on the fence will be negligible."

Arcadis believe that induced voltages on the fence are unlikely to exceed the norms, based on the source being a cable and the separation between cable and fence. The length of the parallel geometry however was an area of uncertainty. Checks based on the norm *NEN 3654, Mutual Influence Of Pipelines And High-Voltage Circuits* [29], referred to as a "unity check" indicates that induced voltages on the fence should not exceed the norms.

Chapter 5 states that "Metal objects that cross power cables will not cause a problem with regard to induced voltage. Only metal objects that run parallel for long distances (i.e. km), this is agreed. The fence at the perimeter of the airport is a metal object that runs parallel for over 1 km, however, it has been agreed that no harmful voltages are expected to occur on the perimeter fence.

4.5 Conclusion

Based on the information reviewed as stated above, although further testing evidence is required , there are no issues raised concerning EMF/RFI emissions due to IFA2 and the expectation remains that risks concerning RFI and EMF will be acceptable as defined in *CAP 760* [15]. Work is in progress on the testing and measurement activities that are planned to verify that requirements are met. All verification required to demonstrate that safety requirements are met is recorded as a dependency in the safety justification.

Recommendations raised in the *Technical Assessment* [36] continue to remain valid. In particular, the recommendations shown in Table 2 below are relevant to this review. Some points that require clarification are raised by the assessment, these should be addressed as the design documentation develops.

No	Recommendation	Current Status
R8	The analysis on RFI so far has focussed on safety related systems. Consideration should also be given to potential interference to other objects and systems, e.g. businesses, mobile phones, etc. which should comply with IEC 61000 standards [30].	RFI impact is concluded to be low / negligible. Some additional recommendations are raised for mitigation of business risk, rather than any safety risk (See R14). Communication methods used by fire brigade or police within an area less than approximability 150m of the convertor station should be checked. This is included as part of the hazard mitigation action in M16B.
R14	It is recommended that measurements are made of existing digital TV and radio shadowing effects in the nearby residential areas, the business parks on the airfield, and users of surrounding land. This will enable a comparison with measurements after the IFA2 Facility has been built to allow for mitigation of business risks, if required.	
R15	It is recommended that a drawing of the airport be created showing all the new and installed equipment and cables, together with the EMC/EMF and RFI influence area. This will provide a reference basis and assist future planning for airport development.	

Table 2 Review of recommendations [36]

5 AVIONICS IMPACTS OF EMISSIONS

5.1 Introduction

This section of the report considers the potential impact on aircraft avionic systems from any radio frequency emissions from the IFA2 Facility.

It has been determined that any emissions from the facility would be of the form of low-level wideband noise that will rapidly diminish with increased distance from the facility. Furthermore, it has been confirmed that the emissions are not at a level to cause equipment damage. It has also been determined that magnetic fields from the facility and associated cables will be localized and less than 10 micro Tesla.

Solent Airport currently supports a diverse range of aircraft operations including:

- General and business aviation fixed and rotary wing aircraft;
- Coastguard Search and Rescue helicopters comprising Leonardo AW169 and Sikorsky S92 aircraft;
- Military aircraft including Hercules, Apache and Chinook aircraft;
- Unmanned Aerial Systems.

The airport is currently a visual operation and does not have any airfield radio navigation aids, although it has been assumed that:

- There are currently aircraft operations into the airport that are supported by but that are not dependent on the use of satellite navigation;
- In the future GNSS Instrument Approach Procedures may be introduced at Solent Airport.

5.2 Approach Taken

Due to the diverse nature of the aircraft and operations into Solent Airport the assessment has taken a generic approach to assess the impacts of the power conversion facility on applications and supporting technologies for which civil aviation standards exist.

The assessment of impact on military aircraft is therefore limited to systems that are required for aircraft to operate as General Air Traffic (GAT), which encompasses all flights conducted in accordance with the rules and procedures of the International Civil Aviation Organisation (ICAO). By this definition some equipment carried on military aircraft required for State operational purposes, known as Operational Air Traffic (OAT) may be beyond the scope of this assessment.

Unmanned Aerial Vehicles (UAVs) currently cover a broad range of platforms and missions that are not yet subject to agreed standards. The assessment of UAV technologies is therefore undertaken at a high level and may require further assessment as the technologies mature.

It should be noted that there are many diverse UAV operations for photographic purposes e.g. overhead line and building inspection. These operations raise the potential for UAVs to be operated in very close proximity to, or even within the power conversion facility, and are therefore outside of the operational envelope of a conventional aircraft.

5.3 Impact on Avionics Systems

5.3.1 Flight Management System

The manner in which equipment is integrated on modern aircraft is unique to each aircraft type. Historically Communications, Navigation and Surveillance (CNS) equipment were installed on aircraft as equipment performing specific functions. In current avionics, there is a high degree of integration that combines diverse functions and data into what is generically termed a Flight Management System (FMS), although the precise terminology and system boundaries vary between system suppliers and aircraft integrators.

An FMS is an on-board multi-purpose navigation, aircraft performance and aircraft operations computer. It is designed to provide integrated and harmonised data between different elements associated with a flight from pre-engine start and take off, through to landing and engine shut-down.

An FMS comprises four main components:

- The flight management computer;
- The automatic flight control or automatic flight guidance system;
- The Aircraft Navigation System;
- An Electronic Flight Instrument System (EFIS) or equivalent electromechanical instrumentation.

The FMS may also include capabilities to integrate high resolution digital maps and to display weather radar images.

It has already been established that the emissions from the power conversion facility will be low level wideband 'electrical noise' that will not cause damage to electronic systems. As a result, the impacts on aircraft systems relate to the potential for loss or corruption of data fed to the FMS processing systems from various sensors on the aircraft that have external antennas.

5.3.2 Aircraft Navigation Function

The aircraft navigation function continuously determines the aircraft position using a combination of data from different sources to establish the most probable position. Sensors that contribute to the estimation of position may include Inertial Reference System (IRS) and Global Navigation Satellite System (GNSS) inputs in addition to receivers for ground based navigation aids such as Non Directional Beacons, VHF Omni Range Distance Measuring equipment and Instrument Landing Systems (NDB, VOR, DME and ILS). Other inputs may include information from the air data computer derived from the static and pitot ports that sense the external air pressure.

5.3.3 Aircraft Functions other than Navigation

In many aircraft the FMS, or sensors that provide inputs to the FMS, also supply Position Navigation or Time (PNT) data to other aircraft functions including but not limited to Terrain Awareness and Warning System (TAWS) and Automatic Dependent Surveillance-Broadcast (ADS-B)

Additionally, the FMS may provide time for the synchronization of the aircraft clock and precise time stamping of data messages and aircraft position for cabin moving map displays.

5.3.4 Terrain Awareness and Warning Systems (TAWS)

Terrain Awareness and Warning Systems (TAWS) are also referred to as Ground Proximity Warning System (GPWS) or Enhanced (EGPWS). TAWS is an automatic safety net that acts to reduce the incidence of Controlled Flight into Terrain which historically has been a major cause of aircraft accidents.

The TAWS function relates the aircraft position in three dimensions, determined from GNSS that may be derived from the FMS, or a dedicated GNSS receiver, to a digital terrain/obstacle/airport database. This enables independent confirmation of the aircraft height over the terrain map.

The TAWS also takes inputs from the radio altimeter and from other navigation sensors to provide a timely and distinctive warning to the flight crew of sink rate, ground proximity, rising terrain ahead of the aircraft, altitude loss after take-off or go-around, incorrect landing configuration and downward glide slope deviation.

It is worthy to note that TAWS is a safety net and is not certified for aircraft navigation. Attention is drawn to the loss of an S92 search and rescue aircraft in Ireland in May 2017 where the TAWS was ineffective, as an island was not included in the terrain database.

5.3.5 Automatic Dependent Surveillance-Broadcast (ADS-B)

ADS-B is a modern surveillance technique that relies on aircraft broadcasting their identity, GNSS position and other information derived from the aircraft FMS. This information is broadcast on the aircraft transponder and can be received on the ground for surveillance purposes (ADS-B Out) or on-board other aircraft in order to facilitate airborne situational awareness and aircraft spacing and self-separation (ADS-B In).

5.3.6 Attitude and Heading Reference Systems (AHRS)

The AHRS provides attitude, pitch and roll, heading, turn, standard turn bank angle, slip, angular rate, acceleration, and other information to enable a pilot, autopilot or other equipment in the aircraft to control and guide the aircraft in a safe manner.

The primary inputs to the AHRS are from on board inertial and magnetic sensors. The AHRS may also be aided by inputs from other sensors including an Air Data Computer or GNSS. The loss of the aiding inputs may cause AHRS mode changes and degraded performance.

It is noted that there has been a reported occurrence of in-flight disturbances in a Phenom 300 following loss of GNSS that resulted in cascaded failures of the AHRS, stall warning protection and yaw damper systems.

It is noted that in some aircraft, attitude and heading information from the AHRS may also be provided to assist weather radar antenna pointing. Additionally, it is possible that GNSS aiding may be employed within the SAR aircraft, embedded within searchlights and FLIR/Cameras for stabilization.

5.4 Impact of Wideband Noise on Aircraft Sensors

5.4.1 VHF/UHF Communication and Conventional Navigation Aids

Noting the similarities in the powers, frequencies and modulation schemes of the Radio Frequency (RF) technologies in navigation and aeronautical and maritime communications systems, these systems are considered as a 'technological class' of systems.

Conventional communication and navigation systems used in aviation applications are based on analogue technologies employing high power transmitters with amplitude, frequency or pulse modulation systems. The use of high power transmitters, together with relatively narrow band receivers, results in high signal to noise ratios.

The limited RF bandwidths of this class of system effectively limits the noise power from a wideband emission that could enter the receiver. In the event of high levels of interference, the performance of the communications channel will gracefully degrade with reduced audio signal to noise ratios.

5.4.2 Global Navigation Satellite System (GNSS)

It is clear from the analysis in this document that position derived from GNSS is a key input to many aircraft safety related systems, including navigation, TAWS, ADS-B and the AHRS. It should be noted that the AHRS also provides steering commands to the flight control systems.

The spread spectrum signals from GNSS satellites were designed to be covert and are below the level of the thermal noise. The GNSS receiver uses correlation techniques to recover the GNSS signal. Any wideband interference within the GNSS frequency band adds to the level of the existing thermal noise, although the receiver is able to recover the GNSS signals with noise levels significantly higher than the thermal noise level.

Aircraft use of GNSS and the GNSS receivers employed are subject to certification by regulatory authorities. In Europe, this role is undertaken by the European Aviation Safety Agency (EASA). The loss of GNSS is a consideration in the aircraft certification process that requires an alternate means or reversion mode to be available on the aircraft.

5.4.3 Radio Altimeter

Radio altimeters are used primarily in the areas around airports during aircraft approach and landing although they continue to operate throughout a flight providing an input to the TAWS safety net.

The radio altimeter determines aircraft height by transmitting a signal towards the ground and by measurement of time delay or phase between transmitted and received signals. Radio altimeters operate in the 4200-4400 MHz band and are either pulsed or Frequency Modulated Continuous Wave (FMCW) systems. The altitude measurement range of radio altimeters is typically between 100 to 2500 feet. Radio altimeters employ a large bandwidth that allows accurate measurements to be performed with low levels of transmitted power.

As with all radar systems that rely on passive reflection, the received signal has a low signal to noise ratio. Any wideband electrical noise emissions from the facility would increase the receiver noise floor potentially eroding radio altimeter sensitivity.

The major factor that mitigates the impact of wideband noise is that the radio altimeter has a high gain antenna with a narrow beam-width directed towards the ground. The directional antenna therefore reduces the area of influence of any interference sources on the ground to being directly under the aircraft.

5.5 Conclusion

The analysis considers the potential impact on aircraft avionic systems from any radio frequency emissions from the IFA2 Facility and concludes that there are no impacts of concern; any emissions from the IFA2 Facility will rapidly diminish with distance and will have no discernible impact on aircraft that are operating within the normal bounds of the airfield.

6 INSTRUMENT LANDING SYSTEMS

6.1 Introduction

Solent Airport currently supports visual operations and does not have any airfield radio navigation aids. This section of the report identifies potential future options that may be available for the airfield to improve the navigation environment and analyses their compatibility with the airport and with the IFA2 Facility.

The option for future upgrading of the aerodrome to have an instrument approach capability, which is expected to have the strongest business case for implementation, is also proposed.

6.2 Aids for Aerodrome Location

Before the advent of satellite navigation many aerodromes (e.g. Cotswold, Shobdon and Rochester) serving General Aviation (GA) aircraft, installed Medium Frequency Non-Directional Beacons (NDBs). The NDBs enabled aircraft equipped with Automatic Direction Finding (ADF) equipment to navigate to the aerodrome. Other airfields additionally installed a Distance Measuring Equipment (DME) allowing aircraft to determine distance to the aerodrome (e.g. Blackbushe and Fairoaks).

When NDB and DME are used together, by having a range and bearing to the aerodrome, an aircraft can determine its own position relative to the navigation aids, which also allows it to remain clear of other airspace structures. NDB and DME facilities installed in this manner provide pilots with an aid to navigation, although the facilities provide no operational credit to improve the aerodrome operating minima. It is noted however, that a number of training organisations have designed ‘discrete’ Instrument Approach Procedures (IAPs) to allow instrument flight training in visual conditions.

The provision of navigation facilities at an aerodrome requires the operator of the facilities to be certified by the UK CAA, as a Communication Navigation Surveillance (CNS) Air Navigation Service Provider (ANSP). A considerable level of effort is therefore required to bring the airfield into the CAA regulatory oversight processes for ANSPs. Therefore, the high capital expenditure for the installation of the NDB and DME facilities together with the ongoing running costs of the facilities, balanced against the low operational benefits, are unlikely to result in a positive business case.

It should be noted that within the GA community, the carriage of satellite navigation devices has effectively replaced the need for NDB/DME for aerodrome location purposes.

6.3 Instrument Approach Procedures (IAPs)

There are global and European safety initiatives by the International Civil Aviation Organisation (ICAO) and the European Aviation Safety Agency (EASA) to ensure that three-dimensional approaches with vertical guidance are available at all instrument runway ends. The expectation is that as three-dimensional approaches become available at all instrument runways, the two-dimensional approaches will fall into disuse and will be withdrawn. This is of particular relevance to NDB approaches that require high levels of skill to fly accurately. It should be noted however that at this time there are no impending regulations requiring existing two-dimensional approaches to be withdrawn, or that preclude the installation of new two-dimensional IAPs.

6.3.1 CAA Publication CAP 1122

International regulations currently require that IAPs can only be implemented into an instrument runway and at an aerodrome that has an Air Traffic Service (ATS), including approach control. A cross-CAA working group evaluated the issues associated with the approval of instrument approaches where one or more deficits in either aerodrome infrastructure or Air Traffic Service provision previously precluded promulgation of an IAP.

In 2014, the CAA published *CAP 1122* [39] titled “Application for instrument approach procedures to aerodromes without an instrument runway and/or approach control.” The publication details a framework for a ‘risk based’ approval process for certain aerodromes that do not meet all of the standards. The objective of *CAP 1122* [39] is to detail a way forward that will allow wider deployment of IAPs at UK aerodromes whilst providing continuing assurance regarding acceptable levels of safety and utilising current policy to the greatest extent possible.

The implementation of IAPs to aerodromes without an instrument runway and/or approach control is an exception to the normal standard. It may not therefore be possible to adequately mitigate the limitations to ensure a safe operation at all locations. One of the limitations of an approval under the *CAP 1122* [39] framework is that the Obstacle Clearance Height (OCH) of the approach will be limited to a minimum of 500 feet.

Although *CAP 1122* [39] was developed in response to a high demand for satellite based IAPs from smaller aerodromes, is also applicable to IAPs supported by conventional navigation aids and therefore applies to all of the implementation options identified in the following sections.

6.4 Two-Dimensional Instrument Approach Guidance

Two-dimensional IAPs only provide lateral guidance to an aircraft on approach, with the vertical path being determined by aircraft height. This is determined by the aircraft barometric altimeter, which allows the descent to be managed by the pilot in accordance with the instrument approach chart.

Two-dimensional approaches may be provided by a conventional navigation aid, generally referred to as a Non-Precision Approach (NPA), or by Global Navigation Satellite System (GNSS) where the approach is termed Lateral Navigation (LNAV).

A high proportion of Controlled Flight Into Terrain (CFIT) accidents have been shown to occur during Non-Precision Approaches (NPAs). Factors contributing to these accidents include loss of situational awareness and the lack of precise vertical guidance.

6.4.1 Conventional Non-Precision Approaches

A conventional NPA is supported by a ground based navigation aid, either an NDB or a localiser for lateral guidance, together with a DME for provision of range information. An NPA may also be based on a VHF Omni Range (VOR) facility although these are normally sited for terminal or en-route navigation.

As there are no suitably located VOR facilities capable of supporting an instrument approach in the vicinity of Solent Aerodrome, the VOR option will not be considered further.

6.4.1.1 NDB/DME Approach

An NDB only provides a signal with the origin being at a known location and does not provide any guidance information, other than a Morse code identification signal. The aircraft ADF equipment determines the bearing to the NDB but not the track. As a result, flying an NDB approach accurately, requires a high degree of pilot skill to account for wind drift to remain on the intended approach path. In cross wind conditions this can be a high workload activity that is undesirable in the final approach phase of flight.

It should also be noted that many new aircraft are not equipped with ADF and in many older aircraft the ADF has been removed to make space for panel mounted GNSS equipment.

6.4.1.2 Localiser/DME Approach

A localiser operates in the VHF band, between the FM broadcast band and the aeronautical VHF communications band. The localiser comprises equipment housed in a shelter and a large antenna array that forms the approach guidance. For obstacle limitation purposes the localiser antenna is normally located between 500 and 1000 feet from the stop end of the runway. From initial inspection of the *Solent Aerodrome Chart* [41] it is apparent that there is limited terrain at the stop end of Runway 21, which would preclude siting of a localiser antenna for a runway aligned approach. It is permissible for a localiser antenna to be sited offset from the runway centreline at a location where the localiser course intersects the runway centreline and is at an angle not exceeding 5°, to create an offset approach.

The localiser DME is an expensive capital item with initial implementation costs exceeding £0.5M together with on-going revenue costs including radio licences and annual flight inspection.

It should be noted that the localiser equipment only serves one runway end and that if an approach is required to both ends of the runway then a second localiser installation is required. With careful siting the DME facility may serve the approaches to both runway ends.

6.4.2 RNAV (GNSS) Two-Dimensional Approaches

An Area Navigation (RNAV) Lateral Navigation (LNAV) approach is a two-dimensional approach that can be flown by aircraft equipped with GNSS. The equipment must comply with the relevant aviation Technical Standards Orders (TSOs) or European TSOs that provide either integrity through Receiver Autonomous Integrity Monitoring (RAIM) or a Satellite Based Augmentation System (SBAS), such as the European Geostationary Overlay Service (EGNOS).

A major advantage of an LNAV approach based on GNSS at a small airfield is that the aircraft positioning for the approach is provided by a satellite navigation constellation and no navigation equipment is required on the ground at the airfield.

6.5 Three-Dimensional Instrument Approach Guidance

6.5.1 Instrument Landing System (ILS)

An Instrument Landing System comprises a localiser and Ultra High Frequency (UHF) Glide Path equipment, sited approximately 300 meters beyond the landing threshold, that defines the vertical approach path.

The cost of implementation of an ILS with its associated remote control and indication system at a new site are significant and likely to be in excess of £1M for each runway end.

6.5.2 GNSS Approach with Vertical Guidance

A GNSS Localiser Performance Vertical (LPV) approach is a three-dimensional approach that provides horizontal and vertical guidance, with accuracies comparable to an ILS.

An LPV approach requires the use of GNSS that is augmented by an SBAS, such as EGNOS in the European region. Aircraft equipment is required to be compliant with *TSO/ETSO 145* [42] or *146* [43] and is widely available within business and general aviation aircraft.

The LPV and LNAV approaches share a common lateral profile and within the UK, when an LPV approach is implemented, the approach chart is also required to include the two-dimensional LNAV approach. This ensures that aircraft with GNSS, compliant with *TSO/ETSO C129* [44] that does not include an SBAS capability, are also able to use the approach.

6.6 Recommended Option

The assessment has identified no specific risks related to IFA 2 in introducing a future ILS system at Solent Airport. Whilst there are no current plans to introduce ILS, the assessment has considered those issues that will need to be progressed by the airport operator should the decision be taken to introduce ILS in the future.

In determining the relative benefits of the instrument approach types identified in the preceding paragraphs, it should be recalled that the international standards for an Instrument Approach Procedure require the existence of an instrument runway and an approach control service.

Within the UK, an IAP implemented in accordance with the CAA's *CAP1122* [39] framework will be limited to a minimum descent height of 500 feet above the runway threshold. This regulatory limitation determines that all of the options for the provision of an instrument approach at Solent Airport will provide the same operational performance capability in respect of cloud base and visibility.

The operational benefits for all of the instrument approach types that may be considered by Solent Airport in the future are identical. This leads to a strong business case for GNSS based approaches as they do not require investment in the installation and ongoing maintenance costs of ground based navigation aid infrastructure.

7 UNMANNED AERIAL VEHICLE (UAV)

7.1 Introduction

Unmanned Aerial Vehicles (UAVs) had previously been considered at a fairly high level. At this stage of the project, a more detailed assessment has now been carried out, whereby the potential impact (risks and effects) that Unmanned Aerial Vehicles (UAVs) could have on the IFA2 Facility has been assessed, and is now included as part of the Hazard Identification and Risk Assessment [2 & 37].

This section of the report presents the initial findings covering effects, controls, and mitigations, and recommends actions to be considered in achieving the levels of safety required of the IFA2 Facility at Solent Airport. It goes some way to addressing the potential risk associated with UAVs and how they might be mitigated by the IFA2 programme and also other parties.

7.2 General UAV Issues Considered

This section addresses how UAV operations lead to accidents and applies to non-commercial and commercial operators (it does not address the risks to infrastructure or people from the payloads that may be carried on UAVs; e.g. Radar, Lidar, Lasers etc.). The difference is that the controls and mitigations avoiding and preventing accidents are quite different for non-commercial and commercial operations as regulated by the CAA and EASA (in *CAP 722* [31]) and in the future through the outcome of *EASA NPA 2017-05 (A) and (B)* [32]).

7.2.1 The Consequence of UAV Failure

There are four significant events that could result in UAV accidents that apply to both non-commercial and commercial operation of UAVs. They are:

- Controlled Flight into terrain (CFIT). (Intended impact on ground and infrastructure due to UAV risk mitigation processes (i.e. it is the safest choice to make);
- Un-Controlled Flight into terrain (UCFIT). (Impact on ground, infrastructure and personnel due to unexpected UAV operation);
- Mid Air Collision;
- Impacts on infrastructure and personnel on the ground (prior to and after flight, during take-off, taxiing and landing).

7.2.2 Causes of UAV Failures:

- Loss of Data Control Link;
- Equipment failure;
- Loss of operator control (or Operating System control);
- Human error;
- Meteorological effects;
- GPS masking.

7.2.3 Hazards Related to UAVs:

There are three concerns from the IFA2 risk analysis in the *Hazard Log Report* [2, 37] that may impact UAV operations at Solent Airport (covered by HAZ21):

- Impact on wind flow due to the IFA 2 converter station building;
- EMI and RFI effects on digital and magnetic navigation equipment generated by the IFA2 infrastructure;
- The dissipation of heat through the air.

7.3 The Risks from Non-Commercial UAVs

For the purposes of this UAV impact analysis, non-commercial UAVs are those that are operated outside the specific requirement of *CAP 722* [31] and are flown as leisure craft for hobby and non-commercial gain. Solent Airport have only experienced one event breaching the airport perimeter with non-commercial UAVs

in the last fourteen months, when a UAV was found early in the morning on the runway. Ownership was not established and RCAM noted the event. Due to the event occurring outside Solent Airport operation hours, the safety of other airspace users was not compromised. In an analysis of the CAA Mandatory Occurrence Reports no evidence was found of any occurrence reported about UAVs at Solent Airport, which suggests that the risks from non-commercial incursions to Solent Airspace are low, but should not be discounted. Solent Airport does not currently have proactive defences against UAVs that might breach their airspace boundaries, but they consider that they have very good local relationships and currently are satisfied that their approach to managing safety impacts from non-commercial UAVs is proportionate. As they currently operate in Class G airspace, this is a reasonable position to take, leaving the obligation on pilots transitioning through that airspace to maintain visual awareness of other airspace users and pilots take full responsibility for their own safety, although they can ask for help form ATC.

National Grid needs to be aware that there is a risk that non-commercial UAVs could impact the facility if they breach the airport boundary and the IFA2 boundary. They could impact the facility and cause infrastructure damage or impact with personnel causing serious injury, or death (depending on the UAV, the type of impact and the area of impact).

7.4 Risks Associated with Commercial UAVs

Currently, Solent Airport does not host commercial UAV operations although Fareham Borough Council (FBC) has been approached by Tekever and it is understood that they may be a future tenant (for operation, manufacture, test and evaluation). Solent Airport has previously hosted UAV operations for FBC as a one-off-task which were supervised by RCAM, outside normal operation hours. RCAM have minor and very brief experience of overseeing the management of UAVs, but they are very aware of their obligations in doing so. Furthermore, the airport Manager prior to moving to Solent Airport was part of the ATM operations at Boscombe Down when UAV operations were safely integrated into the extremely complex and busy airfield operations. If in time UAV operations are considered at Solent Airport, the risks associated with their operation will have to be identified and managed appropriately by stakeholders.

UAV operations are slightly different depending on; location, planned tasks, equipment, co-operating systems and processes, but the arrangements for setting up safe systems of work is well documented and well understood throughout the regulating, operating and ATM organisations.

7.5 Controls and Mitigations and Actions Against HAZ21

Controls, mitigations and actions are identified in HAZ21 [2, 36] relating to UAVs in the context of potential effects from the IFA2 Facility. They are deemed reasonable and sufficient in the light of the current analysis and there are currently no recommendations to adding further controls, mitigations and actions not otherwise identified.

7.6 Reporting and Recording of UAV Incidents and Accidents

EASA and thus the CAA have in place a process which operators should use to report aviation occurrences, this is the Mandatory Occurrence Reporting (MOR) System as laid out in *CAP 382 Mandatory Occurrence Reporting Scheme* [33] and directed by *EU376/2014* [34] or *IR2015/1018* [35]. Regarding the MORs, note the following points:

- There are numerous times when a possible occurrence has been reported several times;
- The details of the occurrence are often scant or incomplete;
- There are few occurrence reports raised by commercial UAV operators;
- There are no occurrence reports raised by non-commercial UAV operators.

Notwithstanding the foregoing observations, it is recognised that the reports are investigated and reviewed by the CAA monthly and although there is regular reporting by airline or private operators of seeing UAVs in flight, there is generally only a slight reduction in safety margins.

It is considered that appropriately qualified personnel reviewed the findings of the Air Accidents Investigation Branch (AAIB) incidents and thus we have not conducted any further review on the record of UAV accidents.

7.7 CAA's Current View on UAV Safety

As the world view on UAV safety management matures it is important to bear in mind that regulation changes are likely. Constant review of safety arrangements should be undertaken. It is worth noting that the CAA's current view on the future of UAV safety is:

- The CAA would welcome a register of UAV users that is tied to systems allowing real-time tracking and tracing of UAVs. This would be a significant aid to the police and others involved in enforcing UAV regulations;
- The CAA would welcome steps to introduce no fly zones to improve safety and are actively involved in work to define these for UAVs in the future;
- Fitting geofencing to UAVs, automatically stopping them flying close to airports and other key infrastructure, is also a key element of helping to make sure UAVs fly safely. (Forthcoming UAV rules for Europe being proposed by the EASA also call for mandatory geofencing for UAVs) (Note that if this is not implemented effectively, the solution may introduce different risks that have to be managed).

The current law requires that anyone operating a UAV must do so responsibly and observe all relevant rules and regulations. The rules for flying UAVs are designed to keep all airspace users' safe. The CAA is very clear that it is totally unacceptable to fly UAVs close to airports and other aircraft and anyone breaching the rules can face severe penalties including imprisonment. The CAA's 'drone code' provides advice on how to fly UAVs safely and responsibly.

7.8 Conclusions

This latest assessment has not identified any additional risks and mitigation measures that were not previously known, and there are currently no recommendations to add further controls, mitigations and actions not otherwise identified.

It is concluded that the proposed IFA2 Facility would not exacerbate the possible risks posed by UAVs themselves upon Solent Airport.

There is a potential for non-commercial, third party UAVs from external sources to enter the airport and IFA2 Facility boundaries, potentially causing damage or injury / death (depending on the type and size of UAV) to personnel. This is a generic external risk affecting all airports. Appropriate measures to prevent this need to be considered by the Airport Operator. There is no reason to believe why suitable measures should not be achieved within the programme for introducing UAVs to Solent Airport.

7.9 Recommendations

These conclusions are deemed valid at the time of writing although, it would be prudent for all safety stakeholders to be conscious of the latest availability of UAV information as the project moves forward from:

- Regulation;
- Mandatory Occurrence Reporting;
- Air Accident Investigation Reports;
- Local police reporting of non-commercial UAV incidents.

8 CONCLUSION

The technical assessments presented above, provide support to the interim Safety Justification [38] for the IFA2 Facility at Solent Airport and are part of the work intended to support the application to the Fareham Borough Council (FBC) Executive Committee for the full planning acceptance and consent to progress to the next stage in the project. The assessments cover the following:

- a revised assessment of airfield safeguarding taking account of the revised IFA2 design;
- additional wind flow analysis covering the interaction effects between the IFA2 Converter Station and the Faraday Business Park;
- further independent peer review of some additional documents related to Radio Frequency Interference (RFI) and Electromagnetic Frequency (EMF) documents and consideration of EMF/RFI effects and to consider some specific hazards within the hazard log;
- consideration of the possible effects upon Maritime & Coastguard Agency (MCA) equipment arising from the IFA2 Facility;
- an assessment of options for future navigational systems including an instrument landing capability, both generically and in the context of the IFA2 Facility at Solent Airport. Currently there are no plans to introduce ILS to the airport;
- an assessment of Unmanned Aerial Vehicles (UAVs), considering the risks that non-commercial UAVs could pose to Solent Airport and whether the IFA2 Facility could exacerbate these risks.

The conclusions reached on each of the above topics is given below.

Aerodrome Safeguarding Analysis

The aerodrome safeguarding analysis aims to ensure that the existing proposed development will have no impact on the safe operation of the airport. The proposed design of the buildings within the development are not infringing any of the obstacle limitation surfaces (OLS) and are compliant with the associated legislation and standards. The design of the IFA 2 building roof is pitched, which is less attractive to birds than a flat roof. A bird hazard management plan will be needed. Lighting within the development should follow the Airport Operators Association (AOA) advice [11] to ensure that the operation of the airport is not adversely impacted. The use of cranes during construction may present a temporary risk, but the type of crane used should be considered and agreed with the airport at the earliest opportunity, in order to assure that any risk is mitigated and is acceptable, particularly as the site is in such close proximity to the runway.

Wind Assessment

The wind effects analysis has considered the impact of the updated design of the IFA2 Converter Station combined with the future proposed Faraday Business Park buildings on the main runway and covers a realistic range of wind directions and wind speeds. One main effect observed is that the future proposed Faraday Business Park buildings act as a shield to the IFA2 Facility and have the overriding impact on the runway. This also explains the worst-case wind direction now being at the angle of 90^0 EoN, compared to 70^0 EoN from the earlier analysis when only the IFA2 Building is considered. This is because at this angle the future buildings produce three tails of faster winds, which covers the biggest area on the main runway compared to the other angles. The highest relative increase wind speed onto the main runway caused is a maximum of 29% at a height of 5m above the ground.

The wind impacts indicated above can be mitigated by extending the “frontline” buildings nearest the runways and closing the gaps.

Additionally, it was confirmed at the hazard identification and risk assessment [2, 37] studies report that localised changes in wind patterns are easily managed and that pilots quickly become familiar with any changes in wind patterns and adapt their flying accordingly through good airmanship.

Technical Assessment of EMF/RFI Effects

The work included in Arcadis’ *Technical Assessments* [1, 36] completed the main review of the analysis available concerning EMF and RFI effects. Due to additional information being made available very recently,

a further review regarding EMF and RFI has been conducted. Additionally, some areas where there were perceived to be gaps in the existing hazard mitigation evidence have also been considered.

Based on the evidence reviewed so far, whilst further testing evidence is required, there are no issues concerning EMF/RFI emissions due to the IFA2 facility and the expectation remains that risks concerning RFI and EMF will be acceptable as defined in *CAP 760* [15]. Work is in progress to complete the testing and measurement activities that are planned to verify that the requirements and the planning conditions are met. All verification required to demonstrate that safety requirements are met is recorded as a dependency in the Safety Justification [38]. Some points requiring clarification are raised by the assessment, these should be addressed as the design documentation develops.

Avionics Impacts of Emissions

The impact upon avionics equipment from emissions originating from IFA2 has been analysed. The analysis includes assessment of the impacts on Flight Management Systems (FMS) and other specific aircraft navigation systems. The analysis also assessed the impact of wideband noise on aircraft sensors.

It has been determined that any emissions from the IFA2 Facility will rapidly diminish with distance and will have no discernible impact on aircraft that are operating within the normal bounds of the airfield using the systems assessed within this assessment.

Instrument Landing Systems

The assessment has identified no specific risks related to IFA 2 in introducing a future ILS system or similar system at Solent Airport. Whilst there are no current plans to introduce ILS, the assessment has considered possible options for future systems and issues that will need to be progressed by the airport operator should the decision be taken to introduce an instrument landing capability or similar in the future.

It should be noted that the international standards for an Instrument Approach Procedure (IAP) require the existence of an instrument runway and an approach control service. Within the UK, an IAP implemented in accordance with the CAA's *CAP 1122* [39] framework will be limited to a minimum descent height of 500 feet above the runway threshold. This regulatory limitation determines that all of the options for the provision of an instrument approach at Solent Airport will provide the same operational performance capability in respect of cloud base and visibility. The operational benefits for all of the instrument approach types that may be considered by Solent Airport in the future are identical. This leads to a strong business case for GNSS based approaches as they do not require investment in the installation and ongoing maintenance costs of ground based navigation aid infrastructure.

Unmanned Aerial Vehicles

Unmanned Aerial Vehicles (UAVs) had previously been considered at a fairly high level. At this stage of the project, a more detailed assessment has now been carried out, whereby the potential impact (risks and effects) that UAVs could have on the IFA2 Facility and vice versa has been assessed in more detail, and is now included as part of the Hazard Identification and Risk Assessment [2 & 37].

This latest assessment has not identified any additional risks and mitigation measures that were not previously known, and there are currently no recommendations to add further controls, mitigations and actions not otherwise identified.

It is concluded that the proposed IFA2 Facility would not exacerbate the possible risks posed by UAVs themselves upon Solent Airport.

There is a potential for non-commercial, third party UAVs from external sources to enter the airport and IFA2 Facility boundaries, potentially causing damage or injury / death (depending on the type and size of UAV) to personnel. This is a generic external risk affecting all airports. Appropriate measures to prevent this need to be considered by the Airport Operator. There is no reason to believe why suitable measures should not be achieved within the programme for introducing UAVs to Solent Airport.

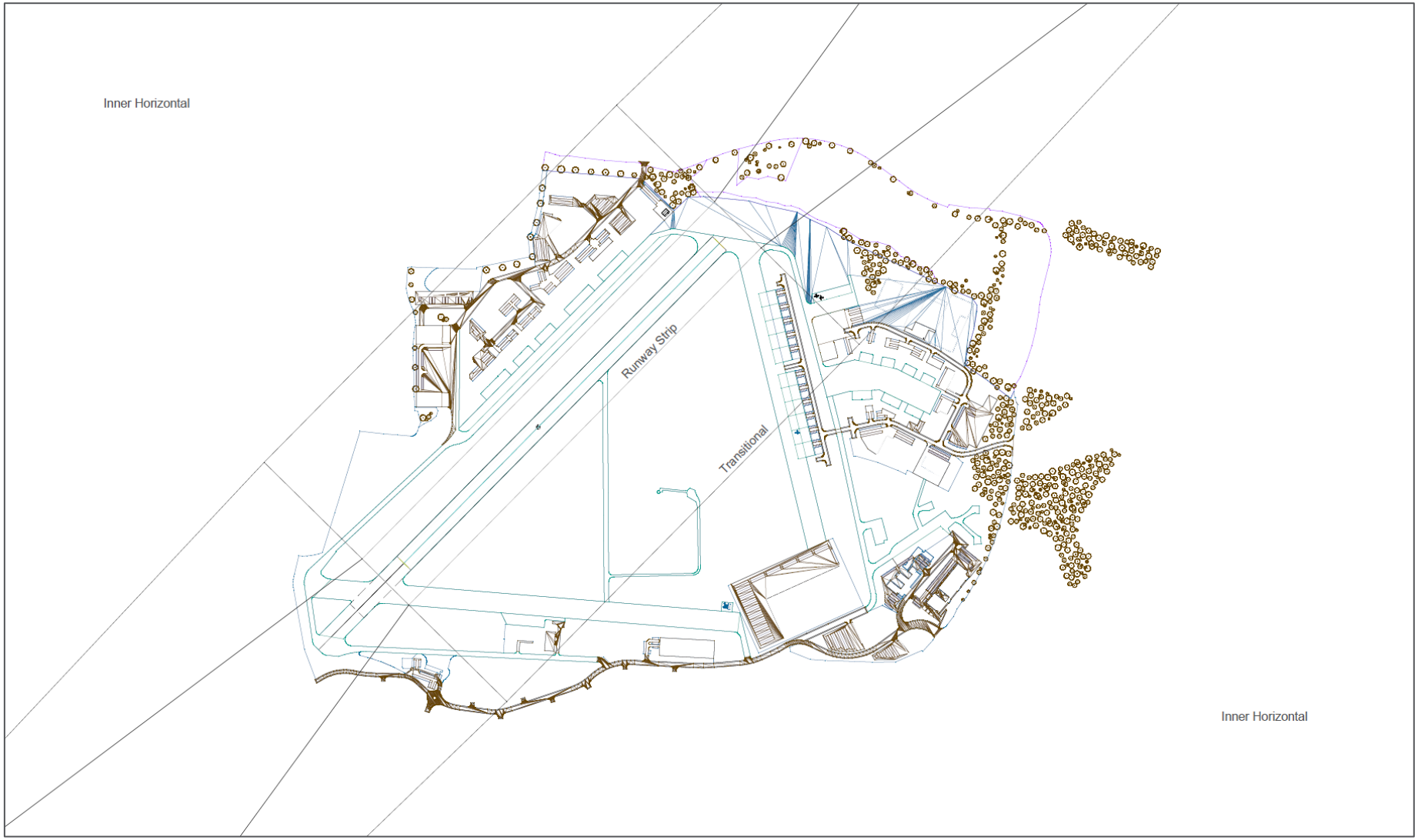
9 APPENDICES

APPENDIX A – APPENDICES RELATED TO SAFEGUARDING CHAPTER 2.0

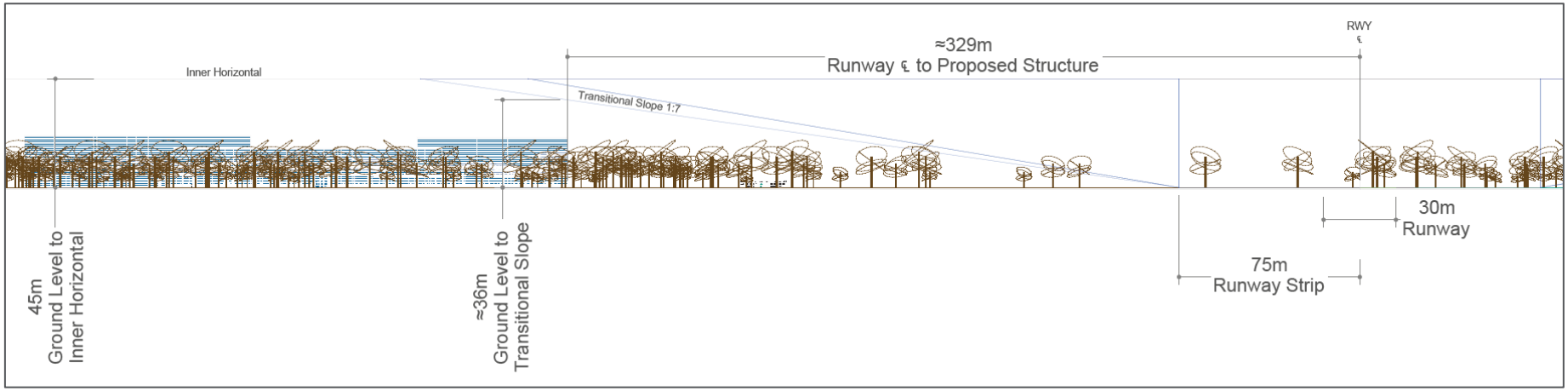
A.1 Position of Buildings in Relation to Airport and OLS

A.2 Position of Buildings in Relation to OLS with Background Image

A.3 Position of Buildings in Relation to OLS without Background Image



A.4 Position of Converter Station in Relation to the Relevant OLS



APPENDIX B – APPENDICES RELATED TO WIND ASSESSMENT CHAPTER 3.0

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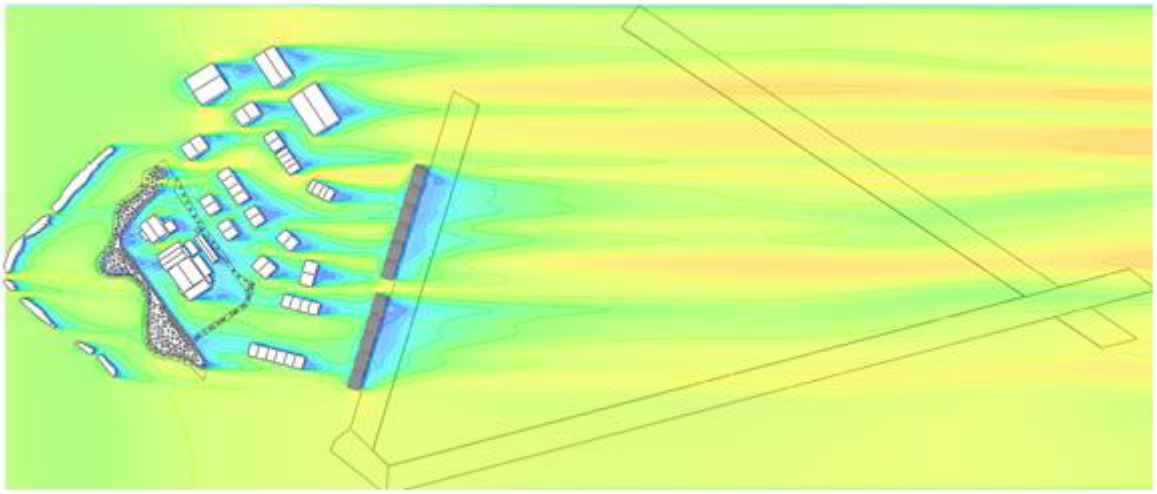

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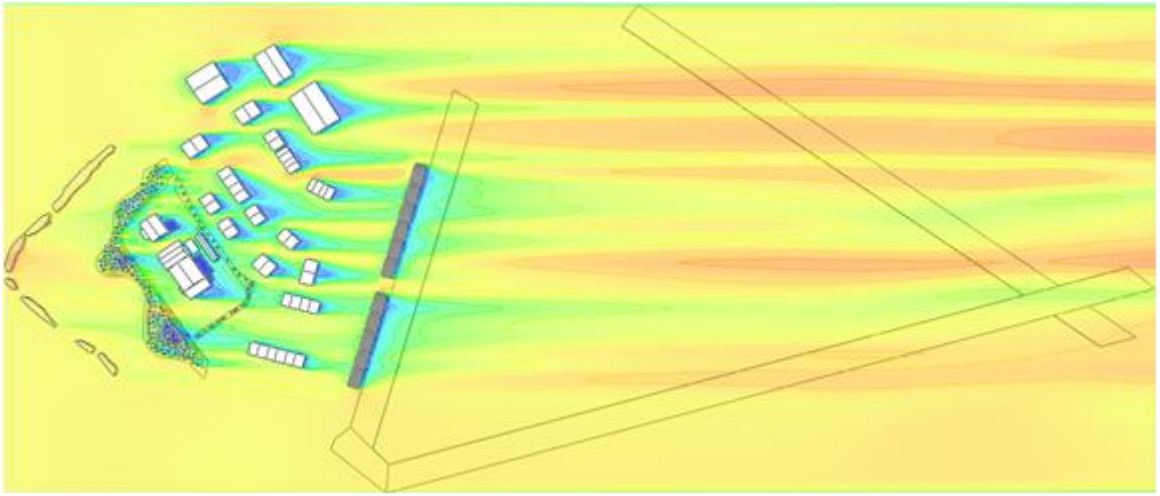

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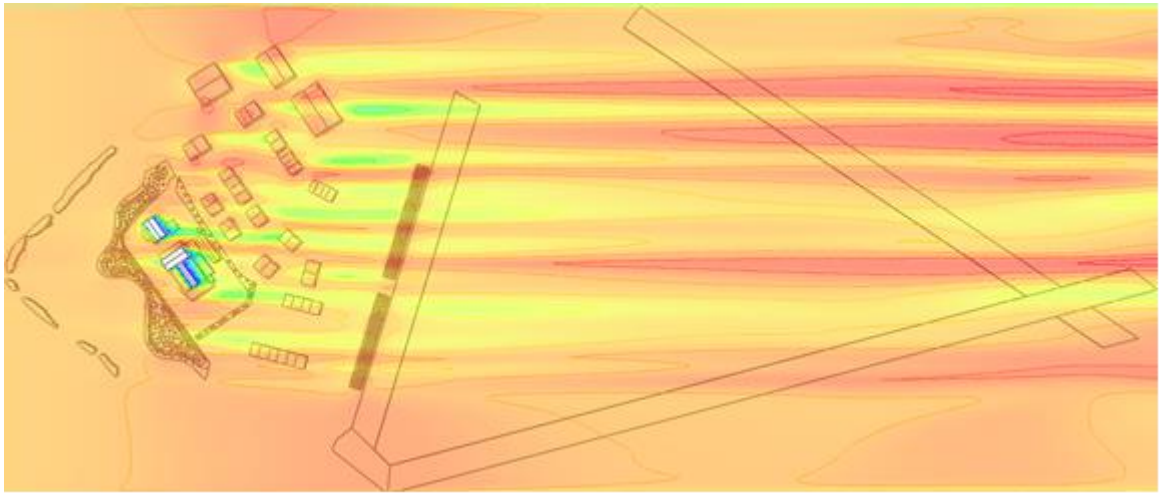

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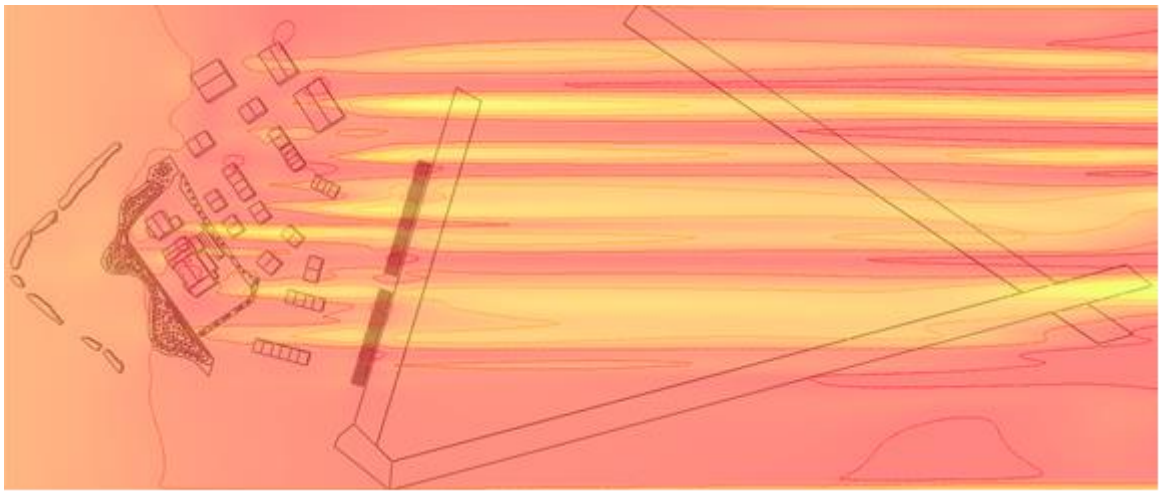

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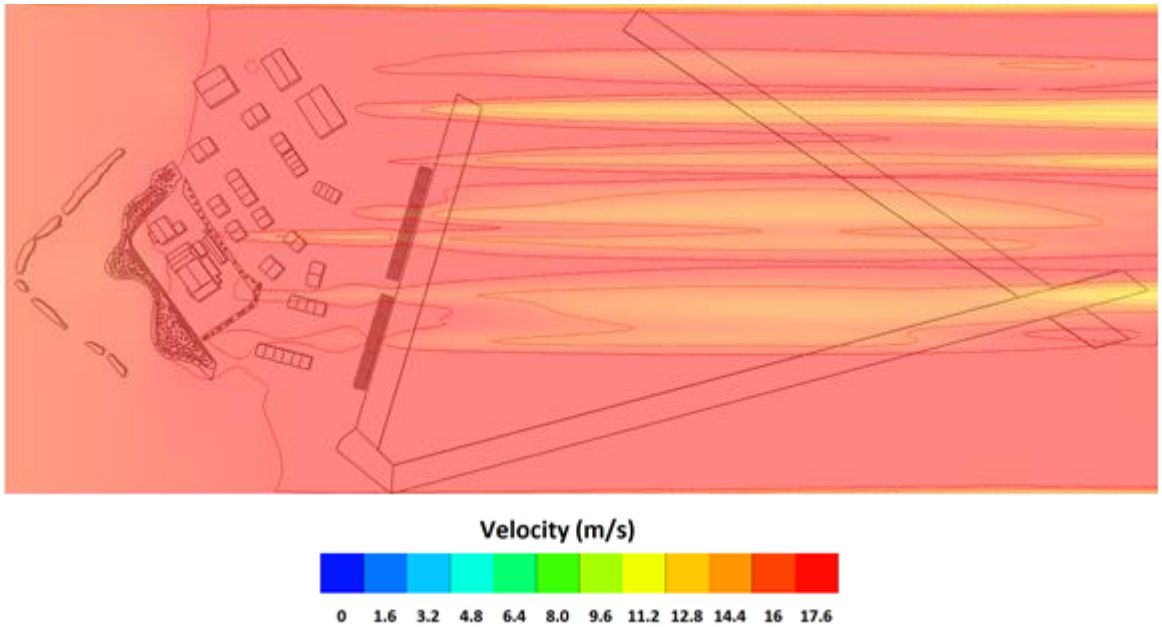

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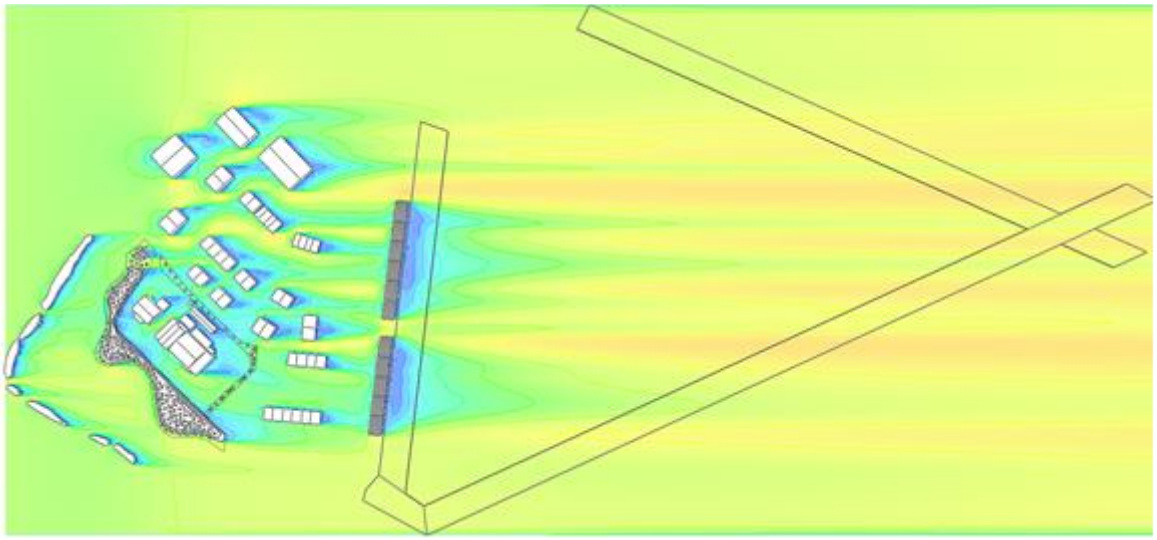

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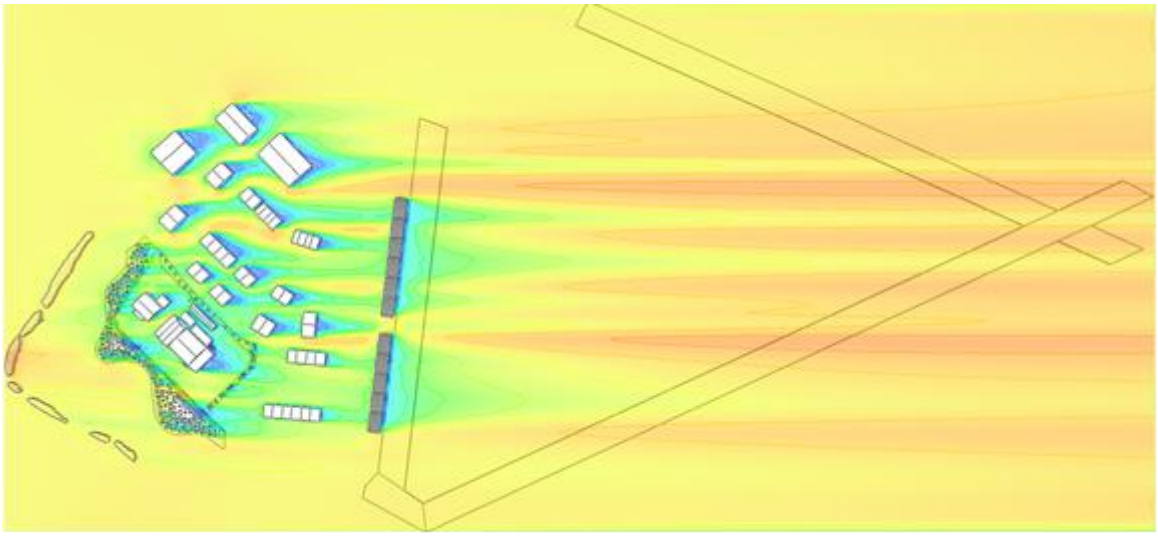

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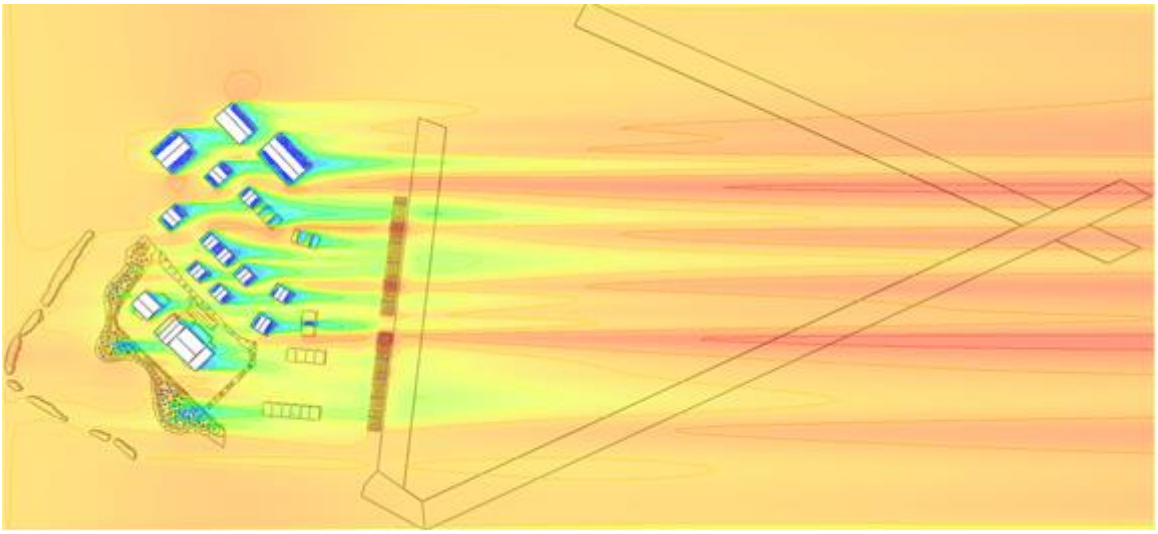

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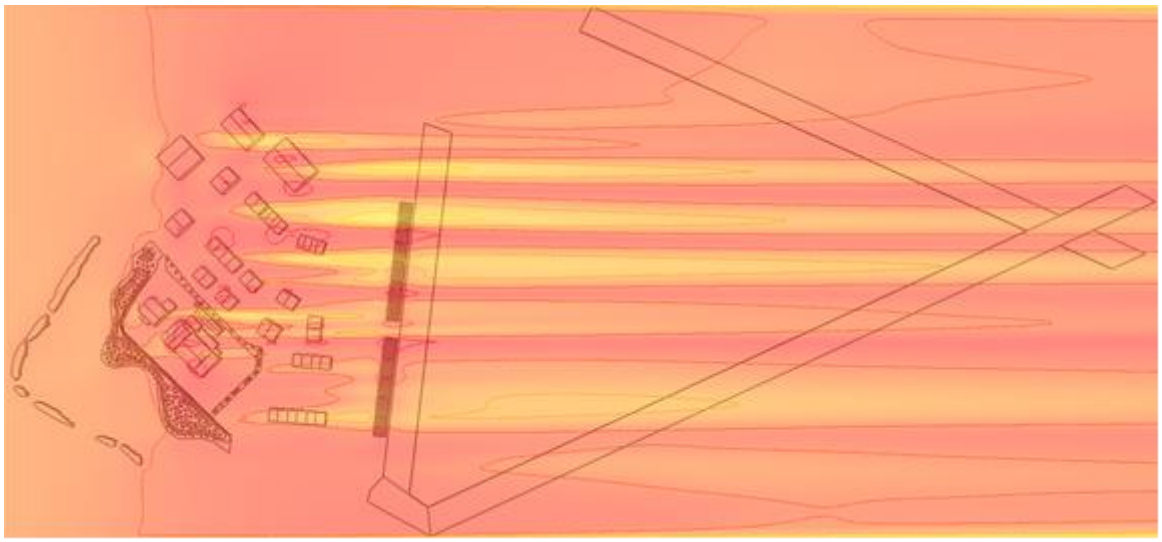

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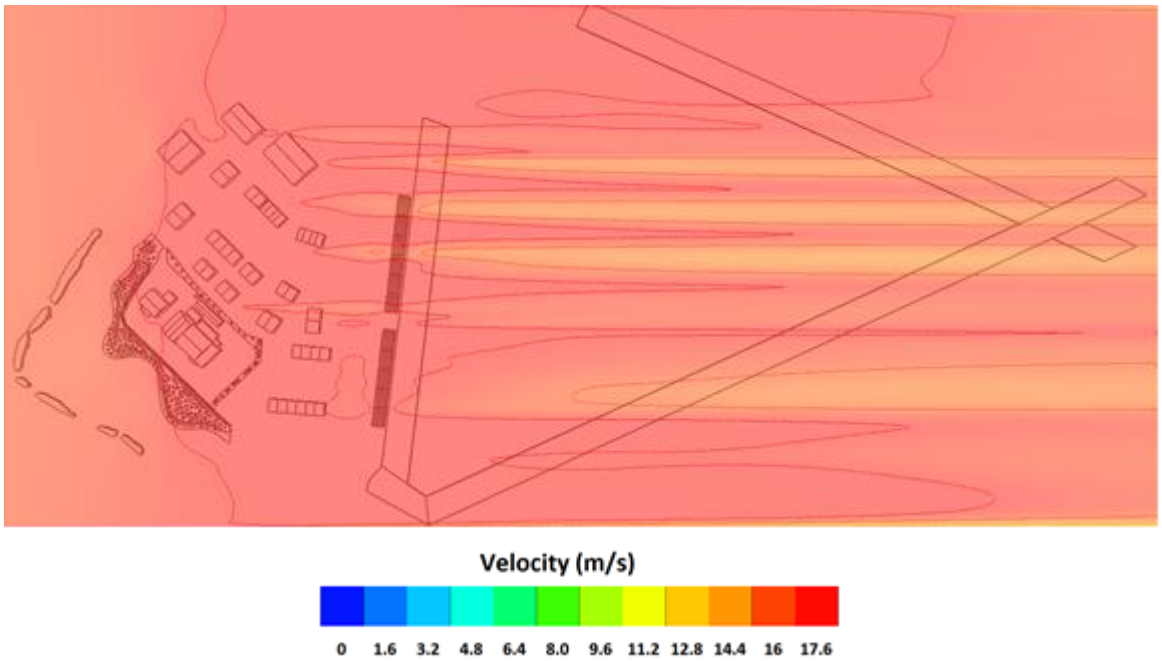

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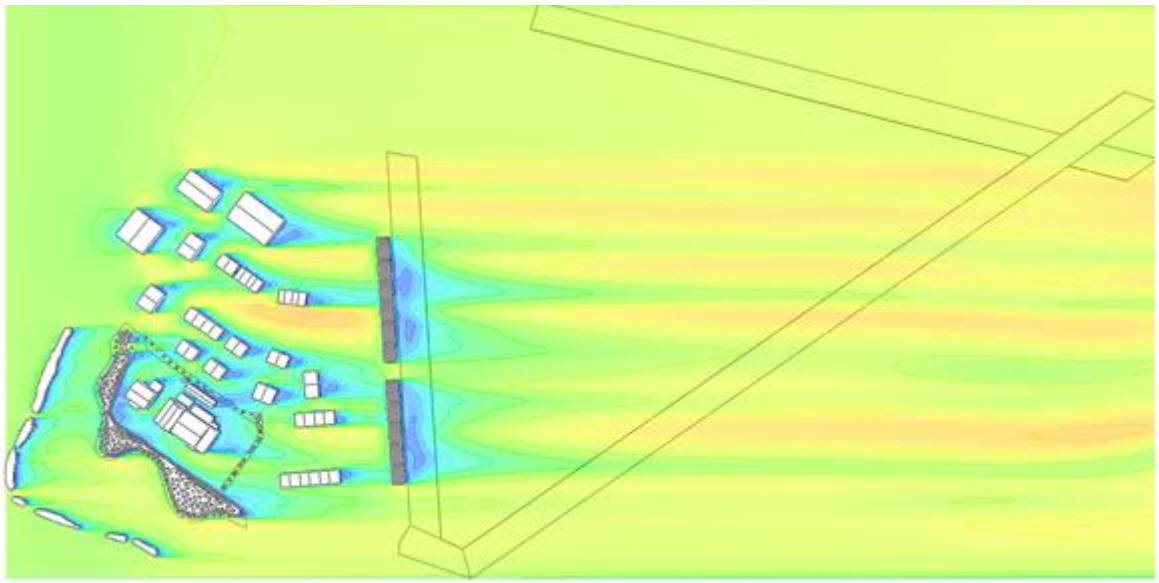

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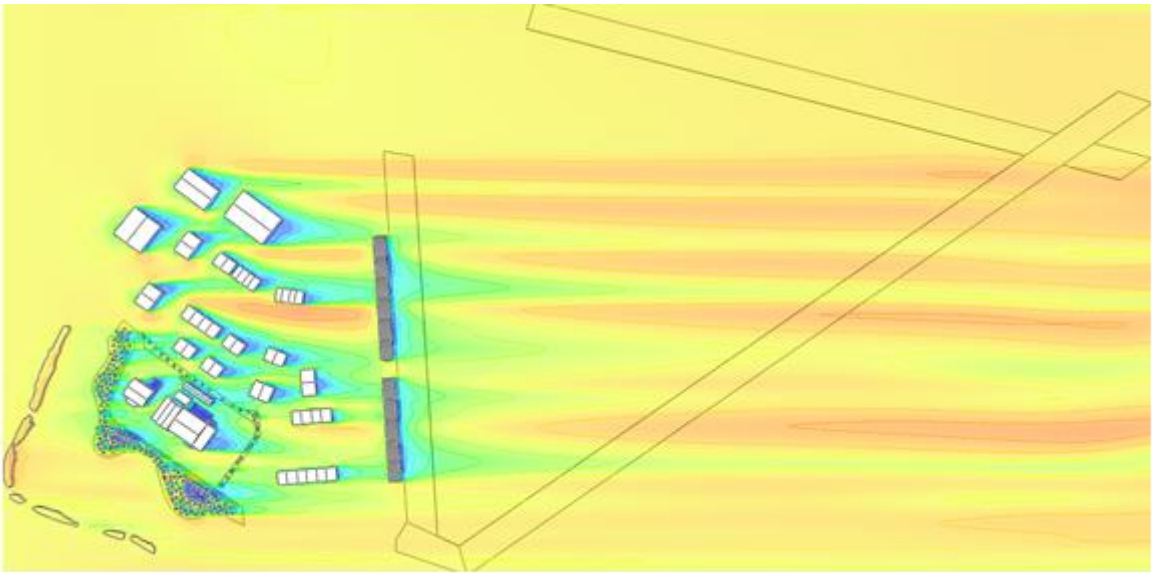

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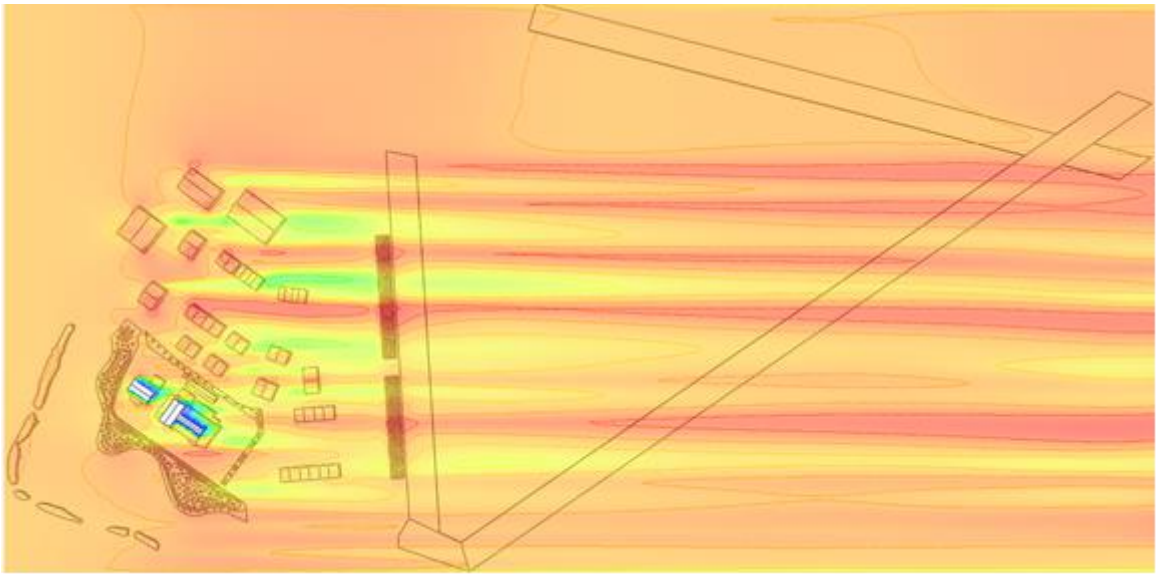

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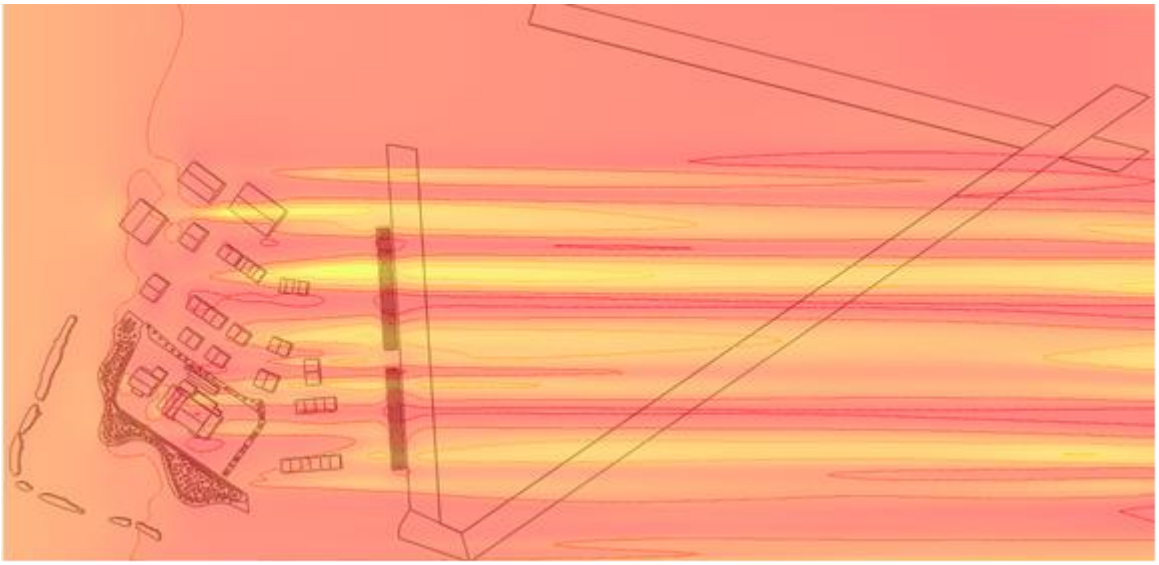

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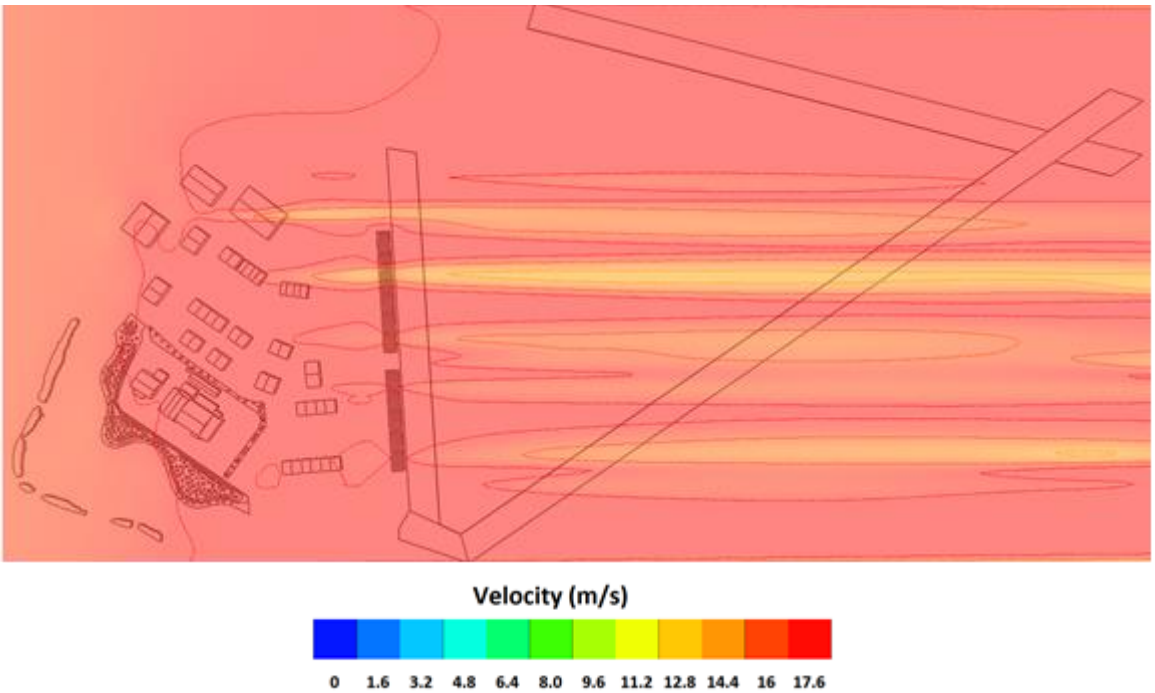

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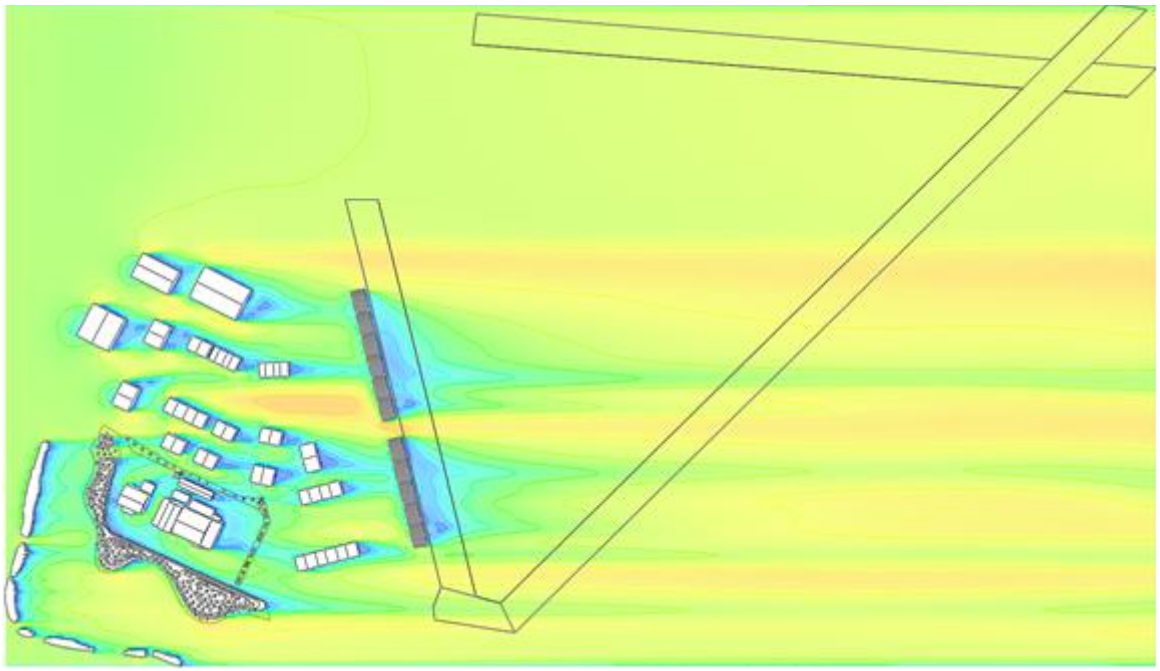

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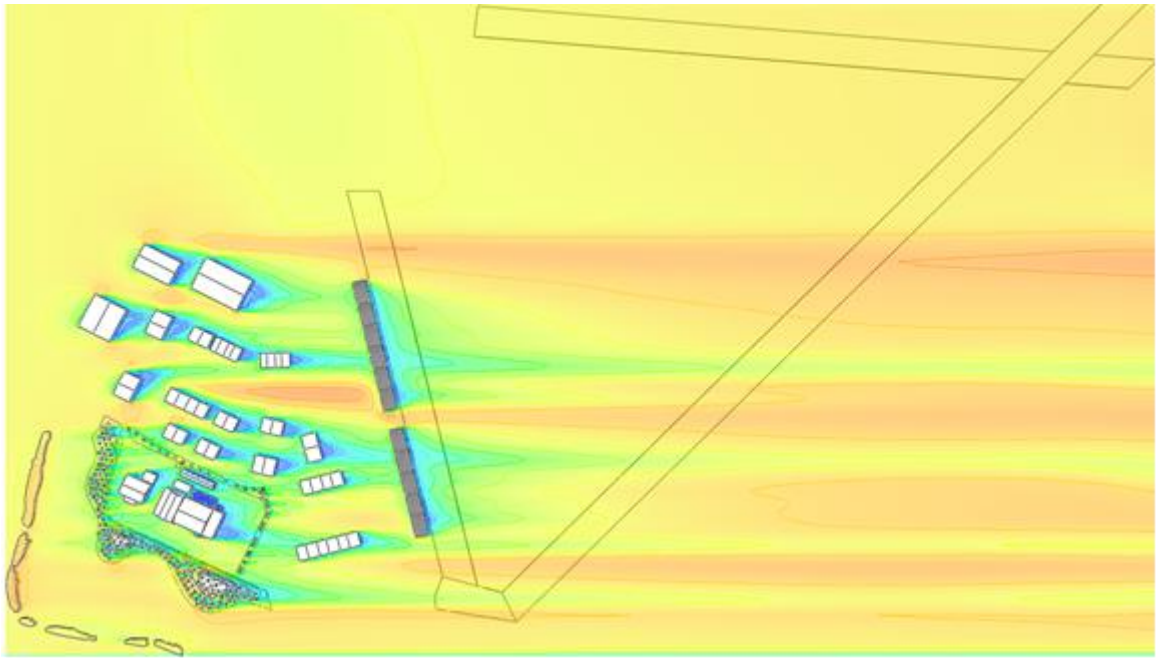

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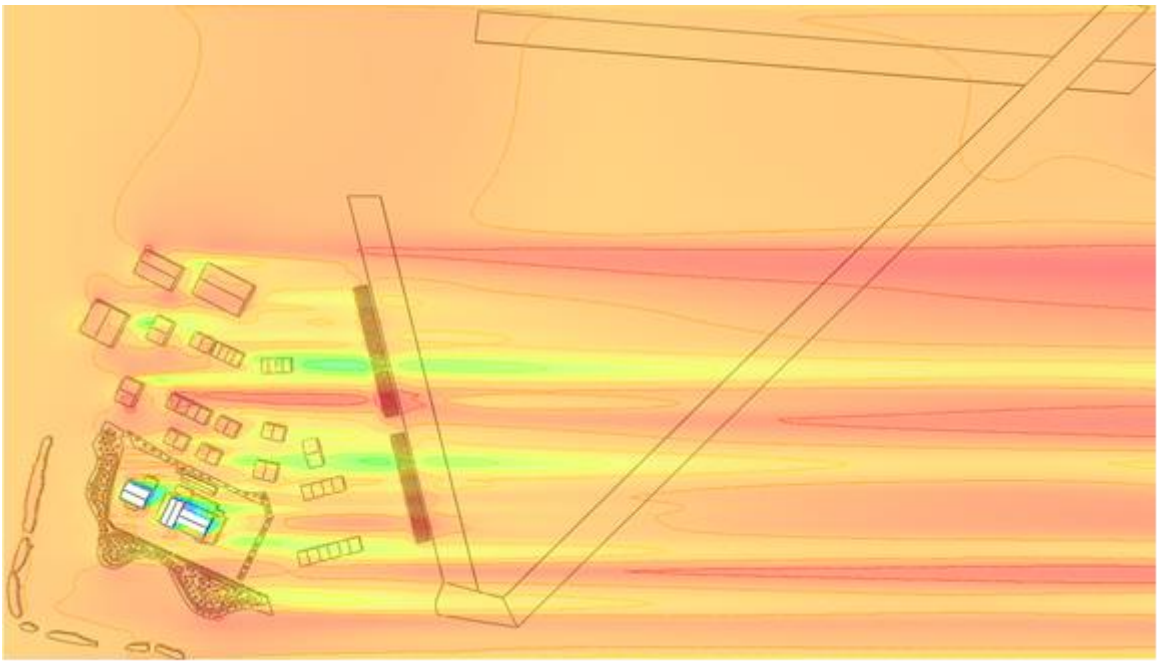

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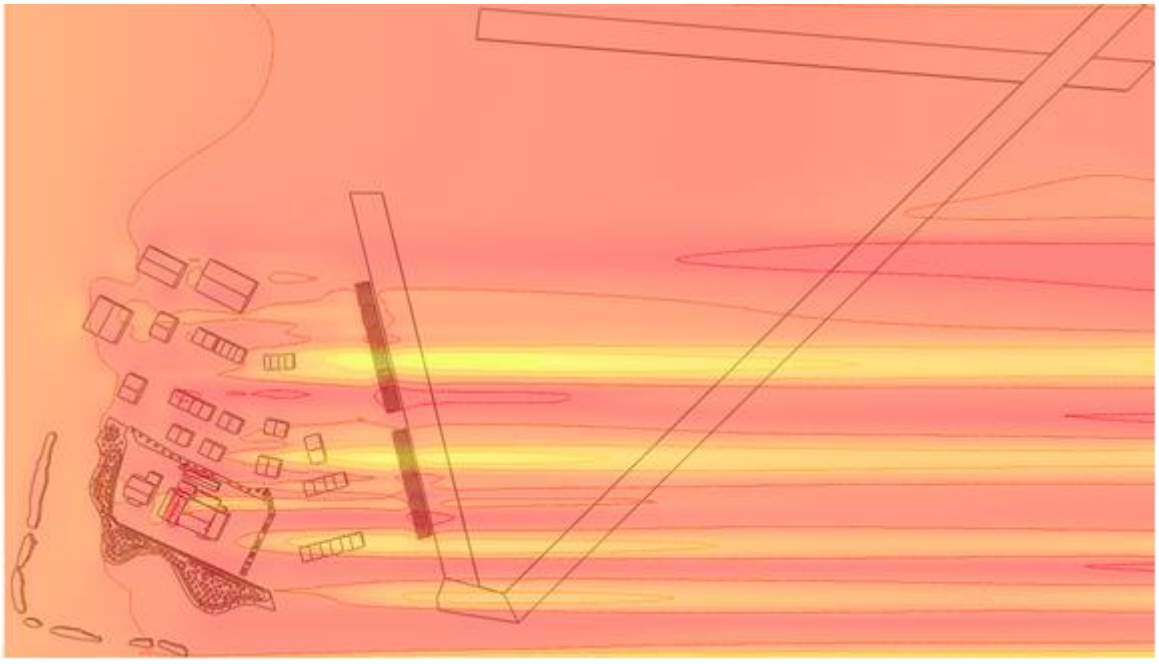

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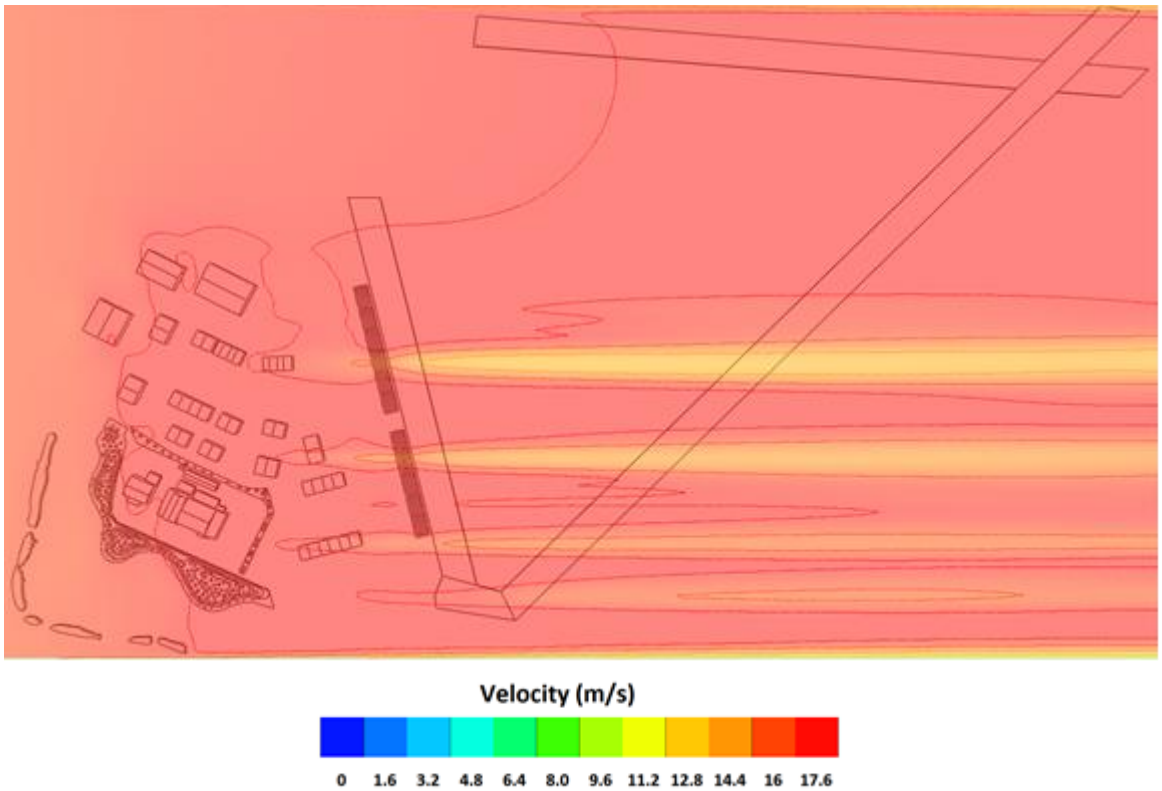

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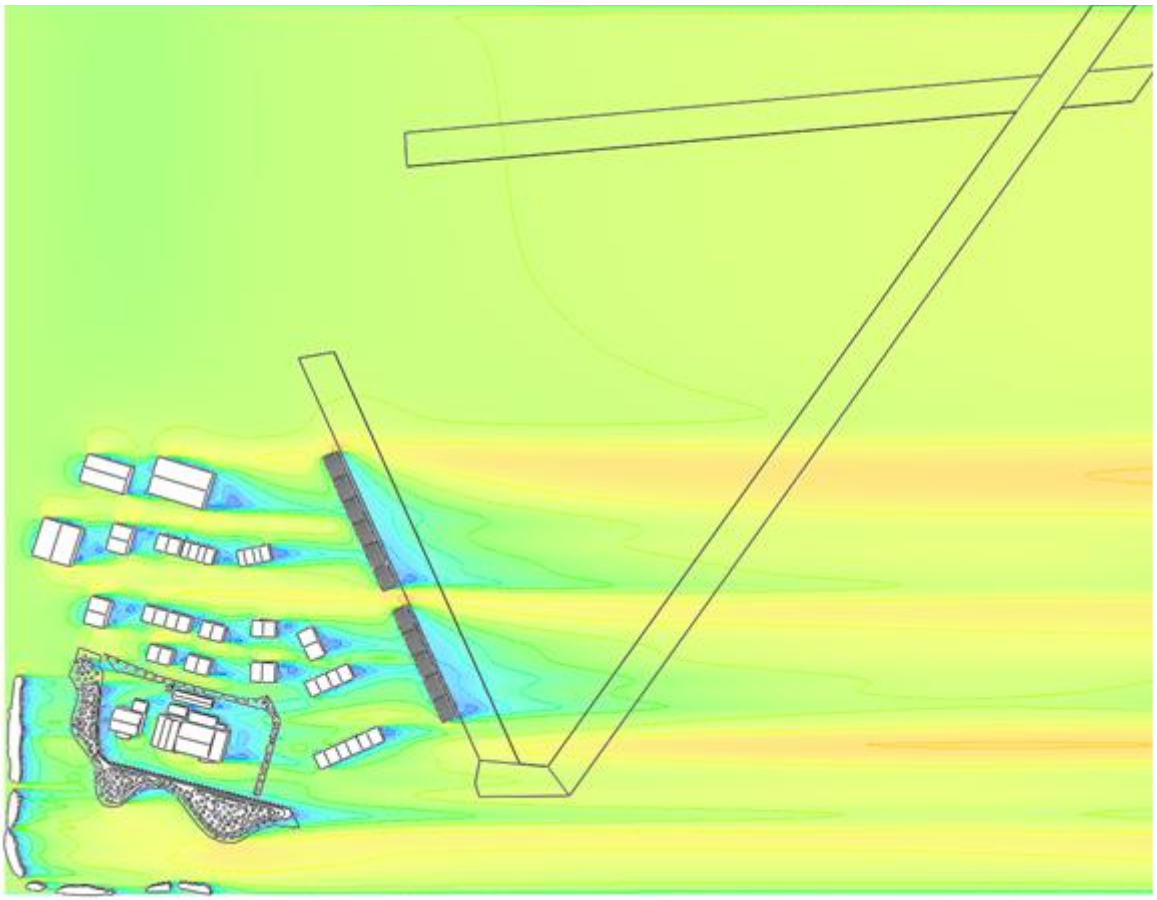

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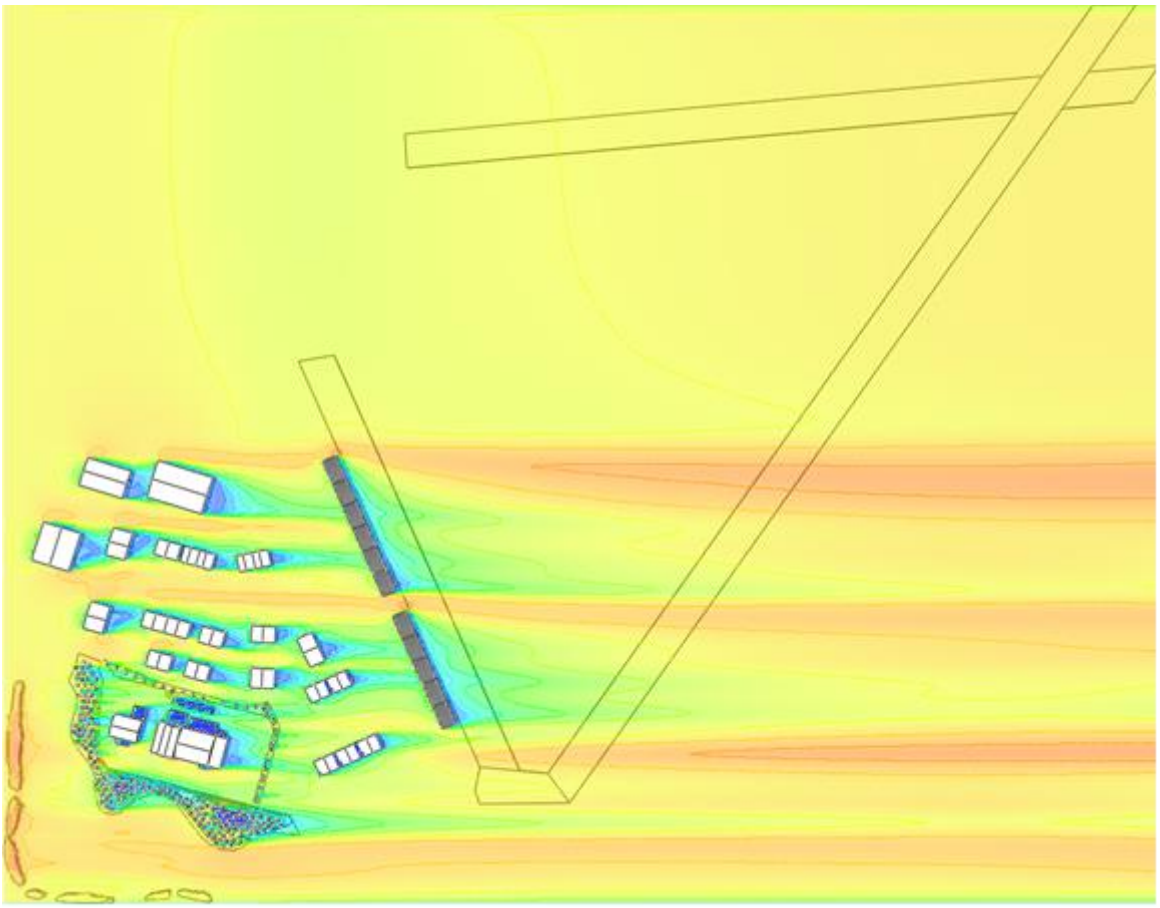

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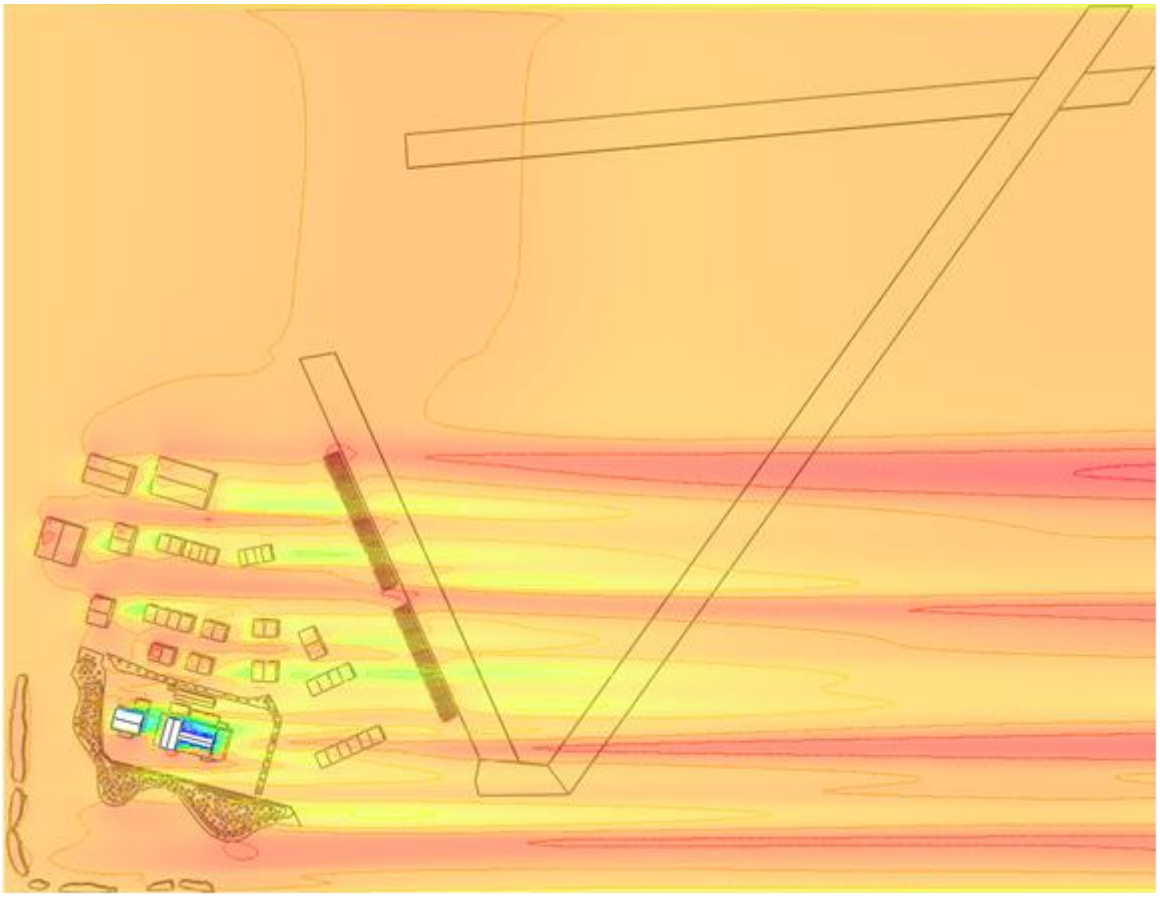

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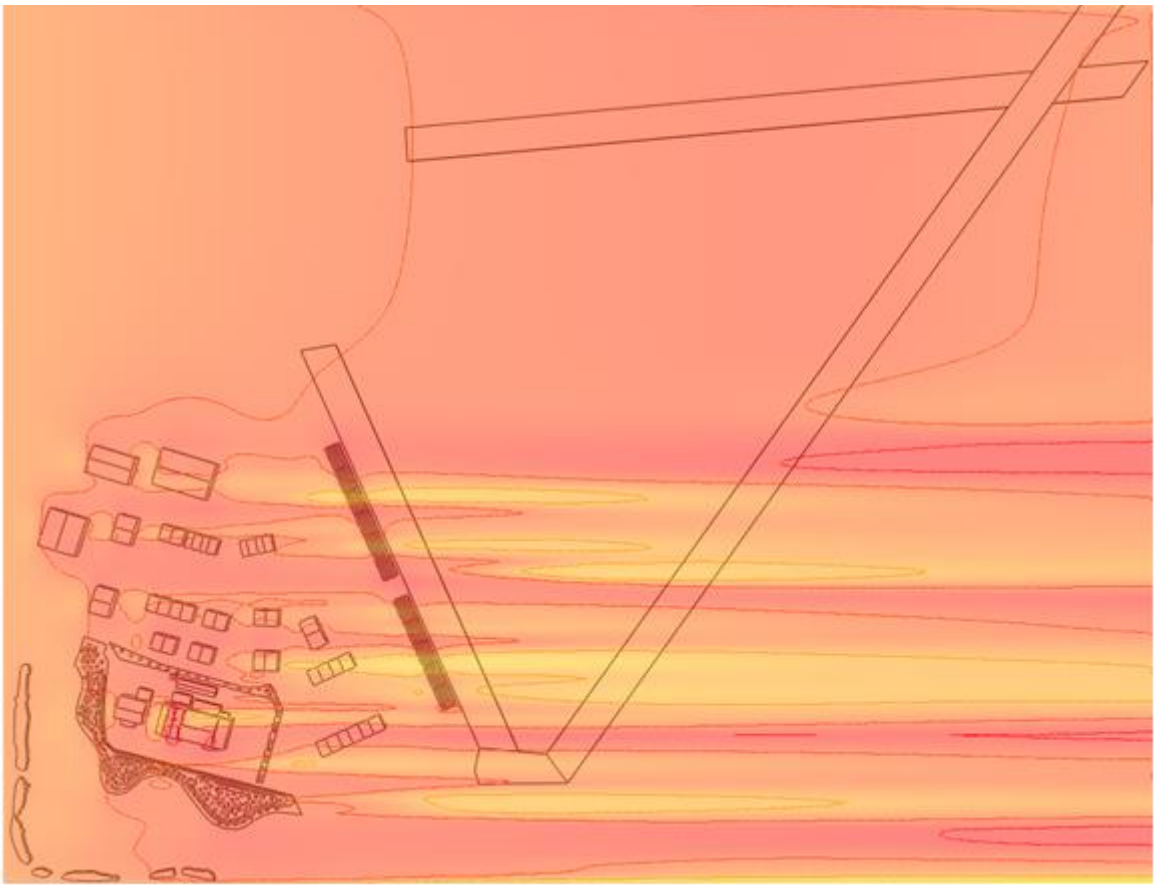

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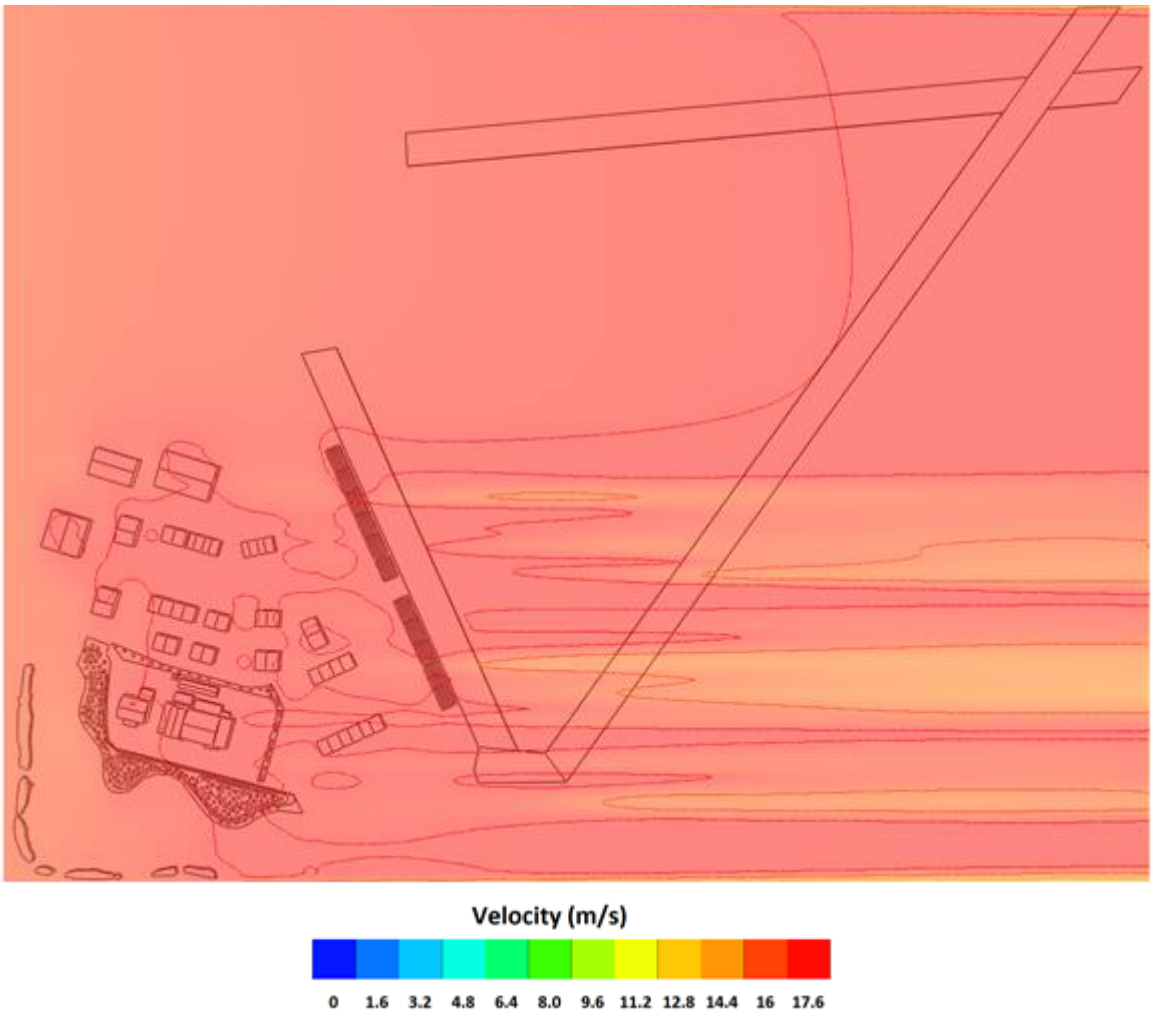

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APPENDIX A4

ARCADIS Design & Consultancy for natural and built assets

TECHNICAL ASSESSMENT

Wind Flow Analysis for the IFA2 Facility

35588103/RP/260917/2

NOVEMBER 2017

Incorporating

EC HARRIS BUILT ASSET CONSULTANCY

Hyder

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VERSION CONTROL

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EXECUTIVE SUMMARY

National Grid Interconnector Holdings (NG) is proposing to develop and implement a new electricity interconnector facility, the Interconnexion France-Angleterre 2 (IFA2). The facility is being developed jointly with Réseau de Transport d'Electricité (RTE), the French transmission system owner and operator. It will link the United Kingdom's electricity transmission network with France's, and is expected to help enhance the security, affordability, and sustainability of energy supply to both countries.

The facility consists of two converter stations, one sited in each country. The UK converter station is to be sited to the north-east of Solent Airport at Daedalus ("Solent Airport"). National Grid proposes to route high-voltage direct current and high-voltage alternating current cables in a shared cable corridor to the west.

This report presents a more detailed flow wind analysis, where the model used to simulate the wind flow has been developed in more detail with the revised IFA 2 building profile and to take into account more of the immediate surroundings such as the upstream earth mounds planned (to relocate earth displaced by the construction). The analysis also includes the current (not future) proposals of the development for the Faraday business park, which includes two buildings that are adjacent to the IFA2 converter building and one building adjacent to the Taxi-Way.

In addition to the more detailed wind flow analysis, also included in this report is a comparison of the wind flow analysis (which has been carried out using CFD simulation) and wind tunnel testing of the IFA 2 facility and surroundings (including the current proposals for the Faraday business park) that has been separately carried out by RWDI.

The validation (comparison of wind tunnel testing and the CFD results) study has resulted in the following findings:

- It is observed that the wind speeds seen in the wind tunnel testing are generally higher than in the CFD simulation results. This could be explained by a number of reasons, such as the turbulence model used, or the surface roughness in the model, however, it is considered more conservative to base the design of the higher (or more extreme) values of local wind speed.
- A strong correlation can be observed where the discrepancy is within a 15% margin, which is considered acceptable to use the CFD modelling for any further validation.
- The general trend of the CFD results is in line with wind tunnel results, in other words, the wind speed increases with respect to height from ground level for each location reference for both the CFD simulation and the wind tunnel results.

Overall, the conclusions of the work reported in this document support the preliminary analysis carried out previously, i.e. risks are expected to be acceptable as defined in CAP 760 [8] for current airport operations with any localised impacts managed through airmanship and reports to airport management to be included in Notice to Airmen (NOTAMs) if necessary.

REFERENCES

Ref No	Reference Identifier	Title
1	35588100/NT/300916/1	Technical Assessment (Main Report) of the possible impact of the IFA2 Interconnector at Solent Airport Daedalus.
2	35588100/NT/300916 Addendum 1	Technical Assessment - Wind Flow Analysis
3	1JNL549328	Potential new solution with layout rotation in Daedalus
4		Excel Spreadsheet - Dimensions for wind calculations provided by National Grid
5	35588102/RP/010617	Wind Flow Analysis for the IFA2 Facility
6	RWDI #1703422	AIRPORT RUNWAY WIND STUDY

TERMS AND DEFINITIONS

Term/Abbreviation	Definition
CFD	Computational Fluid Dynamics
EPSRC	Engineering and Physical Sciences Research Council
AGL	Airfield Ground Lighting
EoN	East of North

1 INTRODUCTION

References [1], [2], and [5] present the preliminary wind analysis carried out to assess the potential impact of the proposed IFA2 Converter Building on the trailing winds on the main runway at Solent Airport, based on outline proposals for the IFA 2 building structure. This work was undertaken in support of the planning application process for the IFA 2 facility, together with hazard identification and risk assessment and other technical assessments.

The preliminary analysis concluded that the highest relative increase wind speed onto the main runway caused by the building is a maximum of 30%, at a height of 5m above the ground (for wind speeds of 10, 15, and 20m/s respectively). At low wind speeds like 5m/s, the building has little to no impact on the main runway in the wind direction coming from the direction of the building onto the main runway. Similarly, at wind speeds more than 5m/s in the same direction, there is no significant building wake impact above 30m above the ground.

It was confirmed at the Hazard Identification and Risk Assessment study reported in [1] that localised changes in wind patterns are easily managed and that Pilots quickly become familiar with any changes in wind patterns and adapt their flying accordingly through good airmanship.

A recommendation was raised in [2] that the analysis should be repeated when the final design of the converter station and future development plans for the area are known.

Since completion of the preliminary analysis, the design of the Converter Station has been revised slightly, the height has been reduced and the building is more compact. Additionally, some further details are known regarding the landscaping in the immediate vicinity of the of the building. These changes have the potential to affect the previous results in terms of wind turbulence, which is likely to be reduced since the span of the geometrical extent has reduced.

This report presents a more detailed wind analysis, where the model used to simulate the wind flow has been developed in more detail with the revised IFA 2 building profile and to take into account more of the immediate surroundings such as the upstream earth mounds planned (to relocate earth displaced by the construction). The analysis also includes the current (not future) proposals of the development of Faraday business park, which includes two buildings that are adjacent to the IFA2 converter building and one building adjacent to the Taxi-Way (illustrated by the red circles in Figure 1 below).

As previously, the analysis assesses the potential impact of the IFA2 converter station on trailing winds on the main runway, considering both pessimistic and more realistic wind conditions.

Figure 1 below shows the extent of the domain (i.e. the area modelled) that is to be analysed using Computational Fluid Dynamics (CFD). CFD is a tool that uses numerical analysis and data structures to solve and analyse problems that involve fluid flows.

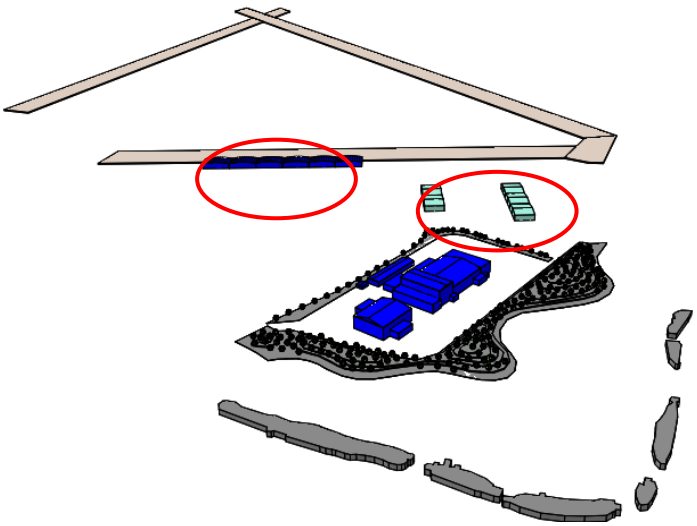


Figure 1 – CFD Domain of Analysis

In addition to the more detailed wind flow analysis, also included in this report is a comparison of the wind flow analysis (which has been carried out using CFD simulation) and wind tunnel testing of the IFA 2 facility and surroundings (including the current proposals for the Faraday business park) that has been separately carried out by RWDI.

2 ANALYSIS

2.1 Investigation of the Worst Case Wind Direction

In order to determine the worst-case wind direction in terms of impact on the runway, a CFD analysis has been carried out. The method of CFD analysis has been chosen as the most appropriate tool to model the turbulence effects in the wind patterns.

The CFD analysis is based on a wind velocity of 20m/s because the wind rose data indicates that this could be a maximum wind speed. This input represents the meteorological wind speed which is measured at a height of 10m above ground. The details of this has been justified in the previous wind assessment report [5]

Figure 2 below shows the results of the analysis of a range of wind angles between 60^0 to 100^0 EoN (at 20m/s) to determine worst-case wind direction in terms of impact of the combination of buildings on the main runway (also see Appendix A for magnified images of the results).

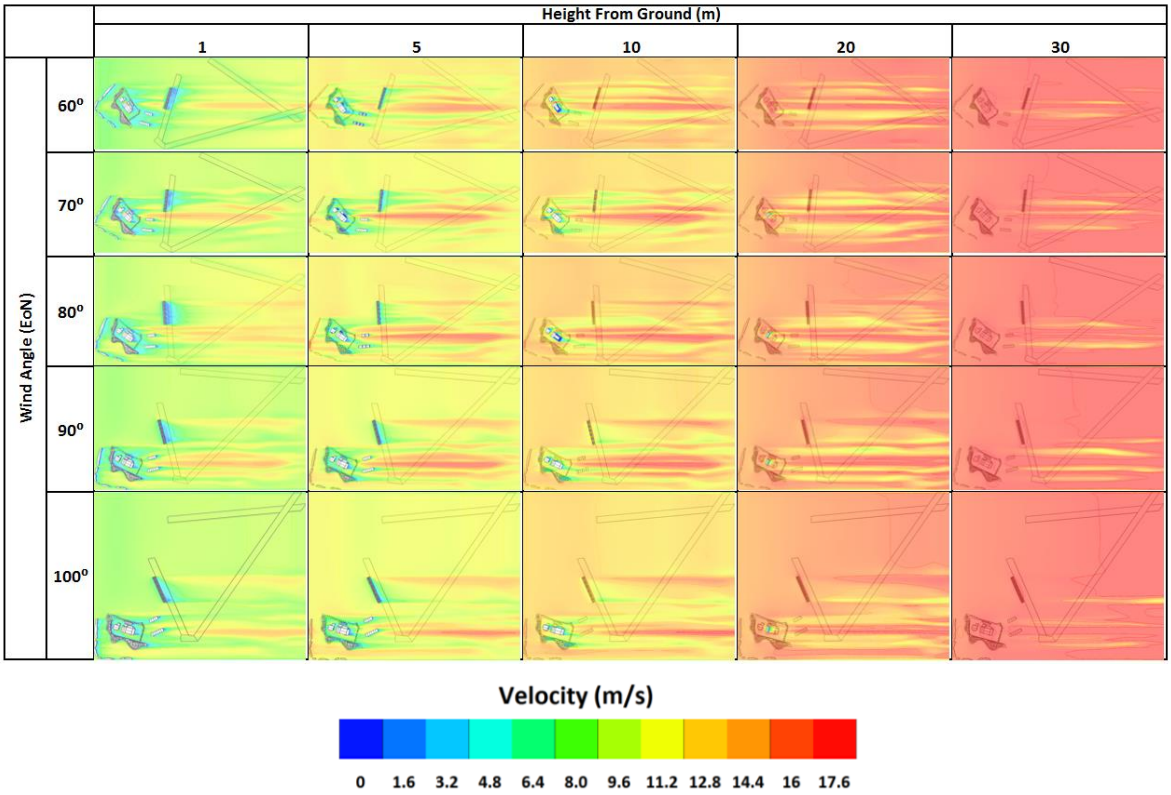


Figure 2 – Results of wind flow for a range of directions and heights (flow direction from left to right).

In order to determine the worst-case direction in terms of impact on the runway, it is necessary to consider both wind speed and the zone of impact, a higher wind speed over a larger area being the worst case. From the results illustrated in Figure 2 above, it is concluded that the worst-case wind direction is at the angle of 70^0 EoN (East of North). Whilst the highest wind speed reached is similar for all angles, at 70^0 EoN the buildings produce the faster winds over a larger area on the main runway compared to the other angles. It is also worth noting that generally over a height of 20m above the ground, the building acts a windshield where the tails are slower than the prevailing wind direction.

3 EVALUATION OF RESULTS

The 70^0 EoN is considered as the worst case angle for the new configuration that includes the Faraday business park buildings. Figure 3 below shows the results for 20m/s at 5m from the ground. The red circles over the red 'tails' indicate the main wind speed increase, which is due to the proposed IFA2 buildings.

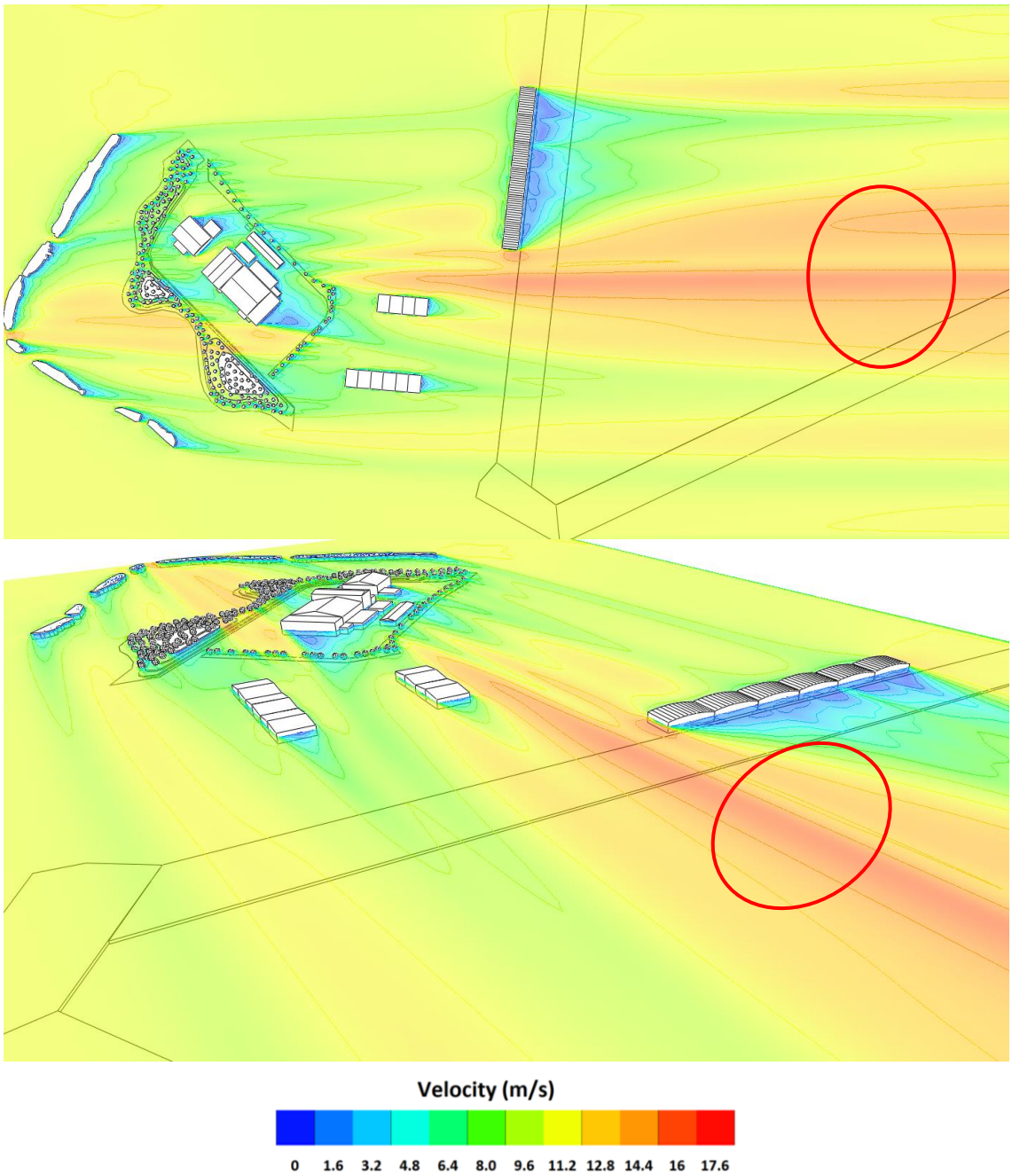


Figure 3 – Angle=90^0, 20m/s at 5m from ground.

4 VALIDATION OF THE CFD RESULTS

In order to provide reassurance of the reliability and accuracy of the CFD wind analysis results, wind tunnel testing of the proposed IFA 2 building and its surroundings has also been carried out. This will also provide the necessary confidence to the proposed design.

RWDI was instructed by National Grid to assess the effect of the proposed IFA2 on the wind conditions over the existing runway through wind tunnel testing of a scaled model of the proposed development with existing and future surroundings. The details of the wind tunnel testing can be found in the report RWDI #1703422 [6]. Figure 4 below shows the wind tunnel study model for the proposed configuration.

Figure 4 – Wind tunnel study model for proposed configuration.

4.1 Validation methodology

The proposed IFA2 configuration is selected for the purposes of this validation because this case is considered the most relevant as it represents the current proposal. The validation approach taken compares the wind velocities on the main runway for the various measurement locations in the wind tunnel test rig, as shown in Figure 5. This comparison is made for the 70^0 EoN angle in order to obtain a direct correlation between the CFD results and the wind tunnel experimental results.

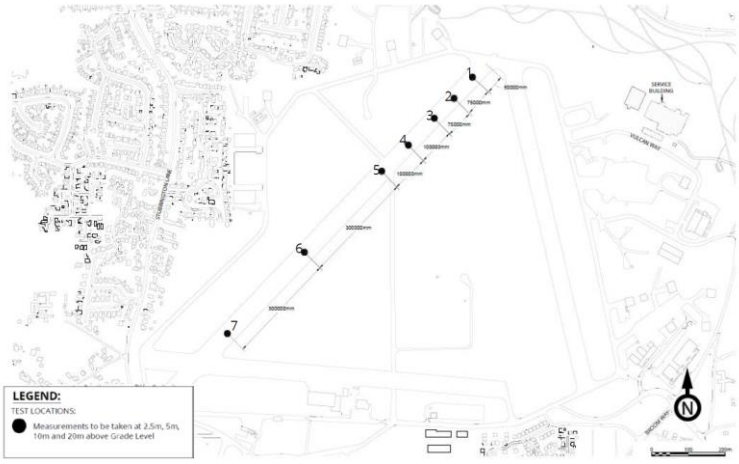


Figure 5 – Plan view of measured locations in wind tunnel.

4.2 Validation Results

Figures 6, 7, and 8 below show the comparison between wind tunnel experimental results and the CFD results at 5 m, 10 m, and 20 m respectively. This comparison was isolated for the wind angle of 70^0 EoN since it is considered to be the worst case based on the CFD results. It is observed that the wind speeds are generally higher in the CFD simulation results. This could be explained by a number

of reasons, such as the turbulence model used, or the surface roughness in the model, however, it is considered more conservative to base the design of the higher (or more extreme) values of local wind speed. A strong correlation can be observed where the discrepancy is within a 15% margin, which is considered acceptable to use the CFD modelling for any further validation.

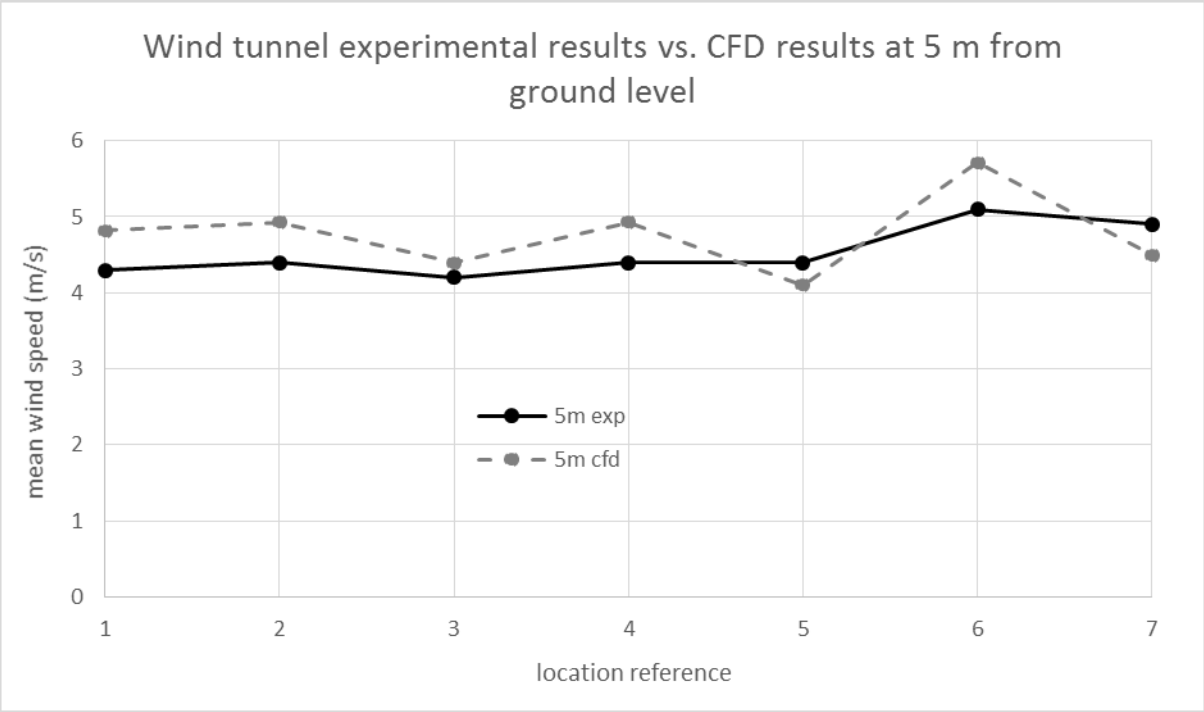


Figure 6 – Wind tunnel experimental results vs. CFD results at 5 m from ground level.

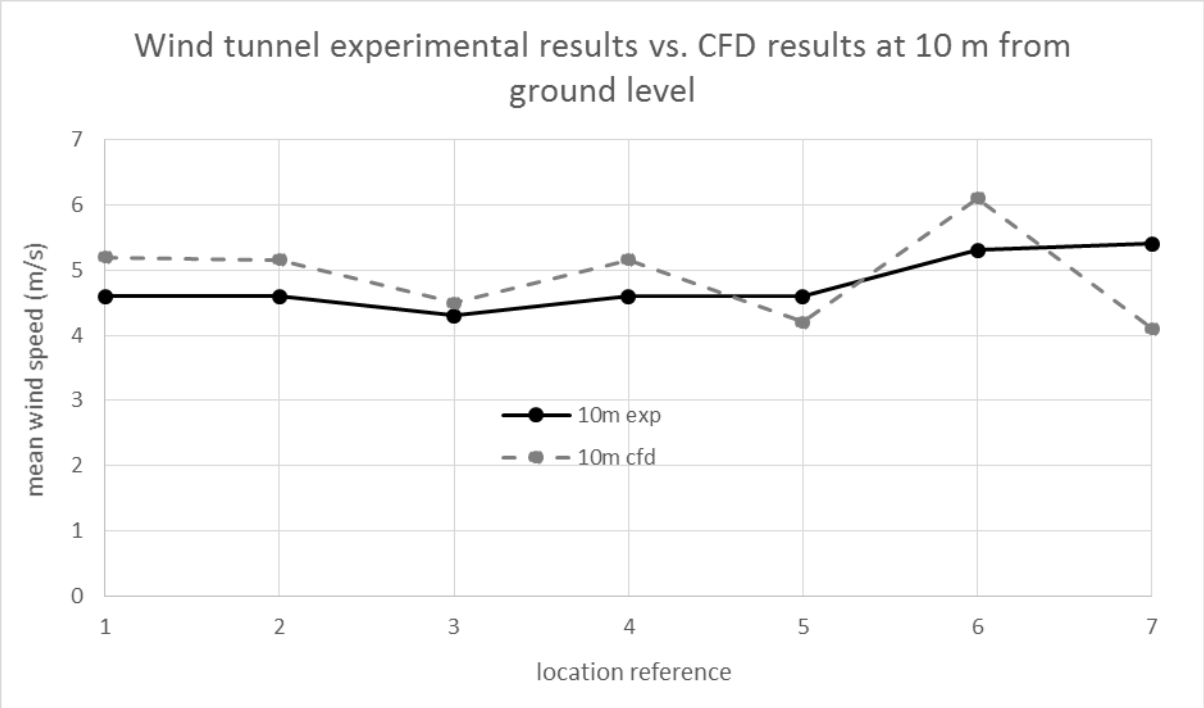


Figure 7 – Wind tunnel experimental results vs. CFD results at 10 m from ground level.

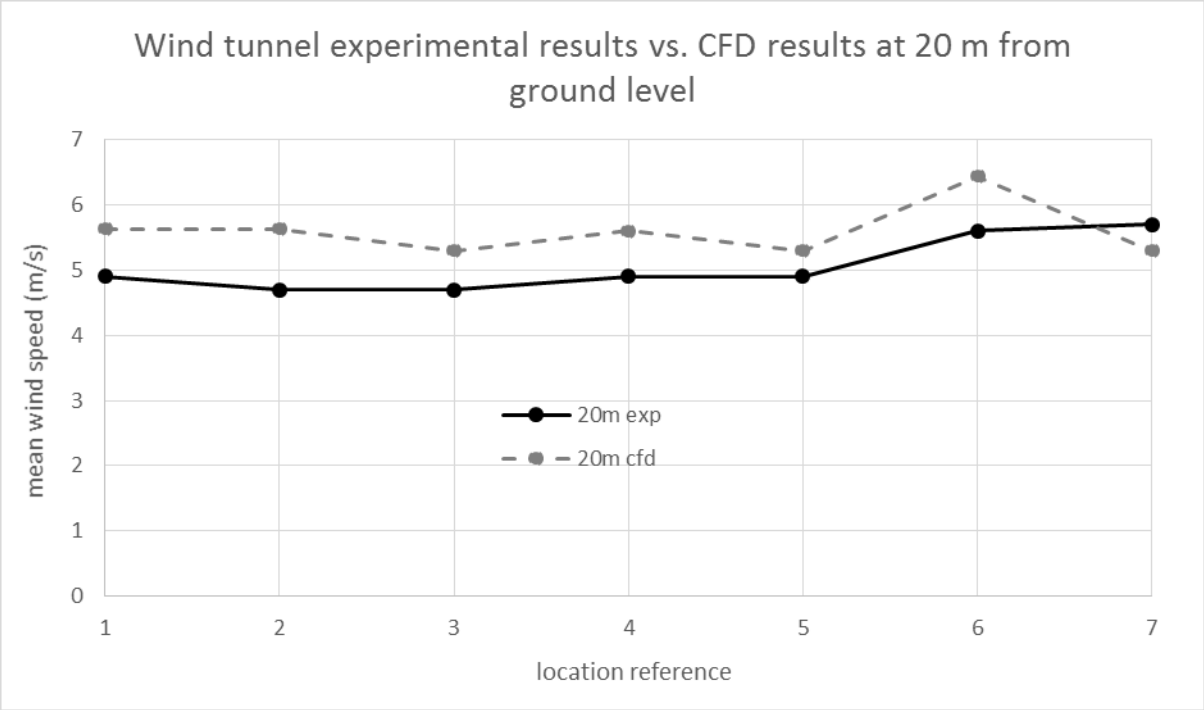


Figure 8 – Wind tunnel experimental results vs. CFD results at 20 m from ground level.

Figure 9 below shows a summary of the presented graphs, and illustrates that the general trend of the CFD results is in line with the wind tunnel results, for example, the wind speed increases with respect to height from ground level for each location reference with only one exception at location 7.

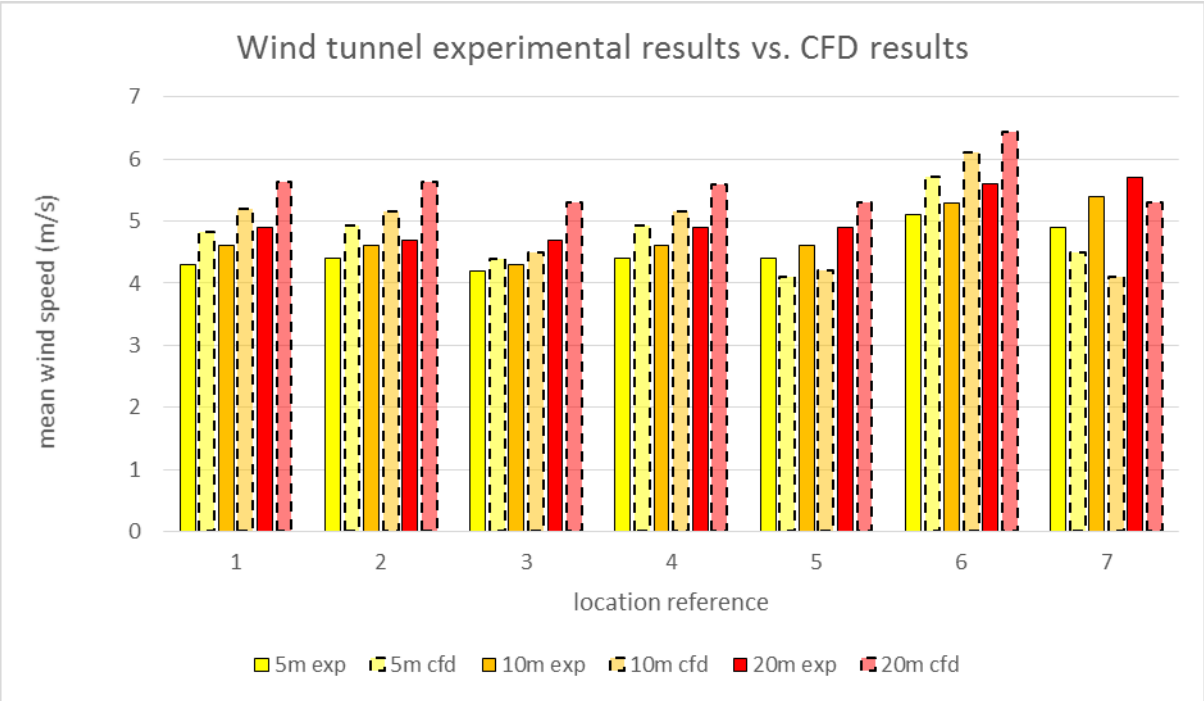


Figure 9 – Summary of wind tunnel experimental results vs. CFD results

5 CONCLUSION

The detailed wind effects analyses that have been carried out consider the impact upon the main runway of the updated IFA 2 converter station design, and cover a realistic range of wind directions and wind speeds. The worst-case wind direction is at the angle of 70^0 EoN. This is because at this angle the building produces three tails of faster winds, which covers the biggest area on the main runway compared to the other angles.

It was confirmed at the Hazard Identification and Risk Assessment study reported in [1] that localised changes in wind patterns are easily managed and that pilots quickly become familiar with any changes in wind patterns and adapt their flying accordingly through good airmanship.

The wind tunnel validation study has resulted in the following findings:

- It is observed that the wind speeds are generally higher in the CFD simulation results. This could be explained by a number of reasons, such as the turbulence model used, or the surface roughness in the model, however, it is considered more conservative to base the design of the higher (or more extreme) values of local wind speed.
- A strong correlation can be observed where the discrepancy is within a 15% margin, which is considered acceptable to use the CFD modelling for any further validation.
- The general trend of the CFD results is in line with wind tunnel results, in other words, the wind speed increases with respect to height from ground level for each location reference for both the CFD simulation and the wind tunnel results.

The conclusions of this report supported those of the preliminary analysis in [1] and [2] i.e. risks are expected to be acceptable as defined in CAP 760 [8] for current airport operations with any localised impacts managed through airmanship and reports to airport management to be included in Notice to Airmen (NOTAMs) if necessary.

APPENDIX A

Magnified images of the results in Figure 2 for a wind velocity of 20m/s are shown below:

Figure A1 Angle=60^0 @ 1m

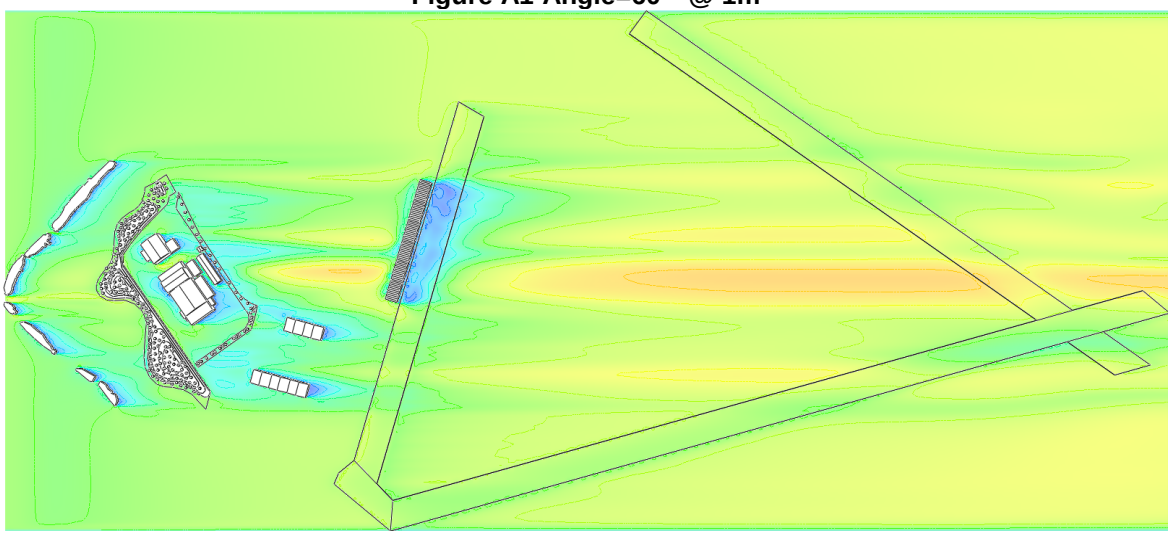
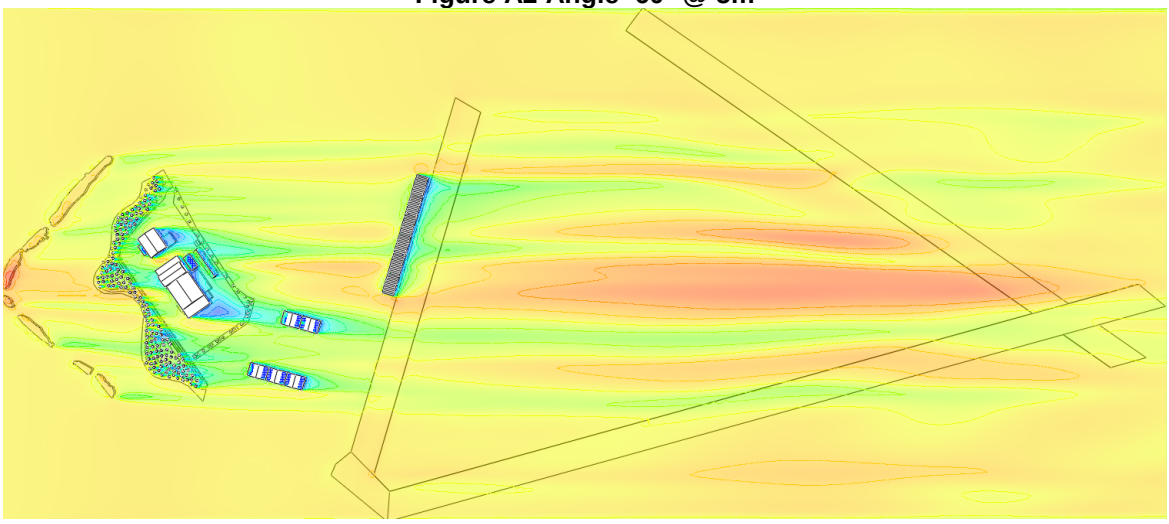


Figure A2 Angle=60^0 @ 5m



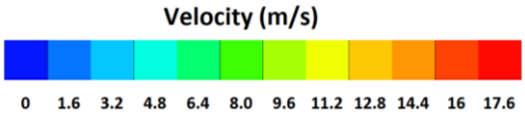


Figure A3 Angle=60^0 @ 10m

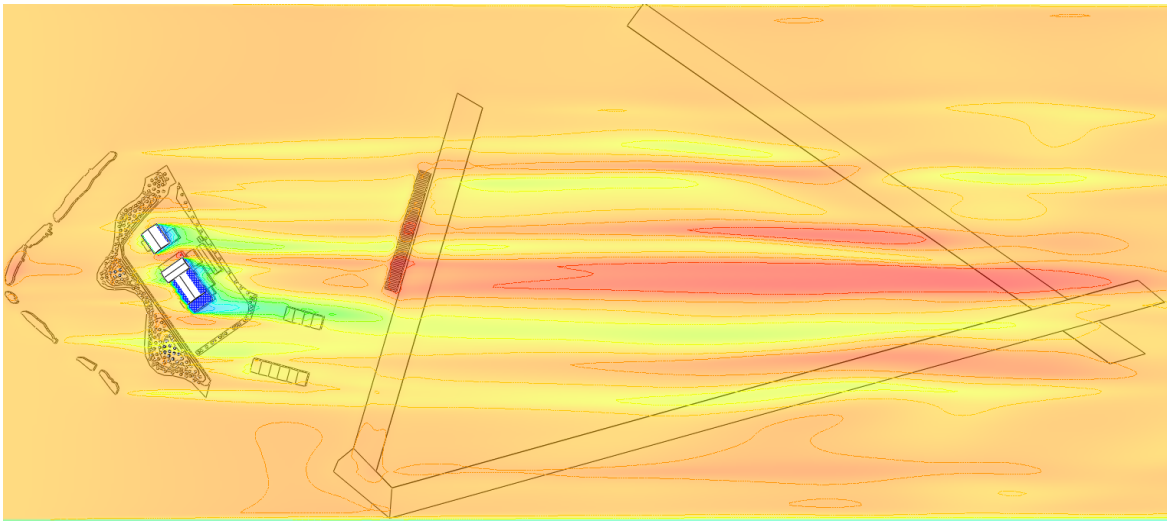
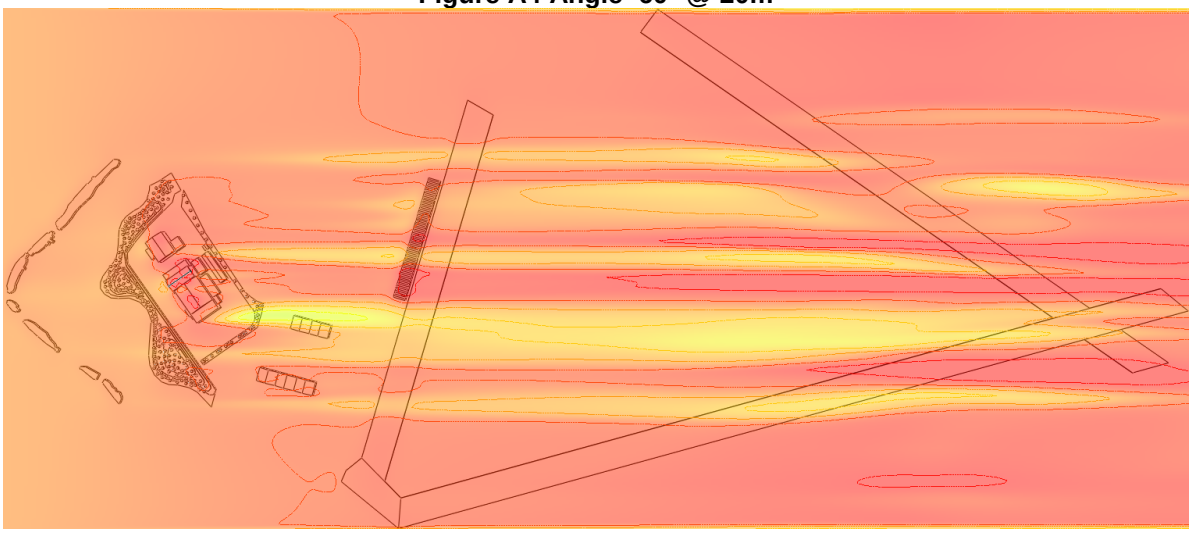


Figure A4 Angle=60^0 @ 20m



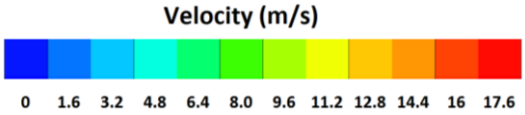


Figure A5 Angle=60^0 @ 30m

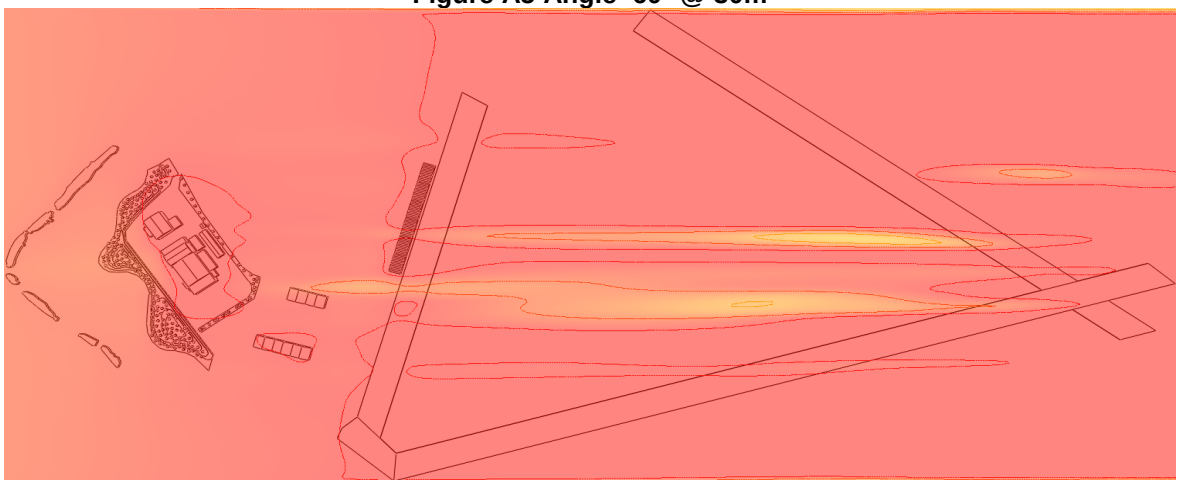


Figure A6 Angle=70^0 @ 1m

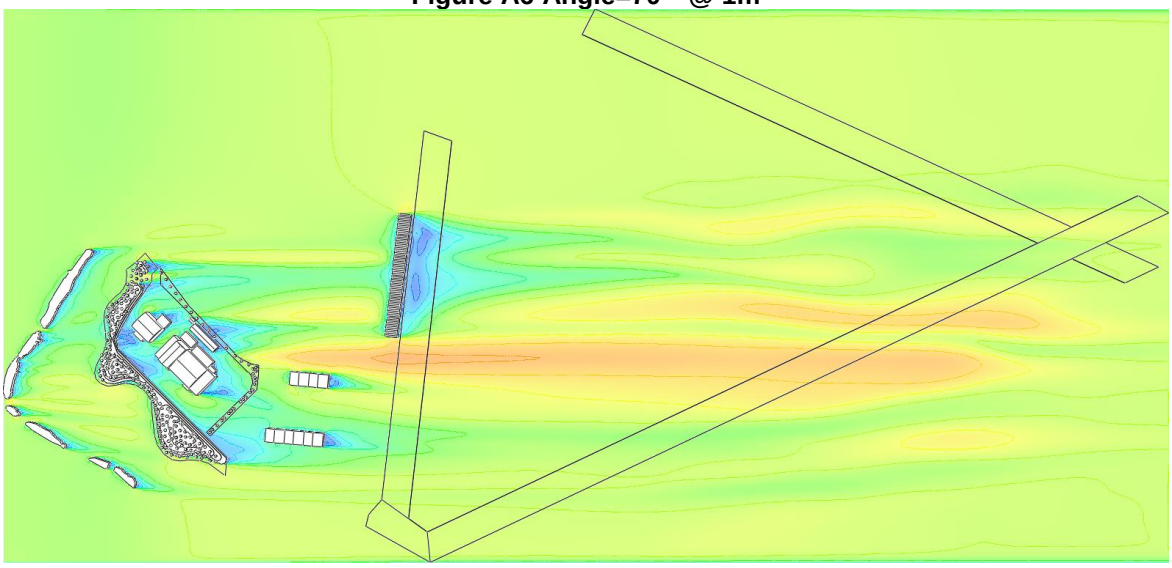
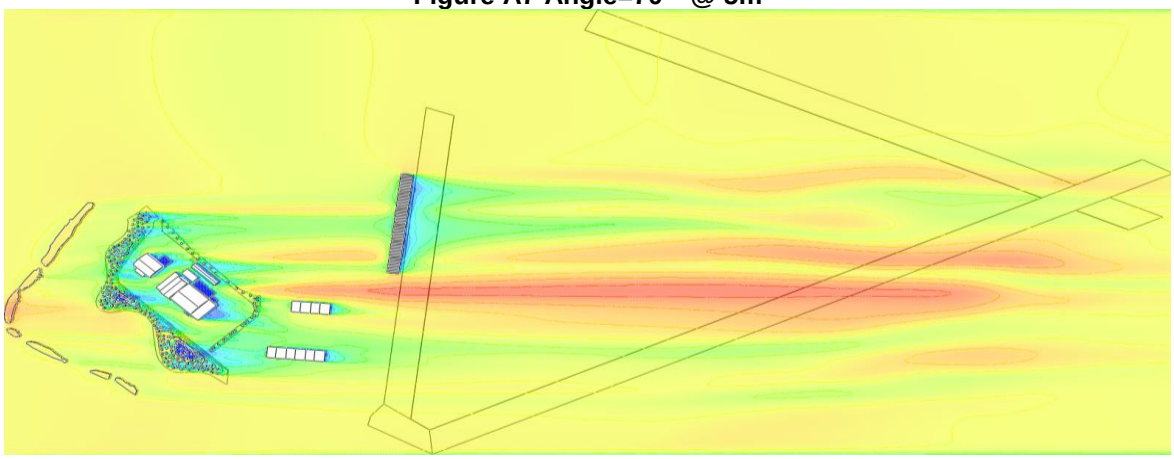


Figure A7 Angle=70^0 @ 5m



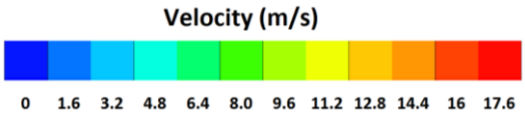


Figure A8 Angle=70^0 @ 10m

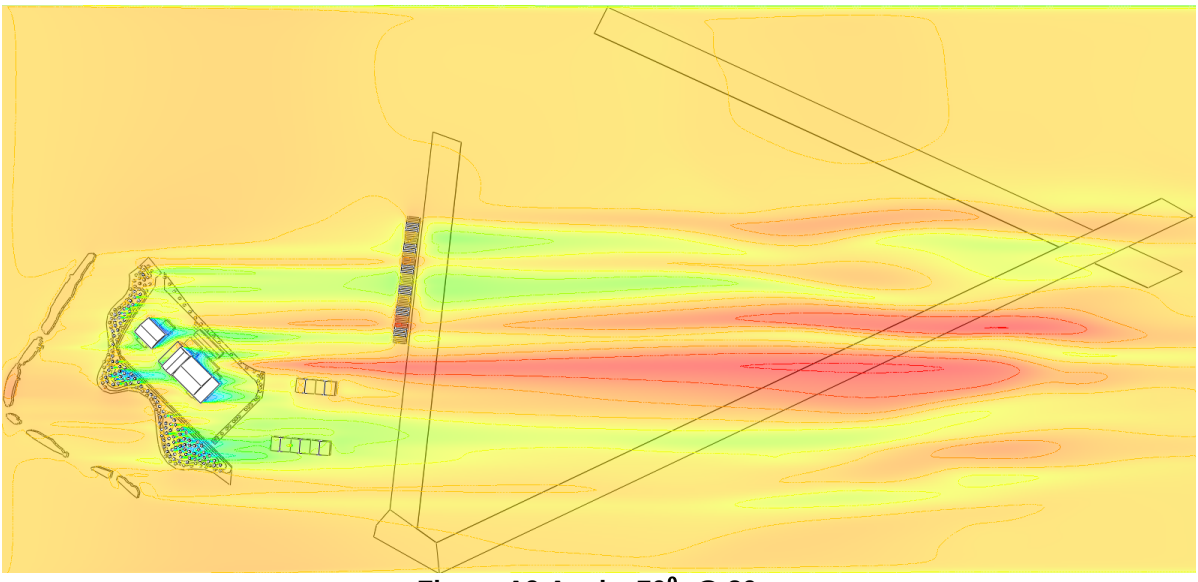


Figure A9 Angle=70^0 @ 20m

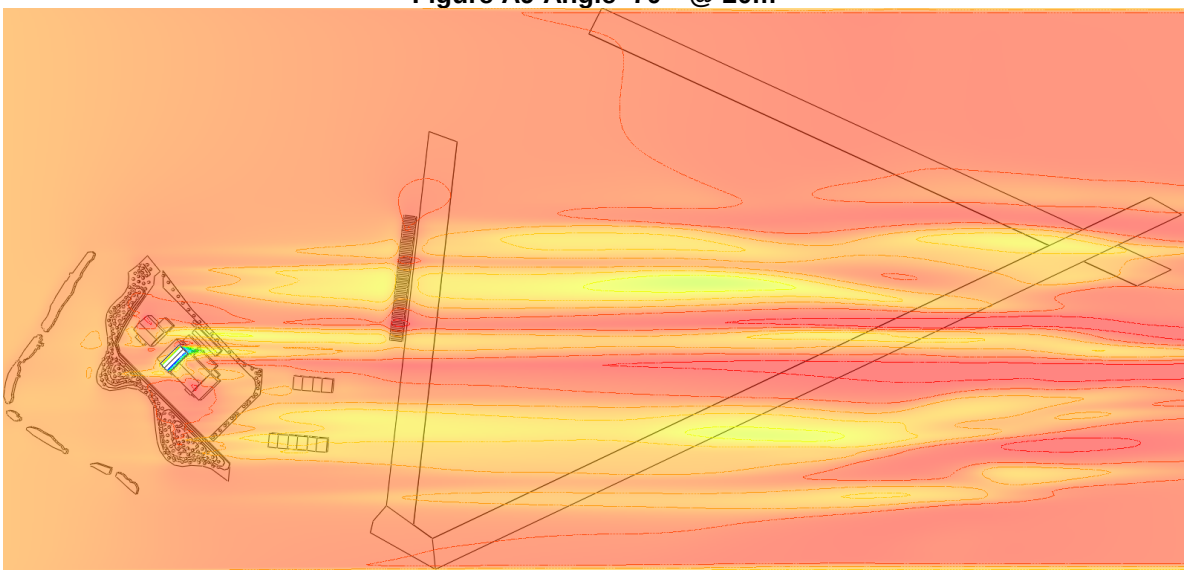


Figure A10 Angle=70^0 @ 30m

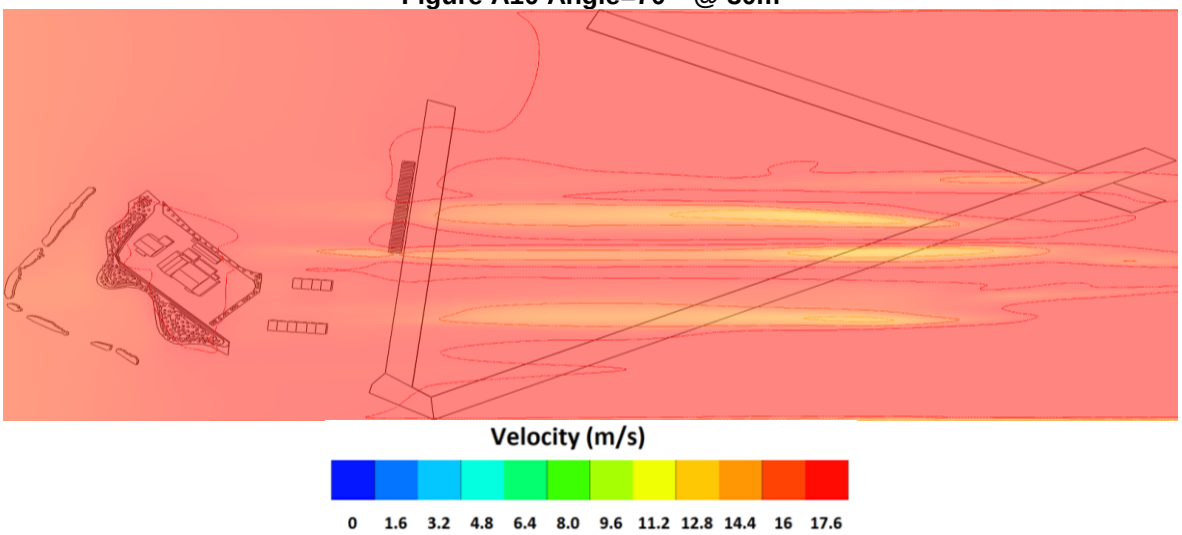


Figure A11 Angle=80^0 @ 1m

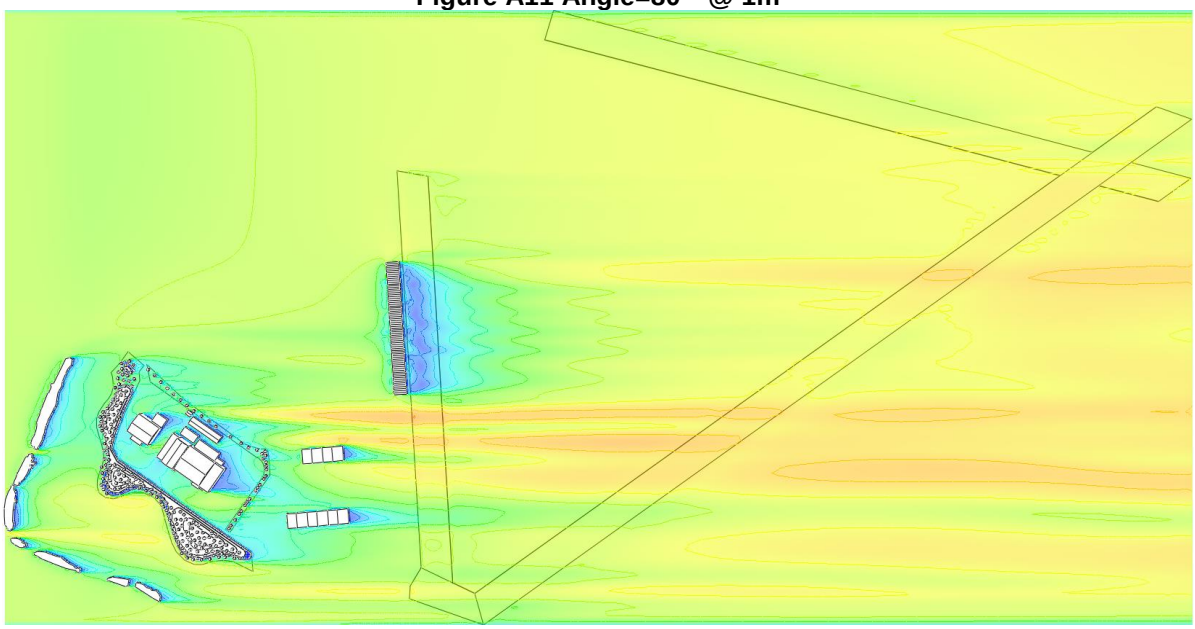
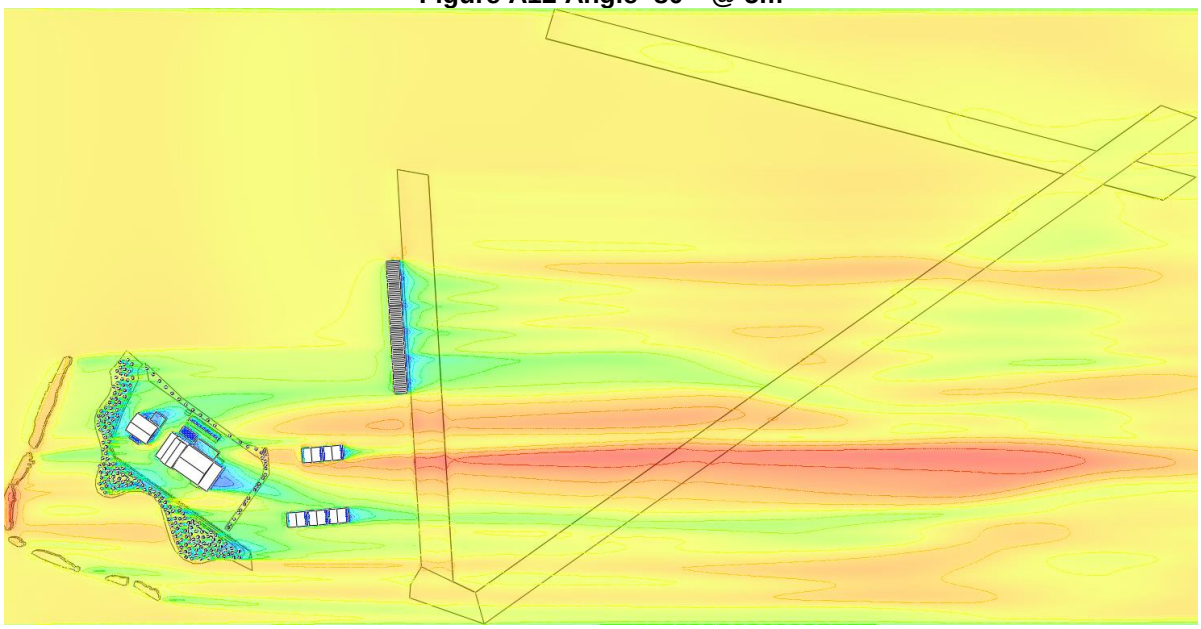


Figure A12 Angle=80^0 @ 5m



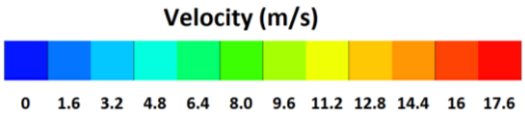


Figure A13 Angle=80^0 @ 10m

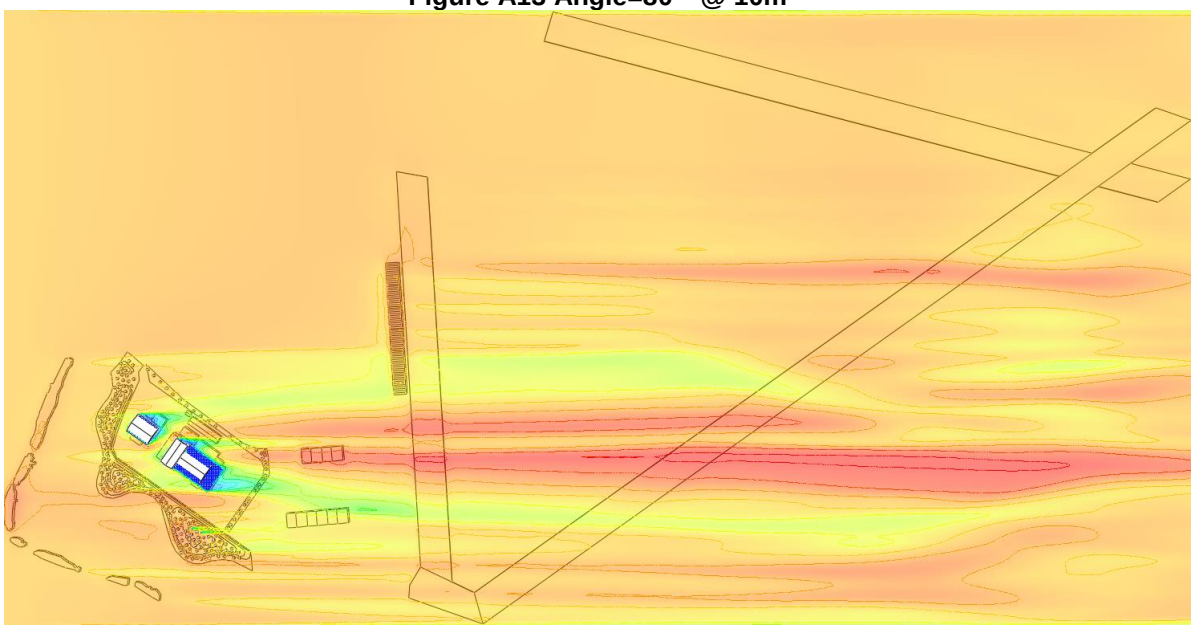
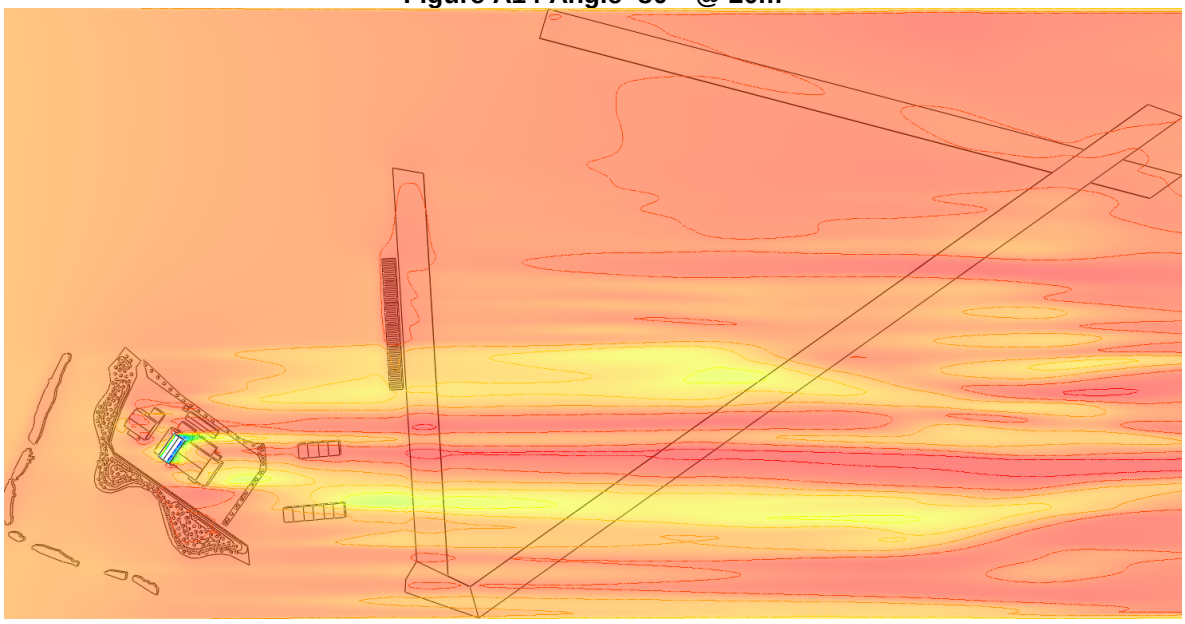


Figure A14 Angle=80^0 @ 20m



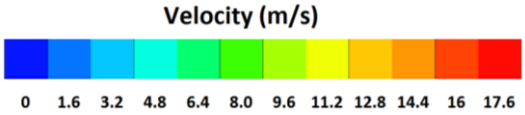


Figure A15 Angle=80^0 @ 30m

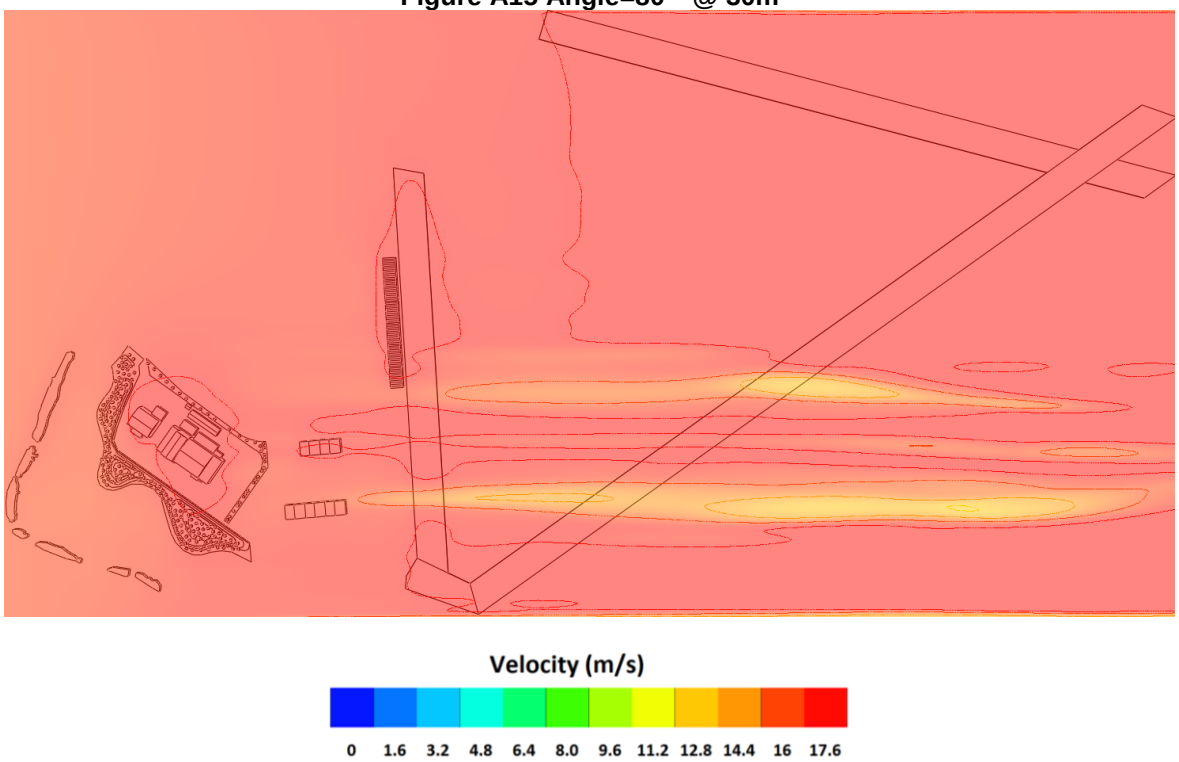


Figure A16 Angle=90^0 @ 1m

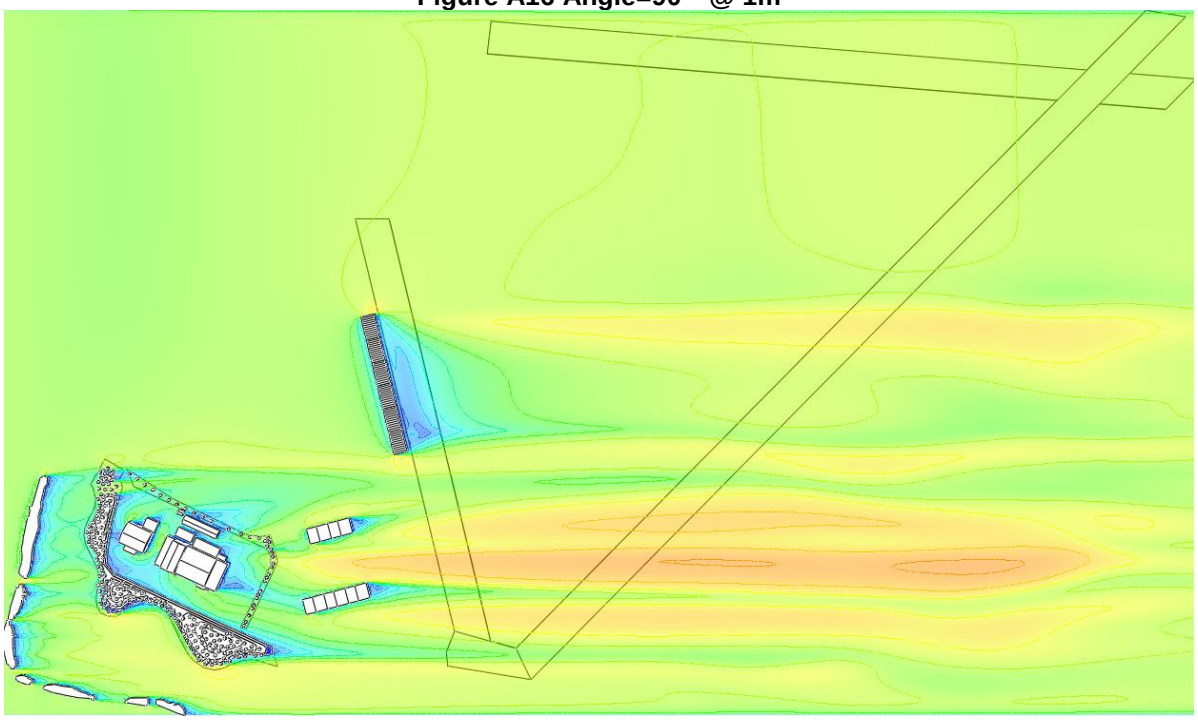
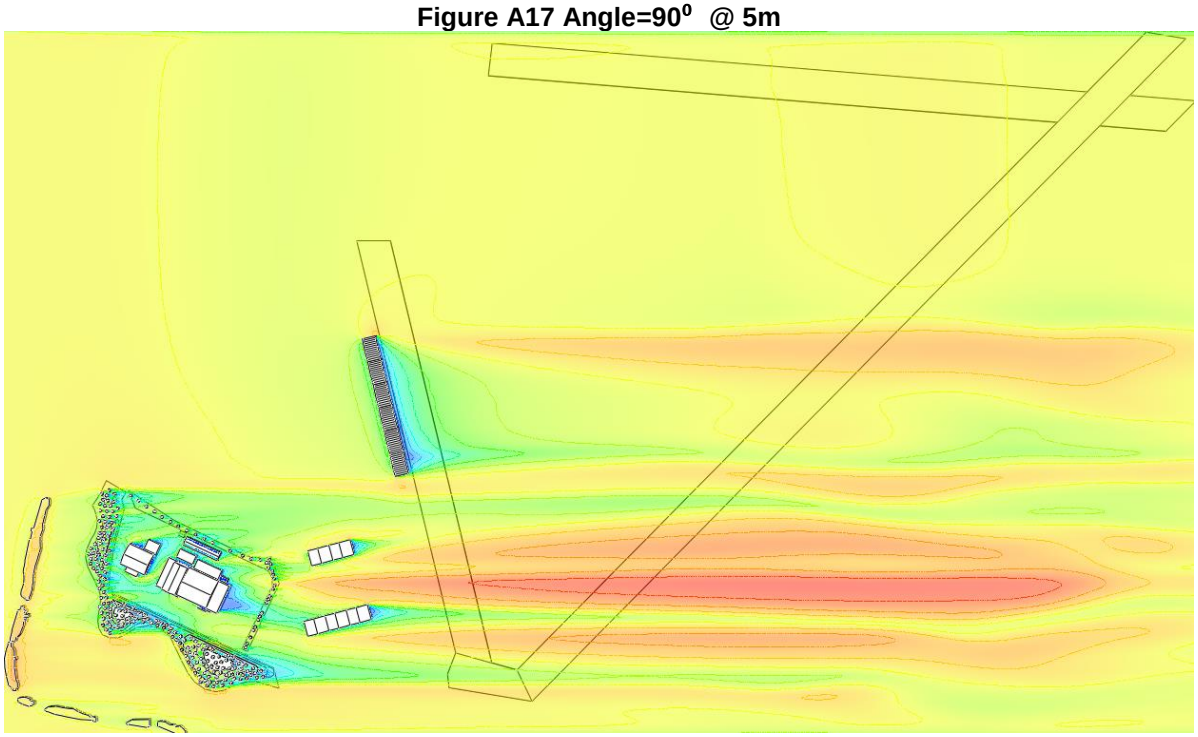


Figure A17 Angle=90^0 @ 5m



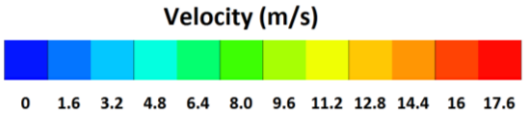


Figure A18 Angle=90^0 @ 10m

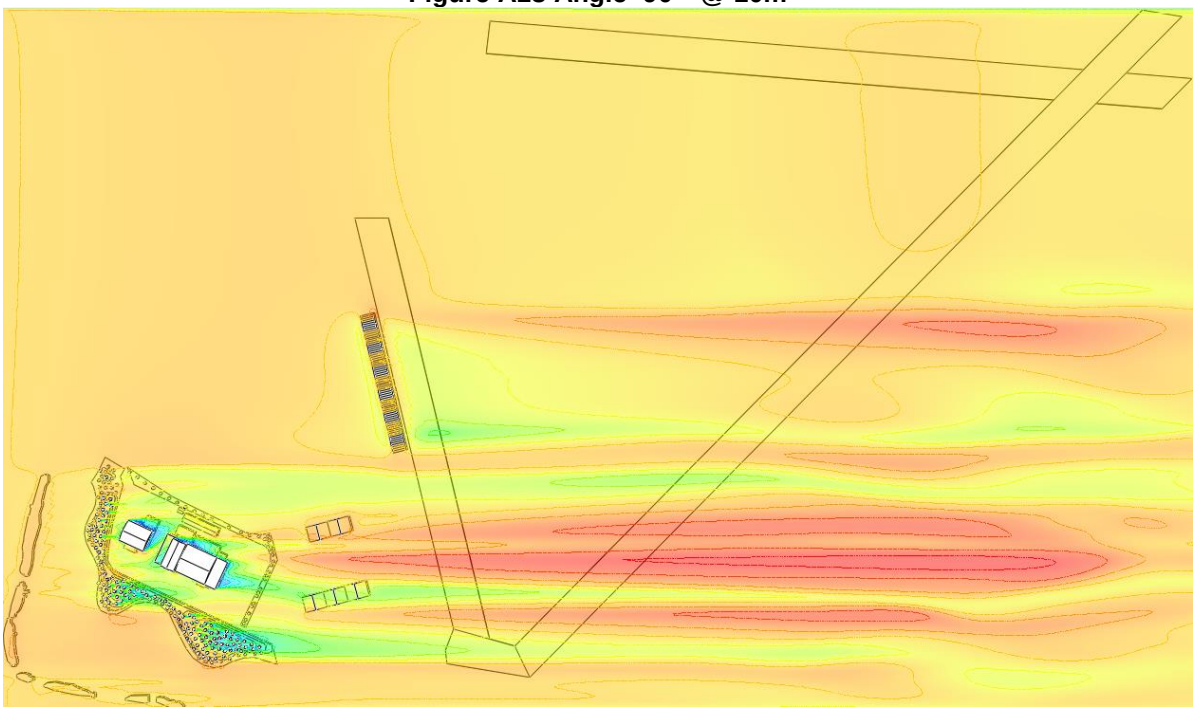


Figure A19 Angle=90^0 @ 20m

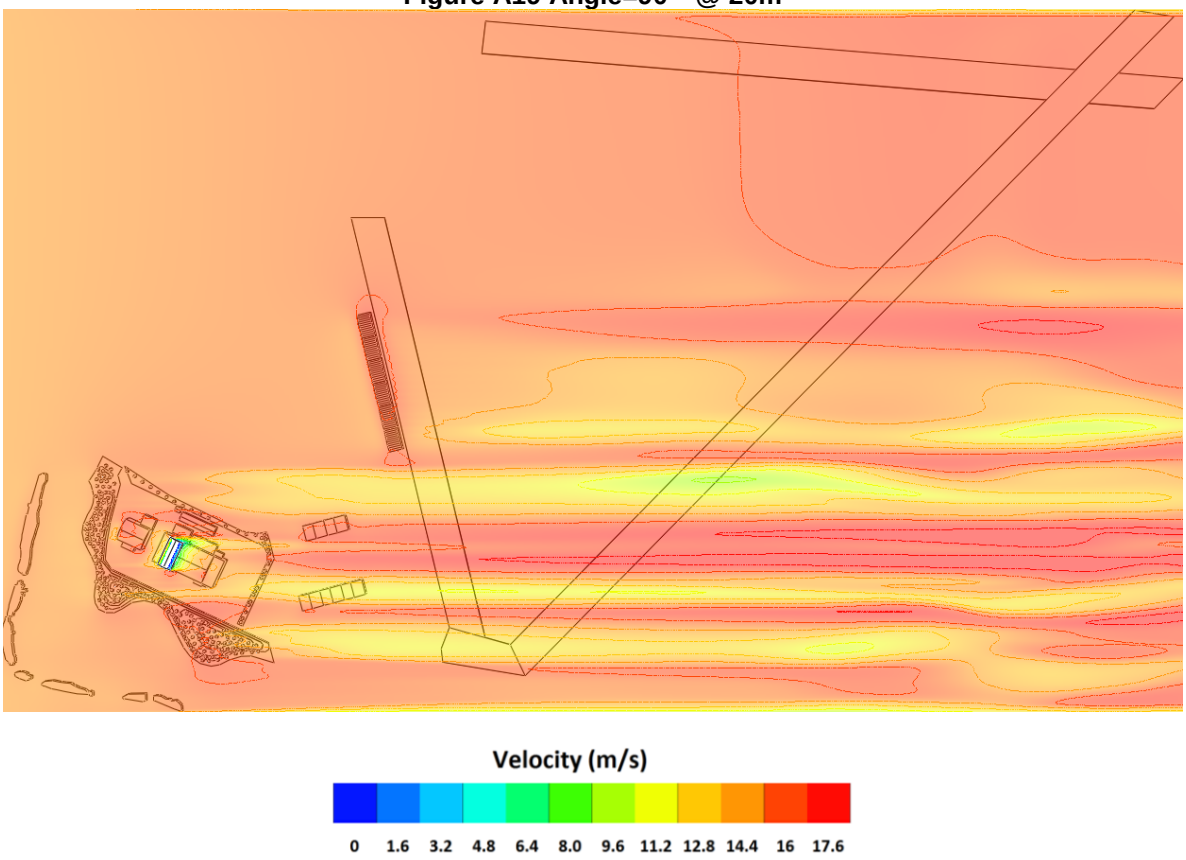


Figure A20 Angle=90^0 @ 30m

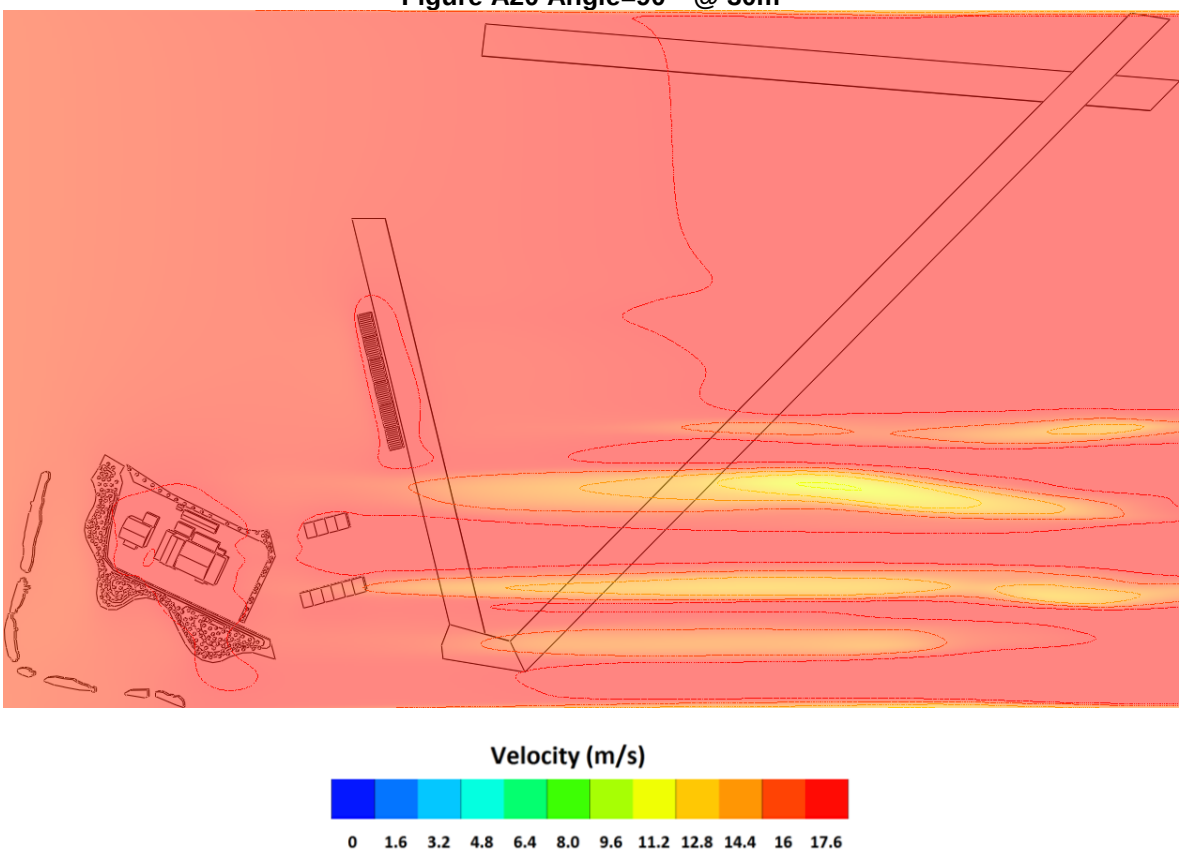


Figure A21 Angle=100^0 @ 1m

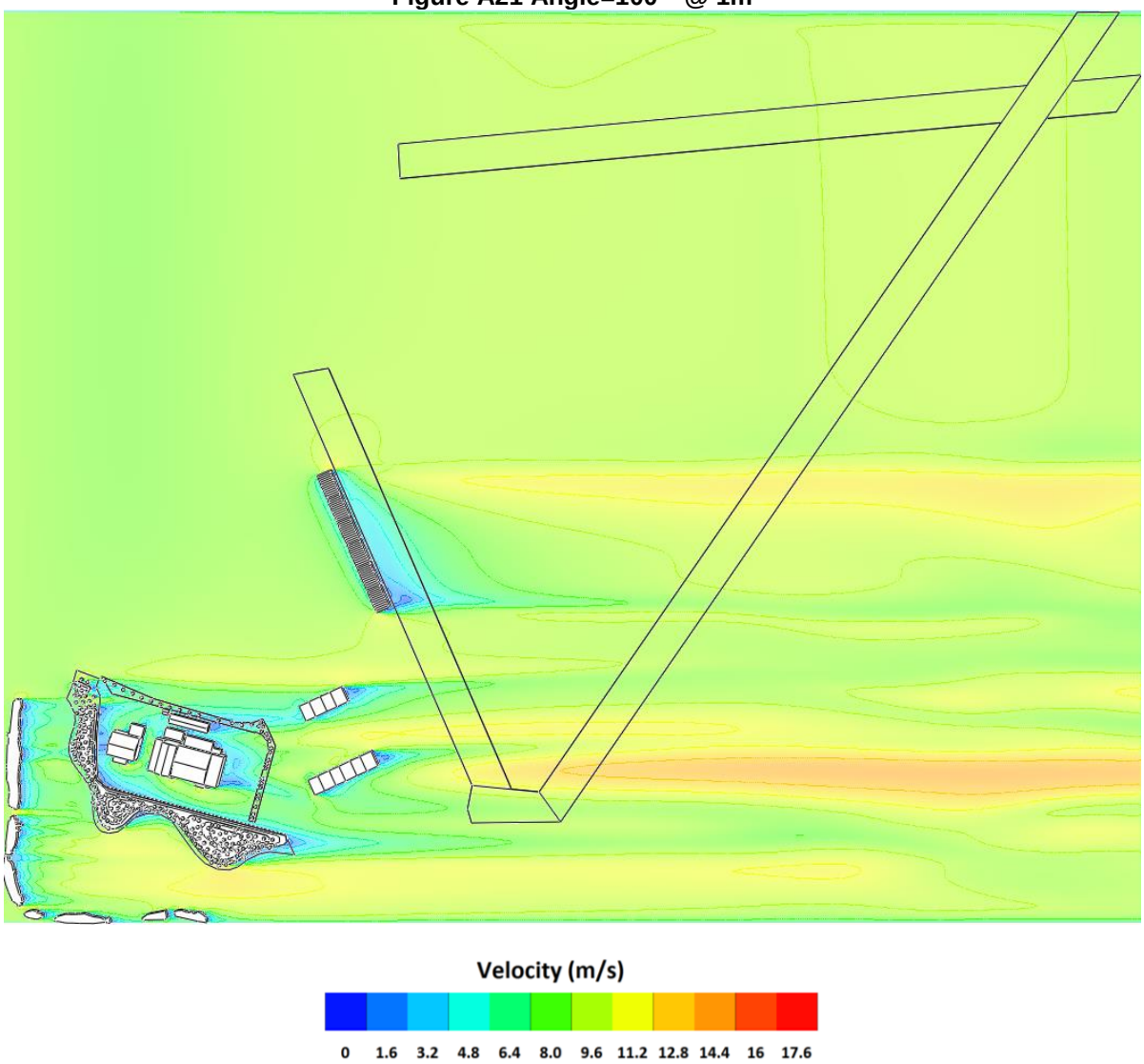
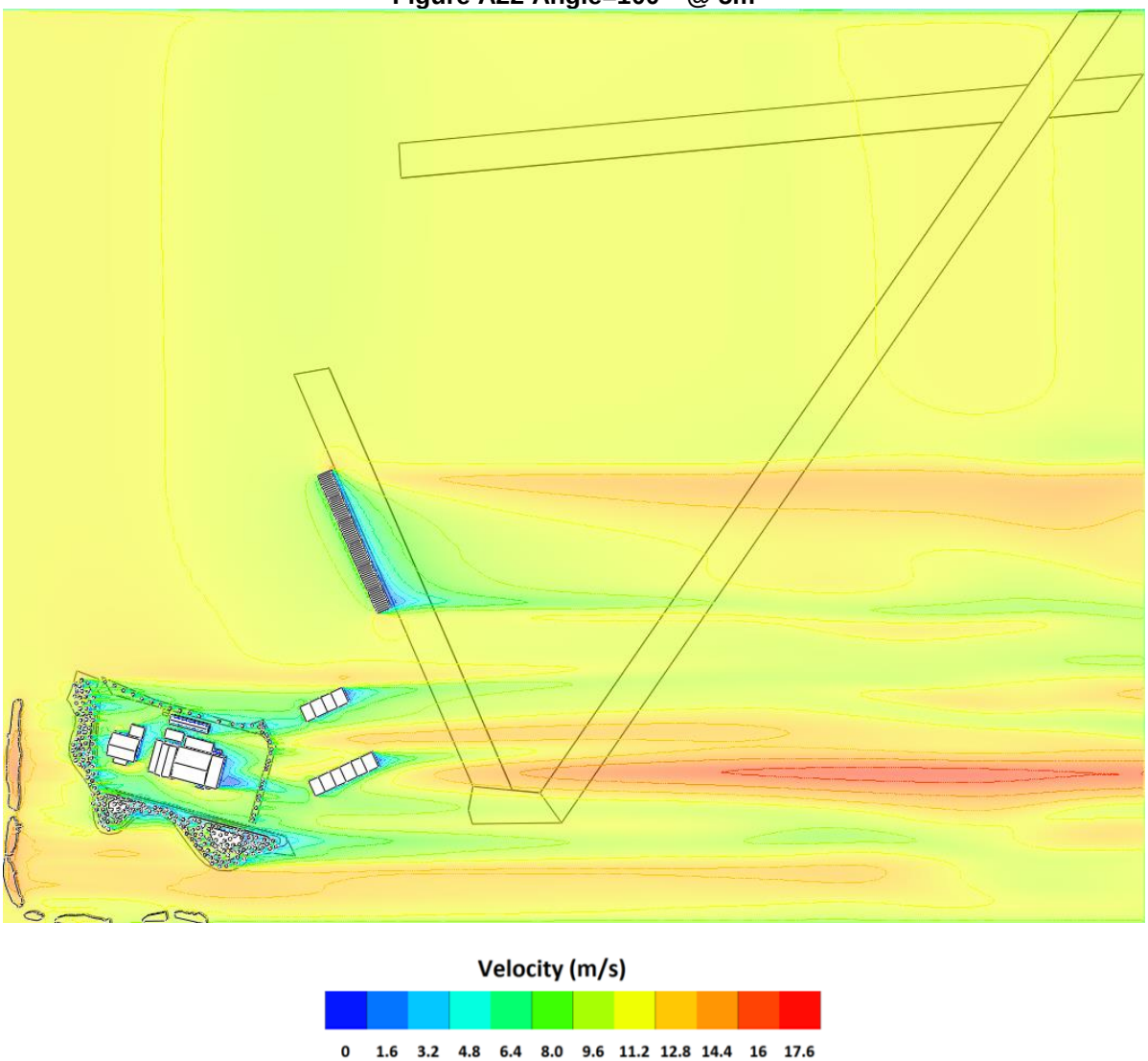


Figure A22 Angle=100^0 @ 5m



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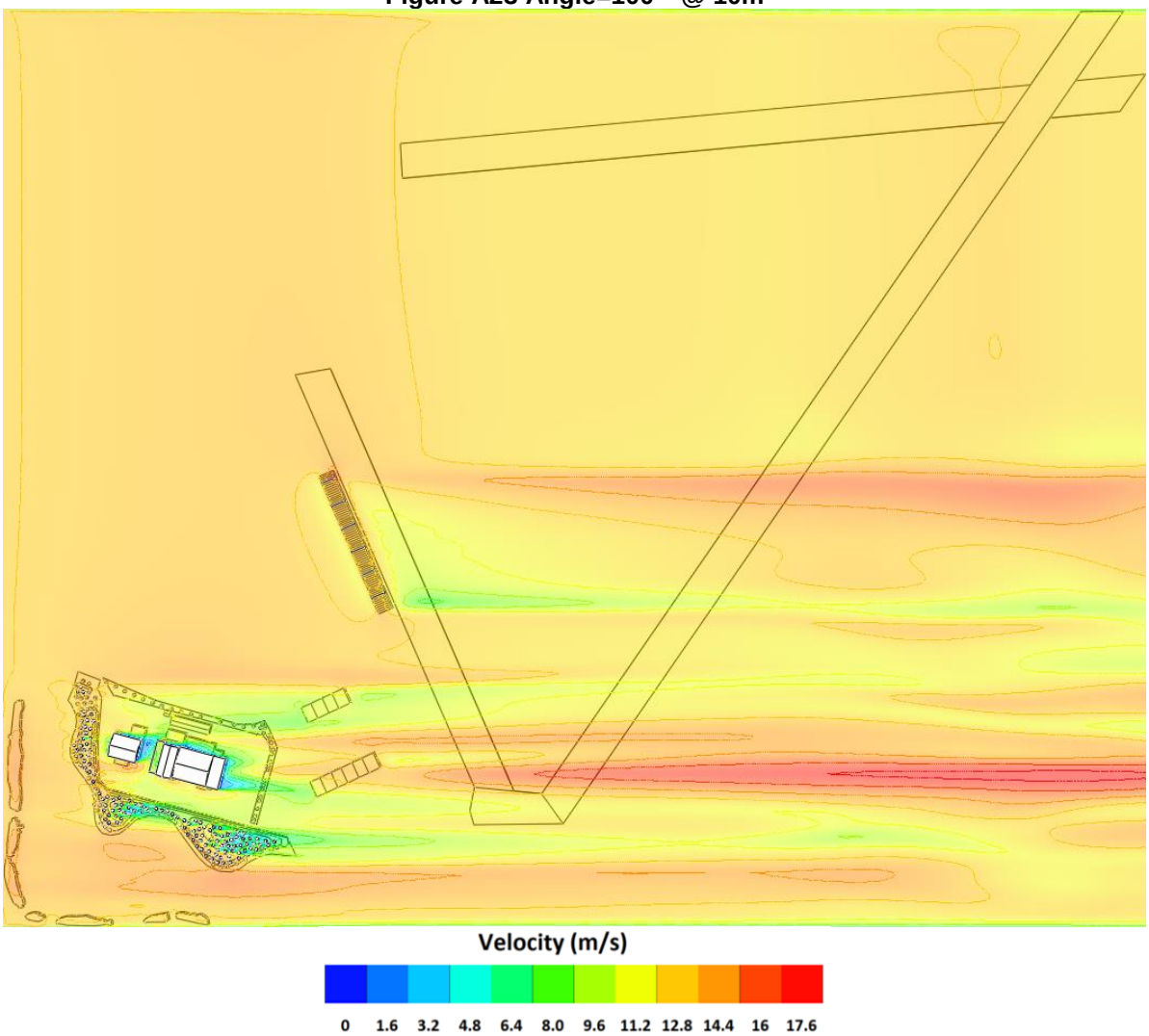

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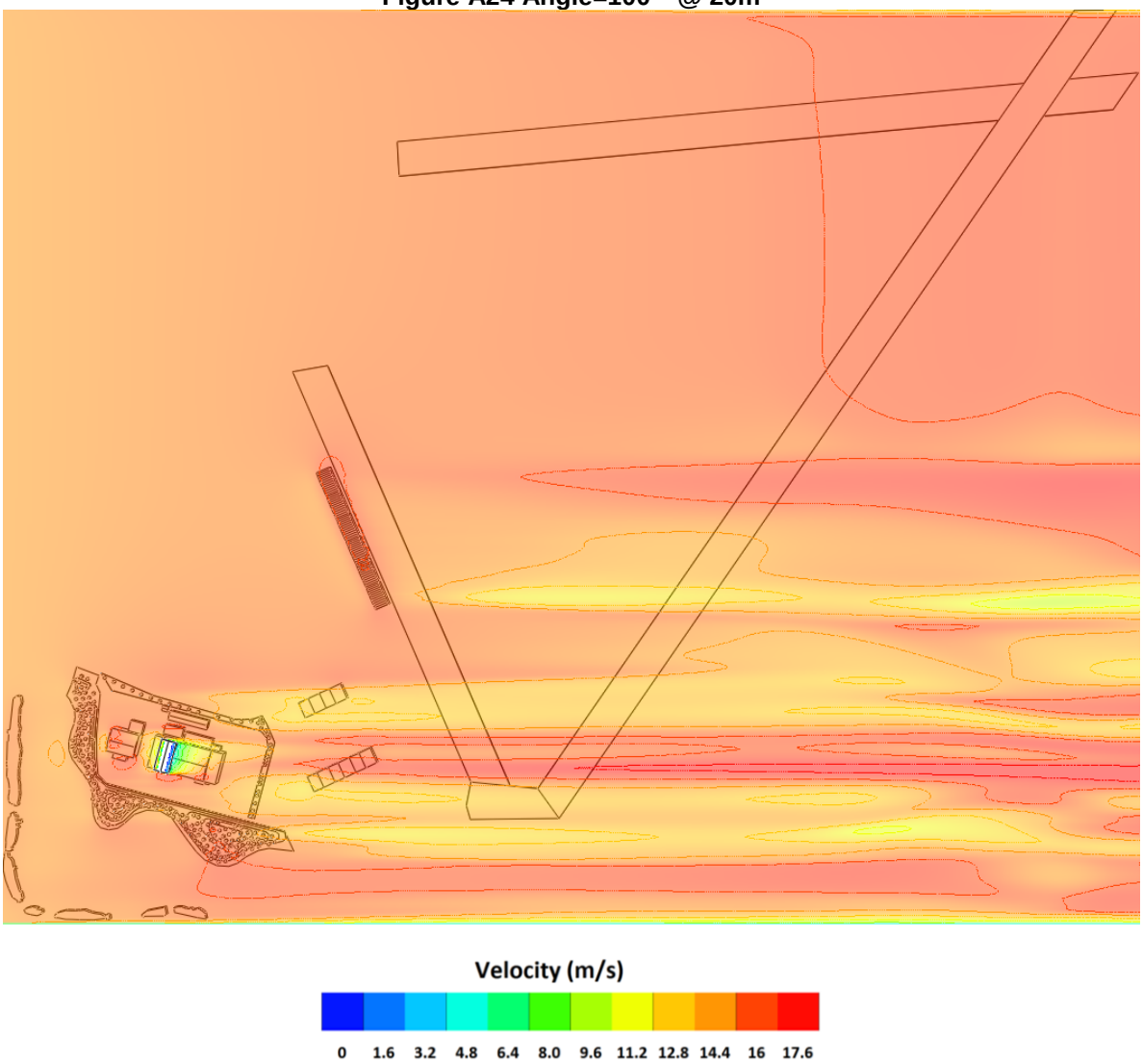

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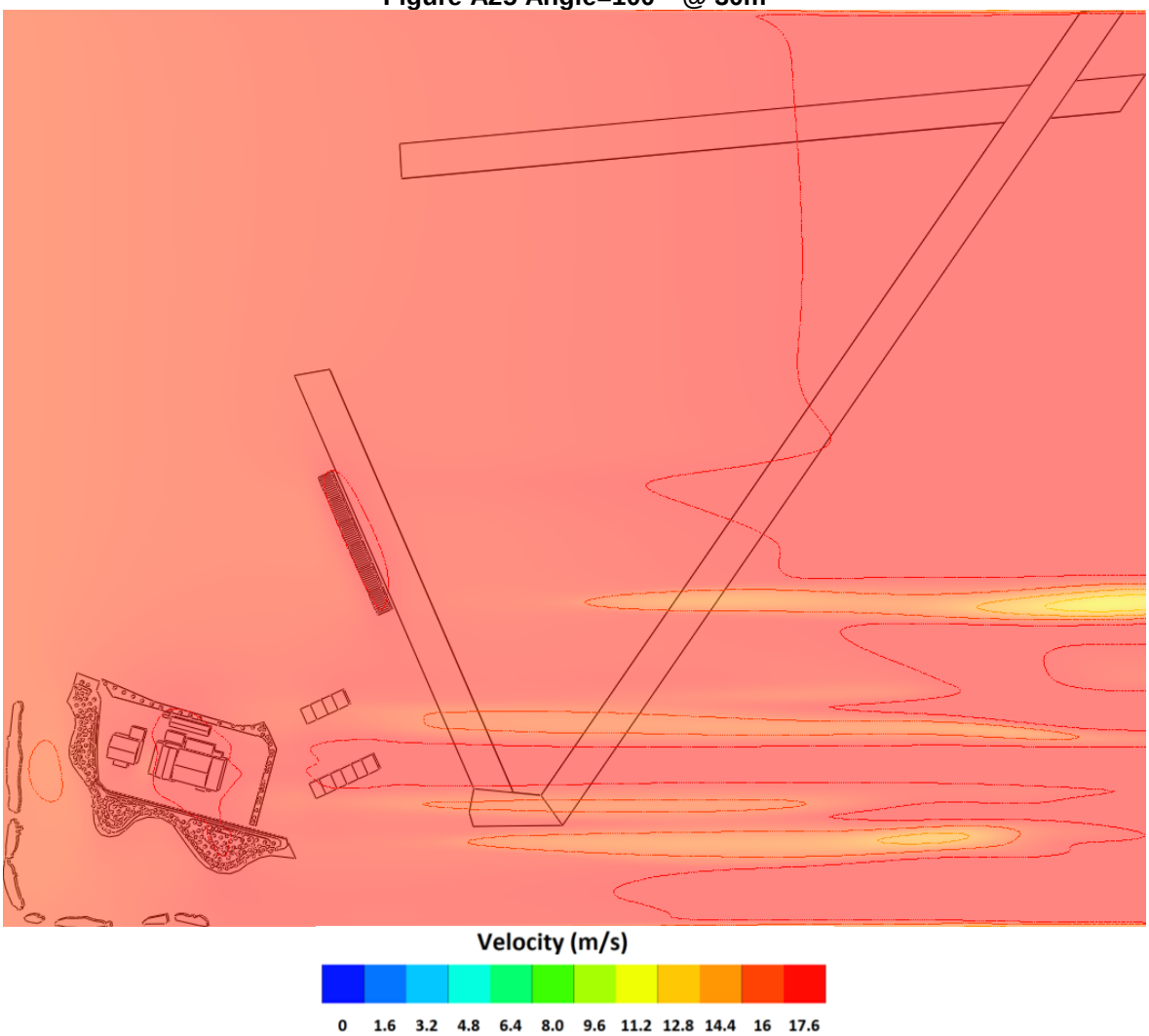

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Key Documents forming the technical study	Summary of findings	Ongoing obligations/testing requirements
Arcadis Technical assessment	No significant impact that cannot be mitigated	To be read in conjunction with Hazard Log, and Safety Justification document
Arcadis Hazard Log	No significant risks that cannot be mitigated	Open hazards to be closed as Construction Methodologies are finalised, development is implemented and ongoing tests/monitoring completed
Arcadis Safety Justification Report	No significant safety matters that cannot be mitigated	
Proposed IFA2 Facility, Daedalus: Occupier Impact Assessment. Lambert Smith Hampton October 2017	No significant impact on commercial operation of Daedalus and delivery of Vision	
Draft construction Methodology and Specification for the Converter station, and Converter Station Design and Access Statement addendum 7.17, and Baker Hicks external flood lighting design and Luminaire Schedule	Safeguarding measures and management controls to address construction on airfield being developed to address all identified hazards	Development of document, detailed design, specification and method statements ongoing
Draft construction Methodology and Specification for the Cable Installation (including landfall)	Safeguarding measures and management controls to address construction on airfield being developed to address all identified hazards	Development of document, detailed design, specification and method statements ongoing
Supplementary evidence forming part of the overall technical assessment		
IFA2 IJV CAB TTR 0004 Technical Note: Tests of aircraft in Electric and Magnetic Fields from IFA2 cables at Solent Airport	No significant impact that cannot be mitigated by design	Test electromagnetic field from cables once in place – to confirm test outputs from trials, to confirm compliance with planning conditions, and monitoring once operational
Technical Assessment – Wind Flow Analysis and Wind flow analysis for the IFA2 Facility reports; National Grid Interconnector IFA2 – Assessment of {Possible Wind Effects on Flying Operations of HMS Daedalus – Ove Arup Report	No significant impact that cannot be mitigated	
Radio Frequency Survey Test Report for IFA2 development at Solent Airport plus peer review, LSA Electromagnetics report, and RTCA/D160 radiated emissions analysis for	No significant impact that cannot be mitigated by design	FISO radios to be tested, and testing to demonstrate acceptable RFI emissions

aircraft radios		
IFA2 Converter TV and Radio Reception Study	No significant impact that cannot be mitigated	Post completion assessment to be undertaken
Radio and Telecomms Interference and EMF assessment ABB HVDC 6.17	No significant impact that cannot be mitigated	
Preliminary impressed voltage assessment for cables at Daedalus	No significant impact that cannot be mitigated by design	Processes to be put in place to ensure any future developments at the Airport do not give rise to risk
Bird Hazard Management Plan	No significant impact that cannot be mitigated by design and management	
Audible Noise Assessment for Planning Application ABB HVDC 7.17	No significant impact that cannot be mitigated by design	Measurements of noise to be taken during commissioning
IFA 2 Fire Systems Description report HVDC 9.16	No significant impact that cannot be mitigated by design	Detailed design as per system description
Consideration of Maritime and Coastal Agency equipment	No significant impact that cannot be mitigated by design	All relevant equipment to be covered by final cable testing once in place.
Assessment of potential impact on Instrument Landing Systems	No significant impact that cannot be mitigated by design, but not relevant as ILS not planned for Solent Airport. No further action.	
Assessment of impact on Unmanned Aerial Vehicles	No significant impact that cannot be mitigated	
Aircraft Magnetic Field Susceptibility Assessment Report for IFA2 – LSA; Electromagnetics Assessment of magnetic field effects on Islander and Defender Aircraft.	No significant impact that cannot be mitigated by design	
Islander and Defender Magnetic Field Susceptibility Assessment Report for IFA2	No significant impact that cannot be mitigated by design	
Quinetiq Assessment of magnetic field effects on Islander and Defender aircraft	No significant impact that cannot be mitigated by design	
Magnetic effect – impact on UK MoD Islander and Defender Aircraft	No significant impact that cannot be mitigated by design	
TUV-SUD IFA22 interconnector review of EMC/EMF Assessment Reports	No significant impact that cannot be mitigated by design	
M16a Assessment of baseline radio blackspots and future testing of new equipment report	No significant impact that cannot be mitigated	Future testing to be carried out for new radio equipment as this coms into use
M16b Survey of TV and Digital networks including Fire	No significant impact	

Brigade, Police, Ambulance/medical		

APPENDIX C

Lambert Smith Hampton

www.lsh.co.uk

PROPOSED IFA2 FACILITY FARADAY BUSINESS PARK (DAEDALUS)

OCCUPIER IMPACT ASSESSMENT

October 2017

Prepared for:
Fareham Borough Council and National Grid

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Lambert Smith Hampton

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1.0 EXECUTIVE SUMMARY

1.1 National Grid (NG) and Fareham Borough Council (FBC) have appointed Lambert Smith Hampton (LSH) to provide a market compatibility assessment and occupier consultation on the proposed IFA2 Enterprise Zone Development at Daedalus.

1.2 It is widely recognised that Daedalus is a key employment site with ambitious potential to attract aviation, marine and advanced engineering companies and as such is fundamental to the future job creation and economic growth of the Solent region. Therefore, it is vitally important to undertake a critical assessment and commercially test the likely impact on attracting business occupiers to this location following implementation of the proposed IFA2 connector facility.

1.3 Our report, in addition to the studies undertaken by Arcadis, has been commissioned by Fareham Borough Council as landowner in conjunction with National Grid to consider the commercial impact of the IFA2 development and its affinity with the Council's vision for Solent Airport at Daedalus.

1.4 Our study considers both primary and secondary data in assessing the likely impact of the IFA2 converter station on potential occupiers for the site, specifically from aviation, aerospace engineering and advanced manufacturing businesses, which are specifically targeted for Daedalus.

1.5 We have purposefully adopted a robust and objective approach to undertaking a thorough investigation of the study brief and the question at issue and our market facing assessment is summarised in the Conclusions section of our report at 10.0.

2.0 OBJECTIVES/INSTRUCTIONS

2.1 A hybrid planning application (P/16/0557/OA) part outline, part full permission has recently been approved for the IFA2 development subject to reserved matters, however there may remain perceptions from a number of interested parties and stakeholders (eg. existing Airfield occupiers, landowner, residents, new employers or employees, planning authority, the Solent LEP etc) about whether this will have any adverse effect on securing occupiers to the Enterprise Zone development (which are intended to be mitigated by planning obligations under a detailed s106 Agreement). Our assessment will be to explore and reassure the adequacy of these mitigation measures in a market facing context and to inform how they are best implemented.

2.2 Our assessment involved an in depth consultation with similar types of occupiers to those being targeted for the Solent Airport at Daedalus including those who may operate sensitive equipment and highly technical machinery.

2.3 The intention is to objectively establish any extent to which the proposed IFA2 development could be specifically identified as having an impact on the development vision, in both a marketing and viability context and to provide recommendations for how to tailor the relevant provision by NG of a technical liaison resource and the funding of a FBC business development resource, in accordance with the s106 planning obligations.

2.4 In summary, LSH are instructed by FBC and NG to assess the commercial impact and whether the proposed IFA2 development will affect the attractiveness of the Solent Airport and deter future businesses from locating to Daedalus.

3.0 OUR METHODOLOGY AND CREDENTIALS

Our Methodology

3.1 LSH adopt a collaborative approach, both with our clients and within our organisation, to apply our wealth of market knowledge and understanding of occupier property requirements to support and supplement our advice.

3.2 LSH has a longstanding network within the local, regional and national business community and our involvement over many years with a number of public sector initiatives, allows us a unique insight into the dynamics of the Solent commercial property market and local economy.

3.3 In undertaking this study, we have assembled a core team of senior and supporting individuals to conduct the necessary research and to provide a qualitative and objective analysis of the impact and compatibility of the proposed IFA2 development within the wider vision for Daedalus.

3.4 To inform and enhance our technical knowledge of the project, we attended meetings and workshops presented by Arcadis and National Grid which were an open forum and these included a practical demonstration of the cable testing and screening and also the on site validation using actual aircraft. In addition we have consulted relevant research documents, the planning history and submissions, media articles and have interviewed and engaged with various personnel (to gather as wider perspective as possible) such as existing occupiers, businesses who may relocate to the site, Council officers, developers, property investors, local commercial agents, National Grid engineers etc.

3.5 We have adopted a staged approach as follows:

3.6 **Stage 1:** Identify the target market, assess occupier specific requirements/selection criteria, comment on current market conditions, consider demand sensitivities and highlight how these generic factors apply to our target audience. To include an assessment of the practical realisation of occupation compared with the aspirations of the Vision and Outline Strategy for Daedalus and the Airfield.

3.7 **Stage 2:** Obtain an objective understanding of the issues likely to be raised in high tech and precision based industries in taking property relocation decisions, any mitigation requirements, and interference to their operational process, and adjoining occupiers' sensitivity etc.

3.8 **Stage 3:** Conduct an in-depth analysis and report demonstrating the extent to which major utilities infrastructure may be considered prohibitive to occupiers assessing property locations and also to review the specific questionnaire responses from occupiers to the IFA2 proposals.

3.9 **Stage 4:** Taking account of specific IFA2 studies completed or being undertaken by other appointed consultants including technical reports, design and access statement, construction methodology and works programme, cable validation testing etc.

Our Credentials

3.10 LSH is the UK and Ireland's largest commercial property consultancy (a subsidiary of Countrywide Plc) with a national network of 31 offices and over 1500 employees. Along the South Coast we have two offices at Fareham and Southampton both with well-established and dedicated Industrial and Business Space departments. We have insightful and comprehensive market knowledge and recently for the tenth consecutive year, have been awarded by the national publication the Estate Gazette, the Most Active Agent in Hampshire and Dorset.

3.11 Consequently LSH have the strongest and largest industrial and business space team on the South Coast with 8 surveyors/negotiators including 3 directors and 2 associates engaged in agency and industrial activity and have instigated more transactions than any other agent both within the Solent region and across the UK thus as well as the strength of our national network and range of service lines, we are assisted by our local market insight.

3.12 We have detailed knowledge of the area and established working relationships with many corporate and local SME businesses which gives us access to the decision making when selecting new premises.

3.13 LSH are a multidisciplinary practice having expertise in industrial, offices, retail, roadside and leisure property. Our surveyors deal with day to day agency and disposals, development appraisals, company acquisitions, investment and funding advice, project management, Landlord and Tenant matters, professional valuations, town planning and property market research. We have undertaken many land use and employment site studies for Hampshire County Council, the Defence Infrastructure Organisation, Portsmouth City Council, Havant Borough Council, East Hampshire District Council, the PUSH Authority, J Sainsbury and national commercial developers and institutional investors / pension funds such as SEGRO, Canmoor, Bericote, Kier, Peel Logistics, Hargreaves, Columbia Threadneedle, Blackrock, British Airways, La Salle, Legal and General etc.

3.14 LSH has a very thorough understanding of land use strategies and delivery plans for key strategic sites. This includes advice in securing viable planning outcomes, devising market led development schemes and the comprehensive marketing thereof, utilising our widespread transactional skill sets and employing our first-hand knowledge of the South Hampshire market, as a key differentiator in successful deal making.. We have developed a very strong business network which is essential to our property activity, where we have learnt of significant local and corporate company requirements for sites and premises.

3.15 The LSH Fareham office is within a 15 minute drive time of Daedalus, having been established there for over 20 years and is further supported by colleagues in our Southampton office.

3.16 We have a strong track record of 'unlocking' sites to release new employment opportunities which is assisted by having market exposure and the full knowledge and agency experience of occupier requirements - we have direct communication and access to the major national investors and developers and a sound market judgement of rents and yields to enable accurate forecasting and evaluation of development appraisals.

4.0 OVERVIEW

Location

4.1 The Solent Airport is located within Fareham Borough Council's administrative boundary on the South Coast of England, almost midway between the expanding Southampton and Portsmouth conurbations, connected by the M27 motorway and the majority of the site has enjoyed Enterprise Zone status since 2012. Hampshire is well connected by land, air and sea with the benefit of two major sea ports, an international airport and strong road links to the national network to underpin the fact that the region has emerged as a key employment player in the marine, aerospace and advanced manufacturing sectors.

4.2 The Solent region is currently home to seven of the UK's top ten aerospace companies, has more than 25 marinas, internationally renowned universities, ambitious and acclaimed FE colleges and more than 3,000 marine and maritime companies in addition to over 14,000 jobs in the manufacturing sector.

4.3 Daedalus is a former naval airfield to the west of Portsmouth Harbour at Lee-on-the-Solent having vehicular access via junctions 9 and 11 to the M27 motorway and beyond. Along Newgate Lane and the A27 at Segensworth and Titchfield, highway works are progressing and in turn the Stubbington by pass link road, a Government backed £34m scheme, will provide much improved connections to Southampton, Portsmouth and the M3 to London.

4.4 Fareham and Gosport Town Centres are within close proximity to the site (each approximately 10 minutes drive).

4.5 Whilst situated outside Fareham Borough Council land ownership, the Daedalus Waterfront site overlooks the Solent and the Isle of Wight with part of the site being regenerated by private developers Tidebank Ltd, who have successfully built out some 2508 sq m of smaller

multi use industrial units on a speculative basis to attract local SME businesses. We are advised that a second phase of development in a similar design and unit size bracket will follow next year with construction starting in Q2.

4.6 The Solent Airport is an operational airfield providing business and leisure travel connectivity to/from mainland Europe, the Channel Islands and the Isle of Man, with 25,000 movements a year. It is managed by Regional and City Airports (RCA). Further air links are provided by Southampton International Airport, approximately 11 miles to the north west of the site.

Description

4.7 The 192 hectare site on the Fareham/Gosport peninsular in Hampshire comprises 4 distinct areas – Faraday Business Park, Swordfish Business Park, Solent Airport and the entrance Gateway sites. It is considered that the airfield remains the focus for the site with built development being directed to the areas around the airfield.

4.8 "The Solent Enterprise Zone at Daedalus, South Hampshire, was designated in 2012 and is one of 24 set up nationally to support local economic and employment growth. By 2026, it is estimated that 3,500 jobs will be created within the Enterprise Zone, turning the area into a destination of choice for businesses within the marine, aerospace and aviation sectors." (ref. http://solentez.co.uk/site/hca/home). The Enterprise Zone extends beyond Solent Airport to the south to include the area known as Daedalus Waterfront.

4.9 Over many years, Fareham Borough Council have identified Solent Airport at Daedalus as being its most significant commercial development opportunity and has proactively engaged with other interested stakeholders to secure funding and enable investment to realise the full employment potential of the site.

4.10 In March 2015 the Council acquired from the HCA some 369 acres of the land at Daedalus, principally comprising the airfield and development areas to the East and West. The Vision and Outline Strategy document prepared by Fareham Borough Council clearly defines the ambition and future intention to create economic growth and prosperity in the Borough and wider Solent region as follows:

"Our vision is for Daedalus to become a premier location for aviation, aerospace engineering and advanced manufacturing businesses, creating many skilled employment opportunities for local people, which is underpinned by a vibrant and sustainable airfield. Building on the existing general aviation uses, the airfield will be an attractive destination for visiting aircraft and will offer the hangars, facilities and service to attract more corporate and commercial aviation activities, allowing it to be self-sustaining in the medium term and contribute positively to the local community".

4.11 Daedalus is recognised nationally and locally as a strategic site with a unique opportunity to create a key strategic employment hub to accommodate businesses that can exploit its location and airfield. It is an important facility as the only hard runway available for general aviation in south Hampshire.

4.12 The site comprises a number of development opportunities including currently Faraday Business Park, in the near future Swordfish Business Park, the existing CEMAST College & Innovation Centre and Solent Airport, with opportunities for airside and non-airside businesses, creating a hub for like-minded occupiers. On Faraday BP, Fareham Borough Council have developed 11 new hangars for letting (6 for business use and 5 for general aviation use) which are just finishing construction.

4.13 Various plots are available on Daedalus East to accommodate commercial buildings on a 'design and build' basis to suit small, medium and large occupiers, with or without airside

access. Following the success of Phase 1 of the Innovation Centre the second phase is due for completion in March 2018 which provides workshop and office space for start-ups and micro businesses.

4.14 Daedalus is the largest employment site in the area with potential to become one of the most desirable locations for aviation, aerospace engineering and advanced manufacturing activity in the South. It is conveniently located near to the Solent Waterfront, has improving accessibility to the area's major road connections and is some 15 minutes drive to J9 of the M27 and, during 2018 will offer a public open space that includes picnic areas and walkways.

Planning Background

4.15 The hybrid planning application has been approved by Fareham Borough Council (Ref: P/16/0557/OA) with reserved matters on 10th April 2017 described as:

'An electrical interconnector with an approximate capacity of 1000 megawatts (MW) extending from Tourbe, Normandy (France) to Chilling, Hampshire. Outline planning permission is sought at Daedalus for: 1. The erection of converter station buildings (to a maximum height of 22 metres) with associated, vehicular accesses and roads, security fencing, landscaping and temporary construction compounds; 2. Creation of public open space and associated facilities, grassland planting and tree planting. Full Planning permission is sought at Hill Head and Stubbington for: 3. Installation of cables between Mean Low Water Springs and the converter station in the north eastern corner of Daedalus Airfield. Full Planning Permission is sought at Chilling for: 4. The Installation of cables between the Mean Low Water Springs and the existing cable sealing end compound at Chilling Lane.'

IFA2

4.16 Daedalus has been identified as a suitable location by the National Grid for an electrical interconnector which will connect the electricity systems of Great Britain and France using high voltage subsea cables from Normandy in France to Hampshire in Great Britain.

4.17 It is described by National Grid as follows:

'IFA2 is a 1,000 MW high voltage direct current (HVDC) electrical interconnector between the British and French transmission systems. It will be the second link to France that National Grid has developed with RTE and will help to enhance the security, affordability and sustainability of energy supplies in both countries.'

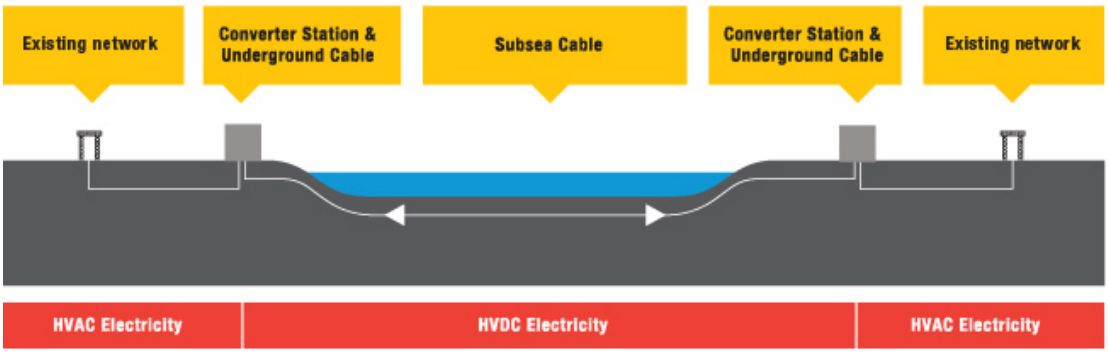
4.18 It aims to be operational by 2020 and will bring a number of benefits including:

Contributing to reduce the cost of electricity for homes and businesses in Great Britain.

Future proofing the security and reliability of electricity supplies for both countries.

Providing opportunities for shared use of renewable energy – helping both countries to meet domestic and international renewable and climate change targets.

4.19 The image below provides a visual representation of the proposed interconnector.



Ref: http://www.ifa2interconnector.com/what-is-an-interconnector/

4.20 As demonstrated, the only impact of the interconnector above ground will be the converter station, with all cables placed below ground. The UK electricity transmission system operates independently from continental Europe and the converter stations and substations make it possible to connect these independent transmission systems.

4.21 As described by the National Grid, 'A converter station converts electricity between Alternating Current (AC) and Direct Current (DC). AC is used in each country's transmission system, while DC is used for sending electricity along the high voltage subsea cables. A substation is a point of connection to the national electricity network. National Grid Electricity Transmission plc is a separate company, with responsibility for work to connect to the existing national electricity network.'

4.22 The images below are some initial visuals of the proposed convertor station.

Ref: Photomontage Viewpoints

Ref: Photomontage Viewpoints

Planning Conditions:

4.23 Planning permission for the converter station has been granted subject to a number of planning conditions. The conditions place obligations on National Grid during design, construction, installation and its performance once completed to ensure the impact of IFA2 is minimised and the functionality of the site is retained once the scheme is complete. The conditions which are particularly relevant to our assessment of the commercial impact of the proposed implementation of IFA2 in this location are summarised as follows;

B CONVERTER STATION DEVELOPMENT	
1.	Ground and floor levels Details of internal finished floor levels, along with finished ground levels of all accesses and roads must be approved. REASON: To ensure a high quality development.
2.	Height/ design of converter station building None of the buildings to be erected upon the site shall exceed 22 metres (save for any lighting protection measures which may exceed this height restriction.) REASON: To ensure a high quality development.
3.	Lighting following site completion A scheme of permanent external lighting must be approved. REASON: To ensure lighting does not materially harm the area or impact upon highway and airport safety.
4.	Noise from use of the buildings and the site Details demonstrating how the buildings will be designed and any external plant attenuated to control noise emissions must be approved. REASON: To ensure that the use of the converter buildings does not cause any noise nuisance to nearby residential properties. The rating level of noise emitted from the converter station buildings shall not exceed whichever is the greater of the existing background noise level or 30dB(A) when measured at the boundaries of any surrounding residential properties. REASON: To ensure that the use of the converter buildings does not cause any noise nuisance to nearby residential properties. A scheme for monitoring sound emitted from the converter station buildings (which will operate for 6 months) must be approved and include: a. All off site noise sensitive properties and locations where readings will be taken from; b. Survey methodology c. Reporting procedures REASON: To ensure that the use of the converter buildings does not cause any noise nuisance to nearby residential properties.

5.	Radio Frequency Interference Details setting out how the building will be designed to ensure that the electromagnetic disturbance arising from use of the site does not prevent radio and telecommunications equipment or other equipment outside the site from operating as intended. REASON: To prevent radio frequency interference to users of surrounding land and buildings.
6.	Construction, operational and abnormal indivisible load accesses and traffic management A construction traffic management plan must be approved. REASON: In the interests of highway safety.
7.	Construction Environmental Management Plan A detailed plan must be agreed including strategy and detailed method statements for storage of fuels, oils, welfare facilities, method of working, phasing of development, maintenance and aftercare of site. REASON: In order to minimise the impact of the development upon nearby residents and businesses, users of the highway and the water environment.
8.	Landscaping implementation Details of the landscaping must be approved. REASON: In order to secure the satisfactory appearance of the development
D CABLE INSTALLATION BETWEEN MEAN LOW WATER SPRINGS AND THE CONVERTER STATION	
9.	Cable installation method Details must be approved. REASON: To ensure that the specific cable installation methods are known.
10.	Alternating and Direct Current cables at airfield taxiways Measurement of AC and DC fields must be undertaken and agreed ad verified results submitted. REASON: To ensure that Alternating Current and Direct Current cables at the site will not materially impact up aviation use and safety at the site. Details of the installation of the cables must be approved to achieve: a. AC magnetic fields of not more than 10 mircroTesla when measured at ground level at each taxi-way crossing of the cables b. Compass deviation of not more than 1 degree when 12 meters or more away from the DC cables measured at 1.5m above ground level at each taxi-way crossing of the cables. REASON: To ensure that Alternating Current and Direct Current cables at the site will not materially impact up aviation use and safety at the site.
11.	Construction Traffic Management Construction traffic management plan for the installation of the cables must be approved. REASONS: In the interest of highway safety.
12.	Construction Environmental Management Plan A detailed plan must be agreed including strategy and detailed method statements for storage of fuels, oils, welfare facilities, method of working, phasing of development, maintenance and aftercare of site. REASON: In order to minimise the impact of the development upon nearby residents and businesses, users of the highway and the water environment.

4.24 Health implications have not been included as a condition as ‘the application submits that the maximum field produced is less than the relevant exposure limits and even outside of the safety margin ‘reference level’. Therefore the proposed development is compliant with the policies in place in the UK to protect public health’. In addition ‘Public Health England notes the conclusions of the EMF assessment that the proposed development would be fully compliant with Government Police on EMFs and fields produced would be below the relevant guidelines. Therefore it has been concluded that ‘On the basis of the exposure limits detailed in the application submission and the consultation response from PHE, Officers consider that the proposal is acceptable.

5.0 MARKET ANALYSIS

Target Market

5.1 Daedalus has been identified as the strategic employment hub for aviation, high-tech manufacturing and marine businesses as recognised in the planning permissions granted on the site.

5.2 The sites unique location adjacent to the waterfront coupled with its access to an operational airfield creates the perfect setting for a specialist hub for like-minded businesses of this nature.

5.3 Accordingly occupiers in the marine and aerospace sectors at local, regional and national levels, especially those companies looking for large space that are mobile would therefore benefit from a facility at Daedalus. In addition contract led opportunities and companies that have already strong relationships in the area with existing companies or indeed the major education establishments are suitable tenants for this site.

5.4 The benefit of targeting these specialist sectors in a location such as Daedalus creates an opportunity for a business hub of excellence, specialism and innovation, which this site seeks to create.

Marketing Strategy

5.5 LSH were appointed at the beginning of December 2016 to promote and secure new occupiers at Daedalus following a market campaign undertaken by Jones Lang LaSalle. Following the appointment and in response to an increasingly competitive arena and satisfying occupier expectations, LSH have adopted a measured and strategic approach, which is capable of being adapted and revised as market conditions ebb and flow.

5.6 We contend that he provenance of the site, coupled with the ongoing highway improvements, the Enterprise Zone qualifications, its financial benefits, and identification as a centre of excellence and employment hub for aviation, high-tech manufacturing and marine businesses, provide a strong offering to the market, both locally, regionally and nationwide.

5.7 Key elements of the marketing campaign involved are provided below:

National Property Database: The Database provides a platform to manage key enquiries more effectively as well as the ability to utilise the database for occupier targeting. The database provides a rapid and effective response to enquiries through e-marketing and also tracks occupier interest and provides regular client reporting on occupier activity within the region as well as within the micro environment.

Internet Profile: The site is marketed on our own website, the dedicated Daedalus website and in addition, the use of social and specialist media is an essential ingredient of the promotion of Daedalus.

Signage: Signage in and around the site provides a key visual advertisement for the business opportunities at Daedalus.

Brochure: Bespoke marketing details for each of the key business parks and building opportunities have been created as part of the marketing collateral.

Market Intelligence: Our comprehensive knowledge gained locally, regionally and nationally is used to attract potential occupiers for the various types of development envisaged, to encompass B1 a b and c, B2 or B8 or indeed D1 and D2 type requirements.

Occupier Engagement: Our day to day agency activity relies on personal interaction with potential occupiers on the telephone, by email or in person, to discuss the specific property criteria required by their business and to promote the Daedalus offer.

Market Commentary

5.8 Overall 2016 was a good year for the UK industrial and logistics occupier market, with UK wide take-up up 3% on 2015 and 6% above the five-year annual average. Notably, reflecting strong pent-up demand for quality premises grade A space accounted for a record 34% share of total take up.

5.9 Despite the resurgence of speculative development, overall supply fell by 18% in 2016. However whilst supply has dropped the nature of supply is changing with a greater total supply of grade A stock from a low of 9% to 19%.

5.10 The ongoing lack of supply had driven another year of strong rental growth. Across the UK markets, prime headline rents increased by 5.3% in 2016 from 3.9% in 2015. The industrial market remains buoyant, as evidenced by developer and investor confidence, with a new high recorded for quarterly enquiries despite the uncertainty in the economy with the continuing Brexit negotiations and the aftermath of the snap General Election this June.

Availability

5.11 In the South East supply is now critically low in the region. Total availability contracted by 15% in 2016 to stand at 15.2 m sq ft. The fall was most apparent in the smaller end of the market, with space in units of sub 50,000 sq ft contracting by 20% year on year.

5.12 On the South Coast the industrial market remains particularly hampered by the long term issue of a lack of good quality supply. Strong demand from occupiers is removing almost all prime stock from the market and pushing up rents.

5.13 However we are now seeing the first significant wave of speculative development along the Solent corridor occurring and expect an increase in take-up, as this much needed supply starts to service pent up demand.

5.14 At the present time, steel frameworks are coming out of the ground or have been completed on a few of the numerous speculative developments, which will assist in satisfying demand and will provide much needed new Grade A employment stock and as the region's larger companies expand into bigger premises, secondary stock will be released back into market, thus assisting in the churn of small and medium enterprises.

5.15 We have noted that freehold stock contain the largest portion of demand where there is little or no stock. The vast majority of freehold stock being marketing is shortly placed under offer and it is not uncommon for a number of parties to be contesting the same product.

Take up

5.16 Take up in the South East was 10.2m sq ft in 2016, down 13% from 2015's high but marginally ahead of the 5-year annual average. Fueled by the arrival of new supply to the market, logistics take-up of 2.7m sq ft was the highest since 2008.

5.17 On the South Coast take-up in Q1 2017 was 468,118 sq ft, an increase of 6.12% from the 439,490 sq ft transacted during the previous quarter.

5.18 With the lack of availability across the region we are seeing typical lease terms increase, with the length of term certain increasing and becoming more common as occupiers seek to secure space.

5.19 Enquiry levels on the South Coast saw a significant rise in Q1 2017, with an increase of 38.79% on Q4 2016. This highlights the buoyancy of the South Coast's market despite economic uncertainty and focuses developers in providing much-needed supply to satisfy this demand.

Rents

5.20 Prime rents in the South East remained firmly in growth territory, increasing by 5.9% on average during 2016.

5.21 Prime rents increased by 12% in 2016 to £9.25 per sq ft for mid-box units, and secondary rents increased by 7% to £8.00 per sq ft in Southampton and £7.50 - £7.75 per sq ft in Portsmouth/Fareham. Following significant rental growth over the past few years, the market remains favourable for landlords, with minimal voids seen on good quality multi-let industrial estates across the region.

2017: Current Market Analysis

5.22 The fundamental market dynamics around industrial & logistics bode well for its performance prospects in 2017. However, the environment has become more challenging both for occupiers seeking more flexible options and for would be developers and investors searching for opportunities in the market.

5.23 Despite the spectre of rising inflation and uncertainty on the road to Brexit, the outlook of occupier demand remains positive for 2017. While rising inflation may erode some of the momentum in the market, our analysis of active demand indicates that sentiment remains positive which bodes well for healthy occupier activity in 2017.

5.24 The full impact of Brexit remains unclear and so far the only clear consequence of the vote to leave is the significant fall in the pound, and while this is putting pressure on import prices, it has in fact boosted the competitiveness of UK manufacturing.

5.25 Arguably the central challenge for the market in 2017 is on the supply side. The fundamentals in the occupier market continue to make a compelling case for more development, not only to arrest the critical lack of existing supply but also to accommodate the steady structural growth

in demand for omni-channel fulfilment. The challenge is, as always, ensuring the right product is delivered to the right market at the right time.

5.26 Despite active demand standing higher now than a year ago, indications are that development appetite has receded. This not only reflects caution over the economic outlook, but the acute lack of sites in prime locations, a disconnect in buyers' and vendors' price aspirations on land values and rising build costs, both recent and anticipated.

5.27 However there are undoubtedly untapped opportunities in the market, both geographically and sectorally. We foresee that certain developers may benefit from considering sub-optimal locations, offsetting that risk with more attractive land values yet encouraged by strong rental growth and minimal supply to 'soak up' demand, to justify speculative development.

5.28 While rental growth expectations have been scaled back post-referendum, we envisage continued growth throughout 2017. At the all UK level, prime headline rents are forecast to increase between 2%-3% over the coming year, easing down from the 5.3% seen in 2016.

5.29 We consider that whilst a good number of new industrial schemes have been initiated in the past 12 to 18 months within the Solent region, those that could be regarded now as genuinely competing schemes to Daedalus are arguably few, bearing in mind the location, EZ status, airport factor, tenureship available to owner occupiers, cost and deliverability etc.

5.30 Increasingly we have encountered demand for premises from the advanced manufacturing sector right across the building size range, from niche, prototype and full production/assembly businesses, in principally the marine, defence, aviation, medical device, energy and pharmaceutical activities. There remains a sizeable and important traditional manufacturing sector in the region that will continue to have property needs and Daedalus will certainly appeal to these types of occupiers. In the future, once the infrastructure is complete and delivery timescales are defined, we believe the scale of development at Welborne (the site profile and workforce catchment) will also prove attractive to the general B2 occupier, as well

as distribution and logistics operators benefitting from proximity to the M27. Clearly the availability at Daedalus and Welborne will overlap at some point in the future (potentially a 5 to 10 year window) but by that time, Daedalus will have established a sufficient critical mass as a credible business destination to maintain a positive development momentum.

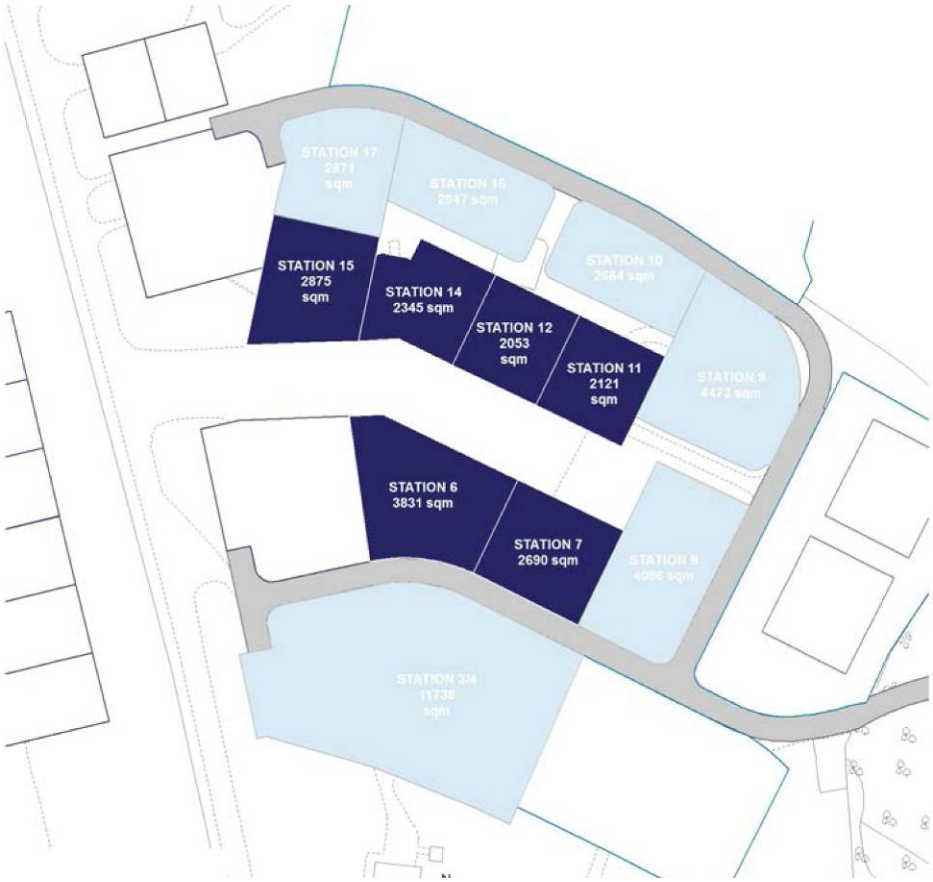
6.0 DAEDALUS MASTERPLAN

Daedalus Masterplan

6.1 The outline planning permission at Daedalus includes opportunities for airside and non-airside businesses and is divided into four distinct regions namely; Faraday Business Park, Swordfish Business Park, Solent Airport and the Gateway sites.

6.2 Plots are available at Daedalus East to accommodate commercial buildings on a 'design and build' basis to suit small, medium and large occupiers, on either leasehold or freehold basis.

6.3 Faraday Business Park has its own dedicated entrance and incorporates Fareham Innovation Centre, CEMAST College. It offers businesses flexible opportunities with airside and non-airside plots on a design and build basis. Airside plots are available from 0.5 – 3.93 acres and non-air side plots are available from 0.65 – 7.07 acres.



6.4 CEMAST is a Centre of Excellence in Engineering, Manufacturing and Advanced Skills Training, which is the main learning centre for students in partner apprenticeship programmes and a host of automotive and engineering courses. The proximity of this facility offers businesses the opportunity of access to potential apprentices and fledging businesses from this centre.

6.5 Swordfish Business Park forms part of the second phase of development at Daedalus. It comprises two zones; an aviation cluster comprising medium to large sized hangarage for commercial aviation businesses and a commercial business park for target-sector based businesses. The business park benefits from prime location adjacent to the runway and has direct access onto Gosport Road.

6.6 Solent Airport has benefited from major investment including £1.5m of runway improvements in 2014. Business Hangers are being speculatively built at the present time and are available from 6,458-38,748 sq ft. The units will be fitted with offices and WC facilities. The airfield has a Civil Aviation Authority (CAA) Aerodrome licence and secured Border Force approval for overseas flights to/from the EU, Isle of Man and the Channel Islands.

SWOT Analysis

6.7 To summarise the market positioning and highlight the attributes in attracting occupiers and satisfying business need, the table below identifies the potential/perceived strengths, weaknesses, opportunities and threats of the offering at Daedalus.

STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
Enterprise Zone Status – discounted business rates at present and funding opportunities	Distance to M27 / congestion at peak times	Specialist hub for aviation, aerospace engineering and advanced manufacturing	Competition from other sites in Solent region
Access to an all-weather licensed airfield	Peninsular location	Planned road improvements	Losing the EZ status and business rates relief incentive
Marine slipway to the Solent for marine businesses	Finite source of electricity supply	Fareham College's Centre of Excellence for advanced skills training	Timing of development coming to market vs UK economic uncertainty
Flexible terms available	Airfield operational restrictions such as height of building	Phase 2 Innovation Centre (operated by Oxford Innovation)	Future availability of skilled workforce being inadequate to match occupier demand
Reasonably priced	Timing to delivery of completed units	14 ha of land available for development	Investment yields becoming less attractive
Low service charge	Ground remediation required	Displacement of naval personnel in area	
Superfast broadband	Lack of lifestyle amenities on site	New hangars under construction	
Occupiers ability to purchase their own site	Limited public transport services	Future speculative development	
Air travel (charter and commercial flights)		Masterplan flexibility	
Local Authority funding			

Competition

6.8 The South Coast has experienced a long period of limited speculative and new commercial developments being brought forward, however the improved market conditions has set the stage for the next wave of development. The fall in supply coupled with the increasing rents and reduced incentives have provided developers with the confidence required to provide the much needed supply.

6.9 Below is a list of new high specification industrial/distribution schemes underway and being actively marketed, offering a range of commercial solutions for occupiers seeking business facilities in the South Coast region.

Mount Park, Southampton Wide Lane, Southampton SO18 2NQ

Site Area: c 26 acres

Size: Min 50,000 – circa 200,000 sq ft

Guide price: £9.00 - £9.50 per sq ft

Planning consent granted on Oct 2016 for a new 7 unit industrial and logistics scheme. The development includes speculative buildings of 60,000 sq ft and 100,000 sq ft.

South Central, Test Lane, Southampton SO16 9JX

Site Area: c 16 acres

Size: Up to 226,000 sq ft

Guide price: £9.50 per sq ft

Full planning consent has been granted. The proposal is to speculatively build a 3 unit scheme comprising a 40,000 sq ft, 50,000 sq ft and 116,000 sq ft unit.

Alpha Park, Electron Way, Chandlers Ford, Southampton S053 4ZR

Site Area: c 8.44 acres

Size: Up to 159,000 sq ft in total

Guide price: £7.75 per sq ft

Full planning consent has been granted. The scheme is a speculative development including 20,000 sq ft, 46,000 sq ft and a 82,000 sq ft for B1,B2 or B8 use.

Merlin Park, Airport Estate, Portsmouth

Site Area: c 3.809 acres

Size: Up to 91,000 sq ft

Guide price: £9.00 per sq ft

Speculative 7 unit scheme with units ranging from 8,000 sq ft to 20,430 sq ft. Construction has commenced.

Berewood, Waterlooville

Site Area: c 25 acres

Size: Up to 200,000 sq ft

Guide price: Leasehold and freehold options are considered at £550,000 per acre.

Infrastructure for the scheme is complete. The intension is to provide self-contained plots for build to suit opportunities.

Pioneer Park, Airport Industrial Estate, Portfield Road, PO3 5FN

Site Area:

Size: 6 units totalling 74,000 sq ft (min) ranging from 4,764 sq ft – 23,029 sq ft.

Guide price: Units 3,8 & 9 £9.25 per sq ft, Units 6 & 7 £8.75

The scheme is under construction for a speculative development of industrial and distribution warehouses. The specification includes a shell fit-out with first floor mezzanines.

Velocity, Havant

Site Area: 5 acres

Size: 30,000 sq ft to 120,000 sq ft.

Guide price: £550,000 - £600,000 per acre

An industrial / distribution scheme, for build to suit opportunities, available on a subject to planning basis.

Dunsbury Park, Havant

Site Area: 45 acres

Size: 20,000 sq ft to 200,000 sq ft

Guide price: £9 - £10 per sq ft

Industrial / distribution Business Park offering bespoke build to suit facilities.

6.10 As stated, whilst there are a good number of industrial schemes being brought forward within the region, those that could be regarded as genuinely competing schemes to Daedalus are arguably few, bearing in mind the location, EZ status, airport factor, tenure ship to owner occupiers, cost and deliverability etc .

6.11 Therefore Daedalus offers a unique opportunity to prospective businesses seeking industrial space. As well as Daedalus providing commercial access to an operational airfield, it also gives occupiers a rare option to purchase land and develop out their own purpose built accommodation. The Berewood site in Waterlooville is the only other location with freehold offerings in the market.

7.0 OCCUPIER SELECTION CRITERIA

Influencing Factors

7.1 In order to understand the criteria which influence a company's choice of site we have identified the key factors which are typically considered of high importance and priority in assessing where the business should locate or relocate its business premises;

7.2 **Location:** Proximity to existing facility to retain workforce/customers or wholesale relocation and expansion to a new marketplace.

7.3 **Accessibility:** Accessibility of the location to road, rail and air communications

7.4 **Workforce Supply:** Availability/ proximity of varied range of skilled labour force within easy commuting distance.

7.5 **Supply:** Availability of the right type, quality, specification, size and use of premises.

7.6 **Environment:** Quality of the setting, compatible neighbours, planning restrictions, flood risk, security, green credentials.

7.7 **Utilities:** Existing capacity, future proofing.

7.8 **Tenure:** Freehold opportunity, land acquisition, leasehold option and flexibility to buy or rent.

Occupier Concerns/Sensitivities

7.9 Successful employment schemes such as Daedalus should offer a quality working environment that is sustainable and attractive to a variety of occupiers or businesses. The ambition is that the site will be a first class destination for aviation, aerospace engineering and advanced manufacturing businesses, which is underpinned by a vibrant and sustainable

airfield and will house a mix of B1 office, B2/B8 industrial / logistics occupiers, and associated complimentary business park uses (such as food/beverage facilities). It is therefore vitally important to consider the potential concerns/sensitivities that occupiers might express to ensure these are minimised and reduced.

7.10 Occupiers identify with a business environment that is attractive, fit for purpose, functional and affordable. This will often include features such as:

- An attractive and modern building that is fit for purpose, staff appealing, energy efficient with an adequate eaves height, good loading and has appropriate service capacities.
- Appropriately priced accommodation with a fair and reasonable service charge.
- An appropriately orientated building on a site with a suitable plot density, with a sufficiently sized yard and loading capabilities with appropriate landscaping and feature grounds.
- Creative and effective signage from a marketing, functional and aesthetic perspective, the external and internal signage is a very important element to the park, providing identification and direction.
- Quality landscaping regime and parkland style environment
- Occupiers will expect a reasonable level of security/ patrols on site, although this is likely to vary according to the nature of the occupiers on site and the types of use.
- Control of parking is important to avoid unauthorised car and lorry / trailer parking over the estate.

7.11 Occupier concerns or sensitivities may therefore include:

- A poorly designed building that is not suitable or fully equipped for purpose
- Unreasonably and inappropriately priced accommodation
- Challenges navigating around the site for occupiers and associated visitors. This will be particularly crucial in this location with the segregation of airside/non airside users.

- A poorly landscaped scheme is unlikely to provide the sense of quality and value however too much may adversely affect the amount of developable space and could also lead to occupiers raising concerns about high service charges.
- Inadequate security particularly for maintaining a safe working environment within an active airfield.
- Operational restrictions which could include hours of operation, user restrictions which could prevent them from operating their business in an efficient manner.
- Poor access in / out and around the site including inadequate parking provision.

7.12 More specifically in connection with the apprehension that the IFA2 project may evoke could include:

- Unacceptable noise levels generated from the convertor station
- Fire risks associated with the proposed facility
- The presence of any Electro Magnetic Fields (EMF) on the conduct of the business both operationally and staff welfare
- Disruption during construction phase of the IFA2 facility
- Health risks/concerns
- Aesthetics, appearance, scale, height of the converter building.
- Workforce perception / retention and recruitment issues
- Future disposal prospects/ how it may affect property value ?

8.0 OCCUPIER CONSULTATION

Consultation Approach

8.1 Our market compatibility assessment and occupier consultation on the proposed IFA2 Enterprise Zone Development at Daedalus examines both primary and secondary data.

8.2 Our assessment of secondary data, considers information we have had access to rather than information we have collated/received directly and forms part of our analysis with the relevant references made. Examples of secondary data are provided below:

- The Media: articles in the press, social media and publications in the public domain
- Engagement forums: presentations, question and answer sessions and cable testing
- Reports: Third party reports including the Arcadis Report

8.3 Our direct consultation approach with prospective occupiers and tenants is two-fold; as sole agents for Daedalus we have the benefit of direct applicant engagement and their feedback on Daedalus, secondly in addition we have also undertaken primary research, as described below.

8.4 Our targeted occupier consultation process has involved engaging with companies that work in the aviation, marine, aerospace engineering and advanced manufacturing sectors, to ascertain search determinants and influencing factors when considering where to locate their business and the extent to which being in close proximity to a facility such as the IFA2 would affect their decision to locate to a particular site.

8.5 Our questionnaire was sent to a range of businesses with representations received from marine, aerospace, advanced manufacturing and engineering companies who were asked to respond on a voluntary and confidential basis (the foregoing list is illustrative of the companies we approached and those that engaged but not exhaustively so).

Babcock International Group	Mimtec Limited
BAe Systems	North Sails
Barnbrook Systems Limited	Percival Aviation Limited
Ben Ainslie Racing	Portsmouth Aviation
Captec Limited	Proptech Aero Limited
Chemring Group	Raymarine
CK Electronics	Rolls Royce Holdings
Coopervision	Saab Seaeye
DKW Precision Engineering Limited	Safran/Turbomeca UK
EADS Airbus	Selden Masts Limited
Eaton Aerospace	Selex ES
Folland Aerotech Limited	STS Defence
Formaplex	Transas Marine
GKN Aerospace Services Ltd	Universal Tool & Production
Leki Aviation	Vector Aerospace International Limited

Questionnaire

8.6 Our approach involved issuing a tailored questionnaire to the identified companies accompanied with a covering letter explaining the nature of the study, details of IFA2 and why they had been approached as a business.

8.7 A copy of the questionnaire is provided below including an explanation for each question asked. A copy of the covering letter can be found in Appendix 1.

Occupier Questionnaire

Thank you very much for agreeing to take part in our survey.

The following information will be used solely for the purposes of this study and will not be used for any other reason. The information collated may be used in the study but the individual responses will not be personally attributable.

Name ……

Company ……..……..

Contact number ..……

Email address ……..……

1) *Does the operation of your business require the use of technical equipment or sensitive machinery?*

   Yes ☐ *No* ☐

Any specific items

……

……

2) *Are you required to undertake any scientific studies before locating your business to ensure the working environment is acceptable and will not affect your business operations?*

   Yes ☐ *No* ☐

3) *Does your business make use of or have need for access to an operational airfield?*

   Yes ☐ *No* ☐

How often would you require access?

……

……

8.8 The first three questions asked are seeking to ascertain the extent to which the company uses technical equipment or would use the operational airfield, which may be considered sensitive to EMF's, and whether the functionality of that equipment means they are required,

as part of their decision making process, to undertake tests to establish the suitability of a particular location.

4) *Please rank the following search determinants when considering a suitable property for your business: (please rank 1 to 5 , 1 being most important, 5 being the least important)*

	1	*2*	*3*	*4*	*5*
Location					
Quality of building					
Building specification e.g. eaves height/ floor loading					
Occupational cost					
Size / layout					
Power supply					
Access to road or rail network					
Proximity to staff amenities i.e. retail or leisure					
Parking provision					
Grants / incentives					
Skilled workforce availability					
Broadband speed					
On site security					
Proximity to complementary businesses					
Quality of environment					
Proximity to further and higher education establishments					

5) *Which of the following factors would significantly reduce the appeal of a particular site or premises: (please number rank 1 to 5, 1 being most significant, 5 being least significant)*

	1	*2*	*3*	*4*	*5*
Planning use					
Access restrictions					
Noisy environment					
Long term construction					
Incompatible neighbours					
Electrical or radio-wave interference					
Level of vibration					
Hours of use restrictions					
Inadequate security					
Undesirable odours					
Proximity to residential					
Flood risk					

8.9 The two questions above are asked in order to establish the occupier selection criteria which would typically be considered of high importance/priority in assessing where the business should relocate/locate to and the factors which would particularly reduce the appeal of a

particular site. The ranking system has been adopted to help the business identify which were more or less important.

6) *Are you aware of Daedalus Solent Enterprise Zone and the commercial opportunities available in this location?*

Yes ☐ *No* ☐

7) *Have you or could you consider it as a suitable location for your business (either as a total relocation or as an additional facility)?*

Yes ☐ *No* ☐

If not please state your reason/s why

……

……

8) *Would the prospect of being located within close proximity to an energy convertor station be of concern to you and your business?*

Yes ☐ *No* ☐

9) *Are you aware of National Grid's IFA2 interconnector facility that is proposed at Daedalus?*

Yes ☐ *No* ☐

8.10 Question 6, 7 and 9 have been asked in order to identify whether the occupiers asked are aware of Daedalus as a commercial business location, what it has to offer and whether it is a location they have or would consider for their business. These questions also indicate the extent to which they are aware of the IFA2 interconnector facility at Daedalus.

10) *Would the prospect of your business being in close proximity to a facility like this be of concern to you?*

Yes ☐ *No* ☐

8.11 Questions 8 and 10 are directly asking occupiers whether locating their business within close proximity of an interconnector facility or the IFA2 at Daedalus, would be a problem for them and the operation of their business.

11) If it was demonstrated that there were no material implications to health, noise or electromagnetic interference, would this provide you with adequate assurance that the site was a viable option for your business?

Yes ☐ *No* ☐

12) If there was a perceived risk of electromagnetic and radio-frequency interference might you instantly disregard the location or undertake further investigation?

Disregard ☐ *Undertake further investigation* ☐

If you selected 'undertake further investigation' please state what you would seek to undertake.

……...

…….....……

13) National Grid is subject to strict planning conditions, and studies that have been conducted show that proximity to a facility of this nature will not have a detrimental impact on neighbouring occupiers. Are you reassured that any concerns you may have are addressed by these measures?

Yes ☐ *No* ☐

8.12 Questions 11, 12 and 13 are seeking clarification on the perceived potential concerns that are often associated with being in close proximity to an interconnector facility, such as the IFA2, and the extent to which assurance, further testing and the strict planning conditions would alleviate these concerns.

14) If you have any other comments please provide them below?

…….....……...

……...

……...

Thank you for your time in undertaking our questionnaire, if you have any questions regarding the survey, please do not hesitate to contact us.

8.13 Due to confidentiality, the information collated from each of the businesses has been provided on the basis that it will be used solely for the purposes of this study and will not be used for any other reason. In addition individual responses collated have not been personally attributed.

8.14 These results have been analysed and the results are provided in the following section.

9.0 CONSULTATION ANALYSIS

Secondary Data

The Media:

9.1 Social media, the press and other publications within the public domain can influence and impact the perception of its readers both in a positive and negative way.

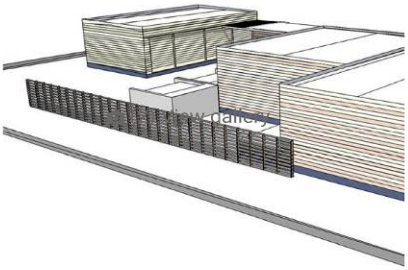
9.2 As part of our analysis we have collated some of these articles and considered the potential impact these may have on potential occupiers considering this location for their business.

9.3 Daily Echo – 13 November 2015

13th November 2015

Huge energy project could bring Hampshire millions of pounds

Emma Streatfield
Senior Reporter



A MAJOR project to keep the lights on in the UK could run from a site in Hampshire.

National Grid wants to build an electricity interconnector between France and Daedalus, near **Fareham**, that would help to import energy from all across Europe.

The IFA2 scheme, or Farelink as the council has labelled it, would be the second interconnector from the UK to France and those involved say this link will help enhance the security, affordability and sustainability of energy supply to both countries.

Cllr Sean Woodward, who announced the £500million project, said money generated to Fareham, which he said would be in the millions, would benefit the Daedalus site and help meet the Solent Enterprise Zone's target to create 3,500 jobs there quicker.

It could also lead to a cafe and visitor centre for the airfield, runway lighting and an extended runway.

Although the interconnector would not need many people to run it, Cllr Woodward said there would be dozens of jobs created during construction.

The converter station at Fareham would convert alternating current, which is used domestically in the UK and France, into direct current so it can be transmitted between the two countries.

This would also allow Britain to export any excess energy it produces to Europe.

A seven storey high building would occupy some of a 10 acre proposed brownfield site in the north east of Daedalus, an area that already houses an airfield and manufacturing within the marine, defence and aerospace sectors.

The land, owned by **Fareham Borough Council**, would be leased or sold to National Grid.

National Grid first approached **Hampshire County Council** several months ago about building the device at Chilling, Warsash, where it already has a site, but was met with concern about damaging the beauty spot.

So the less sensitive site at Daedalus was put forward.

Undersea cabling will transfer power between Daedalus and Chilling to connect to the national grid.

Cllr Woodward said without the scheme it was likely that "the lights will go out" in the UK as it struggled to provide enough energy.

But he said the council would be making sure that the plans would not have any implications on airfield navigation or public health.

Fareham Borough Council's cabinet will decide on whether to sell the land on December 7 and a planning application is expected March next year.

If approved work could start as early as 2017 and the interconnector running by 2020.

Stewart Dunn, Chair of Hampshire **Chamber of Commerce**, said he welcomed the local jobs and steps to ensure a sustainable power supply to homes and businesses.

"It's absolutely essential and particularly after the announcement last month of the closure of Navitus Bay project."

National Grid will hold a number of exhibitions. They are at:

- December 8 – Lockswood Community Centre, Locks Heath, 1.30pm-5.30pm
- December 9 – St Faith's Parish Centre, Lee-on-the-Solent, 4pm – 8pm
- December 10 - Stubbington Baptist Church, Stubbington, 3pm-7pm
- December 11 - Warsash Victory Hall, Warsash, 4pm – 8pm
- December 12 - Crofton Community Centre, Stubbington, 10am – 4pm

9.4 The article above describes the IFA2 proposal and explains some the of benefits of its location at Daedalus including the money generated to Fareham, enhancing the security, affordability and sustainability of energy to both France and the UK and the jobs it would create primarily during its construction. It also states the date exhibitions will be held by National Grid.

9.5 This article explains the wider benefits of the proposed interconnector at Daedalus. The impact of this article on prospective occupiers is therefore likely to be relatively neutral; whilst it describes the facility as 7 storeys high, the proximity and visual impact of this facility on the commercial space is unclear and whilst the article outlines some the benefits, these are not directly relevant to prospective tenants and therefore is unlikely to impact an occupiers decision.

9.6 The Portsmouth News – 27 June 2017

Mixed reaction to new look of interconnector as CGI image released

MP remains critical of building's design

by DAVID GEORGE
The News
david.george@thenews.co.uk

THIS is the first look at new CGI images of the proposed IFA2 interconnector.

Computer-generated images show what the site could look like once construction has been completed at Daedalus Airfield in Lee-on-the-Solent.

The new design sees a large reduction in the building's size, as well as a drop in its carbon footprint.

Councillors and residents have given the new design a mixed response.

Gosport resident Tony Weaver said: 'It blends in nicely with the sky.'

Leader of Fareham Borough Council, Seán Woodward, said: 'They have listened to comments from myself and members of the public.

'If the planning application is approved, I will hold a Community Action Team meeting at 7pm on July 27, at Holy Rood Church in Gosport Road, Fareham.'

But some people are still far from convinced.

Sandy Fuller, from Gosport, said: 'I can't believe that it is so close to the runway.

'I wonder where the construction traffic will enter the site from.'

Gosport councillor Christopher Carter said: 'My understanding is this structure will be over 20m in height and I therefore find these views misleading.

'I have not changed my opinion that I do not support this proposed development.'

Gosport MP Caroline Dinenage added: 'While I am glad the National Grid has taken residents' concerns about the building's size, height, volume and footprint into account, my main objection remains the potential impact of the interconnector on the businesses operating at the Daedalus site, and on our local area more broadly. The design change – while a step in the right direction – does little to allay this.'

Public consultations will be taking place from 4pm-8pm on Friday and 11am-3pm on Saturday at the CEMAST campus in Daedalus Airfield.

The controversial decision to approve the building of IFA2 was made by Fareham Borough Council back in January this year.

A total of 1,134 people officially opposed the motion, all writing to the council to express their concern.

IFA2 will become a base for a 1,000 MW interconnector between England and France, which will cost £500m to build and transfer electricity between the two countries.

ARTIST'S IMPRESSION The latest computer-generated image of the proposed IFA2

9.7 The Portsmouth News – 03 July 2017

Critics speak out at IFA2 consultation

Concerns remain over plans to build huge interconnector at former navy base

by DAVID GEORGE
Gosport reporter
david.george@thenews.co.uk

CONCERNS have been raised at a public consultation over plans to build a huge interconnector.

Members of the public have had the chance to get an in-depth look at the IFA2 project.

IFA2 is the plan for a 1,000 MW interconnector between England and France, costing National Grid £500m to build at Daedalus.

The site will act as a transformer for renewable energy, which will be used by the two countries.

However, even before outline plans were approved in January this year, it has been met with fierce opposition from residents.

Concerns centre on the size of the building, the noise pollution and the safety of the runway at Daedalus in Lee-on-the-Solent.

On Friday and Saturday many attended a public consultation at Cemast in Daedalus.

One resident, who lives near the Daedalus site but wished to remain anonymous, said: 'We are just totally against it.

'We live close to the site and it is certainly going to affect us. It feels wrong.

'It is monstrous. They have reduced it but it is still a very large structure – we don't see it from where we live but others feel the same way about it.

'The 10 jobs it is creating isn't really enough either.'

Cllr John Beavis, member for Lee West at Gosport Borough Council, said residents will continue to fight against the IFA2.

He said: 'To me, the fact that they are going ahead with it when there are so many complaints, means that they are just determined to get on with it.

'The only thing that can save us now is if France pulls the plug on it.'

Sonia Luck, from National Grid, said that all public comments are taken on board as a more detailed plan develops. The size has already been reduced.

She said: 'The objective of this consultation was to update local residents and stakeholders about the details on proposals for the converters station and open space.'

SEE MORE ONLINE

Go to portsmouth.co.uk to watch a video interview that goes with this story

9.8 The articles above express varying opinions on the latest computer-generated images of the interconnector facility at Daedalus. They express the improvements in scale and massing of the facility but also highlight concerns such as its impact on businesses operating in this location, the proximity of the facility to the runway and the safety risks, the potential impact of construction traffic and the noise pollution.

9.9 The concerns and issues raised in this article are likely to be more applicable to prospective tenants at Daedalus such as the potential disruption during the construction and noise levels. Highlighting these factors may subsequently form part of decision making process for occupiers considering this location.

9.10 The News – 9 August 2017

'A bad decision with damaging consequences': The story of IFA2 by Fareham community leader

Day 2 of a two of day public consultation on proposed IFA2 development on the former HMS Daedalus site. - "Gosport councillor for Lee West, John Beavis MBE discuss's the plan with Charlotte Hayden". Picture Credit: Keith Woodland PPP-170307-110329001

Bill Hutchison, chairman of the Hill Head Residents Association has followed the story of the IFA2 proposals for the last two and a half years. Here, he gives his take on the situation up until now.

FOR a year now our MP, Caroline Dinenage, and a group of Councillors and the Residents' Associations have been opposing National Grid plc's planning application to build a 1000MW Interconnector to France at a cost of £500 million on the north side of the former RN airfield at Daedalus, Lee on the Solent.

> **The decision by Fareham and National Grid plc to build the IFA2 Interconnector on the airfield at Daedalus regardless of the agreed local plan and strong local opposition in order simply for Fareham to get National Grids plc's money is a thoroughly bad decision that will have deeply damaging consequences for the development of both the airfield and the Enterprise Zone.**
>
> *Bill Hutchison, chairman of Hill Head Residents Association*

Unfortunately, on 26th July 2017, the Secretary of State for Communities and Local Government confirmed that IFA2 could go ahead.

For many reasons, IFA2 should have been sited at Fawley on the site of the old power station or at Chilling in open countryside but there has been no public examination of these alternatives at all.

National Grid's application for Daedalus has been supported and promoted by Fareham Borough Council throughout because they want a large but so far undisclosed sum of money, a so-called "Premium Payment", from National Grid to put IFA2 on the airfield despite the fact it contravenes Fareham's own Local Plan.

This multinational came along waving lots of money and the agreed Local Plan went out of the window.

Heavy electrics of the size of IFA2 interfere with sensitive electronics and the 1000MW Interconnector will dangerously affect the magnetic compass systems of the light aircraft that use the airfield.

The proximity of the IFA2 converter building and its 2 high voltage DC (390,000v) and 6 high voltage AC (400,000v) cables running under and across the airfield will also deter the aviation and defence businesses that it had been hoped to attract to the airfield's Solent Enterprise Zone.

IFA2 has already destroyed these potential high quality local jobs. Our MP was instrumental in getting support of all kinds for the Enterprise Zone and is very concerned about it.

The way Fareham processed the National Grid plc planning application was outrageous.

The application ran to over 2,300 pages and was by far the largest Fareham had ever received yet objectors were allowed only 3 minutes for an individual and 5 minutes for an Association to put their case at the Planning Committee meeting.

An application of this size and complexity should have been heard before an independent planning inspector with expert advisers to hand at a properly constituted public inquiry. Fareham Planning Committee, who were clearly out of their depth on all technical and aviation matters, approved the application on 23rd January 2017 almost without discussion.

The decision by Fareham and National Grid plc to build the IFA2 Interconnector on the airfield at Daedalus regardless of the agreed local plan and strong local opposition in order simply for Fareham to get National Grids plc's money is a thoroughly bad decision that will have deeply damaging consequences for the development of both the airfield and the Enterprise Zone.

Furthermore, it is the UK consumers who will have to pay for IFA2 through their electricity bills.

SEAN WOODWARD: 'BILL IS WRONG'

'BILL could not be more wrong', says Councillor Sean Woodward, leader of Fareham Borough Council.

'I made a pledge to the people of Fareham that nothing will be built at Daedalus that will affect the operations of the airport and I will stick to that pledge.

9.11 The article above is another example where concerns and issues that are raised may cause a reader to use them as part of the decision making process if they were considering Daedalus as a location for their business.

9.12 Serious occupiers that would like to locate to Daedalus are however likely to undertake their own due diligence and assessment on the impact of this facility on their occupation and operation, such as any electrical interference with sensitive equipment they may use, and any affect it may have on the magnetic compass systems.

9.13 The media can influence and impact its readers. The extent to which it can change people's/businesses perceptions and decisions is difficult to quantify, however what is important is that information in the public domain is accurate. Where information is misleading or false it could lead to misrepresentation, therefore clear accurate communication is vital.

Engagement Forums:

9.14 In addition to our engagement with targeted occupiers, the Landlord and National Grid have completed some direct consultation with existing tenants and local residents. These forums allow information about the proposed facility to be presented and for interested parties to comment and ask questions.

9.15 A number of exhibitions, consultations and engagement forums have taken place in addition to cable testing to which observers could attend. Details and results of these are provided below:

9.16 Public Information Event:

Theme	Comment	Frequency
Principle of development	Opposed to location of converter station	3
	The viability of IFA2 is questionable after Brexit	1
	The county needs this facility and it needs to be built now	1
Environmental impact	I remain very concerned about the noise associated with this project	1
	I see you have well addressed all the earlier concerns about size, noise and RFI, well done	1
	This project will affect Gosport residents more than it will affect Fareham	1
	Desire for more information about public health impact of EMFs	1
Landscaping and design	Suggest that the banking made from the building spoil be positioned nearer the road boundaries –with tree planting on	1
	No mention of the illumination to be provided at the site	1
	The converter station remains large	1
Solent Airport	Desire for more information about potential impact of EMF on operations of Solent Airport	2
	Concerns about unexploded ordinance at Solent Airport	1
Construction	Access to the IFA2 site during construction and laying of the cables will have a significant effect on vehicle traffic in the area	1
	Desire for construction materials to be brought in by sea wherever possible	1
Economic impact	Sceptical about number of jobs likely to be created by the project	1

9.17 Airfield Tenants Meeting held on 15th June 2017;

- Wind flow assessment – some of the attendees aren't satisfied that the computer simulation represents reality and suggested that consideration is given to wind tunnel modelling to validate the computer simulation. The wind tunnel modelling is currently being actioned.
- One tenant wasn't aware of the 2016 HAZID report being published. It was confirmed that this was available on the Fareham Borough Councils website with all the planning documentation.
- One tenant was not satisfied with Fareham Borough Council's handling of tenant's representation at the HAZID workshop. They stated that their concerns are set out in their letter of representation to the Planning Committee.
- The additional RFI screening mitigation explained which will ensure none of the nearby tenants or residents will be affected.
- Arcadis stated that the second phase HAZID report will be published in July 2017 after Fareham Borough Council and National Grid's review.

The attendees of this briefing included:

Name	Organisation
Mike Murray	Britten Norman
John Macleod	NATS
Ricky Basi	NATS
Cathy Hicks	RCA
Terry Coombs	Lee Flying Association
John Davies	Hampshire Aeroplane Club
Martin Heneghan	Portsmouth Naval Gliding Centre
Lloyd Brown	Portsmouth Naval Gliding Centre
Alan James	Universal Tool and Production

9.18 We are aware that the responses provided by National Grid to the comments provided above alleviated the concerns that were raised and where further verification or explanation was required it was provided or notification was given for how and when it would be given.

9.19 Forums provide an important opportunity for stakeholders to ask questions, raise concerns and have their comments heard by those undertaking the proposed development. It also gives the developers an opportunity to listen, respond and action where necessary, with the aim to alleviate the issues raised.

Cable Validation Briefing and Tests

9.20 A significant area of concern, particularly for existing tenants and users of the airfield in addition to the safety of the community which live around the airport, is the effect of the cables on the functionality of the runway and aircraft that use it. To be specific, to measure and assess any electromagnetic interference that could disturb aircraft instrumentation, compass deviation or general negative impact on sensitive equipment.

9.21 The continued use and operation of the airfield is paramount. The planning conditions associated with the IFA2 facility sets out design limitations on the taxiway, which provide some user confidence that the functionality of the runway will not be affected. However to demonstrate this and provide absolute user confidence and transparency, a Cable Validation Test Briefing and subsequent tests were arranged, and users and tenants of the Airport were invited to attend. The briefing was held on Thursday 10th August at Fareham Innovation Centre with subsequent tests at a number of locations held throughout August and September. A copy of the letter and briefing note can be found in Appendix 2.

9.22 The briefing explained the planning conditions, the cable design and depth being laid, the method of calculating the EMF's from the cables, how the screening would affect the readings, the background implication of the earth's natural magnetic field and the equipment which was to be used to perform the tests. National Grid also described in detail the rationale and transparency of how the tests were to be conducted. This included 3 distinct tests:

- Existing Cables; this formal laboratory test was conducted on existing cables within National Grid's ownership. The aim was to replicate and demonstrate the accuracy of the calculations used to measure the EMF theory work.

- Prysmian Laboratory; the aim of this assessment was to test the cables in the IFA2 geometry. We attended the briefing and ground test held at Prysmian Cables & Systems facility at Chickenhall Lane, Eastleigh on Friday 8th September 2017 and the tests conducted demonstrated that when the cables were laid out in the proposed configuration on the surface that the calculations that have been theoretically modelled do comply with the EMF thresholds stipulated in the planning conditions.
- Daedalus Site; this practical test used buried cables on the subject site at the proposed depth and layout formation. This was held on 17th October 2017 and witnessed by various parties including independent companies and prospective users of the airfield who participated in the practical test and taxied aircraft over the cable (results detailed in Technical Note IFA2/IJV/CAB?TTR/0003 National Grid Nov 2107 see Appendix 3).

9.23 The purpose of conducting all these tests was to provide assurance to those with an interest in Solent Airport, that the cables used for IFA2 will comply with the planning conditions on EMFs and will not impact negatively on the operation of the airfield. The continued functionality of the runway is vital therefore the completion of these the tests and the availability of the results has provided reassurance and eliminated the concerns raised.

Primary Data

9.24 LSH have been formally marketing the site since December 2016 and as sole agents for the site, we have first-hand experience of occupier feedback and comments regarding Daedalus as a location for businesses.

9.25 Our experience to date has shown that enquiries we have received for occupiers seeking space of this type and in this location have rarely mentioned nor adversely commented on the proposed IFA2 facility.

9.26 Our marketing campaign to date which effectively commenced in December 2016 has generated a healthy level of interest – detailed below is a record of the number and type of occupiers that have enquired about the commercial offering at Daedalus. In addition, we have identified the competing opportunities these occupiers may have contemplated as an alternative location and also noted the aspects of the site that make the plots particularly appealing to occupiers.

Faraday Business Park Enquiries (Non Airside)

Number of Enquiries: 56

Type of Occupiers: Aviation, Marine, Advanced Engineering / Engineering, Open Storage, Construction Companies (mainly local based companies).

Local Competition Availability: Daedalus Park, Fareham Reach, Second Hand Industrial in Quay Lane (Gosport) No freehold plots available in local area other than Faraday.

Attraction to Faraday Business Park: Plots available on a virtual freehold, Opportunities for companies to Design and Build, Business Rate Relief, Outline consent for B1/B2/B8, competitive prices.

Hangars and Airside Plots Enquiries

Number of Enquiries: 28

Type of Occupiers: Aviation based, Flying Clubs, Existing Occupiers, Private Owners

Local Competition: Limited, but we have interested parties based at Bournemouth, Goodwood, Airbourne Aviation, Lasham and other airfields

Attraction: Business Rate Relief, new build hangers available for letting, Competitive landing charges, proximity to motorway network, competitive prices.

Roadside Plots

Number of Enquiries: 27

Type of Occupiers: Car dealerships, care homes, coffee Shops, childcare facilities, fast food companies, animal kennels/catteries, vets, hotel.

Local Competition: No freehold plots available apart from Daedalus.

Attraction to Daedalus Plots: Road frontage, catchment, availability.

Swordfish Business Park – not yet fully exposed to the market as the necessary infrastructure works prior to the development being delivered will commence during 2018.

9.27 Occupiers who have enquired about taking space in this location have discussed items such as the location and distance from the M27 and motorway networks and rush hour traffic on Newgate Lane and Stubbington Lane. The ongoing and future planned improvements to the local road network are intended to improve capacity and enhance the accessibility of the location – this may begin to counteract a common perception that Daedalus suffers from daytime traffic congestion (in reality it affects rush hour predominantly as indeed do many business park locations along the Solent corridor).

9.28 We have also encountered queries from occupiers that there is a restriction on the types of use permitted at Daedalus, that the plots are only allowed to be occupied by marine, aviation or advanced engineering businesses. Also the limited period to benefit from business rate relief as expiry of this may finish in March 2018, occupiers are now realising that there is inadequate time for them to build and take occupation prior to this date to benefit from the relief. Other queries have included timing to delivery, remediation and environmental requirements, operational restrictions such as hours of use, quoting terms to purchase land or rent units, electricity capacity etc

9.29 Whilst new occupiers have referred to the issues above, there have been to date no enquiries received that have explicitly raised the proposed interconnector facility at Daedalus as an influencing factor, in neither a neutral or negative sense.

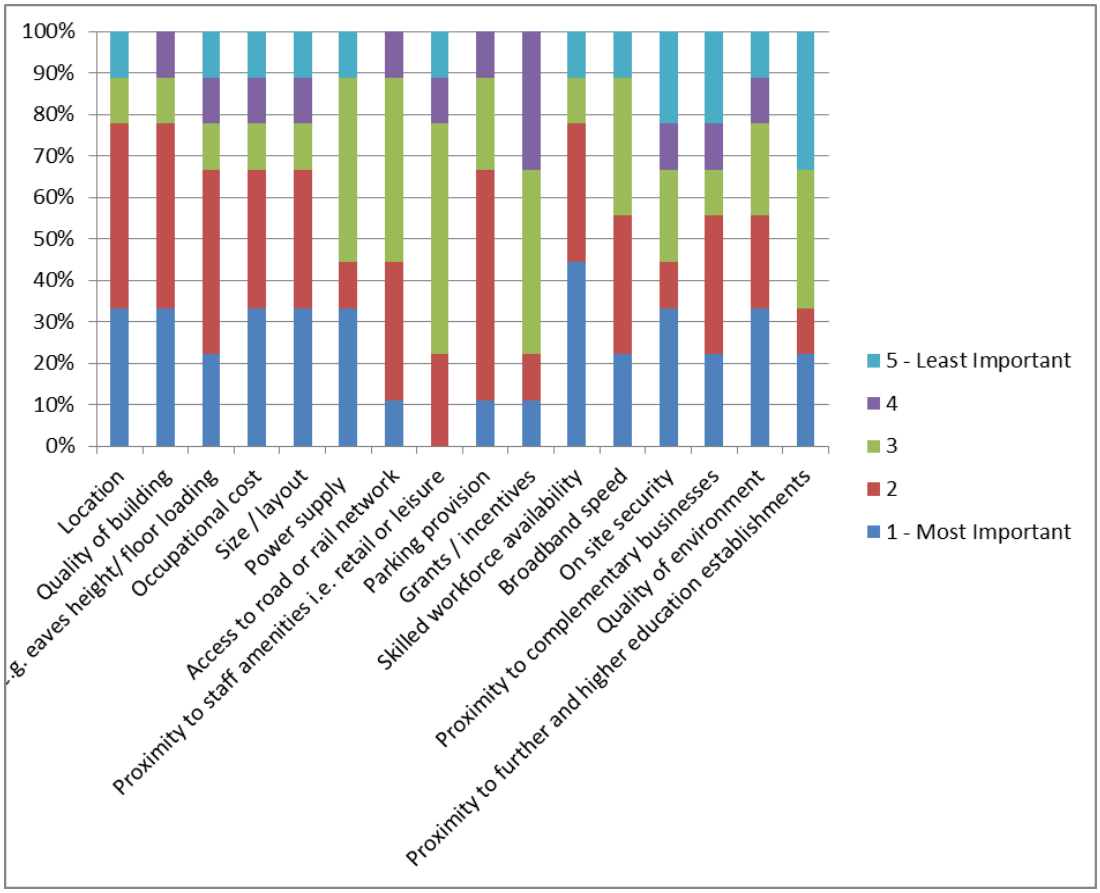
9.30 With various transactions in solicitor's hands and a number of active enquiries being pursued, the anecdotal evidence we have received indicates that the IFA2 facility is currently not a major contributory factor to occupiers when considering this site as a suitable location for their business operation.

Questionnaire Results

9.31 20% of the companies who responded have internal procedures which require scientific studies to be undertaken before locating the business to ensure the working environment is acceptable in all respects – regardless of where the proposed site is.

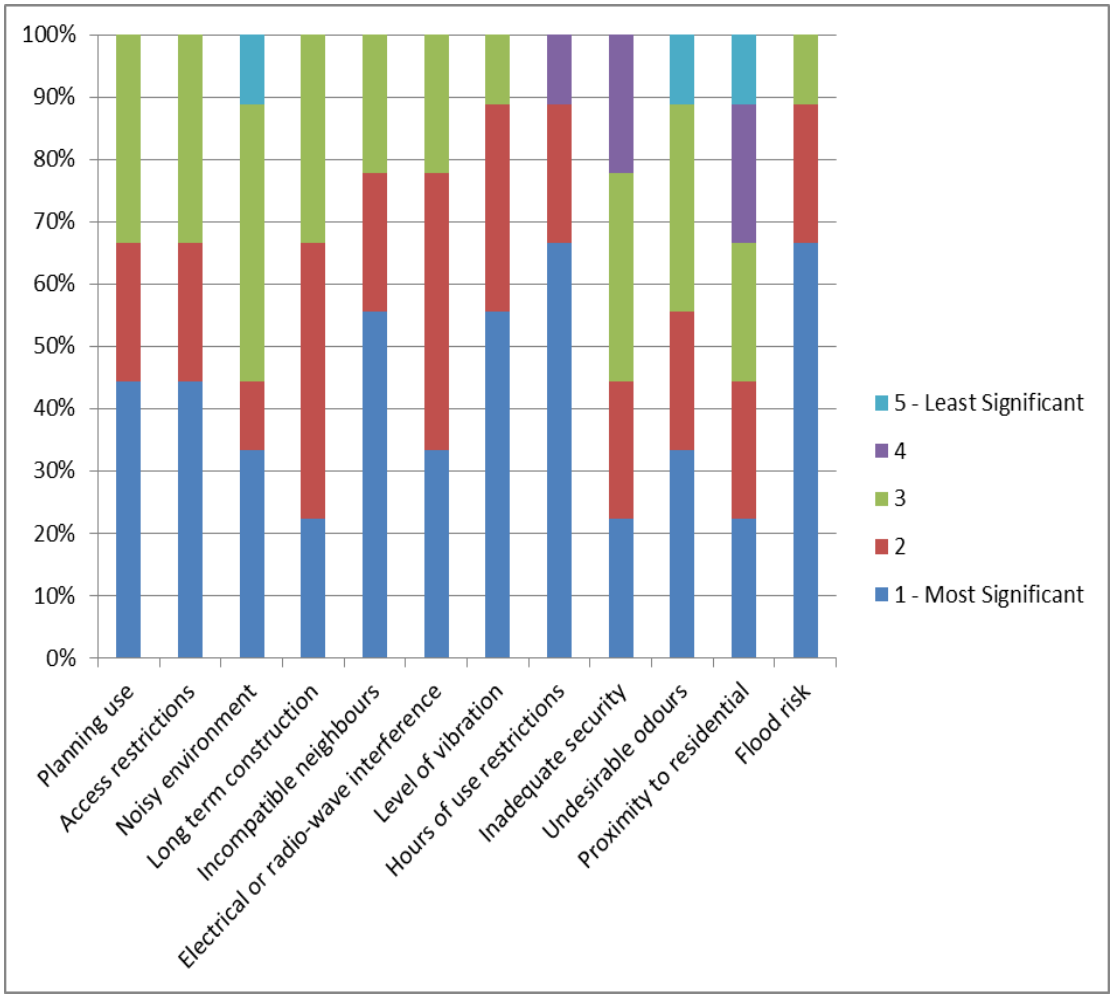
9.32 Some 22% of the businesses indicated they would make use of or would need to have access to an operational airfield.

9.33 The table below indicates the ranking of each of the search determinants in terms of importance. Whilst there is disparity across the various factors there are some patterns that have emerged. Search determinants that are particularly high scoring when considering a site included; the availability of a skilled workforce, location, quality of building, occupational cost size layout and power supply. Less important search determinants include proximity to further and higher education establishments, on site security and proximity to like-minded businesses.



9.34 The table below indicates the ranking of each of the factors that would reduce the appeal of a particular site/premises in terms of significance. Whilst there is no describable pattern across the various factors, there are some trends that have emerged. The factors that would significantly reduce the appeal of a site include; hours of use restrictions, flood risk, unacceptable level of vibration and incompatible neighbours. With less significant factors including noise, undesirable odours and to close proximity to residential.

9.35 Search determinants will vary from business to business with various elements and factors influencing a decision on where a company should establish itself. Each site has also has its own constraints and benefits.



9.36 74% of the companies that responded were aware of the Daedalus Solent Enterprise Zone and the commercial opportunities available there.

9.37 Some 60% of the companies stated they would consider it as a suitable location for their business (either as a total relocation or as an additional facility). Those that did not deem it as suitable included reasons such as; the poor accessibility and road links, the type and size of buildings immediately available and also to have either sufficient expansion space on their existing site or to have recently relocated.

9.38 64% of companies directly stated that the prospect of being located within close proximity to an energy convertor station or more specifically the IFA2 facility at Daedalus would not be of concern to them or the business.

9.39 Out of the remaining 38% of respondents, half of those indicated that if it was demonstrated that there were no material implications to health, noise or electromagnetic interference that this would provide them with an adequate assurance that the site was a viable option for their business. A further 10% of all respondents agreed that the strict planning conditions and studies that have been conducted show that proximity to a facility of this nature will not have a detrimental impact on neighbouring occupiers, and therefore would be reassured by these measures.

9.40 The strict planning obligations provided in section 4.23 - 4.35 set restrictive parameters that must be fulfilled as part of the development of the IFA2 facility to ensure its impact on the functionality and performance as an airfield, as a commercial development site and the effect of the facility on its neighbours is minimised. Our results demonstrate that this to a large degree helps provide the necessary reassurance that occupiers are seeking when considering the impact of being within close proximity to a facility such as the proposed IFA2.

9.41 The remaining 9% in answering question 12 said that they would want to undertake their own investigation and surveillance to satisfy themselves that the location was acceptable in terms of electromagnetic and radio frequency interference.

9.42 Interestingly 20% of those who responded indicated that if there was a perceived risk of electromagnetic or radio-frequency interference, that they would consider disregarding the location, whilst the remainder would undertake further investigation. The responses provided to this question in the context of the other questions asked, quite clearly demonstrate the

power of perception and the importance of relevant data and accurate information being communicated at all levels e.g by the media, marketing agents, planning officers etc.

9.43 One of the respondents to the questionnaire was an established aviation company who operate precise technical equipment and sensitive machinery who have recently relocated to Daedalus to a new facility of some 2230 sq m. They have confirmed that they were fully aware of the proposed IFA2 facility prior to committing to the building and stated that the proximity of the proposed converter facility was not of material concern to them.

10.0 CONCLUSIONS

10.1 The proposed energy converter has not prevented engineering sector occupiers such as Proptech Ltd and Universal Tool Production Ltd, from taking permanent occupation within the Business Park and have confirmed they had prior knowledge of the IFA2 interconnector project.

10.2 Our marketing experience to date has revealed no resistance from occupiers in acquiring business space at Daedalus as a result of the IFA2 development. The total number of interested parties we have discussed the opportunity with is circa 110.

10.3 We are satisfied that the nature of their use and the profile of companies we approached to complete the questionnaire was compatible and typical of the type of occupier we would wish to attract to Daedalus.

10.4 We have conducted a robust and unambiguous questionnaire to illicit open and direct responses from consultees.

10.5 Our primary data results were virtually unanimous - that once the scientific/technical investigative studies were examined and understood, the companies consulted said that any perceived risk (92%) would have been assessed and dismissed.

10.6 74% of respondents were aware of the IFA2 proposals and were undeterred at the prospect of locating on the adjoining Business Park.

10.7 In terms of the search criteria the companies we approached, (those were considered of most importance and those being of least concern), the results were somewhat predictable with the location, quality of building and proximity to a skilled workforce being essential factors and

surprisingly, broadband speed, availability of power supply and grants/incentives were regarded of lesser relevance to their decision making. We suggest this assessment is partly distorted by the size of company that responded to our survey, as the more established businesses would anticipate and accept that such a move would encounter a large capital expenditure in fitting out the site/building to meet their operational needs.

10.8 We analysed the specific responses to the questions relating to 'would being in close proximity to an emergency converter station or case in point the IFA2 facility at Daedalus, be of concern' and applied the qualifications to this question, the findings were:

No concern whatsoever	64%
If demonstrated that no health, noise or EMF interference was present, this would remove any concerns	18%
If the planning conditions were complied with and the technical studies showed no material detrimental impact, then they would be reassured.	10%
They would wish to undertake their own scientific investigation and due diligence to satisfy themselves	8%

10.9 The construction methodology was not available at the time of producing our report therefore the extent of its impact is difficult to comment on. We believe that whilst construction of the converter facility is taking place, it will have some impact on the commercial appeal of Daedalus; however potential occupiers will expect and anticipate some construction taking place, within the immediate vicinity, given its design and build commercial offering.

10.10 Our study and consultation has identified the negative impact perceived risks could have on potential occupiers and tenants, therefore we recommend that accurate, factual information is communicated through clear channels and is available for all potential occupiers and businesses that would, have or are considering Daedalus as a destination for their business.

10.11 We are aware that in order to address any particular concerns, questions or compatibility issues that are raised by future prospective occupiers of the Enterprise Zone, that National Grid will provide a financial contribution to the Council to provide a dedicated business development resource. This resource will promote the attractiveness of Daedalus as an employment destination, which could be secured through a Section 106 agreement and would equate to the appointment of a dedicated full time business development officer for a period of 4 years. This we believe will act as a crucial appointment in minimising and eliminating any concerns that may be raised by potential occupiers. Having a dedicated officer that has access to data, studies, tests, assessments and evidence that demonstrate the impact of the IFA2 on aviation, aerospace engineering and advanced manufacturing businesses would be essential in alleviating any occupier resistance.

APPENDIX 1
Questionnaire Covering Letter

1st June 2017

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Lambert Smith Hampton
3 Manor Court
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PO15 5TH

Our Ref: SM/RD/cc

Dear Sir or Madam,

We have been commissioned by National Grid and Fareham Borough Council to undertake an evidenced-based study and occupier consultation on the IFA2 Interconnector Facility proposed at Solent Airport and commercial development in the Solent Enterprise Zone.

IFA2 is a major electrical interconnector between the British and French transmission systems to supplement the UK domestic and commercial supply, and the proposed location of this facility is to the north of Faraday Business Park at Daedalus, Lee On Solent.

Please click here for further information and to watch a short clip outlining details of the proposed facility.

You may be aware that Solent Airport at Daedalus is a key employment site and it is fundamental to the future economic growth of the region. Therefore it is vital to understand whether the proposed implementation of IFA2 will in any way affect the decision-making of prospective occupiers.

The Solent Enterprise Zone has been identified as a strategic employment hub for aviation, hi-tech manufacturing and marine businesses, so we have focused our research on businesses within these sectors.

We have selected your company as part of our consultation process and would very much value your input. The information collated may be used in the study but the individual responses will not be personally attributable.

IFA2 is an incredibly important facility that will help to reduce the cost of electricity for homes and businesses in the UK and will help to enhance the security, affordability and sustainability of energy supplies in both countries. We are keen to listen to your views so that all the necessary measures can be taken to ensure that the IFA2 facility can co-exist comfortably with existing and future commercial occupiers.

We are therefore grateful for your time in assisting with our study. If you have any queries please contact Sarah Monk or Robin Dickens. Contact details are provided below.

Please return your completed questionnaire by Friday 16th June 2017.

Yours Sincerely

Sarah Monk
Senior Surveyor
DD: 02380 249 180
E: smonk@lsh.co.uk

Robin Dickens
Director
DD: 01489 579 579
E: rdickens@lsh.co.uk

Enc.

APPENDIX 2
Cable Validation Test Invitation and Briefing

Community Relations Team
FREEPOST reference RTRB-LUUJ-AGBY
(IFA2 interconnector)
c/o Newgate Communications,
Sky Light City Tower
50 Basinghall Street, London EC2V 5DE

Freephone: 0800 0194 576
www.ifa2interconnector.com

Robin Dickens
By email: RDickens@lsh.co.uk

4 August 2017

Dear Mr Dickens,

IFA2 – Cable Validation Tests

We will shortly carry out a series of tests on the cables we are proposing to use for IFA2 and specifically the electric and magnetic fields (EMFs) they will emit. I would like to invite you to a briefing to learn more about the tests.

Working alongside the contractors we have appointed to deliver the cable for IFA2, Prysmian, we will carry out validation tests on cables at a number of locations in August and September. The purpose of these tests will be to provide assurance to those with an interest in Solent Airport that the cables used for IFA2 will comply with the planning conditions on EMFs and will not impact negatively on the operation of the airfield.

We recognise that these tests are likely to interest users and tenants of Solent Airport, as well as the community which lives around the Airport. We are therefore holding a briefing session to provide more information about the tests. At the session, we will talk about what tests we are carrying out and how, the way we will present the results, and when and where we will conduct the tests. We will be very happy to answer any questions you may have relating to the validity of the tests or our ability to meet the planning conditions.

A briefing for users and tenants of the Airport will take place from **1430-1630** on **Thursday 10 August 2017** at the **Fareham Innovation Centre, Merlin House, 4 Meteor Way, Fareham, Lee-on-the-Solent PO13 9FU**. Please note that we will only be able to accept one representative from each organisation at the briefing.

We would also welcome observers from local organisations at the tests. We will be able to discuss this possibility in more detail at the briefing session.

We hope to see you at the briefing and would be grateful if you could confirm your attendance. If you would like to attend or have any questions in the meantime, please contact us on 0800 0194 576 or info@ifa2interconnector.com.

Yours sincerely,

David Luetchford
National Grid IFA2

IFA2

Interconnexion France-Angleterre

IFA2

Briefing on Cable Validation Tests
August 2017

National Grid IFA2 Ltd will shortly carry out a series of tests on the cables we are proposing to use for IFA2 and specifically the electric and magnetic fields (EMFs) they will emit. The purpose of these tests will be to provide assurance to those with an interest in Solent Airport that the cables used for IFA2 will comply with the planning conditions on EMFs, thus ensuring that they will not impact negatively on the operation of the airfield. This briefing sets out more details about the tests we will carry out.

Cables and EMFs

IFA2 will use two types of cable: Alternating Current (AC) and Direct Current (DC). These will emit EMFs in different ways.

Current in the **AC cables** will periodically reverse direction with a frequency of 50 Hz. The Earth has no natural AC field, so the only magnetic field in this case will be that generated by the cables.

Current from the **DC cables** will flow in the same constant direction. This adds to the Earth's natural magnetic field, meaning magnetic fields from the DC cables have the potential to interfere with magnetic compasses.

The planning conditions we have to meet

In April 2017, Fareham Borough Council granted planning permission in full for the cables we propose to use for IFA2. This permission is conditional on IFA2 meeting conditions on the level of magnetic fields at Daedalus Airfield. These require that, at the locations where the cables cross the taxiways:

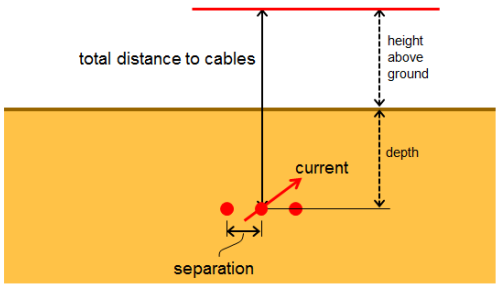
- For the AC cable, the EMF should be no more than 10 µT at ground level
- For the DC cable, the EMF should be no more than 10 µT at 1.5m above ground level
- Magnetic compass interference should be no more than 1° beyond 12 m from cable at 1.5 m above ground level

These conditions set significantly lower limits than those set by the Government for normal public exposure to EMF. We have designed the cables proposed for IFA2 to meet these conditions.

How we calculate a field from a cable

There are three factors which determine the strength of an EMF from a cable:

- **The total distance to the cables:** the further from the cable, the lower the EMF.
- **The separation between cables:** the lower the separation between cables, the lower the EMF
- **Current:** the flow of electric charge through the cable



This limited number of factors makes it relatively simple to calculate EMFs: measuring each of these factors makes it possible to calculate the magnetic field at any given point.

The tests we propose

Our tests are designed to generate confidence that we will meet the planning conditions set for EMFs. We are therefore carrying out a series of tests to show that each part of the way we calculate EMFs is effective. These are planned to take place in August and September this year.

We will first carry out tests on existing National Grid AC and DC cables, to provide assurance that the calculations work for cables in general. The current plan is to carry out tests on AC cables at Chilling in Hampshire and the Goring Gap in Oxfordshire, and on DC cables at Bakers Gap and the Isle of Grain, both in Kent. We chose these test locations taking into account their accessibility, suitability for carrying out tests, and whether they would produce clear and transparent results. If any of these sites prove unsuitable, other options will be considered.

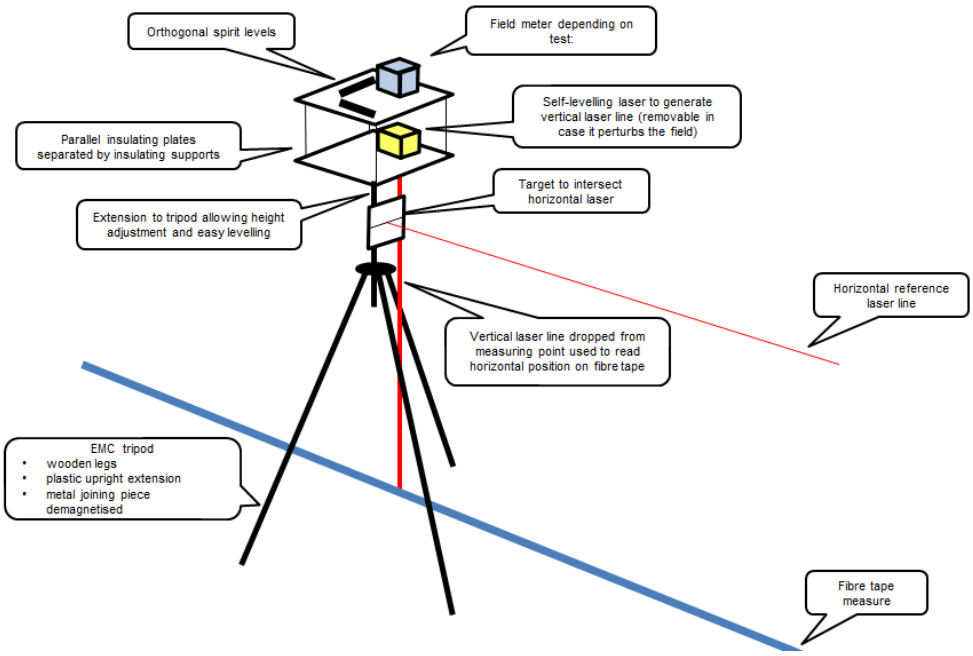
We will then carry out a test at a facility operated by the manufacturer, Prysmian, at Bishopstoke in Hampshire. This will involve laying out the IFA2 cables in the proposed configuration on the surface, and is designed to provide assurance that the calculations will work for the IFA2 layout.

Finally, we will test a length of cable buried at the proposed depth and with the proposed configuration at Daedalus. This is designed to replicate the circumstances proposed for IFA2, and to provide assurance that the calculations work for the installation itself.

How we will carry out the tests

The tests will involve calculating what we expect the EMF to be based on distance from the cables, separation between the cables, and current, and then comparing this with figures obtained through measurement of both AC and DC fields. This will help show how accurate the calculations are compared to measurement.

We need to carry out measurements above the cable, and along a reference line perpendicular to the cable. We will create this reference line by stretching a wire tight between tent pegs, with a similar reference line created at 1.5m above ground level using tripods and a laser. We will then carry out the measurements at ground level, and at 1.5m above ground level using a tripod – as shown in the diagram below.



We will use specialist instruments to take the measurements. For the AC measurements, we will use a handheld **Emdex II** device, while for the DC measurements, we will use a **Bartington MAG01H** device. Each has been calibrated ahead of the tests to ensure maximum accuracy. To assess effects on compasses, we will use a **M73 military prismatic sighting compass.** This is designed to NATO specifications, and is accurate to 0.5°.

There are a number of variables we need to consider when carrying out the measurements:

- **Location and configuration:** In practice, we know the configuration of cables well and this is unlikely to be a limit on the accuracy of tests.
- **Load:** This can present a challenge with existing cables, as the information National Grid holds on this is primarily for day-to-day management of the system and is not designed to be precise. However, we will know the load exactly for the tests at the Prysmian facility and Daedalus.
- **Measurements:** We must understand the accuracy of the instruments we are using to take measurements.
- **Perturbations:** Certain elements, such as iron reinforcing bars in concrete, can have an impact on EMF measurements. We need to be aware of these and what their impact might be on the measurement. As we will be laying the cable for the Daedalus test ourselves, this will not apply here.

We will consider each of these factors in designing our tests and assessing the results.

Transparency and reporting

The purpose of these tests is to generate confidence in our calculations on EMFs, and we are therefore committed to being open and transparent in the way we carry them out. Once we have carried out the tests, we will publish the results on our website.

We will also welcome observers from local councils, residents groups and Solent Airport to our tests. The observers will be able to view the tests and the equipment we use, check our calculations and take measurements themselves.

Further information

For further information, please contact us on 0800 0194 876 or info@ifa2interconnector.com.

APPENDIX 3
IFA2 - Cable EMF Trials Report

nationalgrid

IFA2

Technical Note: Tests to verify ability to comply with planning conditions on Electric and Magnetic Fields for IFA2 Cables at Daedalus Airfield

IFA2-IJV-CAB-TTR-0003

November 2017

1 Executive Summary

1.1 Overview

1.1.1 The IFA2 England-France electricity interconnection will involve installing underground cables, both alternating current (AC) and direct current (DC), across Daedalus Airfield, to the side of the runway but crossing the taxiways. There has been understandable concern that the magnetic fields produced by these cables could interfere with aircraft and hence jeopardise the future safe operation of the airfield.

1.1.2 This concern has been addressed by including within the planning permission granted by Fareham Borough Council (FBC) constraints on the maximum permissible field to be produced by the cables where they cross airfield taxiways. There are three constraints, set out in Planning Condition 48: on the maximum AC magnetic field, on the maximum DC field, and on the deviation caused to magnetic compasses.

1.1.3 Before commencing construction, IFA2 will provide to FBC the detailed layout of the proposed cables, together with evidence that this layout will comply with the planning conditions. The evidence regarding the field levels will be largely based on calculations.

1.1.4 The purpose of the exercise reported in this Report is to provide all parties involved with sufficient confidence that these calculations do indeed correctly predict the fields and compass deviation produced by a cable, and therefore that it will be appropriate for FBC to accept such calculations as sufficient evidence that the proposed cable layout will comply with the planning conditions.

1.1.5 The measurements reported here were in three phases.

- First, measurements were performed on a number of existing National Grid cables with a range of geometries. This verifies the basic concept that calculations do reproduce the fields that are actually present for underground cables.
- Second, measurements were performed on samples of the proposed IFA2 cable geometries laid out and energised at ground level at the Prysmian test facility in Bishopstoke. This verifies that the calculations work for the actual cable geometry in question, but does not test at the actual burial depth.
- Third, measurements were performed on samples of the proposed IFA2 cables buried at the approximate final depth on Daedalus airfield. This verifies the calculations for as close to the actual final layout as possible.

1.1.6 IFA2 is likely to include screening of the magnetic fields where the cables cross the taxiways, partly to ensure that the planning conditions are met by a comfortable margin. None of the existing National Grid cables have any screening of the magnetic field. The test at Prysmian included both screened and unscreened cables. The test at Daedalus was of the screened solution.

1.1.7 The measurements were designed to be as transparent as possible, so as to provide the maximum assurance to stakeholders as to the conclusions.

Stakeholders were invited to witness the majority of these tests, including specifically the tests at Prysmian and Daedalus. When witnessing tests, stakeholders were able to take the measurements for themselves, either using National Grid's calibrated instruments or, if they wished, instruments of their own. Annex F to this Report reproduces the raw data collected in every test conducted (including, for the sake of transparency, some tests that turned out not to be very informative), so that, in principle, stakeholders can also reproduce or check the calculations for themselves, independently of National Grid.

1.1.8 The tests at Daedalus also involved taxying various aircraft over the energised cables, to demonstrate that the maximum fields the cables could produce do not interfere with aircraft systems, or, put another way, to give confidence that the planning conditions are indeed set at an appropriate level. These tests (which, as expected, identified minor compass deviations but none of which detected any other interference) are reported separately in IFA2-IJV-CAB-TTR-0004.

1.2 Conclusions on calculations of fields

1.2.1 Calculations of AC and DC magnetic fields and of compass deviation do indeed predict the actual fields that are produced with considerable accuracy.

1.2.2 The limit of accuracy of the calculation is determined by the limit of accuracy of the input parameters. For existing cables, the accuracy with which the current is known can be a limiting factor on the accuracy of the calculation. For cables such as the IFA2 cables, where the current is known to greater accuracy, the limit on the accuracy of the calculation is determined by the accuracy with which the positions of the conductors under the ground are known.

1.2.3 IFA2 will be designed with a specified depth of burial such that, even allowing for the conductors not necessarily ending up in the exact theoretical positions, the fields produced are still compliant with the planning conditions.

1.3 Conclusions on screening

1.3.1 AC screening of the type and specific design proposed ("passive loop screening") reduces the magnetic fields by a factor of about two.

1.3.2 DC screening of the type proposed (a ferromagnetic screening tube) reduces the magnetic fields and the compass deviation by a factor that, in these tests, varied with the material properties but was always at least a factor of two and often rather more.

1.3.3 For the final IFA2 cables, the screening material for the DC screening will have been developed further, and it is anticipated that the screening factor will be greater than was observed in these tests; but, regardless, it will certainly not be any poorer.

1.4 Overall conclusion

1.4.1 IFA2 will submit the proposed final design for the IFA2 cables to Fareham Borough Council, along with calculations of the magnetic field that will be produced.

1.4.2 The measurement programme reported here provides all stakeholders with confidence that those calculations will be sufficiently accurate (taking account of all uncertainties) and reliable to provide the necessary assurance that the cables will comply with the relevant planning conditions.

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2 Introduction

2.1.1 IFA2 has been granted planning permission to install electricity cables across Daedalus Airfield. These electricity cables produce magnetic fields, and there is concern that these magnetic fields could interfere with aircraft operations. To limit any interference to acceptable levels that do not jeopardise the safe operation of aircraft, the equipment carried by aircraft, or airfield operations, strict limits on the levels of magnetic fields that will be produced, considerably more onerous than would normally be applied, have been agreed. These limits are given force as planning conditions attached to the planning permission granted for the cables by Fareham Borough Council.

2.1.2 IFA2 will design the cables so as to ensure that they comply with these planning conditions. This will be demonstrated in advance by means of calculations of the fields to be produced, and verified after installation and energisation by direct measurement.

2.1.3 To provide confidence to all stakeholders that the calculations do indeed yield the correct results for the fields produced by cables, and therefore that it is appropriate for IFA2 to proceed with the installation of the cables, IFA2 has performed a series of tests to demonstrate the agreement between calculated and measured fields. These tests were performed in three stages:

- **Seven tests on five existing National Grid cables**. These are designed to validate the general principle that the calculations are capable of predicting measured fields in a range of circumstances.
- **A test on the design of cables proposed for Daedalus**, conducted on samples of these cables laid out at ground level at Prysmian's test facility at Bishopstoke (Prysmian are the cable manufacturer). These are designed to validate that the calculations predict the correct field for the design of cables proposed for Daedalus, but do not reproduce the correct depth of burial, as the cables are laid on the surface.
- **A test on a length of the cables buried in the proposed configuration on Daedalus**. These are designed to validate calculations of field for the full geometry of the actual cables, including the approximate depth of burial.

2.1.4 The tests at Prysmian and Daedalus also included screening of the fields.

2.1.5 The test at Daedalus also involved taxying various aircraft over the cables, to check directly that the fields produced do not interfere with aircraft systems. These tests are reported separately.

2.1.6 These tests at Prysmian and Daedalus were conducted at the maximum load the IFA2 cables are intended to be rated at (800 A for AC and 1630 A for DC), thereby simulating the maximum field that could be produced by the final cables. The voltage for these tests was, of course, much lower than the voltage for the final IFA2 cables (the voltage needed to be sufficient just to drive the current through the test loop with no load, as opposed to driving the current across the English Channel and supplying load at the far end). However, the voltage makes no difference to the magnetic field, which is determined solely by the

current. Thus, by using the same maximum current as the IFA2 cables, these tests produce the same maximum magnetic field.

3 The planning conditions

3.1.1 On 10 April 2017, Fareham Borough Council granted planning permission in full for the cables it is proposed to use for IFA2 (Application P/16/0557/OA). This permission is conditional on IFA2 meeting conditions on the level of magnetic fields at Daedalus Airfield (Planning Condition 48). These require that, at the locations where the cables cross the taxiways:

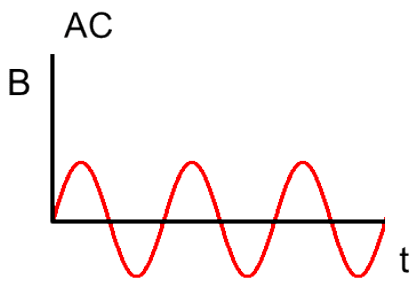
- **For the AC cable**, the EMF should be no more than 10 μT at ground level.
- **For the DC cable**, the EMF should be no more than 10 μT at 1.5 m above ground level.
- **Magnetic compass interference** should be no more than 1° beyond 12 m from cable at 1.5 m above ground level.

3.1.2 These conditions set significantly lower limits than those set by the Government for normal public exposure to EMF. IFA2 has designed the cables that are proposed for IFA2 so as to meet these conditions.

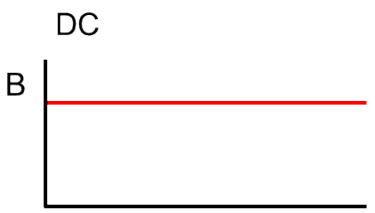
4 Electric and magnetic fields from electricity cables

4.1.1 IFA2 will use two types of cable: Alternating Current (AC) and Direct Current (DC). Neither emit electric fields, because the metal screen ensures the electric field is entirely confined within the cable. They do emit magnetic fields, in different ways. (In the graphs here and subsequently, magnetic field is often denoted by "B", which is the conventional abbreviation in electrical engineering.)

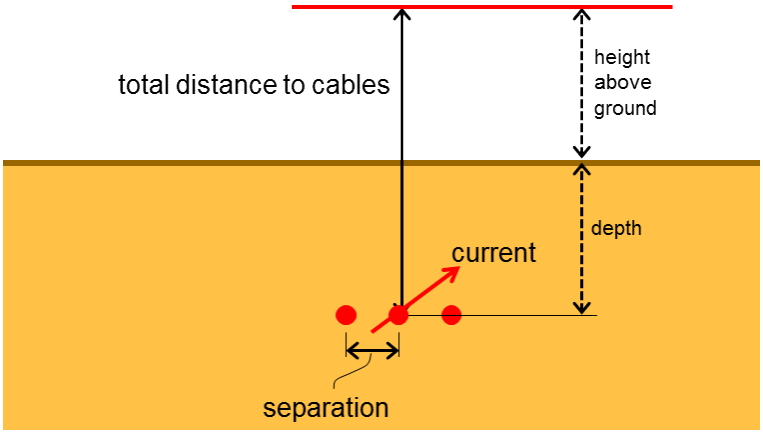
4.1.2 Current in the **AC cables** will periodically reverse direction with a frequency of 50 Hz. The Earth has no natural AC field, so the only magnetic field in this case will be that generated by the cables.



4.1.3 Current from the **DC cables** will flow in the same constant direction. This adds to the Earth's natural magnetic field, meaning magnetic fields from the DC cables have the potential to interfere with magnetic compasses.

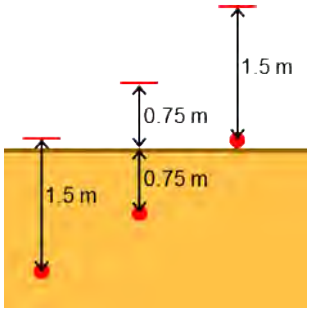


4.1.4 There are three factors which determine the strength of a magnetic field from a cable:



- **The total distance to the cables:** the further from the cable, the lower the magnetic field.
- **The separation between cables:** the lower the separation between cables, the lower the magnetic field.
- **Current:** the flow of electric charge through the cable

4.1.5 Note that the relevant parameter is the total separation from the point of interest to the cables. Magnetic fields are essentially unaffected by soil (or by any other non-magnetic material). This means that it does not matter how much of that total distance is soil (the depth of the cables below the ground) and how much is air (the height of the measurement above ground). The three scenarios in the diagram all produce the same magnetic field.



4.1.6 This limited number of factors makes it relatively simple to calculate EMFs: measuring each of these factors makes it possible to calculate the magnetic field at any given point.

4.1.7 It is important to understand that, if these input parameters are known with complete accuracy, then the field can be calculated with complete accuracy. This makes the calculation of magnetic fields different from modelling some other environmental phenomena. If, for example, we model pollution, we probably have to make all sorts of assumptions and simplifications about how the source produces it, how it disperses, how it is blown in the wind, etc, and we accept that the resulting model is likely to be only approximate. For magnetic

fields, by contrast, there are no approximations in the calculation process, and no extra uncertainties introduced by the calculations. The resulting answer is as exact as the input parameters are exact.

4.1.8 Therefore, the accuracy with which the field can be predicted depends on the accuracy with which the input parameters – distance to cables, separation of cables, and current – are known.

4.1.9 As will be seen from the measurements reported here, when we are dealing with existing cables, some of these parameters have marked uncertainties. The cable records compiled when the cable was installed 40 years ago, for example, indicate the depth of burial, but there may be uncertainty as to whether the local ground level has changed subsequently. Measurements of currents on existing circuits are not designed to be high precision and introduce uncertainties, particularly, as will be explained further below, when the currents are low.

4.1.10 When it comes to the IFA2 cables across Daedalus, however, these parameters are far more in the control of IFA2. The ground level, for instance, is defined by the taxiway surface. IFA2 can require its contractors to bury the cables to a specified depth with a specified degree of accuracy. The maximum current that can be carried is likewise under the control of IFA2. So, for the cables across Daedalus, all parties can have much greater confidence in the accuracy of the calculations.

4.1.11 There will, of course, still be some residual uncertainties, for example in the depth of burial. It is then the responsibility of IFA2 to design the cables such that in the worst case, where the uncertainties accumulate in the worst direction, the field that the cables produce is still compliant with the planning conditions.

4.1.12 For DC cables, the magnetic field produced by the cable adds on to the existing geomagnetic field. A DC field meter measures the total field at a point, that is, the sum of these two fields. As it is, obviously, not possible to turn off the geomagnetic field, it is never possible to measure just the field from the cable alone. The measurements are of the total field, and therefore it is the total field that is calculated for comparison to the measurements. When we talk about “measuring the field from the cable”, we usually mean “measuring the difference that the field from the cable makes to the geomagnetic field”.

5 Overview of test procedure

5.1.1 The basic principle of the tests is:

- **Measure** the fields (or compass deviation) at relevant points above the cable;
- Obtain the relevant parameters and **calculate** the fields at the same points; and
- **Compare** calculated and measured to validate that calculations correctly predict the measured.

5.1.2 Strictly speaking, all that is necessary to verify the calculations is to compare calculated and measured at one point, the point that corresponds to the planning condition. However, it is a basic principle of experimental design that a test that gives the right answer at just one set of values of the input parameters is less persuasive than a test that still gives the right answers when each of the input parameters is varied. Thus, rather than just compare the calculated and measured fields at one point, comparisons were made along a line perpendicular to the cables (to test the validity across a range of distances and orientations relative to the cables), and, for the AC fields and for the same reason, at two heights. DC measurements were likewise performed along a line rather than just at a point, but only at one height, reflecting the greater time taken for these measurements, and the purely practical issue that compass bearings are less back-breaking when taken at something around natural standing height.

5.1.3 Measurements were performed with:

- A calibrated 3-axis AC field meter for the AC fields.
- A calibrated single-axis field meter, used to measure in three orthogonal directions, for the DC field.
- A military-standard NATO-specification prismatic sighting compass for the compass deviations.

5.1.4 The AC and DC field meters are calibrated to 5% accuracy or better. The compass is specified as providing accuracy to half a degree, and experience shows that two independent observers usually agree to within half a degree.

5.1.5 The measurements positions were laid out with various combinations of tape measures, laser pointers and spirit levels for accurate levelling and easy reading.

5.1.6 Full details of the measurements are given in Annex B.

5.1.7 For the existing National Grid cables, the parameters required for the calculations were obtained from various sources.

- **Cable location and direction** (necessary for compass deviation calculations) from Ordnance Survey mapping overlaid with National Grid electronic mapping data.
- **Cable geometries and nominal depths** from National Grid cable records, in some cases supplemented by on-site measurements.
- **Loads for AC cables** from monitoring performed routinely by National Grid System Operations.
- **Loads for DC cables** by phoning the relevant control room and asking for real-time readouts.

5.1.8 For the tests at Prysmian and Daedalus, the relevant parameters were all available directly on site.

5.1.9 The relevant detailed information for each test is set out in Annex F.

5.1.10 AC loads (and therefore AC fields) vary over time, and the first phase of these tests were performed "as found" on live operational circuits, with no ability to control the load. National Grid System Operations record loads at intervals down to a second. For the purposes of these tests, it was found to be accurate enough to obtain loads at five-minute intervals. Each of the tests of AC fields on existing cables had two circuits (or in one case, strictly speaking, two groups for the same circuit, which in electrical and magnetic-field terms amounts to the same thing). For each test, the measurements were performed in a sequence from one side of the first circuit to the far side of the second circuit. The time of the reading of the maximum field directly over each circuit in turn was noted, and the load data for the closest five-minute point used to calculate the fields over that circuit. Thus, each profile of calculated AC field comprises two separate profiles, one for each circuit.

5.1.11 The DC circuits tend to operate at a constant value (often at the rating), so there was no need to perform this stage of reconciling the time of the measurement to the load data for the DC tests.

5.1.12 The monitoring of loads is performed for operational control reasons and is not specified to be a high-precision measurement. There is an additional problem relating to the accuracy when the loads are low. This was flagged to stakeholders in advance as a likely problem. The detailed explanation requires a certain level of electrical engineering terminology and is therefore presented separately in Annex C. The effect of this is that when loads are high, the current measured at the two ends of a circuit should be very similar, with any small differences most likely reflecting the limitations on the accuracy of the measurement, and therefore it should not matter which end of the circuit is used for the load data, nor how far along the circuit between the two ends the measurement point is. When loads are low, however, the current measured at the two ends of the circuit will differ significantly. The current at any point along the circuit should lie between the values at the two ends, but it is beyond the scope of these tests to try to estimate what the actual current is at the point of the measurements.

5.1.13 Two of the AC tests were performed when loads were low enough for this to be significant. For these tests, the best that can be done is to present the calculations based on the loads at each of the two ends, knowing that the calculation at the point of interest should lie between them.

5.1.14 Once the cable parameters and the loads are obtained, the field (or compass deviation) can be calculated. As has been explained, these calculations are exact. It is not the case that the answer obtained will depend on the computational package used. Barring coding errors, any package will give the same answer (to within the rounding error of the computation, which is usually multiple decimal places), and coding errors can be eliminated by comparing different packages. The calculations used here were performed on purpose-written spreadsheets, as it was considered this provided the greatest

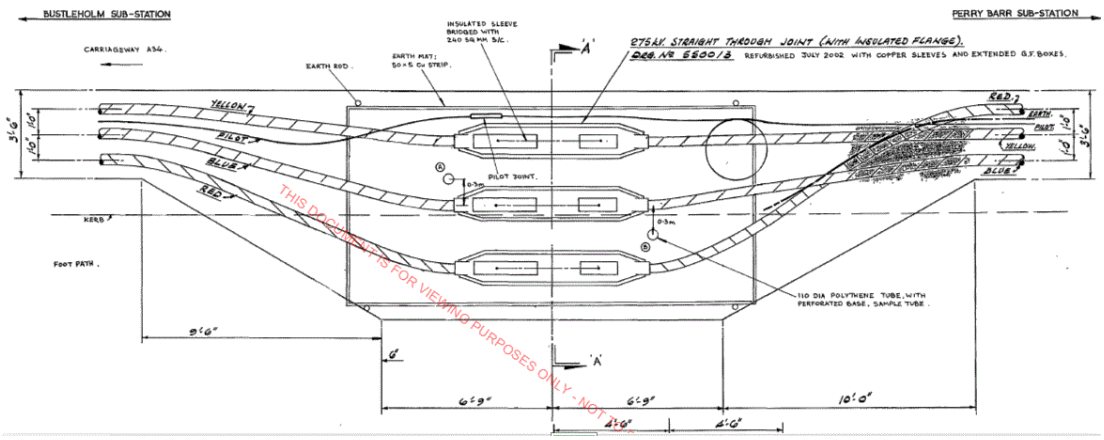
transparency. Details of these spreadsheets, and the other packages they were tested against, are provided in Annex B.

6 Schedule of tests conducted

6.1 Phase 1: tests on existing National Grid cables

6.1.1 For the tests on existing National Grid cables, the requirements for identifying suitable test sites were:

- **Long, straight length of cable** (because the calculation of fields from curved or angled cables, whilst still possible, is more complicated and therefore less transparent).
- Not near any **joints** (because the order of the conductors at a joint changes, as shown in the diagram, again making the calculation more complicated and less transparent).



- Reasonably **flat surrounding land** (because laying out the measurements and determining the height is much easier on flat ground).
- Not near **other sources of field** that would perturb the field from the cable.
- Cable **not switched out** for maintenance.
- (For DC) **closer to N-S than E-W** (because compass deviation is usually a maximum for north-south cables, and zero for east-west cables).
- **Access arrangements** feasible (because most National Grid cables are on private land and can be accessed only with the permission of the landowner).
- In the **south** of the country (for ease of travel).

6.1.2 A shortlist of two locations for DC cables and four for AC was identified that met these criteria:

6.1.3 One, Ross on Wye, was visited but ruled out on grounds of being too hilly to allow easy laying-out of the required measurements.

6.1.4 All the remaining sites were visited and tests performed. At one site, Chilling, three visits were made, as this was the site where the measurement technique was developed. Thus, in total, two DC tests at two sites, and five AC tests at three sites, were performed. This is more than the initially stated proposal for four tests, two each for AC and DC. This report includes details of all tests to avoid any suspicion of cherry-picking or of suppressing inconvenient results. However, one of the tests at Chilling and the test at Perry Park fell foul of the problem relating to low loads described above, and do not actually constitute informative tests.

6.1.5 Details of all sites and tests are given in Annex F. Sufficient detail is given for any interested party to recreate the calculation for themselves and to compare to the measurements. It is recognised that, in practice, it is unlikely that anyone would seek to do this, but it is considered important for the transparency and integrity of the process that IFA2 provides all the relevant information, so that, in principle, stakeholders are not dependent on National Grid's own calculations.

6.2 Phase 1: AC tests

Chilling

6.2.1 Measurements performed by National Grid staff whilst developing and testing the techniques on 12 June and 18 July 2017. A third set of measurements performed by National Grid staff and witnessed by stakeholders on 16 August 2017.

6.2.2 The third set of measurements was performed at a time when the loads were too low for the test to be particularly informative, but, as explained above, the results are included nonetheless in the interests of transparency.

Goring Gap

6.2.3 Measurements performed by National Grid staff on 14 August 2017. As was explained to stakeholders in advance, observers were not invited to this test, because it was conducted on private land, and the landowner requested the minimum number of people to be present so as not to disturb nesting birds in the neighbouring woods.

Perry Park

6.2.4 Measurements performed by National Grid staff on 25 July 2017. The loads were too low for the test to be informative, but, as explained above, the results are included anyway for the sake of transparency. Inspection of load records for three months over the summer showed that loads on this circuit had been consistently low during this summer, so there was little likelihood of being able to return when loads were higher. Therefore no attempt was made to repeat the test with observers.

6.3 Phase 1: DC tests (total DC field and compass deviation)

Grain

6.3.1 Measurements performed by National Grid staff 21 August 2017.

6.3.2 This visit was intended primarily as a check on the feasibility of the location, with the intention of inviting stakeholders to witness tests on a repeat visit. However, the date originally allocated for the witnessed test was used instead for the tests at Bakers Gap. Given that the stakeholders who witnessed the Chilling test stated that they did not feel the need to witness further tests on existing cables, preferring to focus on the Prysmian test, it was not considered necessary to rearrange.

Bakers Gap

6.3.3 Measurements performed by National Grid staff 29 August 2017.

6.3.4 Originally scheduled for 24 August, but that test had to postponed due to the cables tripping out in the morning and still being under test for the rest of the day. Stakeholders were invited to both the original and the rearranged day but none asked to attend. The rearranged day was itself then shifted by one day at the last minute due to the weather forecast, but as no stakeholders were planning to attend, this last-minute switch did not prevent any stakeholders from observing it.

6.4 Phase 2: tests at Prysmian facility, Bishopstoke

6.4.1 Measurements were performed on 4 and 5 September 2017 by National Grid staff, and on 8 September by National Grid staff observed by stakeholders. Tests were performed on both screened and unscreened cables.

6.5 Phase 3: tests at Daedalus Airfield

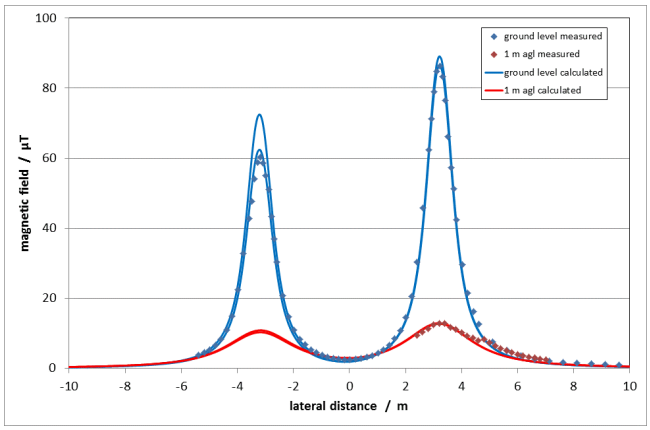
6.5.1 Measurements were performed in detail on 16 October 2017 by National Grid staff. A reduced set of measurements were repeated on 17 October observed

by stakeholders. The cables measured were both AC and DC, with screening, buried at between 1 m and 2 m depth.

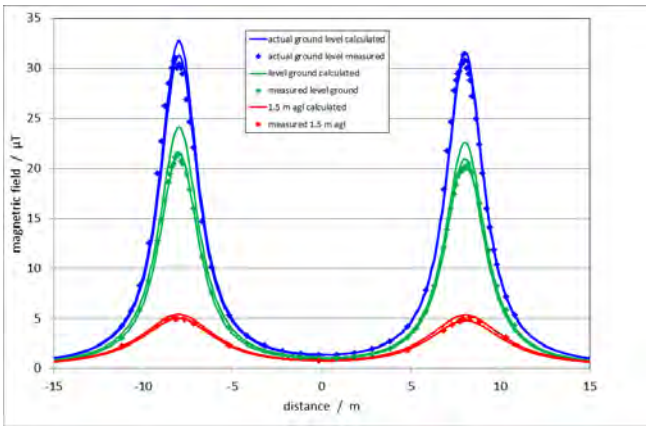
7 Summary of results

7.1.1 Full results of all tests performed are presented in Annex F. Some of these are not informative because, for example, of the low currents at the time of the measurements. This section reproduces the graphs that are most informative.

7.2 Existing cables: AC

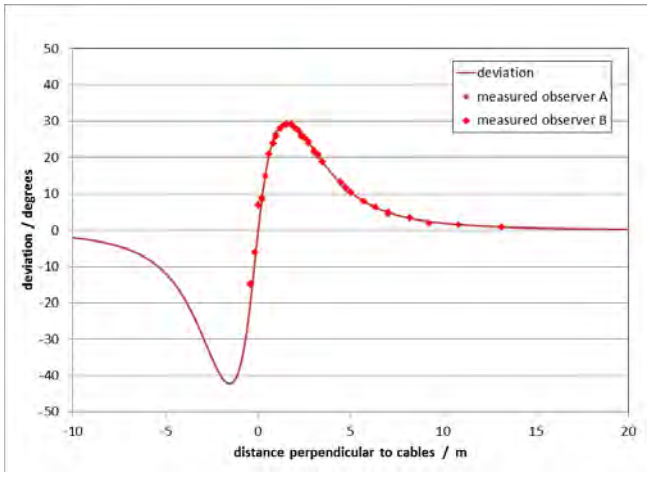


Chilling
Tests on 12 June. Other tests performed on 18 July and 16 August are presented in Annex F.

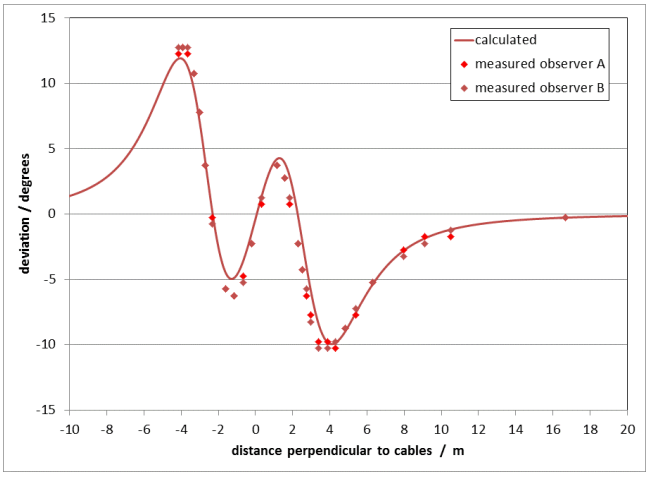


Goring Gap
Results following adjustment for ground level. Results before adjustment are presented in Annex F.

7.3 Existing cables: DC

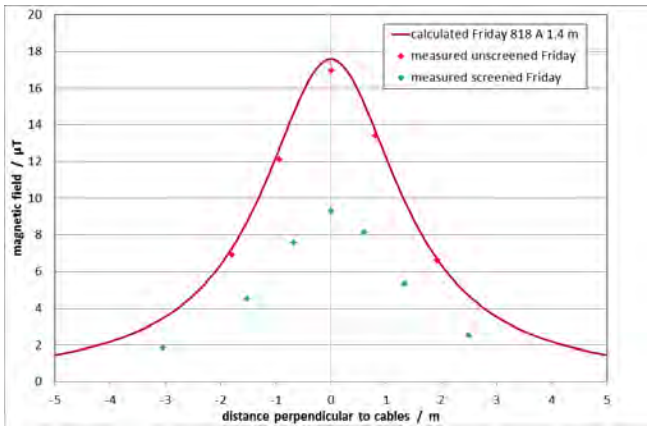


Grain
Compass deviation following adjustment for surmised conductor position. Results before adjustment, and for total DC field, are presented in Annex F.

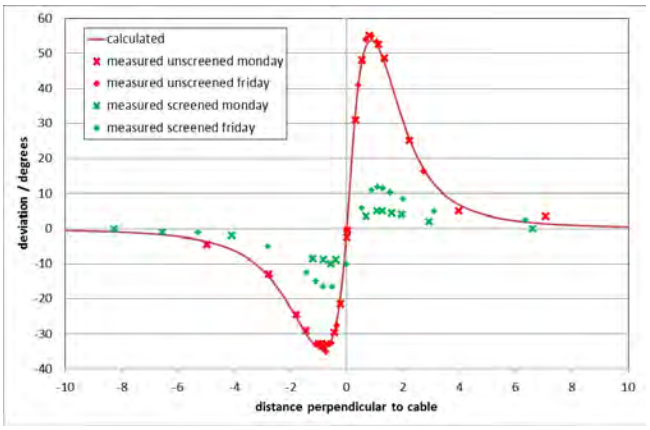


Bakers Gap
Compass deviation. Results for total DC field are presented in Annex F.

7.4 Tests at Prysmian

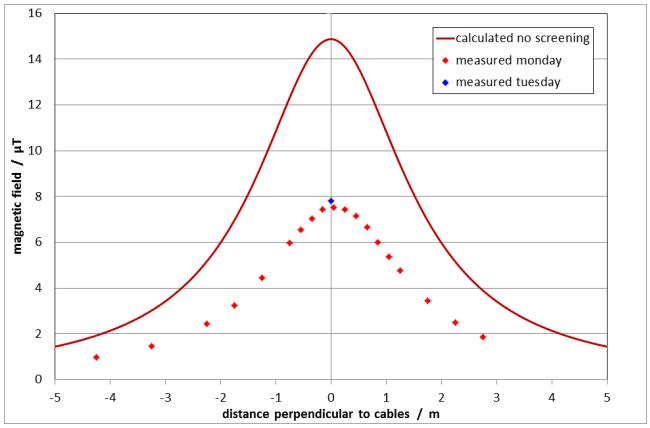


AC
Test performed before stakeholders on Friday. Results from Monday are presented in Annex F.

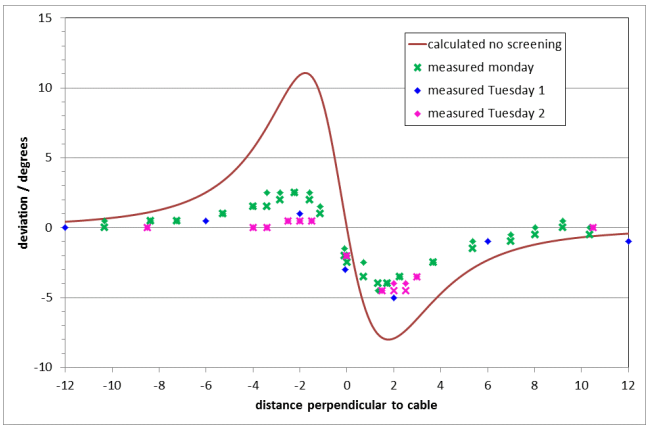


DC
Results for compass deviation. Results for total DC field are presented in Annex F.

7.5 Tests at Daedalus



AC
Detailed tests performed on Monday; single point repeated on Tuesday.



DC
Results for compass deviation (three separate profiles). Results for total DC field are presented in Annex F.

8 Conclusions

8.1.1 These tests confirm that calculating the fields from unscreened underground cables predicts the fields actually produced by the cables. The accuracy of the calculated field is determined by the accuracy to which the input parameters are known.

8.1.2 Specifically, with existing cables, there can be uncertainty in the currents, in the depth of burial, and in the separation of the conductors. Errors in the knowledge of these parameters results in minor discrepancies between calculated and measured fields. When these parameters are known accurately, the calculated field is accurate.

8.1.3 For the tests performed on the trial sections of cable at Prysmian and Daedalus, these parameters are under direct control and are known more accurately. Accordingly, the agreement between calculated and measured fields is even closer.

8.1.4 These tests have demonstrated that the limit on the accuracy of the calculated field for an unscreened cable is the accuracy of knowledge of the input parameters. For the actual cables installed by IFA2, these parameters – cable spacing, depth of burial and current – can be specified by IFA2 to a considerable degree of accuracy. To the extent that there may still be uncertainties, it is the responsibility of IFA2 to produce a design that allows for the residual uncertainties – that is, a design that remains compliant with the relevant planning conditions even taking account of any residual uncertainties in e.g. depth of burial.

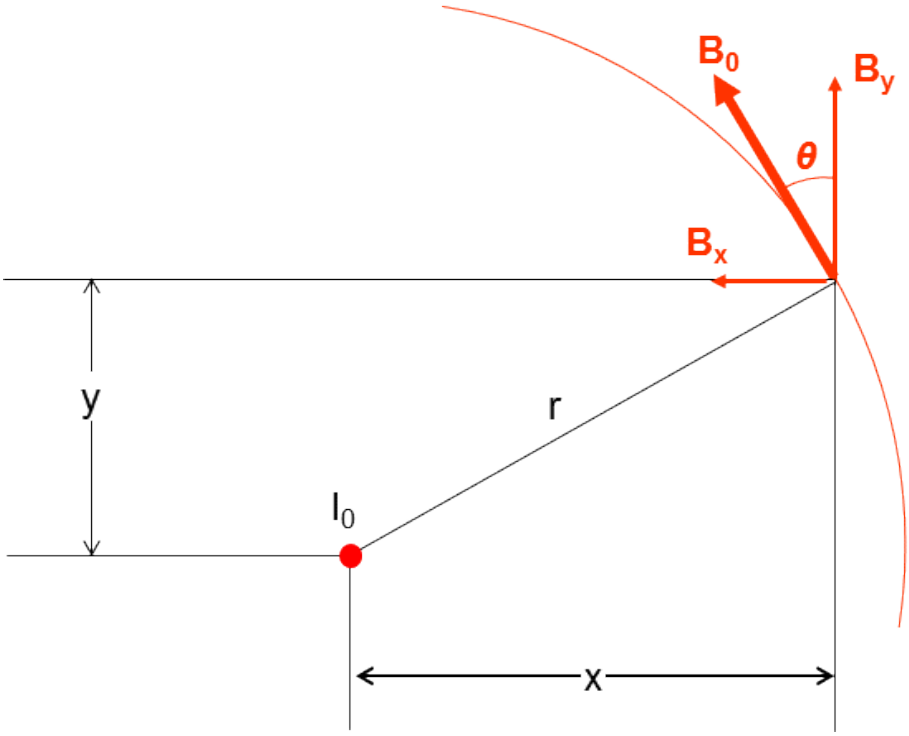
8.1.5 AC screening, of the design tested here, produces a factor of two reduction in the field.

8.1.6 DC screening, of the design tested here, produces a reduction of the compass deviation and of the perturbation to the earth's magnetic field by a factor that was never less than two and often more. The variation in the screening effectiveness is attributed to the variable material properties of the steel tubes used for the screening. It is expected that a better screening factor will be obtained by specifying the material properties more closely than was possible on the timescales of the tests reported here. Nonetheless, these tests have demonstrated that a factor of at least two can be assumed for the DC screening.

9 Annex A: Calculation of magnetic fields

9.1.1 As explained in the main text, if the cable geometry, the position of interest, and the load are known, the calculation of magnetic field is exact.

9.1.2 The principles are illustrated below. For a single conductor, the magnetic field forms concentric circles around the conductor. The field B_0 is therefore tangential to that circle, or at right angles to the line joining the conductor to the point of interest. This is resolved into horizontal and vertical (or "x" and "y") components using simple trigonometry. For AC circuits, it is also resolved into the in-phase and out-of-phase components of the current.



9.1.3 This calculation is repeated for each separate conductor, which, of course, have slightly different "x" values and in some instances "y" values as well. The vertical components from all the separate conductors are added to give the total vertical field, and likewise for the horizontal components. For AC circuits, the total vertical in-phase, vertical out-of-phase, etc, components are added separately. These total vertical and total horizontal components are then combined to give the overall total field.

9.1.4 For the compass deviation, the vertical components of both the geomagnetic field and the field from the cable are ignored, as these do not affect a compass. The horizontal north component of the cable field is added to the horizontal geomagnetic field (which is, by definition, north), and the horizontal east/west component of the cable field is calculated. The compass deviation is defined by the ratio of these two fields, the total north/south and the total east/west fields.

9.1.5 Thus, the actual calculations are very simple, involving no more complicated maths than Pythagoras and sines and cosines of angles. The only complexity comes in keeping track of the multiple different components, adding them all up correctly with a consistent sign convention, etc.

9.1.6 Any competently written program will give the same answer to multiple decimal places; there is no differentiation between programs in terms of the answer given, only in terms of ease of use.

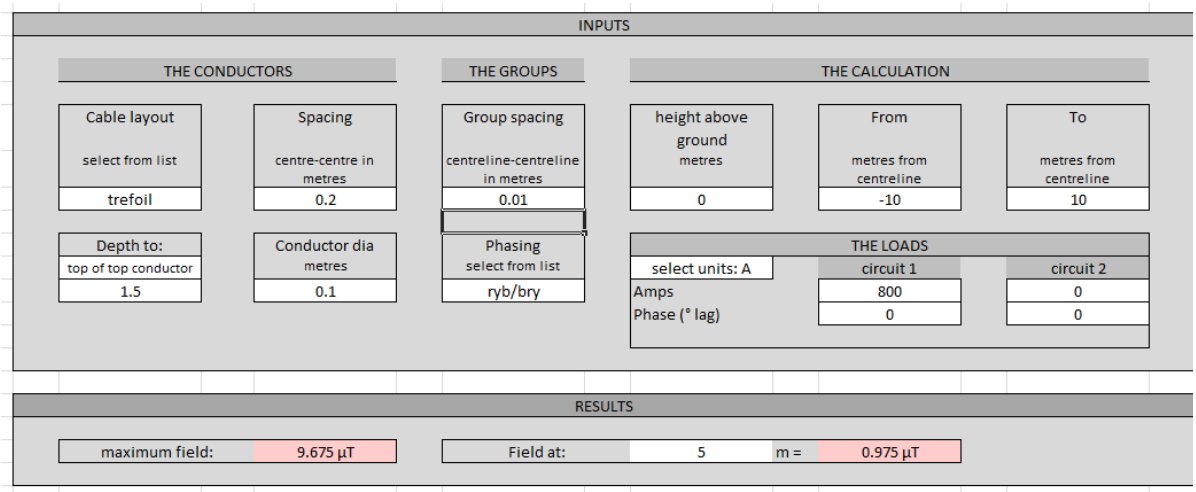
9.1.7 National Grid has three programs available:

- **EFC400,** a commercial program.
- **EM2D**, an in-house program developed and refined over thirty years.
- **Dedicated spreadsheets** written for this exercise (one for AC and one for DC).
- In addition, **Prysmian** has a completely independent program.

9.1.8 Cross-checks have been performed to confirm that these programs do indeed all give the same answers.

9.1.9 The actual calculations presented here were performed on the written-for-purpose spreadsheets. This was for two reasons. Firstly, this was considered to be more transparent to external stakeholders. The other programs are written in code and packaged up, so that effectively the answer has to be taken on trust, whereas with the spreadsheets, the formula entered in each cell can be inspected if desired. Secondly, these spreadsheets were written with the data entry and results output optimised for ease of use in the particular context of these tests.

9.1.10 Selected screenshots of these spreadsheets are given here:



The input and main results screen of the AC spreadsheet

B10 fx =(towers!$B$54-'main calculations'!$A10)/((towers!$B$54-'main calculations'!$A10)^2+(towers!$D$54-towers!$D$62)^2)*phasing!$H$23

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
Conductor	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6
current																								
Field	in v	in h	out v	out h	in v	in h	out v	out h	in v	in h	out v	out h	in v	in h	out v	out h	in v	in h	out v	out h	in v	in h	out v	out h
x																								
-10	78.47	13.67	0	0	-39.1	-6.06	0	0	-38.5	-6.57	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-9.96	78.77	13.77	0	0	-39.2	-6.11	0	0	-38.6	-6.62	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-9.92	79.07	13.88	0	0	-39.4	-6.16	0	0	-38.8	-6.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-9.88	79.37	13.99	0	0	-39.5	-6.21	0	0	-38.9	-6.73	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-9.84	79.68	14.1	0	0	-39.7	-6.25	0	0	-39.1	-6.78	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-9.8	79.99	14.22	0	0	-39.8	-6.3	0	0	-39.2	-6.83	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-9.76	80.3	14.33	0	0	-40	-6.35	0	0	-39.4	-6.89	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Part of the worksheet where the calculations are performed, showing the sequence of calculating the four components of field from the six conductors in turn, and the formula in one particular cell (conductor 1, in-phase current, vertical component)

	Enter values here
Cable bearing (degrees)	16
Height above ground	1.5
Geomagnetic magnitude (µT)	48.8
Geomagnetic dip (degrees)	66.1

	first group				second group			
	1	2	3	4	5	6	7	8
x relative to centre of group of 4	-0.2775	-0.1725	0.1725	0.2775	-0.2775	-0.1725	0.1725	0.2775
group spacing centre-centre	5.15							
calculated x relative to centreline	-2.8525	-2.7475	-2.4025	-2.2975	2.2975	2.4025	2.7475	2.8525
depth of each group / m	1.14				1.25			
current / A	926	-926	926	-926	926	-926	926	-926

One of the input screens for the DC spreadsheet (this is the input for eight conductors, appropriate for Bakers Gap)

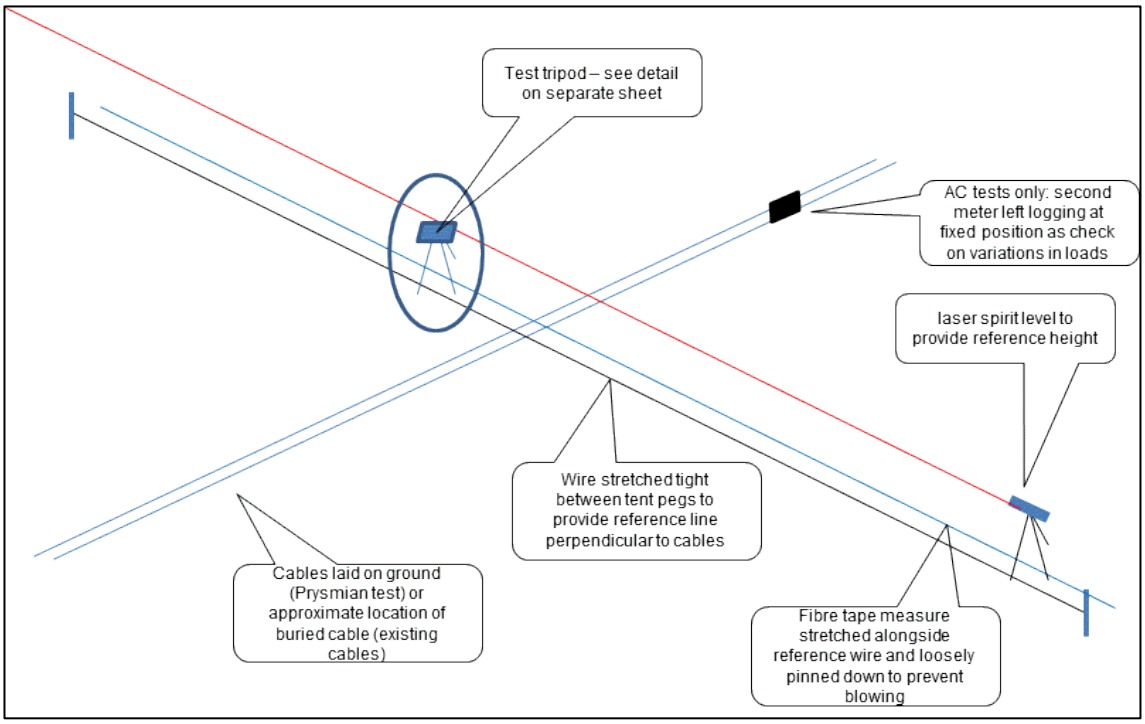
10 Annex B: Details of test procedures

10.1.1 The test procedures comprise two parts: laying out the measurement positions, then actually measuring the fields or compass deviation.

10.2 Site layout

10.2.1 To lay out the measurement positions, a coloured wire was stretched tightly across the site perpendicular to the cables to define a reference line. A fibre tape measure was then gently stretched alongside this to permit the position of readings to be measured. The position of the "zero" of the tape measure, and therefore the absolute meaning of the readings, was arbitrary. An offset specific to each site was subtracted from all readings during calculations, so that the distances presented here are relative to the centre line of the two circuits or cables.

10.2.2 For readings at ground level, the meter was simply held at successive points along this line. Readings above ground level were performed on a tripod. The overall layout of the tests is thus:



10.2.3 To ensure that all measurements were performed at the same height above the cables despite uneven or sloping ground, a laser spirit level was mounted on a tripod, directed along the reference line. The height of the laser was adjusted so that when it intersected a target on the tripod, the top plate of the tripod (on which the measuring instruments were placed) was at the desired height. To enable the horizontal position of the readings to be measured, a laser plumb line (or, in some tests, a traditional string-and-weight plumb line) was placed at the top of the tripod, directed vertically down onto the tape measure.

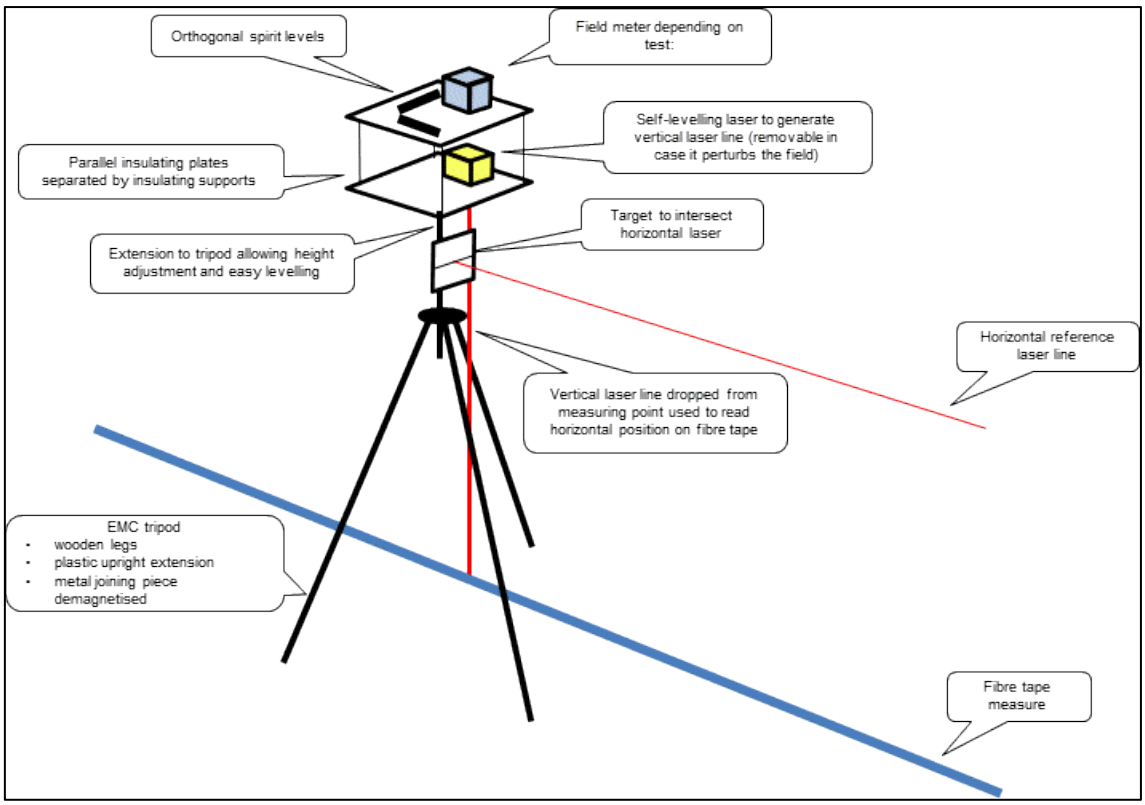
Laser spirit level set up on tripod, generating horizontal laser line across measurement site

Laser from spirit level intersecting target on tripod

Laser plumb line dropped from tripod intersecting measuring tape

10.2.4 When measuring magnetic fields, the presence of any ferromagnetic material must be avoided, as this would perturb the field. Other metals are, strictly speaking, acceptable, certainly for the DC tests and in modest volumes for the AC tests, but it is good practice to avoid metal altogether. The tripod used was specifically designed for EMC measurements, with wooden legs, a plastic upright, and a minimum of metal used (principally for the bracket where the three legs join). This metal bracket was demagnetised prior to the tests. The fixtures constructed to hold the various instruments etc were made from wood and where screws were necessary, these were nylon.

10.2.5 The tripod was equipped with two parallel plates, adjustable for level. The lower plate held the laser plumb line. The upper plate held each measuring instrument in turn, vertically above the laser plumb line and therefore vertically above the measured location on the tape measure.



Two views of tripod set up above measuring tape

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10.3 Measuring instruments

AC field

10.3.1 AC fields were measured using an Emdex II meter, manufactured by Enertech Consultants, California.

10.3.2 This is a three-axis meter. It contains three orthogonal search coils to detect the field in three orthogonal directions, and internal electronics combines these to give the resultant or total field. It is therefore not necessary to align the meter precisely – it gives the same reading at a point regardless of alignment – though it is good practice to maintain a constant alignment.

Emdex II external view

Emdex II internal view, showing the three sensing coils (two at bottom left, the third encased in white epoxy at bottom right)

10.3.3 The specific meter used was serial number 1114, calibrated at the National Physical Laboratory, calibration valid until 14/5/18.

DC field

10.3.4 DC fields were measured using a Bartington MAG01-H fluxgate magnetometer, manufactured by Bartington Instruments, Oxfordshire.

10.3.5 This is a single axis meter. It is therefore necessary to measure the field three times, along three orthogonal directions, then to combine these readings during subsequent calculations to obtain the total field. To facilitate these three orthogonal readings, a wooden cube was made with orthogonal holes to insert the probe, and a flange fixed to the probe so that, when inserted up to this flange, the effective measuring point was at the centre of the cube and therefore the same for all three measurements.

10.3.6 The specific instrument used was recalibrated by the manufacturer immediately prior to this sequence of tests.

Bartington MAG01H meter with probe

Probe inserted into cube to permit three orthogonal measurements

Compass deviations

10.3.7 Compass deviation was assessed by taking the bearing from each point to a distant fixed object (e.g. an electricity pylon or radio mast). If the object is sufficiently distant compared with the distance from the cables of the points of interest, the actual bearing is essentially constant. The indicated bearing then differs from the absolute bearing by the compass deviation.

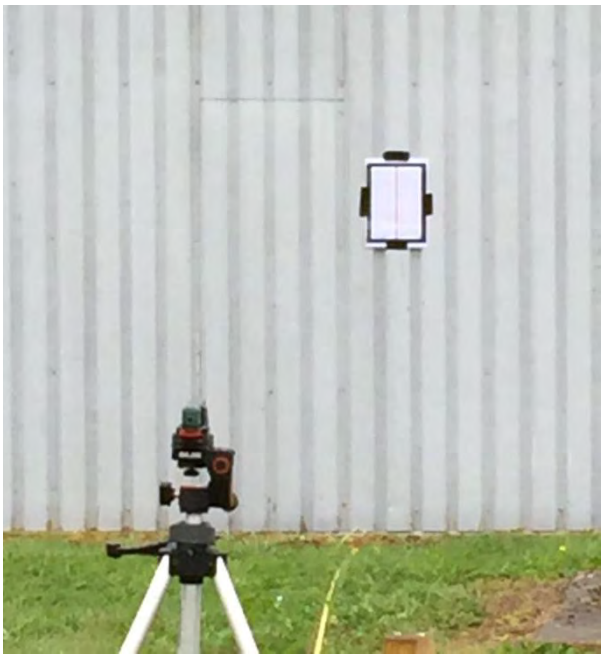
10.3.8 Compass bearings were taken with a NATO-specification British military M73 prismatic sighting compass. This has a stated precision of half a degree and in the tests, when two observers took independent bearings, they always either agreed or were no more than half a degree different.

Compass: general view

Compass being used to take bearing to TV mast on the cliff in the distance

10.3.9 For the tests at Prysmian, the site layout did not permit sighting on a distant object. It was therefore necessary to fix a sighting target to a suitable fixed point.

This target was fixed directly in line with the perpendicular to the cable along which the measurements were made. Thus, although the target was not distant, the unperturbed bearing to it nonetheless remained the same as the measurement point was moved along this perpendicular line.

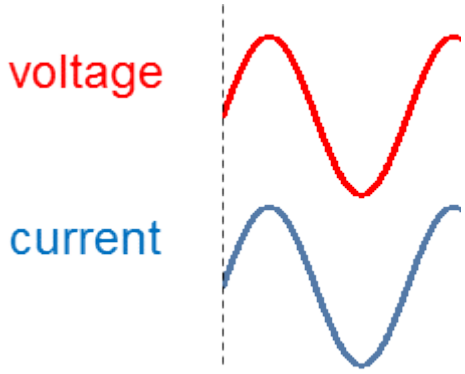


Sighting target fixed to wall at Prysmian in line with measurement perpendicular

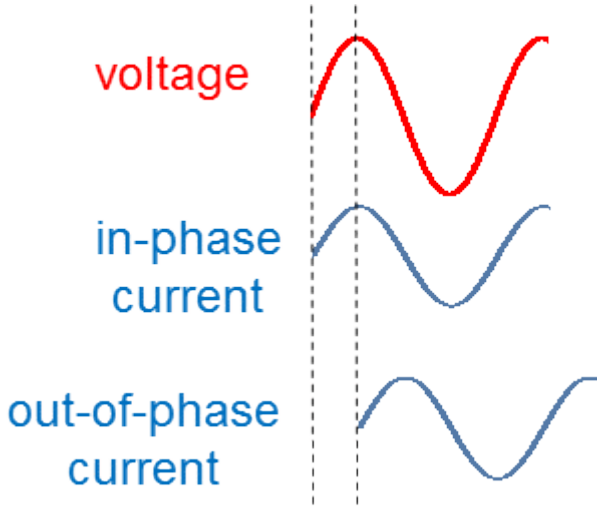
11 Annex C: The problem with low loads

11.1.1 A DC current is defined simply by one parameter: the size of the current.

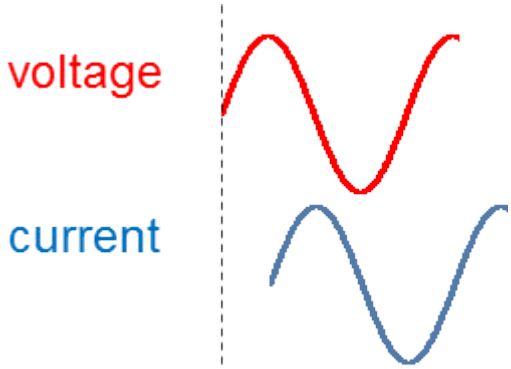
11.1.2 In a simple model, an AC current can also be defined by one parameter. It goes up and down at the same time as the voltage driving it goes up and down, and is defined simply by its size:



11.1.3 This is known as the current being "in phase" with the voltage or the "in-phase current". In practice, however, in real electrical circuits, there is also a component of current that is out-of-phase with the voltage (that is, it has its maximum when the voltage is zero, and its zero when the voltage is a maximum):



11.1.4 These two components of the current – the in-phase and the out-of-phase – combine to give a single current that is somewhere between being in-phase and out-of-phase:



11.1.5 The current can be described by the size of the resulting current, and the amount by which it is shifted from the voltage (the "phase shift"). However, it is more normal to describe the current by its two components: the size of the component of the current that is in-phase with the voltage, and the size of the component that is out-of-phase.

11.1.6 This swapping between different ways of representing currents and voltages in AC circuits is commonplace in electrical engineering. It is rigorously valid – the two descriptions describe an identical current – but it is recognised that it not a particularly intuitive concept.

11.1.7 National Grid usually measures the power, or load, carried by a circuit rather than the current. The power is simply the current multiplied by the voltage. Therefore, the power, like the current, needs two parameters to define it, and those two parameters are usually the "in-phase" and "out-of-phase" components. In conventional electrical-engineering terminology, the in-phase component is called the "real power" or "megawatts" (MW), and the out-of-phase component is called the "reactive power" or "mega-volt-amps-reactive" or "megavars" (MVAr).

11.1.8 The real power is almost entirely constant along the length of a circuit. The reactive power, however, can vary considerably along the length of a circuit, and circuits containing underground cables, which by definition are the circuits of interest here, are particularly prone to this variation of reactive power. This is because some of that reactive power is progressively "used up" in charging the capacitance between the core and the sheath of the cable.

11.1.9 The real power can be measured at either end of a circuit, and either measurement will be a good measure of the real power at any intermediate location along the circuit. The reactive power can also be measured at both ends of a circuit, but is likely to be markedly different at the two ends, and it would be a complex exercise in electrical engineering to model the actual reactive power at any given intermediate location.

11.1.10 As the load on a circuit varies over time, it is principally the real power that is varying. The reactive power varies also, but less so. In particular, when the real power becomes very low, the reactive power, which does not reduce as much, becomes more important and can dominate the total power. Conversely, when the power is high, this is almost always because the real power has risen and become much larger than the reactive power.

11.1.11 Thus, when the power is high, this is dominated by the real power, which is known at an intermediate location. The reactive power, which is not known at an intermediate location, makes only a small difference. The power, and hence current, at the intermediate location can be determined reasonably accurately.

11.1.12 Conversely, when the power is low, this is dominated by the reactive power, which is not known at an intermediate location, and there is no easy way of determining the actual power or current at that intermediate location.

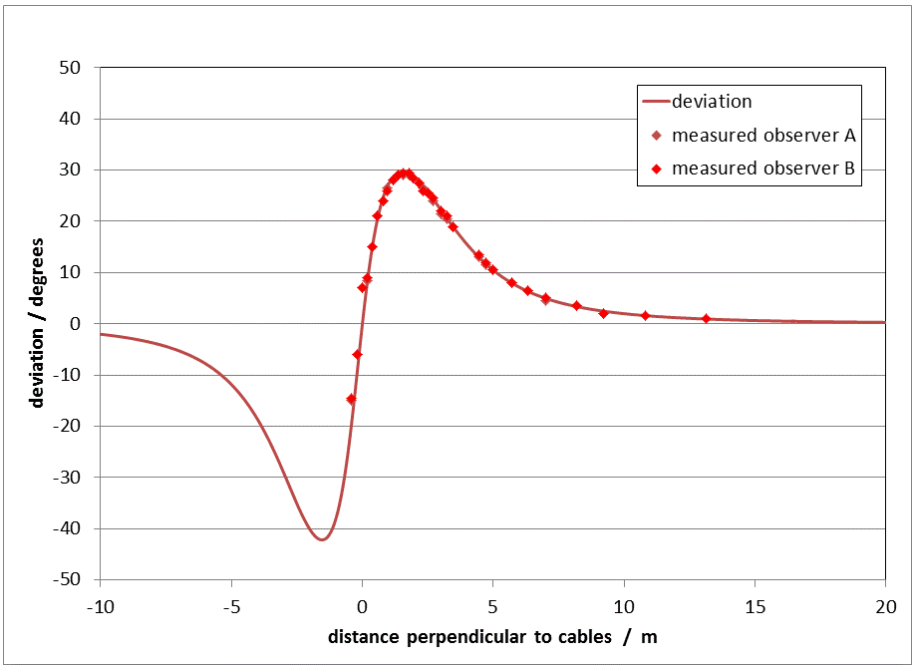
11.1.13 The Phase 1 EMF tests presented here require knowledge of the current at an intermediate location, the location chosen for each test, along a circuit. As set out above, this can be done reasonably accurately when the power is high, but not at all accurately when the power is low. Thus, these tests are satisfactory at high powers, but not really satisfactory at low powers. The best that can realistically be done at low powers is to present calculations based on the loads recorded at the two ends of the circuit, on the assumption that they bracket the load at the intermediate point. This is the procedure followed here, for the sake of completeness, but it is not claimed that such tests provide much useful information.

11.1.14 Of the tests reported here, this applied to Perry Park, and the final test at Chilling.

12 Annex D: Why the compass deviation is asymmetrical

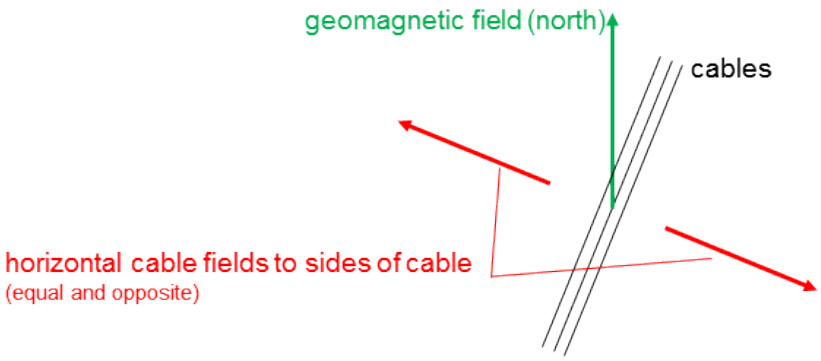
12.1.1 When the results of the measurements of compass deviations are inspected, it can be seen that the deviation is in opposite directions on the two sides of the cable, but that the magnitude of the two variations is typically different: the curve is asymmetrical.

12.1.2 For example, in the following graph (the results from Grain, presented in detail in Annex F), the compass deviation varies from 30° in one direction on one side of the cables to a little over 40° in the other direction on the other side of the cables.

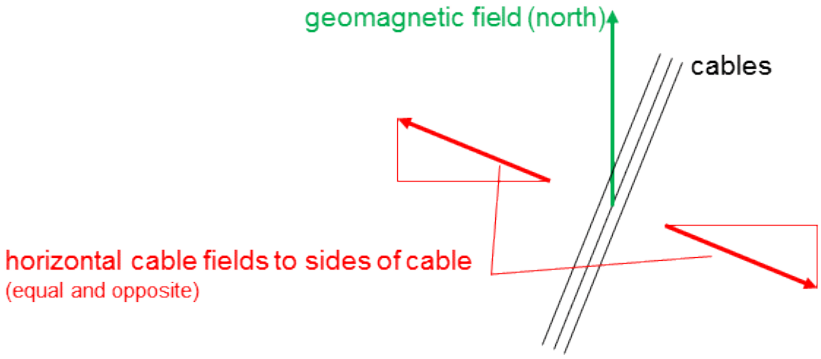


12.1.3 The purpose of these tests is simply to show that the calculations reproduce the measurements, whatever the shape of the curve may be. However, this asymmetry has prompted some questions, so an explanation is provided here.

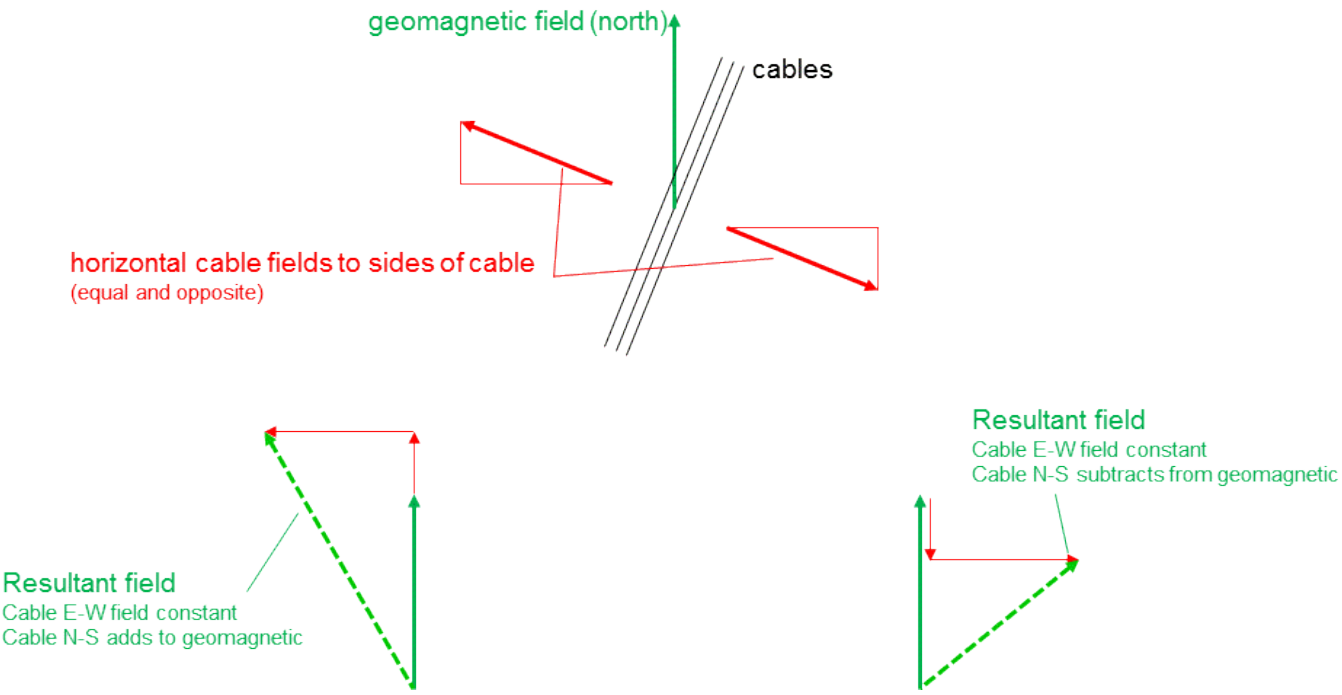
12.1.4 Consider the long, straight cables, at an angle to the geomagnetic north. The field produced by the cables is directed perpendicular to the cables. It is symmetrical about the line of the cables. It is, in fact, only the horizontal component of the field that interacts with a compass needle, not the vertical component. Because of the symmetry in the field, the horizontal field at a certain distance perpendicularly to one side of the cables is equal in magnitude but opposite in direction to the horizontal field at the same distance the other side.



12.1.5 Because the cables are not north-south, the field from the cable is not east-west. We can resolve the field from the cable on each side of the cables into the north-south component and the east-west component:



12.1.6 Now consider how these north-south and east-west components of the cable field add on to (or perturb) the geomagnetic field. On both sides of the cable, the east-west component of the cable field is equal in magnitude, so the east-west deviation of the compass needle is the same size on both sides of the cable, to the east on one side and to the west on the other side. But, on one side, the north-south component of the cable field is adding on to the geomagnetic field, and on the other side it is subtracting from the geomagnetic field. This means that the angle of deviation is different on the two sides.



12.1.7 If the cable is exactly geomagnetic north-south, the compass deviation is symmetrical about the cable. As the bearing of the cables increases, the asymmetry increases.

12.1.8 Often, as the bearing of the cable increases away from north-south, the magnitude of the deviation also decreases. This is because, as the cable angles more away from north-south and therefore the cable field angles more away from east-west, the east-west components of the cable field reduce, and it is these components that bend the resultant field away from north. Eventually, as the cables become east-west, there is no east-west component of cable field, and the compass deviation has reduced to zero.

12.1.9 However, there are situations where this does not happen. This can occur when the cable field is comparable to the geomagnetic field. Then, the north-south component of the cable field can reduce the geomagnetic field so much that the east-west component, although reducing, can still make a significant difference.

13 Annex E: overview of screening

13.1.1 The tests witnessed by stakeholders at Prysmian and Daedalus, and the proposed final design of the cables for Daedalus, involved screening of both AC and DC fields. This Annex gives an overview of how the two types of screening work. The intention is to give sufficient understanding to make sense of the effect the screening has on the field, rather than to give a full text-book account.

13.2 DC screening

13.2.1 DC screening is achieved by placing the cables in a low-carbon steel tube.

Steel tube enclosing the two DC cables

End view of cables inside steel tube.

13.2.2 A simplistic explanation of how this works is as follows. The cables, inside the tube, still produce basically the same magnetic field. The magnetic field lines start by extending out from the cables in much the same way as if there were no screening. When they reach the steel tube, however, most of the field lines get "trapped" or "sucked into" the metal of the tube, and instead of carrying on further away from the cables, they bend round inside the thickness of the tube. Only a few field lines "escape" from the tube or extend outside it. Hence the field outside the tube is considerably reduced.

13.2.3 The effectiveness of the tube depends on the magnetic properties of the tube material. Specifically, the tube needs to be ferromagnetic. Ferromagnetic materials are defined by a property called the "relative permeability", abbreviated μ_r. The higher the relative permeability, the more effective the screening. But the relative permeability of steels is a fairly variable parameter, depending on the carbon content, and, to some extent, on the manufacturing process.

13.2.4 Even if the material properties are known, it is quite difficult to calculate the effect of the screening exactly. Equations can be set up and solved for relatively

simple geometries with high degrees of symmetry. In practice, however, it is usual to perform a numerical calculation.

13.2.5 For these reasons, IFA2 is not presenting calculations of the theoretical screened field. Rather, the unscreened field is calculated (and measured on unscreened cables), then the screened fields measured, to determine the actual screening factor.

13.2.6 The screening effectiveness also depends on the thickness of the tube (fairly intuitively, more metal means that more field lines are captured rather than escaping). The tubes used for the Prysmian and Daedalus tests were made from 3 mm steel. This does not mean that the tubes used for the final installation will also be 3 mm; a separate decision will be made of the optimum screening design, including material grade and thickness, taking account of screening effectiveness as well as practical engineering factors such as mechanical robustness.

13.3 AC screening

13.3.1 AC screening uses a technology called “passive loop” screening.

13.3.2 One or more loops of conductor are laid alongside the stretch of the cables to be screened. The magnetic field produced by the cables passes through these loops. Because it is an alternating field, and because the loops are conducting, the magnetic field induces a current in the loops. But that current then produces its own magnetic field, and the direction of that field is such that it tends to “back off” the magnetic field from the cables.

13.3.3 The efficiency of the screening depends on the geometry of the loops (how close to the cables they are and hence how much of the field from the cables passes through them), and on their electrical properties. There is a body of knowledge on how to optimise these variables so as to maximise the screening effectiveness.

13.3.4 In the tests at Prysmian and Daedalus, four bundles of conductors were used, all interconnected at the ends, so as to form basically three loops (or four, if the two lower and outer conductors are considered to form a loop underneath the cables as well).

Passive screening conductors (red) installed along length of the cables (black)

Passive screening conductors connected at ends to form loops

13.3.5 It is possible to calculate the theoretical screening effectiveness of passive loops, and Prysmian have developed the techniques for doing this. These tests, however, proceeded similarly to the DC case. The unscreened fields were calculated and measured, then the screened fields were measured, to derive an empirical screening factor. For the avoidance of doubt, however, the empirical screening factor obtained was in fact close to the theoretical factor calculated by Prysmian.

14 Annex F: Results of tests

14.1 Notes on the data provided for each test

14.1.1 The sign convention used by National Grid's system for monitoring loads is that they are positive looking into the circuit from the end at which they are measured. Thus, the real power (MW), which is basically the same at the two ends, has the opposite sign when measured at the two ends. If the reactive power (MVAr) has the same sign as measured at both ends, this indicates that it has actually changed direction along the circuit.

14.1.2 AC measurements conducted at "ground level" indicate that the meter was placed touching the ground. The effective centre of the sensing coils within the AC meter is 20 mm from the outside of the case, so the effective height of these measurements is actually 20 mm, and this is the height used for calculations.

14.1.3 For AC cables, the direction of the cables does not affect the field. For DC cables, where the field from the cable has to be added on to the geomagnetic field, the direction or bearing of the cables is a parameter in the calculations. For the tests on existing cables, this was obtained by measuring the bearing to Grid North from Ordnance Survey maps, then adding the magnetic variation, obtained from the online facility on the British Geological Society website, to obtain the bearing to Magnetic North. For the tests at Prysmian and Daedalus, the bearing of the cables was measured with a compass, and was therefore already a bearing to Magnetic North.

14.1.4 For AC cables involving more than one circuit or group (which applied to all the AC tests here), it is necessary to know the relative arrangement of the individual conductors (or "phases" in electrical engineering terminology) in the two circuits or groups. The phases are conventionally labelled by colours, red, yellow and blue, abbreviated to R, Y and B. The actual phase order for the locations tested is given for each AC cable. When it comes to the calculations, it is not necessary to use the absolute assignments; all that matters is the relative order in the two circuits.

14.1.5 For DC cables, where there are only two conductors (as at Grain and the proposed IFA2 configuration), it is obvious that the current flows in one direction in one and the other direction in the other. Where there are multiple conductors, as at Bakers Gap, the relative direction of the current flow in each conductor is relevant, and is given in the data. The overall direction of current flow depends on whether these circuits are importing or exporting (and on the polarity of the voltages) and has to be determined empirically for each test.

14.1.6 As a reminder, for each AC test on existing cables, two calculations are provided, one using the load data from each end of the circuit. The difference between the two ends is expected to be significant when loads are low. When loads are higher, the difference is not expected to be significant (in some cases the two curves cannot be distinguished on the graph because they are so close together), but the full set of calculations are presented in every case regardless.

14.2 Chilling

Dates and details of tests

14.2.1 Tests performed on:

- 12 June 2017 by Chris Haswell and Dr John Swanson;
- 18 July 2017 by Chris Haswell and Drs Hayley Tripp and John Swanson;
- 16 August 2017 by Drs Hayley Tripp and John Swanson, observed by stakeholders.

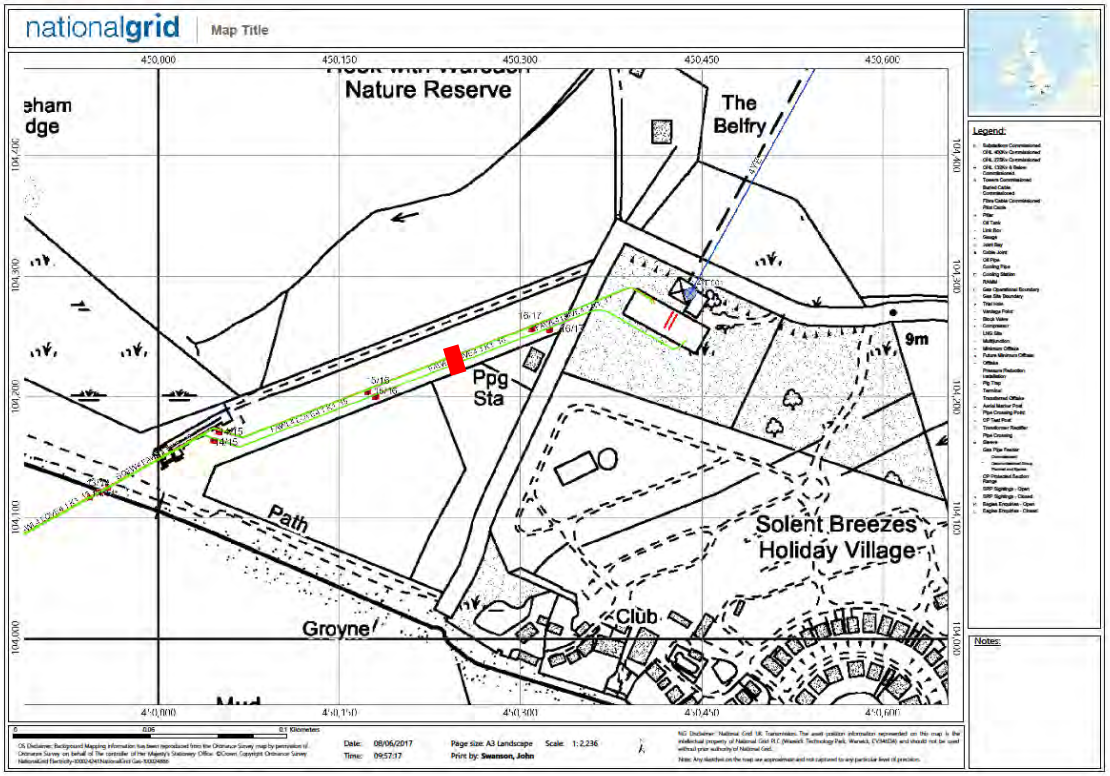
Overall location

14.2.2 These cables form part of the National Grid Fawley - Lovedean and Botley Wood – Fawley circuits

14.2.3 Note that both circuits start at the same place at their western end, Fawley, and run parallel past the test site and on to Botley Wood, where one circuit is connected and the other goes on further to Lovedean, but National Grid practice is to label circuits in alphabetical order.

Detailed location

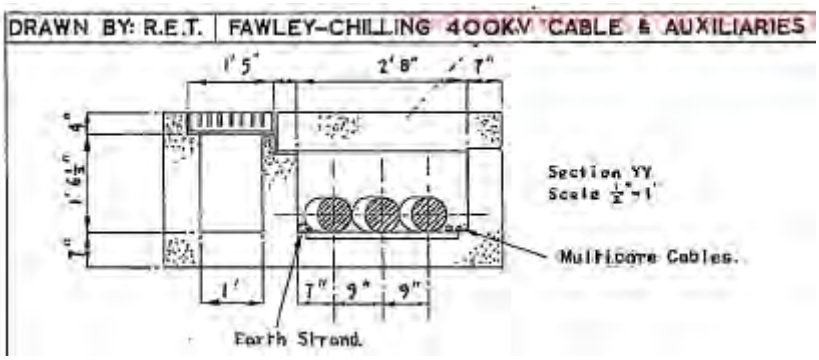
14.2.4 The approximate location of the tests is indicated by the red line.



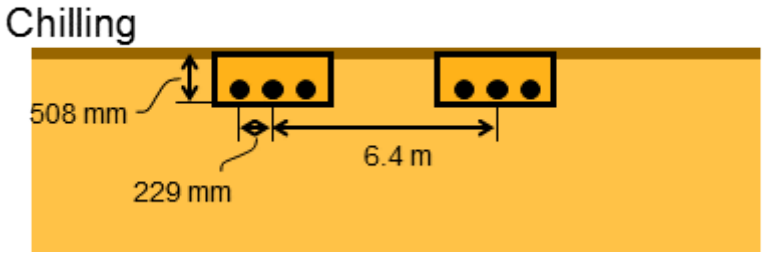
Site photographs

14.2.5 The two cables are laid in concrete troughs as shown in this photograph:

Cable geometry (original records)



Cable geometry (extracted parameters)



Order of phases facing Fawley

RYB BRY

Loads

Date of test			12 June				18 July		16 August			
profile			ground level		1 m agl		ground level	1.5 m agl	ground level		1.5 m agl	
measurement over:			S Cct	N Cct	S Cct	N Cct	N CCt	N CCt	S Cct	N Cct	S Cct	N Cct
time			1205	1210	1255	1300	1210	1130	1055	1100	1110	1120
Fawley – Lovedean (S cct)	measured at Fawley	MW	140.4	137.8	187.2	179.8	237.8	266	-28.6	-18.6	-15.0	-13.8
		MVAr	-2.3	-2.3	-9.2	-11.2	-28.7	-45	18.6	18.6	16.1	16.1
		kV	400.862	401.126	401.236	402.864	402.666	404.338	400.9	401.5	401.3	401
	measured at Lovedean	MW	-144	-144	-180	-180	-252	-252	29.4	23.9	10.2	9.7
		MVAr	-72	-72	-72	-54	-54	-36	-102.4	-102.4	-98.9	-101.5
		kV	396	396	397	398	399	402	399.2	398.9	399.8	398.6
Botley Wood – Fawley (N cct)	measured at Fawley	MW	195.2	195.2	239.2	234.8	284.8	315.2	18.4	28.0	29.6	29.6
		MVAr	11.3	11.3	7.1	2.2	-7	-17.6	23.7	23.7	21.4	21.9
		kV	401.742	401.742	402.16	403.172	403.304	405.174	401.5	402.2	402.2	401.7
	measured at Botley Wood	MW	189	-189	-234	-229.5	-279	-306	-13.5	-22.5	-27	-31.5
		MVAr	-65.25	-65.25	-60.75	-56.25	-45	-38.25	-81	-81	-78.8	-78.8
		kV	399.625	399.5	400.5	400.875	400.875	402.75	399.3	399.8	399.8	399.4

Test results

12 June			
ground level		1 m agl	
distance	field	distance	field
-5.38	3.74	2.4	9.5
-5.18	4.46	2.6	10.4
-4.98	5.36	2.8	11.4
-4.78	6.66	3	12.4
-4.58	8.31	3.2	12.9
-4.38	10.95	3.4	12.8
-4.18	14.9	3.6	11.7
-3.98	22.4	3.8	11.1
-3.78	32.7	4	10.2
-3.58	42.7	4.2	9.2
-3.48	47.6	4.4	8.7
-3.38	54.1	4.6	8
-3.28	58.7	4.8	8.29
-3.18	60.3	5	7.29
-3.08	58.6	5.2	6.35
-2.98	55.1	5.4	5.69
-2.88	51.1	5.6	5.1
-2.78	43.4	5.8	4.48
-2.68	37	6	4.02
-2.58	30.4	6.2	3.65
-2.38	20.7	6.4	3.3
-2.18	14.7	6.6	3.01
-1.98	10.9	6.8	2.67
-1.78	8.3	7	2.4
-1.58	6.7		
-1.38	5.35		
-1.18	4.44		
-0.98	3.69		
-0.78	3.22		
-0.58	2.84		
-0.38	2.61		
-0.18	2.5		
0.02	2.53		
0.22	2.65		
0.42	2.85		
0.62	3.18		
0.82	3.63		
1.02	4.28		
1.22	5.26		
1.42	6.6		

18-Jul			
ground level		1.5 m agl	
d	B / µT	d	B / µT
2.78	75.2	3.19	9.8
2.88	84.5	3.19	9.5
2.98	94.1	3.29	9.4
3.08	102.6	3.38	9.5
3.18	105	3.49	9.2
3.28	103.5	3.59	8.8
3.38	97.2	3.68	8.7
3.48	88.2	4.18	7.3
3.58	75.6	5.19	4.54
3.68	65.5	3.19	8.9
		3.09	8.7
		2.99	8.6
		2.89	8.6
		2.79	8.2
		2.29	7.18
		1.31	4.79
		-3.22	7.8

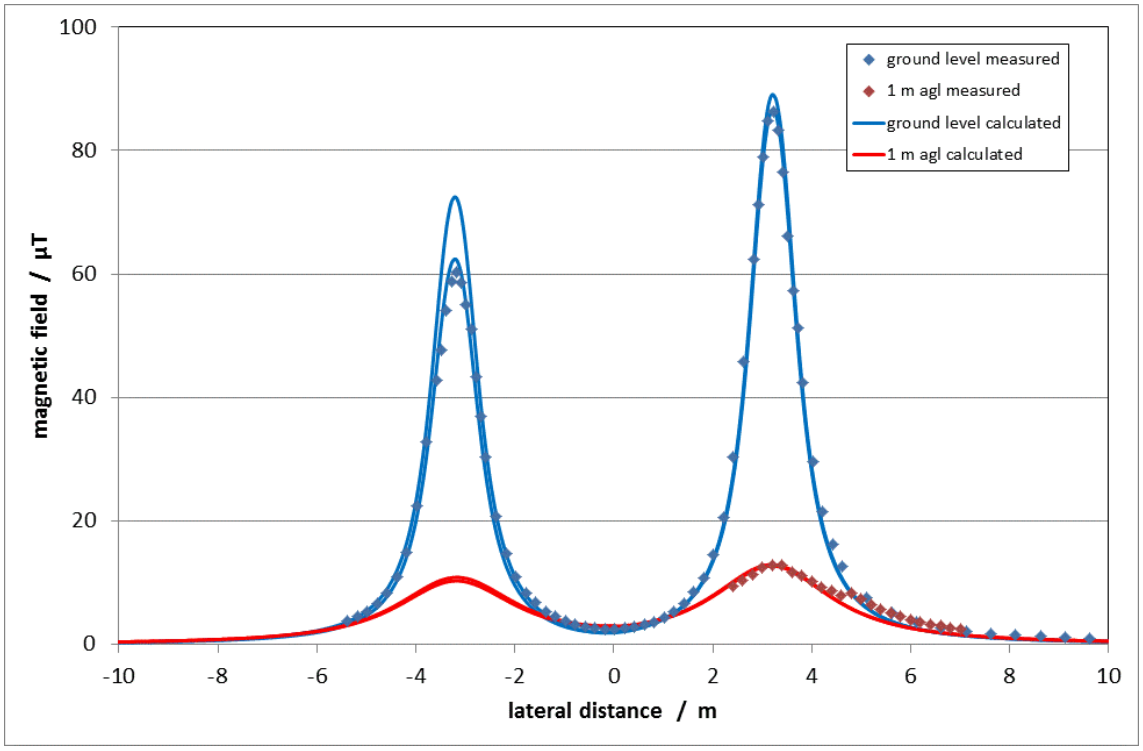
16-Aug			
ground level		1.5 m agl	
d	B	d	B
-7.05	0.53	-6.05	0.58
-6.05	0.98	-4.05	1.72
-5.05	2.28	-3.47	2.3
-4.55	4.14	-3.26	2.32
-4.45	4.84	-3.05	2.34
-4.25	6.6	-2.86	2.34
-4.05	9.6	-2.35	2.04
-3.85	13.76	-0.05	1.14
-3.75	15.84	2.16	2.24
-3.65	18.38	2.76	2.48
-3.55	20.7	2.95	2.48
-3.45	22.72	3.16	2.44
-3.35	24.32	3.35	2.36
-3.25	25.6	3.57	2.24
-3.15	25.6	4.15	1.76
-3.05	24.64	5.95	0.73
-2.95	23.04		
-2.85	20.8		
-2.75	18.24		
-2.65	16.96		
-2.45	11.16		
-2.25	7.42		
-2.05	5.34		
-1.55	2.68		
-1.05	1.52		
-0.05	0.88		
0.95	1.68		
1.45	2.92		
1.95	5.76		
2.15	8.16		
2.35	12.14		
2.55	18.24		
2.75	21.76		
2.85	23.36		
2.95	25.28		
3.05	26.56		
3.15	26.88		
3.25	26.24		
3.35	24.64		
3.45	22.08		

1.62	8.4		
1.82	10.8		
2.02	14.5		
2.22	20.5		
2.42	30.3		
2.62	45.8		
2.82	62.3		
2.92	71.3		
3.02	79		
3.12	84.8		
3.22	86.3		
3.32	83.3		
3.42	76.5		
3.52	66.1		
3.62	57.3		
3.72	51.3		
3.82	42.4		
4.02	29.5		
4.22	21.4		
4.42	16.3		
4.62	12.7		
5.12	7.55		
5.62	5.04		
6.12	3.63		
6.62	2.72		
7.12	2.13		
7.62	1.72		
8.12	1.46		
8.62	1.26		
9.12	1.09		
9.62	0.96		
10.12	0.84		
10.62	0.77		
11.12	0.7		
11.62	0.64		
12.12	0.58		
12.62	0.54		
13.12	0.51		
13.62	0.47		
14.12	0.44		
14.62	0.41		
16.62	0.33		
18.62	0.27		
20.62	0.23		
22.62	0.21		
24.62	0.19		

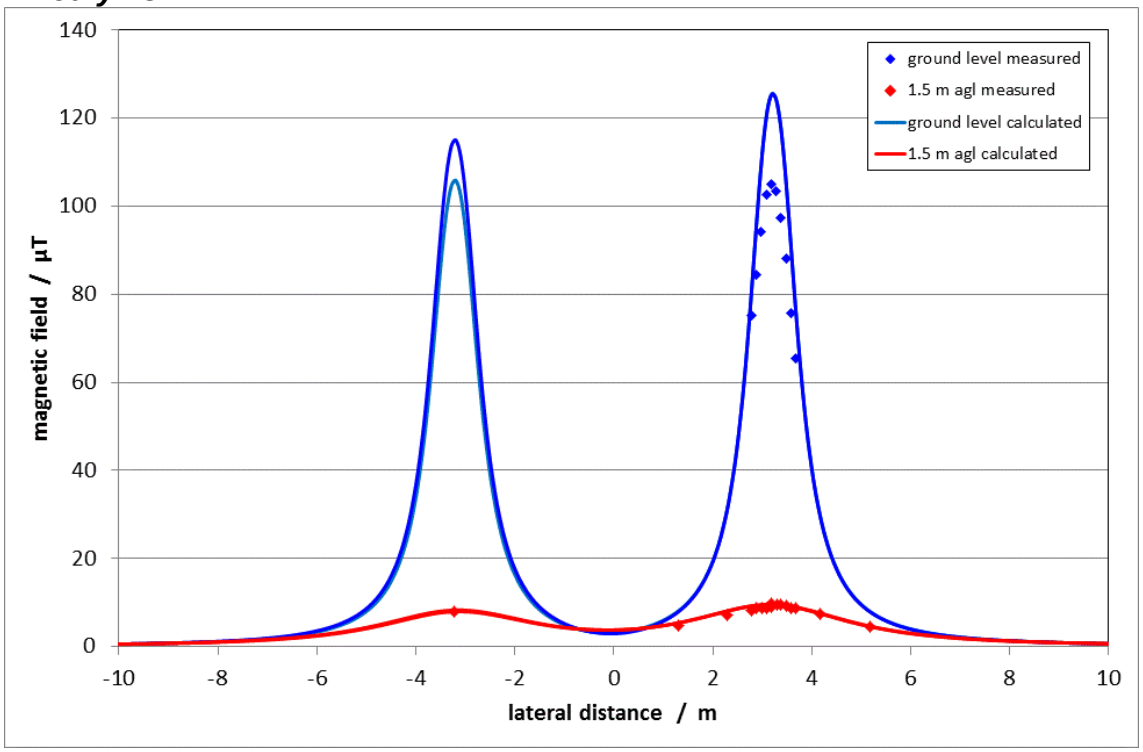
3.55	19.2		
3.65	16		
3.75	13.76		
3.95	9.28		
4.15	6.56		
4.35	4.86		
4.55	3.74		
4.95	2.32		
5.45	1.46		
5.95	1		
6.95	0.53		

Agreement between calculations and measurements

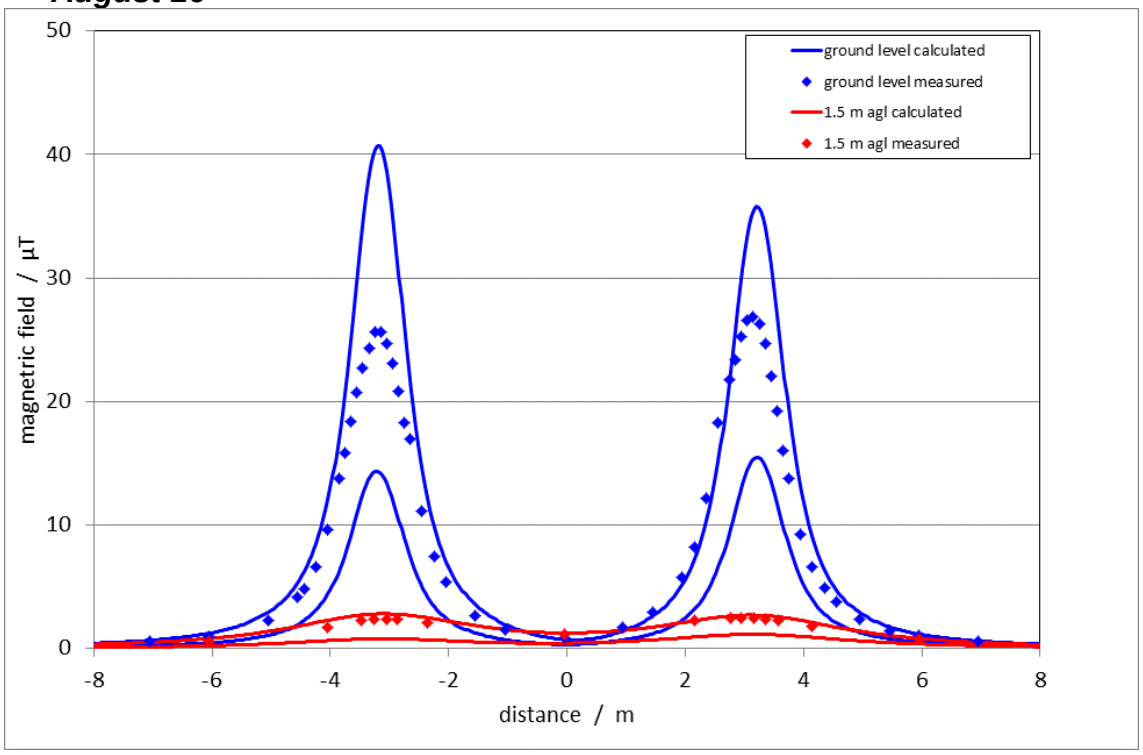
June 12



July 18



August 16

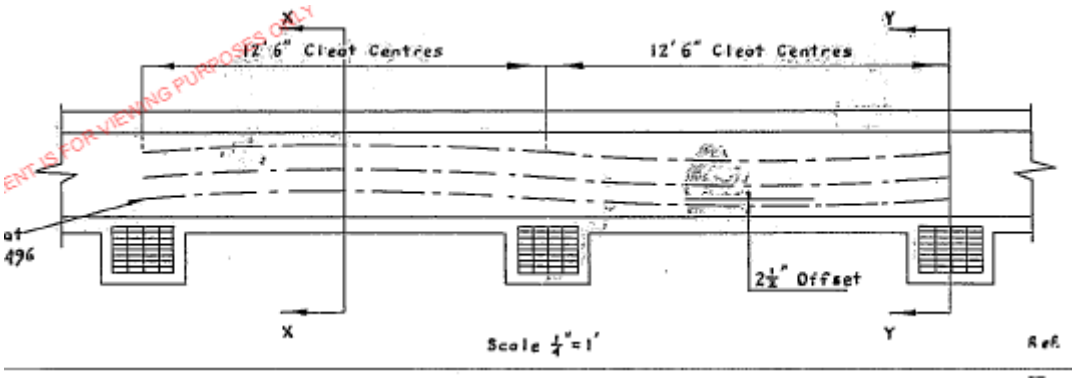


Discussion

14.2.6 In the first two tests, the agreement between calculated and measured fields is good.

14.2.7 In the third test, the loads were very low, and, as explained previously, it is therefore not possible to determine the loads at the point of interest along the circuits with any accuracy. The graph for the third test shows that the fields predicted from the loads measured at the two ends do bracket the measured fields, which is as it should be, but beyond this, little can be deduced from this third test.

14.2.8 For the third test, the measured fields would suggest that the separation of the two circuits was slightly less than found in the other tests. It is not unexpected that the separation would vary slightly. The cables in the troughs are laid in a very gentle "S" bend, to allow for thermal expansion:



14.2.9 The measurements were taken in slightly different positions on each test, and the thermal conditions would be different also. Therefore, it is plausible that the separation of the two circuits would vary.

14.2.10 The cables at Chilling are laid in concrete troughs, and it is believed that the lids of the trough are made from reinforced concrete, and therefore presumably have steel reinforcing bars in them. These steel bars, being ferrous, have the potential to perturb the magnetic field. From the fact that the agreement between calculated and measured is still good, it can only be assumed that this effect is not significant.

14.3 Goring Gap

Dates and details of tests

14.3.1 Tests performed 14/8/17 by Drs Hayley Tripp and John Swanson.

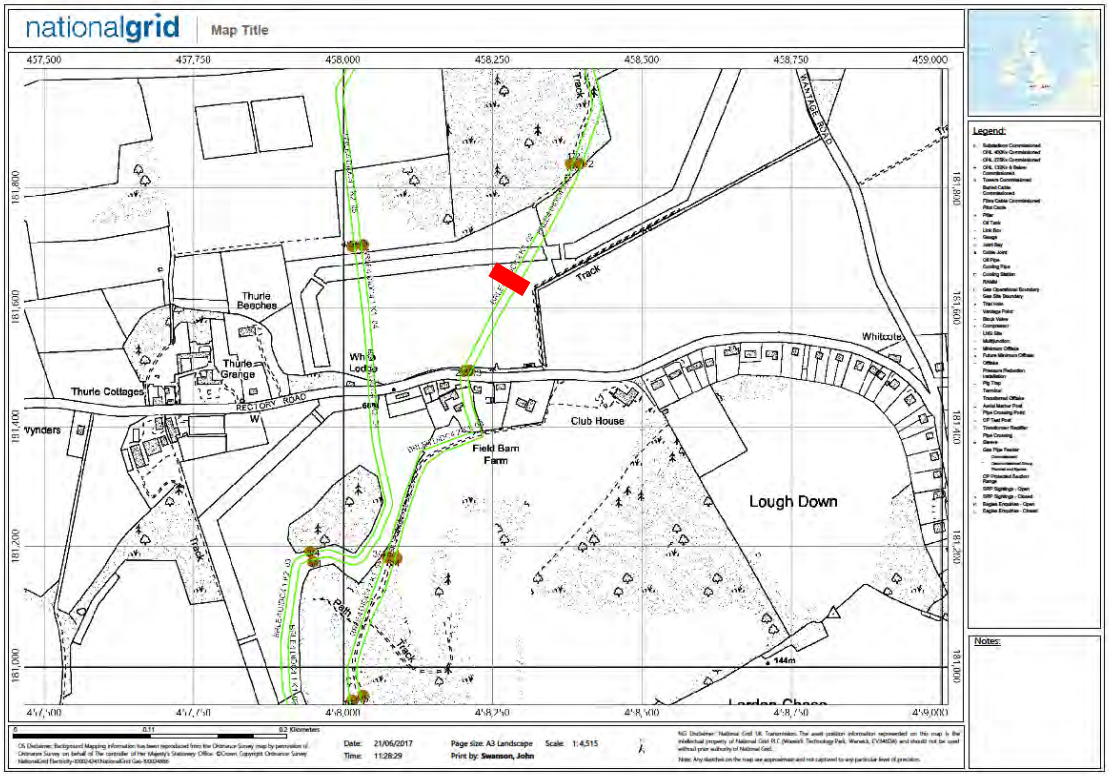
Overall location

14.3.2 These cables for part of National Grid's Bramley –Didcot 1 and 2 circuits.

Detailed location

14.3.3 Approximate location of test shown in red.

14.3.4 Note that these cables comprise two circuits, each with two sets of conductors or "groups". During summer 2017, the western or no 1 circuit was switched out for maintenance. This meant that there were just two groups of conductors in operation. In terms of magnetic fields, this is exactly the same as two circuits each with one group of conductors, as found at the other locations. The only difference is that the load is measured for the circuit as a whole, and therefore has to be divided by two to get the load in each group.

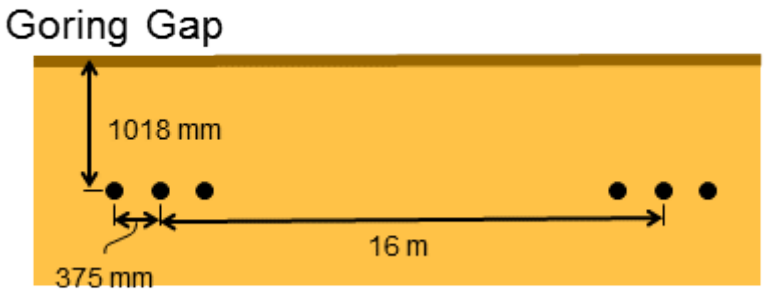


Site photographs

14.3.5 The cables run diagonally from middle-left to far-right of this picture. The tests were performed in the dip just before the fence, as this is where the contours of the land meant that the perpendicular to the cables was closest to level.

Cable geometry (original records)

Cable geometry (extracted parameters)



Order of phases facing north

RBY RBY

14.3.6 Note that the route diagrams indicate that the nominal spacing of the two cables was 13 m. However, on-site measurements clearly indicated a separation of 16 m at this location, and this is the separation used in the calculations.

Loads

14.3.7 Three profiles were taken:

- At ground level, with the meter pushed against the hard ground level at each point;
- At ground level, with the meter held against a horizontal wire stretched tightly across the tops of the various undulations in the local ground level; and
- At 1.5 m above ground level.

profile		"hard" ground level		"level" ground level		1.5 m agl	
measurement over:		W group	E group	W group	E group	W group	E group
time		1055	1100	1130	1135	1115	1125
measured at Bramley	MW	-495	-490	-375	-365	-355	-340
	MVAr	40	35	22.5	22.5	10	12.5
	kV	400	399.75	400.375	399.875	399.625	399.75
measured at Didcot	MW	495	477	391.5	364.5	351	346.5
	MVAr	-157.5	-153	-153	-148.5	-148.5	-144
	kV	399.25	399.25	400.125	399.75	400.125	399.75

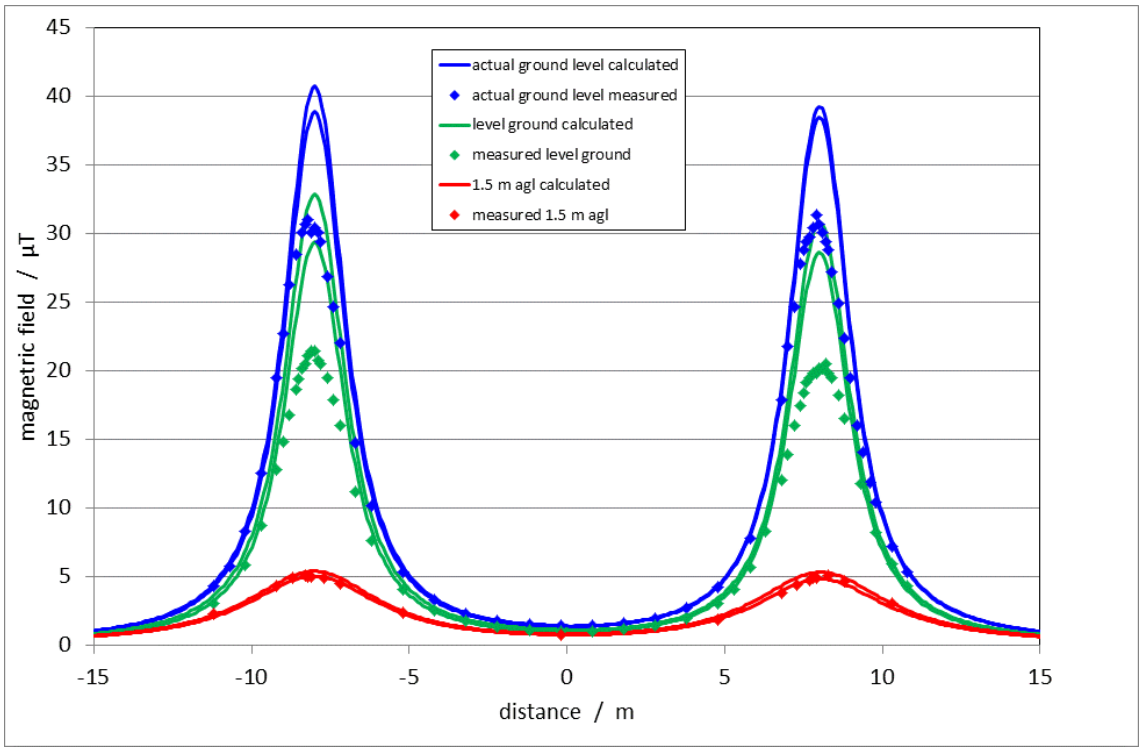
Test results

d / m relative to centre point	B / µT		
	"hard" ground level	1.5 m agl	"level" ground level
-11.2	4.3	2.26	3.04
-10.7	5.8		
-10.2	8.32		5.88
-9.7	12.52		8.74
-9.2	19.52	4.3	12.82
-9	22.72		14.86
-8.8	26.24		16.8
-8.7		4.9	
-8.6	28.48		18.68
-8.5			19.42
-8.4	30.08		20.16
-8.3	30.72	5.06	20.48
-8.2	31.04	5	21.12
-8.1	30.08	5.02	21.44
-8	30.4		21.44
-7.9	30.08		20.8
-7.8	29.44		20.48
-7.7		4.94	
-7.6	26.88		19.52
-7.4	24.64		17.92
-7.2	22.08	4.52	16
-6.7	14.72		11.18
-6.2	10.16		7.6
-5.2	5.34	2.34	4.1
-4.2	3.3		2.54
-3.2	2.32		1.76
-2.2	1.8		1.36
-1.2	1.52		1.14
-0.2	1.42	0.8	1.06
0.8	1.42		1.06

d / m relative to centre point	B / µT		
	"hard" ground level	1.5 m agl	"level" ground level
1.8	1.58		1.18
2.8	1.96		1.46
3.8	2.7		1.98
4.8	4.24	1.86	3.08
5.3			4.1
5.8	7.84		5.68
6.3			8.28
6.8	17.92	3.86	12.04
7	21.76		13.9
7.2	24.64		16
7.3		4.42	
7.4	27.81		17.5
7.5	28.8		18.38
7.6	29.44		19.14
7.7	29.76	4.74	19.52
7.8	30.4	4.88	19.84
7.9	31.36	4.94	19.84
8	30.72		20.16
8.1	30.08		20.16
8.2	29.44		20.48
8.3	28.8	5.06	19.84
8.4	27.2		19.52
8.6	24.96		18.24
8.8	22.4	4.7	16.54
9	19.52		
9.2	16		
9.3			11.8
9.4	14.08		
9.6	11.9		
9.8	10.4		8.22

10.3	7.18	3.08	5.9
10.8	5.36		4.36

Agreement between calculations and measurements

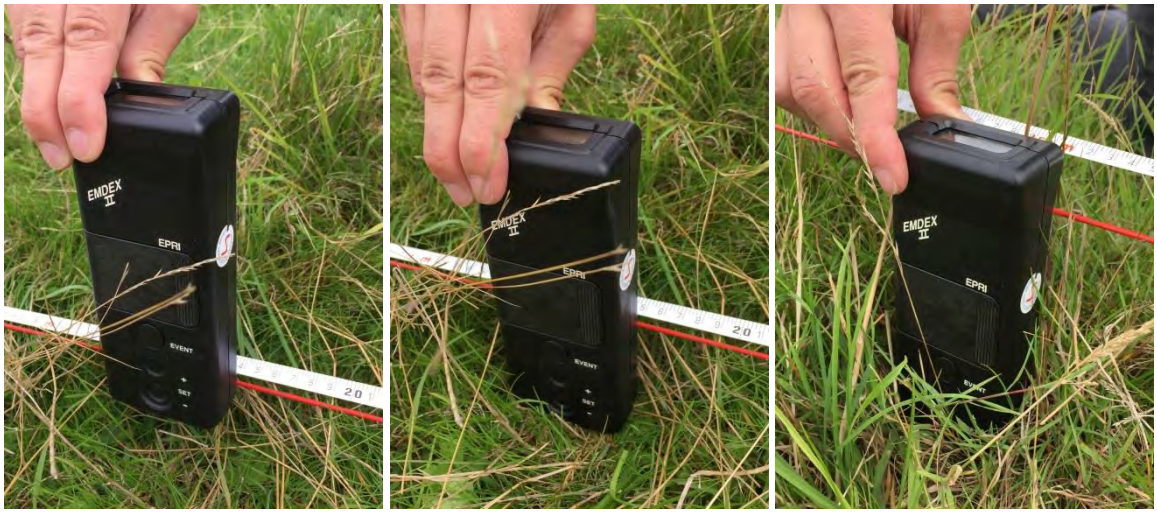


14.3.8 Note that the "actual ground level" and "level ground level" curves are both calculated for 0.02 m above ground level. They differ, not because they are at different heights, but because the loads were different at the times of the two measurements.

Discussion

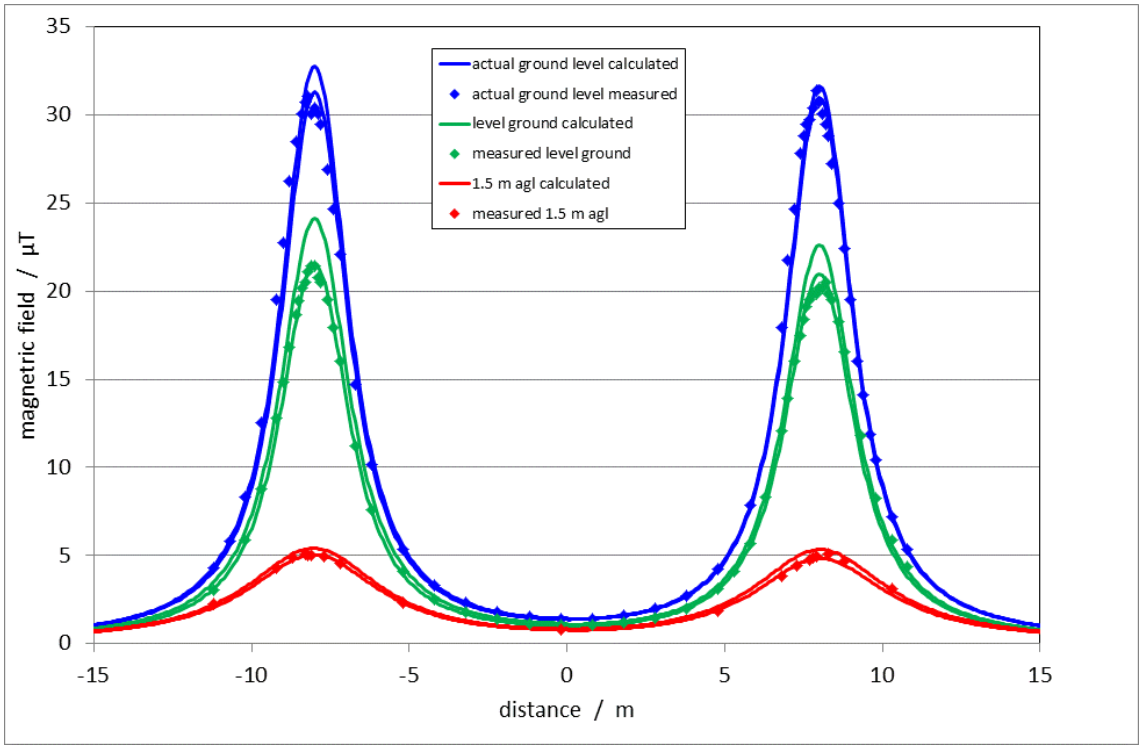
14.3.9 As can be seen, the calculations predict the shape of the field profile quite well, but there is a marked discrepancy in the values: the measured fields are less than the calculated fields.

14.3.10 This was anticipated, because, at this site, comprising rough pasture land, there is a problem defining the ground level. The following photos show three different locations just a metre or so apart. The red wire defines the same horizontal line, and in each case the meter is held against the local ground level. It can be seen that, because of the undulating, tussocky nature of the ground, the actual ground level is quite variable.



14.3.11 It is impossible to determine which the ground level was that the depth was measured against in 1987, thirty years ago, when these cables were laid. Subsequent ploughing could easily have altered the ground level.

14.3.12 Empirically, it was found that if the "hard ground" measurements were assumed to be on average 130 mm above the 1987 notional ground level, and the "level ground" measurements 190 mm above, the agreement between calculated and measured becomes quite good:



14.3.13 This amount of uncertainty in the depth of the cables relative to the current ground level is considered plausible.

14.4 Perry Park

Dates and details of tests

14.4.1 Tests performed 25/7/17 by Chris Haswell and Dr Hayley Tripp.

Overall location

14.4.2 These cables form part of the National Grid Bustleholme-Nechells 1 and 2 circuits.

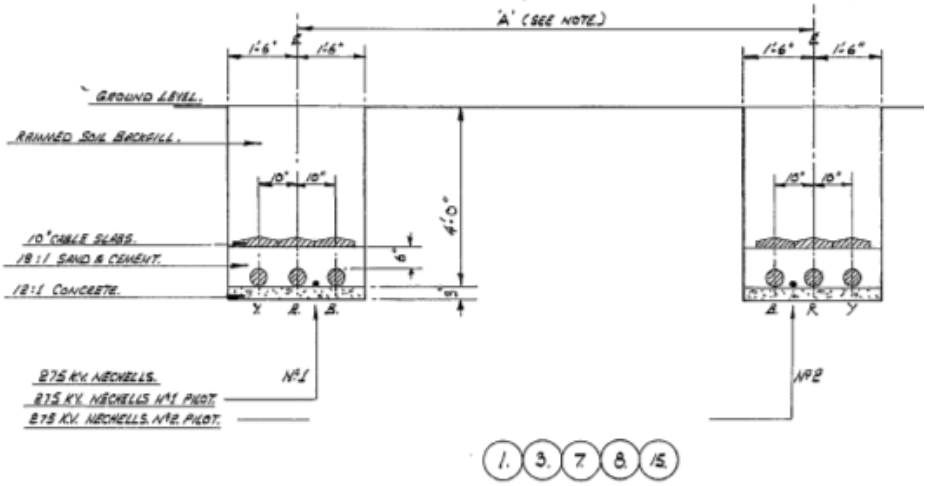
Detailed location

14.4.3 Approximate location of tests shown in red.

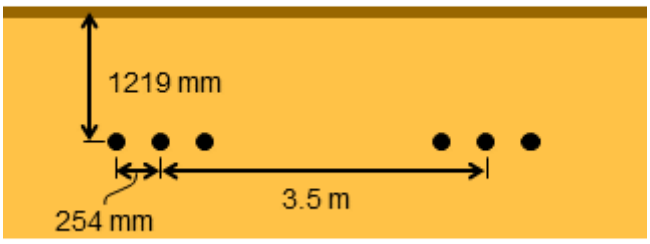
Site photographs

14.4.4 The cables run from far-left to near-right in this photo. The tape measure shows the location of the tests.

Cable geometry (original records)



Cable geometry (extracted parameters)



Order of phases facing west

YRB BRY

Loads

14.4.5 Two profiles were obtained:

- Ground level; and
- 1 m agl.

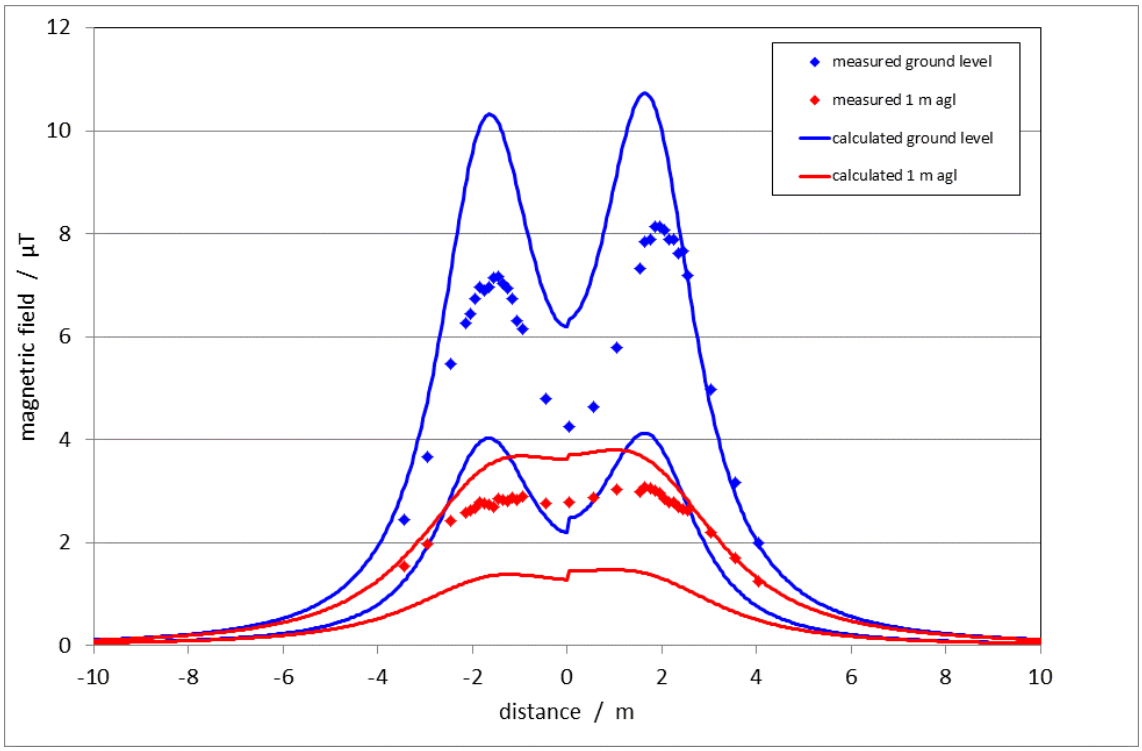
	profile		ground level		1 m agl	
	measurement over:		Cct 1	Cct 2	Cct 1	Cct 2
	time		1415	1420	1415	1420
Circuit 1	measured at Bustleholme	MW	31.3	31.3	31.3	31.3
		MVAr	-7.8	-7.8	-7.8	-7.8
		kV	275	275	275	275
	measured at Nechells	MW	-30	-30	-30	-30
		MVAr	-75	-75	-75	-75
		kV	275	275	275	275
Circuit 2	measured at Bustleholme	MW	23.5	31.3	23.5	31.3
		MVAr	-7.8	-7.8	-7.8	-7.8
		kV	275	275	275	275
	measured at Nechells	MW	-30	-30	-30	-30
		MVAr	-75	-78.8	-75	-78.8
		kV	275	275	275	275

Test results

d / m relative to centre line	B / µT	
	Ground level	1 m agl
-3.45	2.44	1.54
-2.95	3.66	1.96
-2.45	5.48	2.42
-2.15	6.26	2.58
-2.05	6.44	2.62
-1.95	6.74	2.68
-1.85	6.96	2.78
-1.75	6.9	2.76
-1.65	6.96	2.74
-1.55	7.14	2.7
-1.45	7.16	2.86
-1.35	7.04	2.84
-1.25	6.94	2.8
-1.15	6.74	2.88
-1.05	6.32	2.82
-0.95	6.16	2.9
-0.45	4.8	2.76

d / m relative to centre line	B / µT	
	Ground level	1 m agl
0.05	4.26	2.78
0.55	4.64	2.88
1.05	5.8	3.04
1.55	7.32	2.98
1.65	7.84	3.08
1.75	7.88	3.06
1.85	8.14	3.02
1.95	8.14	2.96
2.05	8.08	2.86
2.15	7.9	2.78
2.25	7.88	2.78
2.35	7.62	2.7
2.45	7.66	2.64
2.55	7.2	2.62
3.05	4.98	2.2
3.55	3.16	1.7
4.05	2	1.24

Agreement between calculations and measurements



Discussion

14.4.6 This is a location where the loads were very low, and therefore, as explained previously, it is not possible to determine the loads at the point of interest along the circuit with any degree of accuracy. As can be seen from the graph, the fields calculated from the measured loads at the two ends of the circuit do indeed bracket the measured fields, which is as it should be, but little more can be concluded from this test.

14.5 Grain

Dates and details of tests

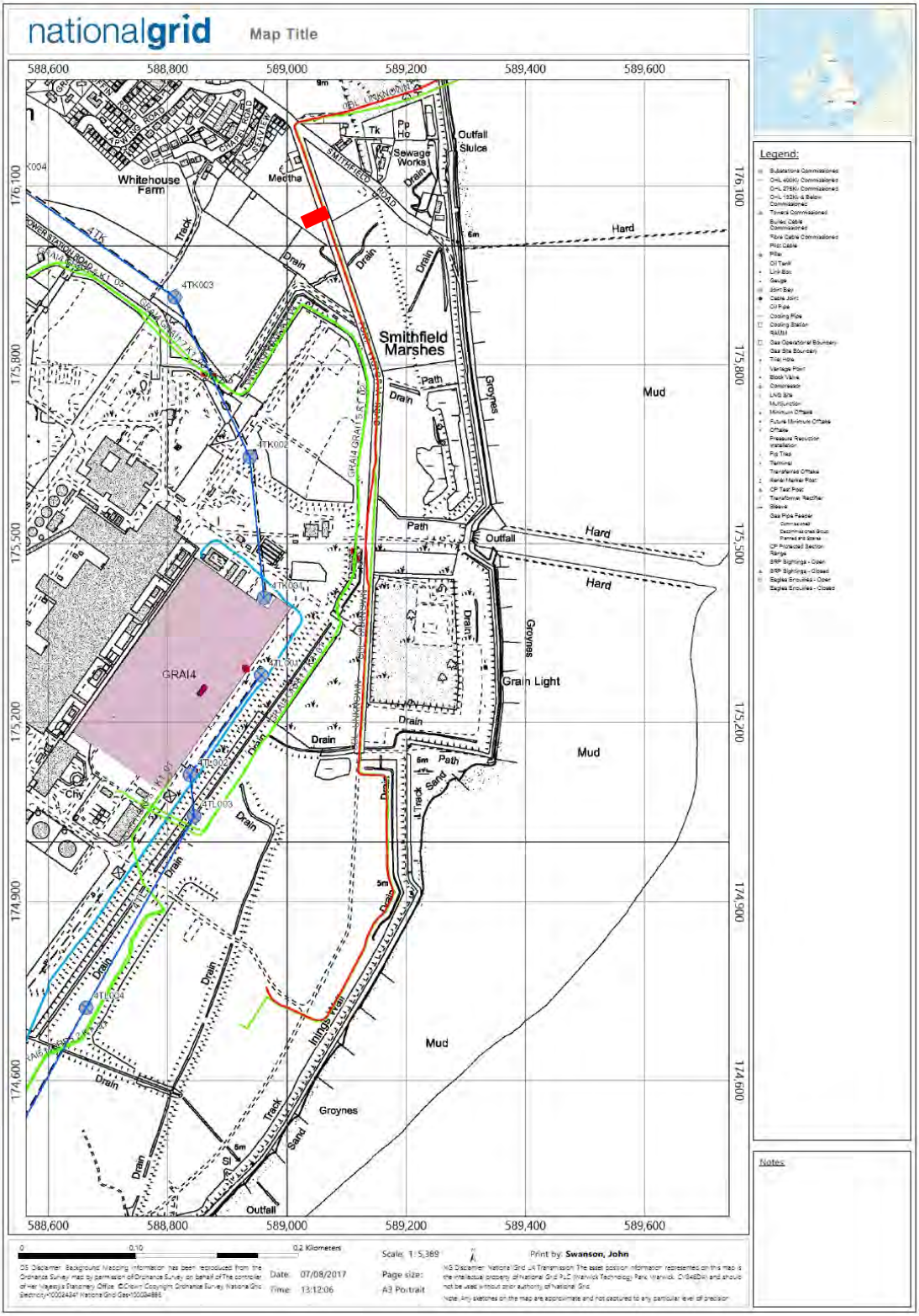
14.5.1 Test conducted 21 August 2017 by Chris Haswell and Dr John Swanson.

Overall location

14.5.2 These cables are the on-land part of the cables to the Netherlands that form the BritNed connection.

Detailed location

14.5.3 The approximate location of the test is shown by the red line.



Site photographs

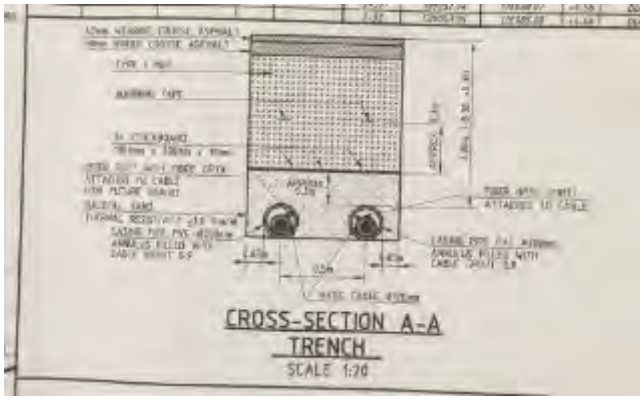
14.5.4 The test was conducted in Port Victoria Road, using the full width of the road and continuing on the west side over the fence into a privately-owned field with

permission from the landowner. Access to the east side of the road was not possible.

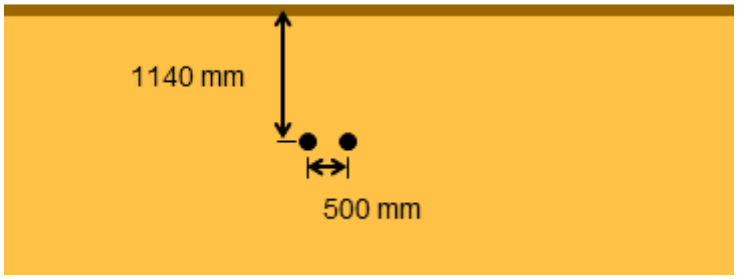
Port Victoria Road, looking across width of road towards field

Field to west of Port Victoria Road, looking back towards road

Cable geometry (original records)



Cable geometry (extracted parameters)



Polarity of cables

\+ -

14.5.5 Cable bearing 160° grid. Variation 2°W.

Loads

14.5.6 As supplied by the control room, the load was a constant 961 MW at ±450 kV, equivalent to 1067 A.

Test results

Compass deviation		
d / m	bearing to distant object	
	Observer A	Observer B
distant from cable	258	258
-0.403	273	272.5
-0.192	264	264
0.011	251	251
0.188	249.5	249
0.376	243	243
0.582	237	237
0.798	234	234
0.971	231.5	232
1.179	230	230
1.359	229	229
1.576	229	228.5
1.789	229	228.5
1.947	229.5	229.5
2.153	230.5	230.5
2.332	231.5	232

Compass deviation		
d / m	bearing to distant object	
	Observer A	Observer B
2.519	232.5	232.5
2.712	234	233.5
3.028	236.5	236
3.246	237.5	237
3.455	239	239
4.469	245	244.5
4.738	246.5	246
4.989	247.5	247.5
5.718	250	250
6.322	251.5	251.5
7.016	253.5	253
8.178	254.5	254.5
9.198	256	256
10.82		256.5
13.13		257
24.7	257.5	258

Total DC field	
d / m	magnetic field / µT

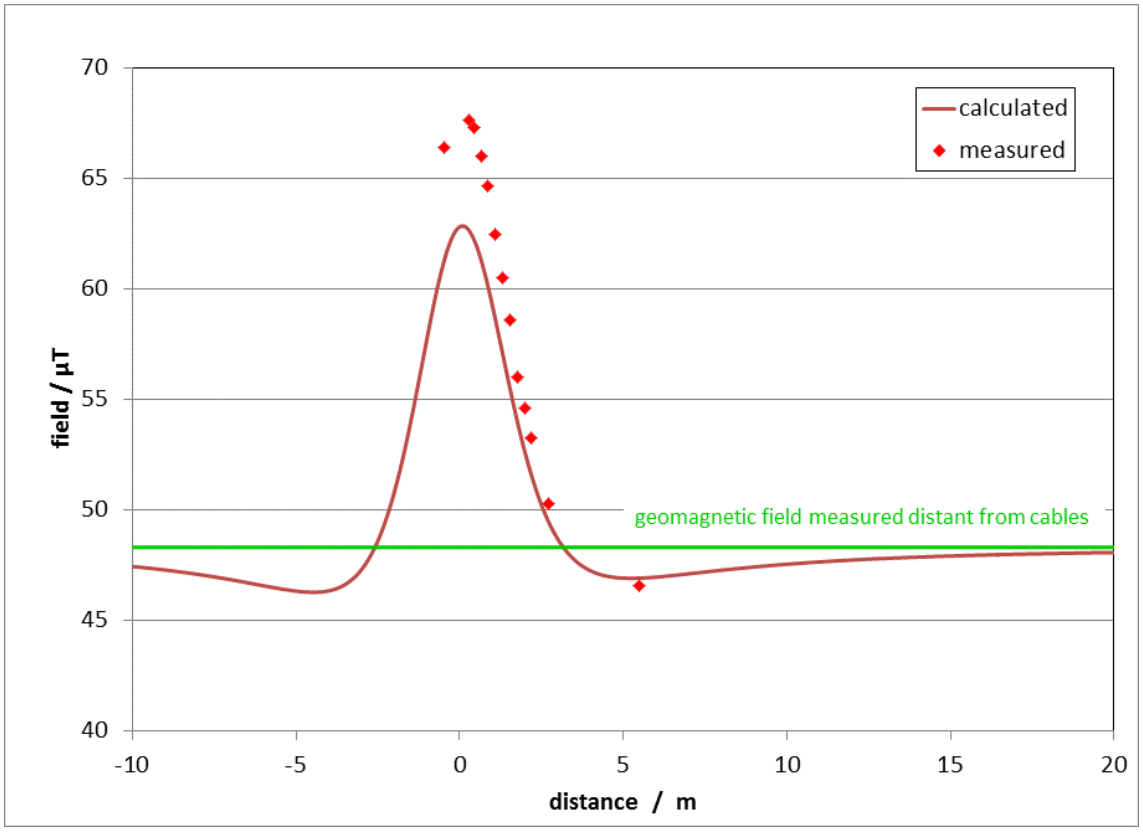
	Bx	By	Bz

Total DC field			
d / m	magnetic field / µT		
	Bx	By	Bz
-0.458	-1.78	19.504	63.48
0.285	9.98	18.79	64.22
0.438	11.02	19.2	63.58
0.65	13.75	18.68	61.81
0.86	16.43	18.21	59.82
1.095	15.83	19.152	57.3
1.324	16.36	19.5	54.89
1.54	16.98	18.89	52.79

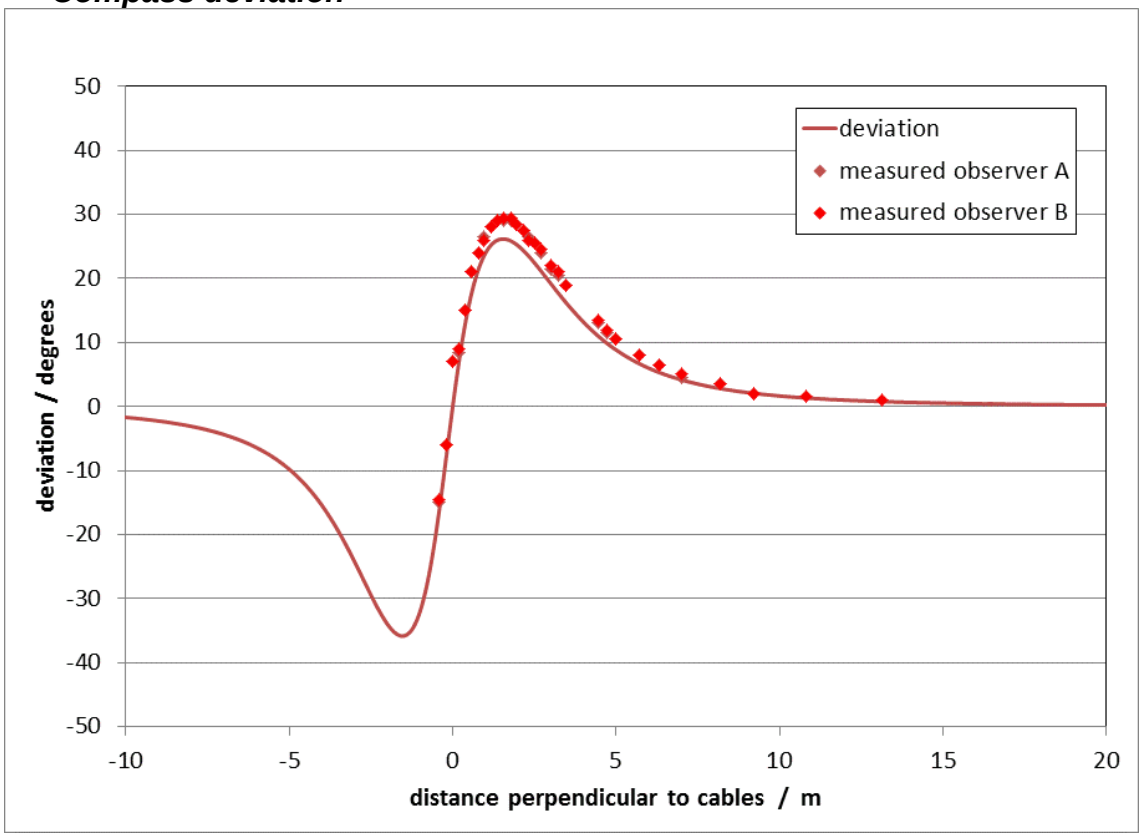
Total DC field			
d / m	magnetic field / µT		
	Bx	By	Bz
1.772	18.25	17.54	49.98
1.99	16.8	18.29	48.63
2.205	16.34	18.89	47.06
2.705	12.03	19.41	44.81
5.494	6.94	17.59	42.53
distant from cables	5.32	15.08	45.57

Agreement between calculations and measurements

Total field

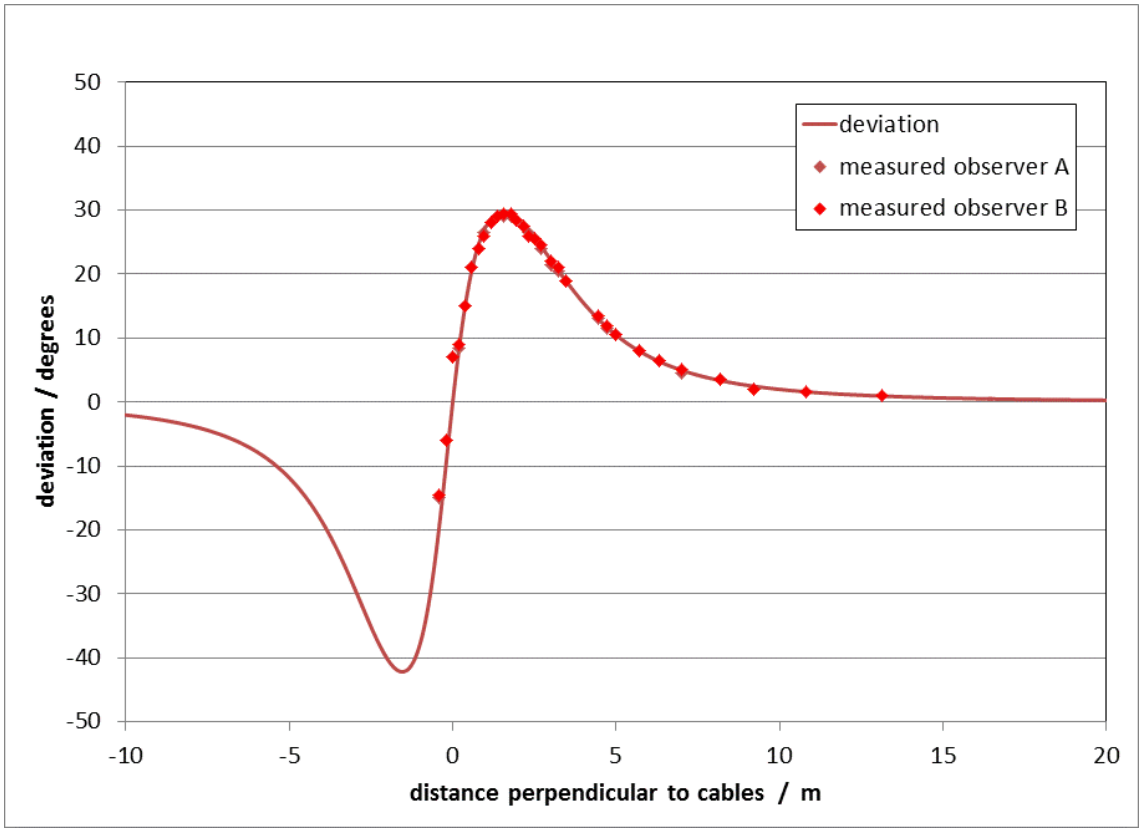


Compass deviation



Discussion

14.5.7 The calculated fields and deviation replicate the shape of the measured field, but there is a scaling discrepancy. This discrepancy would be largely removed if the spacing of the cables were 0.6 m instead of the stated 0.5 m, as shown in the following revised graph for the compass deviation:



14.5.8 A 10 cm variation in the spacing of the cables does not seem out of the question. This raises the question of how one could check the spacing of the cables if desired. One obvious technique would normally be to measure the magnetic field. This therefore creates a paradox: the purpose of the tests is to check that, given the position of the cables, we can calculate the magnetic field; but the most accurate way to determine the position of the cables is to measure the magnetic field!

14.6 Bakers Gap

Dates and details of tests

14.6.1 Test performed 29 August 2017 by Chris Haswell and Dr John Swanson.

Overall location

14.6.2 These cables are the on-land part of the cables to France that form the current IFA (or IFA1) connection.

Detailed location

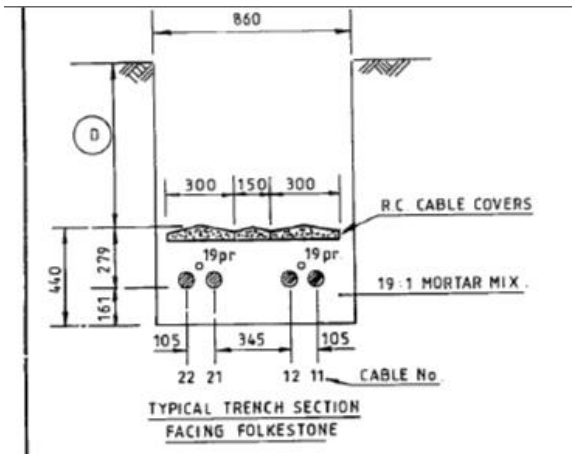
14.6.3 The on-land IFA1 cables run from the convertor station at Sellinge to Folkestone. “Bakers Gap” is the location in Folkestone where the cables leave land and go to sea. The chosen location for the test is just a few hundred metres from Bakers Gap. The approximate location is shown in red.

Site photographs

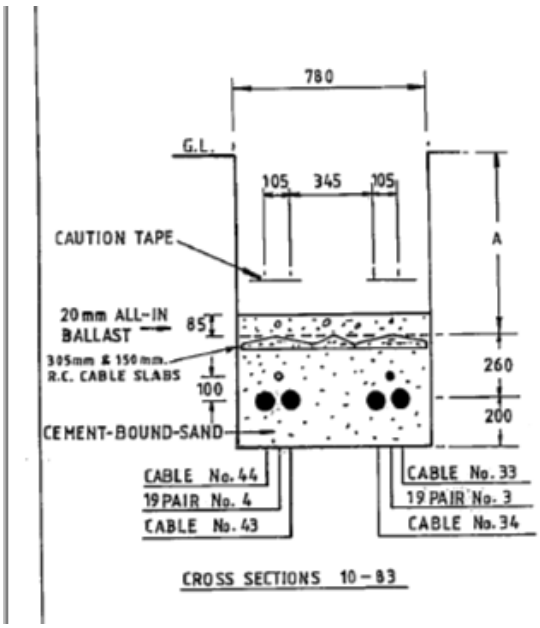
14.6.4 The two bipoles both run on the east side of Wear Bay Road (the right-hand side in the photo). Bipole 1 is close to the edge of the road, Bipole 2 just the other side of the wooden fence. Measurements were made across the verge and

extending into the park, but not, for safety reasons, in the other direction into the road.

Cable geometry (original records)

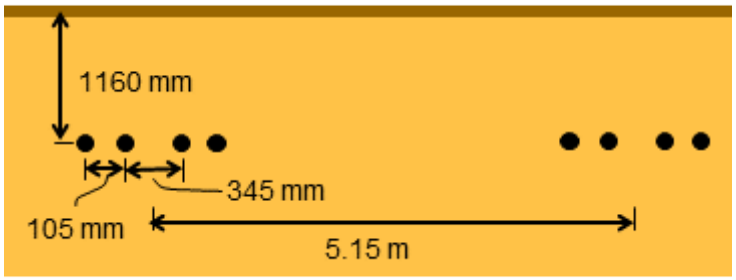


Bipole 1



Bipole 2

Cable geometry (extracted parameters)



Polarity of cables

+ - + - + - + -

14.6.5 Cable bearing 14° grid. Variation 2°W.

Loads

14.6.6 As supplied by the control room, the load was a constant 2000 MW (1000 MW per bipole, the rating) at ±270 kV, equivalent to 963 A per conductor.

Test results

compass deviation		
d / m	bearing to distant object	
	Observer A	Observer B
-4.122	40	39.5
-3.914	39.5	39.5
-3.635	40	39.5
-3.326	41.5	41.5
-3.022	44.5	44.5
-2.696	48.5	48.5
-2.331	52.5	53
-1.598	58	58
-1.154	58.5	58.5
-0.656	57	57.5
-0.215	54.5	54.5
0.334	51.5	51
1.172	48.5	48.5
1.572	49.5	49.5
1.849	51.5	51

compass deviation		
d / m	bearing to distant object	
	Observer A	Observer B
2.286	54.5	54.5
2.539	56.5	56.5
2.744	58.5	58
2.994	60	60.5
3.385	62	62.5
3.897	62	62.5
4.318	62.5	62
4.833	61	61
5.389	60	59.5
6.3	57.5	57.5
7.962	55	55.5
9.116	54	54.5
10.49	54	53.5
16.67	52.5	52.5
distant from cables	52	52

total field			
d / m	magnetic field / µT		
	Bx	By	Bz

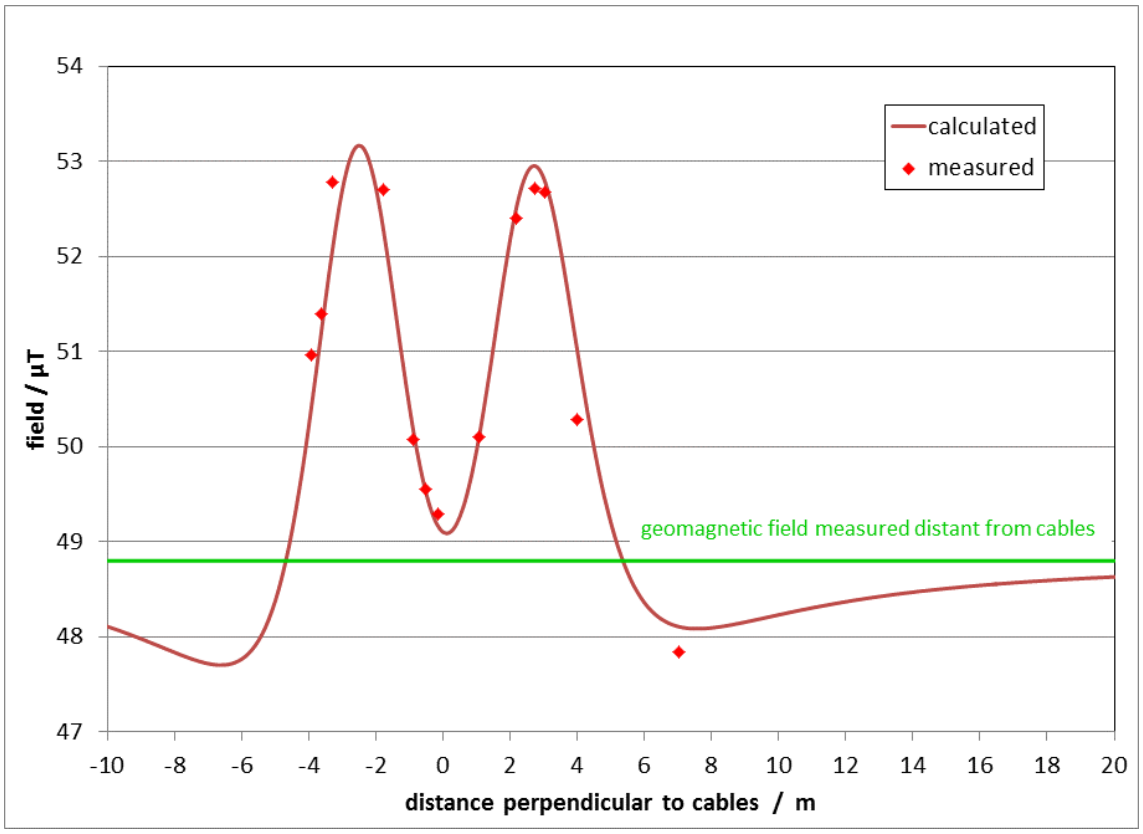
total field			
d / m	magnetic field / µT		
	Bx	By	Bz
-3.93	-3.35	-18.72	47.28

total field			
d / m	magnetic field / µT		
	Bx	By	Bz
-3.649	-2.42	-17.62	48.22
-3.284	-3.32	-18.81	49.2
-1.793	-7.81	-18.58	48.7
-0.897	-7.66	-18.2	46.02
-0.529	-8.62	-18.38	45.2
-0.17	-7.56	-18.39	45.1
1.081	-5.1	-17.72	46.59
2.186	-6.61	-18.1	48.73
2.727	-9.78	-18.42	48.42

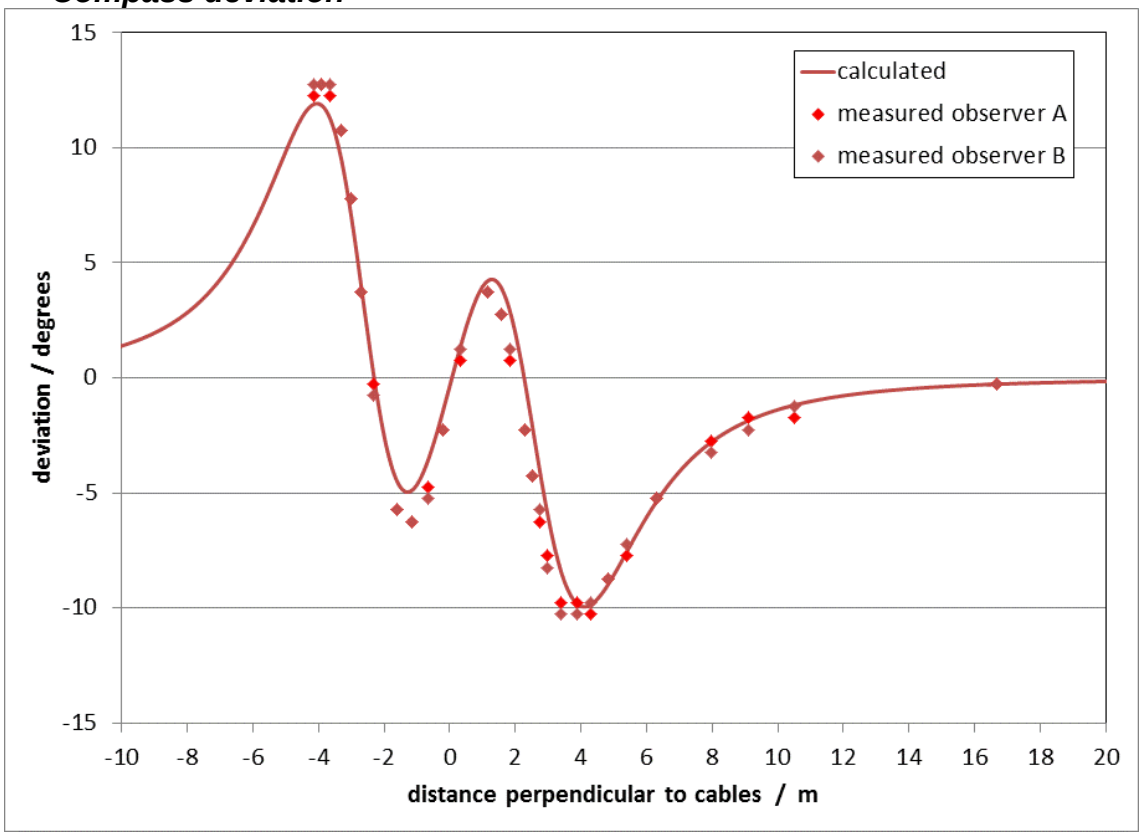
total field			
d / m	magnetic field / µT		
	Bx	By	Bz
3.015	-9.6	-17.22	48.85
4.008	-10.9	-17.62	45.82
7.028	-8.56	-17.08	43.86
10.033	-7.98	-16.95	44.02
16.1	-5.8	-14.8	45.2
distant from cables	-0.03	-19.74	44.63

Agreement between calculations and measurements

Total field

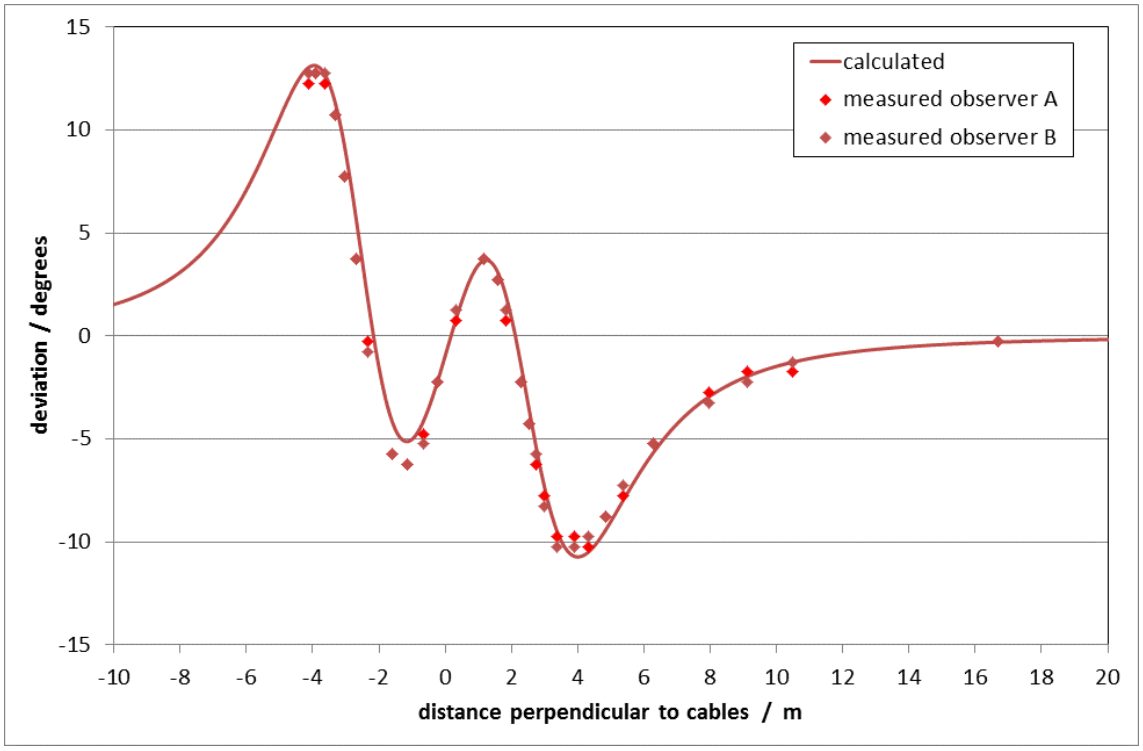


Compass deviation



Discussion

14.6.7 This test was anticipated to be one of the trickiest, because there are 8 separate conductors to account for, increasing the scope for small positional errors to affect the agreement. In fact, as can be seen, the agreement is quite good using the stated parameters. The remaining discrepancies are easily accounted for by small position errors. For example, manually (and post-hoc) adjusting individual conductors by no more than 20 mm each produces the following improved fit:


calculated
measured observer A
measured observer B
deviation / degrees
distance perpendicular to cables / m
15
10
5
0
-5
-10
-15
-10
-8
-6
-4
-2
0
2
4
6
8
10
12
14
16
18
20

14.7 Prysmian: AC tests

Dates and details of tests

14.7.1 Test conducted 4 September 2017 by Dr John Swanson and other members of National Grid and Prysmian staff. Test repeated 8 September 2017 with stakeholders.

14.7.2 This test was conducted at the maximum load the IFA2 cables are intended to be rated at, thereby simulating the maximum field that could be produced by the final cables. (A lower load was used on the Monday when the test setup was still being developed.)

Site layout

14.7.3 The cables were laid out on the ground at Prysmian's test facility at Bishopstoke.

14.7.4 The installation comprised:

- Approx 25 m of HVAC cables installed in plastic ducts in trefoil arrangement.
- Approximately 50 m either end of this length comprised of bonding lead, laid so as to preserve roughly the same spacing, but in flat formation not trefoil.
- Generation equipment to energise the cables at 800 A.
- Passive screening loops along the 25 m length, which could be either disconnected, to test the unscreened condition, or connected, to test the screened condition.

Site photographs

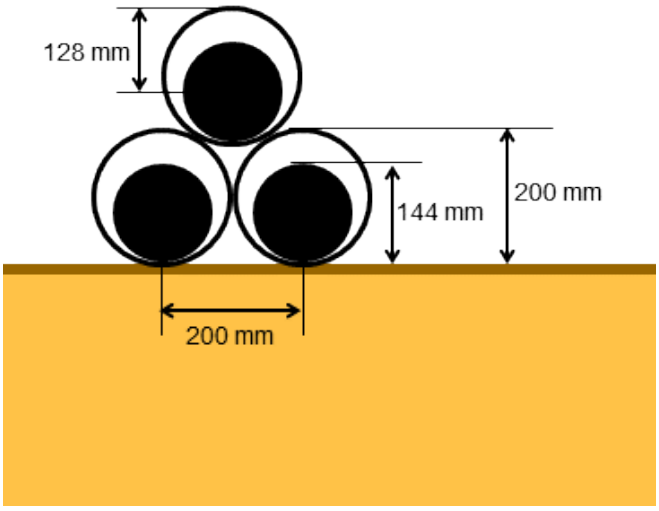
General arrangement of AC cables

Passive screening loops disconnected for unscreened test

passive screening loops connected for screened test

Cable geometry

14.7.5 The cables are 144 mm diameter laid inside a trefoil arrangement of 200 mm diameter plastic ducts.



Loads

14.7.6 The loads were maintained at:

- Monday: 520 A;
- Friday: 818 A.

Test results

Tests on Monday (520 A)

unscreened	
d / m	B / µT
0	9.18
0.58	8.14
1.07	6.38
1.55	4.8
2.29	3.08
3.57	1.6
5.38	0.8
-0.505	8.2
-1.06	6.48
-1.82	4.08
-2.73	2.46
-4.71	1.04
-6.81	0.57

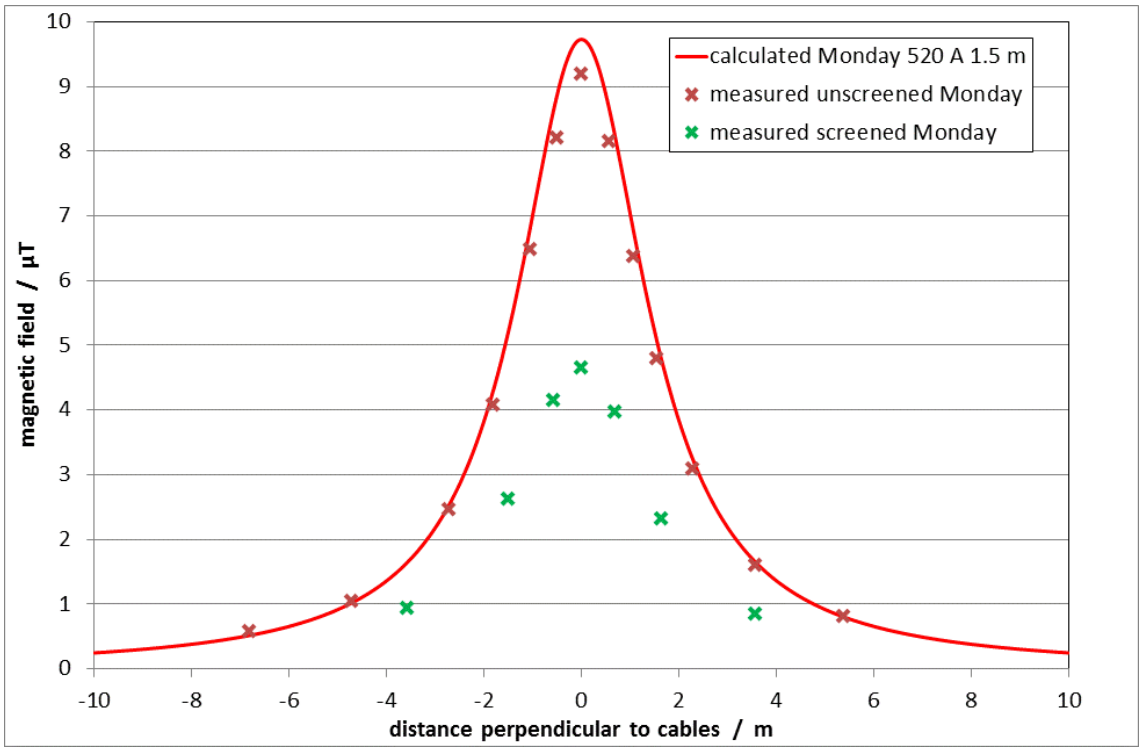
screened	
d / m	B / µT
0	4.64
0.68	3.96
1.63	2.32
3.58	0.85
-0.565	4.14
-1.5	2.62
-3.585	0.94

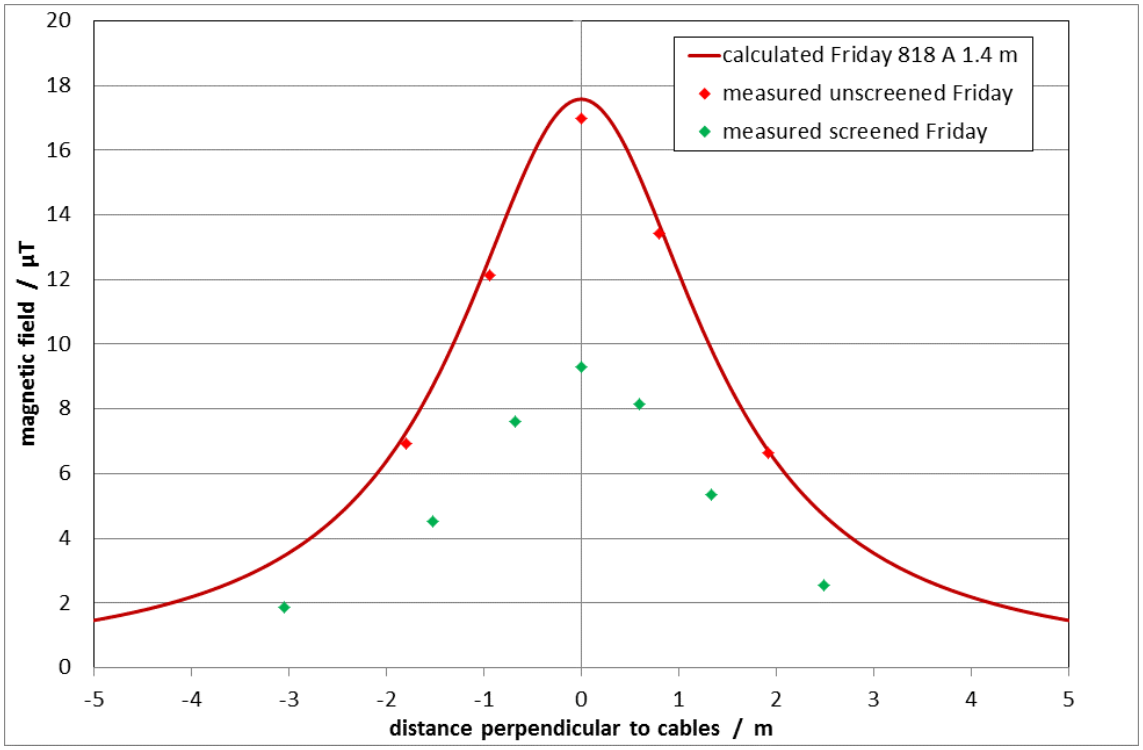
Tests on Friday (818 A)

unscreened	
d / m	B / µT
0	16.96
-0.941	12.14
-1.805	6.94
0.803	13.42
1.921	6.64

screened	
d / m	B / µT
0	9.28
-0.681	7.6
-1.526	4.54
-3.056	1.86
0.597	8.14
1.335	5.34
2.493	2.54

Agreement between calculations and measurements





Discussion

14.7.7 For the unscreened cables, the agreement between calculated and measured fields is good. The fact that the agreement was good on both days, when the currents were different, provides extra reassurance. The small discrepancy of 3-4% is easily within the range explicable by the calibration of the instruments, or by small positional variations in the cables (it would require only 7 mm variation in the cable positions to explain this).

14.7.8 The screening reduces the fields to 50-55% of the unscreened values. Again, this is consistent for the different currents on the two days.

14.8 Prysmian: DC tests

Dates and details of tests

14.8.1 Test conducted 4 September 2017 by Dr John Swanson and other members of National Grid and Prysmian staff. Tests repeated 8 September 2017 with stakeholders present.

14.8.2 This test was conducted at the maximum load the IFA2 cables are intended to be rated at, thereby simulating the maximum field that could be produced by the final cables.

Site layout

14.8.3 The cables were laid out on the ground at Prysmian's test facility at Bishopstoke.

14.8.4 The tests of unscreened and screened cables were physically separate. The unscreened test was conducted on bonding leads laid out on the ground at 200 mm separation, simulating the actual cables. The screened test was conducted on actual HVDC cables, installed in plastic ducts, in turn laid inside the screening tube.

14.8.5 As with the AC test, the 25 m test length was extended by bonding leads for approximately 50 m in each direction.

14.8.6 On the Monday tests, the test line was in line with one of the flanges where sections of the steel screening tube are bolted together. On the Friday tests, the test line was half-way between flanges.

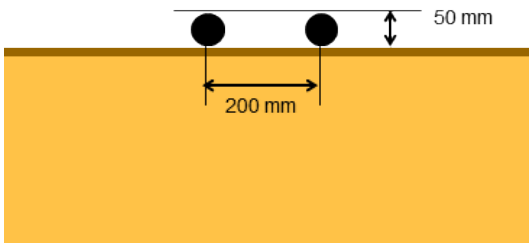
Site photographs

Unscreened test. Bonding leads simulating cables.

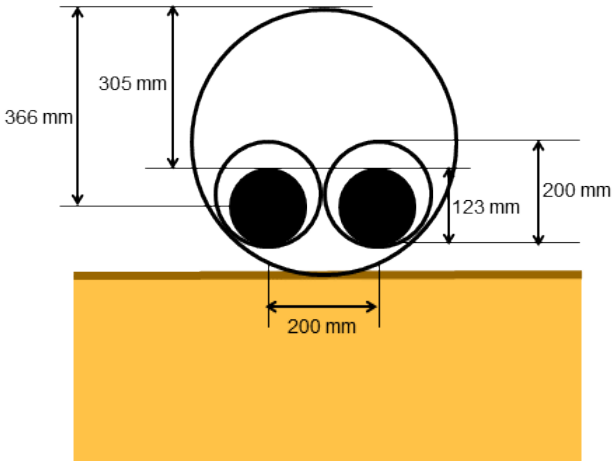
Screened test. View along perpendicular measuring line (Friday) half way between flanges. Tests on Monday were in line with left-hand flange in this picture.

Screened test. End view of cables in steel tube.

Cable geometry



Unscreened



Screened

14.8.7 Cable bearing 20° magnetic.

Loads

14.8.8 The load for all tests was maintained at 1630-1650 A.

Test results

Total field

Monday unscreened

d / m	Bx	By	Bz
0.006	7.033	19.37	13.13
-0.183	15.56	19.3	15.01
-0.561	26.13	19.45	24.45
-2.402	13.99	19.19	48.17
0.008	8.096	18.19	13.45
0.308	-2.155	18.54	15.95
0.683	-10.776	18.6	25.93
1.391	-9.128	17.39	41.96
3.511	4.394	17.91	46.89

Monday screened

d / m	Bx	By	Bz
0	7.022	18.617	41.22

Friday unscreened

d / m	Bx	By	Bz
0	6.184	-19.23	43.65
0	4.56	-18.06	16.17
0.547	7.66	-18.05	23.86
-0.573	-21.65	20.79	26.37

Friday screened

d / m	Bx	By	Bz
0	-10.4	-13.03	37.62
-0.495	-8.4	-16.1	39.5
-1.295	-13.31	-14.82	43.35
-2.633	-10.12	-17.37	44.76
-4.736	-10.47	-17.84	44.56
0.5	-5.753	-14.86	37.86
1.045	-5.67	-15.99	40.95
2.281	-6.56	-18.87	43.66
4.456	-9.88	-18.03	43.87

Compass deviation

Monday unscreened

d	deviation
0.039	-0.5
-0.225	-21.5
-0.432	-29.5
-0.719	-33
-0.999	-33
-0.907	-33
-1.435	-29
-1.789	-24.5

Monday screened

d	deviation
-0.828	-9
-0.568	-10
-0.372	-9
-1.196	-8.5
-2.188	84.5
-4.065	-2
0.703	3.5
1.086	5

Friday unscreened

d	deviation
0	-0.5
0.021	-0.5
-0.348	-27.5
-0.557	-32.5
-0.724	-35
-0.858	-34
-1.101	-33
-2.751	-13.5

Friday screened

d	deviation
0	-10
-0.527	-16.5
-0.838	-16.5
-1.106	-15
-1.43	-12.5
-2.82	-5
-5.283	-1
0.528	6

-2.773	-13
-4.958	-4.5
-12.643	0.5
0.019	-2.5
0.322	31
0.552	48
0.815	55
1.138	52.5
1.348	48.5
2.24	25
3.989	5
7.062	3.5
13.701	0.5

1.281	5
1.593	4.5
1.951	4
2.939	2
6.601	0
-6.542	-1
-8.258	0

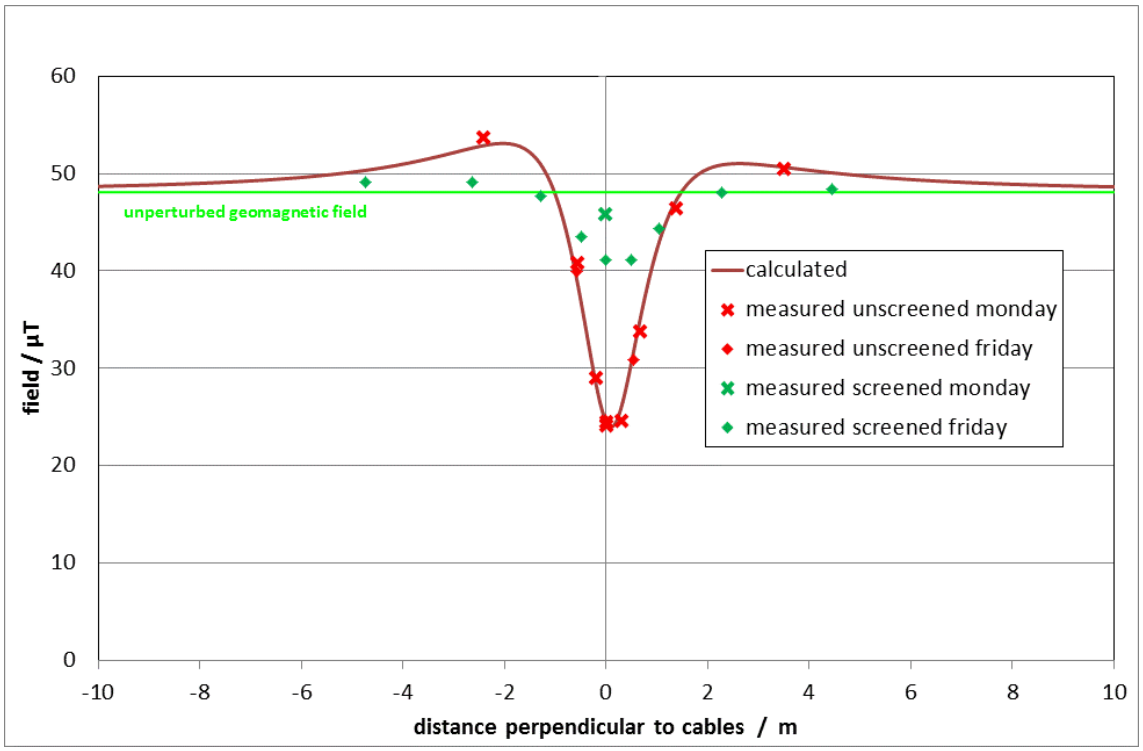
0.409	41
0.677	54
0.881	55
1.076	53.5
2.717	16.5

0.877	11
1.098	12
1.269	11.5
1.269	11.5
1.524	10.5
2.008	8.5
3.1	5
6.346	2.5

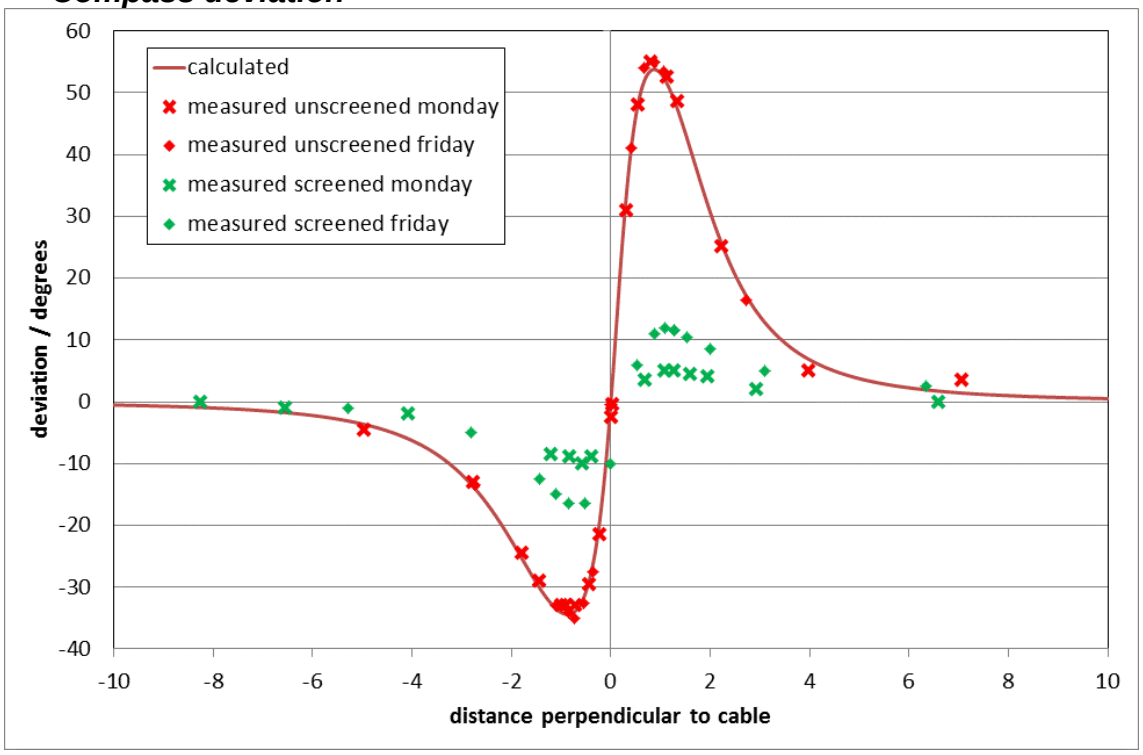
Agreement between calculations and measurements

14.8.9 As the current for the tests on the two days was the same, the results have been consolidated onto a single set of graphs.

Total field



Compass deviation



Discussion

14.8.10 For the unscreened cables, the agreement between calculated and measured, both for total field and for compass deviation, is good. Measured values were also highly reproducible on the two days, providing extra confidence in these results.

14.8.11 For the screened test, three things can be noted:

- The screening provides significant reduction in the field and the compass deviation.
- The extent of the reduction is different for the two tests on different days.
- The shape of the curves is different for the screened and unscreened tests: the asymmetry, predicted and found for the unscreened test and explained in detail in Annex D, is different for the screened test, and the zero-crossing of the compass deviation curve is shifted away from zero distance.

14.8.12 The change in the shape of the curves is explicable by two factors.

14.8.13 Firstly, the two cables in their ducts do not preserve an exact horizontal layout as they pass through the steel tube, but twist slightly, as can be seen (just about) from this photo:

14.8.14 Modelling shows that a twist such as this does indeed produce changes in the symmetry of the curves, including the offset zero-crossing.

14.8.15 Secondly, separate tests show that the magnetic properties of the steel tubes vary along their length. Specifically, there appears to be some weak remnant magnetisation in some of the tubes, which would both affect the measured field directly, but also alter the permeability of the steel and hence its screening effectiveness.

14.8.16 It can be concluded that the steel tubes as used for this test produce an amount of screening that is at least a factor of two and sometimes greater.

14.8.17 These tubes had to be procured to tight timescales to allow these tests to proceed. For the tubes used for the eventual IFA2 installation, it is expected that further work with the suppliers and tighter specifications will reduce the variability and improve the screening effectiveness further.

14.9 Daedalus: AC tests

Dates and details of tests

14.9.1 Test conducted 16 October 2017 by Chris Haswell and Dr John Swanson and other members of National Grid and Prysmian staff. Test repeated 17 October 2017 with stakeholders.

14.9.2 This test was conducted at the maximum load the IFA2 cables are intended to be rated at, thereby simulating the maximum field that could be produced by the final cables.

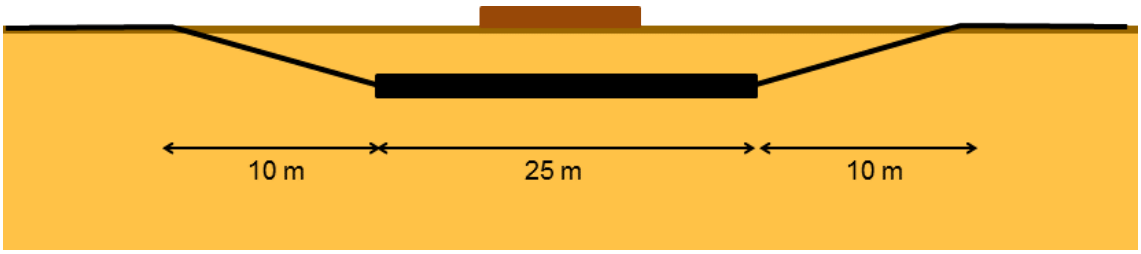
14.9.3 Detailed measurements, at sufficient points to plot a profile, were performed on the Monday. In the interests of time, on the Tuesday, just one point (directly over the cables) was repeated.

Site layout

14.9.4 The cables were buried within the perimeter of Daedalus Airfield towards the south-east edge.

14.9.5 The installation comprised:

- Approximately 25 m of HVAC cables installed in plastic ducts in trefoil arrangement, with passive screening loops, at a depth of approximately 1.2 m to the top of the top duct.
- Approximately 10 m either end of this length comprised of bonding lead, laid so as to preserve roughly the same spacing, but in flat formation not trefoil, and sloping up to ground level
- Further bonding leads at ground level to connect to the generation equipment.
- Wooden trackway running transversely across the middle of the buried section to allow aircraft to taxi over the cables.
- Generation equipment to energise the cables at 800 A.



Longitudinal cross-section of installation

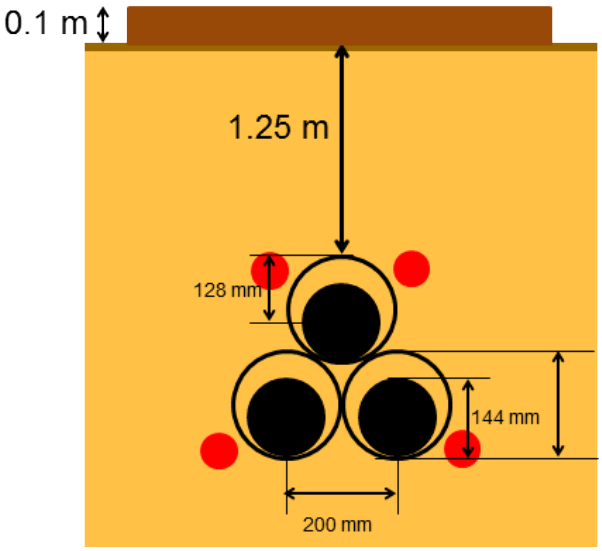
Site photographs

General view of site showing wooden trackway crossing backfilled cable trenches.

AC conductors and passive screening loops, after backfilling main conductor section, but prior to installation of bonding leads.

Cable geometry

14.9.6 The cables are 144 mm diameter laid inside a trefoil arrangement of 200 mm diameter plastic ducts. The top of the top duct was 1.25 m below the ground level, with an extra thickness of 0.1 m on top of that from the wooden trackway.



Loads

14.9.7 The loads were maintained at 800 A.

Test results

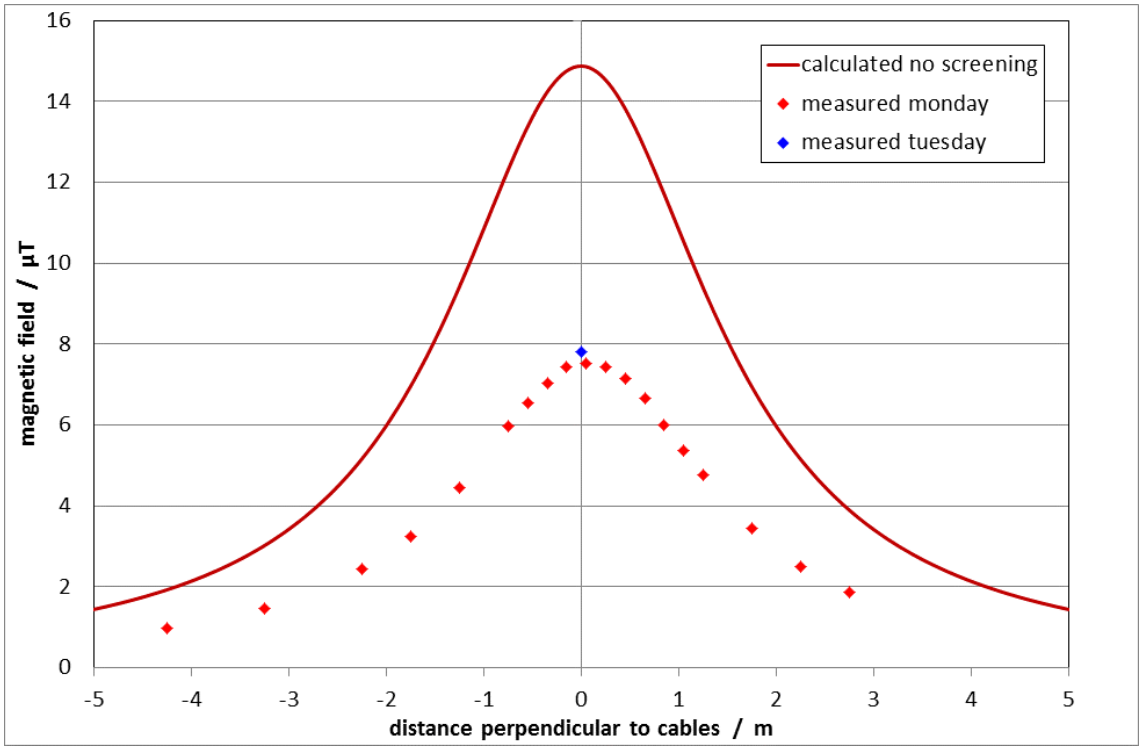
Monday

d relative to centre line / m	B / µT
-5.3	0.7
-4.3	0.97
-3.3	1.46
-2.3	2.44
-1.8	3.26
-1.3	4.46
-0.8	5.98
-0.6	6.54
-0.4	7.04

d relative to centre line / m	B / µT
-0.2	7.44
0	7.52
0.2	7.44
0.4	7.14
0.6	6.66
0.8	6
1	5.36
1.2	4.78
1.7	3.44
2.2	2.5
2.7	1.86
3.7	1.14

Tuesday: single value measured, on centreline, 7.8 µT.

Agreement between calculations and measurements



Discussion

14.9.8 The measured screened field is between 48% and 52% of the calculated unscreened field.

14.9.9 This screening factor is similar to, but marginally better than, that achieved at the Prysmian tests. This improvement may just be random variation, or may reflect the fact that the wooden posts used to retain the cables at Prysmian prevented the screening loops being in the absolutely ideal position, and the positioning may have been slightly better at Daedalus.

14.10 Daedalus: DC tests

Dates and details of tests

14.10.1 Test conducted 16 October 2017 by Chris Haswell and Dr John Swanson and other members of National Grid and Prysmian staff. Test repeated 17 October 2017 with stakeholders.

14.10.2 This test was conducted at the maximum load the IFA2 cables are intended to be rated at, thereby simulating the maximum field that could be produced by the final cables.

14.10.3 For the total DC field, detailed measurements, at sufficient points to plot a profile, were performed on the Monday. In the interests of time, on the Tuesday, just one point (directly over the cables) was repeated.

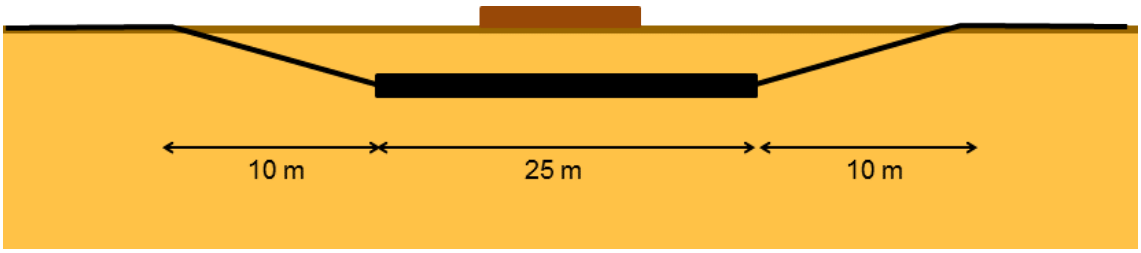
14.10.4 For the compass deviation, three sets of measurements were performed, one by National Grid staff alone on the Monday, a second observed by stakeholders on the Tuesday, and a third by National Grid staff again later on the Tuesday. These were all conducted within the width of the wooden trackway but at different points across its width.

Site layout

14.10.5 The cables were buried within the perimeter of Daedalus Airfield towards the south-east edge.

14.10.6 The installation comprised:

- Approximately 25 m of HVDC cables installed in plastic ducts, inside a low-carbon steel tube, at a depth of approximately 1.1 m to the top of the tube.
- Approximately 10 m either end of this length comprised of bonding lead, laid so as to preserve roughly the same spacing, sloping up to ground level
- Further bonding leads at ground level to connect to the generation equipment.
- Wooden trackway running transversely across the middle of the buried section to allow aircraft to taxi over the cables.
- Generation equipment to energise the cables at 1630 A.



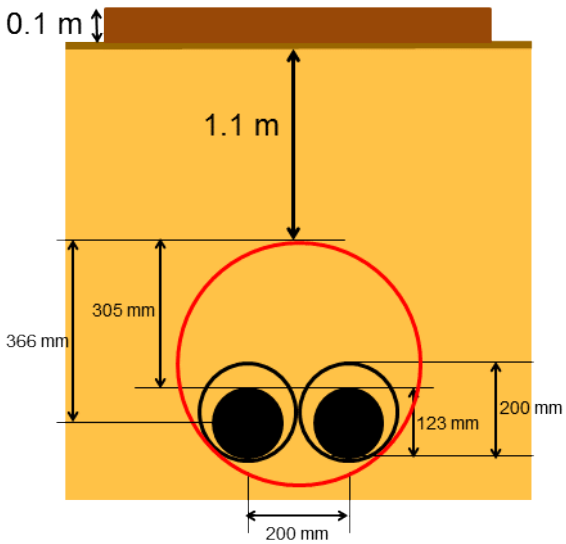
Longitudinal cross-section of installation

Site photographs

General view of site showing wooden trackway crossing backfilled cable trenches.

DC conductors inside steel tube, after backfilling main conductor section, but prior to installation of bonding leads.

Cable geometry



14.10.7 Cable bearing 45° magnetic.

Loads

14.10.8 The load for all tests was maintained at 1630-1650 A.

Test results

Total field

Monday

d / m	Bx	By	Bz
-4.51	12.45	15.22	42.36
-3.42	12.08	15.17	43.67
-2.36	13.52	14.62	44.1
-1.39	13.9	14.05	45.12
-0.9	14.82	13.15	45.81
-0.36	14.16	13.52	46.44
0	15.31	13.33	46.24
0.26	15.49	14.65	45.87
0.7	15.76	13.58	45.69
1.68	15.53	14.51	44.74
2.68	14.91	13.89	44.33
3.65	14.99	14.51	43.58
4.67	15.19	13.53	43.59
distant	12.095	13.887	44.78

Tuesday

d / m	Bx	By	Bz
0	13.75	13.18	46.83

Compass deviation

Monday

d	deviation observer A	deviation observer B
0.01	-2.5	-2
0.71	-3.5	-2.5
1.33	-4	-4.5
1.72	-4	-4
2.25	-3.5	-3.5
3.68	-2.5	-2.5
5.36	-1.5	-1
6.99	-1	-0.5
8.04	-0.5	0
9.2	0	0.5
10.36	-0.5	0
-0.09	-2	-1.5
-1.12	1	1.5

Tuesday first set

d	deviation
-12	0
-6	0.5
-2	1
-0.06	-3
2	-5
6	-1
12	-1

Tuesday second set

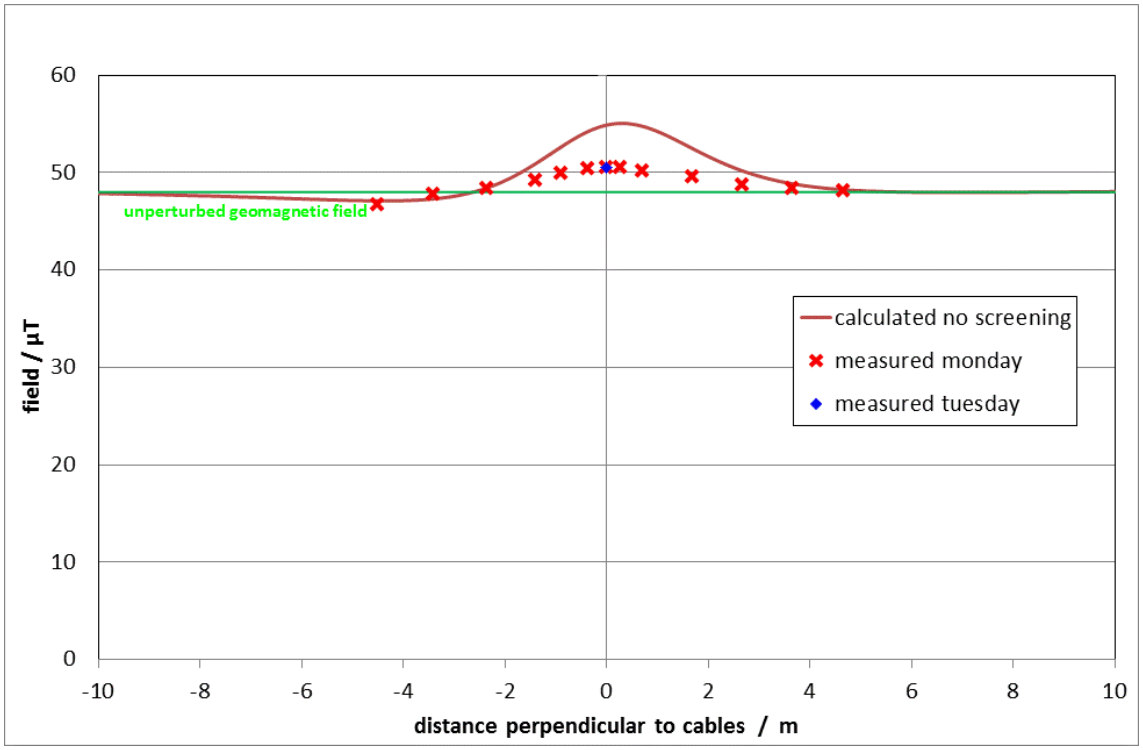
d	deviation observer A	deviation observer B
0	-2	-2
1.5	-4.5	-4.5
2	-4	-4.5
2.5	-4	-4.5
3	-3.5	-3.5
10.5	0	0
-1.5	0.5	0.5
-2	0.5	0.5
-2.5	0.5	0.5
-3.4	0	0
-4	0	0
-8.5	0	0

-1.58	2	2.5
-2.23	2.5	2.5
-2.84	2	2.5
-3.41	1.5	2.5
-3.98	1.5	1.5
-5.28	1	1
-7.24	0.5	0.5
-8.35	0.5	0.5
-10.33	0	0.5

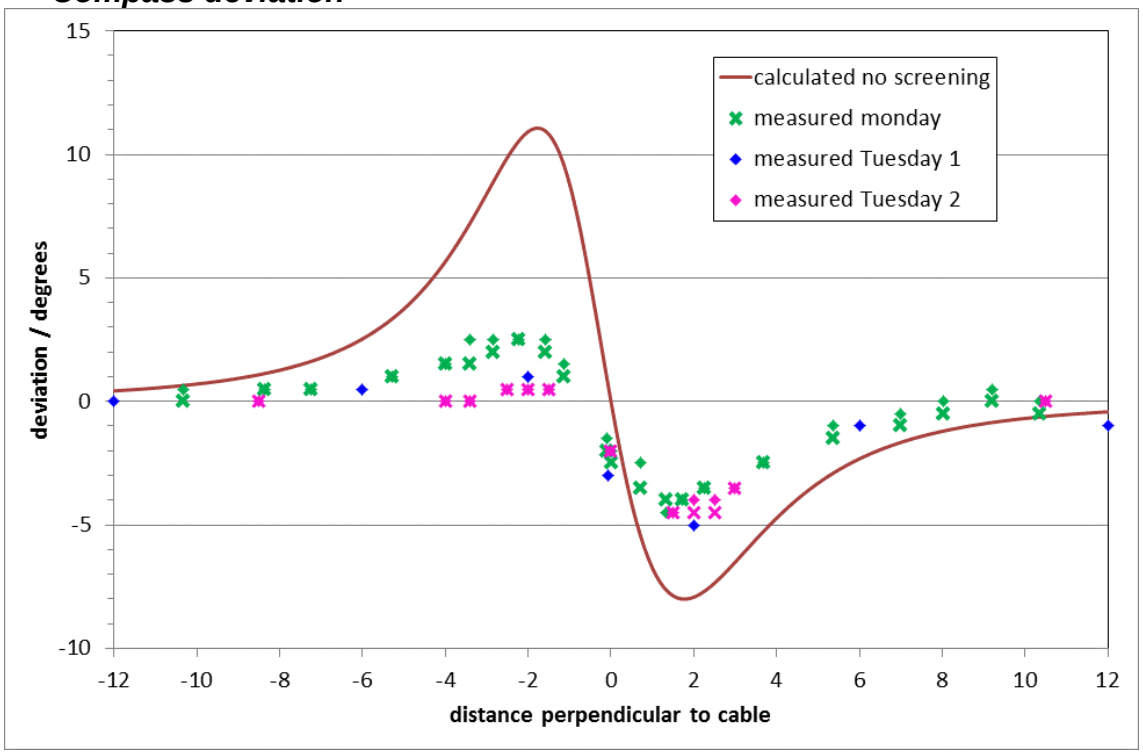
Agreement between calculations and measurements

14.10.9 As the current for each of the tests was the same, the results have been consolidated onto a single set of graphs.

Total field



Compass deviation



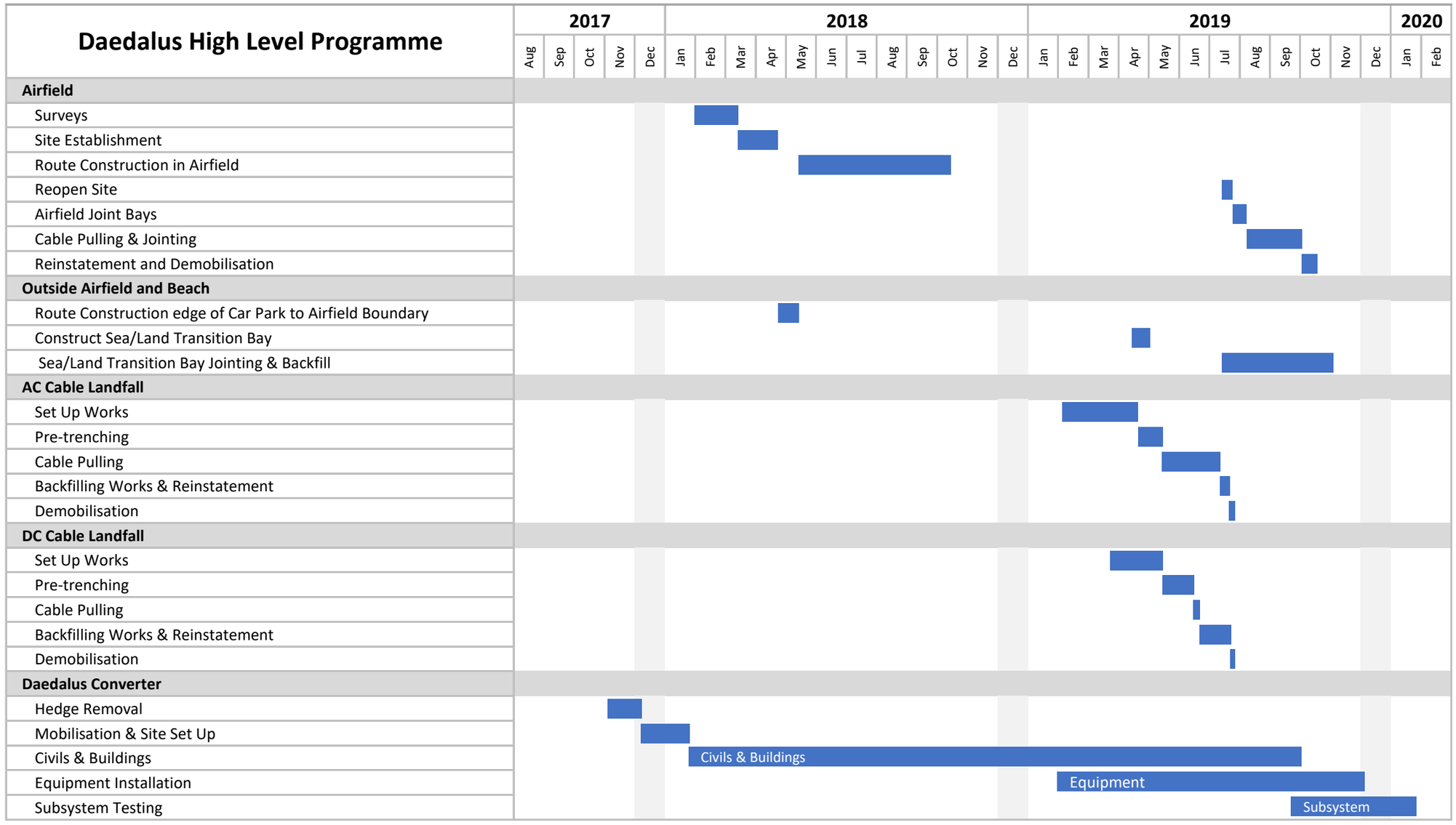
Discussion

14.10.10 As with the Prysmian tests, it can be seen that the screening produces a considerable reduction in both the amount by which the total field deviates from the geomagnetic field, and in the compass deviation. However, also like the Prysmian tests, the amount of reduction varies with the position along the cable.

14.10.11 The screening factor, at its worst, is a factor of about two, and often better.

14.10.12 The steel tubes used for this test were the same ones as used for the Prysmian test, so it is unsurprising that similar effects are noted. These tubes had to be procured to tight timescales to allow these tests to proceed. For the tubes used for the eventual IFA2 installation, it is expected that further work with the suppliers and tighter specifications will reduce the variability and improve the screening effectiveness further.

APPENDIX D



Daedalus High Level Programme
10th Nov 2017

By virtue of paragraph(s) 3 of Part 1 of Schedule 12A
of the Local Government Act 1972.

Document is Restricted

FAREHAM
BOROUGH COUNCIL

Report to the Executive for Decision
04 December 2017

Portfolio:	Policy and Resources
Subject:	**Corporate Strategy 2017-23**
Report of:	Director of Finance and Resources
Strategy/Policy:	Corporate Strategy
Corporate Objective:	All Corporate Objectives Apply

Purpose:
To present the results of the recent draft Corporate Strategy consultation and the proposed final Corporate Strategy covering the period 2017 to 2023.

Executive summary:
Our Corporate Strategy sets out our vision and priorities for the Borough.

It is a key document which influences our medium-term budget planning, our day to day service delivery and the large-scale projects that we will undertake in the future.

On 10 July 2017, the Executive considered the Council's draft Corporate Strategy 2017-23 and approved for it to be circulated for public consultation. 778 people took part in the twelve-week public consultation that ran between 24 July and 16 October.

The majority supported the contents of the Corporate Strategy. Following analysis of the consultation results, two further improvement actions have been added to the Strategy. The first focuses on exploring the best approaches to improving air quality in areas of concern and the second encourages the provision of more A Level courses within the Borough.

The results of that consultation and the updated Corporate Strategy were presented to the Scrutiny Board for consideration on 23 November 2017.

If approved, the new Corporate Strategy will then be presented to Council for approval.

Recommendation/Recommended Option:
It is recommended that the Executive:

a) take note of the results of the Draft Corporate Strategy consultation; and

b) recommend the final Corporate Strategy to Council for adoption.

Reason:
To meet the requirements of the Council's performance management framework.

Cost of proposals:
The financial implications of the Council's priorities will form part of the Council's medium term financial strategy.

Appendices: **A:** Consultation Analysis
B: Corporate Strategy 2017-23

Background papers:

Reference papers:

FAREHAM
BOROUGH COUNCIL

Executive Briefing Paper

Date:	04 December 2017
Subject:	**Corporate Strategy 2017-23**
Briefing by:	Director of Finance and Resources
Portfolio:	Policy and Resources

INTRODUCTION

1. Our Corporate Strategy sets out our vision and priorities for the Borough. It is a key document which influences our medium-term budget planning, our day to day service delivery and the large-scale projects that we will undertake in the future.

2. On 10 July 2017, the Executive considered the Council's draft Corporate Strategy 2017-23 and approved for it to be circulated for public consultation. It also approved the six main priorities in the strategy following an earlier consultation:

- Priority One: Providing Housing Choices
- Priority Two: Protect and Enhance the Environment
- Priority Three: Strong, Safe, Inclusive and Healthy Communities
- Priority Four: Maintain and Extend Prosperity
- Priority Five: Leisure Opportunities for Health & Fun
- Priority Six: Dynamic, Prudent & Progressive Council

3. This report presents the results of the Draft Corporate Strategy consultation, including how the proposed final strategy has been updated to reflect feedback received from residents.

CONSULTATION

4. A twelve-week public consultation ran between 24 July and 16 October. The consultation was publicised via press release, Facebook, Twitter, the Council's website and Council Connect. Email invites were sent to the E-Panel's 2,240 members and 1,500 letters (100 in each Ward) were sent to randomly selected addresses.

5. A static consultation display was stationed in Fareham Shopping Centre and Portchester Library throughout the consultation period. Face-to-face engagement events also took place in Ferneham Hall, Locksheath Shopping Centre, Stubbington Village Centre and Portchester Village Centre as well as at a Youth Conference held in the Civic Offices.

6. The six main priorities proposed in the updated Corporate Strategy were agreed following an earlier public consultation. The focus of the recent 12-week consultation was on the proposed improvement actions supporting the six main priorities.

7. Respondents were asked to rate from low to high, how much of a priority they considered each of the proposed improvement actions. They were also asked to comment on the individual priorities and make suggestions for additional improvement actions.

CONSULTATION RESULTS

8. Overall, 778 people completed the survey. Most respondents considered each of the Council's proposed improvement actions to be a priority. The following section outlines each of proposed improvements and the percentage (in brackets) of respondents who said it was either a medium, fairly high or high priority. This is then followed by an analysis of comments given and other improvement actions proposed by respondents (see Appendix B for more details):

9. Priority One: Providing Housing Choices

- Enable the delivery of Welborne Garden Village, providing new homes, jobs, schools and leisure facilities (74%).

- Prepare a new Local Plan, which will plan for new homes and employment space across Fareham up to 2036 (83%).

- Implement a new Housing Strategy to include affordable options (86%).

10. The highest number of comments given by respondents were linked to the provision of affordable housing, particularly for younger people. Adequate infrastructure e.g. roads and services such as health and education to meet the needs of a growing Borough residents were also common themes to emerge from comments. The Council does not provide roads or education and health services. However, we are consulting with partners such as Hampshire County Council and Fareham and Gosport Clinical Commissioning Group as part of the Draft Local Plan consultation, so that they can plan for future service and infrastructure provision.

11. When asked what other improvements could be included in the Corporate Strategy the focus was again on infrastructure, services and affordable housing. It should be noted that affordable housing options are included in the Welborne Plan, Draft Local Plan and will form part of the future Housing Strategy.

12. Priority Two: Protect and Enhance the Environment

- Transform the fields and verges on the boundary of Daedalus into an exciting new area of public open space (75%).

- Create a new Country Park at Titchfield (74%).
- Transform woodland areas at Coldeast to create new public open spaces (65%).
- Deliver major coastal defence schemes at Portchester and Hill Head (90%).
- Increase our recycling rates and reduce the amount of household waste (92%).

13. The main themes to emerge from the comments on Priority Two were related to increasing recycling, keeping green space and protecting wildlife. These themes also came out strongly when asked about further actions the Council could focus on. It can be argued that improvement actions for Protecting and Enhancing the Environment already tackle these themes. Improving air quality was another proposed improvement action some respondents suggested.

14. Priority Three: Strong, Safe, Inclusive and Healthy Communities

- Promote and support the delivery of a Garden Village at Welborne over the next 20 years (69%).
- Extend Holly Hill cemetery by 400 burial plots to increase the number available in the west of the Borough (64%).
- Review our approach to Community Safety to ensure that we make the Borough as safe as possible (92%).

15. The majority of comments about Priority Three related to a perceived lack of Police presence within the Borough. Some residents also wanted an increase in Police numbers as an improvement action. Whilst it is not the role of the Council to allocate Police resources, the proposed review of Community Safety will require us to continue to work closely with the police on how we can make sure the Borough is as safe as possible. It is important to note that Fareham has the third lowest recorded crime rates in Hampshire. Air quality was again raised as an area of concern amongst some residents.

16. Priority Four: Maintain and Extend Prosperity

- Start the regeneration of Fareham Town Centre (90%).
- Construct an extension to our successful Innovation Centre at Daedalus (74%).
- Enable the redevelopment of Portchester Village Centre (81%).
- Continue to support the creation of new jobs at Daedalus (88%).
- Support the construction of major new highway schemes (86%).

17. The highest number of comments related to Priority Four were about infrastructure, particularly roads. This was also the most popular theme to emerge when asked about other actions the Council could be doing. Improving transport infrastructure falls within the proposed improvement action to ‘support the construction of major new highway schemes.’ A number of comments, particularly from younger respondents, focused on the need to improve the provision of A Levels within the Borough.

18. Priority Five: Leisure Opportunities for Health & Fun

- Transform Westbury Manor Museum into a vibrant “culture stop” in Fareham Town Centre (67%).
- Develop long term plans to bring the Ashcroft Arts Centre and Ferneham Hall together into a new and exciting single arts and entertainment venue (68%)
- Provide new sports pitches and children’s play area at Coldeast (77%).
- Provide a new allotment site in the Stubbington area (64%)
- Improve the facilities at Cams Alders Recreation Ground (70%).

19. Many of the comments provided were complimentary about the Council’s provision of leisure facilities. However, some wanted more facilities across the Borough. Whilst some respondents commented that they did not want Ferneham Hall and the Ashcroft Centre replaced with a new venue, the majority supported this.

20. When asked about other improvement actions, there were a range of responses. The main theme to emerge was the provision of more facilities for both young and old people. However, few examples of what they could be were given.

21. Priority Six: Dynamic, Prudent & Progressive Council

- Continue to work within a balanced and sustainable budget, recognising the reduction in Government funding (94%).
- Continue to implement the Vanguard Methodology, a new way of working that puts the customer at the heart of Council services (90%).
- Develop the Civic Offices to be an attractive working environment for existing and prospective tenants (70%).
- Review all Council owned land and buildings to ensure we make the best use of our assets (95%).
- Be alive to new opportunities for further investment in commercial properties to boost income (88%).
- Continue to explore opportunities for closer working with neighbouring Councils (89%).

22. There were a range of comments related to this priority. Most expressed support for the proposed improvement actions above. Some respondents said that we should only invest in commercial properties within the Borough, others that we should ensure that we only make sound investments.

23. Proposed additional Improvement Actions

24. Following analysis of the supporting comments given by respondents during the consultation it is proposed that two further improvement actions are included in the final Corporate Strategy.

25. The first relates to air quality, which is a topic of interest both nationally and locally. A number of respondents raised this as an issue that should be included in an improvement action within the new Corporate Strategy.

26. On 9 October 2017, the Executive agreed to extend Gosport Road and Portland Street Air Quality Management Areas. A member led steering group and a technical officer group were also established to exploring approaches to improving air quality in areas where the levels of NO2 exceed national guidelines. Taking these factors into account, it is proposed that the following improvement action is included in Priority Three: Strong, Safe, Inclusive and Healthy Communities:

- Explore the best approaches to improving air quality in areas where the levels of NO2 exceed national guidelines.

27. The second new improvement action relates to the provision of A Levels within the Borough. This was an area of concern, particularly amongst younger respondents.

28. Fareham College started providing a limited range of A Levels linked to specific Btec courses in September 2017. However, most young residents need to go outside of the Borough to study for A Levels. Although it is not the Council's role to plan for or provide education, it can encourage and support the relevant partners to do so. It is therefore proposed that the following action be added to Priority Four: Maintain and Extend Prosperity:

- Encourage the provision of more A Level courses with the Borough.

29. The results of the consultation clearly indicate that all the proposed priorities and improvement actions in the Corporate Strategy 2017-23 (appendix C) are supported by most residents. Including the two further actions identified above demonstrates that resident concerns expressed during the consultation have been listened to and the Council will work towards tackling them.

30. The results of that consultation on the draft Corporate Strategy were presented to the Scrutiny Board for consideration on 23 November 2017.

31. CONCLUSION

32. The Corporate Strategy is a key document within the Council's performance management framework. It influences our medium-term budget planning, our day to day service delivery and the large-scale projects that we will undertake in the future.

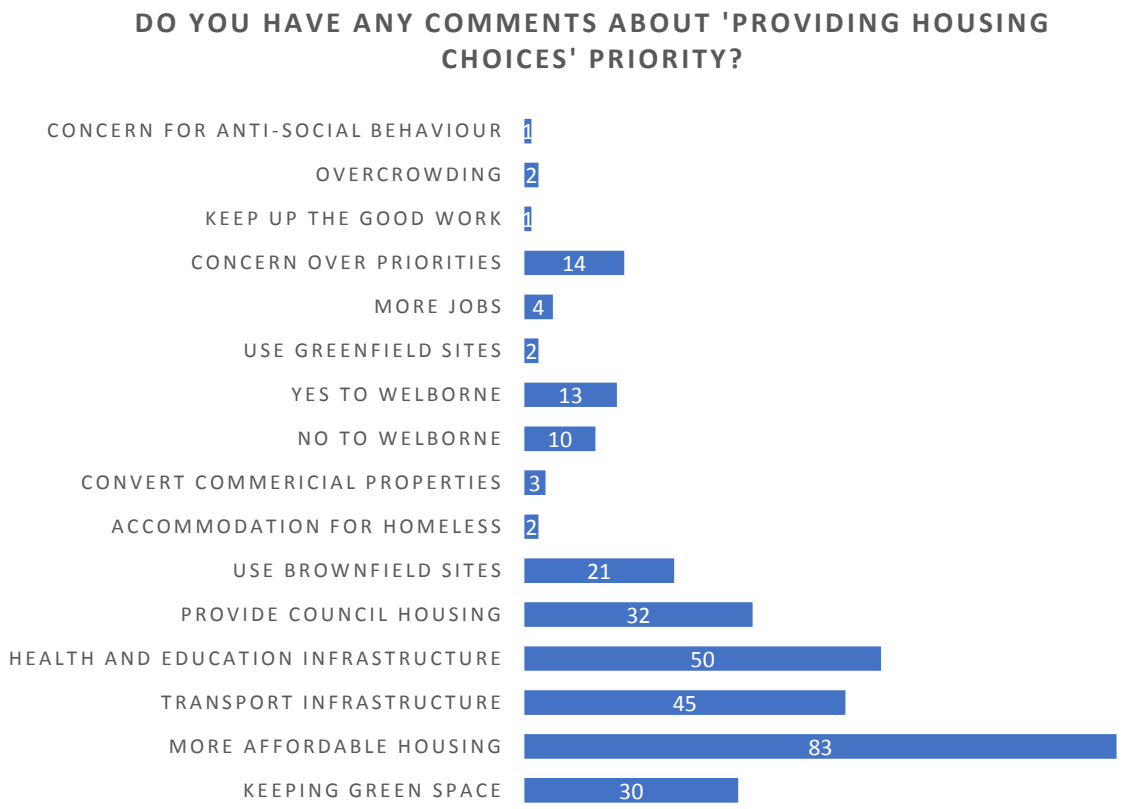
33. An initial consultation on the was carried out in 2016, during which all the proposed priorities in the draft Corporate Strategy were supported by residents. A second consultation took place earlier this year and most residents agreed with all the proposed improvement actions.

34. Following analysis of the consultation results, two further improvement actions have been added to the Strategy. The first focuses on exploring the best approaches to improving air quality in areas of concern and the second encourages the provision of more A Level courses within the Borough.

35. If approved, the new Corporate Strategy would then be presented to Council for approval.

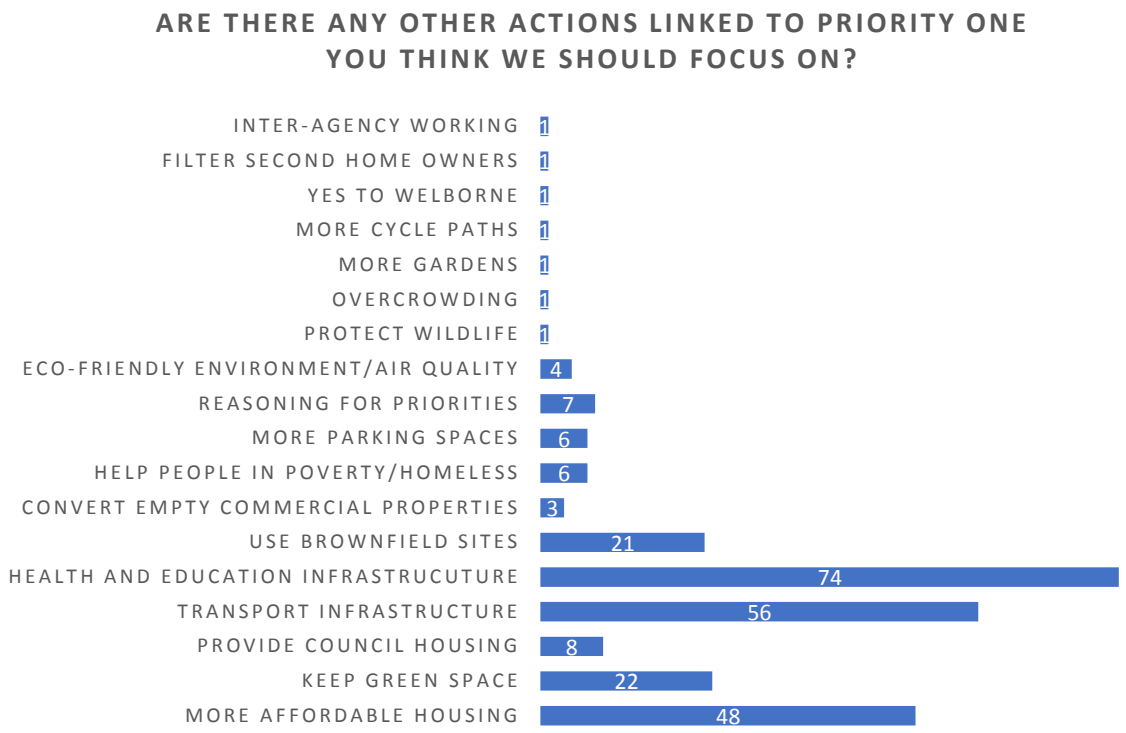
Enquiries:

For further information on this report please contact Roy Brown. (Ext 4409)

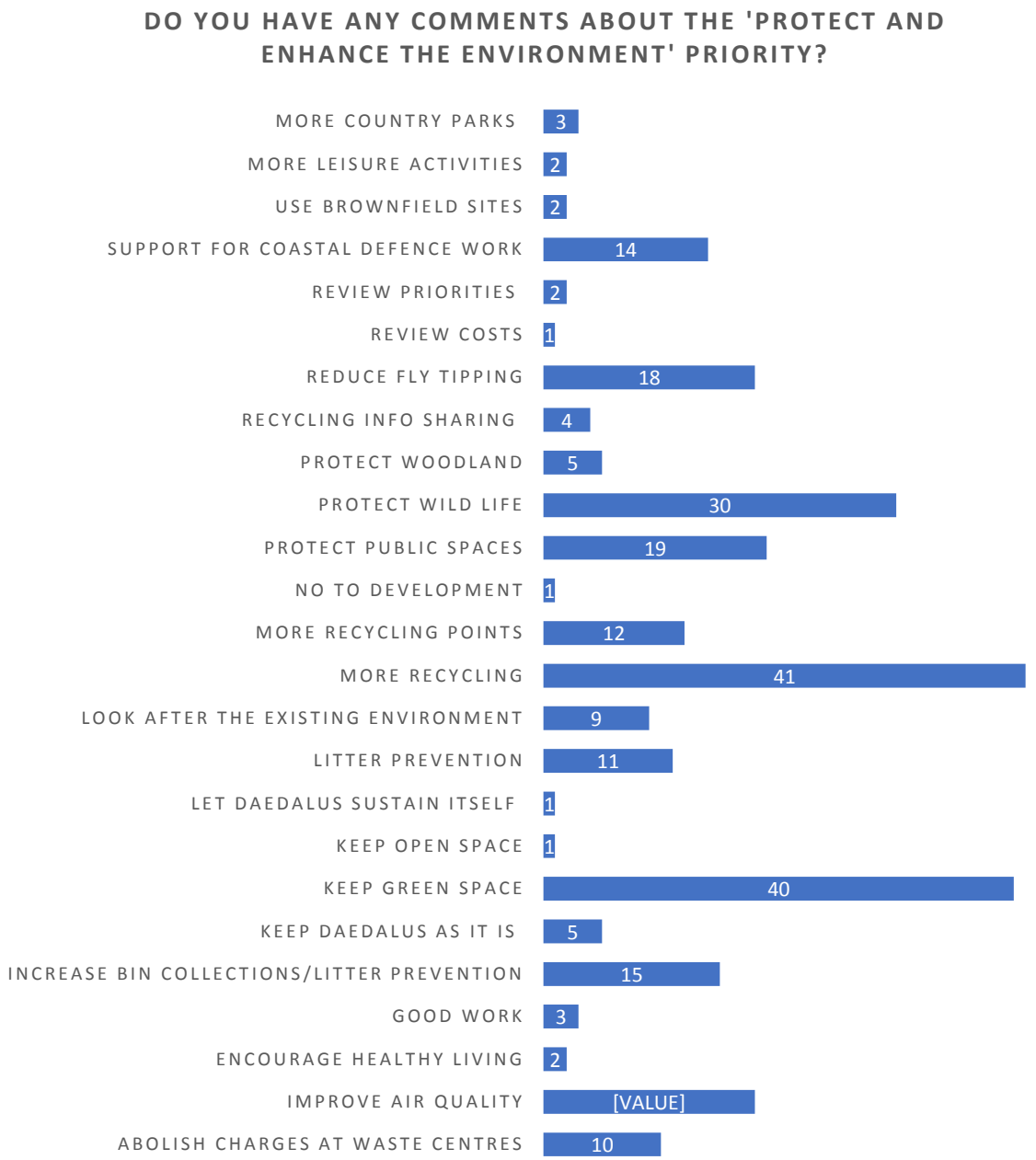


There was a strong response with regards to affordability of houses, particularly for first-time buyers. One person suggested ‘affordable housing is a must to be able to break the poverty cycle due to high private renting costs’. A number were focused around Welborne, with the main concerns focused on its impact on the health and education infrastructure, and on the transport infrastructure.

Some residents commented that they did not want to see the loss of green space, and would prefer building to take place on brownfield sites, or converting commercial properties into housing.



Respondents were most concerned with ensuring infrastructure was in place within the Borough to cope with a growing population on the 'are there any other actions linked to Priority One to focus on?' comments box. One comment reflects this understanding that 'additional social care, education and medical facilities should always accompany housing developments to maintain quality.' A significant number were again focused on the importance of providing affordable housing options.

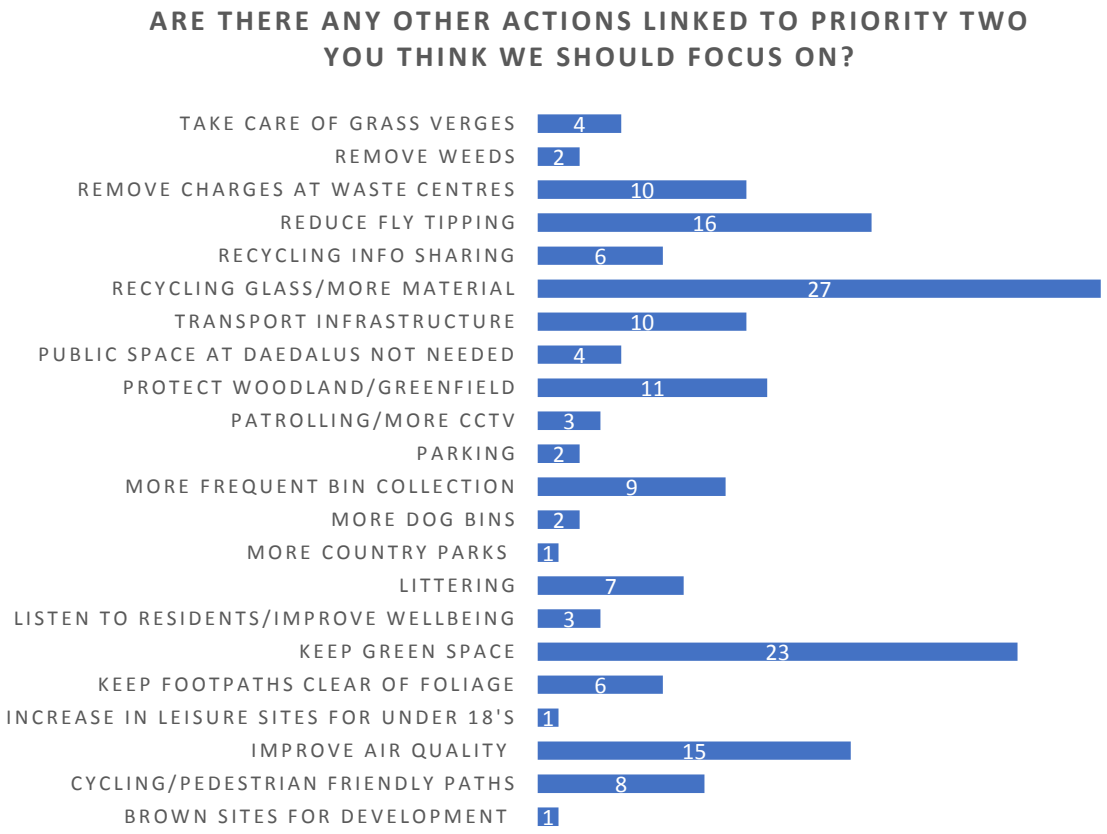


The main comments for 'Do you have any comments about the 'Protect and Enhance the Environment' Priority? included recycling, keeping green space, and keeping wild areas. Most comments about recycling concerned the lack of weekly collections, and how more items should be recyclable. However, there were several comments that were concerned with fly tipping, which they saw as an outcome of charges at waste recycling centres. Another common theme was the wish for a greater focus on air quality within parts of the Borough.

There were also many comments on protecting green space, with some comments criticising the loss of woodland to create an open space at Coldeast. However, there was support for a new Country Park at Titchfield.

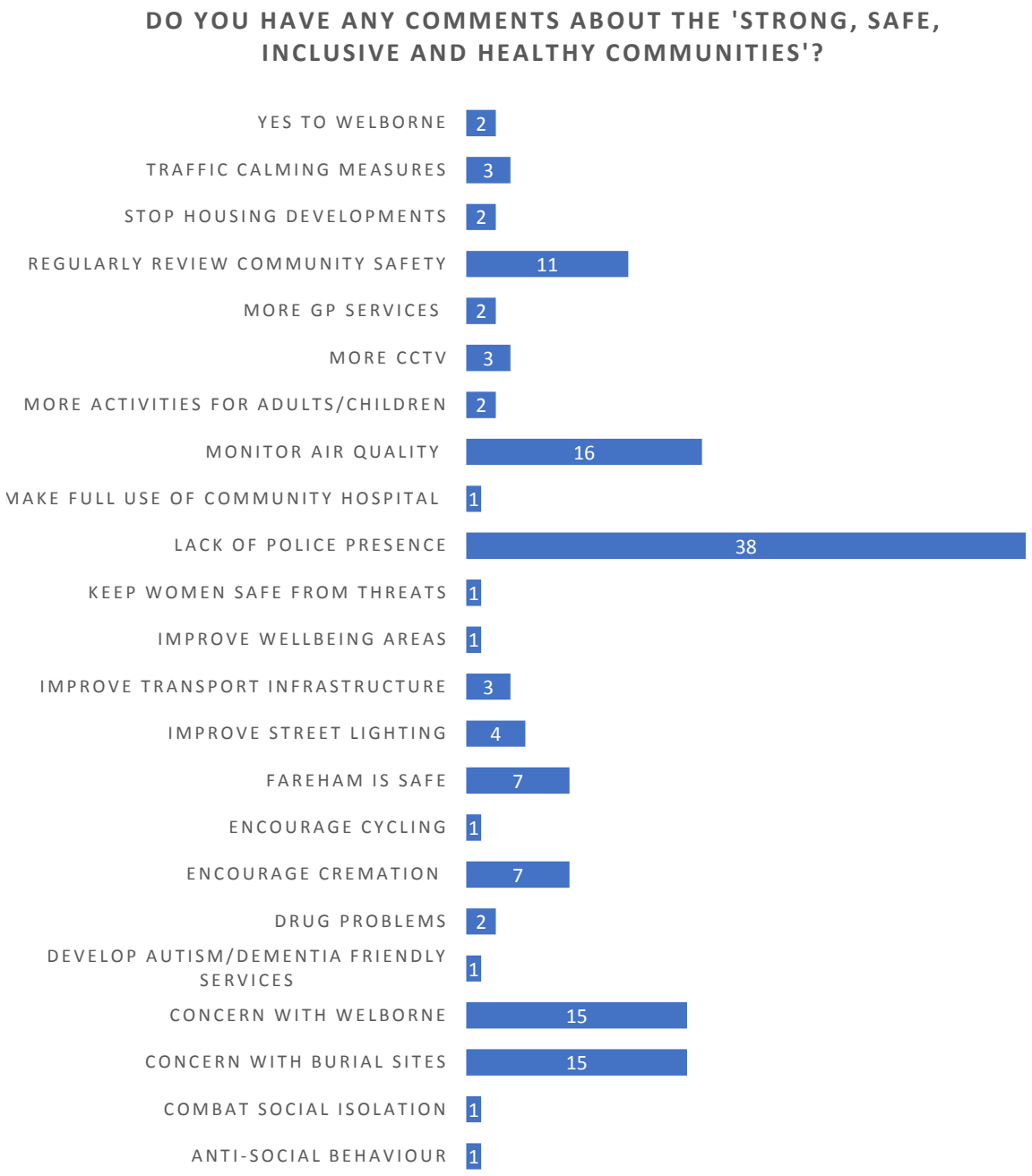
One person stressed 'we are already well provisioned for outdoor recreational spaces locally; efforts and recourses should focus on protecting that'. Green spaces

are something that some respondents seemed passionate to protect, with thirty comments focused on ‘protecting wildlife’, and ‘keeping the countryside preserved’.



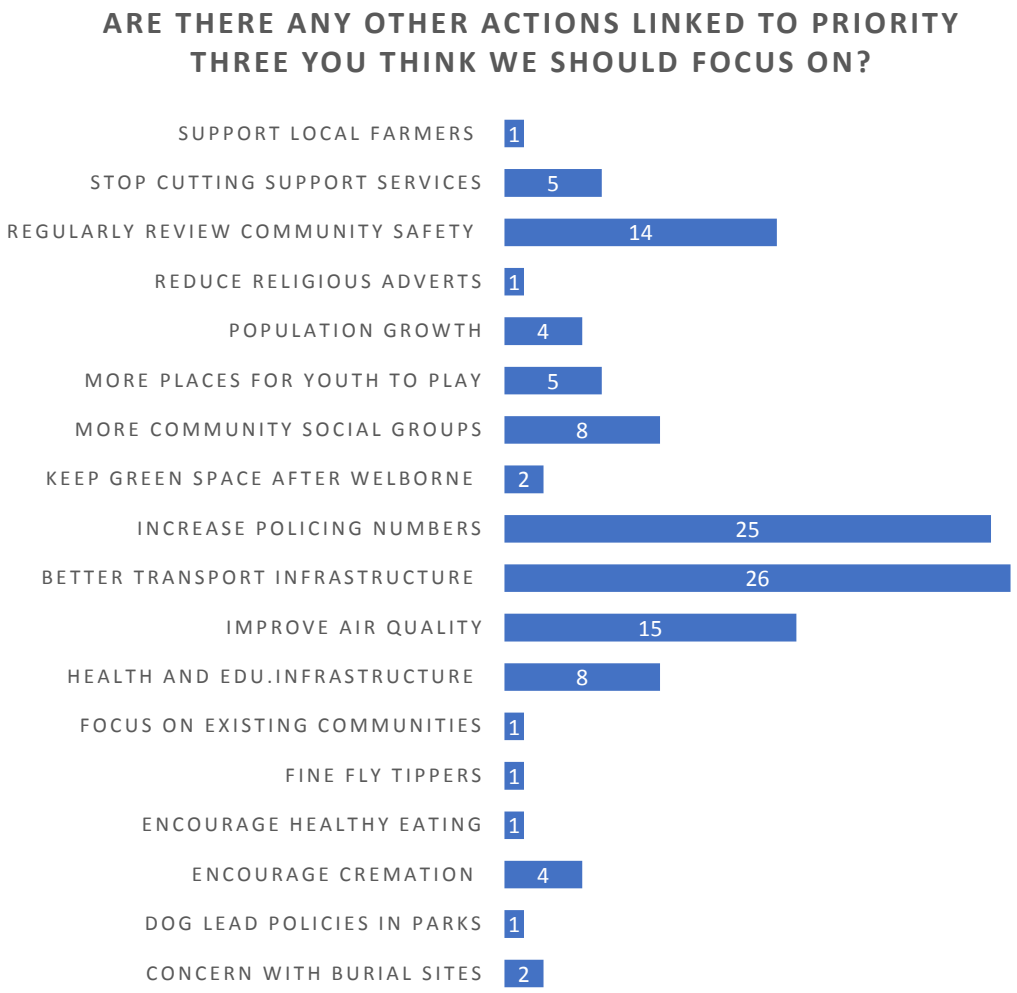
For ‘Are there any other actions linked to Priority Two you think we should focus on?’, comments were again focused around keeping green space, recycling and protecting woodland. However, other issues such as reducing the levels of pollution, and improving transport infrastructure were also concerns. Residents suggested that ‘air quality could be enhanced by improving cycle ways, encouraging bike riding, and improving parking areas would prevent cars from waiting on access roads’ wasting fuel.

Some residents suggested Hampshire County Council’s recycling centre fees needed to be dropped to discourage fly tipping. One person had an idea to ‘run a campaign to encourage streets and neighbourhoods to take pride with glass verges and greens.’ They expanded further ‘one of their neighbours this year has planted bulbs/flowers on the grass verges that lead into our street, it looks great and helps to foster community spirit’.

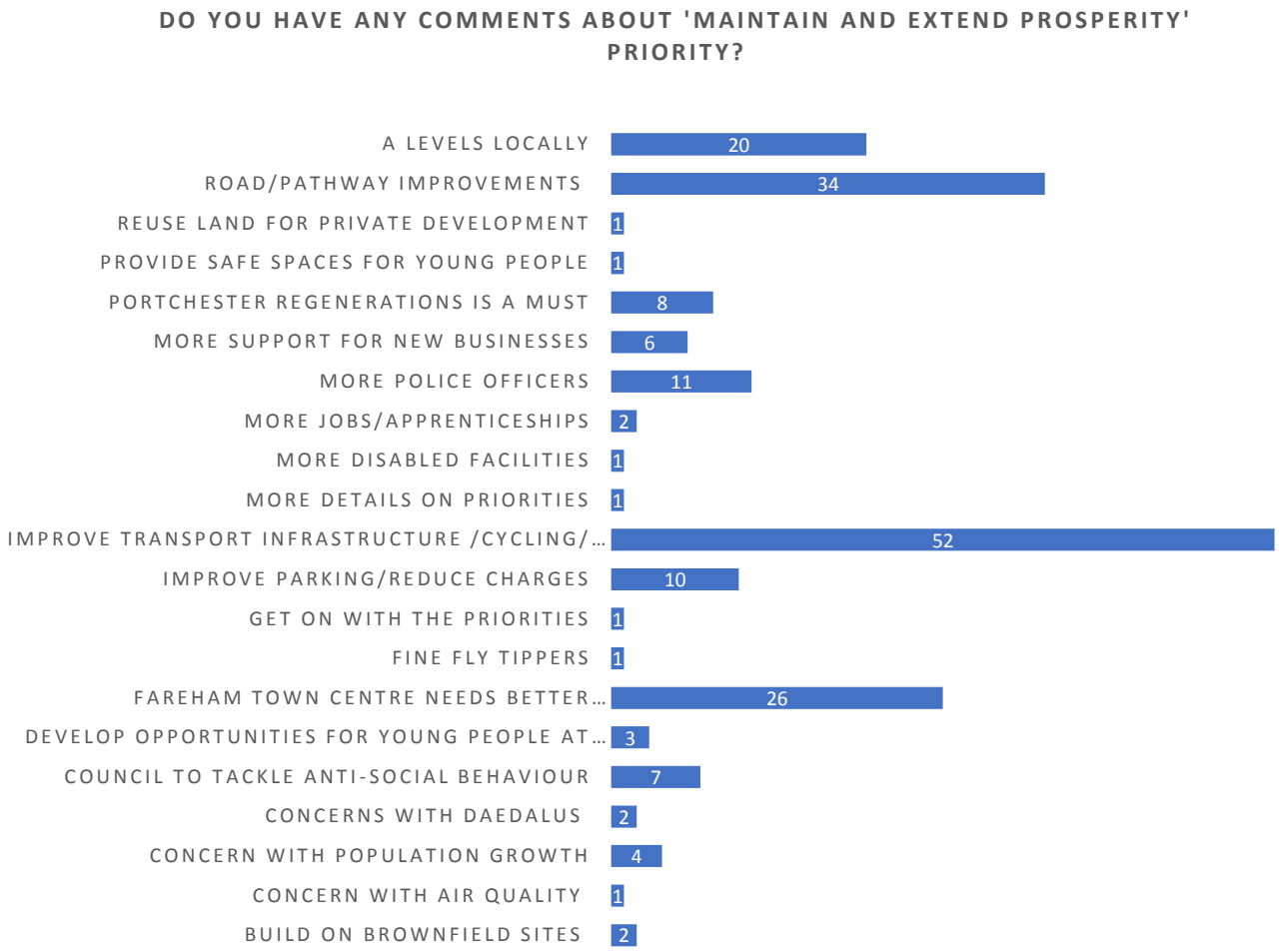


Most comments for ‘Do you have any comments about the ‘strong, safe, inclusive and healthy communities’? comments were concerned about a perceived lack of a police presence across Fareham. The data collected suggests that there were concerns with vandalism, break-ins, anti-social behaviour and the presence of homeless people and addicts. It is interesting to note that Fareham has the third lowest crime rates in Hampshire. Whilst the Council does not have control over policing, the information can be shared with out Police partners and considered when a review of our Community Safety arrangements is undertaken.

Some queries extending Holly Hill cemetery by 400 burial plots. Either people did not want it, or people thought that 400 plots would not be enough. Air quality was again another issue that was raised.



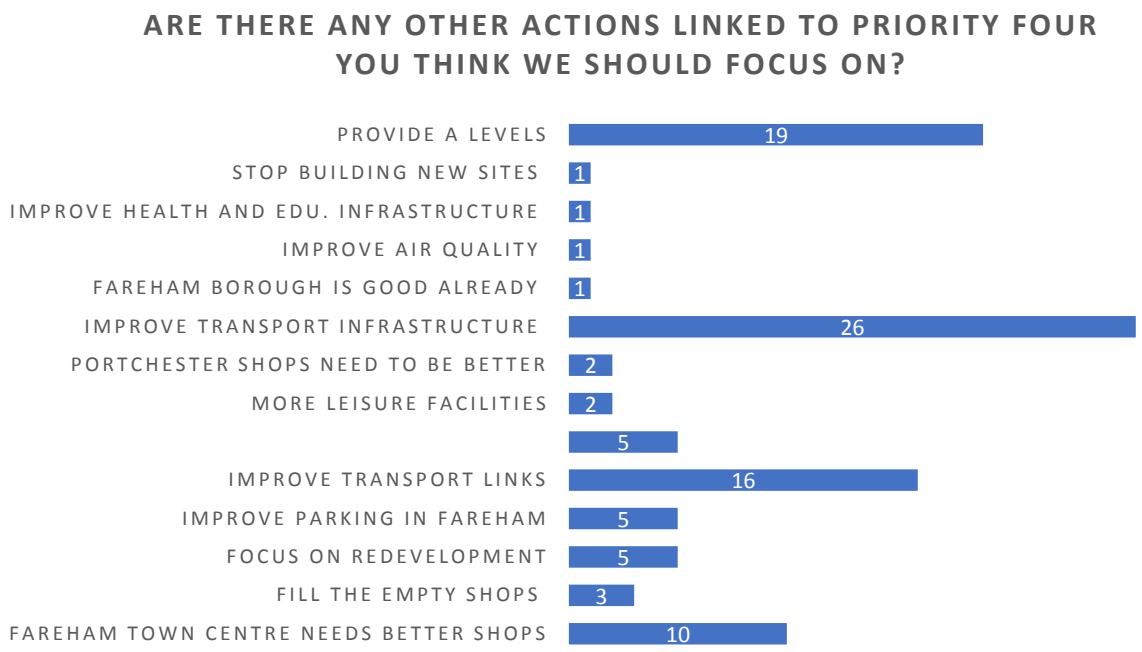
For ‘Are there any other actions linked to Priority Three you think we should focus on?’, there was a range of comments, including encouraging cycling, providing more places for youth to play and more support for the homeless. However, the biggest concern was over the lack of policing presence around the Borough. There were comments about road and cycle path safety, traffic congestion and the impact of population growth in the area.



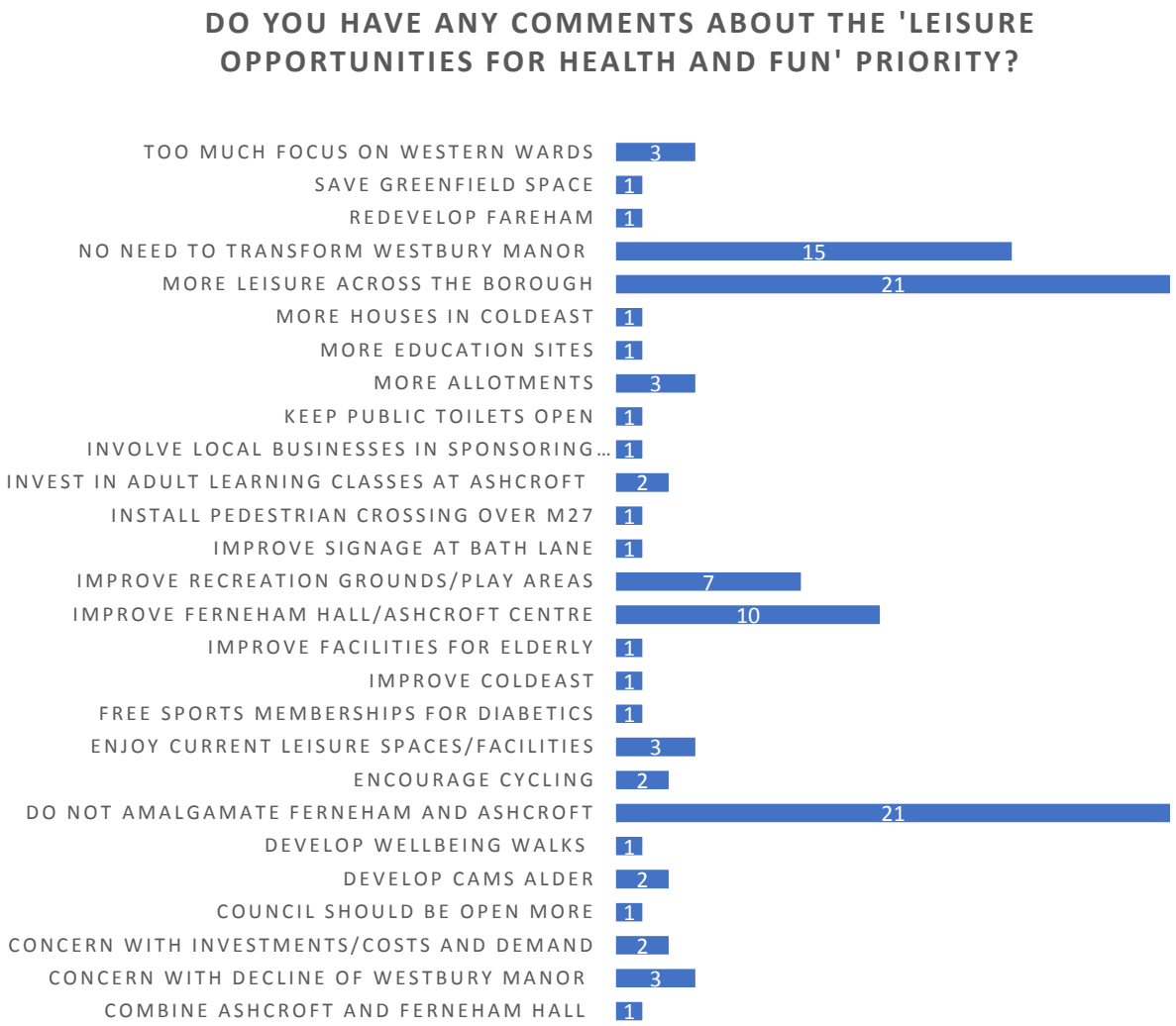
For ‘Do you have any comments about the ‘Maintain and Extend Prosperity’ Priority? were road improvements, concern with transport infrastructure, and Fareham Town Centre requiring better shops.

Comments supported the regeneration of Fareham Town Centre, with the biggest concern was that Fareham Town Centre needing better shops. However, comments were not as supportive for the new major highway schemes, as they did not feel it is needed; are worried about the further traffic problems it could bring; and that the existing roads need to be improved first as part of developing the transport infrastructure.

A number of younger respondents commented on the need to provide more A Level options locally.

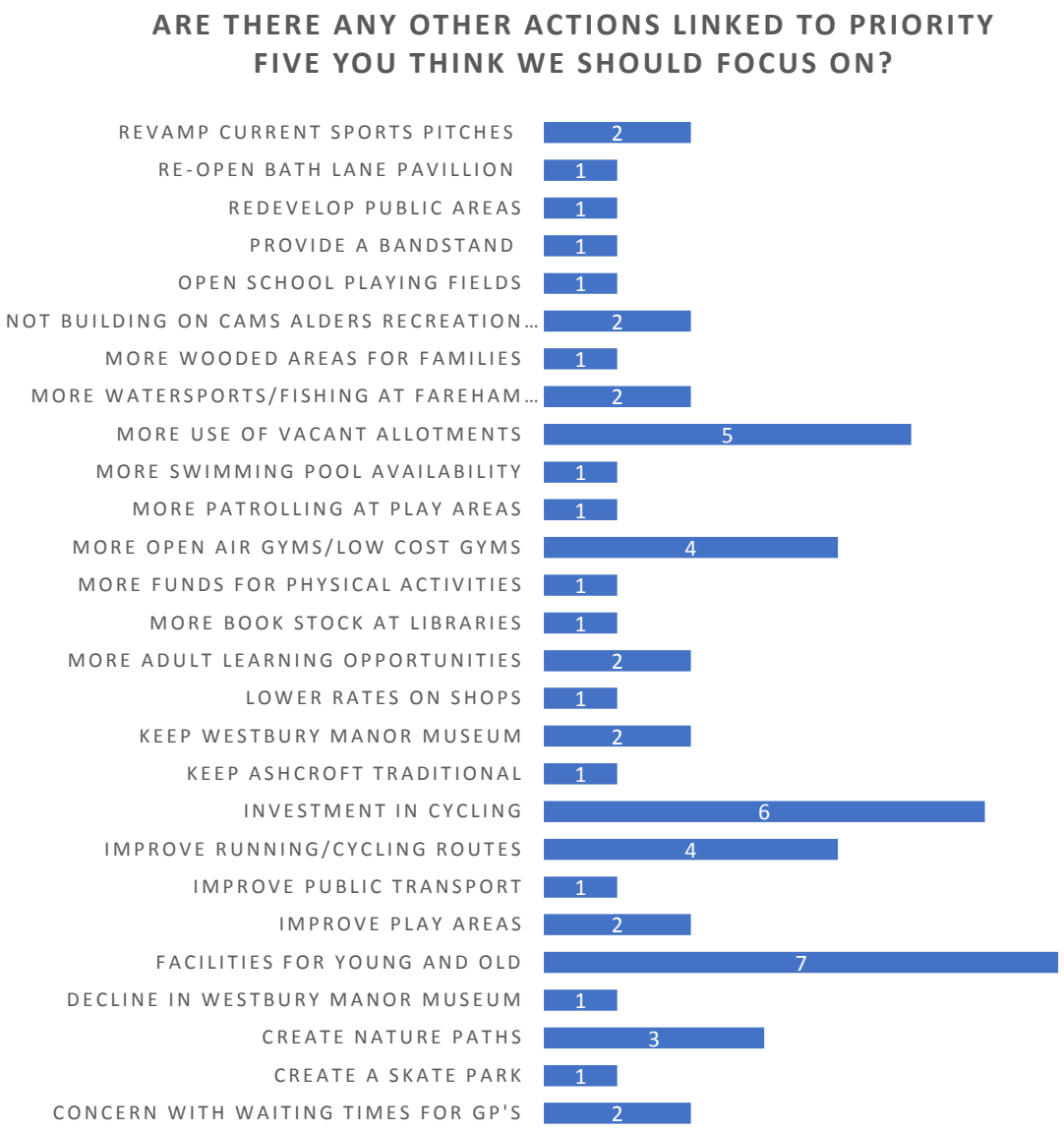


Respondents shared their need for improvements to highways, parking and transport links throughout the Borough (transport infrastructure). There were multiple comments about shops being empty, and the lack of jobs for young people in the area. One person's suggestion was to 'encourage local businesses to invest in Fareham with attractive business rates and start-up business rates and start-up benefits for employing local resident's and college graduates.' They went on to explain the need to 'develop a plan on how the digital economy can improve living standards in the area.' Other residents felt that Fareham needed to 'engage young people in general', and there needed to be greater opportunities in Fareham for 'education linked to jobs, and industry where possible'. Implying that current education facilities post-GCSE for young people needed investment. In addition, a number of younger respondents wanted a more A Level options locally.

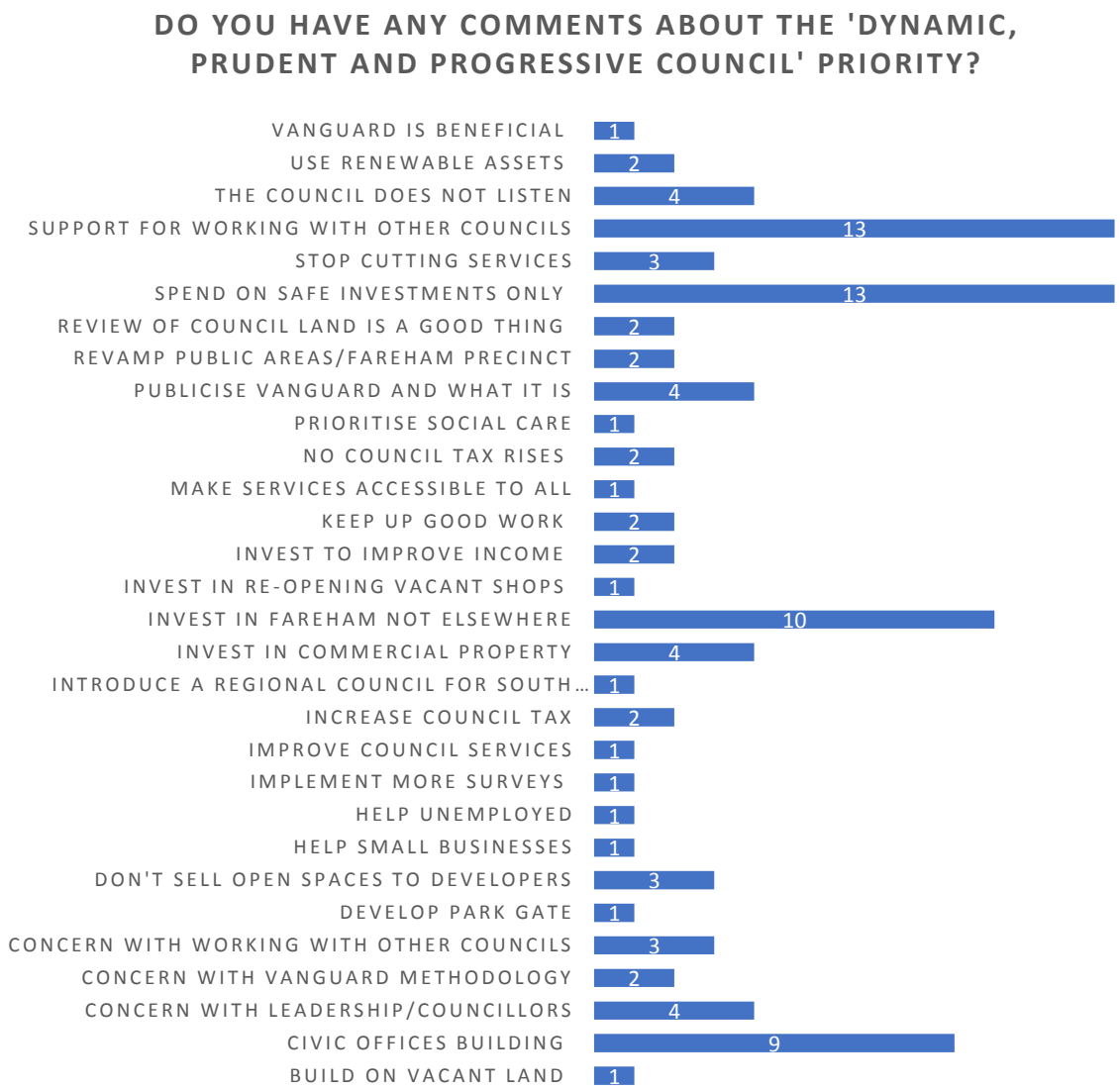


The main comments for ‘Do you have any comments about the ‘Leisure Opportunities for Health and Fun’ Priority?’ were positive, with many comments suggesting that residents enjoy the current leisure facilities and spaces on offer in the Borough. The most common comments were related to continuing to improve recreational, play and sports facilities. There were also some asking for the Ashcroft Arts Centre and Ferneham Hall to be kept separate. However, the number asking for this are small compared to the majority of respondents who believed that it was a priority to combine the two into a single arts and entertainment venue.

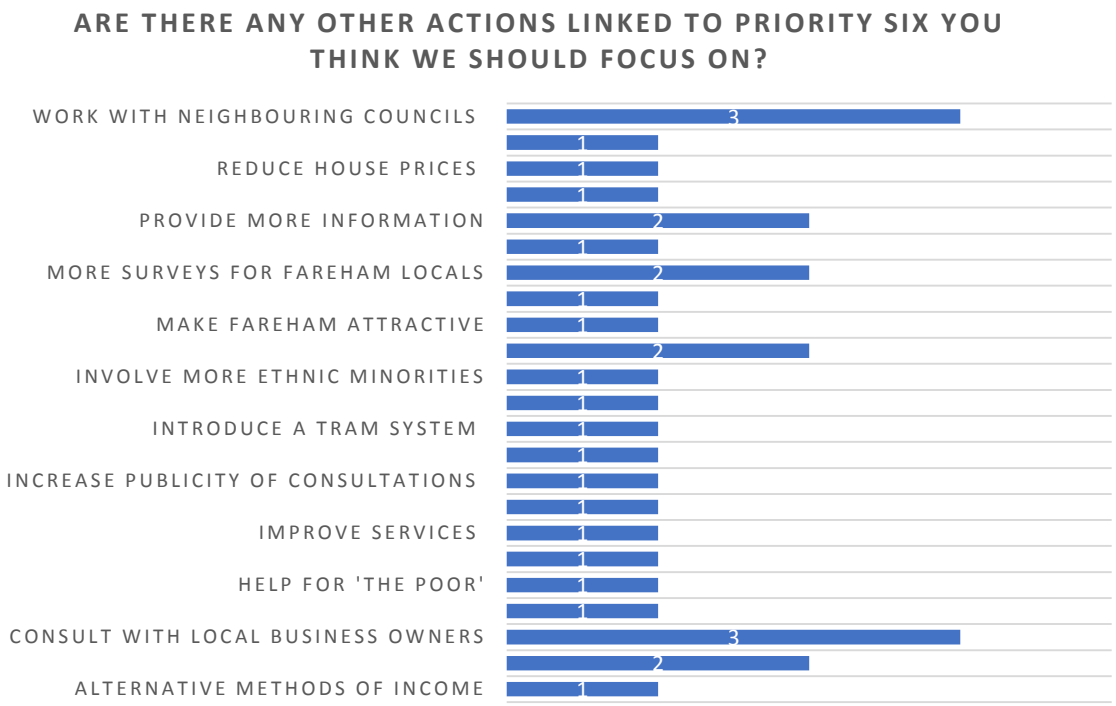
There was support for providing new sport pitches and children’s play area, but comments wanted to see more facilities across the Borough, that catered for both the young and old, and were concerned over there being too much focus in the Western Wards. There was also support for more allotments and concerns that Westbury Manor Museum did not need to transform into a “cultural stop” as it had only recently been refurbished.”



For ‘Are there any other actions linked to Priority Five you think we should focus on?’ answers were mixed for this priority. There was a demand for more play areas in Stubbington, Portchester, Coldeast, and Cams Alders. Some respondents reflected a need to develop services for young and old. Whilst there were divided responses on whether Cams Alders should be regenerated as a sports facility, or left the same, there were consistent responses that there needed to be more investment in cycling areas around the Borough.



For ‘Do you have any comments about the ‘Dynamic, prudent and progressive council’ Priority?’, the number of supporting comments were low. A few comments that came up were in support for working with surrounding councils, with one comment suggesting working closer with Gosport Council to improve traffic congestion could be positive. Also, there were several comments about the improvement of the civic offices, whereby many people commented on its appearance. Another concern was support for investment in commercial properties, but respondents wanted to see the investment in Fareham Borough, and not elsewhere. Some comments suggested that more could be done to publicise Vanguard.



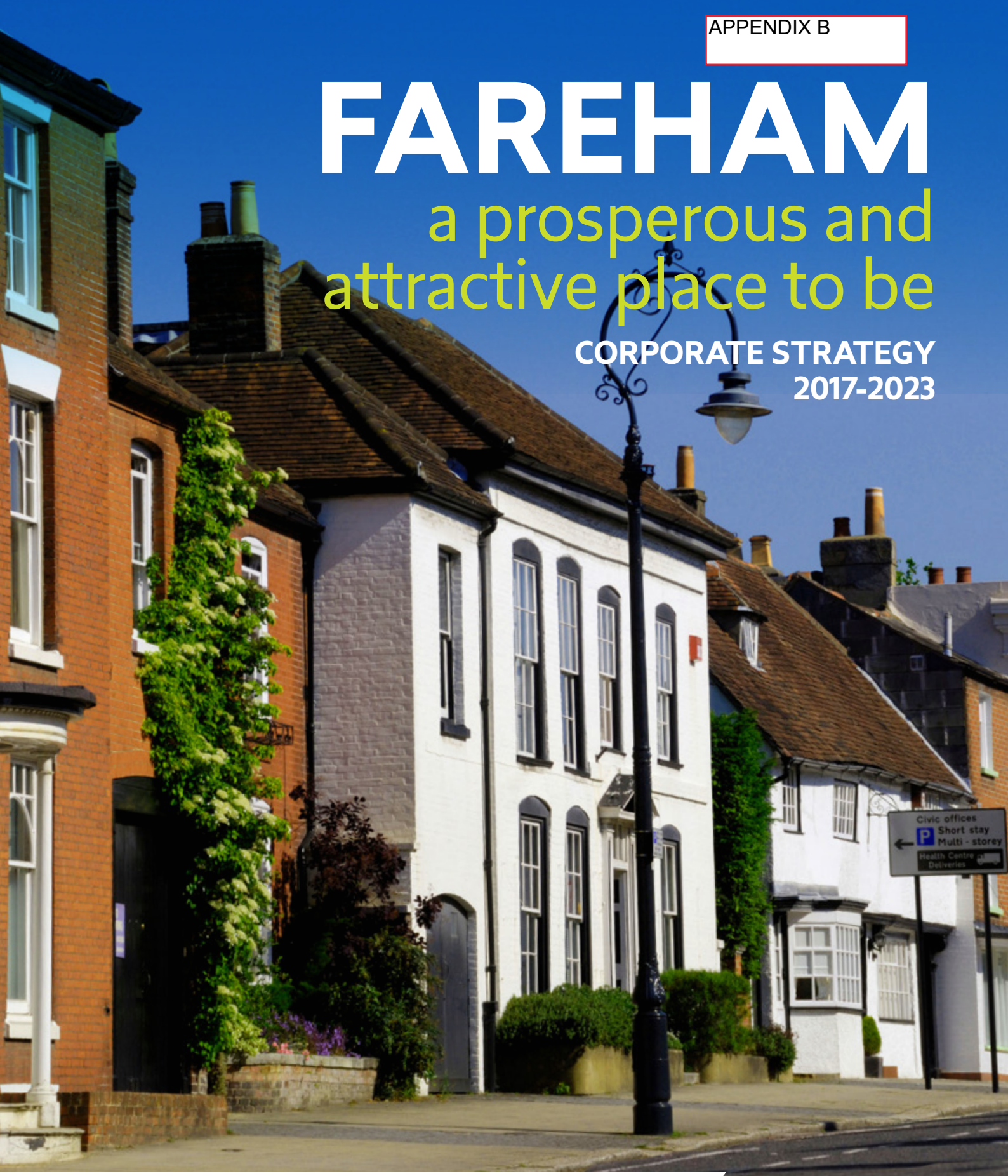
The overall number of comments was very low and no clear theme emerged. The most common theme was for the Council to keep up the good standard of its work. This was followed by working closer with neighbouring Councils.

APPENDIX B

FAREHAM

a prosperous and attractive place to be

CORPORATE STRATEGY 2017-2023



FAREHAM
BOROUGH COUNCIL

PLANNING FOR FAREHAM'S FUTURE

Prosperous, safe, attractive...

Our corporate strategy for Fareham Borough Council sets out our priorities for the next few years, from 2017 to 2023, and shows how we have planned to ensure that Fareham remains a prosperous, safe and attractive place to live and work.

Our approach has been led by a number of factors. First and foremost, our residents, customers, partners and others have told us what is important to them. Our research has also highlighted a range of external influences we need to consider such as economic and social factors and indeed changes to the way our residents live and work.

One factor that cannot be ignored is the continuing reduction in government funding awarded to Fareham Borough Council.

Yet despite this reduction, as you will read, we have exciting plans for the next few years that will provide benefits to many people working and living within the Borough of Fareham.

By focusing on these we believe we can help make sure that Fareham continues to be a great place to live and work.

"...FAREHAM CONTINUES TO BE A GREAT PLACE TO LIVE AND WORK."

A GREAT PLACE TO LIVE...

Located in an area of some 30 square miles along the south coast of Hampshire between Portsmouth and Southampton, Fareham is a popular and attractive place to live. It is well connected to the M27 motorway and has good rail links to London and the wider rail network. There is also easy access to ferry ports and Southampton airport.

Fareham is growing. Our population has steadily increased over the last 30 years and that trend is expected to continue. People are living longer and we have an increasingly ageing population.

For example, Fareham has experienced the largest rise in the number of residents aged 85+ in Hampshire during the last 20 years. By contrast the number of people of working age living in the Borough has reduced; particularly those aged between 25 and 39.

Consistent with the rest of the country the make-up of Fareham's households is changing. Around a quarter of people now choose to live alone so that adds to the number of smaller homes that we need. Additionally an increase in divorce and break ups also means that there are now more 'blended families' living together than ever before. Minority ethnic groups make up a small, but slowly growing, proportion of the population.

Fareham has five distinct communities: **Fareham town; Portchester; Titchfield; Western Wards** and **Hill Head and Stubbington.** The development of **Welborne**, made up of of around 6,000 homes, will create a new distinct community whilst, at the same time, help to meet our future housing needs.

"...THE MAKE-UP OF FAREHAM'S HOUSEHOLDS IS CHANGING."

OPEN FOR BUSINESS

With a well-educated workforce and low levels of unemployment, Fareham is a thriving place for business.

A well-educated workforce makes Fareham an attractive proposition for local businesses. The local talent pool is rich with potential employees equipped with all the skills they need to meet their needs and, whilst Fareham salaries tend to be higher than the national average, they remain well below London-weighted salaries.

The proportion of Fareham residents educated to college level and above is higher than both the south east region and the country as a whole. This is a boost to businesses both in Fareham and its neighbouring cities.

Fareham is a hard-working Borough with the percentage of local people in work higher than both regional and national averages. By contrast the number of residents claiming out of work benefits is low.

"...FAREHAM IS A THRIVING PLACE FOR BUSINESS."

HIGH FLYING PLANS...

Solent Airport at Daedalus is owned by Fareham Borough Council. Forming part of the Solent Enterprise Zone, the site features two new business parks: Faraday and Swordfish.

"...AN UNFLINCHING COMMITMENT TO SUPPORTING AND ENCOURAGING BUSINESS GROWTH..."

Underpinned by an unflinching commitment to supporting and encouraging business growth, Fareham Borough Council's vision for Solent Airport at Daedalus has already begun to take shape.

The Council's Fareham Innovation Centre opened in 2015 as an incubation hub to provide support and guidance to small and start-up businesses. It reached 100% occupancy within a year of opening.

With much of the site benefiting from being part of the Solent Enterprise Zone, businesses that meet the criteria can enjoy access to a range of benefits. This can include up to five years freedom from business rates for businesses opting to buy land to build their own business space or lease existing premises.

Over the coming years, the new development at Welborne, which lies to the north of Fareham, will also play a significant role in creating jobs for the Borough.

SAFE AND HEALTHY

Fareham is a safe and healthy place to live and work. Overall crime levels are low when compared to similar Boroughs in the area.

Life expectancy is higher than the national average for both men and women and our residents are generally healthier than most other areas in the country. Deprivation levels across the Borough are generally very low, but there are some small pockets of deprivation within Fareham town

Fareham is a great place to be healthy and has a variety of sports and leisure facilities for residents to enjoy. We have invested significantly in facilities such as the multi-million pound Holly Hill Leisure Centre which opened in 2016. Within the Borough, residents benefit from two leisure centres, 18 community centres, 24 football pitches, nine cricket squares and two rugby pitches. There are also 17 outdoor recreation sites and 43 children's play areas. The Council also continues to support a wide range of cultural and entertainment activities through Ferneham Hall and Westbury Manor Museum.

694
PITCH BOOKINGS
BETWEEN SEPTEMBER 2015 AND APRIL 2016

HOME is where the HEART is...

Fareham residents are, on the whole, well housed. Around 80% of homes are now owner occupied, which is much higher than the national average. By contrast the proportion of social and private rented housing is very low.

Despite an increase of 31% in property prices between 2011 and 2016 for an an average home in Fareham, house prices remain slightly lower than the Hampshire average although they are higher than some neighbouring authorities. First-time buyers in Fareham struggle to get onto the property market as the ratio between average house prices and earnings is higher than the level for most other areas in south Hampshire.

"FIRST-TIME BUYERS IN FAREHAM STRUGGLE TO GET ONTO THE PROPERTY MARKET..."

THE GREAT OUTDOORS...

With many acres of space safeguarded for wildlife and miles of natural coastline there are ample opportunities for getting out and about with or without the family.

The Council manages 331 acres of land for nature conservation across 25 different sites that include two nature reserves (Holly Hill Woodland Park and Warsash Common), and a Site of Special Scientific Interest (Portchester Common).

Cultivated spaces are important too and add quality to our everyday lives. Two open spaces, the Sensory Garden in Fareham Town Centre and Holly Hill Woodland Park, have consistently been awarded the prestigious Green Flag Award.

Additionally, for 13 consecutive years 'Fareham In Bloom' work has been recognised with a Gold Award in the South and South East in Bloom awards, brightening up our communities.

The great outdoors includes our streets and buildings too and important historic buildings are protected for future generations.

In fact there are 13 conservation areas and nearly 600 listed buildings within the Borough, each offering a little piece of history and helping to weave a picture of Fareham across the ages.

THERE ARE 13 CONSERVATION AREAS:

CAMS HALL
CATISFIELD
FAREHAM HIGH STREET
HOOK
OSBORN ROAD
PORTCHESTER, CASTLE STREET
SARISBURY GREEN
SWANWICK SHORE
TITCHFIELD
TITCHFIELD ABBEY
TOWN QUAY
WALLINGTON
WARSASH

Tell us what WORKS and what DOESN'T

Listening to residents' views is essential to the way the Council works and helps us deliver better services.

Community Action Team (CAT) meetings take place where there is a local 'hot topic' of interest to residents.

Residents can have their say using an online Customer Engagement Panel (the E-Panel) to help customers better understand how we work, have their say and increase openness and transparency. They can also take part in various consultations that take place throughout the year.

Social media is important too. Residents can contact the Council directly on Facebook and Twitter, both of which are used to keep customers up-to-date with useful information including details of any new consultations taking place, public meetings or local events.

Our website contains all the Council's latest news and copies of the Council's Online magazine 'Fareham Today' whilst Council Connect, in Fareham shopping centre, is also a good place to check for information.

Sign up for the Council's e-panel at: www.fareham.gov.uk/epanel

Check out any current consultations at: www.fareham.gov.uk/consultations

SIGN UP TO OUR ONLINE CUSTOMER ENGAGEMENT PANEL (THE E-PANEL) AND JOIN IN THE CONVERSATION

OUR VISION

Fareham is a prosperous, safe and attractive place to live and work. This has occurred through careful management and development, as well as constant attention to our environment and the needs of our communities. Our vision for Fareham's future is based upon the assumption that residents want to preserve all that is good about Fareham, whilst increasing prosperity, providing new homes for our growing communities and making it an even more inclusive and attractive place to live and work.

"FAREHAM IS A PROSPEROUS, SAFE AND ATTRACTIVE PLACE TO LIVE AND WORK."

OUR VALUES

Everything we do is guided by a set of values which are shared by all elected members and employees.

OUR CORPORATE VALUES

Listening and being responsive to our customers

Recognising and protecting the identity of existing communities

Enhancing prosperity and conserving all that is good

Being efficient, effective and providing value for money

Leading our communities and achieving change for the better

OUR PRIORITIES

"LEISURE OPPORTUNITIES AVAILABLE FOR RESIDENTS AND VISITORS ALIKE..."

We will achieve our vision by focusing our efforts and resources on six corporate priorities:

1 PROVIDING HOUSING CHOICES

by working with our key partners to enable and support a diverse housing market so that residents have access to good quality housing that is affordable and offers a choice of tenures. We will take positive steps to prevent homelessness and assist individuals and families in finding good quality accommodation.

2 PROTECT AND ENHANCE THE ENVIRONMENT

by ensuring that Fareham remains a clean and attractive place to live and work. We will make sure that our heritage and natural environment are conserved and enhanced for future generations. We will also minimise the impact on the environment by reducing our use of natural resources; minimising the generation of waste and maximising the collection of recyclable materials.

3 STRONG, SAFE, INCLUSIVE AND HEALTHY COMMUNITIES

by working with others to provide an environment where people of all ages feel safe. We will give people greater influence over the decisions that affect their lives and build more inclusive communities by providing easy access to information and services provided by the Council. We will also ensure that measures are in place to protect the health and safety of people who live, work or visit the Borough.

4 MAINTAIN AND EXTEND PROSPERITY

by working with others to continue to support and promote the economic vitality of the Borough. Developing and improving vibrant town and district centres offering a range of shopping, leisure and employment opportunities, together with the delivery of an employment-led vision for Daedalus will be vital to achieving this.

5 LEISURE OPPORTUNITIES FOR HEALTH AND FUN

so that residents and visitors of all ages can socialise with other members of our communities; participate in arts and entertainment activities; and improve their fitness and health.

6 DYNAMIC, PRUDENT AND PROGRESSIVE COUNCIL

by making sure that the decisions we make are transparent and that arrangements are in place to secure on-going improvement. Our overall priority is to ensure that we offer good value for money by providing high quality services and maintaining high levels of customer satisfaction, whilst keeping council tax levels low when compared to other district councils.

"WE WILL GIVE PEOPLE GREATER INFLUENCE OVER THE DECISIONS THAT AFFECT THEIR LIVES..."

It's the LITTLE THINGS THAT MATTER

Although it is the big projects that get the headlines, it is the day to day work we carry out that takes up most of our time and energy. It is also what the Fareham element of your council tax pays for. We know how important it is to you that we get the basics right and we work really hard to ensure that every day services are run in a way that **is cost effective, efficient and gives good value for money.**

PRIORITY one

Between now and 2023 we have big plans for improvements all of which are driven by our corporate priorities. You will able to keep an eye on how we are doing as key milestones will be included in our annual review.

PROVIDING HOUSING CHOICES

Ensuring everyone has somewhere to live is a vital role for Council.

Working against the backdrop of a national shortfall in housing and accommodation, we have worked hard to develop key strategies that will enable us to ensure there are housing choices for people in Fareham. We will...

- Enable the delivery of a new Garden Village at Welborne, providing thousands of new homes, new jobs, new schools and new leisure facilities.
- Prepare a new Local Plan, which will plan for the provision of new homes, and employment space, across the Borough up to 2036.
- Prepare and implement a new Housing Strategy, to include affordable options, which will determine the Council's future role in the provision of housing.

"ENSURING EVERYONE HAS SOMEWHERE TO LIVE IS A VITAL ROLE FOR COUNCIL."

PRIORITY two

PROTECT AND ENHANCE THE ENVIRONMENT

The environment in which we live helps to shape our experiences and the way we live our lives. We want to make sure that the things we enjoy today will still be around for future generations.

As well as protecting our assets, the next few years will see some exciting developments across the Borough. We will....

- Transform the fields and verges on the boundary of Daedalus into an exciting new area of public open space for the local community.
- Create a new Country Park, at Titchfield, providing easy access to the country-side for local people.
- Transform woodland areas at Coldeast to create new public open spaces.
- Deliver major coastal defence schemes at Portchester and Hill Head.
- Increase our recycling rates and reduce the amount of household waste.

"WE WANT TO MAKE SURE THAT THE THINGS WE ENJOY TODAY WILL STILL BE AROUND FOR FUTURE GENERATIONS."

PRIORITY three

STRONG, SAFE INCLUSIVE AND HEALTHY COMMUNITIES

"PROMOTE AND SUPPORT THE DELIVERY OF WELBORNE..."

Feeling safe and secure in our homes and everyday activities is vital for our wellbeing and peace of mind.

We also know it is important to local people that we recognise and protect the identity of existing and new communities. This includes the provision of local facilities. We will...

- Promote and support the delivery of a Garden Village at Welborne, as part of a planned sustainable new community to come forward over the next 20 years.
- Build 400 new graves as an extension to Holly Hill cemetery to increase the number of burial plots available to those living in the west of the Borough.
- Review our approach to Community Safety, including analysis of CCTV, street lighting and landscaping to ensure that we make the Borough as safe as possible.
- Explore the best approaches to improving air quality in areas where the levels of NO^2 exceed national guidelines.

PRIORITY four

MAINTAIN AND EXTEND PROSPERITY

We recognise that business growth is essential to the local economy, providing good quality jobs for local people and creating attractive, vibrant town and district centres.

As well as supporting and protecting existing businesses we want to attract new employers to our Borough providing opportunities for future generations. We will...

- Commence the regeneration of Fareham Town Centre, which will include the provision of new homes, improvements to retail, leisure and entertainment facilities and changes to parking provision.
- Construct a second phase extension to our highly successful Innovation Centre at Daedalus, offering office and working space to new businesses and creating new jobs within the Borough.
- Enable the redevelopment of Portchester District Centre, which will include improvements to the shopping precinct, the provision of new homes and improvements to car parking facilities.
- Continue to implement our vision for Daedalus. We will build the necessary roads and services to unlock new employment opportunities at Swordfish Business Park, building new hangars and facilities to support the development of the airport and encourage employers to relocate and grow their businesses on the site.
- Support the construction of major new highway schemes across the Borough to include the Stubbington Bypass, improvements to the southern section of Newgate Land and a redesigned "all moves" Junction 10 on the M27.
- Encourage the provision of more A Level courses within the Borough.

PRIORITY five

LEISURE OPPORTUNITIES FOR HEALTH AND FUN

Fareham is an attractive place to live and well-equipped with a whole host of leisure activities.

As a Council we are constantly seeking to improve leisure facilities for residents and over the coming years we will see some exciting developments. We will...

- Transform Westbury Manor Museum into a vibrant "culture stop" in Fareham Town Centre.
- Develop long term plans aimed at bringing the Ashcroft Arts Centre and Ferneham Hall together into a new and exciting single arts and entertainment venue.
- Provide new sports pitches and children's play area at Coldeast.
- Provide a new allotment site in the Stubbington area.
- Improve the facilities at Cams Alders Recreation Ground to meet the needs of the sports clubs and encourage greater participation by the community.

"TRANSFORM WESTBURY MANOR MUSEUM INTO A 'CULTURE STOP'..."

PRIORITY six

A DYNAMIC, PRUDENT AND PROGRESSIVE COUNCIL

We are constantly seeking ways to reduce our spending and make your money work harder so that we can continue to deliver good services.

We will...

- Continue to work within a balanced and sustainable budget, recognising the reduction in Government funding.
- Continue to implement the Vanguard Methodology* across all Council services to ensure a customer focussed approach and the quick resolution of problems.
- Develop the Civic Offices to be an attractive working environment for existing and prospective tenants.
- Undertake a major review of all Council owned land and buildings to ensure that we are making the best use of our assets.
- Be alive to new opportunities for further investment in commercial properties to boost income and help meet corporate priorities.
- Continue to explore opportunities for shared services, partnerships and joint working with neighbouring Councils.

*Vanguard Methodology is a new way of working that puts the customer at the heart of Council services. This means we are changing the way we work to focus on our customers.

Strategic FRAMEWORK

Our strategic framework is made up of key financial and planning documents that help shape the work of the Council.

CORPORATE STRATEGY sets out our vision and priorities for the medium-term (i.e. five years). It also includes a set of improvement actions that describe the key projects and initiatives that we will focus on over this period.

LOCAL PLAN sets out the policies that will determine future land use to meet the needs of the corporate strategy.

MEDIUM TERM FINANCIAL STRATEGY AND ANNUAL BUDGET addresses the financial implications of all the Council's strategies and plans.

The corporate strategy and other strategies and plans are supported by local service agreements, which include a range of measures that demonstrate the general performance and degree of success of the Council.

Email your comments to corporatepolicy@fareham.gov.uk