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UNC Modification 0645S:
Amending the oxygen content limit in the Network Entry Agreement at South Hook LNG

Workgroup Meeting
1st March 2018

Introduction

- At the last meeting, we heard that storage facilities are likely to be the most sensitive type offtake to any increase in oxygen content
- The Workgroup was therefore interested to understand whether South Hook gas might reach the North West and North East of England
- This presentation seeks to discharge Action 0201
  - *"NG to produce a view of the penetration of South Hook gas into the NTS, providing scenarios and a heat map diagram"*

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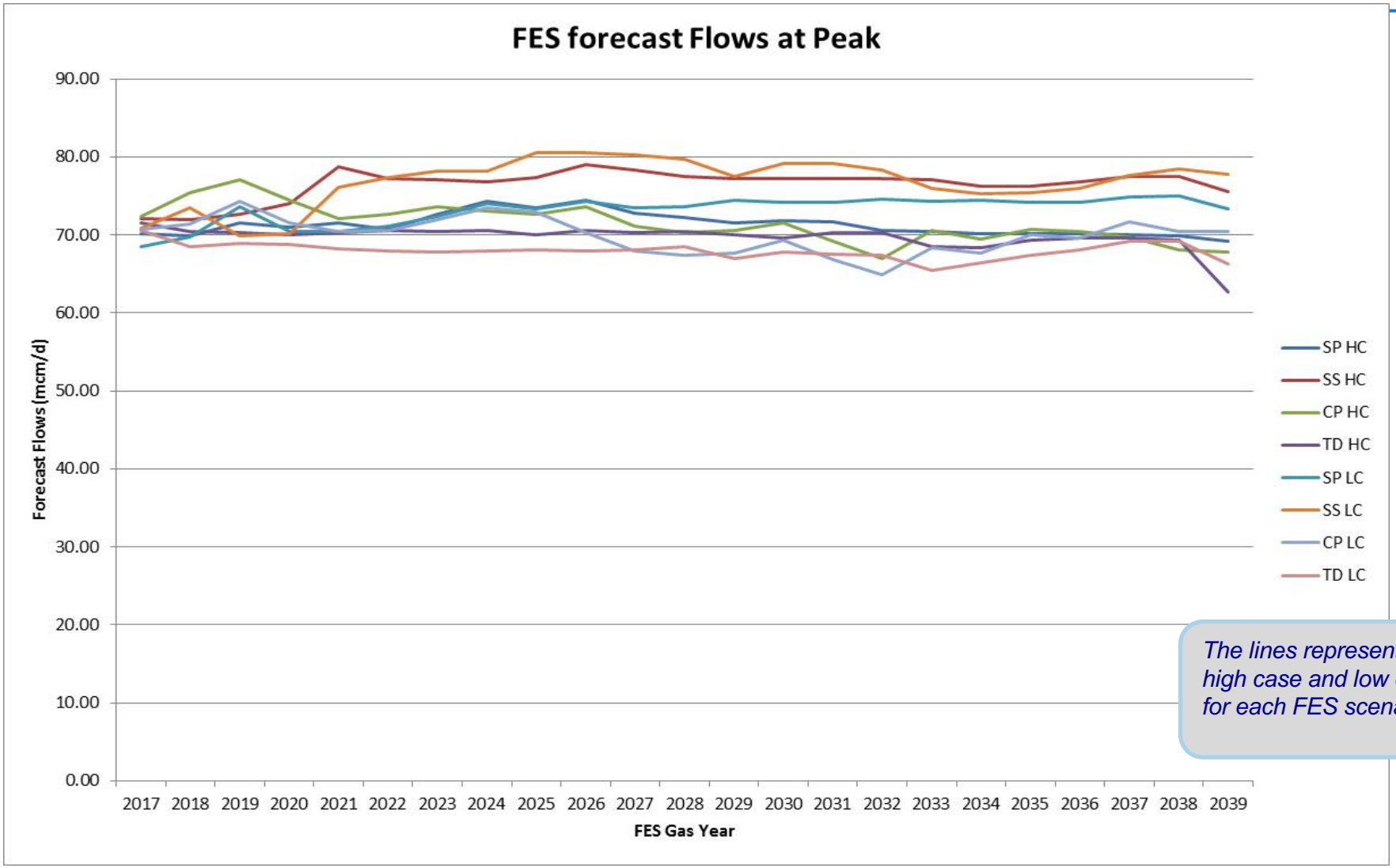
Analysis Assumptions and Approach

- The analysis looked at Milford Haven flows for summer and winter conditions based on 2017 FES forecasts for a selection of years from 2018 to 2039
- During the peak demand conditions, Dragon sub-terminal is forecast to supply up to 20% of Milford Haven gas
- South Hook flows are assumed to have an oxygen content of 200ppm which is then tracked with network simulation with a wide variety of supply and demand conditions
- All other terminals are assumed to flow based on FES forecasts at their contractual specification for oxygen
- Results of analysis for winter and summer conditions are then separately displayed with the use of heat maps to demonstrate the penetration of South Hook gas

Milford Haven forecast flows for winter conditions



The lines represent high case and low case for each FES scenario

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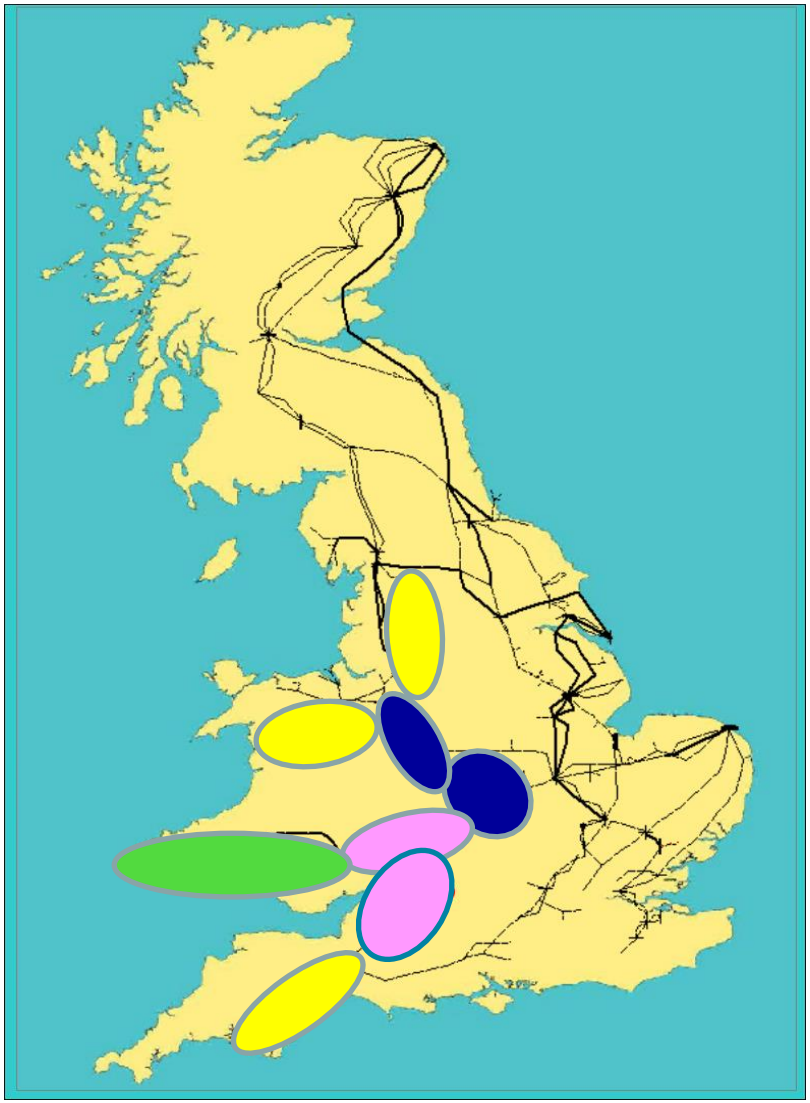
‘Heat Map’ – Milford Max flows during winter conditions



>75%
Milford Gas

50% to 75%
Milford Gas

25% to 50%
Milford Gas

<25%
Milford Gas

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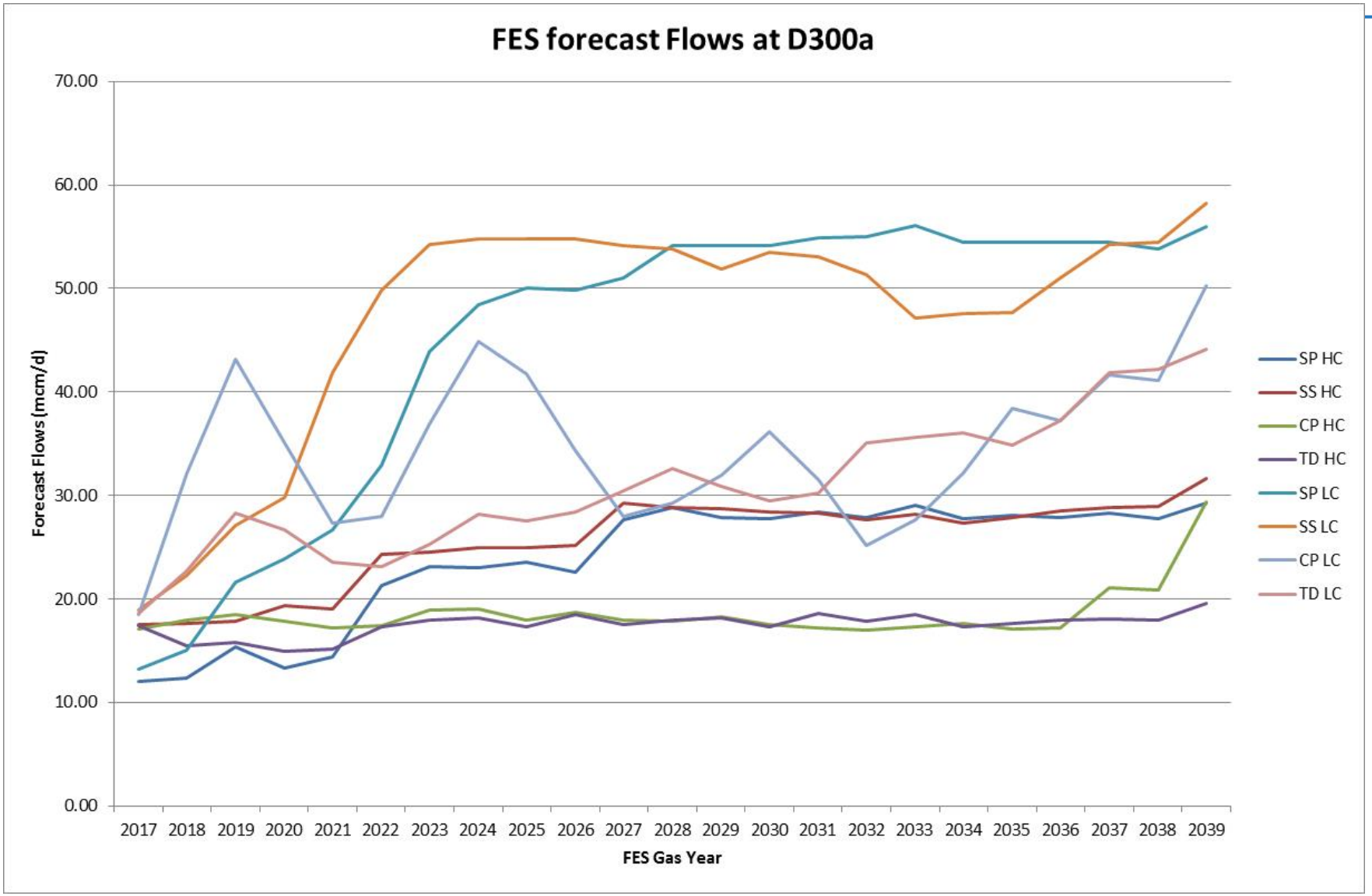
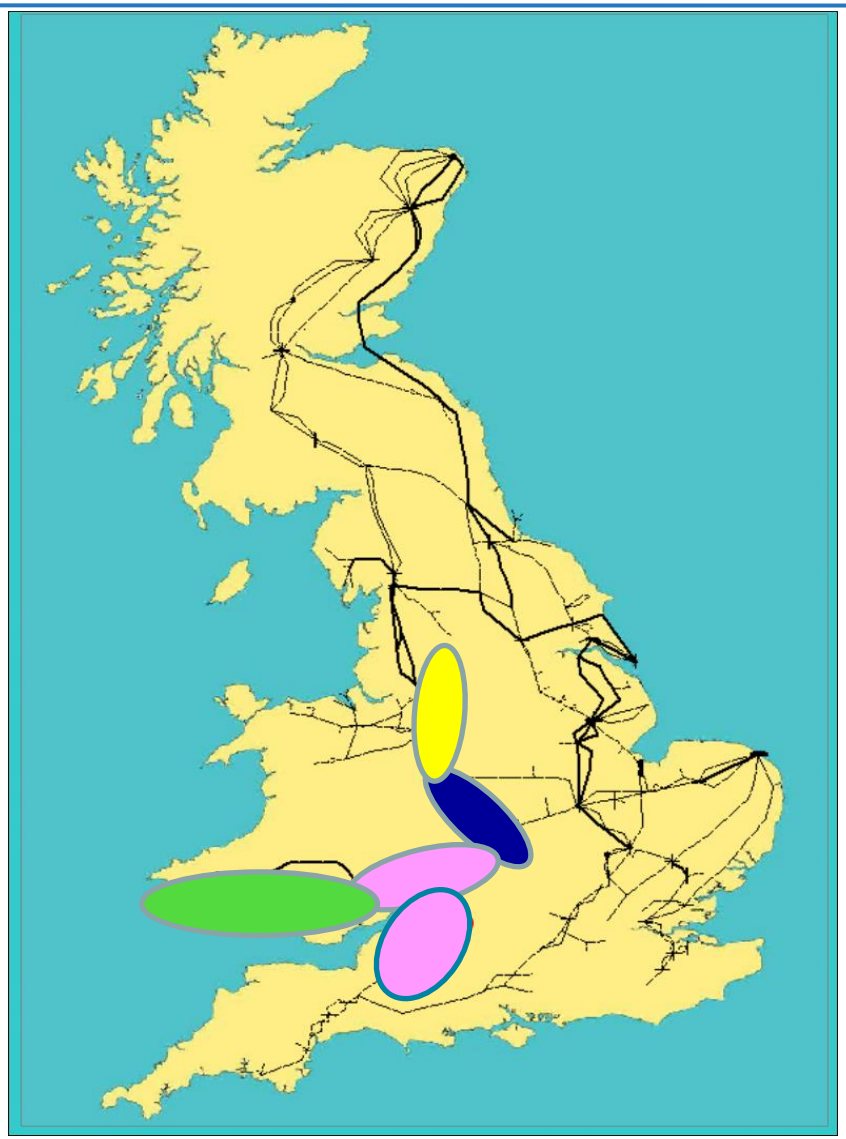
Winter Demand – key results

- Network analysis for winter conditions are based on peak NTS demands of 490 to 530 mscmd along with peak flows from Milford Haven (~60-80 mscmd)
- The Dragon sub-terminal is assumed to make up between 10% and 20% of peak flow, with the remainder from South Hook
- All storage sites are generally assumed to be withdrawing based on the FES forecasts
- Network analysis results indicate up to ~25% of Milford Haven gas is observed to move up to North West, potentially equating to up to ~50ppm of oxygen content in that region

South Hook forecast flows for summer conditions



'Heat Map' of NTS during summer conditions with minimum range of Milford Haven gas



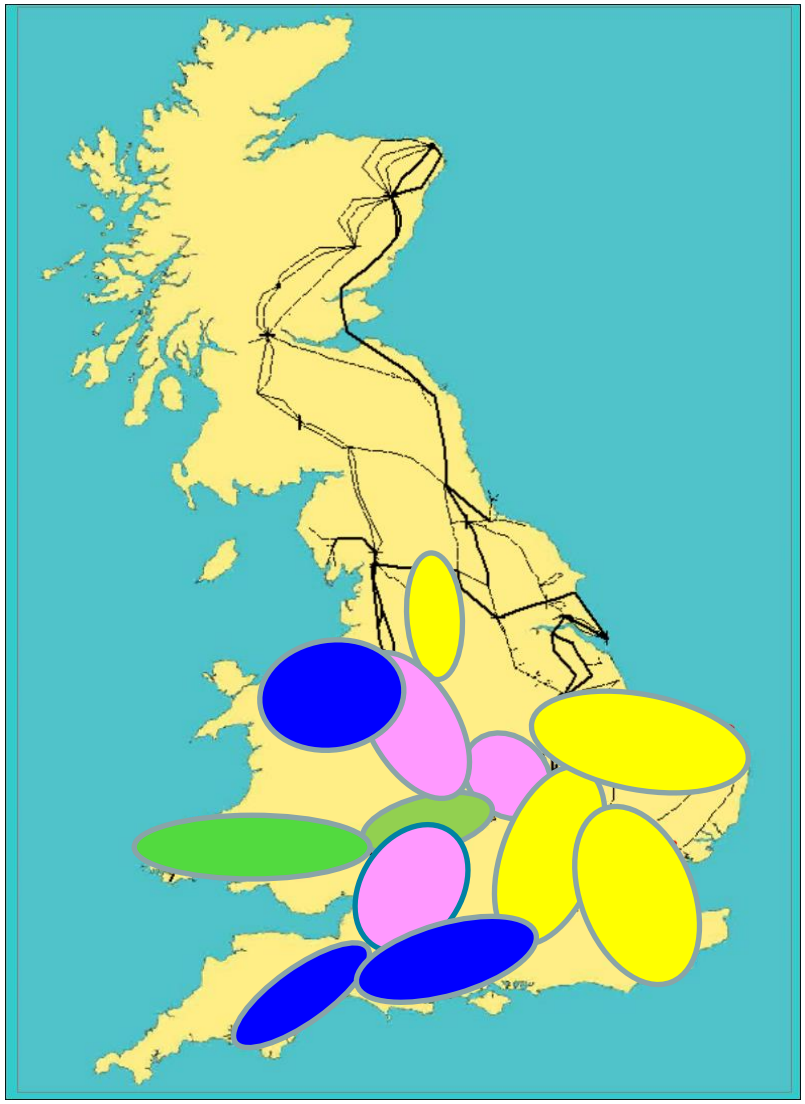
>75%
Milford Gas

50% to 75%
Milford Gas

25% to 50%
Milford Gas

<25%
Milford Gas

'Heat Map' of NTS during summer conditions with average range of Milford Haven gas



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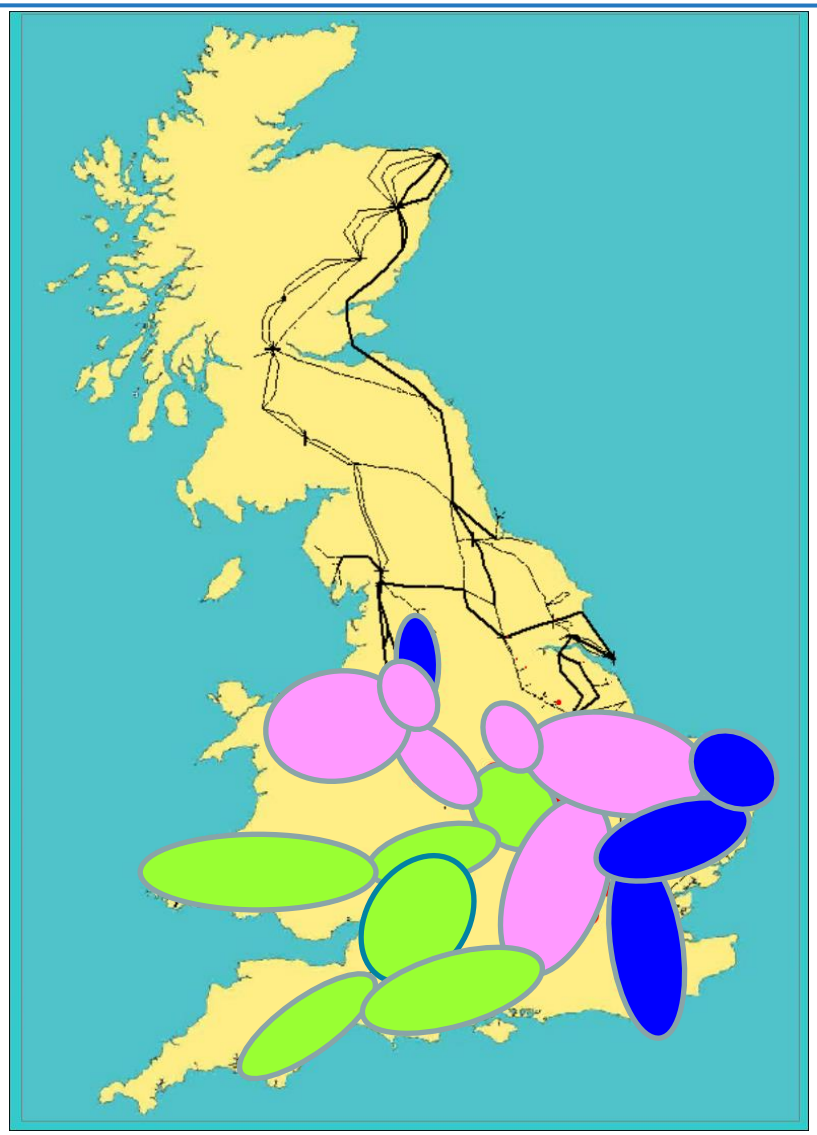
Milford Gas

50% to 75%
Milford Gas

25% to 50%
Milford Gas

<25%
Milford Gas

‘Heat Map’ of NTS during summer conditions with maximum range of Milford Haven gas



>75%
Milford Gas

50% to 75%
Milford Gas

25% to 50%
Milford Gas

<25%
Milford Gas

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Summer Demand – Key Results

- Summer conditions are based on NTS demands of 190 to 200 mscmd with minimum (10-20 mscmd), average (20-40 mscmd) and maximum (40-60 mscmd) range of supplies from South Hook sub-terminal
- All storage sites are generally assumed to be injecting during summer based on the FES forecasts
- High case inputs from South Hook along with low NTS demand conditions leads to a significant proportion of South Hook gas penetrating up to the North West, leading to the potential for up to ~150 ppm of oxygen content in the region

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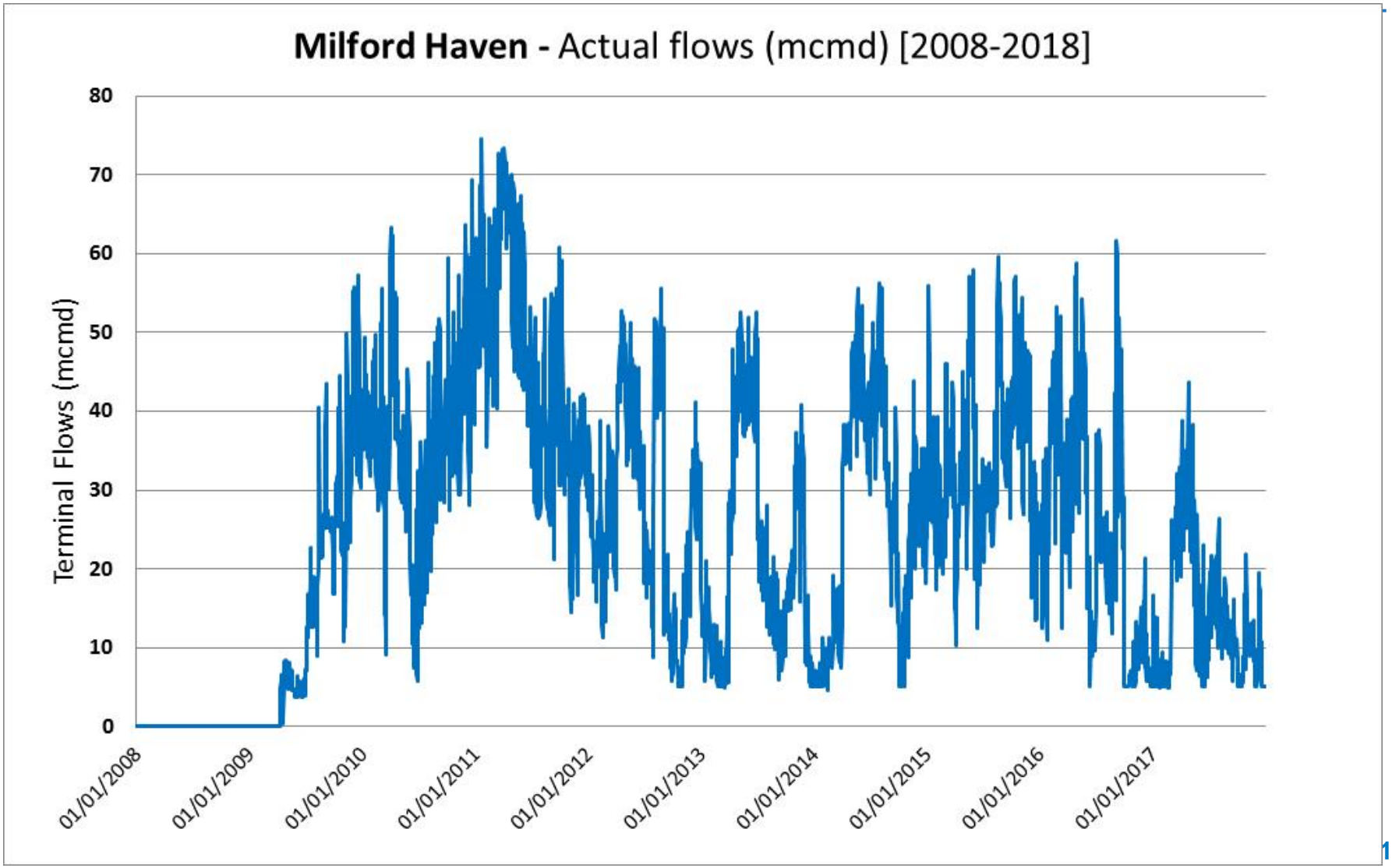
Historic Milford Haven flows in the past decade



Summary

- Network analysis with ‘worst case’ winter conditions indicates up to 25% of Milford Haven gas (with an oxygen content of up to ~50 ppm) reaching the North West
- Network analysis with ‘worst case’ summer conditions indicates up to 75% of Milford Haven gas (with an oxygen content of up to ~150 ppm) reaching the North West
- No scenario indicates Milford Haven gas penetrating into the North East area