

Northern Gas Networks
Climate Change Adaptation Reporting
Power Second Round

July 2015



Climate Change Adaptation Reporting Power

Second Round Reporting

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Introduction

The response is submitted on behalf of the Gas Transmission and Distribution Network Operators for Great Britain.

This group is comprised of:

- National Grid
- Northern Gas Networks
- SGN
- Wales & West Utilities

These companies are all members of the Energy Networks Association (ENA), the industry body for the UK gas and electricity network companies. ENA facilitates the sharing of best practice and helps provide a coordinated approach to the climate change adaptation response by these companies, where that response is considered common to all network operators in Great Britain.

The representatives of the ENA Gas Environment Group have worked collaboratively to develop a comprehensive united industry response to the questions posed by the Climate Change Adaptation Reporting Power, Guidance for Repeat Reporters. The report reflects the common issues faced by the businesses in addressing the risks of climate change. Additional network specific information, where applicable, is included in italics within the body of the report.

The companies control and maintain the critical national infrastructure that delivers vital services into homes and businesses throughout the UK. Gas is transported through Gas Transmission networks to regional Gas Distribution networks that then deliver energy to customers on behalf of suppliers. Business operations include connecting new consumers, maintaining and replacing pipe work and associated assets, and dealing with gas emergencies along pipelines and within domestic, commercial and industrial properties.

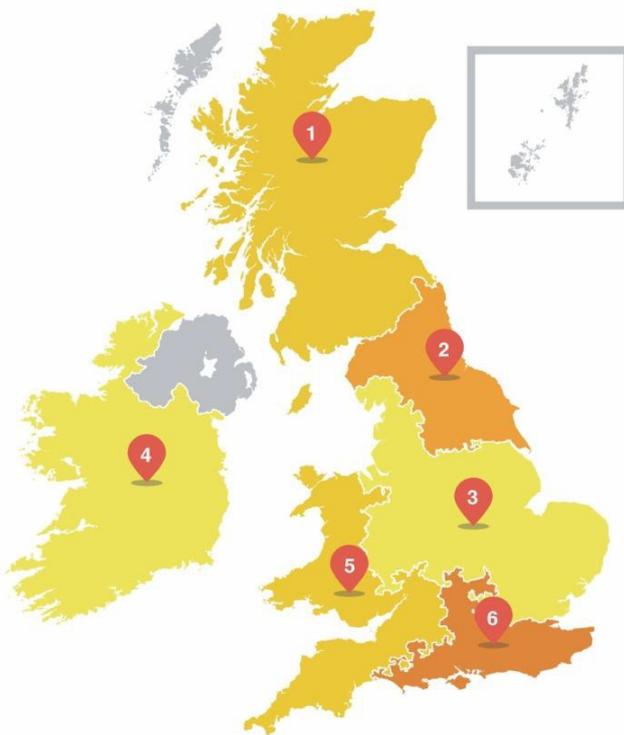
National Grid is the owner and operator of the national gas transmission system and four of the eight regional Gas Distribution networks in Great Britain. The other Gas Distribution Network Operators (GDNs) are Southern Gas Networks (SGN), Scotland Gas Networks (SGN), Wales & West Utilities (WWU) and Northern Gas Networks (NGN).

The primary duties of the companies are covered under the requirements of the Gas Act 1986 and Electricity Act 1989 to develop and maintain efficient, reliable, safe and secure networks and to facilitate competition. Further duties are included within secondary legislation Regulations.

All GDNs operate regulated monopoly businesses operating under licences issued by Ofgem. Allowed revenues for the industry are currently set by Ofgem every eight years under the RIIO (Revenue = Incentives + Innovation + Outputs) Price Control Review framework and these reviews govern the costs and income associated with operating regulated activities.

UK Gas Distribution Network Operators

Gas Distribution



Individual Companies

National Grid Gas (NGG) plc owns and operates the UK Gas Transmission system and the low pressure Gas Distribution in the heart of England distributing to approximately eleven million homes, office and schools via 7,700km of gas pipelines. NGG connects producers, processors, storage, transmission and distribution network operators as well as suppliers to industrial, commercial and domestic users.

SGN is a privately owned Gas Distribution company, operating over 74,000km of gas mains and services in the south and South East regions of England and the whole of Scotland under the banner of SGN. It is the UK's second largest Gas Distribution network company and is responsible for delivering gas to its 5.8 million customers safely, reliably and efficiently.

Wales & West Utilities (WWU) was launched as an independent Gas Distribution business in June 2005 following the sale of the gas network for Wales and the South West of England. With more than 35,000km of mains, WWU transports gas to the homes and businesses of 2.5 million consumers across a geography covering 1/6th of the UK and serving a population of 7.4 million people.

Northern Gas Networks (NGN) is responsible for delivering gas to 2.7 million homes and businesses across northern England. The Company was formed when The North of England Gas Distribution network was acquired from National Grid plc in June 2005. NGN's network consists of 37,000km of gas pipes and associated delivery and storage apparatus. NGN's area covers northern Cumbria, the North East and North, East and West Yorkshire with a population of more than 6 million people.

Gas Distribution

Gas is delivered from the beach terminal through the high pressure National Transmission System (NTS), owned and operated by National Grid, to the GDNs. Gas is delivered into the Local Transmission System (LTS) of each network via offtakes from the NTS. Gas under high pressure in the LTS is moved around the distribution networks and subsequently reduced to Intermediate Pressure (IP), Medium Pressure (MP) or Low Pressure (LP) via Pressure Reducing Installations. Gas is then delivered to commercial and domestic customers via a network of polyethylene (PE) and metallic LP mains and services.

Each GDN's distribution network is comprised of pipelines operating at different pressure tiers. High Pressure (HP) pipelines operate between 70 and 7 Bar, Intermediate Pressure (IP) between 7 and 2 Bar, Medium Pressure (MP) between 2 Bar and 75 mbar and Low Pressure (LP) below 75 mbar. In addition, each company

owns and operates storage infrastructure such as High Pressure vessels and Liquefied Petroleum gasholders.

Adaptation – First Round Reports

The Climate Change Act 2008 provides the framework for ensuring the UK's ability to adapt to climate change. Defra established an Adapting to Climate Change Programme and in November 2009 laid a strategy before Parliament for using the Adaptation Reporting Power under the Act. Responses were subsequently submitted by the companies to the First Round of Adaptation Reporting in 2010, which was designed to:

- Assess the current and predicted impact of climate change in relation to the companies' functions; and
- Outline the proposals and policies for adapting to climate change in the exercise of those functions and the timescales for introducing those proposals and policies.

The Reports therefore represented individual company assessments of existing assets and business processes and identified areas where the environment is capable of impacting the ability to meet its business objective.

This formed part of the process of ensuring the businesses adapt to the expected climate changes including hotter and drier summers, warmer and wetter winters, coastal, river bed and bank erosion and increasingly extreme weather events such as flooding. The main categories of weather events and environmental risks were identified as follows:

- Flooding and heavy rain fall (including saturated ground conditions);
- Snow and ice;
- Increases in temperature, heat waves and drought conditions;
- Coastal erosion from sea level rise;
- River erosion; and
- Storm events and high winds.

Using information drawn from UKCP09 and working alongside the Meteorological Office Hadley Research Centre, the Environment Agency and the Scottish Environmental Protection Agency, the key risks and opportunities facing the businesses were identified. High emissions projections to 2050 and 2080 were used to determine worst case scenarios and for correlation against the lifetimes of existing assets. Account was taken of the expected increase in number, frequency and intensity of weather events.

The risk methodology and categorisation identified a number of potentially vulnerable areas and the mitigation measures that were either in place or needed to be developed further. Decisions on the appropriate controls are dependent on the accuracy of the supporting information and data and whether a quantitative or qualitative assessment has been made.

The Reports highlighted that network assets and processes may be vulnerable to certain aspects of climate change. However, the national and regional infrastructure has a significant degree of resilience to these impacts and none of the identified risks were considered to be high. The management of these risks is now embedded within companies' overall risk management processes to ensure that any appropriate actions are recorded and completed. Responsibility and ownership of these action plans ensures their timely delivery and climate change adaptation is also subject to the same level of ongoing review and evaluation as other business risks.

Revenue is determined by Ofgem price control mechanisms (currently RIIO-GD1 – Revenue = Incentives + Innovation + Outputs) and dictate the expenditure by the businesses, including the level of adaptation investment. Any increase in adaptation related costs will be required over longer medium to long term timescales however.

The inherent resilience of the networks is largely due to the majority of Gas Distribution assets being located underground, with greater resilience built into the Gas Transmission network compared to the distribution network. Those assets most at risk to the weather and climate parameters, highlighted above, are those found above ground; typically large Pressure Reducing Installations (PRIs), critical sites such as data centres, and pipelines in close proximity to watercourses. Impacts are usually localised to the asset and the process it supports and are unlikely to lead to a loss of supply or result in a risk to the system as a whole.

In addition prolonged periods of extreme weather could have a significant impact on the ability of the workforce to access and carry out their roles, particularly field-based engineers. They could also impact on the ability to conduct 'business as usual' activities as a result of the reliance on appropriate adaptation of other major infrastructures, such as telecommunications and transport. Impacts on the operation of supply chain businesses and the continued availability of equipment also needs to be considered. The environmental impact of companies' assets could be affected by the mobilisation and migration of land contaminants from flooding and ground saturation.

These interdependencies can be mitigated through the implementation of maintenance and inspection regimes, the development of flood defence measures, the availability of necessary equipment, up to date contingency measures and ensuring Business Continuity Management Plans are in place.

Understanding Climate Risk - Questions

How has your understanding of climate risks, impacts and their effects on your sector/organisation and stakeholders advanced since your first round report?

There has been no significant change in the understanding of climate change risks since the first round of Adaptation Reports were submitted in 2010/11. This understanding was based on the UKCP09 data published under the Climate Impacts Programme (UKCIP) that forecast the risks under various scenarios to the end of this century.

Similarly Environment Agency flood maps that were available and referenced at the time have not been developed any further and so the perceived risk remains the same. However, all the gas networks operators (GDNs) have experienced severe weather events in last few years which have provided ongoing learning and further insight into, and confidence in, the resilience of the gas networks infrastructure.

Actual flooding events occurring within the years subsequent to the original report have also demonstrated the network's ability to withstand incidents of this nature without impacting on security of supply.

What climate change evidence or research have you used to better understand the implications for organisational functions?

The Companies are still reliant on UKCP09 as the primary source of information and data and which remains the only such reference available. Updates from the Climate Ready service or other updated research data would therefore be welcomed.

Wales & West Utilities has shared information regarding the development of a pilot project with Landmark Information Group to map the physical impacts of climate change.

Has your understanding of thresholds of climate impacts advanced to better pinpoint organisational vulnerability? If so, how?

UKCP09 provides climate information for the UK up to the end of the century. The projections show three different scenarios representing high, medium and low greenhouse gas levels. Information is provided on observed climate data, future climate projections and future marine and coastal projections. These scenarios are still being used and remain the best existing available information.

How have you developed your quantified assessment and analysis of risk likelihood and impacts?

The original round of Adaptation reporting provided Gas Distribution with increased confidence in the level of resilience in our asset infrastructure and this allowed the companies to focus on remaining areas of risk. The existing risk assessments have been reviewed and confirmed as being still fit for purpose and the current risk ratings remain the same based on the available data.

Understanding Uncertainties - Questions

What uncertainties remain in monitoring and evaluating climate risks to your sector's/organisation's functions?

There is a need for cross sector planning scenarios to ensure that sectors with interdependencies have used similar assumptions when reporting; this was not fulfilled in the first round of reporting. This is important to address the wide variety of views regarding the extent and impact of climate change on national infrastructure.

The overall level of uncertainty for gas networks is low as the sector has a high level of inherent resilience due to the level of safety awareness and regulatory overview.

Monitoring, evaluating and adapting to risks of all types, including climate change, are an integral part of business as usual.

What new uncertainties have come to light?

No new uncertainties in Gas Distribution have emerged since the original Adaptation report. The businesses continue to monitor three key areas of flooding, ground subsidence and coastal and river erosion.

Further information on flooding risks is available from both internal and external sources. However, this is limited. Further analysis is still required to understand the impact associated with subsidence/land slips and the extent to which climate change will cause ground movement. Asset replacement programmes continue to reduce this risk by removing brittle metallic mains from the network however. River and coastal erosion continue to be monitored at identified locations and investment strategies are introduced where required.

What further implications do uncertainties have on action your sector/organisation has taken or plans to take?

Any emerging uncertainties will be captured within the risk management approach adopted by the companies and addressed within business work plans.

This process needs to ensure that any asset investment made is necessary, timely and appropriate. All of the companies are regulated monopoly businesses and as such capital and operating expenditure is subject to economic regulation by Ofgem. This is achieved via a periodic price control process known as RIIO (Revenue = Incentives + Innovation + Outputs). The current price control runs from 2013 to 2021 and, unless there are exceptional or unforeseen circumstances, then the levels of approved revenue needed to accommodate the planned asset infrastructure investment and maintenance for this period, including any work required to adapt to climate change, have now been determined.

At present the current UKCP09 data does not support further asset investment beyond that already planned. The existing revenues will allow for some reactive investment but the available forecast projection data does not adequately support significant adaptation investment at this time. However, the Landmark pilot project indicates the potential to generate meaningful asset impact data. This could be used to support further infrastructure investment across multiple industries such as utilities, transport, telecommunications, insurance bodies and construction. Climate change risk will continue to be monitored as part of the companies' approach to risk management and information will be shared with the sector via ENA.

What progress have you made to address information gaps?

Along with other sectors the gas network industry remains reliant on national climate change data, projection scenarios and research published by the Government. Consequently these need to be periodically revised and updated. Access to a tool, such as the Landmark climate change physical impact mapping, would be of great benefit in justifying and delivering robust adaptation measures across the whole of the UK.

In the meantime the ongoing monitoring of network operations, particularly in periods of severe weather, together with sharing of experience across the sector via the ENA, has improved the confidence levels in the resilience of the networks to future climate change impacts. This in turn provides an indication of any appropriate mitigating actions that may be required.

What are the strategic business and methodological assumptions that underpin your analysis of impacts and risks?

Company business strategies are driven by both asset life cycles and the regulatory framework within which the sector operates.

Assets are installed with an expectation of over 40 years of reliable service based on equipment integrity, level of operational use and suitable maintenance regimes. Based on these parameters, and the standards to which such equipment is initially designed, constructed and installed, assets are deemed to be climate resilient during this service lifetime.

The levels of asset investment that are determined in the intervening price control periods assist in the assessment and response to the impact of climate change adaptation. The assumptions that are made as part of this process remain based on the available long term climate data forecasts.

Addressing Barriers and Understanding Interdependencies - Questions

Where you've identified interdependencies, how have these assisted or hindered actions to address climate risk?

The First Round Reports highlighted key interdependencies with other sectors that were not previously required to report via the mandatory process or did not provide a comprehensive level of reporting. Details of fundamental interdependencies with transport, telecommunications and the local authority sectors in particular have resulted in some areas which retain higher risk profiles than necessary and which would have benefited from being designated as Reporting Authorities from the outset.

Within the gas sector, high levels of cooperation exist between all the network operators to manage emergency situations including major incident simulations. This, together with joint working via the ENA, helps to create an environment of cooperation to address climate risk.

What were the main barriers to implementing adaptation actions and why?

The currency and robustness of the existing data set is a potential barrier to an effective adaptation response. It is unclear if the projected climate forecasts within UKCP09, which dictate the required investment now, are sufficiently accurate and robust to inform the required business decisions. Please refer to the previous comments on the Landmark pilot project.

There is also a need for stronger links between the forecasts and the actual projected impact at the local, regional and national environment level i.e. the level of rainfall, frequency of severe events, change in wind levels, the degree, extent and depth of flooding, increased rates of erosion and the exacerbation of land movement etc. that will impact on all sectors.

It remains difficult to accurately predict the level of funding needed by the regulated businesses for long term adaptation measures due to the current periodic price control investment cycle. A detailed process of assessment led to Ofgem determining the allowed level of revenue and investment for the companies only covering the period from 2013 – 2021, including any expenditure required for adaptation.

Have new barriers been identified? Are these being addressed? If so, how?

Any interdependencies with other sectors that are identified, and which impact on the operation of the gas networks, will be included within the company risk and business action plans going forward.

Further research and analysis into climate change impacts would certainly allow risks to be better understood.

Monitoring and Evaluating - Questions

How effectively has consideration of climate change risks been embedded within your sector or organisation?

There is an increasing level of awareness within the companies and its employees on climate change risks and the requirements for both mitigation and adaptation response. This is aided by the sharing of information and best practice via the ENA, the industry body for the sector. ENA represents both the gas and electricity network companies providing opportunities for further liaison and learning opportunities as all energy sector companies are designated as Reporting Authorities and share some common issues.

The gas network businesses already demonstrate comprehensive existing management of their assets and resilience to existing and future climate impacts. Increasingly this is seen as a business as usual aspect of risk management. This work is further supported by the sector's involvement in wider national Government resilience and emergency response fora.

How effective have organisational monitoring and evaluation processes been to ensure adaptation responses are implemented and on track? If these have not been effective, what barriers prevented this?

As per some of the previous answers, actions detailed in the Adaptation Reports continue to be monitored. These Action Plans have been incorporated within the company business plans as appropriate based on the level of risk.

Progression against the understanding of specific issues, such as flooding risks, coupled with experience of recent events has moved the companies forward in their understanding. Local impacts of river and coastal erosion on assets are also monitored and investment is made where required. Greater understanding and analysis of ground movement is potentially one area requiring further investigation, but monitoring parameters within existing risk and incident management systems provide assurance on any future required action.

How effective were monitoring and evaluation processes in determining how the organisation/sector handled recent extreme weather conditions?

The planning of emergency responses in all conditions is part of business as usual practice, and whilst every severe weather episode provides learning and continuous improvement opportunities, the sector managed the recent extreme weather conditions without significant unforeseen problems. No unforeseen changes to the sector approach to adaptation have been identified from these events.

Has the sector/organisation identified any financial benefits from implementing adaptation actions? Perhaps through cost benefit analysis, fewer working days lost, more efficient operations etc?

Minimal financial benefits have been identified by the companies to date, but there is an appreciation of the benefit of early adaptation response where necessary to help mitigate future costs. The costs incurred in resourcing adaptation related work are subsumed within planned operational expenditure.

Has there been sufficient flexibility in the approach to adaptation within the sector/organisation, which allowed you to pursue alternative courses of action? If not what remedial measures could you take to ensure flexibility?

The industry already works within a framework where long term investment, and its underlying assumptions, is subject to periodic regulatory review. The long term safe operation of the gas networks is separately subject to the approval of safety cases with the Health and Safety Executive on a regular basis. These existing arrangements comfortably sit alongside the Adaptation Reporting framework and provide a sufficiently flexible approach.

Opportunities and Benefits - Questions

What action have you taken to exploit opportunities?

Limited opportunities have been identified by the companies to date.

How effective were your efforts?

Not applicable.

Appendix 1 – Assessing Risks

NGN utilise an integrated risk management process to manage business risk exposures. The process includes a Risk Management Policy and framework to ensure that risk management is an integral part of good management practice. It is firmly linked to the ability of the organisation to achieve business objectives.

The output of the 2011 Risk Assessment Process, with a number of newly identified risks, are expressed in a 5 by 5 matrix as detailed below.

		Consequence				
Likelihood		Minimal (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Almost Certain (5)		6 Medium	7 High	8 High	9 Extreme	10 Extreme
Likely (4)		5 Low	6 Medium	7 High	8 High	9 Extreme
Possible (3)		4 Low	5 Low	6 Medium	7 High	8 High
Unlikely (2)		3 Negligible	4 Low	5 Low	6 Medium	7 High
Rare (1)		2 Negligible	3 Negligible	4 Low	5 Low	6 Medium

To further enhance the NGN Business Risk Model for use on climate change a Confidence level was introduced. This was based on the DEFRA Climate Change Risk Assessment methodology which used the following 0 to 4 confidence rating:

- 0 Non-expert opinion, unsubstantiated workshop discussion with no supporting evidence
- 1 Expert view based on limited information, e.g. anecdotal evidence
- 2 Estimation of potential impacts, using accepted methods and with some agreement across the sector
- 3 Reliable analysis and methods, subject to peer review and accepted within a sector as 'fit for purpose'
- 4 Comprehensive evidence using the best practice and published in the peer reviewed literature; accepted as an ideal approach

Climate Change Risks Identified were evaluated and against this model. The detailed output is shown below.

The NGN Risk Management Framework has been revised since the 2011 report. However, it has been agreed the existing assessment is still valid and there is no requirement to reassess against the revised version.

Climate Variable(s)	Environmental Impact	Impact on NGN	Risk Ref	Likelihood			Consequence			Risk Level			Confidence Level (0-4)
				Current	2020	2050	Current	2020	2050	Current	2020	2050	
Summer mean precipitation decrease / Summer mean & max temperature increase	Changes in temperature / soil moisture content	Increase in mains breakage / leakage	CCR1	1	1	2	2	2	2	3	3	4	1
	Changes in temperature / soil moisture content	Movement of pipelines	CCR2	1	1	2	3	3	3	4	4	5	1
	Reduced precipitation leading to drought conditions	Limited water supply during drought	CCR48	1	1	1	1	1	1	2	2	2	1
Winter mean precipitation increase / Winter daily precipitation increase / Summer daily precipitation increase	Increase in peak water in rivers (Fluvial)	Pipelines in Bridge Structures / on pipe bridges are damaged	CCR3	1	1	2	4	4	4	5	5	6	3
	Increase in peak water in rivers (Fluvial)	Mains in Bridge Structures / on pipe bridges are damaged	CCR4	2	2	3	3	3	3	5	5	6	2
	Increase in peak water in rivers (Fluvial)	Pipelines/mains near / under rivers become exposed	CCR5	1	1	2	2	2	2	3	3	4	2
	Wetter streetworks sites	Reduction in the use of recycled / excavated backfill material	CCR6	1	1	2	2	2	2	3	3	4	1
	Wetter streetworks sites	Stability of Trenches / Excavations	CCR7	1	1	2	3	3	3	4	4	5	1
	Flooding	Damage to / Malfunction of AGIs and other key Installations	CCR8	1	1	2	4	4	4	5	5	6	1
	Flooding	Damage to / Malfunction of District Governors	CCR9	1	1	2	3	3	3	4	4	5	1
	Flooding	Damage to / Malfunction of equipment at office / depot locations	CCR10	1	1	2	2	2	2	3	3	4	1
	Flooding	Increase in Gas Supply emergencies caused by water ingress incidents	CCR11	2	2	3	2	2	2	4	4	5	1
	Flooding	Access problems to AGIs and other key Installations	CCR12	1	1	2	2	2	2	3	3	4	1
	Flooding	Access problems to District Governors	CCR13	1	1	2	1	1	1	2	2	3	1
	Flooding	Access problems to office / depot locations for key staff	CCR14	1	1	2	4	4	4	5	5	6	1
	Flooding	Access problems to streetworks sites / emergency jobs	CCR15	1	1	2	4	4	4	5	5	6	1
	Flooding	Deterioration of plant and equipment on all fixed asset sites	CCR16	1	1	2	2	2	2	3	3	4	1
	Flooding	Mobilisation and migration of contaminants due to flooding	CCR49	1	2	3	3	3	3	4	5	6	1
	Flooding / increase in humidity	Increase in mean humidity resulting in the sweating of pipes	CCR50	1	1	2	2	2	2	3	3	4	1
	Flooding / increase in humidity	Impacts on supply chain - access problems	CCR51	1	1	2	3	3	3	4	4	5	1
	Increased occurrence of Snow and ice	Access problems to AGIs and other key Installations	CCR17	2	2	2	2	2	2	4	4	4	3
	Increased occurrence of Snow and ice	Access problems to District Governors	CCR18	2	2	2	1	1	1	3	3	3	3
	Increased occurrence of Snow and ice	Access problems to office / depot locations for key staff	CCR19	2	2	2	4	4	4	6	6	6	3
Increased occurrence of Snow and ice	Access problems to streetworks sites / emergency jobs	CCR20	2	2	2	4	4	4	6	6	6	3	
Summer mean temperature increase / Summer max daily temperature Increase	Increased temperature in IT Servers	Malfunction of IT Servers due to prolonged high temperatures	CCR21	1	1	1	4	4	4	5	5	5	3
	Increased temperature in non-air conditioned offices/depots	Office staff suffering from heat exhaustion leading to loss of productivity	CCR22	1	1	2	2	2	2	3	3	4	3
	Increased temperature in streetworks and fixed asset work sites	Front-line staff suffering from sunstroke and heat exhaustion affecting vital work	CCR23	1	1	2	3	3	3	4	4	5	3
	Increased temperature in streetworks and fixed asset work sites	Changing requirements of PPE to be capable of use in warmer conditions	CCR24	1	1	2	1	1	1	2	2	3	3
	Increased temperature in streetworks and fixed asset work sites	Chemical Based products used in mains repair / replacement will not function correctly	CCR25	1	1	2	2	2	2	3	3	4	2
	Increased temperatures	Changes to specific gravity of gas as a result of increased temperatures	CCR52	1	2	2	2	2	2	3	4	4	1

Climate Variable(s)	Environmental Impact	Impact on NGN	Risk Ref	Likelihood			Consequence			Risk Level			Confidence Level (0-4)
				Current	2020	2050	Current	2020	2050	Current	2020	2050	
Summer mean temperature increase / Winter mean temperature increase	Perceived decreased gas load demand averaged over year	Potential reduction in funding for investment in Gas Infrastructure despite increasing Peak Day Load	CCR26	1	1	2	4	4	4	5	5	6	1
	Increased humidity	Reduced PE fusion quality	CCR53	1	1	2	3	3	3	4	4	5	1
	Increase in temperatures	Increase in dust generation and migration	CCR54	1	2	3	1	1	1	2	3	4	1
Sea level rise and storm surge	Increase in peak water in rivers	Pipelines in Bridge Structures / on pipe bridges are damaged	CCR27	1	1	2	4	4	4	5	5	6	1
	Increase in peak water in rivers	Mains in Bridge Structures / on pipe bridges are damaged	CCR28	2	2	3	3	3	3	5	5	6	1
	Increase in peak water in rivers	Pipelines/mains near / under rivers become exposed	CCR29	1	1	2	2	2	2	3	3	4	1
	Increase in peak water in rivers	Pipelines/mains near coast become exposed	CCR30	1	1	2	2	2	2	3	3	4	1
	Flooding in Costal Areas	Damage to / Malfunction of AGIs and other key Installations	CCR31	1	1	2	4	4	4	5	5	6	1
	Flooding in Costal Areas	Damage to / Malfunction of District Governors	CCR32	1	1	2	3	3	3	4	4	5	1
	Flooding in Costal Areas	Damage to / Malfunction of equipment at office / depot locations	CCR33	1	1	2	2	2	2	3	3	4	1
	Flooding in Costal Areas	Increase in Gas Supply emergencies caused by water ingress incidents	CCR34	1	1	2	3	3	3	4	4	5	1
	Flooding in Costal Areas	Access problems to AGIs and other key Installations	CCR35	1	1	2	2	2	2	3	3	4	1
	Flooding in Costal Areas	Access problems to District Governors	CCR36	1	1	2	1	1	1	2	2	3	1
	Flooding in Costal Areas	Access problems to office / depot locations for key staff	CCR37	1	1	2	4	4	4	5	5	6	1
	Flooding in Costal Areas	Access problems to streetworks sites / emergency jobs	CCR38	1	1	2	4	4	4	5	5	6	1
Flooding in Costal Areas	Deterioration of plant and equipment on all types of fixed asset sites	CCR39	1	1	2	2	2	2	3	3	4	1	
Increased frequency and intensity of storms	Storm Damage	Loss of communication links with Field Staff	CCR40	1	1	2	4	4	4	5	5	6	1
	Storm Damage	Loss of communications links / telemetry on fixed asset sites	CCR41	1	1	2	3	3	3	4	4	5	1
	Storm Damage	Damage to AGIs and other key Installations	CCR42	1	1	2	3	3	3	4	4	5	1
	Storm Damage	Damage to District Governors	CCR43	1	1	2	2	2	2	3	3	4	1
	Storm Damage	Damage to buildings and equipment at office / depot locations	CCR44	1	1	2	2	2	2	3	3	4	1
	Storm Damage	Field staff unable to undertake Working at heights	CCR45	1	1	2	1	1	1	2	2	3	1
	Storm Damage	Signs and Barriers on streetwork sites being disturbed leading to greater risk of MOP Injury	CCR46	1	1	2	2	2	2	3	3	4	1
	Storm Damage	Deterioration of plant and equipment on all types of fixed asset sites	CCR47	1	2	2	2	2	2	3	4	4	1
	Storm Damage	Increased likelihood of lightning strikes	CCR55	1	2	3	3	3	3	4	5	6	1
	Storm Damage	Latent damage, flashovers and transient interruptions to the electricity supply (indirect impact)	CCR56	1	2	2	2	2	2	3	4	4	1

Transposed to the matrix format the Risk Assessment output can be summarised as:

Current	Consequence				
Likelihood	Minimal (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Almost Certain (5)					
Likely (4)					
Possible (3)					
Unlikely (2)	18	11 17	4 28	19 20	
Rare (1)	13 24 36 45 48 54	1 5 6 10 12 16 22 25 29 30 33 35 39 43 44 46 47 50 52 56	2 7 9 23 32 34 41 42 49 51 53 55	3 8 14 15 21 26 27 31 37 38 40	
2020	Consequence				
Likelihood	Minimal (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Almost Certain (5)					
Likely (4)					
Possible (3)					
Unlikely (2)	18 54	11 17 52 56	4 28 49 55	19 20	
Rare (1)	13 24 36 45 48	1 5 6 10 12 16 22 25 29 30 33 35 39 43 44 46 47 50	2 7 9 23 32 34 41 42 51 53	3 8 14 15 21 26 27 31 37 38 40	
2050	Consequence				
Likelihood	Minimal (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Almost Certain (5)					
Likely (4)					
Possible (3)	54	11	4 28 49 55		
Unlikely (2)	13 18 24 36 45	1 5 6 10 12 16 17 22 25 29 30 33 35 39 43 44 46 47 50 52 56	2 7 9 23 28 32 34 41 42 51 53	3 8 14 15 19 20 26 27 31 37 38 40	
Rare (1)	48			21	

Appendix 2 – NGN CCA Action Plan

Business Function	Climate Variable	Predicted Impact of Climate Variable	Impact on NGN	Risk Ref	Likelihood of event occurring and confidence in assessment.	Potential Impact in NGN and its stakeholders	Proposed Action to Mitigate Impact	Timescales over which risks are expected to materialise and planned action	Timescale over which actions were planned	2014 review Progress on implementation of actions/ comments	Assessment of extent to which actions have mitigated risk	Benefits/ challenges experienced
Asset Management	Winter mean precipitation increase / Winter daily precipitation increase / Summer daily precipitation increase	Increase in peak water in rivers (Fluvial)	Pipelines in Bridge Structures / on pipe bridges are damaged	CCR3	Likelihood: Current 1 2020 1 2050 2 Confidence Rating: 2	Significant uncontrolled release of gas, increasing NGNs carbon footprint. Major Gas Supply Emergency.	Pipelines generally cross rivers under the river bed or on purpose built pipe bridges. Regular maintenance and inspections are in place to confirm their integrity	Timescales will be assessed and remedial action undertaken based on ongoing maintenance and inspection regime	Risk Based Inspection Interval.	Ongoing inspection and maintenance schedule. A number of bridge support structures repaired, due to fluvial erosion.	We have a better understanding of the condition of pipe bridges/structures. Those bridges where bank erosion is a problem, have had physical upgrades to the support structure. No pipeline supply interruptions attributed to fluvial flooding	Integrity of supply maintained and in some cases improved for the high risk locations. Challenges have arisen from more extensive repairs required on some bridge crossings due to increasing frequency of high river levels.
Asset Management	Winter mean precipitation increase / Winter daily precipitation increase / Summer daily precipitation increase	Increase in peak water in rivers (Fluvial)	Mains in Bridge Structures / on pipe bridges are damaged	CCR4	This event has occurred twice in NGN (details in section 4.5) Likelihood: Current 1 2020 1 2050 2 Confidence Rating: 2	Large uncontrolled release of gas increasing NGNs carbon footprint. Large Gas Supply Emergency.	All mains in 3 rd party river crossings (circa 2068), have been identified and collated into database. If flooding does occur In a particular river valley then Network Analysis, contingency plans (RO/NROs) will be prepared for all affected plant	Action currently underway includes Working with Local Authorities to obtain their risk score for the bridges. Once this has been obtained then Network Analysis, contingency plans (RO NROs) can be proactively prepared depending on level of risk.	Risk Based Inspection Interval. 2 years to develop an accurate overcrossin g DB.	Top 10 highest risk bridges in each Local Authority area have been identified and contingency plans drawn up to ensure customer gas supply can be maintained in a flooding event.	Increased understanding of vulnerable locations and supply resilience. Highway authority are now more aware of our apparatus and therefore take this into consideration in their own maintenance programme.	Increased confidence that risk to structures is generally minimal. Better understanding of network configuration and resilience in the event of a bridge failure. Obtaining information from highways authorities can be challenging and getting towards a manageable list of high risk bridges.

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		Flooding	Damage to / Malfunction of AGIs and other key Installations	CCR8	Likelihood : Current 1 2020 1 2050 2 Confidence Rating: 1	Significant uncontrolled release of gas. Major Gas Supply Emergency.	Flood Risk Analysis has been undertaken as detailed in section 4.2	Mitigation Measures identified as contingency will be instigated based on ongoing risk assessment.	Flooding assessment completed and ongoing site upgrade programme	Assessment Completed Assessment information has been used in the design process for site upgrade projects. Example, Hexham Reservoir Site is due for upgrade in 2014.	Increased confidence that in the majority of cases, if sites flood, continuity of supply is not interrupted. General site upgrades now take account of flood risk and incorporated in design phase.	A greater understanding of flood risk on AGI's. Challenges arise from site specific issues, such as poor drainage which are not always easily recognisable until after a flooding event.
Operational Activities	Winter mean precipitation increase / Winter daily precipitation increase / Summer daily precipitation increase	Flooding	Access problems to office / depot locations for key staff	CCR14	Likelihood: Current 1 2020 1 2050 2 Confidence Rating: 1	Disruption to key NGN Operational Activities	BCM Plans are regularly updated and tested. Key functions (System Control, Dispatch and Incident Control Rooms, main offices) have bespoke fallback facilities	Business Continuity Management is embedded into business. It will continue to be reviewed and tested as per ongoing future needs.	New procedures to be implemented by December 2015	Winter contingency procedure includes some aspects relevant to climate change. The scope of the procedures is currently (July 2015) being extended to include all year round severe weather events such as flooding, which gives greater relevance to the events which would be experienced as a result of climate change.	Existing procedures include events that are likely to be experienced through climate change	Drafting of new procedures has increased awareness and implementation of final documents will improve resilience

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			Access problems to streetworks sites / emergency jobs	CCR15	Likelihood: Current 1 2020 1 2050 2 Confidence Rating: 1	Reduction in NGNs ability to respond to emergency jobs and undertake repair work.	Mitigation measures detailed on CCR20 will also apply to this risk.	NGN will be prepared for access problems as per CCR20 by winter 2011/12.	New procedures to be implemented by December 2015	Winter contingency procedure includes some aspects relevant to climate change. The scope of the procedures is currently (July 2015) being extended to include all year round severe weather events such as flooding, which gives greater relevance to the events which would be experienced as a result of climate change.	Existing procedures include events that are likely to be experienced through climate change	Drafting of new procedures has increased awareness and implementation of final documents will improve resilience
		Increased occurrence of Snow and ice	Access problems to office / depot locations for key staff	CCR19	Likelihood: Current 2 2020 2 2050 2 Confidence Rating: 3	Disruption to key NGN Operational Activities	BCM Plans are regularly updated and tested. Key functions (System Control, Dispatch and Incident Control Rooms, main offices) have bespoke fallback facilities	Business Continuity Management is embedded into business. It will continue to be reviewed and tested as per ongoing future needs.	New procedures to be implemented by December 2015	Winter contingency procedure includes some aspects relevant to climate change. The scope of the procedures is currently (July 2015) being extended to include all year round severe weather events such as flooding, which gives greater relevance to the events which would be experienced as a result of climate change.	Existing procedures include events that are likely to be experienced through climate change	Drafting of new procedures has increased awareness and implementation of final documents will improve resilience

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Operational Activities	Winter mean precipitation increase / Winter daily precipitation increase / Summer daily precipitation increase	Increased occurrence of Snow and ice	Access problems to streetworks sites / emergency jobs	CCR20	Likelihood: Current 2 2020 2 2050 2 Confidence Rating: 3	Reduction in NGNs ability to respond to emergency jobs and undertake repair work.	Mitigation measures are have been identified, actioned (see 4.5.2) and will be fully embedded in NGNs operations by winter 2011/12.	During the 2010/11 winter prolonged low temperatures resulted in snow falling but not melting, causing widespread and prolonged access problems.	New procedures to be implemented by December 2015	Winter contingency procedure includes some aspects relevant to climate change. The scope of the procedures is currently (July 2015) being extended to include all year round severe weather events such as flooding, which gives greater relevance to the events which would be experienced as a result of climate change.	Existing procedures include events that are likely to be experienced through climate change	Drafting of new procedures has increased awareness and implementation of final documents will improve resilience
Business Planning	Summer mean temperature increase / Winter mean temperature increase	Perceived decreased gas load demand averaged over year	Potential reduction in funding for investment in Gas Infrastructure despite increasing Peak Day Load	CCR26	Likelihood: Current 1 2020 1 2050 2 Confidence Rating: 1	Deterioration of Assets due to lack of funding.	Continue to peruse innovation strategy in order to move to low carbon economy while maintaining gas as a viable fuel source.	Work is underway on NGNs business plan for the next formula period. NGN will need to continue to work with Ofgem through future reviews.	New procedures to be implemented by December 2015	Winter contingency procedure includes some aspects relevant to climate change. The scope of the procedures is currently (July 2015) being extended to include all year round severe weather events such as flooding, which gives greater relevance to the events which would be experienced as a result of climate change.	Existing procedures include events that are likely to be experienced through climate change	Drafting of new procedures has increased awareness and implementation of final documents will improve resilience

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Asset Management	Sea level rise and storm surge	Increase in peak water in rivers	Pipelines in Bridge Structures / on pipe bridges are damaged	CCR27	Likelihood: Current 1 2020 1 2050 2 Confidence Rating: 1	Significant uncontrolled release of gas increasing NGNs carbon footprint. Major Gas Supply Emergency.	Pipelines cross rivers under the river bed or on purpose built pipe bridges. Regular maintenance and inspections are in place to confirm their integrity	Timescales will be assessed and remedial action undertaken based on ongoing maintenance and inspection regime	Risk Based Inspection Interval.	Ongoing inspection and maintenance schedule. A number of bridge support structures repaired, due to fluvial erosion.	We have a better understanding of the condition of pipe bridges/structures. Those bridges where bank erosion is a problem, have had physical upgrades to the support structure. No pipeline supply interruptions attributed to fluvial flooding	Integrity of supply maintained and in some cases improved for the high risk locations. Challenges have arisen from more extensive repairs required on some bridge crossings due to increasing frequency of high river levels.
Asset Management	Sea level rise and storm surge	Increase in peak water in rivers	Mains in Bridge Structures / on pipe bridges are damaged	CCR28	Likelihood: Current 1 2020 1 2050 2 Confidence Rating: 1	Large uncontrolled release of gas increasing NGNs carbon footprint. Large Gas Supply Emergency.	All mains in 3 rd party river crossings (circa 2068), have been identified and collated into database. If flooding does occur In a particular river valley then Network Analysis, contingency plans (RO/NROs) can be prepared for all affected plant	Action currently underway includes Working with Local Authorities to obtain their risk score for the bridges. Once this has been obtained then Network Analysis, contingency plans (RO NROs) can be proactively prepared depending on level of risk.	Risk Based Inspection Interval. 2 years to develop an accurate overcrossing DB.	Top 10 highest risk bridges in each Local Authority area have been identified and contingency plans drawn up to ensure customer gas supply can be maintained in a flooding event.	Increased understanding of vulnerable locations and supply resilience. Highway authority are now more aware of our apparatus and therefore take this into consideration in their own maintenance programme.	Increased confidence that risk to structures is generally minimal. Better understanding of network configuration and resilience in the event of a bridge failure. Obtaining information from highways authorities can be challenging and getting towards a manageable list of high risk bridges.

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		Flooding in Coastal Areas	Damage to / Malfunction of AGIs and other key Installations	CCR31	Likelihood: Current 1 2020 1 2050 2 Confidence Rating: 1	Significant uncontrolled release of gas increasing NGNs carbon footprint. Major Gas Supply Emergency.	Flood Risk Analysis has been undertaken as detailed in section 4.2	Mitigation Measures identified as contingency will be instigated based on ongoing risk assessment.	Flooding assessment completed and ongoing site upgrade programme	Assessment Completed Assessment information has been used in the design process for site upgrade projects. Example, Hexham Reservoir Site is due for upgrade in 2014.	Increased confidence that in the majority of cases, if sites flood, continuity of supply is not interrupted. General site upgrades now take account of flood risk and incorporated in design phase.	A greater understanding of flood risk on AGI's. Challenges arise from site specific issues, such as poor drainage which are not always easily recognisable until after a flooding event.
Operational Activities	Sea level rise and storm surge	Flooding in Coastal Areas	Access problems to office / depot locations for key staff	CCR37	Likelihood: Current 1 2020 1 2050 2 Confidence Rating: 1	Disruption to key NGN Operational Activities	BCM Plans are regularly updated and tested. Key functions (System Control, Dispatch and Incident Control Rooms, main offices) have bespoke fall back facilities	Business Continuity Management is embedded into business. It will continue to reviewed and tested as per ongoing future needs.	New procedures to be implemented by December 2015	Winter contingency procedure includes some aspects relevant to climate change. The scope of the procedures is currently (July 2015) being extended to include all year round severe weather events such as flooding, which gives greater relevance to the events which would be experienced as a result of climate change.	Existing procedures include events that are likely to be experienced through climate change	Drafting of new procedures has increased awareness and implementation of final documents will improve resilience

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			Access problems to streetworks sites / emergency jobs	CCR38	Likelihood: Current 1 2020 1 2050 2 Confidence Rating: 1	Reduction in NGNs ability to respond to emergency jobs and undertake repair work.	Mitigation measures detailed on CCR20 will also apply to this risk.	NGN will be prepared for access problems as per CCR20 by winter 2011/12.	New procedures to be implemented by December 2015	Winter contingency procedure includes some aspects relevant to climate change. The scope of the procedures is currently (July 2015) being extended to include all year round severe weather events such as flooding, which gives greater relevance to the events which would be experienced as a result of climate change.	Existing procedures include events that are likely to be experienced through climate change	Drafting of new procedures has increased awareness and implementation of final documents will improve resilience
	Increased frequency and intensity of storms	Storm Damage	Loss of communication links with Field Staff	CCR40	Likelihood: Current 1 2020 1 2050 2 Confidence Rating: 1	Reduction in NGNs ability to respond to emergency jobs, undertake repair work and key maintenance activities.	BCM Plans include contingencies. In addition NGN are working proactively through the E3C and GATG on telecoms resilience.	Business Continuity Management is embedded into business. It will continue to be reviewed and tested as per ongoing future needs.	New procedures to be implemented by December 2015	Winter contingency procedure includes some aspects relevant to climate change. The scope of the procedures is currently (July 2015) being extended to include all year round severe weather events such as flooding, which gives greater relevance to the events which would be experienced as a result of climate change.	Existing procedures include events that are likely to be experienced through climate change	Drafting of new procedures has increased awareness and implementation of final documents will improve resilience

Further or new actions planned	Risks addressed by actions	Timescale for new/further actions planned
Proactively contacting Local Authorities to ensure that flood plans take into account Northern Gas Networks Assets	Coastal and Fluvial flood risk to AGI's.	December 2016
Implement contingency plans from CCR4 and CCR28 into policy	The risk of damage to pipe bridges due to flooding	August 2015
NGN do not currently have a Climate Change Policy. Assistance from a consultant may be required to write and provide practical guidance to NGN	All areas	NGN Climate Change Strategy written
Develop a climate change management procedure	<p>This will allow for the changing nature of climate change risks to be better understood, quantified and managed.</p> <p>It will create a more informed and integrated proactive approach to managing and responding to extreme weather and climate change impacts, including a better understanding of the financial implications and benefits of adaptation measures. This will also allow for more accurate and informed impact threshold / trigger levels to be identified.</p>	June 2016
Undertake a quantitative climate change risk assessment	<p>This will allow for the changing nature of climate change risks to be better understood, quantified and managed, and for climate change risks to be better communicated and 'owned' by the appropriate business functions.</p> <p>It will allow for NGN to be more confidently prepared for future climatic conditions and potentially enabling long-term cost and resource savings to be achieved. It will also help to identify at which point specific adaptation measure should be implemented to have the greatest benefit.</p>	December 2016

<p>Enhance relationships with stakeholders</p>	<p>This will provide a greater opportunity to share and capture good practice examples and ways of improving their level of resilience to climate change and extreme weather events. It also provides the opportunity for cross-sector, cross-asset and cross-boundary collaboration and innovation.</p> <p>It will allow NGN to gain a better understanding of existing and planned flood defence schemes (and their effectiveness), and capture more detailed information on high risk flood locations.</p> <p>Strengthening this relationship will also allow NGN to provide input into future local flood defence/mitigation studies and schemes.</p> <p>Would assist NGN in identifying effective ways of mitigating future risks, and in the justification for the required funding for mitigation and resilience to be achieved.</p>	<p>June 2017</p>
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