



# Bioresources forecasting accuracy incentive workshop

4 October 2017

	<b>Agenda Item</b>	<b>Time</b>
1	Introductions	13:00 - 13.05
2	Description of the forecasting incentive in draft methodology Alison Fergusson, Ofwat	13:05 – 13:25
3	How the incentive works and its calibration Andrew Snelson and Stephen Riches, Anglian Water Discussion	13:25 - 14:20
	Break	14:20 - 14:30
4	Forecasting uncertainty, in particular the impact of wastewater P removal Frank Grimshaw and Richard Brindle, United Utilities Discussion	14:30 – 15:15
5	Next steps	15:15 – 15:30

## Description of the incentive

Sludge production from wastewater treatment, as per the definition developed through the sludge working group.

Sludge production in tonnes dry solids for the PR19 average revenue control:

- is a measure of untreated sludge (primary, secondary and tertiary) produced by in-area wastewater treatment processes in a year;
- does not include the grit and screenings removed through preliminary wastewater treatment processes; and
- is measured preferably at the boundary between network plus and bioresources as defined in RAG 4.06, or if not at the point of treatment. There should be continuous measurement via instrumentation rather than by composite or spot sampling.

We expect the data to be different to what companies have previously reported to Ofwat as total sewage sludge produced (MP05611) in June Return and other submissions due to:

- exclusion of inlet works grit and screenings (4 companies included in MP05611); and
- measured rather than deemed/calculated

## The problem – transition from regulation to markets

- We are introducing an **average revenue control**, £/quantity of bioresources produced.
- Historically, the sector has **estimated rather than measured** quantities.
- So **forecasts for PR19 may be inaccurate** and difficult for Ofwat to assess accuracy
- There is **risk of under or over recovery of revenues**. If companies under-forecast expected volumes, then they will gain higher revenues from customers than their costs when actual volumes turn out to be higher than forecast.

## Our proposed solution

- Use **tonnes of dry solids** (TDS) of sludge produced by Network plus as the volume measure. This **received support** when we consulted on it in May 2016.
- However, without intervention companies would be incentivised to under forecast quantities.
- To protect customers we propose to introduce:
  - a **forecasting accuracy incentive** based on measured volumes compared to forecasts.
  - a **cap on total revenue** where actual volumes are significantly higher than forecasts

## What it applies to:

- Applies to 5 year total volume, not annual variation
- **Deadband of +/-3%** around forecast – no penalty applies within the deadband

## How much of a penalty?

- At >3% variance between forecast and actual a penalty applies
- Penalty starts at 2% of average revenue per TDS
- Penalty rises to 3% when the variance is 7%, and is linear change (so at 5% variance the penalty is 2.5% of average revenue per TDS).
- Any variance above 7% incurs the 3% penalty rate
- Any variance above **107%** of forecast TDS would be **capped**

## When does it apply?

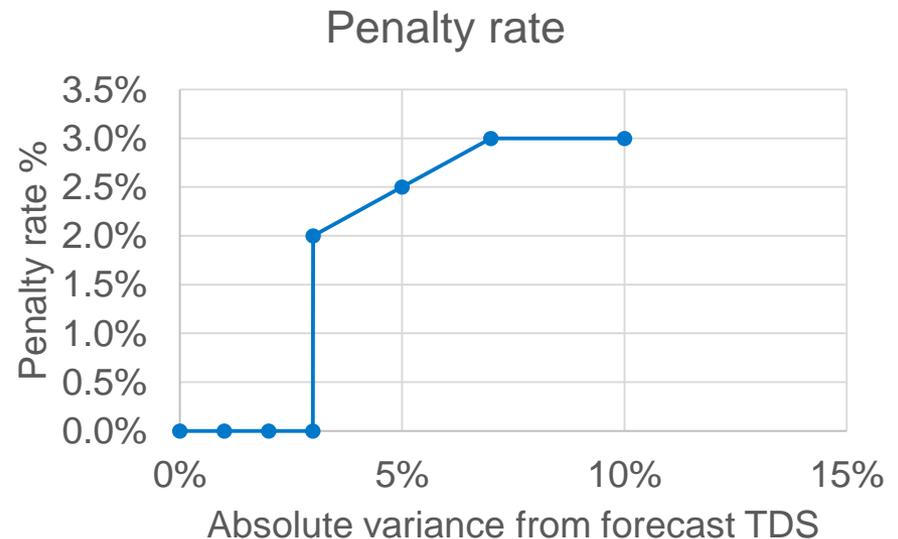
- Penalty would be applied at PR24 as part of reconciliation process
- Where companies can provide evidence in the first two years of the control period that material variations in recorded volumes from the forecast are the result of measurement changes rather than forecasting error we would consider adjusting the way the accuracy incentive is applied.

## Clarity on Penalty calculation (similar to ODI penalty):

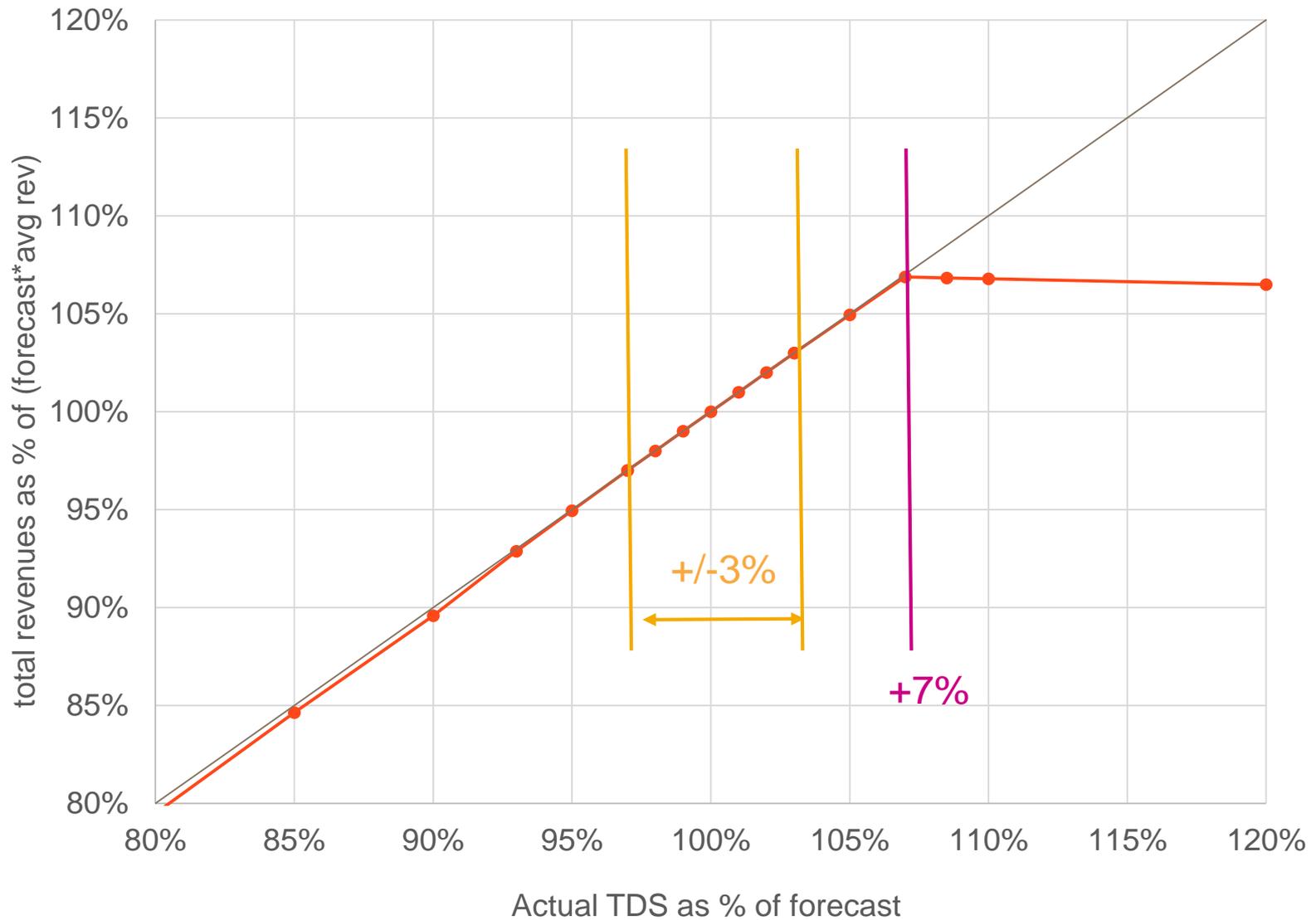
- $BFAI = AR * |ATDS - (FTDS * (1 + DB)) * PR|$
- Where
  - BFAI = penalty, £m
  - AR = average revenue at Yr 5 (ie with inflation applied to FD no), £/TDS
  - ATDS = actual sludge quantity measured (5 year total), TDS
  - FTDS = forecast sludge quantity (5 year total), TDS
  - DB = deadband as %age = 3%
  - PR = penalty rate

Penalty rate, as % of average revenue:

- Starts at 2% when variance >3%
- Rises to 3% when variance =7%
- Linear increase between 3 and 7% variance
- Stays at 3% for variance >7%

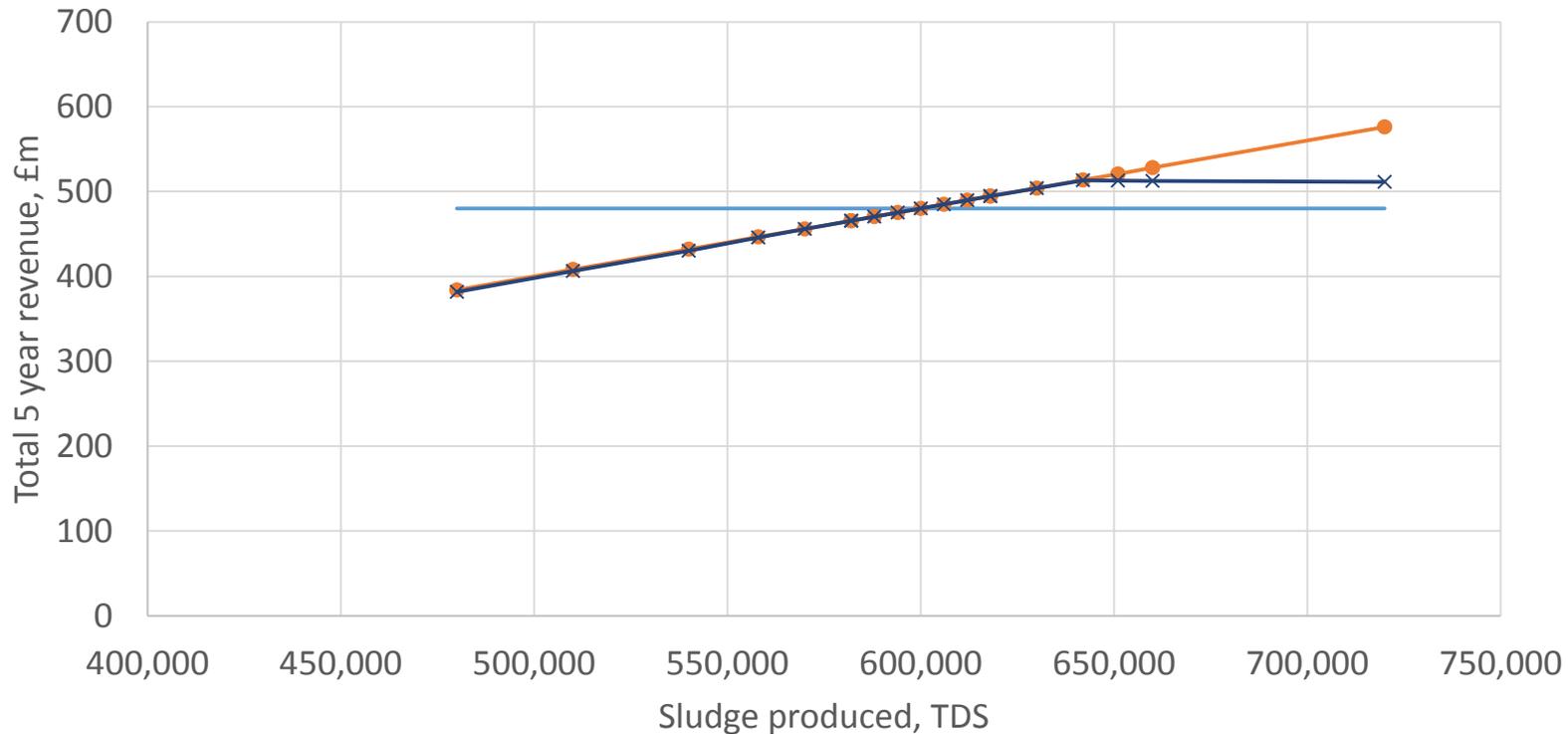


# Incentive impact on expected total revenues



Assuming:

- Forecast TDS is 600,000
- Average revenue is £800/TDS



- 5 years revenue at forecast TDS, £m
- 5 years revenue at actual TDS (unadjusted)
- ×— Total revenues with penalty and cap applied

A company forecasts a five year total sludge production of 600,000 TDS.

Its average revenue is £800/TDS.

If it produced the forecast TDS, total revenue for the 5 year period would be **£480m**.

The company measures sludge production of 570,000 TDS.

The company collects revenue associated with 570,000 TDS, which is **£456m**, substantially lower than the £480m expected.

A penalty would also apply. 570,000 is 95% of the forecast of 600,000 TDS which is outside the **3% deadband**. It is half way between 3% variance and 7% variance which is the range over which the penalty rate increases between 2 and 3%. So, the penalty rate is 2.5%.

$$BFAI = AR * |ATDS - (FTDS * (1 + DB)) * PR|$$

$$\begin{aligned} BFAI &= £800 * |(570,000 - (600,000 * (1 - 0.03))) * 0.025| \\ &= \mathbf{£0.240m} \end{aligned}$$

A company forecasts a five year total sludge production of 600,000 TDS.

The average revenue is £800/TDS.

If it produced the forecast TDS total revenue for the 5 year period would be **£480m**.

The company measures sludge production of 660,000 TDS.

Without any cap or penalty, total revenues would be

$660,000 * £800 = \mathbf{£528m}$ , substantially more than the £480m expected.

Since 660,000 TDS is more than **107%** of forecast, total revenues are **capped** at

$1.07 * 600,000 * £800 = \mathbf{£513.6m}$ .

A penalty would also apply

660,000 TDS is 110% of the forecast of 600,000 TDS, which is above the 7% variance where the maximum penalty rate applies. So, the penalty rate is 3%.

$$BFAI = AR * |ATDS - (FTDS * (1 + DB)) * PR|$$

$$BFAI = £800 * (660,000 - 600,000 * (1 + 0.03)) * 0.03$$

$$= \mathbf{£1.008m}$$



## Protecting customers and companies

- The bio-resources control exposes [the company] to **volume risk** post-2020 – since it is an average revenue control. We would be concerned if this led to stranding of efficiently-incurred pre-2020 assets.
- We think the adjustment needs to **differentiate between fixed and variable costs**. For example, if companies forecast high production, but in practice produce smaller amount of sludge it would mean they are not recovering fixed costs (albeit they are also avoiding variable costs).
- We would also expect to see that the forecasting incentive mechanism should provide the **same level of risk to both upside and downside** scenarios – and therefore believe that the 7% cap should apply in both directions
- We very much support the requirement that sludge TDS is measured at the boundary, to avoid the risk of companies benefiting from approximate values derived by calculation. However, it is not clear how Ofwat plans to **protect customers** in the event that **a company is unable to comply** with that requirement.



### Legitimate variance between forecast and actuals

- The **lack of a defined NEP** at the time of the submission of the Business Plan prevents an accurate estimate of the associated volume of bioresource arising from the delivery of the NEP.
- We believe that companies should be able to make representations to **make adjustments to the cap** where it is demonstrably in the interests of customers for [innovation on P removal solutions]
- We ...**welcome the ability to make a case** in the first two years where material variations are observed through improvements in measurement.
- We note that there is a potential two-year window of opportunity to request a reset of forecast, however for this to be an effective risk mitigant it is important that the **specific steps/asks are detailed**.

### Measurement accuracy

- We agree that the accuracy forecasting incentive **needs a dead band** due to the variability of sludge measurement
- The **accuracy of measurement equipment**, due to the inherent varied nature of sludge, will be **significantly greater than the 3%** forecast target.
- Whilst we agree the company should hold the volume risk, a **move to 3% accuracy** within such a tight timeframe **seems unnecessary**.
- Our response to the introduction of a forecast incentive would be to increase substantially the resources we apply to **meter maintenance and calibration**, and the cost of this would be reflected in our PR19 bioresources plan.

# Questions of clarification



[www.ofwat.gov.uk](http://www.ofwat.gov.uk)  
[Twitter.com/Ofwat](https://twitter.com/Ofwat)

Incentive and its calibration  
Andrew Snelson and Stephen Riches,  
Anglian Water



## **Bioresources Forecasting Accuracy Incentive 4 October 2017**

Andrew Snelson, Economic Regulation Manager  
Stephen Riches, Process Manager, Asset Planning

LOVE EVERY DROP. PUT WATER AT THE HEART  
OF A WHOLE NEW WAY OF LIVING.

## Key features

- Required because large forecasting errors at PR19 will produce an incorrect ARC and potentially harm customers
- No penalty provided actual sludge volumes over the five years are within 3% of forecast volumes

### Penalty 1

- If actual sludge volumes are  $\pm 3-7\%$  different from forecasts a penalty equivalent to 2-3% of the ARC is applied to each tds over/under the forecast

### Penalty 2

- In addition, if actual sludge volumes exceed 7% of the total forecast volume the company can claim no revenue for the excess
- Where a company can provide evidence in the first 2 years that variances are due to measurement changes rather than forecasting error application of the incentive may be adjusted
- Penalty determined at PR24 and applied to AMP8 revenues

## Questions

- Is it reasonable to apply a forecast incentive mechanism?
- What would be the consequences for our revenues of different volume outturns?
- How variable have sludge volumes been historically?
- What confidence grades have companies applied to their data?
- What would cause sludge volumes to vary beyond forecast levels?

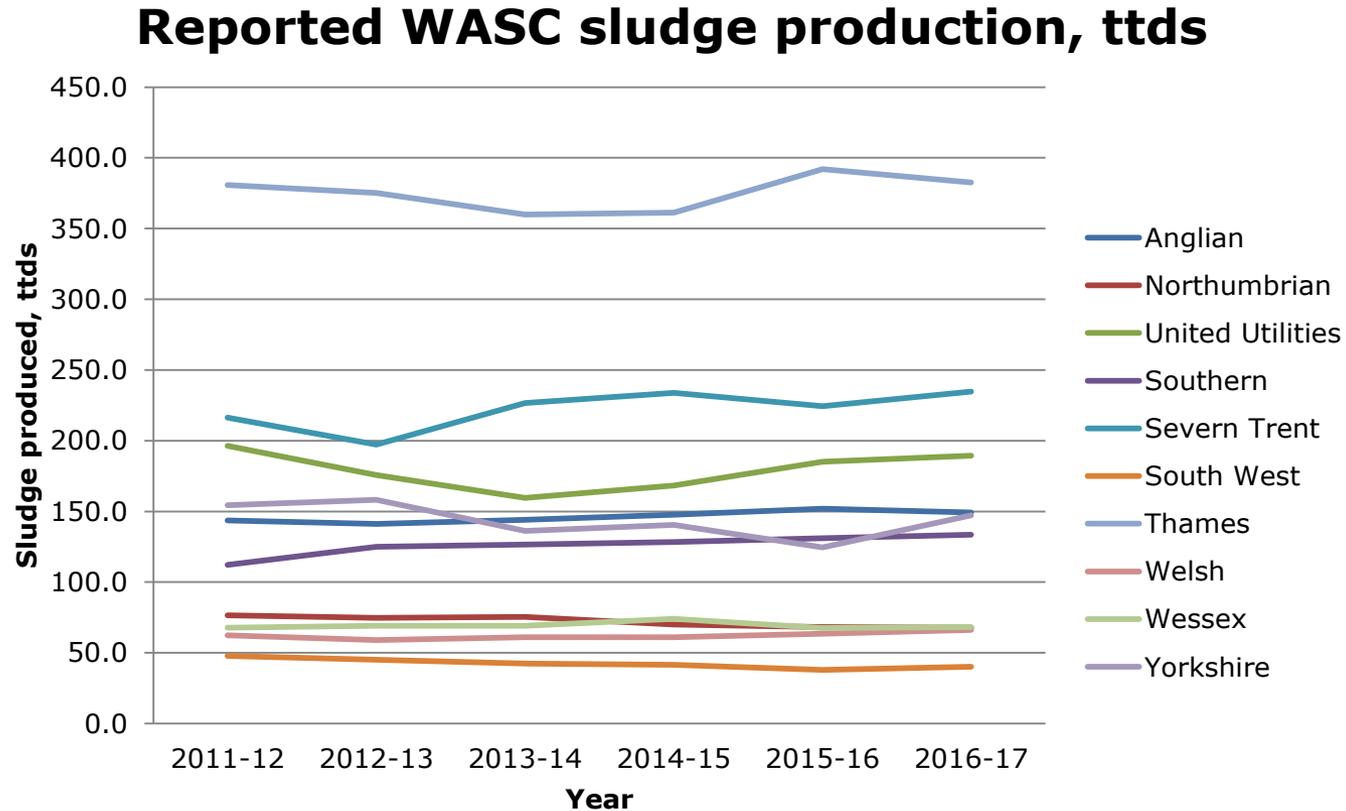
## Is it reasonable to apply a forecast incentive mechanism?

Revenue requirement	£m		430
Real sludge production forecast	ttds	<i>150 ttds/yr</i>	750
Real average revenue control	£/ttds		573
Gamed sludge production forecast	ttds	<i>135 ttds/yr</i>	675
Gamed average revenue control	£/ttds		637
Actual sludge production	ttds	<i>150 ttds/yr</i>	750
Revenue billed	£m		478
Gamed revenue	£m		48

## What would be the consequences for our revenues of different volume outturns?

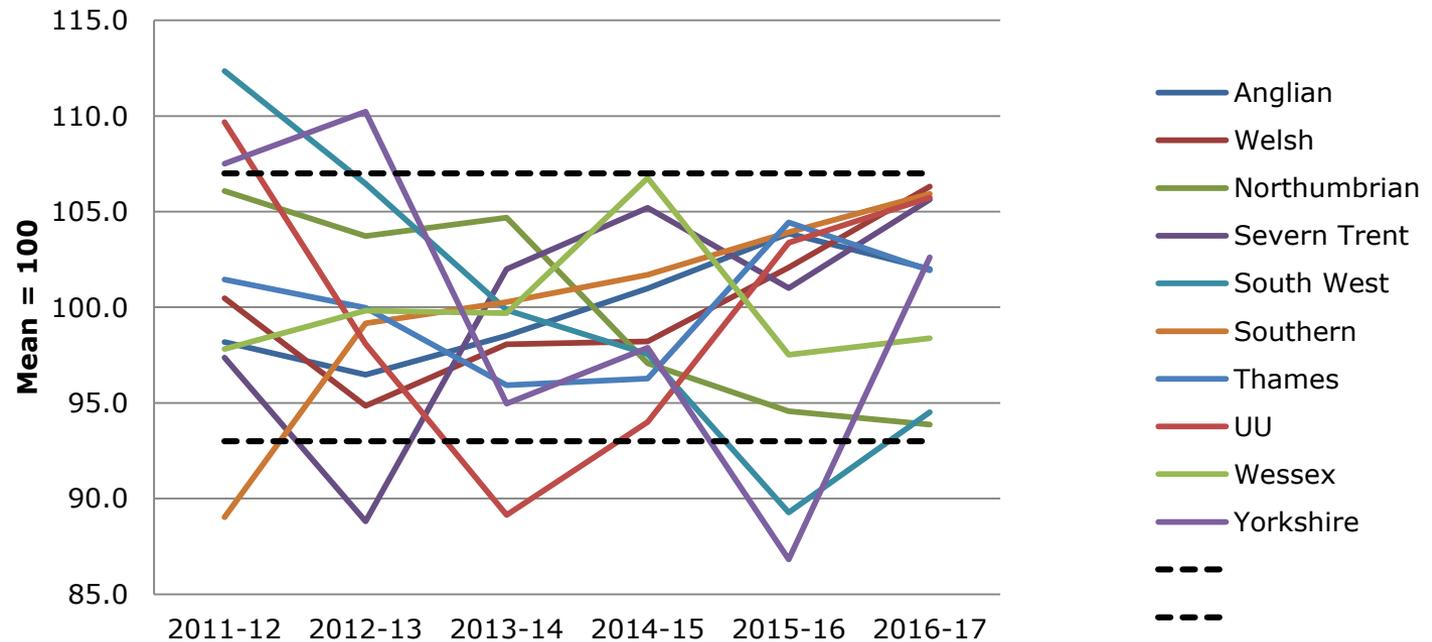
Actual sludge produced over 5 years	Variance from allowed sludge production	Revenue without BFAI	Revenue with BFAI	BFAI penalty
<i>ttds</i>	<i>%</i>	<i>£m</i>	<i>£m</i>	<i>%</i>
675	-10%	387	385	0.3%
750	0%	430	430	0%
788	+5%	451	451	0.1%
825	+10%	473	459	3.0%
900	+20%	516	459	11.0%

# How variable have sludge volumes been historically?

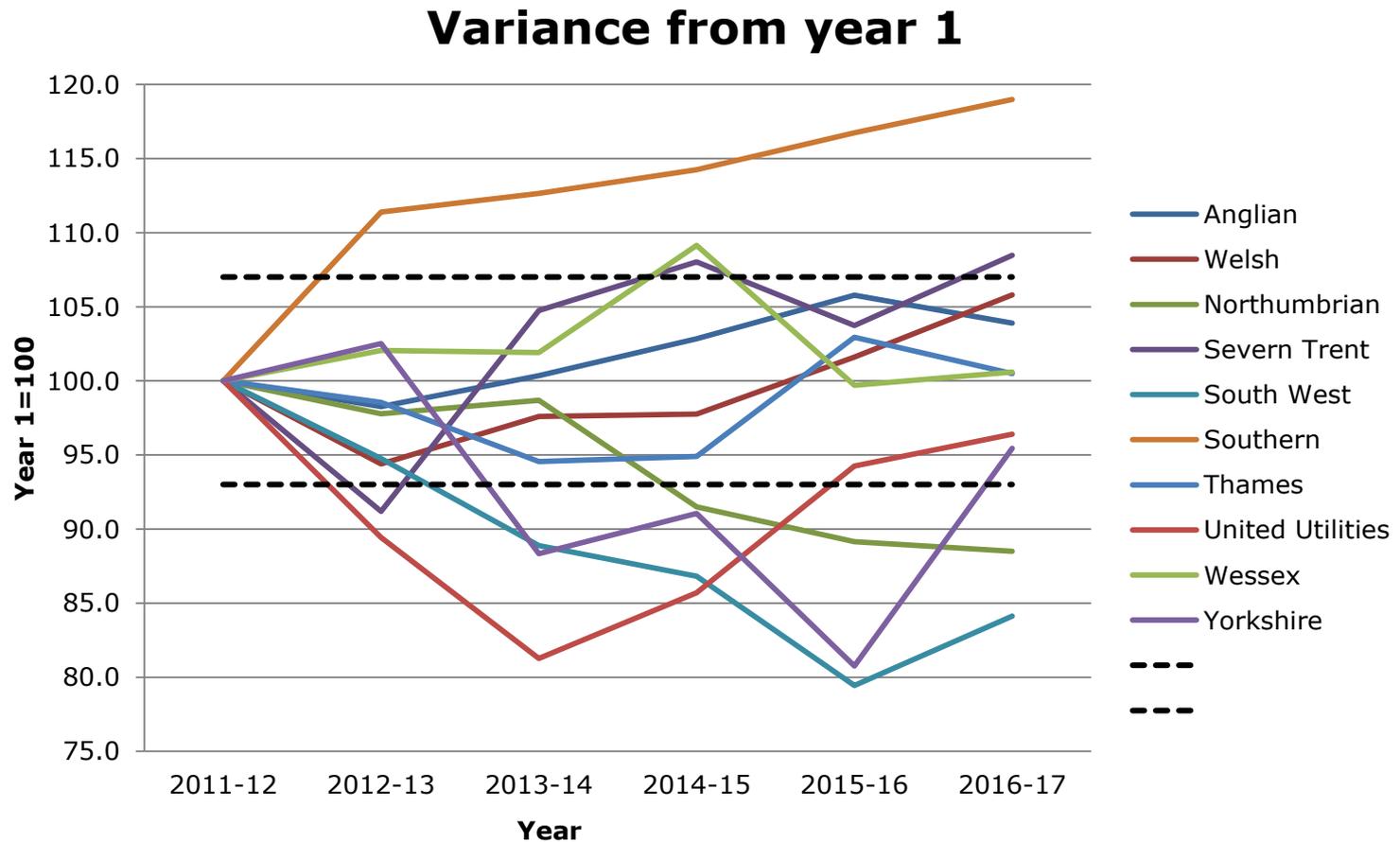


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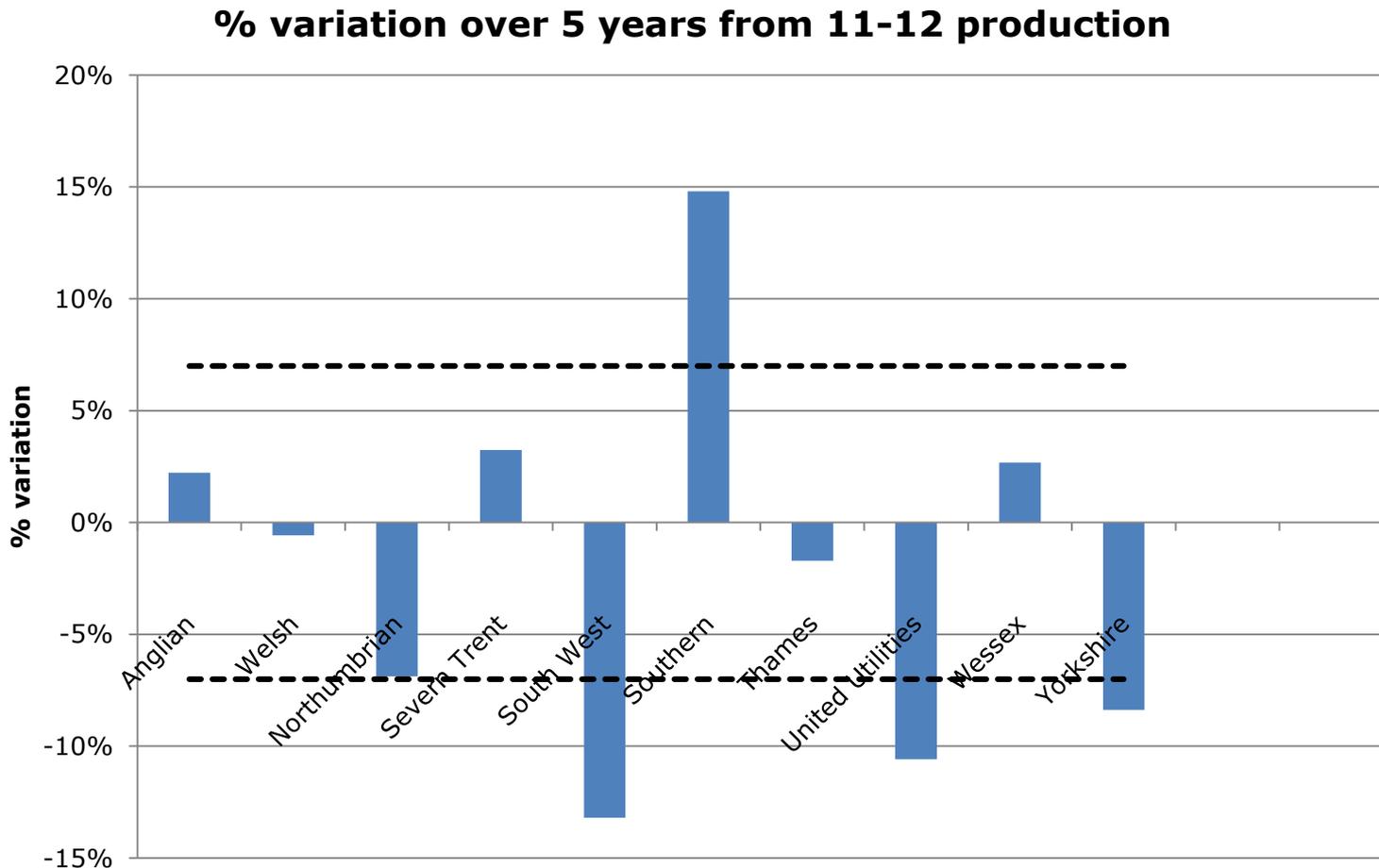
## Variance from mean



# How variable have sludge volumes been historically?



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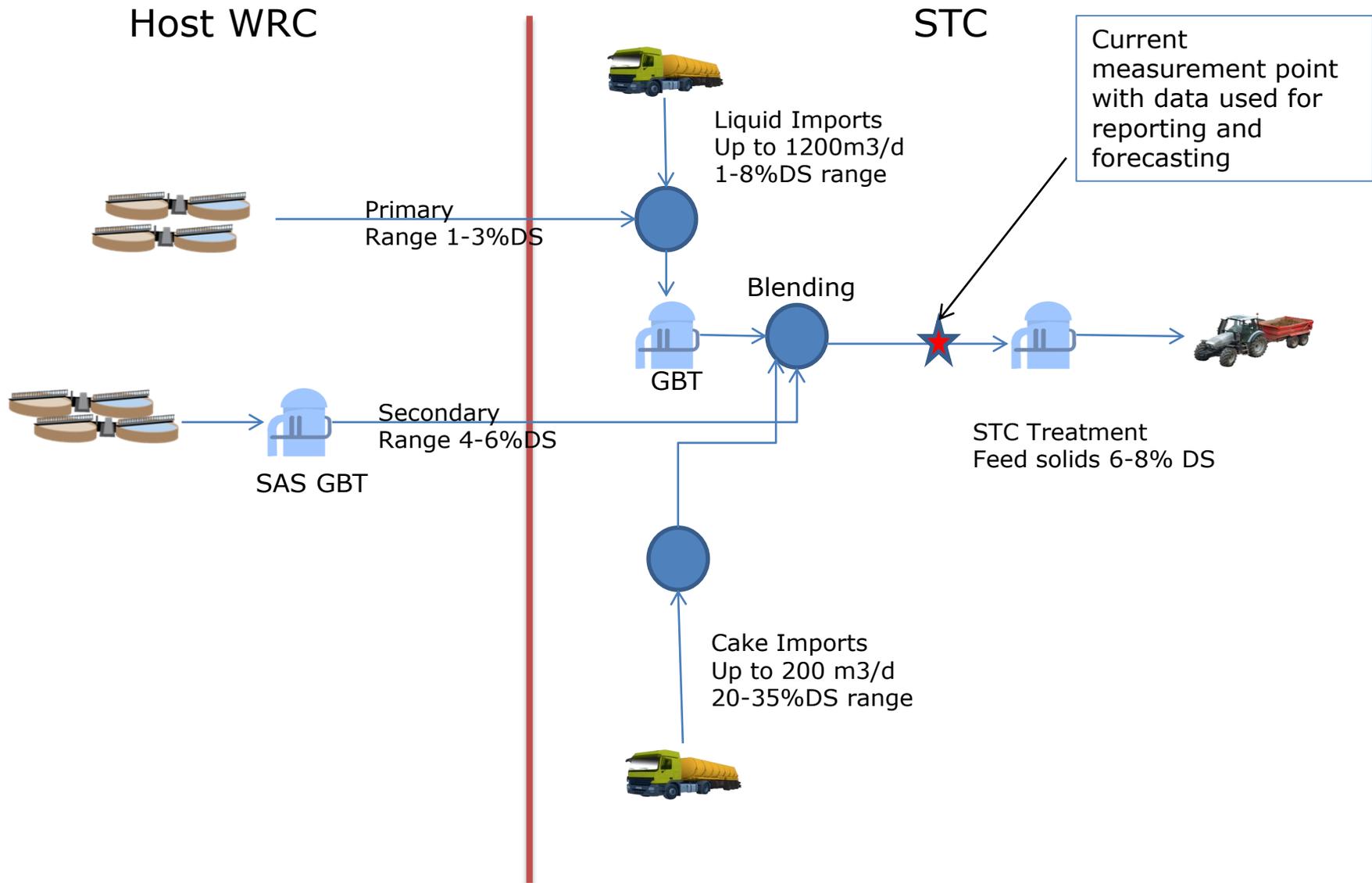
## What confidence grades have companies applied to their data?

Anglian	B2
Welsh	B2
Northumbrian	A2
Severn Trent	B2
South West	B2
Southern	B2
Thames	A2
United Utilities	B2
Wessex	B3
Yorkshire	A2

## What would cause sludge volumes to vary beyond forecast levels?

- Quality schemes (especially iron dosing for phosphate removal)
- Growth
- Trade effluent
- Improvement in measurement

# Sludge Measurement at a typical STC



# Sludge Measurement

- Measurement of flow and dry solids at the point of treatment gives the most accurate result as sludge has been conditioned, screened and is at its most consistent form %DS prior to treatment
- If measure at each individual transfer there would typically be five points of measurement
- Liquid and indigenous sludge is typically unscreened and can be highly variable
- Cake imports very difficult to measure dry solids online. Trialling new technology but post dilution rather than as delivered
- Typical accuracy of dry solids meters +/- 3 to 5% and requires regular operational and maintenance interventions

## Conclusions



- An incentive is required to protect customers
- Revenue loss for variance between 3% and 7% is reasonable
- Revenue loss for variance over 7% could be punitive
- Revenue loss from BAI for outturn sludge production *below* allowed sludge production seems unnecessary
- Measurement error could be substantially greater if companies move to measure at the Ofwat-preferred bioresources boundary

Forecasting uncertainty  
Frank Grimshaw and Richard Brindle,  
United Utilities

# Forecasting Uncertainty – Impact of Wastewater P Removal

Frank Grimshaw & Richard Brindle

# Sludge Production Forecast Factors

Sludge Production forecast is built from:

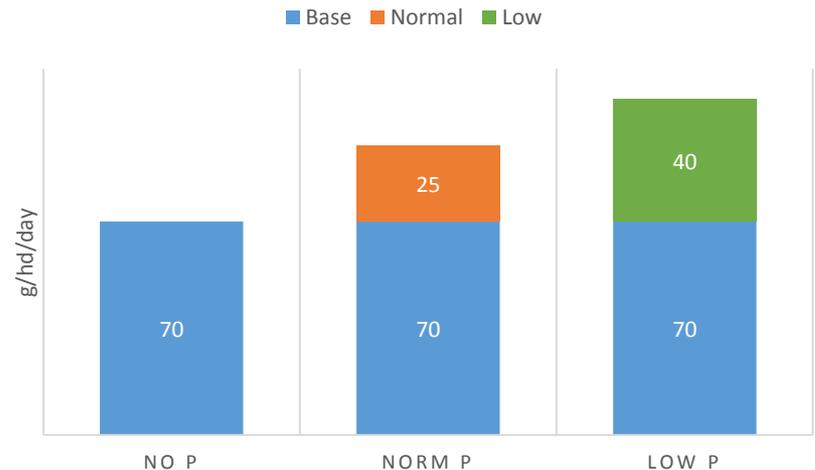
- Population and Trade Effluent projections
  - Population forecasts and TE volumes are an acceptable risk – companies managed this risk in earlier price reviews when we had an overall price control, before switching to a revenue cap
- Level of Phosphorus Removal from sewage treatment. Phosphorus removal technology (biological or chemical)
  - Companies can't forecast with any certainty sludge production from P schemes in AMP7.

Sludge make per population calculated using Asset Standard assumptions:

Conventional ASP site = **70g/hd/day**

P removal site (5-1mg/l) = **95g/hd/day**

Low P site (<1mg/l) = **110g/hd/day**



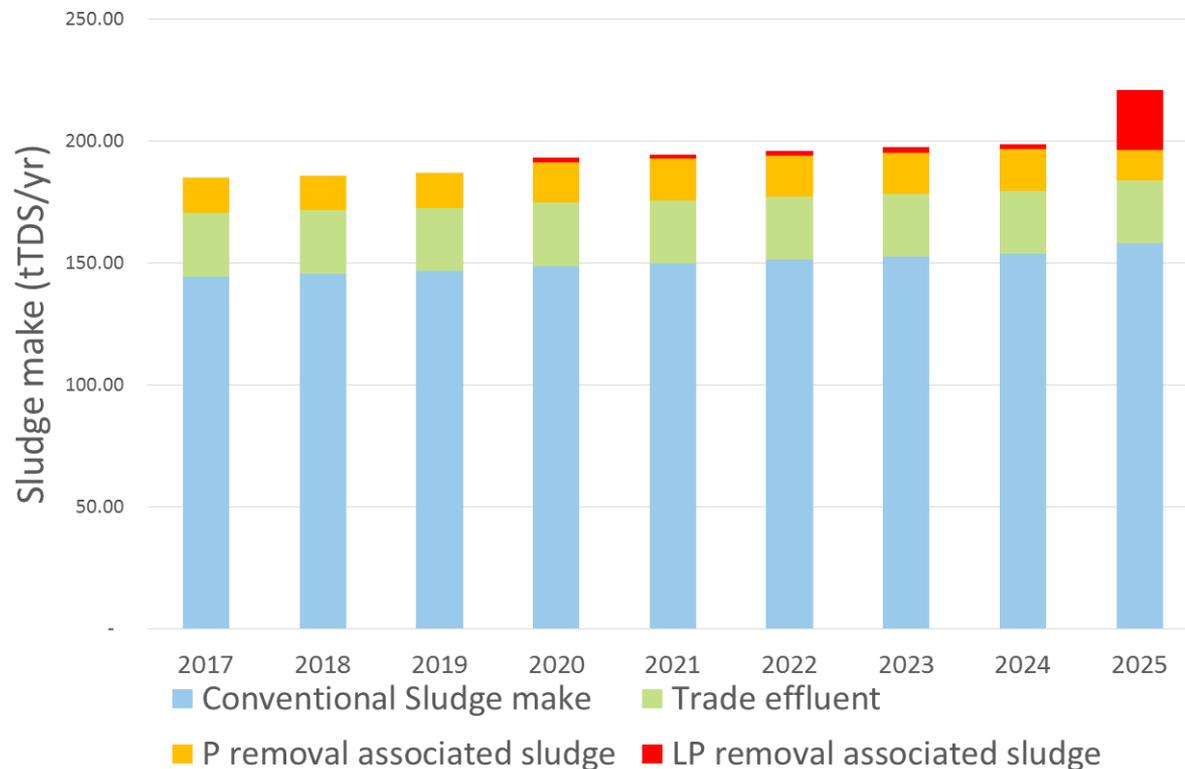
# Illustrative Data

In this illustration most schemes delivered in last year of AMP7

**19%** increase in yearly sludge production from 2017-2025

sludge production from P is **11%** of AMP7 total

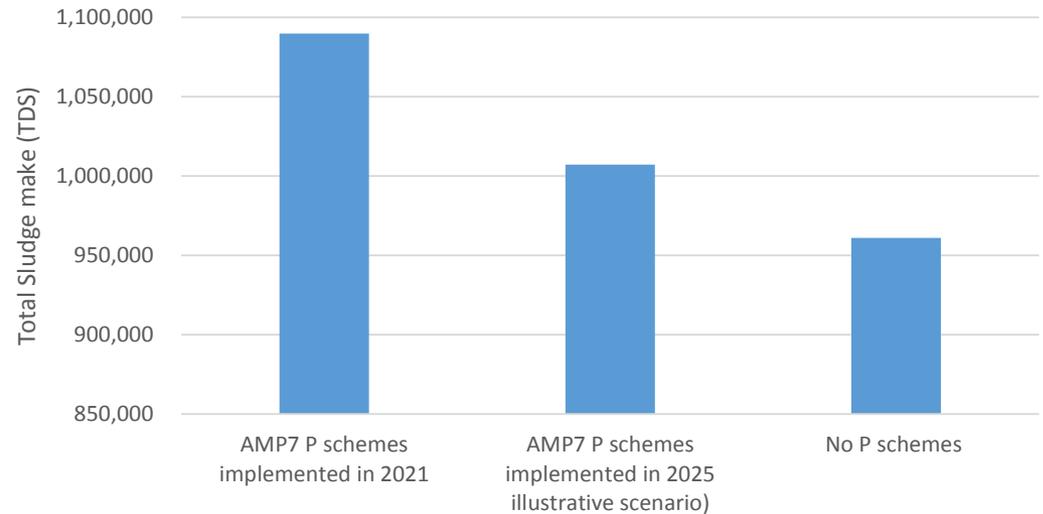
### Source of sludge production in AMP7



# Uncertainty with AMP7 P Forecasting

- Number of sites with P consents to be defined by WINEP
- Level of consents to be defined ('normal' P or low P)
- Year of delivery of schemes
- Low P technology not evaluated for sludge production.
- Technology selected (biological or chemical)
- Forecasting certainty will improve as P schemes are implemented

Comparison of lowest and highest case scenarios  
(no new P schemes/all chemical P schemes implemented in 2021)



- Range of 961ttds – 1,090ttds
- 129ttds difference (c.13%)

# Options available to manage P uncertainty

Uncertainty	Management control	Mitigation
Number of sites with P consents to be defined by WINEP	No, discussions with EA ongoing till 2021	Change control process from WINEP3. Sites in and out of scope.
Level of consents to be defined ('normal' P or low P)	No, discussions with EA ongoing till 2021	Change control process from WINEP3. Sites at low P consent level.
Year of delivery of schemes	Partial	Change control process from WINEP3 brings this into management control.
Technology selected (biological or chemical)	Yes	Not required or change control process

# Potential Adjustment Mechanism

Forecast includes a defined volume of P removal by site based on:

- Timing of scheme implementation
- Method of removal (biological or chemical)
- Level of P removal in consent

Adjustment options:

1. Volume could be adjusted by a pre-determined amount if any of these changes (difficult to pre-determine for tight P consents)
2. **Measurement before and after implementation, with adjustment for difference in volume change from forecast:**
  - **Allows for timing changes, change of method and uncertainties about impact of P removal on volume**
3. Wider bands – but doesn't address wrong incentives on treatment method

# Potential mechanism - example

- Company changes treatment method – no change in costs
- Without an adjustment, loses revenue and incurs penalty
- With adjustment – revised volumes used for PR24 adjustment
- For a timing change, cost assumption for P costs would also be adjusted

	PR19	Change to biological treatment	Adjustment for change to treatment method	Revised price control (for PR24 adjustment)
<b>Volume</b>				
Base	100	100		100
P removal	20	10	-10	10
Total	120	110		110
<b>Costs</b>	Forecast	Actual		
Base	100	100		100
P removal	20	20		20
Total	120	120		120
<b>Price control per ttds</b>	£1	£1		£1.09
Revenue	£120	£110		£120
Penalty		0.17		
Net		109.83		

# Questions

Next Steps: what do we need to move this forward?