

Engineering Justification Paper

# CPM6944 Wivelsfield (West Sussex IPMP)

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## 2 Introduction

Reinforcement has been identified within the West Sussex MP system, specifically relating to an anticipated system capacity failure at Wivelsfield. 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 our customers. Our networks operating at pressures 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 our 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 found in the north-east of the West Sussex IPMP Grid is primarily covered by the Mid Sussex and Lewes District Local Plans. The Local Plan sets out planning policies to guide development, such as housing and employment for the next 10-20 years. A collated list of documents is used to produce the Local Plan, these include Annual Monitoring Reports and Housing Land Audits. SGN have used the Local Plan and its associated documents to identify developments on each specific grid.

Two developments trigger reinforcement on the leg; South of Rocky Lane & Weald Rise (320 dwellings) and Land east of B2112 (100 dwellings). South of Rocky Lane started construction in 2019 and the council's trajectory for the site indicates that it expects to build 40 homes a year. The land east of B2112 was included in Lewes Council's September 2018 released SHELAA, indicating that it is developable and could go ahead in GD2.

## 3 Equipment Summary

The West Sussex IP/MP system (Grid 309) is part of the greater south-east IP/MP system. The grid feeds several large settlement areas such as; Littlehampton, Horsham, Haywards Heath and Burgess Hill, it also encompasses eight different council areas.

The north-east section of the West Sussex grid MP system is supplied through Burgess Hill DPG (1.8bar) in the south and Haywards Heath TRS (1.8bar) in the north. The flow from each of these sources come together and supply the MP leg leading from Haywards Heath down to Wivelsfield. It is on this leg where development is expected to trigger the requirement to reinforce.

Table 1 - Equipment Summary for the North-East Section of the West Sussex Grid

Equipment	Tier	Comment
Haywards Heath TRS	HP-MP	Outlet pressure 1.8bar
Anstey TRS	HP-IP	Outlet pressure 6.9bar
Burgess Hill DPG	IP-MP	Outlet pressure 1.8bar
5.9km x 180mmPE	MP	Single fed leg supplying gas to the tail of the system.

### Security

## 4 Problem Statement

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

New connections to SGN networks reduce available capacity and when pressures are predicted to fall below minimum acceptable levels it is necessary to reinforce or increase pressures to facilitate increased capacity in the system.

In the case of the Wivelsfield MP leg, the potential development identified within the Local Plan and associated documents for Mid Sussex and Lewes, will see the network approach capacity within 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 pressures surveys to ensure the successful outcome is delivered.

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

### **4.1 Narrative Real-Life Example of Problem**

In the case of the Wivelsfield MP leg, significant ongoing committed development at existing GT sites, combined with potential development identified within the Local Plan and associated documents, will see the network approach capacity in RIIO-GD2.

Failure to reinforce this area will result in SGN becoming a blocker to proposed development which, if connected prior to reinforcement, will result in the loss of supply to approximately 3,000 customers.

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 Milton Heights, Milton, Abingdon, Oxfordshire (P18143337).

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 72 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 500 new/existing customers.

Security

Table 2 - Development Summary

Development Name	Site Usage	Site Status	Confidence
South of Rocky Lane	320 Houses	Under Construction	Highly Probable (>90% confidence)
Land east of B2112	100 Houses	No Planning Permission	Good Prospect (>50% confidence)

Please see Appendix A 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 RIIO-GD2 as 'High' and have included the funding request in both SGN's Base Growth and High Growth scenarios.

## 4.2 Spend Boundaries

The spend associated with these reinforcement works provides capacity within the MP system to support projected development during RIIO-GD2.

The monies associated with these works ensure security of supply for existing customers and connection of planned development to the network.

Costs contained within this paper have been prepared using average contracted rates at depot level and validated against known costs for similar, completed projects.

Not included within this spend are the costs for subsequent phases of reinforcement required to support demand out-with the RIIO-GD2 period and/or any costs associated with reinforcement of the upstream transmission system.

## 5 Probability of Failure

As development identified for Wivelsfield MP leg progresses, the Network is predicted to fail between 90-95% peak demand by winter 2025/26, putting at risk supplies to approx. 3,000 existing 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 ensure that the models continue to be accurate and fit for purpose. The latest system performance review confirmed the accuracy of the model against actual pressures recorded on 31 January 2019.

Figure 3 – Rocky Lane DG Logger Graph 31/01/2019

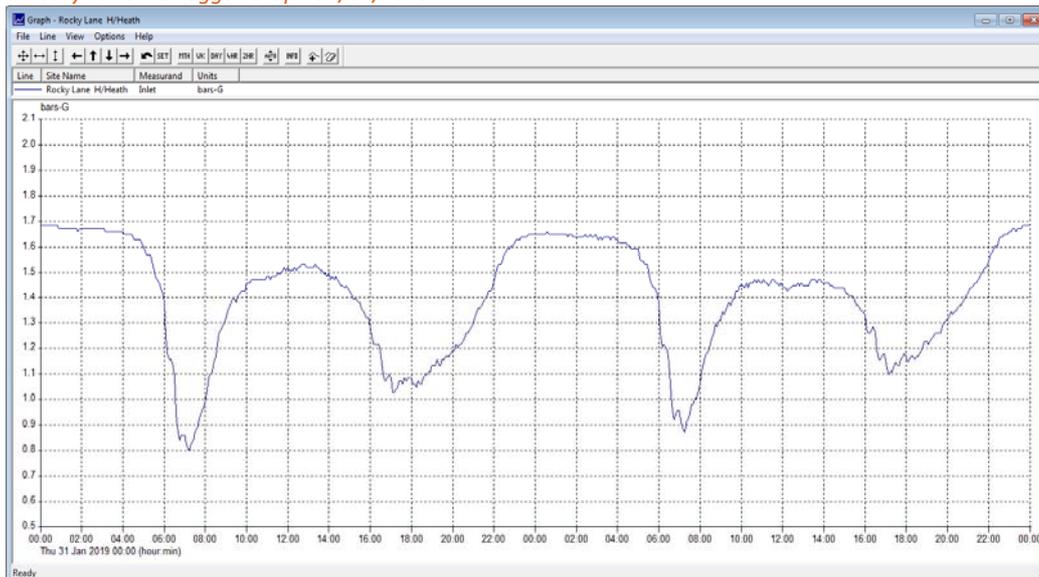


Table 3 - System Performance Review – 31st January 2019 (81% peak demand)

System	Site	System Pressure 81%		System Pressure (1 in 20)	
		Recorded Actual	Modelled Predicted	Min. Acceptable	Modelled Predicted
West Sussex MP	Rocky Lane DG	0.8bar	0.92	0.35bar	0.61bar
West Sussex MP	South Road DG	n/a	0.89	0.35bar	0.56bar

South Road DG does not have a logger installed, however it is worth noting pressures on the tail of the system compared to Rocky Lane DG.

**Security**

### Network Growth

The Local Plans and associated documents have been reviewed and an assessment made as to the probability of sites contained therein progressing to construction (see Table 2).

The resulting outputs have been applied to the network model, providing confidence that pre-emptive repair of the network (i.e. reinforcement) will be required during RIIO-GD2 to ensure SGN meets its Licence Conditions, maintaining minimum supply pressures under all demand conditions.

## 6 Consequence of Failure

### Loss of Supply to Customers

Failure to reinforce will put at risk the supply to customers on the Wivelsfield MP leg. Ultimately this will lead to the loss of supply to approximately 3,000 customers. Due to failing to meet SGN's Licence Conditions, it will attract adverse publicity and damage the company's reputation.

Affected customers will include the entirety of the village of Wivelsfield Green, residents living in the south of Haywards Heath, a primary school and a Hospice.

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 4 - Projected RIIO-GD2 (2025/26) Pressures without Reinforcement*

Location	Min Required Pressure (bar)	Min. Modelled Pressure (bar)
Wivelsfield	0.35	0

### Security

### Safety Impact of Failure

Reinforcement of the Wivelsfield MP system is required to meet the obligations 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**

### **7.1 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 due to non-compliance with SGN’s Licence Condition.

#### **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**

This option has been discounted as asset replacement does not inherently provide additional capacity.

#### **Pre-emptively Repair**

Mains reinforcement and/or Interruption based on model data prior to network failure. Four options have been considered for further investigation:

- Option 1 – Main Lay Haywards Heath
- Option 2 – Main Lay Burgess Hill
- Option 3 – Raise Source Pressures
- Option 4 - Interruption

#### **Do Nothing**

This is not considered an option. Identified growth dictates the requirement to provide additional capacity on this system through reinforcement.

## 7.2 Option 1 Summary – Main Lay Haywards Heath

### The technical detail of option

This option involves the construction of approximately 0.99km x 250mmPE MP. It reinforces the existing parallel 180mmPE MP main.

### The basis for cost estimate/unit cost

Costs for this option, amounting to £0.665M, 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

This option delivers a robust reinforcement solution within the West Sussex MP network. It may also be possible to phase the reinforcement in line with development and spread the costs over a number of years instead of just one, which is the current plan.

### Delivery Timescales

The reinforcement is scheduled for 2024/25 and it is expected to be completed in the same financial year.

### Key Assumptions Made

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

### Any other items that differentiate the option from the others considered

This is the most economical option that can ensure security of supply at the tail of the system.

Security

## 7.3 Option 2 Summary - Main Lay Burgess Hill

### The technical detail of option

This option involves the construction of approximately 2.9km x 180mmPE MP.

### The basis for cost estimate/unit cost

Costs for this option, amounting to £1.136M, 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

This option delivers a robust reinforcement solution within the West Sussex MP network.

### Delivery Timescales

The reinforcement is scheduled for 2024/25 and it is expected to be completed in the same financial year.

### Key Assumptions Made

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

### Any other items that differentiate the option from the others considered

The reinforcement adds a second feed to the tail at Wivelsfield, which has proven to be a weak area in the West Sussex MP system.

Security

## 7.4 Option 3 Summary – Raise Source Pressures

This option was disregarded, as an increase to source pressure from 1.8bar to 2bar did not provide the required minimum system pressure across the MP network.

## 7.5 Option 4 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.

Interruptible consumers receive discounted transportation charges for the flexibility they provide to the system for demand side management at times of high demand.

All eligible interruptible sites were reviewed, and none are in a location where they could be considered as an alternative to reinforcement.

## 7.6 Options Technical Summary Table

Table 5 - Options Technical Summary Table

Option	First Year of Spend	Final Year of Spend	Volume of Interventions	Design Life (Years)	Total Cost (£M)
1. Main Lay Haywards Heath	2024/25	2024/25	0.99km x 250mmPE MP	10	0.665
2. Main Lay Burgess Hill	2024/25	2024/25	2.9km x 180mmPE MP	10	1.136
3. Raise Source Pressures	n/a	n/a	n/a	n/a	n/a
4. Interruption	n/a	n/a	n/a	n/a	n/a

*Costs inclusive of Overheads and Efficiencies*

## 7.7 Options Cost Summary Table

Table 6 - Summary of Cost

Option	Volume of Interventions	Cost (£M)	Total (£M)
1	0.99km x 250mm PE MP	0.665	0.665
2	2.9km x 180mmPE MP	1.136	1.136

*Costs inclusive of Overheads and Efficiencies*

## 8 Business Case Outline and Discussion

Validation, a robust model maintenance process and system performance checks have confirmed the accuracy of the West Sussex IPMP 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 between 90-95% peak demand by winter 2025/26, putting at risk supplies to 3,000 existing customers.

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

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. There have been no external costs incurred in assessing the options considered as these have been prepared by the in-house Network Planning and Design teams.

### 8.1 Key Business Case Drivers Description

#### Reinforcement: Option 1 – Main Lay Haywards Heath

The reinforcement runs parallel to the existing 180mmPE MP. The existing main is currently sensitive to additional demand downstream and as new development connects to the MP system, substantial pressure loss is expected. Therefore, the main was an obvious option to reinforce.

The reinforcement starts in the centre of the town of Haywards Heath and then follows B2272 Franklyn Road. The route is extremely likely to cause disruption to the public, mainly to traffic coming in and out of town.

Reinforcement can potentially be phased in line with the developments driving the reinforcement, providing some flexibility in the scheduling and splitting costs over multiple years instead of just one.

#### Reinforcement: Option 2 – Main Lay Burgess Hill

The reinforcement takes a different main laying approach to Option 1; instead of following the route of existing mains, it links two parts of the network together that are currently not directly connected.

The system becomes more resilient as it introduces a second feed to the tail at Wivelsfield Green.

The main disadvantage would be that it would increase flow coming from Burgess Hill DPG. The DPG is likely to be at capacity towards the end of GD2, if this option were to go ahead the DPG would be required to be replaced before the reinforcement goes ahead.

*Table 7 - Summary of Key Value Drivers*

Option No.	Name of Option	Key Value Driver
1	Main Laying Haywards Heath	Economically the best option. Medium-term solution.
2	Main Laying Burgess Hill	Most expensive. Medium-term solution.

## 8.2 Business Case Summary

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

Table 8 - Business Case Matrix

	Main Laying Haywards Heath	Main Laying Burgess Hill
CAPEX (£M)	0.665	1.136
Design Life	10 years	10 years
Positive Impact/Pros	Meets license obligations to maintain security of supply. Possible to phase reinforcement over a number of years splitting costs. Most economical option.	Meets license obligations to maintain security of supply. Enhanced resilience to West Sussex MP system.
Negative Impact/Cons	Likely to cause disruption to public and land owners.	Likely to cause disruption to public and land owners. Overall Cost. Triggers replacement of Burgess Hill DPG (CPM5293).

*Costs inclusive of Overheads and Efficiencies*

## 9 Preferred Option Scope and Project Plan

### 9.1 Preferred option

**Reinforcement: Option 1 – Main Laying Haywards Heath**

Approx. 0.99km x 250mmPE MP.

### 9.2 Asset Health Spend Profile

Table 9 - 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	0	0.665	0	0

*Costs inclusive of Overheads and Efficiencies*

### 9.3 Investment Risk Discussion

#### Delay/Cancellations

The project is demand driven by a small number of developments. If these developments are delayed or the developer pulls out, then the investment will be a risk as the reinforcement may be postponed to a later date or no longer be required.

Mid-Sussex Council was contacted regarding the details of the developments and as a result SGN were sent the latest development trajectories for all sites in the district. The information gave SGN confidence that the developments would be constructed and to trigger the requirement to reinforce.

Out of all future developments South of Rocky Lane has the largest influence on pressures at the tail of the network. In 2018 the site had a connection request accepted by SGN and will therefore use gas. The site started construction in 2019 and as per the council's trajectory the site is expected to build 40 homes/year.

### **Costs**

SGN have 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 time of construction. Examples of such could include unforeseen increases in contractor rates driven by a surplus of market demand for labour or sharp cost increases for materials.

### **Costs Under/Overspend**

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.

### **Political/Environment Situation (i.e. low/zero carbon)**

As stated in the SGN Environmental Action Plan, and in line with current UK Government targets, SGN's long term target is to achieve Net Zero emissions by 2045. This means a 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 facilitating a move toward a renewable or low carbon heat solutions by the end of the RIIO-GD2 period. As such, throughout the RIIO-GD2 period we will continue to closely monitor this emerging heat strategy with a view to refining any potential impact on current growth forecasts.

## Appendix A - Categorisation of Potential Load Growth

The following Table sets out the manner in which identified potential load growth has been categorised and applied, leading to customer driven reinforcement, when looking to establish the optimum investment strategy for SGN's 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"> <li>1. Quotation accepted but not yet on stream</li> <li>2. Building is in progress.</li> <li>3. Detailed planning permission granted.</li> <li>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"> <li>a. Domestic sites where there is a high demand for housing and there is a shortage of land available.</li> <li>b. Interest has been shown in having a connection made to a non-domestic site and economic factors suggest development will go ahead.</li> </ol> </li> </ol>	✓	✓
Probable (>75% confidence)	Connection Likely in RIIO-GD2 for majority of sites	<ol style="list-style-type: none"> <li>1. Outline planning consent has been granted.</li> <li>2. Recent development has been carried out in the area.</li> <li>3. The land is a prime site for development, but no connection enquires have yet been received.</li> <li>4. Adopted Local Plan Site</li> </ol>	✓	✓
Good prospects (>50% confidence)	Connection expected for some sites in RIIO-GD2	<ol style="list-style-type: none"> <li>1. Proposed Local Plan Site</li> <li>2. No indication of planning permission being granted for the site.</li> <li>3. The site is outside existing gas supply areas.</li> <li>4. The site would involve physical problems in delivering a gas supply.</li> <li>5. The site would require substantial additional infrastructure, e.g. additional roads, schools.</li> <li>6. Site marked "reserve" in Local Plan.</li> <li>7. Site is known to be contaminated ground.</li> <li>8. Site has "protection" orders served over it – e.g. SSSI.</li> </ol>		✓
Poor prospects	Significant time or investment	<ol style="list-style-type: none"> <li>1. Does not meet the above planning criteria.</li> <li>2. Site has been deemed as 'speculative'.</li> </ol>		

(<50% confidence)	required to progress	3. The site would require significant additional infrastructure, e.g. additional roads, schools.		
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## Appendix B - Overall Sites Driving Reinforcement

### Domestic

Town	Site	Site Reference	Sum of GD1	Sum of GD2	Sum of Post GD2	Sum of Total
<b>Haywards Heath</b>	South of Rocky Lane	DM/16/4496	80	200	40	320
<b>Wivelsfield Green</b>	Land east of B2112	14WV	0	100	0	100

The above trajectory is based on previous council trajectories of the sites.

## Appendix C - List of Acronyms

Acronym	Backronym (spelled out acronym)	Definition / explanation
<b>Pressure Tiers</b>		
○ <b>HP</b>	○ High Pressure	○ High Pressure i.e. above 7bar LTS (NTS)
○ <b>IP</b>	○ Intermediate Pressure	○ Intermediate Pressure i.e. 2 – 7bar
○ <b>MP</b>	○ Medium Pressure	○ Medium Pressure i.e. up to 2bar
○ <b>LP</b>	○ Low Pressure	○ Low Pressure i.e. up to 75mb
<b>CSEP</b>	Connected System Exit Point	Third party connection to Gas network from an iGT or UIP
<b>DG</b>	District Governor	Pressure regulator primarily used for reducing pressures from IP and MP tiers to LP.
<b>DPG</b>	Distribution Pressure Governor	Pressure regulator primarily used for reducing pressures from IP tier to MP.
<b>HDPE</b>	High Density Polyethylene	Material standard for plastic pipe – High density allows for use at > 2bar operation due to thicker pipe wall. Reduced internal diameter increases weight of pipe, is not suitable for use < 2bar. Cheaper material and jointing than Steel.
<b>iGT (GT)</b>	Independent Gas Transporter	Third party supplier of gas and infrastructure to closed developments, not generally adopted by SGN.
<b>LTS</b>	Local Transmission System	High Pressure system feeding from National Offtakes to P(T)RS Inlets
<b>MDPE</b>	Medium Density Polyethylene	Material standard for plastic pipe – Medium density allows for greater internal diameter for extra capacity required at lower tiers, but thinner pipe wall thickness is not considered safe for operation at >2bar. Cheap material and jointing due to electro fusion welding.
<b>MOP</b>	Maximum Operation Pressure	Highest design pressure for a mains system, however regulator may be set lower than this but not higher.
<b>NTS</b>	National Transmission System	High Pressure system feeding National Offtakes from Terminals
<b>PMAC</b>	Pressure Management and Control	Third Party monitoring system which communicates live data via BT Comms link, facilitates remote control of pressure settings and profiles on SGN Plant, used at all Plant levels.
<b>P(T)RS</b>	Pressure (Transmission) Regulator Station	Pressure regulator primarily used for reducing pressures from HP (LTS/NTS) tier to IP / MP or LP.
<b>UIP</b>	Universal Infrastructure Provider	Provides and connects infrastructure to gas network but does not supply gas. UIP infrastructure is generally adopted by SGN.
<b>RIIO-GD1</b>	Revenue=Incentives + Innovation + Outputs – Gas Distribution 1	8-Year price control period (2013-2021)
<b>RIIO-GD2</b>	Revenue=Incentives + Innovation + Outputs – Gas Distribution 2	Proposed 5-Year price control period (2021-2026)
<b>SHP</b>	SHP File Format	SHP is a file extension for a Shapefile shape format used in geographical information systems (GIS) software.

<b>ST</b>	STEEL	Steel pipe material is used where PE cannot i.e. protection from heavy traffic or bridge crossings, Regulator outlets where excessive gas cooling may be experienced at pressure reduction. Steel pipe laying can be expensive due to welded joints.
<b>1:20</b>	1:20 Demand Conditions	Designing a network to operate whilst experiencing demand conditions historically only seen every 20 years, during severe weather events.