

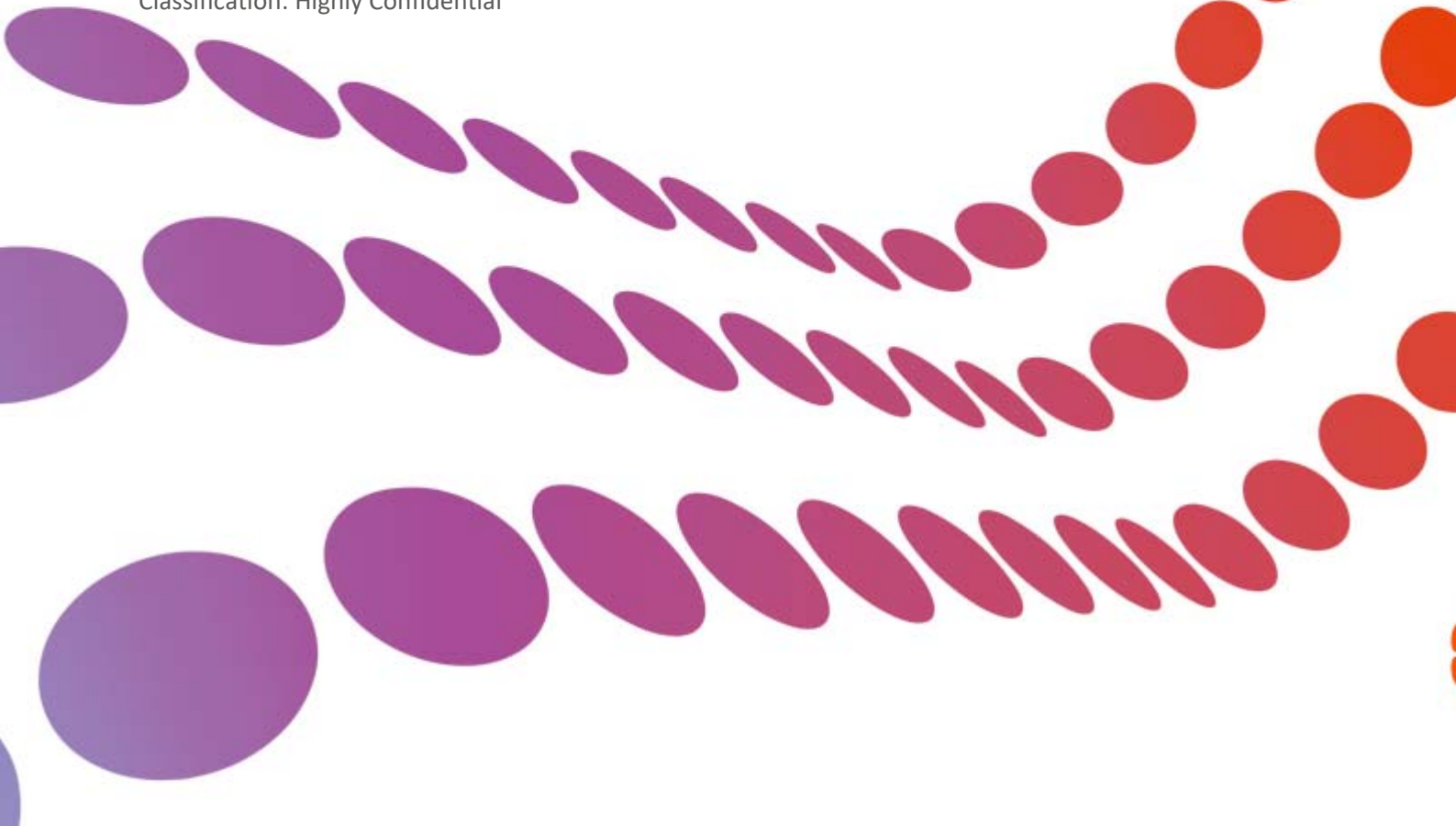
Engineering Justification Paper

CPM7459 Aberdeen City (Aberdeen – City Gate – Inverurie IPMP) Appendix B – Asset Health

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1 Table of Contents

1 Table of Contents	2
2 Introduction	3
2.1 General Background	3
2.2 Site Specific Background.....	3
3 Equipment Summary	4
4 Problem Statement	5
4.1 Narrative Real-Life Example of Problem	5
4.2 Spend Boundaries.....	7
5 Probability of Failure	7
5.1 Probability of Failure Data Assurance	7
6 Consequence of Failure	9
7 Options Considered	10
7.1 First Option Summary: Hilton Drive	11
7.2 Second Option Summary: A92.....	12
7.3 Third Option Summary: Interruption	12
7.4 Options Cost Details	13
7.5 Options Cost Summary Table	13
8 Business Case Outline and Discussion	13
8.1 Key Business Case Drivers Description	13
8.2 Business Case Summary	14
9 Preferred Option Scope and Project Plan	15
9.1 Preferred option	15
9.2 Asset Health Spend Profile	15
9.3 Investment Risk Discussion	15
Appendix A - Development Trajectory Aberdeen IPMP	16
Appendix B - Categorisation of Potential Load Growth	18
Appendix C - List of Acronyms	19

2 Introduction

SGN anticipates development to result in a system capacity failure in Aberdeen, thus, reinforcement has been identified within the Fraserburgh – Craibstone IP system. This project is part of a wider programme of reinforcement associated with the RIIO-GD2 Business Plan Appendix covering Capacity Management.

2.1 General Background

The SGN distribution system is built to ensure security of supply for all customers. SGN's networks operating at below 7bar are designed to meet a peak six-minute demand level that could be experienced under 1:20 conditions, supporting a safe, secure and reliable service to those customers and meeting requirements outlined within the Licence Condition, including, but not limited to, Condition 16 contained therein.

Link: [Gas Transporters Licence – Standard Conditions](#)

Where capacity constraints are identified that are likely to impact on SGNs ability to ensure security of supply to all customers, Network Planning will look to establish optimum cost-efficient reinforcement strategies to mitigate that risk. Such constraints may arise as a result of a number of factors, but the most common is increased demand levels, often resulting from new connections.

SGN has initiated an extensive programme of stakeholder engagement, working closely with Local Authorities, both in Scotland and the South of England, to establish a fully informed and independently sourced picture of planned development.

This engagement has provided SGN with confidence that the sites identified will progress to development and, to support this level of growth, SGN has developed a programme of reinforcement across its network.

2.2 Site Specific Background

Development within the Fraserburgh – Craibstone Grid is covered by the Aberdeenshire Local Development Plan (ALDP) and the Aberdeen City Local Development Plan (ACLDP) which present strategies for directing growth for the next 10-20 years.

The driver(s) for this reinforcement project are Local Development Plan (LDP) sites located within the Aberdeen Local MP system. Development on this system has a direct influence on pressure at the southern tail of the Fraserburgh – Craibstone network.

3 Equipment Summary

Craibstone TRS supplies at 7bar east towards Dyce and then onto the Local MP system within the city of Aberdeen itself, via DPGs at Ashill, Quarry Road, Garthdee and Teddar Road. The IP system thereafter extends towards Bridge of Don and onto Scotstoun DPG where the MP travels North. The North-East area of the grid is energised from NTS offtakes at Kinknockie and St Fergus.

Security

4 Problem Statement

Why are we doing this work and what happens if we do nothing?

New connections to SGN's networks reduce available capacity. It is necessary to reinforce or elevate pressures to increase capacity in the system when pressures are predicted to fall below minimum acceptable levels.

In the case of the Fraserburgh – Craibstone IP system, significant potential development identified within the LDP and associated documents will see the network approach capacity early in RIIO-GD2.

Failure to reinforce the network will restrict the delivery of these developments.

What is the outcome that we want to achieve?

Maintain SGN's Licence Conditions to ensure security of supply and support economic prosperity by not becoming a blocker to development.

How will we understand if the spend has been successful?

On completion of the proposed reinforcement, SGN will monitor system performance to ensure expected system pressures are maintained. This will take the form of regular system performance checks and localised pressure surveys to ensure a successful outcome is delivered.

At a customer level, SGN will have delivered a reinforcement that ensures a safe and secure network, meets stakeholder aspiration and ensures developments progress on time.

4.1 Narrative Real-Life Example of Problem

Substantial development has been identified in the region of North Aberdeen, which will have a significant impact on the available capacity within the Fraserburgh – Craibstone IP system. The existing network will require significant reinforcement to support these sites.

A recent example of good planning to meet customer expectation, whilst also ensuring security of supply, occurred following the acceptance of a quotation to supply a new development at New Mills Balerno (P17141081).

Network analysis confirmed a requirement to reinforce SGN's system in advance of connecting the fully developed site load. However, network analysis also confirmed an interim load/connection of 30 new properties in advance of reinforcement, thereby meeting the GT/Developer's schedule of works.

Reinforcement to supply the full development was subsequently planned and completed in advance of connections beyond the interim load, ensuring security of supply to approximately 350 new/existing customers.

Security

The developments driving this reinforcement are listed in Table 1 below:

Table 1: Development Driving Reinforcement

Development Name	Site Usage	Site Status	Confidence
Broadford Works	460 houses	Allocation within the Adopted Local Development Plan, 2018 HLA	Probable (>75% confidence)
Pittodrie Stadium	350 houses	Allocation within the Adopted Local Development Plan, 2018 HLA	Probable (>75% confidence)
Davidsons Papermill	580 houses	Planning Permission	Highly Probable (>90% confidence)
Rowett South	1700 houses	Planning Permission	Highly Probable (>90% confidence)
Greenferns	1070 houses	Allocation within the Adopted Local Development Plan, 2018 HLA	Probable (>75% confidence)
Maidencraig	733 houses	Planning Permission	Highly Probable (>90% confidence)

Please see Appendix B of this document which gives further details of the criteria applied when determining the attributable 'confidence' level of the above sites progressing to development.

Through this determination SGN have deemed the requirement for this reinforcement within the RIIO-GD2 period as ‘High’ and have therefore included the funding request in both our Base Growth and High Growth scenarios.

4.2 Spend Boundaries

The spend associated with these reinforcement works provides capacity within the Fraserburgh – Craibstone IP grid to support the project development during RIIO-GD2.

The monies associated with these works ensure security of supply for existing customers and connection of planned development. Costs have been prepared using average contracted rates at depot level and validated against known costs for similar, completed projects.

5 Probability of Failure

As development identified for Aberdeen progresses, the Fraserburgh – Craibstone grid is predicted to fail at 94% demand by winter 2025/26, putting at risk supplies to 39,000 customers.

5.1 Probability of Failure Data Assurance

Model Validation

To ensure the accuracy of the Network Analysis models, validation is carried out in line with the published requirement under Section 17 of SGN’s Safety Case and is a fundament of SGN’s Licence to Operate.

Validation ensures that the current models are an accurate representation of the actual gas transportation system and can be used to predict network behaviour under a variety of conditions, including the 1 in 20 design condition.

In addition to the Validation Programme, a robust model maintenance process and annual system performance checks ensures that the models continue to be accurate and fit for purpose.

Table 2: System Performance Review – 31st January 2019 (84% peak demand)

System	Site	System Pressure (84% Pk hr)		Yr 1 System Pressure (1 in 20)	
		Recorded (Actual)	Modelled (Predicted)	Min. Required (Acceptable)	Modelled (Predicted)
Fraserburgh – Craibstone IP	Ashhill DPG	4.57bar	4.58bar	2.76bar	2.77bar

Security

Network Growth

The Aberdeenshire and Aberdeen City Local Development Plans and associated documents have been reviewed and an assessment made as to the probability of sites contained therein progressing to construction (see Table 1).

The resulting outputs have been applied to the network model, providing confidence that reinforcement will be required during RIIO-GD2 to ensure SGN meets its Licence Conditions, maintaining minimum supply pressure under all demand conditions.

6 Consequence of Failure

Loss of Supply to Customers

Failure to reinforce will put at risk the supply to customers in Aberdeen.

The loss of Ashhill DPG would result in the loss of supply of up to 39,000 customers and a failure to meet SGN's Licence Conditions, attracting adverse publicity and damage to the company's reputation.

Among the affected customers would be Aberdeen Royal Infirmary, Woodend Hospital, Aberdeen Fire Station and numerous primary and secondary schools.

Financially, after the first 24 hours, affected householders will be compensated for time without gas. Domestic customers will receive £41 for each 24-hour period without gas, small businesses will receive £69 for each 24-hour period without gas.

Table 3: Projected Pressures (2025/26) without Reinforcement

Location	Min. Required Pressure (bar)	Min. Modelled Pressure (bar)
Mounthooly DG	138 mbar	-3695 mbar

Security

Safety Impact of Failure

Reinforcement of the Fraserburgh - Craibstone IPMP system is necessary to meet the requirements of our Licence Condition.

In this instance, a failure to reinforce will result in a system failure during peak winter conditions. The resulting loss of supply may have serious health and safety implications for vulnerable customers who rely on gas for essential heating and cooking facilities.

Environmental Impact

A system failure on this scale will result in a major recovery exercise. Environmental impacts will include increased travel to site by SGN operatives, leading to an increase in greenhouse gas emissions and disruption to the public.

On site, the use of fossil fuels to power plant and equipment required in the restoration of supplies will further increase greenhouse gas emissions, as will subsequent travel/plant in use for the reinstatement of public highways following the conclusion of these works.

7 Options Considered

Options Summary

In accordance with the guidelines set out in the Ofgem guidance document '*Engineering Justification Paper Frameworks for RIIO-GD2 and RIIO-GT2*' – Appendix B (Section 7), the following options have been considered:

Replace on Failure

Wait until the network fails then replace the system. This option has been discounted as it is impracticable to replace the Fraserburgh – Craibstone IP system.

Repair on Failure

Mains reinforcement after the network has failed. This option has been discounted due to non-compliance with SGN's Licence Condition.

Pre-Emptively Replace

Replace the network before the network fails. This option has been discounted as it is impracticable to replace the Fraserburgh – Craibstone IP system.

Pre-Emptively Repair

Mains reinforcement based on model data prior to network failure. Two options have been considered for further investigation, both main-laying solutions.

Security

Do Nothing

Not considered practicable as potential development identified/ programmed within the LDP and associated documents will see the Fraserburgh – Craibstone IP system approach capacity early in RIIO-GD2.

7.1 First Option Summary: Hilton Drive

The technical detail of the option i.e. capacity, system rating, availability etc.

The first option considered for further investigation, **Hilton Drive**, involved the construction of approximately 1.72km x 355mm HDPE IP mains.

The basis for the cost estimate/unit cost

Costs for this option, amounting to £0.864m, have been prepared using average contracted rates at depot level and validated against known costs for similar, completed projects.

The perceived benefits of the option

The proposed works provide capacity for the development identified within the LDP that is scheduled for construction during RIIO-GD2.

Delivery timescales

This project is scheduled to commence in 2022/23 and is expected to be completed within the same financial year.

Key assumptions made

It is assumed that the known potential demand growth within RIIO-GD2, and beyond, will require the same level of gas supply as is currently experienced.

Any other items that differentiate the option from the others considered

This route, by avoiding crossing the River Don and a railway line, is expected to present significantly less engineering difficulty and disruption to the public.

7.2 Second Option Summary: A92

The technical detail of the option i.e. capacity, system rating, availability etc.

The second option considered for further investigation, **A92**, involved the construction of approximately 1km x 355mm HDPE IP mains.

The basis for the cost estimate/unit cost

Costs for this option, amounting to £0.687m, have been prepared using average contracted rates at depot level and validated against known costs for similar, completed projects.

The perceived benefits of the option

The proposed works provide capacity for the development identified within the LDP that is scheduled for construction during RIIO-GD2.

Delivery timescales

This project is scheduled to commence in 2022/23 and is expected to be completed within the same financial year.

Key assumptions made

It is assumed that the known potential demand growth within RIIO-GD2, and beyond, will require the same level of gas supply as is currently experienced.

Any other items that differentiate the option from the others considered

This route is significantly shorter and therefore less costly for materials; however, it presents some significant engineering challenges.

This option follows the A92, a major road, and therefore will cause significant disruption to the public.

7.3 Third Option Summary: Interruption

In addition to the above, consideration was given to interruption.

As part of Interruption Reform, also known as the Mod 90 process, SGN has the option to offer a tender for interruptible contracts to customers to offset the need to invest for capacity.

7.4 Options Cost Details

Table 4: Summary of RIIO-GD2 Costs

Option No.	First Year of Spend	Final Year of Spend	Volume of Interventions	Design Life (years)	Cost (£m)
1/ Hilton Drive	2022/23	2022/23	1.72km x 355mm HDPE	10	0.864
2/ A92	2022/23	2022/23	1km x 355mm HDPE	10	0.687

7.5 Options Cost Summary Table

Table 5: Summary of RIIO-GD2 Costs

Option No.	Volume of Interventions	Cost Breakdown (£m)	Cost (£m)
1/ Hilton Drive	1.72km x 355mm HDPE		0.864
2/ A92	1km x 355mm HDPE		0.687

Commercial Confidentiality

8 Business Case Outline and Discussion

Validation of the network analysis model, a robust model maintenance process and system performance checks have confirmed the accuracy of the Fraserburgh – Craibstone IP model for use in network analysis.

A full review of the relevant Local Plans and associated documents, followed by close engagement with stakeholders, has provided confidence in the level of development expected during RIIO-GD2.

The development outputs have been applied to the validated network model which predicts a failure at 94% demand by winter 2025/26, putting at risk supplies to 39,000 customers.

To mitigate this risk and meet Licence Conditions it will be necessary to pre-emptively reinforce the network during the RIIO-GD2 period.

For the purposes of this report, costs associated with the identified options have been collated using average contracted rates at depot level and validated against known costs for similar, completed projects.

8.1 Key Business Case Drivers Description

Pre-emptively Repair: Option 1, Hilton Drive

This option provides a robust solution in support of the sites identified, by the Aberdeen City Local Development Plan and associated documents, for development during RIIO-GD2.

Disruption to the public and engineering difficulty will be mitigated by avoiding crossing the River Don and the railway lines.

Pre-emptively Repair: Option 2, A92

This option provides a robust solution in support of the sites identified, by the Aberdeen City Local Development Plan and associated documents, for development during RIIO-GD2.

This route is the shortest possible, therefore reducing materials costs, however, involves crossing the River Don and the railway lines. This solution is therefore likely to present significant engineering challenge, disruption to the public and potentially further cost.

Table 6: Summary of Key Value Drivers

Option No.	Desc. of Option	Key Value Driver
1	Hilton Drive	Longer route, reduced engineering challenge, minimally disruptive.
2	A92	Short route, significant engineering challenge and disruption to road users.

8.2 Business Case Summary

This project is driven by SGN's Licence Conditions to ensure security of supply.

Table 7: Business Case Matrix

	Hilton Drive	A92
Cost (£m)	0.864	0.687
Positive Benefit (Pros)	A robust reinforcement solution. Reduced disruption to public by avoiding busy roads.	A robust reinforcement solution. Comparatively short route, saving on materials costs.
Negative Impact (Cons)	Comparatively long route, increased materials cost.	Significant public disruption by following busy roads. Engineering Difficulty – river and rail crossings.

Costs inclusive of Overheads and Efficiencies

9 Preferred Option Scope and Project Plan

9.1 Preferred option

Pre-Emptively Repair – Option 1, Hilton Drive: 1.72km x 355mm HDPE IP reinforcement.

9.2 Asset Health Spend Profile

Table 8: Summary of Schedule of Spend

Asset Health Spend Profile (£m)						
Pre GD2	2021/22	2022/23	2023/24	2024/25	2025/26	Post GD2
0	0	0.864	0	0	0	0

Costs inclusive of Overheads and Efficiencies

9.3 Investment Risk Discussion

The requirement for reinforcement of the Fraserburgh – Craibstone IP system is demand driven, primarily by development identified within the Aberdeen City Local Development Plan and associated documents. Through this determination SGN has identified this reinforcement is required within the RIIO-GD2 period.

Risk exists that the planned development does not materialise or proceeds more slowly than anticipated. As reinforcement will not be required until the latter half of RIIO-GD2, the progress of development will be modified to suit at that time.

SGN has prepared costs using average contracted rates at depot level and have validated them against known costs for similar, completed projects. Nevertheless, whilst all reasonable steps have been taken to ensure accuracy of costs outlined in this paper, it is recognised that external variables may change and subsequently impact on actual costs at the time of construction. Examples of such could include unforeseen increases in contractor rates driven by a surplus of market demand for labour or cost increases for materials.

Factors such as market driven demand linked to the economy, the UK's potential exit from the European Union, emerging decarbonisation strategies and industry innovation can potentially impact on the scope of works outlined in this paper. SGN has proposed a volume driver funding mechanism to de-risk underspend/overspend for these works. Further details of this proposal can be found in Section 6.2 in the RIIO-GD2 Business Plan Appendix for Capacity Management.

As stated in our Environmental Action Plan, and in line with current Scottish Government targets, SGN's long term target is to achieve Net Zero emissions by 2045. This means decarbonisation of the energy network and supporting the transition to an environmentally sustainable low-carbon energy system. Indeed, SGN recognise that there have been preliminary government targets set to facilitate a move toward renewable or low carbon heat solutions by the end of the RIIO-GD2 period. As such, throughout the RIIO-GD2 period SGN will continue to closely monitor this emerging heat strategy with a view to refining any potential impact on current growth forecasts.

Appendix A - Development Trajectory Aberdeen IPMP

Domestic	Demand (Dwellings)			
Site	GD1	GD2	Post GD2	Total
AECC BRIDGE OF DON	100	400	0	500
BALGOWNIE CENTRE	0	0	132	132
BALMEDIE SOUTH	0	0	50	50
BANKHEAD ACADEMY	0	0	70	70
BLACKDOG	83	375	100	558
BROADFORD WORKS	0	100	360	460
CORSEDUICK ROAD	0	0	95	95
CRAIBSTONE SOUTH B	0	0	300	300
CROMLEYBANK	0	566	414	980
DAVIDSONS PAPERMILL	120	275	185	580
EAST WOODCROFT NORTH	56	0	0	56
GORDON CENTRE	0	0	110	110
GRANDHOME	0	550	3500	4050
GREENFERNS	0	100	970	1070
HILLBRAE WAY	48	180	112	340
INVERUGIE MEADOWS/WATERSIDE PHASE 1	0	225	350	575
INVERUGIE MEADOWS/WATERSIDE PHASE 2	0	0	690	690
KIRKTON DEVELOPMENT	0	50	430	480
KNOCKHALL ROAD	60	0	0	60
LAND ADJ PARK VIEW	0	0	32	32
LAND AT ARTLAW CRES / NETHER ADEN ROAD	0	20	0	20
LAND AT NETHER ADEN	0	215	285	500
LAND AT NORTHWOODS 1	40	60	0	100
LAND AT NORTHWOODS 2	0	200	214	414
LAND OFF NORTHFIELD	0	15	25	40
LAND WEST OF BOOTHBY ROAD PHASE 1	60	39	0	99
LAND WEST OF BOOTHBY ROAD PHASE 2	0	0	240	240
MAIDENCRAIG	101	250	382	733
MANOR WALK	71	0	0	71
PITODRIE STADIUM	0	100	250	350
ROWETT SOUTH	336	657	707	1700
SMITHFIELD PRIMARY	87	0	0	87
SOUTH OF ALLOCHY ROAD	30	43	0	73
SOUTH OF CHAPELWELL PARK	120	30	0	150
SOUTH OF NETHER ADEN ROAD	39	0	0	39
SOUTH OF WESTFIELD FARM	88	0	0	88
WEST OF MCBEY WAY	0	75	0	75
WOODSIDE	60	200	140	400
Grand Total	942	3243	8477	12662

The sites listed in Section 3.1 as the primary drivers for this reinforcement are highlighted above.

Non-Domestic Site (Non-domestic)	Demand (scmh)			
	GD1	GD2	Post GD2	Total
BALMACASSIE	0	288	0	288
BUS3 PETERHEAD 1	100	0	0	100
BUS3 PETERHEAD 2	0	300	210	510
CHAPELHILL ROSEHEARTY/WATERMILL	0	85	0	85
CRAIBSTONE NORTH AND WALTON FARM	0	45	540	585
DUBFORD COMMUNITY FACILITIES	0	56	0	56
DYCE DRIVE	0	450	450	900
EAST OF A90	0	0	17	17
FINDLAY FARM	0	243	0	243
GRANDHOME	0	102	0	102
KIRKTON DEVELOPMENT	0	126	0	126
LAND AT NETHER ADEN	0	82	0	82
LAND AT WELLBANK	0	180	0	180
MENIE ALLOCATION	0	0	381	381
MURCAR	0	235	237	472
PHINGASK	0	0	60	60
PRIM FOUR EXTENSION FIVE	0	0	600	600
REDWOOD COTTAGE	0	0	128	128
WEST PITMILLAN	28	28	0	56
Grand Total	128	2220	2623	4971

Appendix B - Categorisation of Potential Load Growth

The following Table sets out the manner in which identified potential load growth has been categorized and applied, leading to customer driven reinforcement, when looking to establish the optimum investment strategy for our networks.

DEFINITION TABLE				
Confidence	Definition	Factors to be considered	Base Growth	High Growth
Highly probable (>90% confidence)	Connection expected in RIIO-GD2 for all sites	<ol style="list-style-type: none"> 1. Quotation accepted but not yet on stream 2. Building is in progress. 3. Detailed planning permission granted. 4. Economic conditions indicate that sites for consumers of a particular type are likely to be developed, e.g. <ol style="list-style-type: none"> a. Domestic sites where there is a high demand for housing and there is a shortage of land available. b. Interest has been shown in having a connection made to a non-domestic site and economic factors suggest development will go ahead. 	✓	✓
Probable (>75% confidence)	Connection Likely in RIIO-GD2 for majority of sites	<ol style="list-style-type: none"> 1. Outline planning consent has been granted. 2. Recent development has been carried out in the area. 3. The land is a prime site for development, but no connection enquires have yet been received. 4. Adopted Local Plan Site 	✓	✓
Good prospects (>50% confidence)	Connection expected for some sites in RIIO-GD2	<ol style="list-style-type: none"> 1. Proposed Local Plan Site 2. No indication of planning permission being granted for the site. 3. The site is outside existing gas supply areas. 4. The site would involve physical problems in delivering a gas supply. 5. The site would require substantial additional infrastructure, e.g. additional roads, schools. 6. Site marked “reserve” in Local Plan. 7. Site is known to be contaminated ground. 8. Site has “protection” orders served over it – e.g. SSSI. 		✓
Poor prospects (<50% confidence)	Significant time or investment required to progress	<ol style="list-style-type: none"> 1. Does not meet the above planning criteria. 2. Site has been deemed as ‘speculative’. 3. The site would require significant additional infrastructure, e.g. additional roads, schools. 		

Appendix C - List of Acronyms

Acronym	Backronym (spelled out acronym)	Definition / explanation
Pressure Tiers ○ IP ○ MP ○ LP	○ Intermediate Pressure ○ Medium Pressure ○ Low Pressure	○ Intermediate Pressure i.e. 2 – 7bar ○ Medium Pressure i.e. up to 2bar ○ Low Pressure i.e. up to 75mb
CSEP	Connected System Exit Point	A connection point for one of more Individual System Exit Points, most usually supplying a GT Network (see GT below).
DG	District Governor	Pressure regulator primarily used for reducing pressures from IP and MP tiers to LP.
DPG	Distribution Pressure Governor	Pressure regulator primarily used for reducing pressures from IP tier to MP.
GT	Independent Gas Transporter	GT networks are directly connected to the Gas Distribution Network (GDN) via a Connected System Entry Point or indirectly to the GDN via another IGT.
HDPE	High Density Polyethylene	Pipe material for use in 7bar rated systems.
HLA	Housing Land Audit	Local Authority planning document.
LDP	Local Development Plan	Local Authority planning document.
PE	Polyethylene	Pipe material.
RIIO-GD1	Revenue=Incentives + Innovation + Outputs – Gas Distribution 1	8-Year price control period (2013-2021)
RIIO-GD2	Revenue=Incentives + Innovation + Outputs – Gas Distribution 2	Proposed 5-Year price control period (2021-2026)
SHP	SHP File Format	SHP is a file extension for a Shapefile shape format used in geographical information systems (GIS) software.
ST	Steel	Pipe material.
TRS	Transmission Reduction Station	Pressure regulator primarily used for reducing pressures from Local Transmission System tier to IP/MP.
1:20	1:20 Demand Conditions	Designing a network to operate whilst experiencing demand conditions historically only seen every 20 years, during severe weather events.