Ministry of Defence

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[redacted]

[redacted]

16 January 2020

Ref. FOI2019/13198

Dear [redacted],

Thank you for your email of 26 November 2019 requesting the following information:

"1. Any written outputs as a result of a CIRAM (Cliamte Impacts Risk Assessment Methodology) assessment of HM Naval Base Clyde.
2. I note that, in 2017, in response to a Scottish Natural Heritage report which said the Faslane nuclear submarine base could be at risk from rising seas, the MoD said the following: "We closely monitor the effects of climate change on our bases and track potential risks to our infrastructure. A workshop on this was held at HMNB Clyde earlier this year, and we will continue to monitor the situation closely." Please could you provide any written outputs/reports from this workshop whether part of a wider CIRAM assessment or not."

I am treating your correspondence as a request for information under the Freedom of Information Act 2000 (FOIA).

A search for the information has now been completed within the Ministry of Defence (MOD) and I can confirm that all the information in scope of your request is held.

The information you have requested can be found at Annex A-E, but some of the information falls entirely within the scope of the absolute exemptions provided for at Sections 40 (Personal Data) of the FOIA and has been redacted.

Section 40(2) has been applied to some of the information in Annex E in order to protect personal information as governed by the General Data Protection Regulation and Data Protection Act 2018. Section 40 is an absolute exemption and there is therefore no requirement to consider the public interest in making a decision to withhold the information.

Under Section 16 of the Act (Advice and Assistance) you may find it helpful to know that in Annex A, no executive summary was inputted and therefore no information for this is held.

You may also wish to know that the facilities are assessed against a design basis allowing for a change in Faslane water levels of over four metres, which is why they are scored as green within the Climate resilience risk register.

If you have any queries regarding the content of this letter, please contact this office in the first instance.

If you wish to complain about the handling of your request, or the content of this response, you can request an independent internal review by contacting the Information Rights Compliance team, Ground Floor, MOD Main Building, Whitehall, SW1A 2HB (e-mail CIO-FOI-IR@mod.gov.uk). Please note that any request for an internal review should be made in writing within 40 working days of the date of this response.

If you remain dissatisfied following an internal review, you may raise your complaint directly to the Information Commissioner under the provisions of Section 50 of the Freedom of Information Act. Please note that the Information Commissioner will not normally investigate your case until the MOD internal review process has been completed. The Information Commissioner can be contacted at: Information Commissioner's Office, Wycliffe House, Water Lane, Wilmslow, Cheshire, SK9 5AF. Further details of the role and powers of the Information Commissioner can be found on the Commissioner's website at https://ico.org.uk/.

Yours sincerely,

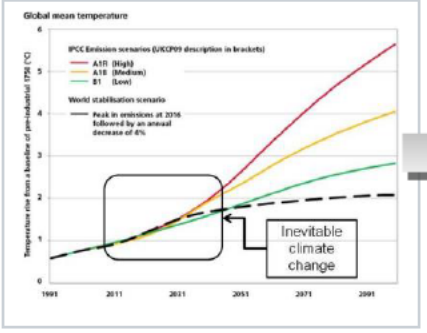
DIO Secretariat

Defence Infrastructure Organisation

Climate Impact Risk Assessment

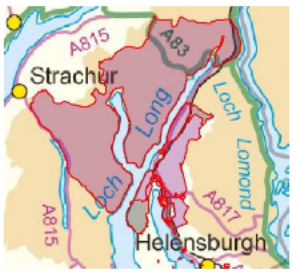
Annex A - Estate and Climatic Information
HM Naval Base Clyde

Climate change information



Climate-resilient risk management process

Climate resilient MoD site



Contents:

EXCUTIVE SUMMARY

SUMMARY OF KEY RISKS ON THE ESTABLISHMENT TO BE INSERTED AFTER WORKSHOP

1 Introduction

1.1 Scope of CIRAM assessment at Clyde

Climate change is a global issue, but its impacts are felt locally and are affected by physical, social and economic factors specific to a given area.

The UK National Security Strategy (NSS) 2010 A Strong Britain in an Age of Uncertainty [1] highlights natural hazards such as floods as one of the national security priorities (Tier 1 risks), together with terrorism, cyber attack and international military crises. The NSS emphasises the need to predict, prevent and build resilience to these risks and remain adaptable for the future.

Climate change has been identified as a risk multiplier likely to exacerbate existing vulnerabilities to natural hazards.

The Climate Impact Risk Assessment Methodology (CIRAM) aims to support the NSS and other Gov commitments in climate resilience, by identifying the impact of climate change on the operational functionality of MOD sites. It also aims to identify any management mitigation measures needed to maintain operational capability and reputation of the site, whilst achieving better value for money, minimising maintenance costs and avoiding damage costs arising from climatic events.

This document summarises some of the current and future climate related findings Clyde and the surrounding area and will help inform the CIRAM workshop.

1.2 The critical operational functions identified for Clyde are:

Deliver the integrity of the Independent British Strategic Nuclear Deterrent by supporting the Vanguard Class Submarines, in their inter-patrol period and in preparations for readiness for return to operational patrol. To support other base ported Fleet units, including the ASTUTE Class SSNs.

1.2.1 Contractors, lodger units and sister sites integral to delivering defence objective of main site

HMS Neptune
Babcock Marine Services
Queens Harbour Master

2 Site Information

2.1 Site Location

HM Naval Base Clyde, at Faslane, is located on the eastern shore of Gare Loch in Argyll and Bute, to the north of the Firth of Clyde and some 25 miles north west of Glasgow. Faslane is home to the United Kingdom's strategic nuclear deterrent and the headquarters of the Royal Navy in Scotland.

Figure 1: HMNB Clyde Source: Geode

2.2 Site layout

The Naval Base comprises of the Naval Base at Faslane itself, the Royal Naval Armaments Depot at nearby (RNAD) Coulport, HMS Caledonia at Rosyth (not within the scope of this CIRAM assessment), as well as Navy Buildings at Greenock and a number of military ranges.

RNAD Coulport, eight miles from Faslane, beside Loch Long, is responsible for the storage, processing, maintenance and issue of the Trident Weapon System and the ammunitioning of all submarine embarked weapons.

HMS Caledonia, at Dunfermline on the east coast of Scotland, provides accommodation and support for naval personnel standing by the ships and submarines in refit at the nearby Rosyth dockyard.

Responsibility for the day-to-day management of the functions of HM Naval Base Clyde is the Naval Base Commander Clyde who is The Authorisee of the Nuclear Site.

2.3 Environmental Setting - State of the Clyde

According to the Scottish Sustainable Marine Environment Initiative (SSMEI) the Firth of Clyde has a coastline of approximately 700km and includes eight sealochs, five estuaries and numerous islands. On the basis of underlying geology, tidal aspects and exposure to wind and wave it can be

broadly divided into four physical types: sealochs, estuaries, inner and outer firth. The SSMEI summarized each as follows:

2.3.1 Sealochs

The Firth contains eight sealochs. The Gareloch, Loch Long, Loch Goil, Holy Loch, Loch Striven, Loch Riddon and Loch Fyne branch from the northern shore of the Firth into the mountains of Argyll and Dunbartonshire, with Loch Goil branching from Loch Long. Campbeltown Loch is located in the Outer Firth on the Kintyre Peninsula. Several of these sea lochs are fjordic in character and extremely deep in places. Some lochs (e.g. Striven and Goil) have shallow sills at their mouths, which restrict the circulation of water and reduce the horizontal exchange of water with the main channel of the Firth. Others, such as Loch Long and Holy Loch, are simple glaciated channels.

2.3.2 The Estuaries

An estuary can be described as 'a partially enclosed area at least partly composed of soft tidal shores, open to saline water from the sea, and receiving fresh water from rivers, land run-off or seepage' (Davidson et al. 1991). The Clyde is the major estuary of the area and runs through the centre of Glasgow, stretching downstream to Gourock. It is fed by the freshwaters of the River Clyde, White Cart, Black Cart, River Gryfe and River Leven.

2.3.3 The Inner Firth

The Firth can be split into two broad areas according to exposure to wave action. The first of these, the Inner Firth, is a sheltered area which includes the Kyles of Bute and Largs Channel. It is 30km long and up to 6km wide and has several of the characteristics of a fjordic system, since it consists of glaciated valleys now covered by seawater. The tidal range is relatively small at about 1.8m for mean neap tides and 3.1m for mean springs tides. Tidal velocities are also weak, in the range 0.1-0.4 ms-1. This results in small tidal excursions, typically about 3.6 to 3.8 km on a spring tide.

Figure 2: Inner Firth of the Clyde
Source: SSMEI

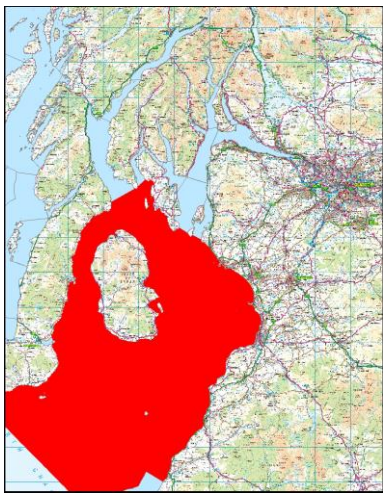


Figure 3: Outer Firth of the Clyde
Source SSMEI

2.3.4 The Outer Firth

Whilst more exposed than the Inner Firth, this area remains reasonably sheltered from the prevailing south-westerly winds by Northern Ireland, the Kintyre Peninsula, and the Isle of Arran. The maximum fetch for south-westerly winds is 96km and wave heights rarely exceed 2.5m. The water circulation across the area is weak, with the direction of movement dictated by the wind when it exceeds 7m/s. Under conditions of gentler winds, the water circulation is a weak northwards movement as part of the general circulation of the Firth.

2.3.5 Ecology

The Clyde supports a rich and varied wildlife. Consequently, a number of international and national designations exist for the protection of important intertidal communities. These include Sites of Special Scientific Interest (SSSIs), Ramsar Sites and Special Protection Areas (SPAs).

The Marine Climate Change Partnership (2013) has identified that species ranges and migration patterns have already been altered in the area, in particular due to increased sea temperatures. Some non-native species such as Chilean oyster have increased in abundance and distribution. Intertidal species including topshells, honeycomb worms, brown alga and limpets are also increasing. In addition, Scotland's State of the Environment Report (2014) identifies that the population of seabirds also shows increases.

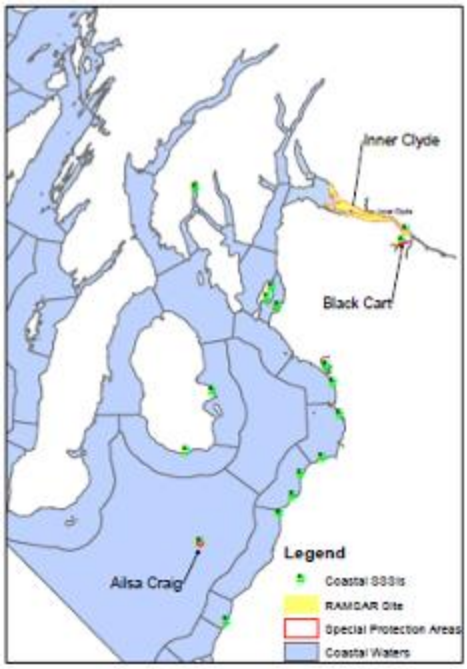


Figure 4: Intertidal Designations
Source: SSMEI

2.3.1 Geology

The location is classified in the Southern Highland Group - Psammite And Pelite. Metamorphic Bedrock formed approximately 502 to 1000 million years ago in the Cambrian and Periods. Originally sedimentary rocks formed in deep seas. Later altered by low-grade metamorphism.

Setting: Originally sedimentary rocks formed in deep seas. These rocks were first deposited as graded clastic sediments or turbidites in the deep sea, and then later metamorphosed, though there is evidence of their sedimentary origin.

2.3.2 Hydrogeology

The Clyde area is defined by the Environment Agency as “Total catchment (Zone 3)” - Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75.
In short, the groundwater under the land adjoining the Clyde is classified as a “potentially vulnerable area”. This simply means that it is at risk from numerous factors and is subject to the local area plan and monitored by the Local Authority.

2.3.3 Hydrology

The entire shoreline within the Clyde is classified as at high risk of coastal flooding. There are multiple areas of land immediately surrounding the Clyde that are at high risk of surface water flooding and a number of tributaries flowing into the Clyde are at medium or high risk of flooding.

2.3.4 Geological Hazards

Around the shoreline of the Clyde there are numerous areas subject to localised natural susceptibility to coastal erosion. For the most part they are low or medium risk but there are some isolated areas of higher risk.

2.3.6 Forestry

Surrounding the Clyde are numerous parcels of designated ancient woodland.

2.3.7 Archaeology and Historic Environment

The Clyde estate shares a border with the Loch Lomund & the Trossachs National Park and also contains a number of historic buildings such as Carrick Castle. There are a number of SSSI’s and special protection areas in small localised pockets in and around the area.

3 Brief summary of potential Climate Change Risks

3.1 Climate Ready Clyde

Glasgow and Clyde Valley have launched the next phase of 'Climate Ready Clyde' – an initiative aiming to build resilience to Climate Change impacts. Following a vision document and successful business case, supported by Sniffer and Adaptation Scotland, the Steering Group has received funding of £100,000 from the Scottish Government to move the initiative into delivery.

Over the next three years, the initiative will engage partners in the development of a regional climate change risk assessment and adaptation strategy, as well as a range of added value activity, such as research and evidence development, expert advice and input into plans and projects, alongside events, knowledge sharing and best practice.

3.2 Climate Change in Scotland

'All public bodies need to be resilient to the future climate and to plan for business continuity in relation to delivery of their functions and the services they deliver to the wider community'. Public Bodies Climate Change Duties: Putting them into practice, Scottish Government, 2011

According to the Scottish Climate Impacts Partnership (SCCIP), the last century has been a period of rapid climate change across Scotland. The Scottish climate has warmed, while altered precipitation patterns have led to drier summers, wetter winters and an increased frequency of heavy rain events. The SCCIP identified that climate change and severe weather events have already impacted many aspects of society, including buildings and property, health, agriculture, transport, water resources and energy demands.

More recent analysis undertaken by the UK Climate Change Risk Assessment (CCRA) for Scotland (2012), Marine Climate Change Partnership (2013), Scotland's State of the Environment Report (2014), Strategy Development Plan for Glasgow and the Clyde Valley (2015) confirm that the climate in Scotland has changed over the last 100 years. Current trends including more heavy rainfall and severe weather events, increases in land and sea water temperature, drier summers, sea level rise and coastal change are expected to continue in the future. The potentially most significant impacts for Scotland have been identified as:

- Changes in soil condition and quality, biodiversity and landscape;
- Reductions in river flows and water availability;
- Changes or losses to native species and migration patterns and increased risk of invasive species;
- Changes in coastal evolution affecting people, property, infrastructure, landforms, habitats and species;
- Changes to ocean water temperature and quality, affecting the quality of shellfish and species distribution e.g. the location of commercial fish stocks and expansion of non-native species;
- Increased risk of pests and diseases affecting agriculture and forestry;
- Increases in flooding both on the coast and inland, affecting people, property, infrastructure, landforms, habitats and species;
- Increase in insurance losses, ICT disruption and transport network disruption resulting from an increase in the occurrence of extreme weather events; and
- An increase in the number of people at risk of death, injury or mental health problems as a result of flooding.

3.3 Changes in Temperature

The SCCIP reported in 2011 that recent temperatures for Scotland are the highest in the records, with average annual temperature increasing by more than 1 °C between 1961 and 2004 (see Section 6). Furthermore, the Fisheries Research Services, who maintain a network of coastal temperature monitoring stations around the coast of Scotland, have reported that the temperature of oceanic water flowing past Scotland has increased at a rate of between 0.22-0.40°C per decade. For all offshore sites monitored, temperatures observed in 2003-2004 were the warmest on record, with 2006 being the second warmest on record.

More specifically for Western Scotland and during the same period 1961 - 2004, the UK CCRA 2012 identified that annual averages have increased in all seasons between 0.7^{o}C (autumn) and 1^{o}C (spring, summer and winter); minimum and maximum temperatures also increased at all seasons; the daily temperature range increased for the spring, autumn and winter; extreme temperature range increased 2^{o}C; and the number of heatwave days increased by 4 days. It needs to be noted that since 2004 there have been a couple of cold spells. This data should be reflected in the update of the CCRA in 2017.

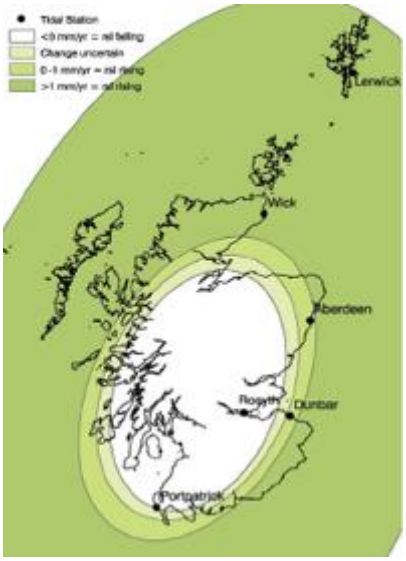


Figure 6: Present rates of relative sea-level change
Source: SSMEI

	Observed change in Scotland's climate between 1961 and 2004*
Temperature	Recent temperatures for Scotland are the highest in the records, with average annual temperature increasing 1 °C between 1961 and 2004. This applies across all seasons.
Rainfall	Annual precipitation in Scotland increased by 21% between 1961 and 2004, with an almost 70% increase in winter precipitation for Northern Scotland. Heavy rainfall events have increased significantly in winter, particularly in northern and western regions.
Snow cover	There has been a 25% reduction in winter days with snow cover, with even larger percentage decreases in spring and autumn. The snow season has shortened, starting later and finishing earlier in the year.
Days of frost	Since 1961 there has been a more than 25% reduction in the number of frost days across Scotland, with a downward trend since the 1980s.
Growing season	The growing season is now nearly 5 weeks longer in Scotland (comparing 1961 to 2004), with the greatest change occurring at the beginning of the season.
Sea level**	Sea level at all of Scotland's ports has been rising over the last century, with the rate accelerating over the last two decades (now exceeding 3-4 mm/yr in 9 out of 10 ports).

Table 1: Observed change in Scotland's climate
Source: SCCIP

3.4 Changes in Sea Level

All Scottish mainland tide gauges have recorded a sea-level rise over the last 100 years. Such increases in sea level are offset, in some areas, by the rise in the Scottish land mass which has continued since the melting of the overlaying ice sheets at the end of the last ice age.

Estimates of current sea level change for Scotland, adjusted to take account of uplift movements, are shown in Figure 6. This indicates that at present relative sea level rises within the Firth are continuing to fall.
However, predicted increased rates of sea level rise within the Firth (see Section 6) would lead to increased risk of damage associated with storm surges.

The UK CCRA for Scotland suggested that rates of peak land uplift around Glasgow have decreased from 1.6mm/yr to 0.6mm/yr and that all areas in Scotland have experienced relative sea level rise over the last few decades.

The Strategy Development Plan for Glasgow and the Clyde Valley (2015) recognises sea level rise as a risk and considers a projected increase of 70cm by the end of the century. Whilst the SEPA Flood Risk Management Strategy for the Clyde and Loch Lomond Local Plan District considers the UKCP09 High Emissions scenario (see section 6) of 0.47m by 2080.

More detailed and up to date analysis will be published by the Firth of Clyde Forum.

4 Flood risk

All the UK regions have already experienced an increase over the past 45 years in the contribution to winter rainfall from heavy precipitation events. Heavy precipitation events are projected to increase across the UK in both winter and summer, leading to an increase in fluvial and surface water flooding.

Flooding has been identified by the UK CCRA and Cabinet Office (CO) as one of the highest priority risks for the UK i.e. action needs to be taken by the 2020s.

4.1 Coastal Flooding

Flooding of coastal communities and transport links around the Firth and into the Clyde Estuary from high tides, storm surges and wave impacts occur on an almost annual basis. The Scottish Environment Protection Agency (SEPA) has recorded positive surge values in the Clyde Estuary of up to 2m during major storm surge events and the coastal rail and road links in North Ayrshire, the Helensburgh area and parts of Argyll and Bute can be particularly affected by waves and spray. Historic incidents include:

- January 1991 - flooding caused widespread impacts to coastal communities such as Tarbet, Rothesay, Dumbarton and Saltcoats. The Marine Climate Change Impacts Partnership (MCCIP) estimate that damage in the Clyde Estuary cost in exceed of £10m. The Clyde Estuary Flood Warning System was launched in 1999 as a result.
- December 1999 - high tides, combined with a storm surge, resulted in some minor flooding along the Firth of Clyde coast and more significant flooding in the Clyde Estuary.
- January 2002 – Low atmospheric pressure combined with winds exceeding 110 km/h resulted in a severe storm surge.

With climate change projections suggesting increased storm activity, including storm surges and increases in mean sea levels these incidents are likely to increase in frequency and intensity.

The Strategy Development Plan for Glasgow and the Clyde Valley (2015) confirms that sea level rise and coastal flooding are already having a widespread impact on coastal areas with impacts for coastal communities and infrastructure.

4.2. Flooding along the River Clyde

The River Clyde flows for around 100 miles from its source in the Southern Uplands, down through central Scotland to Glasgow and out into the Firth of Clyde. Flooding along the River Clyde can be both fluvial and tidal. In recent years flooding has occurred in 2002, 1994, and 1991. Research shows that around 23,000 properties are at risk from a 1 in 100 chance flood in any year from the River Clyde and its tributaries, with a further 23,000 properties at risk from tidal flooding in the Clyde estuary.

River flooding occurs when a river breaks or overtops its banks, inundating the surrounding area. The key factors are intensity and duration of rainfall and initial catchment conditions; a wet catchment has no extra capacity to store water, so river flows peak faster. An increase in the frequency of flooding in the future is likely due to climate change.

The SEPA Flood Risk Management Strategy for the Clyde and Loch Lomond Local Plan District published in Dec 15 shows that the area has been identified as potentially vulnerable to river and coastal flooding. In addition to residential and non-residential properties at risk a number of infrastructure assets are at risk. These include educational buildings, emergency services, healthcare facilities, electricity sub stations, telecommunications, oil refining and distribution, gas regulating, mineral and fuel extraction sites, road and railway routes and the airport.

Specifically within the catchment group of the Firth of Clyde (see Figure 6), this area is characterised by an average annual rainfall of 2,515mm which is very high within Scotland. Annual damages due to river flooding in this catchment group account for about £1.18 million.

UK Climate Projections (UKCP) 09 projections show that peak river flows in the Firth of Clyde could increase by 44%.

4.3 Surface Water Flooding

The SEPA Flood Risk Management Strategy for the Clyde and Loch Lomond Local Plan District also identifies surface water flooding as a key risk within the district which causes annual damages of about £20 million.

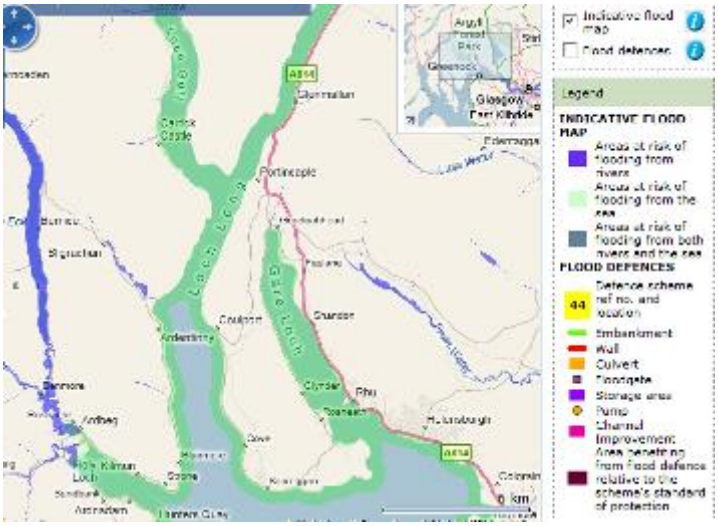


Figure 7: Flood Map
Source: SEPA

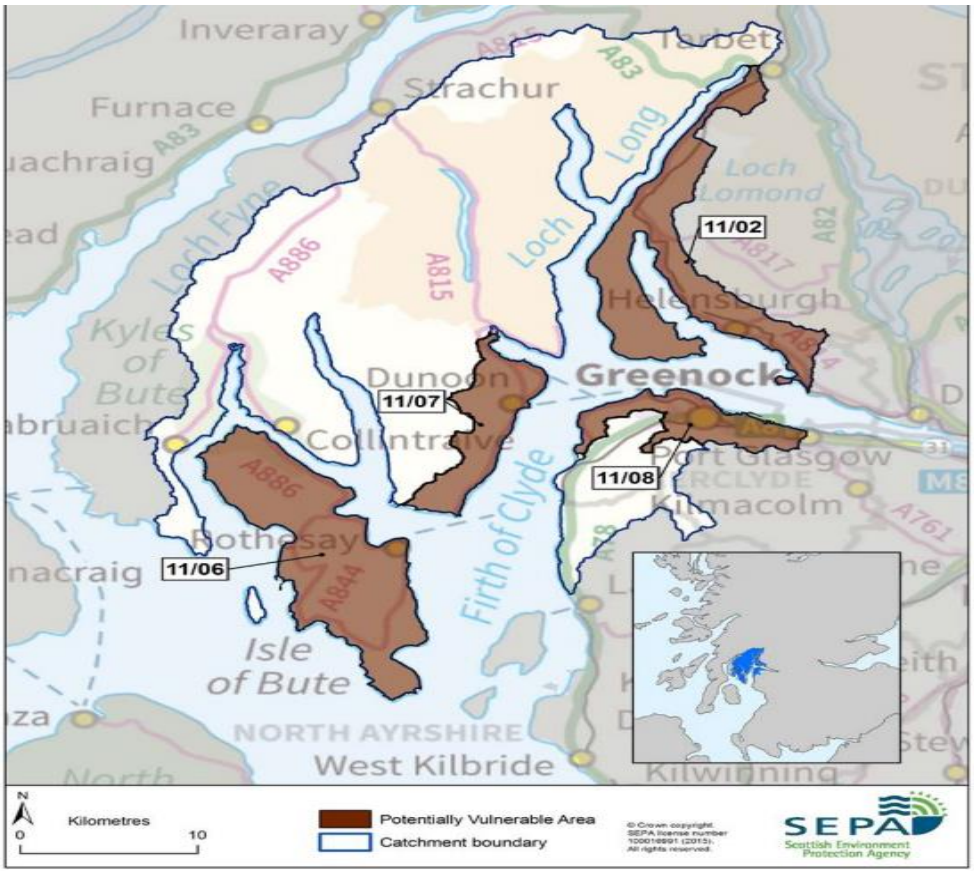


Figure 8 Areas potentially vulnerable to river flooding (highlighted in brown) within the River catchment for the Firth of Clyde catchment group. Source: Clyde and Loch Lomond Local Plan District

5 Water resources

EA, CO and UK CCRA have identified that UK water resources are already under pressure. Reliable supplies of additional water for abstraction are not available across much of England and Wales. Current water resources planning framework is likely to maintain water supplies by the 2020s, however a stricter and wider range of supply and demand measures will need to be taken to maintain water supplies by the 2050s.

Climate change together with population growth will increase existing pressures on water availability. Climate change is likely to alter the water cycle significantly as the amount and distribution of rainfall changes. Short duration droughts (12-18 months) are likely to become more frequent despite the increased resilience of public water supply and more winter storage.

Although the availability of water for abstraction varies through the year, the balance between available resource and demand for abstraction is of greatest significance during the summer. This is already a particular problem in the East and South East of England where water resource availability compares to that of drier countries like Spain and Italy, see Figure 9.

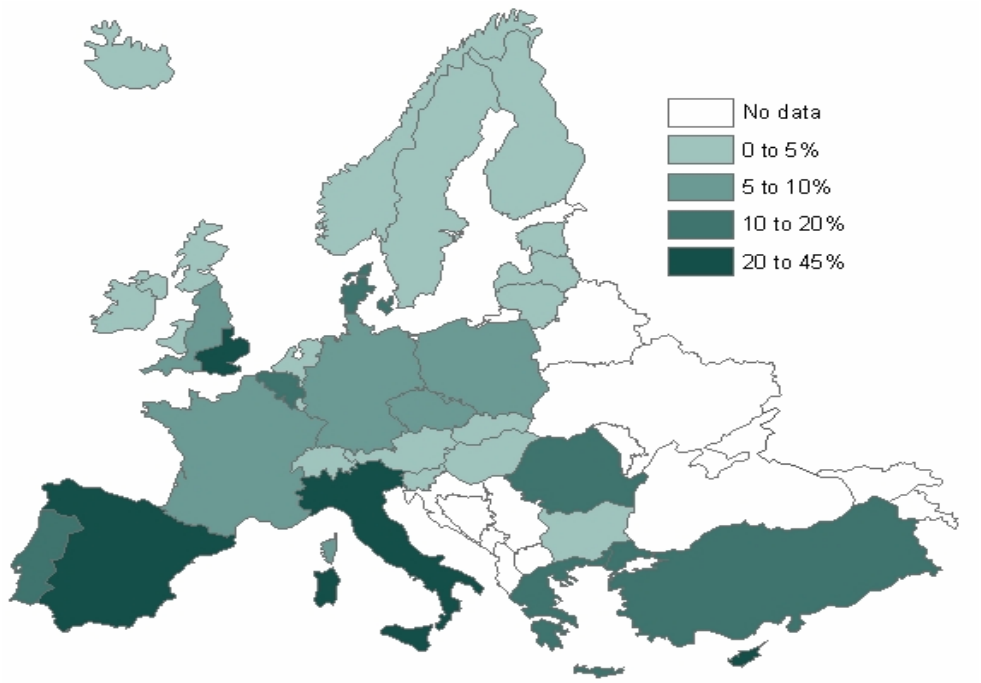


Figure 9 Water exploitation index (actual abstraction as a proportion of effective rainfall). Source: European Environment Agency Water Exploitation Index

Scotland has water resources of generally high quality and with adequate volume to meet current demands. Water resources however, are not uniformly distributed and there are significant pressures on both quantity and quality in some regions. Land use and climate change have the potential to affect total runoff which, in turn, has implications for the water supply chain.

5.1 Changes in Precipitation

The UK CCRA identified that in the west of Scotland, average total precipitation increased at all seasons; the number of heavy rain days increased in the spring, summer and winter; maximum 5-day rainfall amounts increased around 25%; and snow cover decreased over 40% in spring, 70-80% in the autumn and 26-37% in the winter.

In addition to river flooding, increases in precipitation and heavy rainfall events increase the risk of surface water flooding.

6 Wildfire risk

Wildfires have added to the National Risk Assessment and National Risk Register as a high priority risk for the UK. Cabinet Office (CO) and CCRA analysis identify that although wildfires are usually started by human activity hot, dry and windy weather conditions have a significant influence on the incidence for wildfires to start and/or spread.

Existing data on wildfire indicates that fire season in the UK normally occurs between March – May and July – September. Data also indicates that in years where there has been a significant drought (1995, 2003 and 2006) the number of wildfires increased significantly.

Present risk is particularly high in heath, moorland and forests as grass, gorse and heather are prone to wildfires.

Research undertaken by Manchester University suggests that a 1°C temperature increase in summer average temperatures will lead to a 17-28% increase in the number of outdoor fires in England and Wales and a 2°C increase will result in a 34-56% increase.

The CCRA analysis used the established McArthur Forest Fire Danger Index (FFDI), which looks at how the conditions that have the potential to lead to a wildfire might change. The outputs of the analysis indicate that the FFDI will increase across the whole of the UK by the 2080s, with the largest increase (over 40%) in the south east of England and extending into south Wales, and the smallest increase along the north coast of Scotland. See Figure 5.

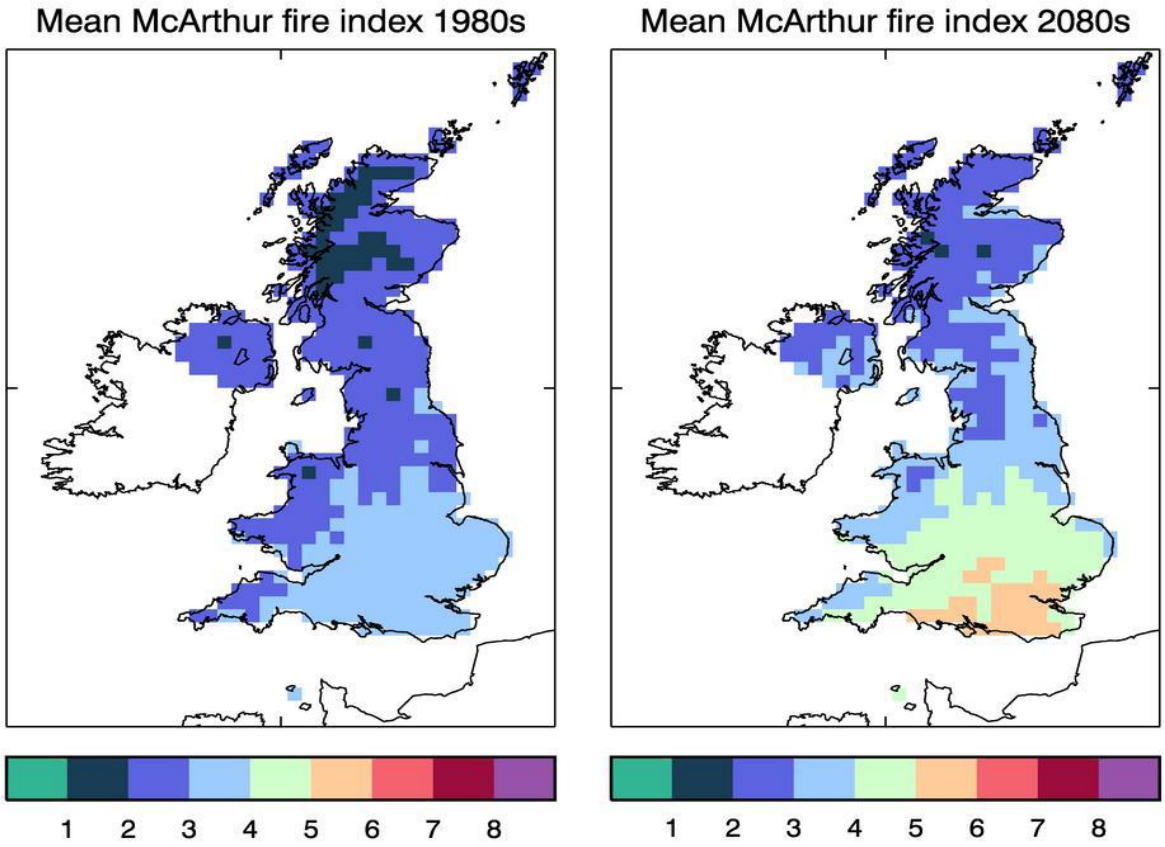


Figure 11 McArthur Forest Fire Danger Index for UK using UKCP09; 1 = fire will not burn; 5 to 12 = 'Moderate' risk. (Source: Met Office for the CCRA)

7 Summary of Historic and Projected Climatic Information [36]

UK Climate Projections (UKCP09)

The MOD methodology for assessing climatic risks uses the UK Climate Projections (UKCP09) to inform the assessment. UKCP09 provides climate information designed to help those needing to plan how they will adapt to a changing climate. UKCP09 is the fifth generation of climate change information for the UK, and its projections are based on a methodology designed by the Met Office.

MOD has agreed to use UKCP09 high emissions scenario. Unless otherwise stated the scenarios described below relate to the **projected changes by 2050s** relative to the 1961 – 1990 baseline and give the projections by season under the '**high emissions scenario'** from UKCP09 (the UK's most-up-to date climate change projections).

7.1 Temperature

7.1.1 **Observed changes:** In the West of Scotland, the annual daily mean temperature has increased by 1.16oC from 1961 to 2006. In summer this it has risen by 1.25oC and in winter by 1.44oC.

7.1.2 **Projected change in mean temperature for summer**: By the 2050s it is very likely that the average summer temperature will increase by between +1.4 ^{o}C to +4.4 ^{o}C.

7.1.3 **Projected number of hot days annually (days above 25oC):** By the 2080s (2070 – 2099) and under the medium emissions scenario it is very likely that there will be between 5 hot days (where 25oC is likely to be exceeded every 9 in 10 years) and 25 hot days (where 25 oC is likely to be exceeded every 1 in 10 years) in the area of Clyde. Under the 50% probability it is very likely that there will around 15 hot days (where 25oC is likely to be exceeded every 5 in 10 years).

7.1.4 **Projected change in temperature of the warmest day in summer:** By the 2050s it is very likely that the maximum daily temperatures in summer will change by between -1.1^{o}C and +9.5^{o}C.

7.1.5 **Projected change in mean daily maximum temperatures in summer:** By the 2050s It is very likely that summer mean daily maximum temperatures will increase between +1.2 ^{o}C and +5.6^{o}C.

7.1.6 **Projected change in mean winter temperature:** By the 2050s it is very likely that winter temperature will increase by between 1.2 ^{o}C to 3.4 ^{o}C.

7.1.7 **Projected change in temperature of the coolest day in winter:** By the 2050s it is very likely that the temperature on the coolest day in winter will increase by between -0.5 ^{o}C to +4.1 ^{o}C.

7.1.8 **Projected change in temperature of the warmest night in summer:** By the 2050 it is very likely that the temperature on the warmest night in summer will increase by between 0.5 ^{o}C and 6.6 ^{o}C.

7.2 Precipitation

7.2.2 Observed changes: In the West of Scotland the summer precipitation has increased by 4.3% and winter precipitation has increased by 58.6% from 1961 to 2006.

7.2.3 Projected change in mean summer precipitation: By the 2050s it is very likely that summer precipitation will change by -32.8 to +2.7%.

7.2.4 Projected changes in mean winter precipitation: By the 2050s it is very likely that winter precipitation will change by increase by 4.5% to 32.7%.

7.2.5 Change in precipitation on the wettest day in winter: By 2050 it is very likely that the average precipitation on the wettest day in winter will change by -2.7% to +25.2%.

7.3 Humidity

7.3.2 Observed changes in humidity: Total annual humidity has decreased by 2.1% from 1960 – 2006 in the West of Scotland based on a linear trend. Summer humidity has decreased by 1.6% and winter humidity has decreased by 1.9%.

7.3.3 Projected changes in humidity: By 2050 it is very likely that the average humidity will change by between -0.5% and 0.7% in winter and -7% and 0.7% in summer.

7.4 Cloud Cover

7.4.2 Projected changes in cloud cover: By 2050 it is very likely that the average cloud cover will change by between -1.6% and 3.3% in winter and -8.1% and 1.7% in summer.

7.5 Storms

7.5.2 Observed changes in storminess: Severe windstorms around the UK have become more frequent in the past few decades, although not above that seen in the 1920s. Robust projections of changes in storm track are not yet possible.

7.6 Sea Level Rise

7.6.2 Observed changes in sea temperature: The average coastal sea-surface temperature has increased by an average of 0.7 ºC around the UK.

7.6.3 Observed changes in sea levels: Sea level around the UK rose by about 1 mm/yr in the 20th century, corrected for land movement. The rate for the 1990s and 2000s has been higher than this.

7.6.4 Projected changes: It is very likely that the sea levels will increase by 2050 between 1.4cm and 24.2cm (5% and 95% probabilities) near Gare Loch. The central estimate is an increase of 12.8cm.

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DIRECTIONS ON POPULATING THE CRRR

This Climate Resilience Risk Register (CRRR) has been created to assess and record climate risks impacting a site, using CIRAM (Climate Impacts Risk Assessment Methodology) and adheres to the standards set out in JSP 892 Risk Management Directive.

The CRRR is to be completed during the CIRAM workshop. During the working session, each potential impact area on site (eg built estate, runway, etc.) should be discussed alongside each potential climatic variable that could increase risk to the site. Appendix 7H to the CIRAM Guidance provides a prompt for the workshop facilitator to follow that covers each of these areas.

The risk register contains a number of pre-filled cells with dropdown options based on JSP 892 criteria and recognised climate risks to MOD sites. The following sets out a step by step guide to populating the cells.

It should be noted that a number of areas on site could face the same risk (eg flooding could effect the training area, travel, and built estate). These should be detailed as separate risks.

Description	
Risk ID	Number of risks identified.
Area Impacted	Select from the drop down list of potential elements of an MOD site that could be impacted by climate.
Date Identified	Input the date when the risk was first identified (likely to be date of CIRAM workshop).
Background information	
Risk Cause	In accordance with JSP 892 a description should be given of the cause, event and consequence of the risk. Select from the drop down list of climate variables that have potential to cause the risk.
Risk Event	In accordance with JSP 892 a description should be given of the cause, event and consequence of the risk. Select from the drop down list of risk events.
Risk Consequence for Site	In accordance with JSP 892 a description should be given of the cause, event and consequence of the risk. Detail the consequences of the risk event for the area impacted.
Risk Category	Select from the drop down list the appropriate JSP 892 risk category (more information detailed on RISK SCORING tab).
Inherent Risk - the pre-mitigated assessment of the impact and likelihood of the risk, based on the assumption that controls and mitigations that are currently in place and have a specific and significant effect on the risk do not exist or do not function as intended. This assessment determines a worst case scenario for the risk.	

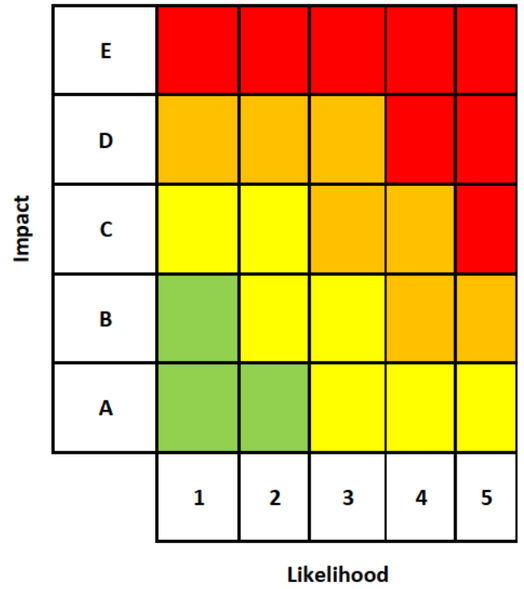
Likelihood	Select from dropdown list the appropriate JSP 892 likelihood score (more information detailed on RISK SCORING tab).
Impact	Select from dropdown list the appropriate JSP 892 impact score (more information detailed on RISK SCORING tab).
Largest risk impact	Select from dropdown list the JSP 892 risk impact category with the highest impact (more information detailed on RISK SCORING tab).
Inherent Assessment	The template will automatically generate this.
Current Activities	
Controls / Mitigations	Input the existing controls and mitigation measures that are currently in place.
Residual Risk - the current assessment of the impact and likelihood of the risk, based on how it is currently being managed. It assumes that the specific and significant controls and mitigations that are currently in place to manage the risk are working as intended.	
Likelihood	Select from dropdown list the appropriate JSP 892 likelihood score (more information detailed on RISK SCORING tab).
Impact	Select from dropdown list the appropriate JSP 892 impact score (more information detailed on RISK SCORING tab).
Largest risk impact	Select from dropdown list the JSP 892 risk impact category with the highest impact (more information detailed on RISK SCORING tab).
Residual Assessment	The template will automatically generate this.
Target Risk - the desired impact and likelihood levels for the risk, based on the amount of exposure the Department is comfortable accepting for the benefits it derives from taking the risk, and the feasibility and cost of further response activities.	
Likelihood	Select from dropdown list the appropriate JSP 892 likelihood score (more information detailed on RISK SCORING tab).
Impact	Select from dropdown list the appropriate JSP 892 impact score (more information detailed on RISK SCORING tab).
Target Assessment	The template will automatically generate this.
Response Plan Activities	
Risk Response	Select from the drop down list the chosen risk response type (detailed in JSP 892).
Activity	Detail activities that are underway/ planned to respond to the risk.
Owner	Input the **role** of the risk owner (in case of staffing changes). This is the individual with responsibility for ensuring that the risk is managed and monitored over time. A risk owner should have sufficient authority to ensure that the risk is effectively managed but may not be the one who actually takes action to address the risk.

Due Date	Input when the response activity is due to be completed.
On Schedule?	Select from the drop down list whether activities are on schedule.
Reason Behind?	If activities are not on schedule, detail the rationale for this.
Revised Due Date	Input revised due date if appropriate.

MOD RISK ASSESSMENT CRITERIA

JSP 892. Risk Management

According to JSP 892 (Risk Management), the impact and likelihood of a risk occurring must be measured in a consistent way in order to allow the size/significance of risks to be compared. The MOD Risk Assessment Criteria measures risk impact and likelihood against five levels of severity and should be used to assess all risks on an inherent, residual and target basis.



Likelihood Criteria

The below criteria should be used for measuring the likelihood of a risk occurring.

The likelihood can be measured using any of the 3 likelihood criteria shown below: the probability percentage, the perceived approximate frequency, or based on how commonly it has occurred in the past. Note that based on the specific risk being assessed, one measurement scale may be more applicable than the others. In terms of climate related risk, most sites will find the latter two the most useful criteria to score against.

Where multiple scales are applicable, the assessment should be based on the scale with the highest likelihood. For example, if a risk has never occurred in MOD history but has a 30% probability of occurring, then the likelihood assessment should be documented as 3.

	Likelihood	Probability	Approximate frequency	Description
5	Very high	> 90%	Occurs at least once every 5 years	Is a common occurrence in MOD
4	High	51 - 90%	Occurs once every 5 - 10 Years	Has occurred within MOD many times
3	Medium	26 - 50%	Occurs once every 10 - 20 years	Has occurred in MOD on several occasions
2	Low	11 - 25%	Occurs once every 20 - 50 years	Has occurred on a small number of occasions in MOD's history
1	Very low	< 10%	Occurs less than once every 50 years	Has occurred once / never in MOD history

Impact Criteria

The below criteria should be used for measuring the total potential impact(s) of a risk, if it were to occur.

Where multiple impact areas are applicable, the assessment should be based on the area with the highest impact. For example, if a risk has a potential reputational impact of E and a financial impact of C, then the impact assessment should be documented as E.

Financial	Reputational	Impact on outputs / capability	Health, safety & environment

E **Critical**	>£250m	• Significant long-term (at least the duration of the current political term) damage to strategically important international relationships, such as NATO, USA, Canada, France, other nations & significant treaties/unions (e.g. EU), leading to a refusal to enter into joint operations, training exercises, procurement arrangements, share intelligence etc • Long-term (at least the duration of the current political term) damage to the UK's international geo-political agenda (e.g. damage to our credibility within the EU or NATO) • Significant and prolonged (at least the duration of the current political term) adverse ministerial interest; Minister for Defence resignation • Launch of an internationally high profile public enquiry(s) or litigation(s), leading to public outrage and damage to MOD perception; causing the general public or MOD enemies to question MOD's ability to protect the UK and its service personnel • Unfavourable hearing at the House of Commons Defence Select Committee or Public Accounts Committee • Long-term (at least the duration of the current political term) outrage & protests from gate keepers (key campaigner / activist groups) leading to substantial damage to MOD perception	• Critical constraint on the ability to deliver one or more of the Military Tasks and/or DLODs (Defence Capability Assessment Register BLACK - Cannot deliver output)	• Multiple fatalities or multiple severe permanent disabilities (in a non-theatre environment) which causes inability to continue a normal way of life/reduces quality of life • Permanent loss/damage beyond remediation to an important and publically high profile natural resource/geographical area/species • Multiple incidents causing a major environmental impact (EA Common incident Categorisation Scheme - Cat 1)
D **Severe**	£150m - £250M	• Significant short-term [less than 6 months] or moderate long-term (at least the duration of the current political term) damage to strategically important international relationships, such as; NATO, USA, Canada, France, other nations & significant treaties / unions (e.g. EU), leading to a reluctance to enter into joint operations, share intelligence etc • Significant short-term [less than 6 months] or moderate long-term (at least the duration of the current political term) damage to the UK's international geo-political agenda (e.g. damage to our credibility within the EU or NATO) • Concerted action in parliament causing ministers to call for the resignation of the Minister for Defence • Single high profile litigation against MOD	• Significant constraint on the ability to deliver one or more of the Military Tasks and/or DLODs (Defence Capability Assessment Register RED - Can deliver output but with very significant risk)	• Single death or injuries to multiple individuals which are life threatening and/or have a short-term impact on normal way of/quality of life (in a non-theatre environment) • Severe damage over a wide area and/or on a prolonged basis to a natural resource, including controlled waters, or geography requiring multi-year remediation • Single incident causing a major environmental effect (EA Common Incident Categorisation Scheme - Cat 1) • Multiple incidents causing significant environmental effect (EA Common Incident Categorisation Scheme - Cat 2)

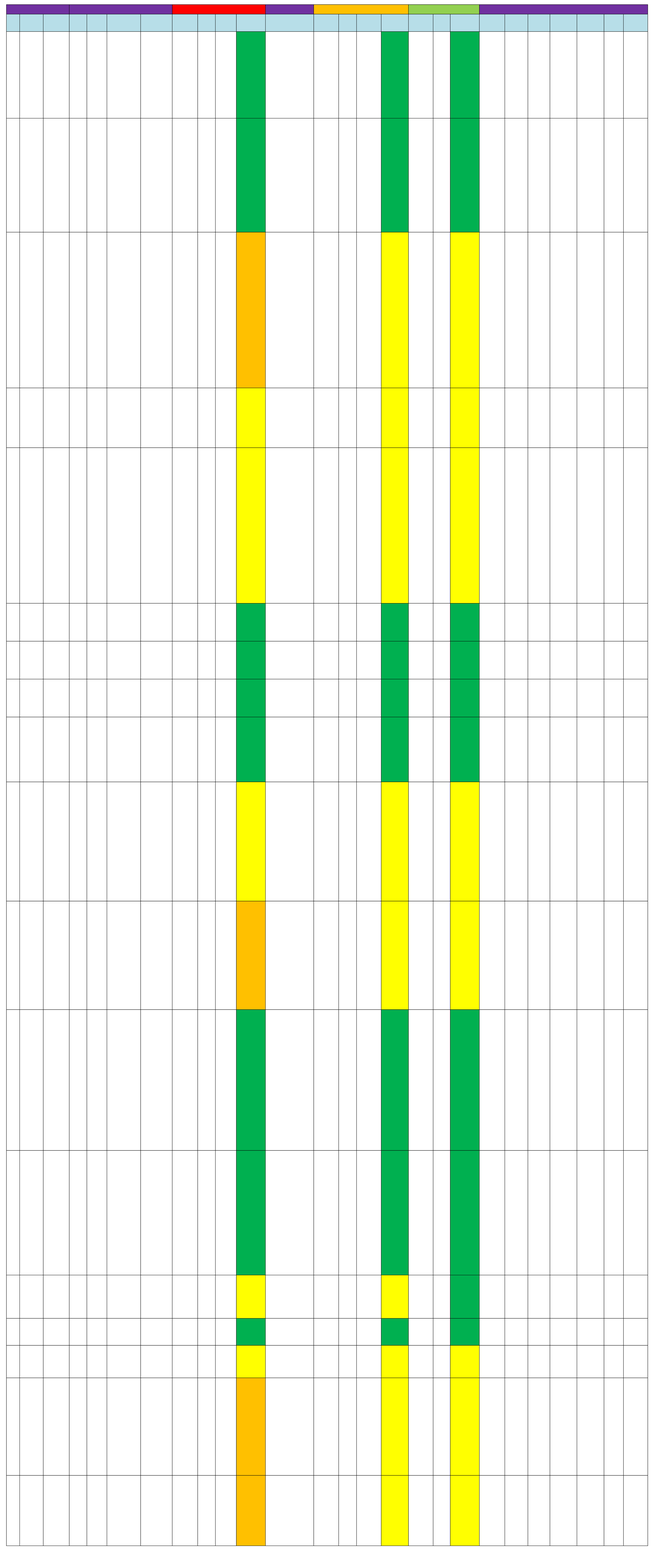
C **Major**	£100m - £150m	• Negative questions posed to minister in parliament • Short-term [less than 6 months] major outrage & protests from multiple a key campaign/ activists / gate keeper group	• Major constraint on the ability to deliver one or more of the Military Tasks and/or DLODs (Defence Capability Assessment Register AMBER - Can deliver output but with significant risk)	• Single injury which causes permanent disability or permanent impact on way of life (in a non-theatre environment) • Injuries to multiple individuals of a non-life threatening nature which have a short-term impact on normal way of/quality of life (in a non-theatre environment) • Moderate damage to an extended area and/or area with moderate environmental sensitivity (scarce/ valuable environment) that requires months of remediation • Single incident causing a significant environmental impact (EA Common Incident Categorisation Scheme - Cat 2
B **Moderate**	£50m - £100m	• Short-term [less than 6 months] major outrage & protests from multiple non-key campaign/ activists / gate keeper groups	• Some moderate constraint on the ability to deliver one or more of the Military Tasks and/or DLODs (Defence Capability Assessment Register YELLOW - Can deliver output but with minor risk)	• Injuries to multiple individuals of a non-life threatening, non-permanent nature which require first aid only (in a non-theatre environment) • Moderate damage to an area, and that can be remedied with MOD resources • Multiple incidents causing minor environmental effect (EA Common Incident Categorisation Scheme - Cat 3)
A **Minor**	£10m - £50m	• Regional outrage & protests from non-key campaigner/ activist / gate keeper group	• Minor constraint on the ability to deliver one or more of the Military Tasks and/or DLODs (Defence Capability Assessment Register GREEN - Can deliver output (no/minimal risk))	• Injury of a non-life threatening, non- permanent nature which requires first aid only (in a non-theatre environment) • Limited short term damage to an area of low environmental significance/ sensitivity • Incidents causing minor environmental impacts (EA Common Incident Categorisation Scheme - Cat 3)

MOD RISK CATEGORIES

The MOD Risk Categories can be used as a guide to ensure a broad range of risks are considered during risk identification exercises. Additionally, the categories will be used by the DARA team to conduct risk consolidation and reporting analysis.

When assigning a category to a risk, assign it to the cause or event of the risk, not the consequence.

Risk Category and associated core MOD function	Description
Strategic, i.e. Direct	How MOD is managed, strategy, policies and compliance
Operational, i.e. Operate	Military operations
People, i.e. Generate and Develop	Recruitment, retention, training and development, engagement, culture and behaviour of military and civilian personnel
Capability, i.e. Acquire	The acquisition of equipment, systems and other items that the armed forces need
Infrastructure, i.e. Enable	All support services
Finance, i.e. Account	The accounting and reporting of defence activity and spending to Parliament and the public



Site Name: HMNB Clyde
Site Code: NBFL
Region: Scotland
TLB: NAVY COMMAND
Date of workshop [DD/MM/YYYY]: 08/03/2017

Date CRRR Adopted [DD/MM/YYYY]: 05/05/2017
Date 5 Year Review Due: 05/05/2022

Attendees

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[redacted]	EPAM	[redacted]	[redacted]	Clyde
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