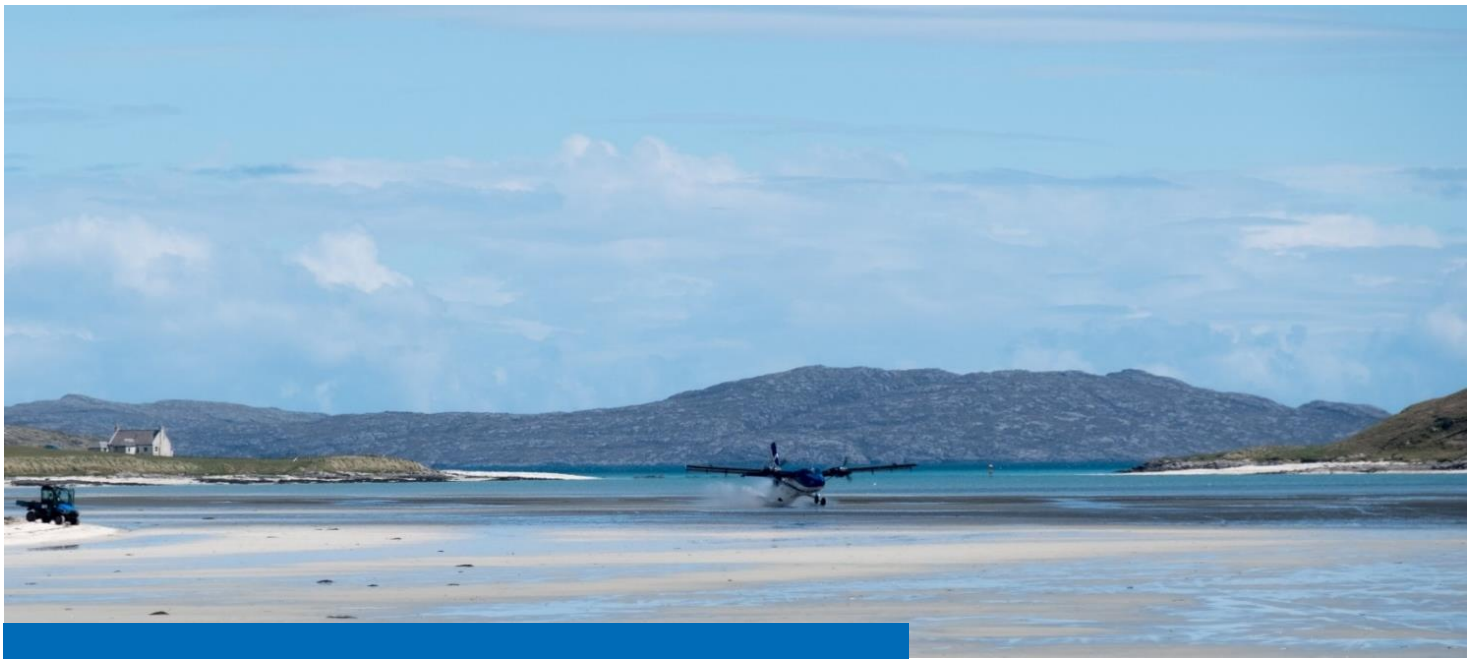
Highlands and Islands Airports Limited
Puirt-adhair na Gàidhealtachd is nan Eilean Earranta

Creating a world fit for the future

RICARDO



Highlands and Islands Airports Limited
Climate Change Adaptation Report

Report for Highlands and Islands Airports Limited

Report for Highlands and Islands Airports Limited

ED17758 | Issue number 2 | Date 16/05/2023

Customer:
Highlands and Islands Airports Limited

Customer reference:
7721482

Contact:
Richard Smithers, Gemini Building, Fermi Avenue, Harwell, Didcot, OX11 0QR, UK

T: +44 (0) 1235 753 615
E: Richard.Smithers@ricardo.com

Authors:
Charis Evans, Richard Smithers, Carys Jones, Rosie Dalley, Simon Morris

Approved by:
Richard J. Smithers

Signed

Date:
16/05/2023

Table of Contents

Executive Summary

Purpose of this report

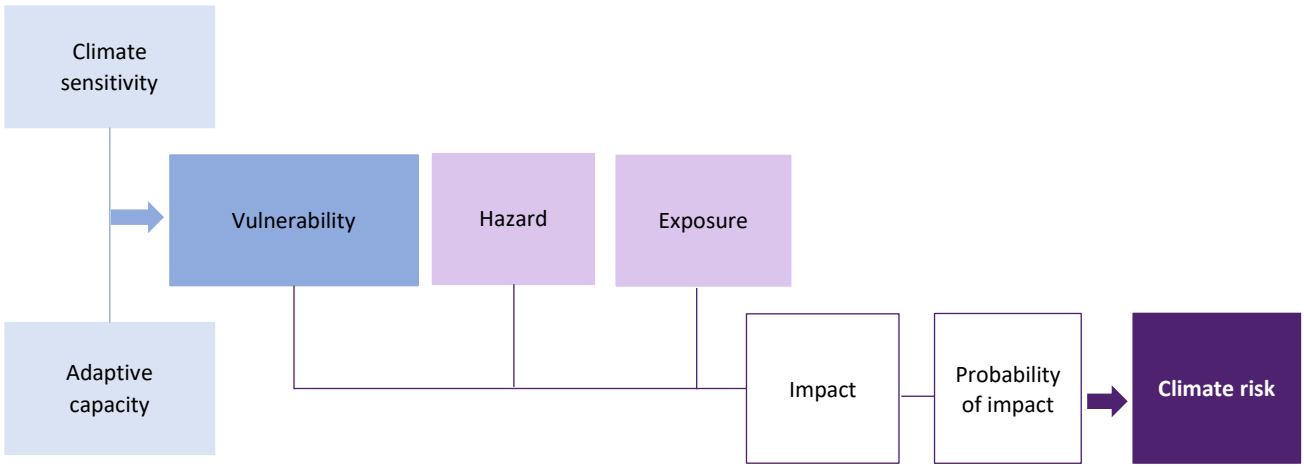
Highlands and Islands Airports Limited (HIAL) is responsible for 11 regional airports serving some of Scotland's remotest communities across the Highlands and Islands. This Climate Change Adaptation Report, produced alongside HIAL's climate mitigation strategy, summarises a climate vulnerability and risk assessment (VRA) of HIAL's operations, infrastructure, and strategic functions undertaken by Ricardo in February to May 2023. This summary report is complimented by a supplementary Excel document detailing individual regional airport risks following the standard DEFRA airport climate change risk template.

The aviation industry is highly sensitive to climate-related hazards and resultant climate vulnerabilities and risks have the potential to cause severe disruption to airport operations, delays for passengers, and ultimately, reductions in the safety of HIAL aircraft. The most recent Intergovernmental Panel on Climate Change (IPCC) assessment report states that countries nationally determined contributions (NDCs) make it likely that warming will exceed 1.5°C during the 21st century, with every additional increment of global warming increasing the severity of extreme events.[1] Previously, the latest UK climate projections suggested that even under a stringent greenhouse gas emissions reduction scenario, a degree of physical climate risk is now scientifically inevitable. HIAL's airports provide a lifeline service to individuals, communities and businesses across Scotland's Highlands and Islands, and it is essential for HIAL to ensure that its operations, infrastructure, and strategic functions are resilient to climate variability and change.

Approach to considering climate risks

The VRA systematically establishes and interacts ratings of the components of climate risks in accordance with the IPCC's definitions of terms. First, **climate sensitivities** and associated **adaptive capacities** were rated in order to rate **climate vulnerabilities**. The magnitude and frequency of **exposure** of climate vulnerabilities to **climate-related hazards** was then rated to determine the scale of potential **climate impacts** and in combination with their likelihood resulted in ratings of **climate risks**.

Figure 1: Interactions of VRA climate risk components



[1] IPCC, 2023: Summary for Policymakers. In: Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland.

Ricardo held two workshops with airport managers from each of HIAL's regional airports and key HIAL staff to identify and rate climate vulnerabilities, risks and adaptation options. The latter adaptation options were additional to relevant existing control measures or strategies that can mitigate climate risks.

As well as summarising the VRA findings, this report highlights the highest climate change risk ratings for each airport following the standard template used by UK airports in the third round of Climate Change Adaptation Reporting under the Climate Change Act 2008 (Appendix 3-13). The template details additional risk scores based on three time periods; post-control; 2050 and 2080. The full risk assessments following the standard template and the complete VRAs that underpin them can be found in the supplementary Excel document. This risk assessment has been developed in a way to allow regular update by HIAL.

Summary and recommendations

The VRA addresses people, assets, and services associated with each of HIAL's 11 regional airports. It is HIAL's airport runways that are most at risk from climate-related hazards, especially coastal flooding and the impacts of sea-level rise at Barra, Benbecula, Dundee, Islay, Stornoway and Sumburgh airports. This is not surprising given the coastal nature of the majority of HIAL regional airports. Airport aprons are also at risk but have much lower risk ratings than airport runways except at Barra airport. Terminal buildings across the HIAL estate are generally identified as 'medium impact, medium likelihood' risk ratings, where terminal buildings are often set back from the coastline or some distance from other key water sources and the main risk is of high temperatures causing passenger discomfort. However, Barra and Islay's airport terminal buildings were identified as higher risk ratings due to the impact of sea-level rise at Barra and heavy rainfall causing additional water ingress and surface flooding at Islay airport. Overall, 25-30 climate risks have been identified and categorised by climate variable for each HIAL airport in the standard risk assessment template.

As part of this climate change risk assessment, existing control measures as well as bespoke adaptation actions have been identified to mitigate the potential physical risks of climate change. These adaptation actions range from the enhanced review and ongoing monitoring of airport building control requirements to recording and monitoring incidents of climate-related hazards. Additionally, not all impacts associated with climate change should be considered as negative, changes arising from climate change can also present positive opportunities for HIAL, such as changes to destination choices and the potential for rainwater harvesting at airport sites. These climate change opportunities are summarised in Chapter 5.

With the complete risk assessment and underlying VRA, HIAL recognises the need to address climate change risks by embedding climate change adaptation into its risk governance processes, strategic business planning, existing risk management strategies and climate mitigation strategies. It is also important that HIAL engage with identified stakeholders to further assess the recommended adaptation options.

1. Introduction

Highlands and Islands Airports Limited (HIAL) is responsible for the management and operation of 11 regional airports serving some of Scotland's remotest communities. With regional airports located at Barra, Benbecula, Campbeltown, Dundee, Inverness, Islay, Kirkwall, Stornoway, Sumburgh, Tiree and Wick John O'Groats, HIAL has successfully developed a regional airport group across a very large and diverse geographical area. As such, HIAL is fundamental in ensuring essential transport connectivity and supporting the livelihoods of communities and businesses across Scotland's Highlands and Islands. In 2019, total passenger numbers exceeded 1.68 million with aircraft movements in the range of 130,000. As a private company wholly owned by Scottish Ministers, HIAL's mission is to create social benefit and economic prosperity by building Scotland's sustainable regional airport group of the future, reinforced by the vision to become a net zero regional airport group.

Figure 2: HIAL Airport Locations.

This Climate Change Adaptation Report summarises a climate vulnerability and risk assessment (VRA) conducted for each of HIAL's 11 regional airports. This report highlights the highest climate change risk ratings for each airport, following the standard template used by UK airports in the third round of Climate Change Adaptation Reporting of the Climate Change Act 2008. The risks and opportunities identified in this report will inform HIAL's existing risk management processes to ensure that HIAL's climate change adaptation response remains appropriate and effective.

1.1. Climate change overview

The most recent assessment report from the Intergovernmental Panel on Climate Change (IPCC) states that "Global greenhouse gas emissions in 2030 implied by nationally determined contributions (NDCs) announced by October 2021 make it likely that warming will exceed 1.5°C during the 21st century and make it harder to limit warming below 2°C…. With every additional increment of global warming, changes in extremes continue to become larger."[2] Previously, the latest UK Climate Projections 2018 (UKCP18) suggested that even under a stringent greenhouse gas emissions reduction scenario, a degree of physical climate risk is now scientifically inevitable. It is projected that in the UK there will be an increase in warmer, wetter winters and hotter, drier summers as well as in the frequency and magnitude of extreme weather events.

HIAL's airports provide a lifeline service to communities and businesses across Scotland's Highlands and Islands. So, this report has been prepared to ensure that climate-related risks, the relevance of existing control measures or strategies, and further adaptation options have been assessed. It will thereby enable HIAL to ensure that its operations, infrastructure, and strategic functions are resilient to climate variability and change.

[2] IPCC, 2023: Summary for Policymakers. In: Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]

1.2. Approach to climate change at HIAL

HIAL have a well-established risk management and assessment process that covers various risk categories, including weather-related disruptions. Climate risks identified in the standard risk assessment template, underpinned by the completed VRAs, will be included in the appropriate departments risk register and managed through HIAL's established risk management process and procedures. Weather-related disruption is an issue that HIAL have had to face historically, and climate-related hazards will not be a new challenge. Adverse weather plans already exist for each of the regional airports and climate-related impacts identified through this assessment will need to be incorporated into existing policies. Crises and contingency planning are managed via a tactical response defined by bronze, silver, and gold crisis management teams. Control meetings at each level are determined by several criteria with crisis management teams drawn from experienced staff with familiarity of key systems, assets, and operations across the airport.

2. Establishing a climate baseline

2.1. Climate baseline

To understand climate risks, historical observations of climate-related hazards were reviewed to establish a baseline. This informed the assessment of HIAL's existing vulnerability to climate-related hazards. The climate across Scotland's Highlands and Islands is classified as temperate with rainfall throughout the year. Given that HIAL's airports are spread across Scotland, regional climate variations do exist. The climate of western Scotland (where Barra, Benbecula, Campbeltown, Islay and Tiree regional airports are located) is much milder than that of eastern Scotland (Dundee and Inverness) due to the strong influence of the warmer Gulf Stream for example. With winds mainly blowing from the sea, annual mean temperatures on the west coast are in the range of 9.5 to 9.9°C. Annual mean temperatures in northern Scotland (where Stornoway, Kirkwall and Wick John O'Groats regional airports are located) tend to fall due to altitude. The lowest annual mean temperatures for low lying areas in the UK is about 7°C in the Shetlands (Sumburgh airport). Appendix 1 details average annual maximum and minimum temperatures across HIAL and various climate baseline years.

2.2. Historical observations of climate change

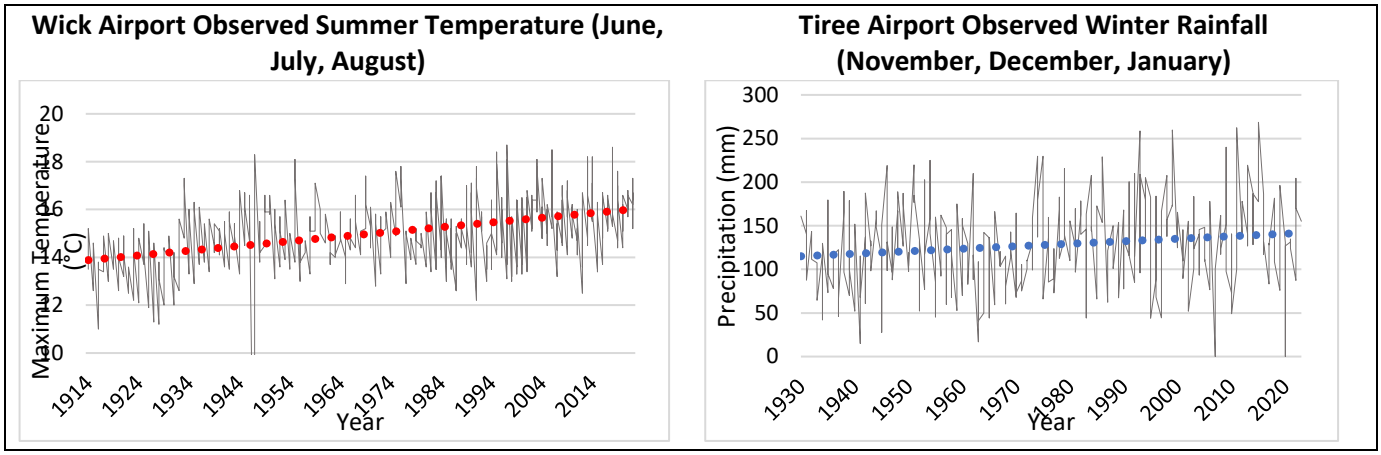
Over the last few decades, Scotland has experienced a warming trend, shifting rainfall patterns and rising sea levels. Scotland's 10 warmest years on record have all occurred since 1997 and the average temperature in the last decade has been around 0.7°C than the 1961-1990 average[3].

Evidence of warming trends can already be seen across many HIAL airports. Figure 3 shows observed summer temperatures at Wick Airport since 1914, utilising historic data from the airport weather station provided by the Met Office.[4]

There is also evidence of increasing rainfall across Scotland in the past decade, with an increasing proportion coming from heavy rainfall events. Over the last decade, the average year has been 9% wetter than a 1961-1990 baseline. Again, evidence of this can already be seen across many HIAL airports by assessing historic weather station data. On average, Tiree airport has seen an increase in winter rainfall from ca.110mm in 1930 to ca. 150mm today.

[3] Adaptation Scotland, 2021. Climate Projections for Scotland Summary. Available here: https://www.adaptationscotland.org.uk/why-adapt/climate-trends-and-projections
[4] Historic station data, 2023. Available here: Historic station data - Met Office

Figure 3: Examples of evidence of a changing climate across HIAL's airports (Wick John O'Groats and Tiree regional airports).



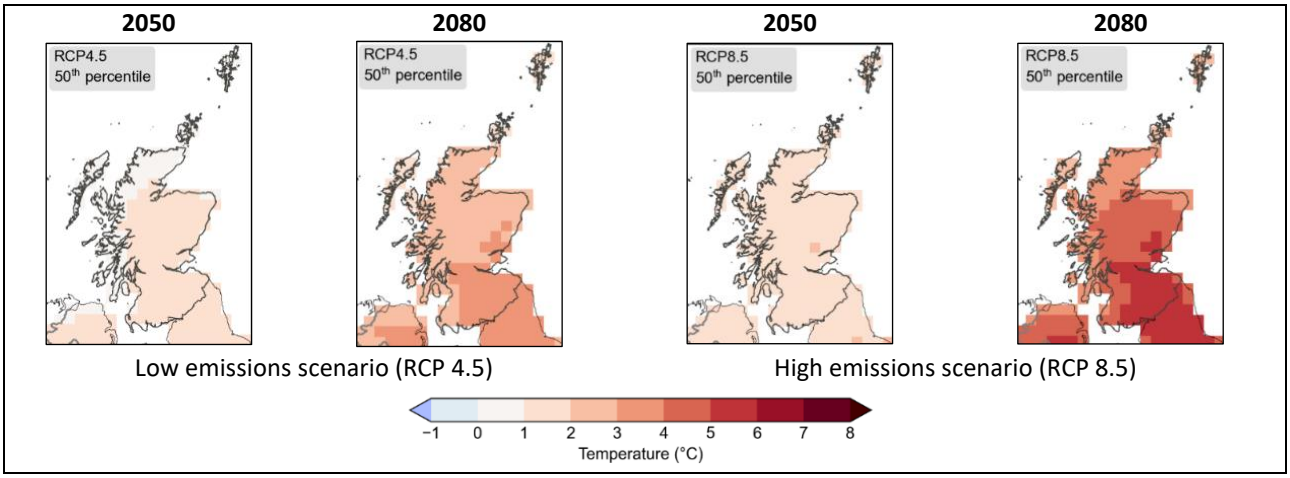
3. Establishing future climate projections

The UK Climate Projections 2018 (UKCP18) provided by the Met Office Hadley Centre Climate Programme, were used to assess future climate risks. UKCP18 uses cutting-edge climate science modelling and probabilistic projections to provide the most up-to-date assessment of how the UK's climate will change up to 2100 under several emissions scenarios. Although multiple emissions scenarios are available within the UKCP18 tool, for the purpose of this analysis two emissions scenarios (identified by the IPCC as Representative Concentration Pathways) have been used: **RCP 4.5,** the most probable baseline emissions scenario, which represents a 2.4°C global mean surface temperature increase; and **RCP 8.5,** a high emissions scenario, which represents a 4.3°C global mean surface temperature increase.

3.1. Temperature

Historic observations of temperature show an annual warming across Scotland, which is projected to continue. UKCP18 climate projections indicate that there will be an increase in both summer and winter temperatures across Scotland. UKCP18 climate projections for mean summer temperature under RCP4.5 are projected to increase by 0.8°C by the 2050s and by 1.6°C by the 2080s. Under RCP8.5, mean summer temperatures are expected to rise by 1.1°C by the 2050s and by 2.4°C by the 2080s. Variations in UKCP18's regional projections are that summer warming will be greatest on the west coast of Scotland, i.e., in the vicinity of Barra, Benbecula, Campbeltown, Islay and Tiree Airports.

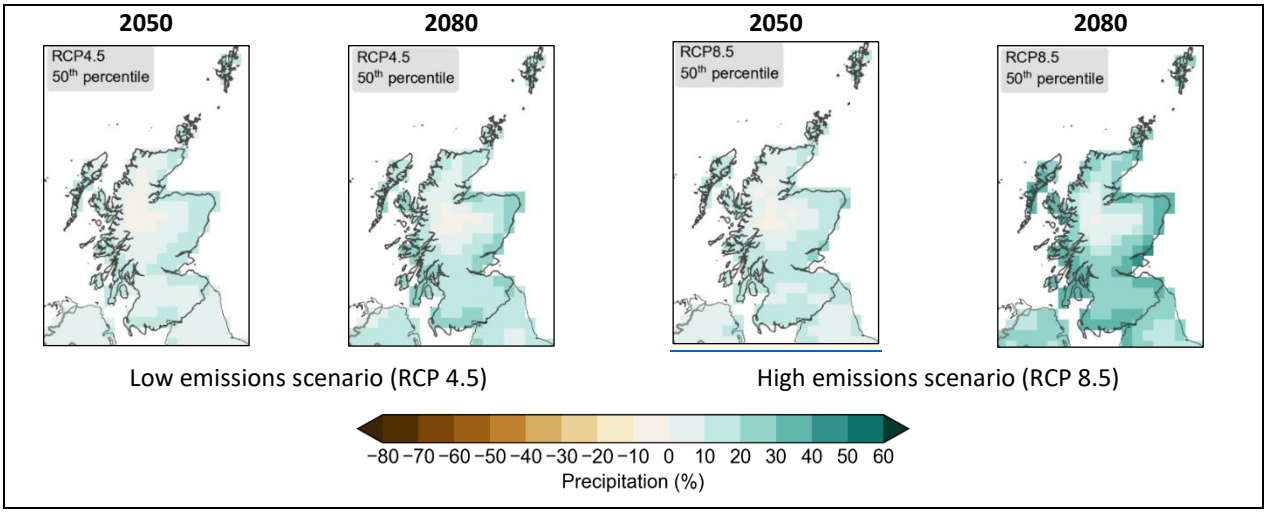
Figure 4: UKCP18 mean summer temperature projections in 2050 and 2080 under RCP4.5 and RCP8.5 compared to the 1981 – 2000 baseline.



3.2. Precipitation

Historic observations of precipitation show high levels of variability trending towards warmer wetter winters. Under UKCP18 projections, both summer and winter rainfall are expected to increase across Scotland. UKCP18 projections for mean winter precipitation across Scotland under RCP4.5 are projected to increase by 8% by the 2050s and 11% by the 2080s. Under RCP8.5, winter precipitation is expected to increase by 10% by the 2050s and 18% by the 2080s. Regional variations project that increases in winter precipitation will be greatest on the Orkney and Shetland islands where HIAL's Kirkwall and Sumburgh airports are located. Although Scotland's winter temperatures are projected to increase, cold and snow events remain a possibility.

Figure 5: UKCP18 mean winter precipitation projections in 2050 and 2080 under RCP4.5 and RCP8.5 compared to the 1981 – 2000 baseline.



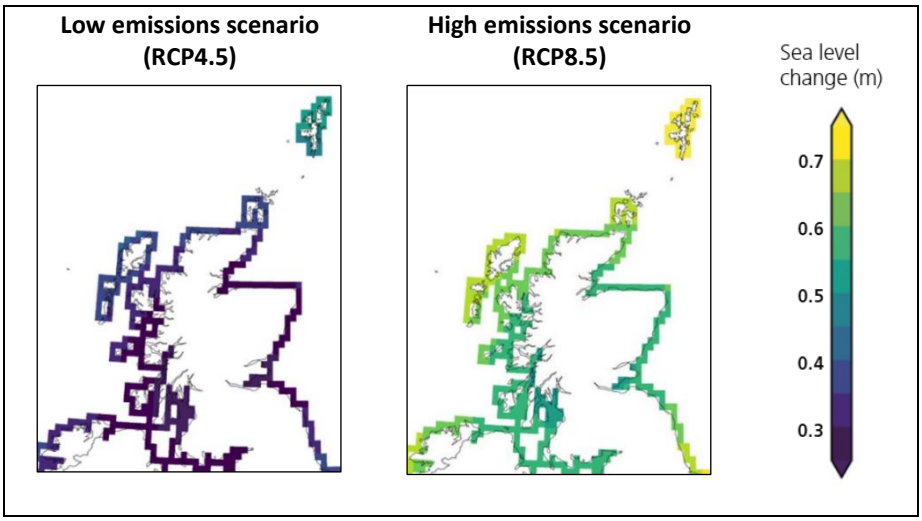
3.3. Storms, lightening and wind

UKCP18 projections indicate an increase in near-surface wind speeds across Scotland for the second half of the 21st century in winter. However, the projected increase in wind speed is modest compared to natural variability, so confidence is low. Warming water in the North Atlantic could potentially increase the likelihood of ex-tropical storms being directed across the UK during autumn but other factors also influence the frequency and magnitude of storms across the UK, which vary significantly each year. Scotland's weather is likely to remain variable with more extreme weather events likely to occur with climate change.

3.4. Sea-level rise

Sea levels around Scotland's coastline are projected to rise in the decades ahead, increasing flooding and coastal erosion. There are regional variations in projected sea-level rise, primarily due to vertical land movement caused by glacial rebound from the last ice age. Under RCP4.5, sea level is projected to rise by 0.3-0.4m by 2100 and 0.5-0.6m surrounding the Shetland islands. Under RCP8.5, sea level is projected to rise by 0.5 to 0.6m, and by more than 0.7m surrounding the Shetland islands compared to a 1981-2000 baseline. Sea level rise projections provided under UKCP18 are considered the most likely range of change, however the possibility of sea level rise outside of this range cannot be ruled out.

Figure 6: UKCP18 median projected sea level rise around Scotland's coast by 2100 under RCP4.5 and RCP8.5 emissions scenarios compared to the 1981 – 2000 baseline.



4. Airport vulnerability and risk assessment

The VRA addressed people, assets, and services associated with each of HIAL's 11 airports. Ricardo undertook a desk-based review of the best available evidence, which was validated and supplemented by two workshops held with airport managers from each of HIAL's airports to identify and rate climate vulnerabilities, risks and adaptation options, the latter where additional to relevant existing control measures or strategies that can mitigate the climate risks.

The VRA systematically established and interacted ratings of the components of climate risks in accordance with the IPCC's definitions of terms (Box 1). First, **climate sensitivities** and associated **adaptive capacities** were rated in order to rate **climate vulnerabilities**. The magnitude and frequency of **exposure** of climate vulnerabilities **to climate-related hazards** was then rated to determine the scale of potential **climate impacts** and in combination with their likelihood resulted in the overall ratings of **climate risks** (on a 5-point scale, as defined in Table 2) reported in the airport risk assessment templates.

The effects of existing control measures in combination with future planned control measures (i.e., adaptation actions arising from consideration of the VRA) on reducing sensitivities and/or increasing adaptive capacities and/or reducing the exposure of resultant climate vulnerabilities to climate-related hazards were subsequently considered to determine the future risk scores also reported in the airport risk assessment templates.

Risk Ratings	
1	Very low impact, very low likelihood
1	Very low impact, low likelihood
1	Low impact, very low likelihood
2	Medium impact, very low likelihood
2	Low impact, low likelihood
2	Medium likelihood, very low impact
3	Medium impact, medium likelihood
3	High impact, medium likelihood
4	Medium impact, high likelihood
4	High impact, high likelihood
5	Very high impact, high likelihood

Box 1: IPCC AR6 definitions of key terms

Sensitivity: Degree to which a system or species is affected, adversely or beneficially, directly or indirectly, by climate variability or change.
Adaptive capacity: Ability of systems, institutions, humans, and other organisms to adjust to potential damage, take advantage of opportunities, or respond to consequences.
Vulnerability: Propensity or predisposition to be adversely affected. Vulnerability encompasses sensitivity or susceptibility to harm and lack of capacity to cope and adapt.
Hazard: Potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.
Exposure: The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected.
Impact: The consequences of realized risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather and climate events), exposure, and vulnerability.
Risk: Results from the interaction of vulnerability (of the affected system), its exposure over time (to the hazard), as well as the (climate-related) hazard and the likelihood of its occurrence.

4.1. Terminal buildings

HIAL's terminal buildings are sensitive to climate-related hazards. The majority of HIAL's terminal buildings (Benbecula, Campbeltown, Dundee, Inverness, Kirkwall, Stornoway, Sumburgh, Tiree and Wick) were given a risk rating of 3 - medium impact, medium likelihood. Terminal buildings are sensitive to high temperatures causing passenger discomfort especially where no air conditioning is present in the terminal building, as is the case at all airports except for Dundee and Inverness. Heavy rainfall is another key climate sensitivity and may cause surface flooding and water ingress. HIAL's terminal buildings are well designed, comply to strong building regulations and are subject to frequent risk assessments. This suggests that HIAL's terminal buildings are generally able to adjust or respond within existing climate limits, but major challenges may be presented beyond them.

Impacts of increasing exposure to climate-related hazards include passenger discomfort due to high temperatures, an increasing number of health and safety incidents and greater energy demand for cooling systems with increasing financial costs and GHG emissions. Surface flooding and water ingress to the terminal buildings may cause disruption to key terminal services. Barra and Islay's terminal buildings have a higher risk rating. Barra's terminal building is very climate sensitive to sea-level rise and is highly exposed to coastal flooding, given its proximity to the shoreline. Islay's terminal building is equally at a higher risk due to high exposure to surface flooding from the Glenegedale River, which runs adjacent to the terminal building.

Table 1: VRA risk ratings for terminal buildings across HIAL regional airports

Airport	Impact Rating	Probability of Impact	Risk Rating
Barra Airport	4. High impact	3. Medium likelihood	4. High impact, medium likelihood
Benbecula Airport	3. Medium impact	3. Medium likelihood	3. Medium impact, medium likelihood
Campbeltown Airport	3. Medium impact	3. Medium likelihood	3. Medium impact, medium likelihood
Dundee Airport	3. Medium impact	3. Medium likelihood	3. Medium impact, medium likelihood
Inverness Airport	3. Medium impact	3. Medium likelihood	3. Medium impact, medium likelihood
Islay Airport	4. High impact	4. High likelihood	4. High impact, high likelihood
Kirkwall Airport	3. Medium impact	3. Medium likelihood	3. Medium impact, medium likelihood
Stornoway Airport	3. Medium impact	3. Medium likelihood	3. Medium impact, medium likelihood
Sumburgh Airport	3. Medium impact	3. Medium likelihood	3. Medium impact, medium likelihood
Tiree Airport	3. Medium impact	3. Medium likelihood	3. Medium impact, medium likelihood
Wick John O'Groats Airport	3. Medium impact	3. Low likelihood	3. Medium impact, low likelihood

4.2. General office buildings and Air Traffic Control (ATC)

General office buildings and ATC towers across the HIAL estate may be sensitive to climate-related hazards. High temperatures may cause increasing staff discomfort and difficult working conditions, leading to increasing health and safety incidents and staff absence. Office buildings and ATC towers at Barra, Dundee, Islay, Stornoway and Sumburgh are particularly at risk due to a lack of air conditioning units. HIAL staff can adjust or respond within existing climate limits, but minor challenges are presented beyond given UKCP18 projections indicating increasing exposure to high temperatures. Campbeltown, Kirkwall, Tiree and Wick John O'Groats have air conditioning units installed so will be less exposed to high temperatures and therefore have a low-risk rating.

4.3. Other airport buildings, appliance bays and vehicle storage

Several other secondary buildings are situated across each HIAL airport estate, and these provide critical operational airport functions including warehouse storage, generator cabins, appliance bays, vehicle storage, workshops, pumphouses etc. Most additional airport buildings are very sensitive to climate-related hazards, especially where high temperatures reduce the performance or result in failure of critical airport appliances (e.g., generators) or where heavy rainfall causes water ingress to key airport facilities. Across HIAL's smaller and more remote island airports (Barra, Benbecula, Islay, Tiree), airport appliance and storage facilities are predominantly isolated single structures made of tin or metal and these buildings may be less resilient to severe or extreme weather events.

4.4. Airport apron and airport runways

Given the coastal nature of the majority of HIAL's airports, airport aprons and runways may be highly sensitive to climate-related hazards. The VRA concluded that airport runways at Barra, Benbecula, Dundee, Islay, Stornoway and Sumburgh are at a high or very high-risk ratings and Barra airport is the only airport apron at high risk due to its proximity to the shoreline.

Barra's three runways are defined as extremely climate sensitive to sea level rise and coastal flooding. High temperatures also harden the natural beach runway surface and reduce natural drainage functionality, resulting in excess surface water and increasing algae. Flight times are varied with high tide and major challenges to adjust or respond within existing climate limits makes Barra's runways highly vulnerable. With UKCP18 climate projections indicating sea level rise of up to 0.6m by 2100 on the west coast of Scotland, there is potential for complete loss of Barra's airport runway with aircraft unable to land.

Dundee airport has one runway of 1,400m in length adjacent to the shoreline. Use of the runway is very sensitive to climate-related hazards despite a small coastal zone and airport road which provides a barrier to the shoreline. Dundee's airport runway is able to adjust within climate limits but major challenges are presented beyond these limits. Similarly, Benbecula, Islay, Stornoway and Sumburgh's runways are equally vulnerable to coastal flooding.

HIAL's airport runways are not just sensitive to sea level and coastal flooding. All airport runways are sensitive to surface damage caused by temperatures exceeding design standards resulting in melting and cracking of the runway surface. Higher temperatures can also cause land to dry out and become less permeable. Airport runways are designed to withstand temperature extremes and most of HIAL's runways can adjust or respond within existing climate limits with minor challenges beyond these limits.

Table 2: VRA risk ratings for airport runways across HIAL

Airport	Apron Risk Rating	Runway Risk Rating
Barra Airport	5. Very high impact, high likelihood	5. Very high impact, high likelihood
Benbecula Airport	3. Medium impact, medium likelihood	5. Very high impact, high likelihood
Campbeltown Airport	3. Low impact, medium likelihood	3. Medium impact, medium likelihood
Dundee Airport	3. Low impact, medium likelihood	5. Very high impact, high likelihood
Inverness Airport	3. Medium impact, medium likelihood	3. Medium impact, medium likelihood
Islay Airport	3. Low impact, medium likelihood	4. High impact, medium likelihood
Kirkwall Airport	3. Low impact, medium likelihood	3. Medium impact, medium likelihood
Stornoway Airport	3. Low impact, medium likelihood	4. High impact, medium likelihood
Sumburgh Airport	3. Low impact, medium likelihood	4. High impact, medium likelihood
Tiree Airport	3. Low impact, medium likelihood	3. Medium impact, medium likelihood
Wick John O'Groats Airport	3. Low impact, medium likelihood	3. Medium impact, medium likelihood

4.5. Fire station and emergency services

HIAL's airport fire service carries out a variety of duties not just firefighting. These include daily inspections of the runway, maintenance of the airfield, de-icing, snow clearance, parking of aircraft and training of first aid. The airport fire services across HIAL may be sensitive to climate-related hazards, especially where fire risk is likely to increase due to extreme temperatures, frequent periods of drought and increasing lightening following extreme weather events. Extreme temperatures may also increase emergency service utilisation due to increasing incidence of heat-related illnesses. The airport fire services have strong capabilities to deal with increased fire risk and the airport fire service is most likely able to adjust or respond regardless of climate, making it somewhat resilient to future climate hazards.

Some airport fire services, such as Barra and Islay, are more exposed to extreme heat and increased fire risk as the airport site is remote and often surrounded by vegetation and grassland which can be extremely problematic in drought conditions. Severe impacts include the fire services inability to cope with an increasing demand for services as fire risk increases. Fire training grounds (FTGs) across HIAL airport sites may be sensitive to climate impacts, reducing the fire services ability to respond and disrupting training sessions. For example, at Dundee airport FTG facilities are located close to the shoreline and are vulnerable to sea level rise and coastal flooding.

5. Climate change risk assessment and adaptation actions

5.1. Adaptation actions

As part of this risk assessment, existing control measures or strategies and additional actions required to adapt to the potential physical risks of climate change have been identified. Within the second workshop, stakeholders were advised that adaptation actions should seek to reduce vulnerabilities by reducing climate sensitivity or increasing adaptive capacity, and that options might include the development and management of operational strategies, infrastructural changes, or capacity-building. They were also guided that some options might involve adjusting (climate-proofing) current activities, whilst other options might be new, or require major transformations in airport operations.

A full list of the existing control measures as well as adaptation action recommendations are provided in the supplementary Excel document. Table 3 summarises the key adaptation action themes identified.

Table 3: Summary of key adaptation action themes identified

Action Theme
Review conditions regularly and ensure that optimal conditions are maintained
Record and monitor incidents of climate-related hazards through a central log
Enhance review and ongoing monitoring of building control requirements (heating, ventilation, and air conditioning – HVAC – system and building performance standards)
Ensure that future building design and development considers and manages risks from climate change
Ongoing engagement and interaction with interdependent stakeholders e.g., airline partners, local authorities, SEPA
Continuous review and update of airport adverse weather plans and contingency planning
Improve programme and build evidence base for monitoring tidal variation and coastal erosion

5.2. Climate change opportunities

Not all impacts associated with climate change should be considered as negative, changes arising from climate change can also present positive opportunities for HIAL. The opportunities discussed and identified through the adaptation workshops are detailed below:

- **Changes to destination choices:** With warmer weather projected across Scotland's Highlands and Islands and increasing heat stress impacting overseas travel, an increasing number of tourists may visit Scotland.
- **Reduced heating of airport buildings:** Warmer winter temperatures predicted under the UKCP18 are likely to shorten the time when heating is required in airport buildings. This will reduce energy costs as well as GHG emissions.
- **Potential for rainwater harvesting at airport sites:** With precipitation set to increase under UKCP18 projections across the Highlands and Islands, rainwater harvesting could act as a potential opportunity, especially for remote islands where freshwater may become scarce such as Barra or Benbecula.

5.3. Interdependencies

Through completion of the VRA and airport standard risk assessment template, several interdependencies and stakeholders were identified. It is important that HIAL engage with these stakeholders, especially in relation to the recommended further adaptation options.

- Island residents and businesses: HIAL provide a lifeline service to residents and businesses across the Scotland's highlands and islands.
- Local authorities: Local authorities have a crucial role to play in the climate change adaptation agenda in both delivering adaptation strategies devised from national adaptation agendas (Adaptation Scotland) as well as co-ordinating bottom-up action in their role as community leaders.
- Road networks: As well as passengers and HIAL staff travelling to the airports, supplies such as fuel, de-icer are dependent on road networks to and from the airport.
- Energy and water suppliers: HIAL airports require a stable supply of energy and water to operate and are dependent on suppliers to ensure that their infrastructure is adequate to meet future climate changes.

- Scottish Environmental Protection Agency (SEPA): SEPA play a key role in managing and mitigating Scotland's flood risk at the local and national level. SEPA also play a key role in managing and mitigating water quality and pollution risk, such as de-icer pollution from airport run off
- Scottish and UK Government: Policies must align and support national climate objectives, especially given that HIAL operates under the Public Service Obligation.

5.4. Uncertainties

The risk assessment and underlying VRA has been completed using UKCP18, the most up to date climate model available provided by the UK Met Office. As our understanding and ability to simulate climatic changes is advancing, it is important to recognise that climate models are not able to fully represent all of the features seen in the present-day climate. There are still several limitations and uncertainties associated with our ability to project 21st century weather and climate and it is important to remember that climate projections should not be misinterpreted as climate predictions. The scientific community adopts the term projections, not predictions, when describing future changes in climate, as projections involve assumptions in parameters, e.g., future socio-economic and technological developments and are therefore subject to substantial uncertainty.

All future modelling simulations are conditioned on a limited number of representative concentration pathways (RCPs) and projections are strongly dependent on future global greenhouse gas emissions. While global projections provide a range of climate futures, they cannot cover all potential future climate outcomes. For this reason, UKCP18 uses probabilistic projections where probabilities represent an indication of how much the evidence from models and observations taken together support a particular future climate outcome. There is more evidence for outcomes near the centre of the distribution than in the tails, therefore 50% probabilistic projections are favoured.

6. Next steps

In order to ensure that HIAL's climate change adaptation response remains appropriate and effective the following next steps have been identified:

- Responsibilities are assigned for all identified climate risks, which should be incorporated into HIAL airports' existing risk registers
- The climate risk register is reviewed annually to check that the existing and future control measures (i.e., adaptation actions) are implemented, the climate risks are regularly reassessed and any additional climate risks are included in the register
- The annual review of climate risks pays due heed to the latest climate science to ensure that existing and future control measures are appropriate
- External stakeholders to the airport and aviation industry continue to be consulted to share best practices regarding climate risk assessment, adaptation, and resilience

Appendix 1: Average annual maximum and minimum temperatures across HIAL

Airport	Closest Weather Station	1961 - 1990		1971 - 2000		1981 - 2010		1991 - 2020	
Barra Airport	Barra Airport	11.3	7.1	11.6	7.3	11.9	7.5	12.1	7.7
Benbecula	South Uist Range	10.9	6.3	11.1	6.5	11.5	6.9	11.7	7.0
Campbeltown	Machrihanish	11.9	6.2	12.1	6.3	12.4	6.4	12.6	6.6
Dundee	Mylnefield	11.8	5.0	12.1	5.2	12.4	5.3	12.8	5.4
Inverness	Inverness	11.9	5.4	12.2	5.6	12.5	5.6	12.7	5.7
Islay	Port Ellen	11.8	5.8	12.0	6.0	12.2	6.2	12.4	6.4
Kirkwall	Kirkwall Airport	10.2	5.1	10.5	5.3	10.7	5.5	11.0	5.8
Stornoway	Stornoway Airport	10.9	5.2	11.0	5.6	11.2	5.9	11.5	6.2
Sumburgh	Lerwick	9.2	4.8	9.3	5.0	9.6	5.3	9.8	5.6
Tiree	Tiree Airport	11.4	6.5	11.6	6.6	11.8	6.9	11.9	7.1
Wick	Wick Airport	10.4	4.8	10.6	4.9	10.8	5.1	11.0	5.4
HIAL	**Average**	**11.1**	**5.7**	**11.3**	**5.8**	**11.5**	**6.1**	**11.8**	**6.3**
Scotland	**Average**	**10.3**	**3.8**	**10.5**	**4.0**	**10.8**	**4.2**	**11.1**	**4.4**

Appendix 2: Definition of VRA ratings

Rating	Definition
Sensitivity Ratings	
1	Insensitive to climate-related hazards
2	May be sensitive to climate-related hazards
3	Sensitive to climate-related hazards
4	Very sensitive to climate-related hazards
5	Extremely sensitive to climate-related hazards
Adaptive Capacity Ratings	
1	Major challenges to adjust or respond within existing climate limits
2	Minor challenges to adjust or respond within existing climate limits
3	Able to adjust or respond within existing limits but major challenges beyond them
4	Able to adjust or respond within existing limits but minor challenges beyond them
5	Able to adjust or respond regardless of climate
Vulnerability Ratings	
1	Highly resilient
2	Resilient
3	Potentially vulnerable
4	Vulnerable
5	Highly vulnerable
Exposure Ratings	
1	No asset located where climate-related hazard will occur
2	Few assets located where climate-related hazard will occur
3	Some assets located where climate-related hazard will occur
4	Many assets located where climate-related hazard will occur
5	All or most assets located where climate-related hazard will occur
Impact Rating	
1	Very low impact
2	Low impact
3	Medium impact
4	High impact
5	Very high impact
Probability Rating	
1	Very low likelihood
2	Low likelihood
3	Medium likelihood
4	High likelihood
5	Very high likelihood

Appendix 3: Barra Airport highest climate risk ratings

Barra Airport Climate Change Risk Assessment

STAGE A: Current Risks												STAGE B: Adaptation Actions		STAGE C: Potential Climate Impacts				
								Current						Future				
Risk Code	Climate Variable	Risk or Opportunity (including indirect and interdependency risks)	Decision threshold, process or trigger point for action on the risk	Location	Business Function Risk Owner	Interdependencies	Potential Consequences (Functions, Service, Assets affected)	Impact rating	Probability of impact rating	Overall risk rating	Existing Control Measures or Strategies	Further Planned Control Measures or Actions	Risk Score (Post-Control)	Risk Score [2050 + Post-Control]	Risk Score [2080 + Post-Control]	Narrative on Horizon Scores	Assumptions and interdependencies (incl. data, operational, regulatory changes etc)
BRR CCRA03	Temperature	**Overheating of airport buildings:** High temperatures may reduce the performance of some sensitive or mechanical equipment, which consequently may fail to operate correctly. Increasing the amount of technical or mechanical equipment used at Barra airport may create difficulties where specialist engineers outside of Barra or bespoke mechanical parts are needed to fix faulty systems. Barra currently has no BMS.	Critical thresholds not currently tested	Airfield Operations	Airport Manager	Requirement of sufficient energy capacity available at the airport. Back-up capacity needs to be available should grid not be able to meet increased energy demand.	Increased energy demand for cooling systems increasing financial costs. Temperature sensitive infrastructure may experience failure, damage or inefficiency leading to operational disruption.	4	4	**4**	Alignment to HIAL asset infrastructure register when planning for new assets or replacements assets Consistent maintenance of sensitive and mechanical equipment Upskilling of staff to fix sensitive or mechanical equipment when faulty Internet of things concept utilised for some airport devices and equipment, but there is a need to centrally store and report this information	Provision of Building Management System (BMS) at Barra Airport Provision of HVAC systems and monitoring of temperatures in buildings Continue to review and ensure robustness of cooling systems for sensitive or mechanical equipment Ensure that future building design and development of the terminal building manages risks from climate change	3	3	4	UKCP18 climate projections are for mean summer temperatures on the west coast of Scotland to rise under the most probable baseline emissions scenario (RCP4.5) by 1°C by the 2050s and by 1.8°C by 2080 and under a high emissions scenario (RCP8.5) by 1.3°C by 2050 and by 2.8°C by 2080	Mitigations and future risk based on current BMS and HVAC systems
BRR CCRA10	Temperature	**Changes to bird migration patterns resulting in increase in bird strike risk:** Changes to airfield habitats and wildlife populations near to the airfield may occur with climate change. Barra is located within a large, protected area for wildlife and there are large bird populations on the island,	Critical threshold not currently tested, requires further research	Airfield Operations	Airport Manager	Fire Service, Bird Management Contractors, Airlines, RSPB	Increases in aircraft bird strike risk resulting in accidents or diversions. Reputational damage, frequent delays and flight cancellation.	4	4	**4**	Annual bird strike management standards check carried out by third party experts who determine risk of bird strike Wildlife reports and engagement with external sources other than airports (e.g., WWF, various industry forums) Onsite bid and wildlife management	Annual review of a Wildlife Hazard Management Plan Awareness of changing physical characteristics of airfield	4	4	4	UKCP18 climate projections are for mean summer temperatures on the west coast of Scotland to rise under the most probable baseline emissions scenario (RCP4.5) by 1°C by the 2050s and by 1.8°C by 2080 and under a high emissions scenario (RCP8.5) by 1.3°C by 2050 and by 2.8°C by 2080	None
BRR CCRA28	Sea-level rise	**Sea-level rise leading to loss of low-lying destination airports:** Barra airport is on the frontline of sea level rise and the risk of flight cancellation is becoming more at the forefront of climate risks. Sea level rise will cause disruption to Barra's airport buildings, beachfront apron and beach runway as well as other infrastructure including utility supplies and surface transport routes. Barra's terminal building is located only meters from high tide mark.	Critical threshold not currently tested	Airside Operations, Landside Operations	All departments	Aircraft provide a lot of lifeline services to Barra residents and businesses	Inability to receive aircraft with essential services to the island disrupted.	5	5	**5**	Contingency plans in place for changes to flight schedules and airport closure Ongoing engagement with other airports, sharing of best practice Surveying beach levels Communication with pilots in Glasgow ahead of take-off to update on tide movements	Consultation looking at longer term risks and impacts of sea level rise at Barra Improve programme and build an evidence base for monitoring tidal variation and coastal erosion Frequent engagement with operator Loganair to revisit scheduling of flights either side of low tide optimum Investigate opportunity for increased funding for sea wall protection	4	4	4	As compared to a 1981-2000 baseline, by 2100, sea level on Scotland's west coast is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 0.3-0.4m and under a high emissions scenario (RCP8.5), by 0.5 to 0.6m.	None

Full HIAL Climate Change Risk Assessment can be found in the supplementary Excel document

Appendix 4: Benbecula Airport highest climate risk ratings

Benbecula Airport Climate Change Risk Assessment

STAGE A: Current Risks											STAGE B: Adaptation Actions		STAGE C: Potential Climate Impacts				
								Current					Future				
Risk Code	Climate Variable	Risk or Opportunity (including indirect and interdependency risks)	Decision threshold, process or trigger point for action on the risk	Location	Business Function Risk Owner	Interdependencies	Potential Consequences (Functions, Service, Assets affected)	Impact rating	Probability of impact rating	Overall risk rating	Existing Control Measures or Strategies	Further Planned Control Measures or Actions	Risk Score (Post-Control)	Risk Score [2050 + Post-Control]	Risk Score [2080 + Post-Control]	Narrative on Horizon Scores	Assumptions (incl. data, operational, regulatory changes etc)
BEB CCRA10	Temperature	**Changes to bird migration patterns resulting in increase in bird strike risk:** Changes to airfield habitats and wildlife populations near to the airfield may occur with climate change. Benbecula sees geese migration each year, with migration patterns changing with climate change.	Critical threshold not currently tested, requires further research	Airfield Operations	Airport Manager	Fire Service, Bird Management Contractors, Airlines, RSPB	Increases in aircraft bird strike risk resulting in accidents or diversions. Reputational damage, frequent delays and flight cancellation.	4	4	**4**	Annual bird strike management standards check carried out by third party experts who determine risk of bird strike •Wildlife reports and engagement with external sources other than airports (e.g. WWF, various industry forums) Onsite bid and wildlife management	Annual review of a Wildlife Hazard Management Plan Awareness of changing physical characteristics of airfield	4	4	**4**	UKCP18 climate projections are for mean summer temperatures on the west coast of Scotland to rise under the most probable baseline emissions scenario (RCP4.5) by 1°C by the 2050s and by 1.8°C by 2080 and under a high emissions scenario (RCP8.5) by 1.3°C by 2050 and by 2.8°C by 2080.	None
BEB CCRA14	Rainfall	**Localised onsite surface flooding:** Particularly heavy episodes of rainfall may result in surface flooding at Benbecula airport and water ingress to airport buildings. Surface flooding across Benbecula has increased in recent time, especially given the low lying and flat nature of the island, but to date this has not affected the airport.	Critical level will be dependent on the volume of rainfall and third-party actions taken on sites surrounding the airport.	Airfield Operations, Facilites Management	Airport Manager	SEPA, local authority, local environmental bodies	Potential for flooding and damage to critical airport assets and infrastructure. Possible backlogs, delays, diversions, and cancellations to flights which would result in increased disruption.	4	3	**4**	Ongoing monitoring of SEPA flood warning data Flood risk plans in place Ongoing flood survey and percolation tests to evaluate future drainage types put in place to prevent future flooding	Improve understanding of flood risk and improve existing controls as required considering future climate projections Ensure airport stakeholders are up to date and aware of SEPA flood warning following newly updated flood plans Continuous review and update of airport flood risk plans	3	4	**4**	Precipitation on the west coast of Scotland is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 9% by the 2050s and 13% by 2080 and under a high emissions scenario (RCP8.5) by 10% by 2050 and 19% by 2080.	None
BEB CCRA28	Sea-level rise	**Sea-level rise leading to loss of low-lying destination airports:** Although SEPA suggest a low risk of coastal flooding for Benbecula's airport building, there are areas adjacent to the runway on the South and East sides which are in SEPA high risk areas for coastal flooding.	Critical threshold not currently tested	Airside Operations, Landside Operations	All departments	Aircraft provide a lot of lifeline services to Benbecula residents and businesses	Inability to receive aircraft with essential services to the island disrupted.	4	4	4	Contingency plans in place for dealing with offsite impacts affecting transport routes and utility supplies Ongoing engagement with other airports and sharing of best practice Strong coastal protection programme in place with focus on gabion basket placement and planting of natural marram grass Regular monitoring of tidal marker posts and recording of coastal protection works	Consultation looking at longer term risks may be undertaken as significant changes are unlikely to occur in the short-term Development of a surface management flood plan	4	5	5	As compared to a 1981-2000 baseline, by 2100, sea level on Scotland's west coast is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 0.3-0.4m and under a high emissions scenario (RCP8.5), by 0.5 to 0.6m.	None

Full HIAL Climate Change Risk Assessment can be found in the supplementary Excel document

Appendix 5: Campbeltown Airport highest climate risk ratings

Campbeltown Airport Climate Change Risk Assessment

STAGE A: Current Risks												STAGE B: Adaptation Actions		STAGE C: Potential Climate Impacts				
								Current						Future				
Risk Code	Climate Variable	Risk or Opportunity (including indirect and interdependency risks)	Decision threshold, process or trigger point for action on the risk	Location	Business Function Risk Owner	Interdependencies	Potential Consequences (Functions, Service, Assets affected)	Impact rating	Probability of impact rating	Overall risk rating	Existing Control Measures or Strategies	Further Planned Control Measures or Actions	Risk Score (Post-Control)	Risk Score [2050 + Post-Control]	Risk Score [2080 + Post-Control]	Narrative on Horizon Scores	Assumptions (incl. data, operational, regulatory changes etc)
CAL CCRA03	Temperature	**Overheating of airport buildings:** High temperatures may reduce the performance of some sensitive or mechanical equipment, which consequently may fail to operate correctly. Campbeltown currently has no BMS.	Critical threshold not currently tested	Airfield Operations	Airport Engineer & Airport Manager	Requirement of sufficient energy capacity available at the airport. Back-up capacity needs to be available should grid not be able to meet increased energy demand.	Increased energy demand for cooling systems increasing financial costs. Temperature sensitive infrastructure may experience failure, damage or inefficiency leading to operational disruption.	4	4	4	Alignment to HIAL asset infrastructure register when planning for new assets or replacements assets Consistent maintenance of sensitive and mechanical equipment Upskilling of staff to fix sensitive or mechanical equipment when faulty Internet of things concept utilised for some airport devices and equipment, but there is a need to centrally store and report this information	Provision of Building Management System (BMS) Continue to review and ensure robustness of cooling systems (HVAC systems) for sensitive or mechanical equipment Ensure that future building design and development of Campbeltown airport manages risks from climate change	3	3	4	UKCP18 climate projections are for mean summer temperatures on the west coast of Scotland to rise under the most probable baseline emissions scenario (RCP4.5) by 1°C by the 2050s and by 1.8°C by 2080 and under a high emissions scenario (RCP8.5) by 1.3°C by 2050 and by 2.8°C by 2080.	Mitigations and future risk based on current BMS and HVAC systems
CAL CCRA15	Rainfall	**Localised onsite surface flooding:** Particularly heavy episodes of rainfall may result in surface flooding at Campbeltown airport and water ingress to airport buildings. SEPA risk mapping indicates several small-scale areas of medium and high risk within the airport boundary, as well as high risk of river flooding from Machrihanish water located in the airport's southern boundary.	Threshold to be confirmed following further flood risk assessment	Airfield Operations, Facilities Management	Airport Manager	SEPA, local authority, local environmental bodies	Potential for flooding and damage to critical airport assets and infrastructure. Possible backlogs, delays, diversions, and cancellations to flights which would result in increased disruption.	4	4	4	Ongoing monitoring of SEPA flood warning data Flood risk plans in place CCTV used to monitor airport flooding	Improve understanding of flood risk and improve existing controls as required considering future climate projections Ensure airport stakeholders are up to date and aware of SEPA flood warning following newly updated flood plans Continuous review and update of airport flood risk plans	3	4	4	Precipitation on the west coast of Scotland is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 9% by the 2050s and 13% by 2080 and under a high emissions scenario (RCP8.5) by 10% by 2050 and 19% by 2080.	None
CAL CCRA19	Rainfall	**Release of contaminated surface water into surrounding water bodies:** Pollution Control Systems (interceptors) are challenged during extreme rainfall events. Excess rainfall may overwhelm the interceptors (open interceptors) resulting in pollution of local watercourses.	Interceptor capacity limits	Airside Operations, Landside Operations	Airport Manager, Engineering Manager	SEPA, local authority	Regulatory notifications or fines, breach of Controlled Activities Regulation (CAR) resulting in Enforcement Action from SEPA. Reputational damage of environmental pollution. Restrictions for future development	4	4	4	Monthly water quality monitoring and review programme Ongoing monitoring and maintenance of interceptors which are under a planned maintenance programme Established contingency plans to deal with pollution Balancing Pond System water storage capacity	Improve understanding of flood risks and improve existing controls considering future climate projections Monitor surface water drainage system performance and stress test predicted climate change performance Carry out an assessment of drainage system capacity Complete surface water modelling to take appropriate action Implementation of water quality management e.g. sweepers for de-icer in winter months and improvement to current interceptors and holding tanks.	3	3	3	Precipitation on the west coast of Scotland is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 9% by the 2050s and 13% by 2080 and under a high emissions scenario (RCP8.5) by 10% by 2050 and 19% by 2080.	None

Full HIAL Climate Change Risk Assessment can be found in the supplementary Excel document

Appendix 6: Dundee Airport highest climate risk ratings

Dundee Airport Climate Change Risk Assessment

STAGE A: Current Risks											STAGE B: Adaptation Actions		STAGE C: Potential Climate Impacts				
								Current					Future				
Risk Code	Climate Variable	Risk or Opportunity (including indirect and interdependency risks)	Decision threshold, process or trigger point for action on the risk	Location	Business Function Risk Owner	Interdependencies	Potential Consequences (Functions, Service, Assets affected)	Impact rating	Probability of impact rating	Overall risk rating	Existing Control Measures or Strategies	Further Planned Control Measures or Actions	Risk Score (Post-Control)	Risk Score [2050 + Post-Control]	Risk Score [2080 + Post-Control]	Narrative on Horizon Scores	Assumptions (incl. data, operational, regulatory changes etc)
DND CCRA04	Temperature	**Structural damage to runway and aprons:** Airfield surface and sub-surface structural damage to runway and aprons caused by temperatures exceeding design standards resulting in melting and cracking of surface. Higher temperatures also cause land to dry out and become less permeable.	UK tarmac standards (roads, aprons etc) begin to lose integrity once temperatures in the shade exceed 32°C. Tarmac itself is black, absorbs heat and can hit 80°C at such temperatures. Runway surfaces design standards withstand far higher temperatures to be able to cope with aircraft braking.	Airfield Operations	Airport Manager	Loganair	Increased operational disruption and flight disruption which could lead to airport closure. Increased erosion may mobilise pollutants and increase sediment loads or turbidity in run off. Damage to water infrastructure (including drainage and utility pipes). Upper strata dry out may cause surface water seepage into groundwater. Financial costs to repair surface damage. Reputational damage.	5	3	4	Limited issue to date with runway and apron surface melting Frequent visual inspections of runway Runway surface maintenance projects Review of landing procedures and regular engagement with Logainair	Further integration of temperature risks into ongoing runway surfacing design and maintenance projects across HIAL Development of a summer high temperature inspection plan similar to that of a winter weather plan	3	2	2	UKCP18 climate projections are for mean summer temperatures on the east coast of Scotland to rise under the most probable baseline emissions scenario (RCP4.5) by 0.8°C by the 2050s and by 1.7°C by 2080 and under a high emissions scenario (RCP8.5) by 1.1°C by 2050 and by 2.6°C by 2080.	None
DND CCRA15	Rainfall	**Hardening of natural airport surfaces with reduced natural drainage function resulting in increased run-off and risk of flooding:** Increased flood risk due to impermeable ground. Stormwater drainage must be planned and maintained, return periods for flooding should be revised e.g. 1 in 100 year event.	Critical threshold not currently tested	Airfield Operations	Airport Manager	SEPA, local authority	Operational disruption due to excess surface water on aprons, runways and other airport surface. Airport closure. Financial costs to repair/replace affected infrastructure,	4	3	4	Ongoing monitoring of ground inspection Drainage maintenance regime Flood and pollution control system in place	Carry out assessment of drainage system capacity, maintenance and upgrade requirements	3	4	4	Precipitation on the east coast of Scotland is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 8% by the 2050s and 9% by 2080 and under a high emissions scenario (RCP8.5) by 10% by 2050 and 13% by 2080.	None
DND CCRA27	Sea-level rise	**Disruption to airfield and airport services from sea level rise:** Surrounding tides at Dundee airport can breach airfield at high tide. Tides have not reached the runway yet but could do in the future.	Critical threshold not currently tested	Airside Operations, Landside Operations	All departments	Loganair	Inability to receive aircraft with essential services to the disrupted.	5	5	5	Contingency plans in place for dealing with offsite impacts affecting transport routes and utility supplies Ongoing engagement with other airports and sharing of best practice Ongoing engagement with the council regarding coastal flooding defences along waterfront	Consultation looking at longer term risks may be undertaken as significant changes are unlikely to occur in the short-term Continued engagement with Dundee Council regarding sea and coastal defences Monitoring and recording of flood data through a dedicated flood log to detail incidences of flood occurrence at airport site Development of a surface management flood plan	4	5	5	As compared to a 1981-2000 baseline, by 2100, sea level on Scotland's west coast is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 0.3-0.4m and under a high emissions scenario (RCP8.5), by 0.5 to 0.6m.	None

Full HIAL Climate Change Risk Assessment can be found in the supplementary Excel document

Appendix 7: Inverness Airport highest climate risk ratings

Inverness Airport Climate Change Risk Assessment

STAGE A: Current Risks												STAGE B: Adaptation Actions		STAGE C: Potential Climate Imapcts				
								Current						Future				
Risk Code	Climate Variable	Risk or Opportunity (including indirect and interdependency risks)	Decision threshold, process or trigger point for action on the risk	Location	Business Function Risk Owner	Interdependencies	Potential Consequences (Functions, Service, Assets affected)	Impact rating	Probability of impact rating	Overall risk rating	Existing Control Measures or Strategies	Further Planned Control Measures or Actions	Risk Score (Post-Control)	Risk Score [2050 + Post-Control]	Risk Score [2080 + Post-Control]	Narrative on Horizon Scores	Assumptions (incl. data, operational, regulatory changes etc)
INV CCRA01	Temperature	**Decrease in passenger and staff comfort within airport buildings:** Overheating in Inverness' airport buildings will lead to thermal discomfort and increased heat stress for passengers and HIAL staff.	Sustained temperatures above 25-30°C require additional cooling mechanisms or changes to staff working patterns	Airport Facilities	Facilities Management Team	External occupational health service. Any third-party staff.	Negative impact on passenger and staff wellbeing with an increase in Health & Safety incidents and accidents. Increased energy demand for cooling systems with increasing financial costs and carbon emissions. Reduced staff productivity and possible increase in staff absence.	3	3	3	Temporary spot cooling fans available across head office and all departments Provision of water coolers across airport buildings (Security, Admin, Fire Station, and Gatehouse Kitchens) Trained first aiders and medical personnel are onsite HIAL occupational health awareness campaigns Air conditioning system efficiency on newer buildings, air conditioning recently retrofitted in departure lounge	Review conditions regularly and ensure optimal conditions are maintained Provision of new HVAC systems Carry out enhanced review and ongoing monitoring of building temperature control requirements (HVAC system and building performance standards)	2	2	3	UKCP18 climate projections are for mean summer temperatures in the northeast of Scotland to rise under the most probable baseline emissions scenario (RCP4.5) by 0.8°C by the 2050s and by 1.6°C by 2080 and under a high emissions scenario (RCP8.5) by 1.1°C by 2050 and by 2.5°C by 2080.	Assumptions that there would be a continued Occupational Health Service provided by HIAL
INV CCRA03	Temperature	**Overheating of airport buildings:** High temperatures may reduce the performance of some sensitive or mechanical equipment, which consequently may fail to operate correctly.	Critical threshold not currently tested	Airfield Operations	Airport Engineer & Airport Manager	Requirement of sufficient energy capacity available at the airport. Back-up capacity needs to be available should grid not be able to meet increased energy demand.	Increased energy demand for cooling systems increasing financial costs. Temperature sensitive infrastructure may experience failure, damage or inefficiency leading to operational disruption.	3	4	4	Alignment to HIAL asset infrastructure register when planning for new assets or replacements assets Inverness airport has a Building Management System (BMS) Consistent maintenance of sensitive and mechanical equipment Upskilling of staff to fix sensitive or mechanical equipment when faulty Internet of things concept utilised for some airport devices and equipment, but there is a need to centrally store and report this information	Continue to monitor BMS Continue to review and ensure robustness of cooling systems (HVAC systems) for sensitive or mechanical equipment Ensure that future building design and development of Inverness airport manages risks from climate change	3	3	2	UKCP18 climate projections are for mean summer temperatures in the northeast of Scotland to rise under the most probable baseline emissions scenario (RCP4.5) by 0.8°C by the 2050s and by 1.6°C by 2080 and under a high emissions scenario (RCP8.5) by 1.1°C by 2050 and by 2.5°C by 2080.	Mitigations and future risk based on current BMS and HVAC systems
INV CCRA15	Rainfall	**Localised onsite surface flooding:** Particularly heavy episodes of rainfall may result in surface flooding at Inverness airport and water ingress to airport buildings. SEPA risk mapping indicates several small-scale areas of medium risk within the airport boundary. Previously, the airport had only experienced surface flooding of the airport car park.	Threshold to be confirmed following further flood risk assessment	Airfield Operations, Facilities Management	Airport Manager	SEPA, local authority, local environmental bodies	Potential for flooding and damage to critical airport assets and infrastructure. Possible backlogs, delays, diversions and cancellations to flights which would result in increased disruption.	4	3	4	Ongoing monitoring of SEPA flood warning data Flood risk plans in place Inverness airport has surface water capture systems in place	Improve understanding of flood risk and improve existing controls as required considering future climate projections Ensure airport stakeholders are up to date and aware of SEPA flood warning following newly updated flood plans Continuous review and update of airport flood risk plans	3	4	4	Precipitation in northeast Scotland is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 6% by the 2050s and 5% by 2080 and under a high emissions scenario (RCP8.5) by 7% by 2050 and 9% by 2080.	None

Full HIAL Climate Change Risk Assessment can be found in the supplementary Excel document

Appendix 8: Islay Airport highest climate risk ratings

Islay Airport Climate Change Risk Assessment

STAGE A: Current Risks												STAGE B: Adaptation Actions		STAGE C: Potential Climate Impacts				
								Current			Future							
Risk Code	Climate Variable	Risk or Opportunity (including indirect and interdependency risks)	Decision threshold, process or trigger point for action on the risk	Location	Business Function Risk Owner	Interdependencies	Potential Consequences (Functions, Service, Assets affected)	Impact rating	Probability of impact rating	Overall risk rating	Existing Control Measures or Strategies	Further Planned Control Measures or Actions	Risk Score (Post-Control)	Risk Score [2050 + Post-Control]	Risk Score [2080 + Post-Control]	Narrative on Horizon Scores	Assumptions (incl. data, operational, regulatory changes etc)
ILY CCRA03	Temperature	**Overheating of airport buildings:** High temperatures may reduce the performance of some sensitive or mechanical equipment, which consequently may fail to operate correctly. Islay currently has no BMS.	Critical threshold not currently tested	Airfield Operations	Airport Engineer & Airport Manager	Requirement of sufficient energy capacity available at the airport. Back-up capacity needs to be available should grid not be able to meet increased energy demand.	Increased energy demand for cooling systems increasing financial costs. Temperature sensitive infrastructure may experience failure, damage or inefficiency leading to operational disruption.	4	4	4	Alignment to HIAL asset infrastructure register when planning for new assets or replacements assets Consistent maintenance of sensitive and mechanical equipment Upskilling of staff to fix sensitive or mechanical equipment when faulty Internet of things concept utilised for some airport devices and equipment, but there is a need to centrally store and report this information"	Provision of Building Management System (BMS) Continue to review and ensure robustness of cooling systems (HVAC systems) for sensitive or mechanical equipment Ensure that future building design and development of Islay airport manages risks from climate change"	3	3	4	UKCP18 climate projections are for mean summer temperatures on the west coast of Scotland to rise under the most probable baseline emissions scenario (RCP4.5) by 1°C by the 2050s and by 1.8°C by 2080 and under a high emissions scenario (RCP8.5) by 1.3°C by 2050 and by 2.8°C by 2080.	None
ILY CCRA14	Rainfall	**Flooding of surrounding rivers leading to onsite flooding:** Glenegedale and Machrie Rivers are in close proximity to the airport and there is a high chance of flooding from both of these rivers. Glenegdale river poses a high risk of flooding to the east side of the airfield and Machrie river on the south side.	Critical level will be dependent on the volume of rainfall and third-party actions taken on sites surrounding the airport.	Airfield Operations, Facilities Management	Airport Manager	SEPA, local authority, local environmental bodies	Potential for flooding and damage to critical airport assets and infrastructure. Possible backlogs, delays, diversions, and cancellations to flights which would result in increased disruption.	4	3	4	Ongoing monitoring of SEPA flood warning data Flood risk plans in place	Improve understanding of flood risk and improve existing controls as required considering future climate projections Ensure airport stakeholders are up to date and aware of SEPA flood warning following newly updated flood plans Continuous review and update of airport flood risk plans Carry out de-silting and bank stabilisation works at on-site burns to increase channel capacity	3	4	4	Precipitation on the west coast of Scotland is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 9% by the 2050s and 13% by 2080 and under a high emissions scenario (RCP8.5) by 10% by 2050 and 19% by 2080.	None
ILY CCRA31	Sea-level rise	**Disruption to airfield and airport services from sea level rise:** Although SEPA suggest a low risk of coastal flooding for Islay airport, the westerly end of the runway and airport field may be disrupted by storm surges and sea level rise in the future.	Critical threshold not currently tested	Airside Operations, Landside Operations	All departments	None	Inability to receive aircraft with essential services to the disrupted.	5	5	5	Contingency plans in place for dealing with offsite impacts affecting transport routes and utility supplies Ongoing engagement with other airports and sharing of best practice	No action required in the short term Consultation looking at longer term risks may be undertaken as significant changes are unlikely to occur in the short-term Development of a surface management flood plan	4	5	5	As compared to a 1981-2000 baseline, by 2100, sea level on Scotland's west coast is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 0.3-0.4m and under a high emissions scenario (RCP8.5), by 0.5 to 0.6m.	None

Full HIAL Climate Change Risk Assessment can be found in the supplementary Excel document

Appendix 9: Kirkwall Airport highest climate risk ratings

Kirkwall Airport Climate Change Risk Assessment

STAGE A: Current Risks												STAGE B: Adaptation Actions		STAGE C: Potential Climate Impacts				
								Current						Future				
Risk Code	Climate Variable	Risk or Opportunity (including indirect and interdependency risks)	Decision threshold, process or trigger point for action on the risk	Location	Business Function Risk Owner	Interdependencies	Potential Consequences (Functions, Service, Assets affected)	Impact rating	Probability of impact rating	Overall risk rating		Existing Control Measures or Strategies	Further Planned Control Measures or Actions	Risk Score (Post-Control)	Risk Score [2050 + Post-Control]	Risk Score [2080 + Post-Control]	Narrative on Horizon Scores	Assumptions (incl. data, operational, regulatory changes etc)
KOI CCRA10	Temperature	**Changes to bird migration patterns resulting in increase in bird strike risk:** Changes to airfield habitats and wildlife populations near to the airfield may occur with climate change.	Critical threshold not currently tested, requires further research	Airfield Operations	Airport Manager	Fire Service, Bird Management Contractors, Airlines, RSPB	Increases in aircraft bird strike risk resulting in accidents or diversions. Reputational damage, frequent delays and flight cancellation.	4	4	4		Annual bird strike management standards check carried out by third party experts who determine risk of bird strike Wildlife reports and engagement with external sources other than airports (e.g. WWF, various industry forums) Onsite bid and wildlife management	Annual review of a Wildlife Hazard Management Plan Awareness of changing physical characteristics of airfield	4	4	4	UKCP18 climate projections are for mean summer temperatures on Orkney and Shetland to rise under the most probable baseline emissions scenario (RCP4.5) by 0.7°C by the 2050s and by 1°C by 2080 and under a high emissions scenario (RCP8.5) by 0.9°C by 2050 and by 1.4°C by 2080.	None
KOI CCRA14	Rainfall	**Localised onsite surface flooding:** Particularly heavy episodes of rainfall may result in surface flooding at Kirkwall airport and water ingress to airport buildings. SEPA risk mapping indicates several small-scale areas of medium and high-risk flooding within the airport boundary, especially at the east and west corners of the runway.	Threshold to be confirmed following further flood risk assessment	Airfield Operations, Facilites Management	Airport Manager	SEPA, local authority, local environmental bodies	Potential for flooding and damage to critical airport assets and infrastructure. Possible backlogs, delays, diversions and cancellations to flights which would result in increased disruption.	4	3	4		Ongoing monitoring of SEPA flood warning data Flood risk plans in place CCTV used to monitor airport flooding	Improve understanding of flood risk and improve existing controls as required considering future climate projections Ensure airport stakeholders are up to date and aware of SEPA flood warning following newly updated flood plans Continuous review and update of airport flood risk plans	3	4	4	Precipitation on Orkney and Shetland is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 10% by the 2050s and 12% by 2080 and under a high emissions scenario (RCP8.5) by 12% by 2050 and 20% by 2080.	None
KOI CCRA28	Sea-level rise	**Disruption to airfield and airport services from sea level rise:** Although SEPA suggest a low risk of coastal flooding for Kirkwall airport, localised coastal flooding may occur due to the airport's proximity to the coast.	Critical threshold not currently tested	Airside Operations, Landside Operations	All departments		Inability to receive aircraft with essential services to the disrupted.	5	5	5		Contingency plans in place for dealing with offsite impacts affecting transport routes and utility supplies Ongoing engagement with other airports and sharing of best practice	No action required in the short term Consultation looking at longer term risks may be undertaken as significant changes are unlikely to occur in the short-term Development of a surface management flood plan	4	5	5	As compared to a 1981-2000 baseline, by 2100, sea level on Scotland's north coast is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 0.4-0.5m and under a high emissions scenario (RCP8.5), by 0.6 to 0.7m.	None

Full HIAL Climate Change Risk Assessment can be found in the supplementary Excel document

Appendix 10: Stornoway Airport highest climate risk ratings

Stornoway Airport Climate Change Risk Assessment

STAGE A: Current Risks											STAGE B: Adaptation Actions		STAGE C: Potential Climate Impacts				
								Current					Future				
Risk Code	Climate Variable	Risk or Opportunity (including indirect and interdependency risks)	Decision threshold, process or trigger point for action on the risk	Location	Business Function Risk Owner	Interdependencies	Potential Consequences (Functions, Service, Assets affected)	Impact rating	Probability of impact rating	Overall risk rating	Existing Control Measures or Strategies	Further Planned Control Measures or Actions	Risk Score (Post-Control)	Risk Score [2050 + Post-Control]	Risk Score [2080 + Post-Control]	Narrative on Horizon Scores	Assumptions (incl. data, operational, regulatory changes etc)
SYY CCRA10	Temperature	**Changes to bird migration patterns resulting in increase in bird strike risk:** Changes to airfield habitats and wildlife populations near to the airfield may occur with climate change. Stornoway airport is surrounded by protected areas (SSSI and SPA). The airport is home to an increasing geese population where annual culling is needed.	Critical threshold not currently tested, requires further research	Airfield Operations	Airport Manager	Fire Service, Bird Management Contractors, Airlines, RSPB	Increases in aircraft bird strike risk resulting in accidents or diversions. Reputational damage, frequent delays and flight cancellation.	4	4	4	Annual bird strike management standards check carried out by third party experts who determine risk of bird strike Wildlife reports and engagement with external sources other than airports (e.g., WWF, various industry forums) Onsite bid and wildlife management	Annual review of a Wildlife Hazard Management Plan Awareness of changing physical characteristics of airfield	4	4	4	UKCP18 climate projections are for mean summer temperatures in northern Scotland to rise under the most probable baseline emissions scenario (RCP4.5) by 0.7°C by the 2050s and by 1.2°C by 2080 and under a high emissions scenario (RCP8.5) by 1°C by 2050 and by 2.2°C by 2080.	None
SYY CCRA14	Rainfall	**Localised onsite surface flooding:** Particularly heavy episodes of rainfall may result in surface flooding at Stornoway airport and water ingress to airport buildings. SEPA flood risk mapping indicates that there is a medium and high risk of surface water flooding at the south side of the airport runway and around the HMCG Stornoway Air Wing).	Threshold to be confirmed following further flood risk assessment	Airfield Operations, Facilities Management	Airport Manager	SEPA, local authority, local environmental bodies	Potential for flooding and damage to critical airport assets and infrastructure, including loss of IT equipment. Possible backlogs, delays, diversions and cancellations to flights which would result in increased disruption.	4	3	4	Ongoing monitoring of SEPA flood warning data Flood risk plans in place Stornoway have new ground power units that are shower proof	Improve understanding of flood risk and improve existing controls as required considering future climate projections Waterproofing and storm proofing of all exposed assets such as runway lighting Ensure airport stakeholders are up to date and aware of SEPA flood warning following newly updated flood plans	3	4	4	Precipitation in northern Scotland is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 4% by the 2050s and 9% by 2080 and under a high emissions scenario (RCP8.5) by 5% by 2050 and 15% by 2080.	None
SYY CCRA29	Sea-level rise	**Sea-level rise and increased storm surge risks:** Stornoway airport is sensitive to coastal flooding from sea level rise given the airfields proximity to the coast. The airfield has flood in the past, with the east side of the airport and runway at high risk. £8m has been spent on flood defences to date. If sand dunes are lost to erosion, the airport will certainly flood.	Critical threshold not currently tested	Airside Operations, Landside Operations	All departments		Inability to receive aircraft with essential services to the disrupted.	5	5	5	Contingency plans in place for dealing with offsite impacts affecting transport routes and utility supplies Ongoing engagement with other airports and sharing of best practice Monitoring and recording of flood data through a dedicated flood log to detail incidences of flood occurrence at airport site	No action required in the short term Consultation looking at longer term risks may be undertaken as significant changes are unlikely to occur in the short-term Development of a surface management flood plan	4	5	5	As compared to a 1981-2000 baseline, by 2100, sea level on Scotland's north coast is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 0.4-0.5m and under a high emissions scenario (RCP8.5), by 0.6 to 0.7m.	None

Full HIAL Climate Change Risk Assessment can be found in the supplementary Excel document

Appendix 11: Sumburgh Airport highest climate risk ratings

Sumburgh Airport Climate Change Risk Assessment

STAGE A: Current Risks											STAGE B: Adaptation Actions		STAGE C: Potential Climate Impacts				
								Current					Future				
Risk Code	Climate Variable	Risk or Opportunity (including indirect and interdependency risks)	Decision threshold, process or trigger point for action on the risk	Location	Business Function Risk Owner	Interdependencies	Potential Consequences (Functions, Service, Assets affected)	Impact rating	Probability of impact rating	Overall risk rating	Existing Control Measures or Strategies	Further Planned Control Measures or Actions	Risk Score (Post-Control)	Risk Score [2050 + Post-Control]	Risk Score [2080 + Post-Control]	Narrative on Horizon Scores	Assumptions (incl. data, operational, regulatory changes etc)
LSI CCRA12	Temperature	**Increased ground movements due to drought conditions:** Increased ground movement leading to airside and landside surface damage, instability of surrounding building and infrastructure, sub-surface structural damage (e.g. to drainage and utility pipes, cables and chambers)	Critical threshold not currently tested	All departments	Airport Manager	Building contractors	Financial costs to repair damage and replace affected assets. Operational disruption and airport closure. Reputational damage and need for increased maintenance. Increase in the number of health and safety incidents.	3	2	3	Regular inspections Rapid maintenance response Regular surface relaying Surfaces defined by detailed design standards based on current best practice Sink hole risk assessments	Pavement Condition Index surveys instead of visual inspection	3	4	4	UKCP18 climate projections are for mean summer temperatures on Orkney and Shetland to rise under the most probable baseline emissions scenario (RCP4.5) by 0.7°C by the 2050s and by 1°C by 2080 and under a high emissions scenario (RCP8.5) by 0.9°C by 2050 and by 1.4°C by 2080.	None
LSI CCRA14	Rainfall	**Localised onsite surface flooding:** Particularly heavy episodes of rainfall may result in surface flooding at Sumburgh airport and water ingress to airport buildings. SEPA flood risk mapping indicates that there is a medium and high risk of surface water flooding within the airport boundary.	Threshold to be confirmed following further flood risk assessment	Airfield Operations, Facilites Management	Airport Manager	SEPA, local authority, local environmental bodies	Potential for flooding and damage to critical airport assets and infrastructure, including loss of IT equipment. Possible backlogs, delays, diversions and cancellations to flights which would result in increased disruption.	4	3	4	Ongoing monitoring of SEPA flood warning data Flood risk plans in place Stornoway have new ground power units that are shower proof	Improve understanding of flood risk and improve existing controls as required considering future climate projections Waterproofing and storm proofing of all exposed assets such as runway lighting Ensure airport stakeholders are up to date and aware of SEPA flood warning following newly updated flood plans	3	4	4	Precipitation on Orkney and Shetland is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 10% by the 2050s and 12% by 2080 and under a high emissions scenario (RCP8.5) by 12% by 2050 and 20% by 2080.	None
LSI CCRA28	Sea-level rise	**Disruption to airfield and airport services from sea level rise:** Although SEPA suggest a low risk of coastal flooding for Sumburgh's airport boundary, the areas surrounding the airport are at high risk. Given the airports proximity to the coast, it is likely that the airport will see increased coastal flooding.	Critical threshold not currently tested	Airside Operations, Landside Operations	All departments		Inability to receive aircraft with essential services to the disrupted.	5	5	5	Contingency plans in place for dealing with offsite impacts affecting transport routes and utility supplies Ongoing engagement with other airports and sharing of best practice	No action required in the short term Consultation looking at longer term risks may be undertaken as significant changes are unlikely to occur in the short-term Development of a surface management flood plan	4	5	5	As compared to a 1981-2000 baseline, by 2100, sea level on Scotland's north coast is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 0.4-0.5m and under a high emissions scenario (RCP8.5), by 0.6 to 0.7m.	None

Full HIAL Climate Change Risk Assessment can be found in the supplementary Excel document

Appendix 12: Tiree Airport highest climate risk ratings

Tiree Airport Climate Change Risk Assessment

STAGE A: Current Risks												STAGE B: Adaptation Actions		STAGE C: Potential Climate Impacts				
								Current						Future				
Risk Code	Climate Variable	Risk or Opportunity (including indirect and interdependency risks)	Decision threshold, process or trigger point for action on the risk	Location	Business Function Risk Owner	Interdependencies	Potential Consequences (Functions, Service, Assets affected)	Impact rating	Probability of impact rating	Overall risk rating	Existing Control Measures or Strategies	Further Planned Control Measures or Actions	Risk Score (Post-Control)	Risk Score [2050 + Post-Control]	Risk Score [2080 + Post-Control]	Narrative on Horizon Scores	Assumptions (incl. data, operational, regulatory changes etc)
TRE CCRA03	Temperature	**Overheating of airport buildings:** High temperatures may reduce the performance of some sensitive or mechanical equipment, which consequently may fail to operate correctly. Tiree currently has no BMS.	Critical threshold not currently tested	Airfield Operations	Airport Engineer & Airport Manager	Requirement of sufficient energy capacity available at the airport. Back-up capacity needs to be available should grid not be able to meet increased energy demand.	Increased energy demand for cooling systems increasing financial costs. Temperature sensitive infrastructure may experience failure, damage or inefficiency leading to operational disruption.	4	4	4	Alignment to HIAL asset infrastructure register when planning for new assets or replacements assets Consistent maintenance of sensitive and mechanical equipment Upskilling of staff to fix sensitive or mechanical equipment when faulty Internet of things concept utilised for some airport devices and equipment, but there is a need to centrally store and report this information"	Provision of Building Management System (BMS) Continue to review and ensure robustness of cooling systems (HVAC systems) for sensitive or mechanical equipment Ensure that future building design and development of Tiree airport manages risks from climate change	3	3	4	UKCP18 climate projections are for mean summer temperatures on the west coast of Scotland to rise under the most probable baseline emissions scenario (RCP4.5) by 1°C by the 2050s and by 1.8°C by 2080 and under a high emissions scenario (RCP8.5) by 1.3°C by 2050 and by 2.8°C by 2080.	None
TRE CCRA12	Temperature	**Increased ground movements due to drought conditions:** Increased ground movement leading to airside and landside surface damage, instability of surrounding building and infrastructure, sub-surface structural damage (e.g. to drainage and utility pipes, cables and chambers)	Critical threshold not currently tested	All departments	Airport Manager	Building contractors	Financial costs to repair damage and replace affected assets. Operational disruption and airport closure. Reputational damage and need for increased maintenance. Increase in the number of health and safety incidents.	3	2	3	Regular inspections Rapid maintenance response Regular surface relaying Surfaces defined by detailed design standards based on current best practice Sink hole risk assessments	Pavement Condition Index surveys instead of visual inspection	3	4	4	UKCP18 climate projections are for mean summer temperatures on the west coast of Scotland to rise under the most probable baseline emissions scenario (RCP4.5) by 1°C by the 2050s and by 1.8°C by 2080 and under a high emissions scenario (RCP8.5) by 1.3°C by 2050 and by 2.8°C by 2080.	None
TRE CCRA28	Sea-level rise	**Disruption to airfield and airport services from sea level rise:** Although SEPA suggest a low risk of coastal flooding for Tiree airport, southern parts of the airfield may be disrupted by storm surges and sea level rise in the future. The areas surrounding the airport are at high risk of coastal flooding including the beach south of the airport and marsh area west of the airport. The network of rivers and marshes (An Fhaodhail) to the west of the airport are at high risk of coastal flooding and this may directly impact coastal flooding within the airport boundary.	Critical threshold not currently tested	Airside Operations, Landside Operations	All departments		Inability to receive aircraft with essential services to the disrupted.	5	5	5	Contingency plans in place for dealing with offsite impacts affecting transport routes and utility supplies Ongoing engagement with other airports and sharing of best practice	No action required in the short term Consultation looking at longer term risks may be undertaken as significant changes are unlikely to occur in the short-term Development of a surface management flood plan	4	5	5	As compared to a 1981-2000 baseline, by 2100, sea level on Scotland's west coast is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 0.3-0.4m and under a high emissions scenario (RCP8.5), by 0.5 to 0.6m.	None

Full HIAL Climate Change Risk Assessment can be found in the supplementary Excel document

Appendix 13: Wick John O'Groats Airport highest climate risk ratings

Wick John O'Groats Airport Climate Change Risk Assessment																		
STAGE A: Current Risks													STAGE B: Adaptation Actions		STAGE C: Potential Climate Impacts				
								Current							Future				
Risk Code	Climate Variable	Risk or Opportunity (including indirect and interdependency risks)	Decision threshold, process or trigger point for action on the risk	Location	Business Function Risk Owner	Interdependencies	Potential Consequences (Functions, Service, Assets affected)	Impact rating	Probability of impact rating	Overall risk rating	Existing Control Measures or Strategies	Further Planned Control Measures or Actions	Risk Score (Post-Control)	Risk Score [2050 + Post-Control]	Risk Score [2080 + Post-Control]	Narrative on Horizon Scores	Assumptions (incl. data, operational, regulatory changes etc)
WIC CCRA01	Temperature	**Decrease in passenger and staff comfort within airport buildings:** Overheating in Wick's airport buildings will lead to thermal discomfort and increased heat stress for passengers and HIAL staff.	Sustained temperatures above 25-30°C require additional cooling mechanisms or changes to staff working patterns	Airport Facilities	Airport Manager	External occupational health service. Any third party staff.	Negative impact on passenger and staff wellbeing with an increase in Health & Safety incidents and accidents. Increased energy demand for cooling systems with increasing financial costs and carbon emissions. Reduced staff productivity and possible increase in staff absence.	3	3	3	Temporary spot cooling fans and desk fans available if required Trained first aiders and medical personnel are onsite HIAL occupational health awareness campaigns Provision of water coolers across airport buildings (Security, Admin, Fire Station and Gatehouse Kitchens) New air conditioning and building control temperature systems recently installed	Review conditions regularly and ensure optimal conditions are maintained Planning and monitoring of building performance standards, especially with seasonal change, following installation of capital plan building control system	2	2	3	UKCP18 climate projections are for mean summer temperatures in Northern Scotland to rise under the most probable baseline emissions scenario (RCP4.5) by 0.7°C by the 2050s and by 1.2°C by 2080 and under a high emissions scenario (RCP8.5) by 1°C by 2050 and by 2.2°C by 2080.	None
WIC CCRA14	Rainfall	**Localised onsite surface flooding:** Particularly heavy episodes of rainfall may result in surface flooding at Wick airport and water ingress to airport buildings. SEPA flood risk mapping indicates that there are some smaller areas of medium and high-risk surface flooding within the airport boundary, especially near the main buildings and parts of the runway area.	Threshold to be confirmed following further flood risk assessment	Airfield Operations, Facilities Management	Airport Manager	SEPA, local authority, local environmental bodies	Potential for flooding and damage to critical airport assets and infrastructure, including loss of IT equipment. Possible backlogs, delays, diversions and cancellations to flights which would result in increased disruption.	4	3	4	Ongoing monitoring of SEPA flood warning data Flood risk plans in place Wick's runway was refurbished two years ago and the runways drainage systems was modified	Improve understanding of flood risk and improve existing controls as required considering future climate projections Waterproofing and storm proofing of all exposed assets such as runway lighting Ensure airport stakeholders are up to date and aware of SEPA flood warning following newly updated flood plans	3	4	4	Precipitation in northern Scotland is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 4% by the 2050s and 9% by 2080 and under a high emissions scenario (RCP8.5) by 5% by 2050 and 15% by 2080.	None
WIC CCRA15	Rainfall	**Hardening of natural airport surfaces with reduced natural drainage function resulting in increased run-off and risk of flooding:** Increased flood risk due to impermeable ground. Wick's drainage must be planned and maintained, return periods for flooding should be revised e.g. 1 in 100 year event.	Critical threshold not currently tested	Airfield Operations	Airport Manager	SEPA, local authority	Operational disruption due to excess surface water on aprons, runways and other airport surface. Airport closure. Financial costs to repair/replace affected infrastructure,	4	3	4	Ongoing monitoring of ground inspection Drainage maintenance regime Flood and pollution control system in place	Carry out assessment of drainage system capacity, maintenance and upgrade requirements	3	4	4	Precipitation in northern Scotland is projected to rise under the most probable baseline emissions scenario (RCP4.5) by 4% by the 2050s and 9% by 2080 and under a high emissions scenario (RCP8.5) by 5% by 2050 and 15% by 2080.	None

Full HIAL Climate Change Risk Assessment can be found in the supplementary Excel document