

TA14.3 Cost Adjustment Claim 3 – Growth – Whitfield Technical Annex

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Navigation: TA.14.3 Cost Adjustment Claim 3 – Growth – Whitfield

Purpose: This technical annex provides the evidence to support the Cost Adjustment Claim on Growth – Whitfield.

The table below summarises the Ofwat tests that are addressed by the evidence presented in this Annex.

Table: Relevant Ofwat tests

Ref	Ofwat test	Comment
Primary Focus Areas		
CE 4	To what extent are cost adjustment claims used only where prudent and appropriate, and where they are used, are cost adjustments well evidenced, efficient and challenging?	<ul style="list-style-type: none"> High quality plan: The company will submit an efficient level of total expenditure in all areas. High quality plan: The company will have an effective approach to managing and reducing doubtful debt and improving revenue recovery. High quality plan: This will include identifying current barriers to revenue recovery, benchmarking with best practice outside the sector and how these barriers will be addressed in PR19 High quality plan: The company will avoid cost adjustment claims where possible, including by taking account of offsetting favourable circumstances. Where the company raised claims, they are efficient and well evidenced Ambitious and innovative plan: The company will present strong evidence of sector-leading cost efficiency. <p>We have developed and applied a consistent framework and process for reviewing and assessing all CACs and tested all claims against Ofwat’s final methodology guidance.</p> <p>Using this approach we have submitted CACs that we think are prudent and appropriate and where we believe there are genuine gaps in the cost assessment process.</p>

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Executive Summary

This summary is written in the format outlined in the Information Notice (IN/1811 June 2018).

Name of claim	Growth Whitfield
Name and identifier of related claim submitted in May 2018	PR19SRN_CAC02 Wastewater Treatment Works Growth and Resilience
Business plan table lines where the totex value of this claim is reported.	WWS2 26, WWN8
Total value of claim for AMP7	£26.4m
Total opex of claim for AMP7	£Nil
Total capex of claim for AMP7	£26.4m
Depreciation on capex in AMP7 (retail controls only)	n/a
Remaining capex required after AMP7 to complete construction	£0m
Whole life totex of claim	£29.4m (20 year whole-life cost of the combined solution estimated at £35.7m) ¹
Do you consider that part of the claim should be covered by our cost baselines?	Yes, estimated at £5m
Materiality of claim for AMP7 as percentage of business plan (5 year) totex for the relevant controls.	1.1% of the totex value of Wastewater Network Plus for the AMP
Does the claim feature as a Direct Procurement for Customers (DPC) Scheme?	No

¹ Our whole life costs and cost benefit figures have been calculated by extracting a 20 year portion of costs/benefits from a 60 year model. Further details are included in [TA.14.5 - PR19 Approach to Optioneering](#)

	Brief summary of evidence to support claim against relevant test	List of accompanying evidence, including document references, page or section numbers.
Need for investment/ expenditure	<p>The investment is required to ensure that we can continue to treat wastewater arising from a large new development without a detrimental impact on the environment.</p> <p>The investment would deliver additional treatment capacity of 20,000 PE¹ at a new wastewater treatment works serving the Whitfield development in Dover. It is required to ensure that we can continue to meet our statutory duty to accommodate forecast growth, without harm to the environment whilst improving resilience. Without this investment, the additional flow presented by the development to the works would breach our statutory obligations and wastewater treatment works discharge permits.</p> <p>It would also considerably impact on our wider environmental and customer obligations through increased spills to the environment, increased flooding risk and impact on customer wellbeing.</p>	<p>TA14.3 Growth Whitfield, Page 10</p> <p>Business Plan Chapter 4 – Customer and Stakeholder Engagement</p> <p>¹https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/datasets/tablea11principalprojectionuksummary</p>
Need for the adjustment (if relevant)	<p>Based on PR14 outcomes we have calculated a notional revenue allowance of £5m associated with the growth that the new treatment works will accommodate.</p> <p>Due to the scale and scope of works required to service the Whitfield development, and the engineering challenges faced in the area, an incremental approach of the type that has historically been pursued – and thus reflected in the Ofwat cost models – is not reflective of the unusual challenges of this specific development. This is further evidenced by the fact that the costs associated with this individual catchment alone represent around 50% of our estimated revenue allowance for wastewater treatment growth.</p>	<p>TA14.3 Growth Whitfield, Pages 9-14</p>
Outside management control (if relevant)	<p>The need for the expenditure is driven by government-led concentrated housing growth and significant engineering challenges within one catchment in our region.</p> <p>The Whitfield development (which comprises up to 5,750 homes) is part of an Adopted Core Strategy² and accepted Masterplan³ by Dover District Council and development has already commenced. We have engaged and consulted with Dover District Council to influence the development.</p> <p>We have a statutory duty to accommodate this growth, without a detriment to the environment or customers.</p>	<p>TA14.3 Growth Whitfield, Pages 13-14</p> <p>²Dover District Council Adopted Core Strategy https://www.dover.gov.uk/Planning/Planning-Policy-and-Regeneration/PDF/Adopted-Core-Strategy.pdf</p> <p>³ Dover District Council Whitfield Masterplan https://www.dover.gov.uk/Planning/Planning-Policy-and-Regeneration/PDF/Whitfield-Masterplan.pdf</p>

<p>Best option for customers (if relevant)</p>	<p>Customers expect us to ensure that future generations have access to the same level of wastewater services as we do today, and are willing to invest now to ensure that there is no deterioration in services in the future. We have considered six options for providing wastewater treatment services to the Whitfield development. We have carried out both a qualitative (SWOT) and a quantitative assessment of whole life totex on each option. Aligning our quantitative and qualitative assessments indicates that a new treatment works with a long sea outfall is the best option for customers. This option is both technically viable and the least whole life cost. In acceptability testing, 76% of customers supported the need to deliver this growth scheme</p>	<p>TA14.3 Growth Whitfield, Pages 15-19. Detailed Technical Annex Chapter 4: Customer and Stakeholder Engagement and Participation</p>
<p>Robustness and efficiency of claim's costs</p>	<p>Our robust development of the costs associated with wastewater growth and resilience has gone beyond our standard our cost estimation process, with more detailed assessment for each option and additional challenge through independent technical experts from our Strategic Solutions Partner. Assurance has been undertaken by Jacobs in July/August 2018.</p>	<p>TA14.3 Growth Whitfield, Page 19 Detailed Technical Annex TA14.4 Cost estimation</p>
<p>Customer protection (if relevant)</p>	<p>Customers are protected if the investment is cancelled or delayed by the proposal of a project delivery specific, penalty-only ODI (type P -CAC).</p>	<p>TA14.3 Growth Whitfield, Page 19 See performance commitment submission ref: PR19SRN_WWN14</p>
<p>Affordability (if relevant)</p>	<p>Overall affordability has been considered in the context of our wider plan. The total amount of this claim is £26.4m. This equates to approximately £1.00 annual increase to the average wastewater customer. Overall, we project customer bills will decrease by over 3% including our Cost Adjustment Claims.</p>	<p>TA14.3 Growth Whitfield, Page 19</p>
<p>Board assurance (if relevant)</p>	<p>Our Board has reviewed all our Cost Adjustment Claims. The Board support the need for the investment at the named treatment works to ensure that we continue to meet our statutory obligations.</p>	<p>TA14.3 Growth Whitfield, Page 20</p>

Cost Adjustment Claim Summary

What is the claim for?

This claim relates to work required for a sewage treatment solution for a distinctive growth hotspot at the Whitfield development near Dover. At Whitfield we will see significant, concentrated growth at levels far higher than the national average which is unlikely to be adequately funded through Ofwat's modelled cost allowance.

We forecast significant growth in the number of properties connected to our wastewater network throughout AMP7. In order to provide affordable homes and to achieve government targets for house building, we are observing a move away from urban infill and an increase in the number of large-scale, greenfield developments that place disproportionate impact on the existing assets serving an area.

Table 1 - Catchment and overall population growth

	Population at 2020 (000)	Population growth to 2025 (000)	% increase at 2025	Population growth to 2040 (000)	% increase at 2040
Whitfield (Dambridge Option 2)	25	4.3	17.2	13.8	55.2
Southern Water overall	4,682	214	4.6	699	14.9
England average ²			2.7		8.9

Current forecasts indicate that, for many of our catchments, our levels of growth will be significantly above the national average. At Whitfield specifically, for the viable transfer option, growth to 2025 is likely to be far above the national average and is an exception even in terms of the high growth we are seeing across our asset area. It has been identified in Dover District Council's Adopted Core Strategy³ as a location for major urban expansion with the development of up to 5,750 homes (see Figure 1).

Historically, we have been able to accommodate growth through incremental investment at our wastewater treatment works (WTWs), generally by removing process bottlenecks or increasing treatment capacity. This may not be the case for large scale, greenfield developments and has been shown to be difficult for Whitfield. In the short term we have been supporting the initial phases of Whitfield in this way, however in the next AMP the size of the development will have passed the threshold beyond which incremental network and WTW process improvements will be sufficient, and at which point a more substantial (in this case highly atypical) investment solution will be required. We will therefore need, during AMP7, to develop and implement a solution which meets the needs of the local community and its growth for several AMPs forward.

Therefore, having assessed six options for serving the Whitfield development, the preferred option for the catchment is construction of a new wastewater treatment works. This option represents the best combination of lowest whole life costs, customer disruption and environmental impact.

²<https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/datasets/tablea11principalprojectionuksummary>

³<https://www.dover.gov.uk/Planning/Planning-Policy-and-Regeneration/PDF/Adopted-Core-Strategy.pdf>

We have also considered the possibility of phasing some of the development of the WTW across AMPs (beyond AMP7) in line with the possible development trajectories of housebuilding at the locality; however, to minimise complexity of the work and the associated whole life cost, our base proposal is to fully construct the WTW in AMP7.

We acknowledge that there is considerable uncertainty in the timing of this project due to external factors. We propose to review build schedules at key project gateways, continue to work collaboratively with local stakeholders and have modified our proposed Performance Commitment to ensure customer protection in the case of delayed expenditure or savings being made. Further details can be found in the supporting Detailed Technical Annex, beginning on page 21 below.

All options assessed involve a high degree of risk and complexity. We do not believe Ofwat's cost models will be calibrated to allow for such solutions as historically growth has typically been accommodated through incremental capacity extensions at existing works where needed.



Figure 1 - Whitfield urban expansion

Category of Claim

The category of claim is for growth-related costs that are atypical of those modelled by Ofwat cost models.

The current project estimate for the lowest cost viable solution is £31.4 million. Using Ofwat's PR14 methodology⁴, this equates to circa 52% of our total estimated modelled cost allowance for growth of around £60 million. This highlights the exceptional nature of this area and the required solutions to support the projected growth. This localised growth far exceeds the national average population growth along with posing specific engineering and environmental constraints.

⁴The "sewage treatment growth model" used by Ofwat at PR14, is described here: http://webarchive.nationalarchives.gov.uk/20150603214107/http://www.ofwat.gov.uk/pricereview/pr14/prs_web140404pr14whol/esalectostasses

Our remaining wastewater treatment growth programme for AMP7 is currently forecast to be over £95 million so, in the round, we expect the cost allowances for wastewater treatment growth to be insufficient to accommodate the exceptional circumstances at Whitfield. We will therefore not be able to offset the exceptional costs of accommodating growth at Whitfield against lower than average costs of supporting growth elsewhere in the region during AMP7.

The network-related costs associated with the preferred treatment solution have not been included within this claim, as they are not considered exceptional. They are also funded through a different mechanism, including external contributions via the Infrastructure Charge.

We have removed from the claim an estimate of the implicit allowance that we expect to be included in Ofwat's PR19 models for the levels of growth experienced at Whitfield. We have also reflected the implicit allowance from transferring the existing Whitfield village to the new WTW, as this frees up capacity at Broomfield Bank WTW for future growth in the Dover and Folkestone catchment.

Which price control does the claim apply to?

All the costs associated with this claim apply to the Wastewater Network Plus price control.

What is the value of the claim?

The value of the claim is £26.4 million. This is after deducting an estimated implicit allowance that we believe is likely to be reflected in Ofwat's models of £5 million. It is above the materiality threshold of 1% (c. £20 million) of projected business plan totex for Wastewater Network Plus.

The total investment planned is significantly below the £100 million threshold for direct procurement and therefore considered unsuitable for direct procurement. We do, however, recognise that there may be opportunities to explore alternative delivery mechanisms to drive innovative approaches. We are exploring these to ensure the best value solution.

Evidence for claim

The need for the expenditure is driven by government-led concentrated housing growth within one catchment in our region. The Whitfield development, which forms part of the Adopted Core Strategy of Dover District Council, comprises up to 5,750 homes.

The proposed solution would deliver additional treatment capacity of 20,000 Population Equivalent at a new wastewater treatment works. It is required to ensure that we can continue to meet our statutory duty to accommodate forecast growth without harm to the environment, while ensuring our services continue to be resilient. A failure to do so is not acceptable to our stakeholders or our customers and providing suitable investment in growth is essential to maintain a satisfactory level of service to customers, developers, local authorities and other stakeholders.

We have assumed Ofwat will make an allowance for wastewater treatment growth based on the average costs of accommodating population growth at PR14. Due to the scale and scope of works required to service the Whitfield development, and the engineering challenges faced in the area, an incremental approach of the type that has historically been pursued is not possible. This is further evidenced by the fact that the costs associated with this individual catchment represent over half of our estimated modelled revenue projection for growth.

Need for cost adjustment

At PR14, Ofwat made an allowance for wastewater treatment growth based on the average costs of accommodating population growth. The average costs allowed equated to circa £250 (2012-13 prices) for each additional PE. This equates to £281 when inflated to 2017-18 prices using RPI.

For the purposes of this claim, we have assumed that Ofwat will make a similar allowance at PR19 – although we note that the enhancement models presented by Ofwat at the modelling consultation suggest allowances may be increased⁵. Based on our PR19 growth projections, using Ofwat's PR14 models, the total allowance for expected AMP7 WTWs growth would be approximately £60 million (in 2017-18 prices). For Whitfield, this would amount to approximately £5 million. This figure includes the transfer of the existing Whitfield village to the new WTW as this frees up capacity at Broomfield Bank WTW for growth elsewhere within the Dover and Folkestone catchment.

Table 2 - Estimated cost allowance for wastewater treatment growth – Ofwat PR14 models⁶

Model (2017/18 prices)	Unit cost (£s)	Population increase over AMP7 (000s)	Cost allowance (£m)
Weighted unit cost model	270	214	58
Unweighted unit cost model	337	214	72
Simple regression model	247	214	53
Logged regression model	270	214	58
Average allowed cost	281	-	60

⁵ The Ofwat's enhancements models, shared as part of the econometric cost modelling consultation can be found here: <https://www.ofwat.gov.uk/consultation/cost-assessment-pr19-consultation-econometric-modelling/>

⁶ The "sewage treatment growth model" used by Ofwat at PR14, is described here: http://webarchive.nationalarchives.gov.uk/20150603214107/http://www.ofwat.gov.uk/pricereview/pr14/prs_web140404pr14wholesalecostasses

Table 3 - Estimated cost allowance for Whitfield treatment growth – Ofwat PR14 models

Model (2017/18 prices)	Unit cost (£s)	Whitfield population increase over AMP7 (000s)	Cost allowance (£m)
Weighted unit cost model	270	17.8	4.8
Unweighted unit cost model	337	17.8	6.0
Simple regression model	247	17.8	4.4
Logged regression model	270	17.8	4.8
Average allowed cost	281	17.8*	5.0

* Including Whitfield Village transfer

A unique confluence of environmental, engineering and construction constraints mean that the lowest whole-life-cost viable solution, is the provision of a new treatment works. This results in significant costs beyond the modelled allowances, making Whitfield an exceptional case.

Upgrade of the existing treatment works is constrained by rail infrastructure assets, two rail bridges and the requirement to build over the High Speed 1 Tunnel, presenting considerable construction risk and driving up costs.

The proximity of a Source Protection Zone means that, based on information currently available, the Environment Agency would be unwilling to permit a discharge to ground. The consequence is the consideration of a coastal discharge, and the provision of c.8km of infrastructure to enable this, including 3km of long sea outfall.

These two factors mean that the incremental approach allowed for in the model is not suitable in this case, as the existing works are below ground and very difficult to extend in a traditional way. This places unacceptable risks on our statutory obligations, license conditions and customer expectations.

This is a highly unusual site with exceptional solutions required, as evidenced by being our first new greenfield Wastewater Treatment Works as a result of growth since before privatisation.

Based on the increase in population equivalent provided for by the new works, we estimate that Ofwat’s PR14 models would allow funding of £5 million. This compares with a current scheme cost estimate of £31.4 million, giving a shortfall of £26.4 million.

Table 4 - Notional allowed revenue at Whitfield growth hotspot

Scheme	Costed Solution (£m)	Estimated Funding (£m) *	Funding Shortfall (£m)	£/PE required for scheme**
Whitfield	31.4	5	26.4	1,757

* Using £281/PE approximation based on PR14 model uplifted to 2017/18 prices

** Using 2040 design horizon population

We are forecasting significant population growth across the whole of our region to 2040. The projected localised growth in the Whitfield catchment is significantly higher than across the region as a whole and far in excess of the average population growth allowed for at PR14.

Ofwat’s growth allowance at PR14 was associated with average growth of ~3.5% across the sector. The average AMP7 level of growth expected within the Southern Water region not covered by this claim is higher than this at 4.5%, even after removal of the Whitfield development.

Table 5 - Concentrated population growth at Whitfield catchment

Scheme Requiring Cost Adjustment	PE at 2020 (000)	PE growth to 2025 (000)	% increase at 2025	PE growth to 2040 (000)	% increase at 2040
Whitfield (Dambridge WTW options)	25	4.3	17.2	13.8	55.2
Southern Water excluding Whitfield	4,657	210	4.5	685	14.7
Southern Water Overall	4,682	214	4.6	699	14.9

Based on Ofwat’s PR14 models we expect the total TOTEX revenue for wastewater treatment growth to be in the region of £60 million. In comparison, our current forecast of required expenditure to accommodate growth at our wastewater treatment works is significantly higher than the expected allowance. Our current estimate is more than £128 million, of which £31.4 million relates to Whitfield.

Table 6: Wider context of the treatment growth programme

WTW	Expected growth 2025 (000)	Expected growth 2040 (000)	Estimated Ofwat allowance (£m)*	Forecast costs (£m)
Whitfield	4.3	13.8	4.0**	£31.4
Other WTWs	210	685	56.0	£96.7
Total	214	698	60.0	£128.1m

* Based on £281 per PE

** Not inclusive of Whitfield village transfer

This demonstrates that, the Ofwat modelled cost allowance is unlikely to be sufficient to fund the investment that we need to support capacity increases associated with growth at our other wastewater treatment works. We will therefore not be able to offset the exceptional costs of accommodating growth at Whitfield against lower than average costs of supporting growth elsewhere in the region during AMP7.

This illustrates the challenge of providing for future growth in a region where historic growth has exhausted much of the available spare treatment capacity and where we are seeing a change in the nature of development from small scale infill sites to large-scale, greenfield developments.

We have identified Whitfield because there is significant scope for potential underfunding that changes to Ofwat’s models are unlikely to bridge. We also recognise, as indicated by Table 6, that potential for underfunding exists elsewhere in our wastewater treatment growth programme. We are, however, continuing to explore opportunities to close this gap, by developing alternative options to deliver our growth programme. This includes reviewing relative risk levels associated with different options. Nevertheless, as most of our wastewater treatment sites have a defined existing method of operation and treatment, the scope for innovation and alternate approaches is often constrained in relation to new build assets and technologies.

Management control

The need for the expenditure is driven by government-led concentrated housing growth and significant engineering challenges within one catchment in our region.

The Whitfield development is part of an Adopted Core Strategy⁷ and accepted Masterplan by Dover District Council⁸. Development has already commenced. We have engaged and consulted with Dover District Council, from Chief Executive level down, to influence the provision for wastewater management at this development. Developments of this nature should be considered in the context of Government policy, with growth and the provision of new housing a key priority⁹. The South East is an area of high demand and there is significant pressure on all stakeholders to respond quickly and effectively to meet the demands and aspirations of this Government priority.

We have a statutory duty to accommodate this growth, without a detriment to the environment or customers. If we fail to do so there would be a significant effect on river waters, groundwater, and bathing waters through more spills to environment, as well as reduced effluent quality. Flooding is a major concern to our customers and, due to the significant increases in flow associated with these proposals, this would pose a major risk to customer outcomes. Sewer flooding risk within the Whitfield catchment is currently considered high.

This is not acceptable to either us or our stakeholders and customers. Providing suitable investment in growth is essential to maintain levels of service to customers, the environment, developers, local authorities and other stakeholders.

While the Whitfield development is already under construction, more generally we are taking significant steps to be more proactive and collaborative in our approach to supporting growth and resilience across the South East. These steps include the following:

- We are developing catchment growth and comprehensive Drainage Area Plans with a focus on our high growth areas. This enables a stronger understanding of catchment growth and ensures alignment with Local Authority Local Area Plans. This permits a more strategic approach to supporting growth and resilience, both in relation to network capacity and treatment capacity.
- We are continuing to build strong relations with stakeholder communities right across the growth spectrum. This includes county councils, local planning authorities, developers and development bodies. We are implementing a series of 'charrettes' with local stakeholders which are workshops devoted to co-creation efforts to solve particular problems or plan our approaches to supporting growth in target catchments.
- We are adopting an account management approach with our key developers in the region. This is designed to both improve customer service to the developers but also secure improved data and information about development plans, locations, timings and scale. This further informs our growth planning processes to improve security and certainty of investments across the growth spectrum.

⁷ <https://www.dover.gov.uk/Planning/Planning-Policy-and-Regeneration/PDF/Adopted-Core-Strategy.pdf>

⁸ <https://www.dover.gov.uk/Planning/Planning-Policy-and-Regeneration/PDF/Whitfield-Masterplan.pdf>

⁹ The government report 'Fixing our Broken Housing Market' (2017) is focused on enabling the construction of many more homes to satisfy demand much more effectively <https://www.gov.uk/government/publications/fixing-our-broken-housing-market>

All of these changes will help us reduce cost and improve customer service when working with developers.

Need for investment

The investment would deliver additional treatment capacity of 20,000 PE at the new wastewater treatment works serving the Whitfield development. The investment is required to ensure that we can continue to meet our statutory duty to accommodate forecast growth, without harm to the environment whilst improving resilience. The Whitfield development is part of an accepted Masterplan by Dover District Council¹⁰.

Without this investment, the additional flow presented by the development to the existing WTW would breach our statutory obligations and wastewater treatment works environmental discharge permits. It would also impact our environmental and customer obligations through increased spills to the environment, increased flooding risk and impact on customer wellbeing.

A consistent theme through all our customer engagement has been the need to ensure that the rapid housing growth expected in the south east can be accommodated. We have engaged with customers on the specific catchment within this claim, “It sounds like they’re being forward thinking and pragmatic about this – it’s a long-term measure which is good, especially if it means protecting the environment in the future”. Customers understand the basic premise that not having sewerage systems that can cope with new housing developments may lead to the system being overloaded and environmental damage. All feel it is appropriate for us to be building a new wastewater treatment works at Whitfield. Our wider regional results demonstrate that customers are supportive of expenditure which facilitates growth in an efficient and effective manner, whilst ensuring that the services that they currently receive are resilient now and in the future. Further information can be found in our Business Plan [Chapter 4 – Customer and Stakeholder Engagement](#).

¹⁰ <https://www.dover.gov.uk/Planning/Planning-Policy-and-Regeneration/PDF/Whitfield-Masterplan.pdf>

Options

We have considered six options for providing wastewater treatment services to the Whitfield development. These are:

- Option 1: Pumping flows approximately 10 Km to our existing Broomfield Bank WTW, with an associated upgrade at the WTW
- Option 2: Pumping flows approximately 14 kms to our Dambridge WTW, with a rebuild of the works to accommodate the increase in flows
- Option 2a: Pumping flows approximately 14 kms to our to Dambridge WTW, with the development of a new Membrane Bioreactor (MBR) side stream treatment
- Option 3: Development of a new WTW with a discharge to groundwater
- Option 4: Development of a new WTW with a coastal discharge
- Option 5: Development of a new WTW with an inland river discharge

The current preferred option is Option 4. In determining this we have carried out both a qualitative assessment, considering the strengths, weaknesses, opportunities and threats (SWOT) associated with each option, and a quantitative assessment of whole life totex.

More detail on the options considered are set out in the Detailed Technical Annex within this claim.

In order to protect customers, we have developed a simple, transparent Performance Commitment (PC) which would ensure that should we fail to deliver the scheme in AMP7 or deliver it for less than the agreed claim value, additional cost allowances would be returned to customers.

Best option for customers

For the qualitative SWOT analysis, the key selection criteria were:

- Environmental impact and enhancement
- Engineering complexity and certainty
- Constructability
- 3rd Parties
- Land Availability and Permissions

Table 7 - SWOT Analysis for Qualitative Assessment

Option 1 – Pump Flows to Broomfield Bank WTW and upgrade	
Scope	Network: New catchment WPS, 10km rising main (urban), 2 No. railway crossing, river crossing Treatment: New below ground preliminary building, upgrade primary and secondary works hydraulics
Strengths	Expansion on SWS owned land. Good transport links. Construction compound could be available on site. Good ground conditions anticipated. Least long-term impact to external stakeholders. Coastal discharge permits simpler to manage. Releases Whitfield catchment to accommodate future growth in catchment. Offline construction
Weakness	Least resilient to future growth. Complex engineering works. Modification to discharge permit required. Exclusions include pre-thickened sludge storage capacity, chemical storage capacity and storm outfall. Loss of treated effluent to coastal discharge.

Opportunity	Demonstration of complex civil construction
Threat	Construction of basement over HS1 tunnel. Two Urban rail crossing at narrow bridges. River crossing in the centre of Dover Town. Upgrades throughout historic Dover town, and type 2 roads. Upgrade of primary and secondary building highly constrained
Option 2 – Pump Flows to Dambridge WTW and major works rebuild	
Scope	Network: New catchment WPS, 14km rising main (rural) Treatment: Storm tank, inlet works, chemical dosing, ASP, FST, Tertiary, FE, sludge, EICA upgrades
Strengths	Expansion on SWS owned land. Transfer main in rural setting. Treated effluent goes to river, rather than coast. Room for future expansion on site (though will incur demolition costs).
Weakness	Whitfield catchment treated elsewhere. Complex rebuild programme envisaged, on constrained, operational site.
Opportunity	Transformational rebuild of existing site.
Threat	Archaeology on transfer route. Disproportionate tightening of permit. Risk of odour complaints at receiving WTW.
Option 2a – Pump Flows to Dambridge WTW and Side Stream Process	
Scope	Network: New catchment WPS, 14km rising main (rural) Treatment: Storm Tank, inlet works, chemical dosing, MBR, ASP, FST, Tertiary, FE, sludge, EICA upgrades
Strengths	Expansion on SW owned land. Transfer main in rural setting. Treated effluent goes to river, rather than coast. More room for future expansion on site (though will incur demolition costs).
Weakness	Whitfield catchment treated elsewhere, complex rebuild programme envisaged, on constrained, operational site. Difficult process / permit to manage. Higher Opex. Proposed site location within Nitrate, Pesticide and Faecal indication issue / priority zones.
Opportunity	Relocate c. 200m outside sensitive zones. Transformational rebuild of existing site. Demonstration of MBR technology as medium scale (20k PE) as side stream.
Threat	Archaeology on transfer route. Disproportionate tightening of permit potential. Risk of odour complaints at receiving WTW. Reliant on performance of existing process stream for blending.
Option 3 – Pump Flows to new WTW – Groundwater discharge	
Scope	Network: New WPS, 3.1km rising main to WTW Treatment: Land purchase, admin building, inlet works, storm tank, PST, ASP, methanol dosing, FST, FE, sludge, WRPS, EICIA Upgrade, Land Treatment Area [30SS, 20BOD, 10TN]
Strengths	Short transfer route. Discharge to ground replenishes aquifer in abstracted/water stressed region. Resilient to future growth. Treats and discharges the wastewater local to source.
Weakness	New WTW requiring land acquisition and planning permission. GW discharge permits difficult to secure.
Opportunity	Transformational project including groundwater/aquifer recharge potential. Use lessons learnt from Shipton Bellinger AMP6 (Lowest BNR TN Site without chemical discharging to ground).

Threat	Ability to secure permit condition / land / planning permission.
Option 4 – Pump Flows to new WTW – Coastal discharge	
Scope	Network: New WPS, 3.1km rising main to WTW Treatment: land purchase, admin building, inlet works, storm tank, PST, ASP, methanol dosing, FST, FE, sludge, WRPS, EICIA Upgrade, Land Treatment Area [60SS, 40BOD+UWWTD]. 4.1 km rising main from WTW, 2km gravity sewer, 3km long sea outfall.
Strengths	Short transfer route. Resilient to future growth. Treats and discharges the wastewater local to source (although coastal). Simpler to manage permit.
Weakness	New WTW requiring land acquisition and planning permission. Coastal discharge permits difficult to secure. Tunnelling required.
Opportunity	New WTW available – future transformation in area / resilient to further growth.
Threat	Ability to secure permit condition / land / planning permission / MMO licences. Tunnelling required.
Option 5 – Pump Flows to new WTW – Inland river discharge	
Scope	Network: New WPS, 2.5km rising main to WTW Treatment: Land purchase, admin building, inlet works, storm tank, PST, ASP, methanol dosing, FST, FE, sludge, WRPS, EICIA Upgrade, Land Treatment Area [30SS, 10BOD, 10TN], outfall to river Dour
Strengths	Short transfer route. Discharge to ground replenishes aquifer in abstracted/water stressed region. Resilient to future growth. Treats and discharges the wastewater local to source.
Weakness	New WTW requiring land acquisition and planning permission. River discharge permits difficult to secure.
Opportunity	Transformational project including groundwater/aquifer recharge potential. Use lessons learnt from Shipton Bellinger AMP6 (Lowest BNR TN Site without chemical discharging to ground).
Threat	Ability to secure permit condition / land / planning permission.

Quantitative options assessment

The quantitative totex analysis is shown in table 8. Note that the network-related costs associated with the preferred solution have not been included within this claim, as they are not considered exceptional.

Table 8 - Whitfield Solutions Comparison for Quantitative Assessment

Opt	Description	Network (£m)	Treatment (£m)	Total (£m)	20-year WLC (£m)	Status
1	Broomfield Bank	14.3	25.4	39.7	29.9	Rejected
2.	Dambridge (ASP)	13.7	34.4.	48.1	39.8	Rejected
2A	Dambridge (MBR)	13.7	32.5	46.2	36.6	Rejected
3	New WTW GW Discharge	4.3	29.8	34.1	28.7	Further development required
4	New WTW Coastal Discharge	4.3	31.4	35.7	29.4	Preferred
5	New WTW River Discharge	6.2	29.7	35.9	30.2	Further development required

Overall assessment

The quantitative analysis shows at this stage suggests that the lowest cost option for customers is option 3 - development of a new treatment works, with associated groundwater discharge. However, the qualitative assessment indicates that this option is unlikely to be feasible, as initial indications from the Environment Agency are that they would not be willing to support the discharge to ground, which is in a Source Protection Zone/Safeguard area. The initial feedback was that ‘we do not believe that is a good idea to discharge this volume of sewage effluent to the ground in these areas’. On this basis, the current preferred option is Option 4.

Table 9 - Overall assessment

Opt	Description
1	Currently not a preferred option following an initial risk assessment as the new works would be constructed over the existing HS1 train tunnel, the site has multiple major highway, rail and river crossings and involves highly disruptive construction work in the centre of Dover. Extensive dosing may also be required due to rising main length.
2	Rejected on cost grounds
2a	Rejected on cost grounds
3	Currently not a preferred option, as initial feedback from the Environment Agency was not positive about discharging to ground in a Source Protection Zone/Safeguard Area
4	Preferred overall option
5	Currently not a preferred option, as initial feedback from the Environment Agency was not positive about discharging to ground in a Source Protection Zone/Safeguard Area

We recognise that, given the scale of the project, including the very high cost per customer served, we need to do further work before finalising the solution. Our solution development and estimating process will be ongoing to optimise the solutions before delivery commences. Cost savings as a result would be passed back to customers through our proposed Performance Commitment. We are also engaging with potential alternative solution providers to understand whether there are innovative market-based options which will deliver greater value for customers. At this stage we are not assuming that these discussions will result in adoption of a cheaper option, but if they do then our Performance Commitments will

protect customers.

We will particularly be investigating Options 1 and 3 in greater detail as these have potential to be the lowest overall costs, should we be able to overcome the concerns around constructability and groundwater discharge.

Customer protection

Customers are protected if the investment is cancelled or delayed by the proposal of a project delivery specific, penalty-only ODI (type P - CAC): PR19SRN_WWN14. Should the scheme not be delivered, the associated funding allowance will be returned to customers in full. The performance commitment will also protect customers should the project be delivered at a lower cost than the claim value due to a lower cost option becoming viable or a lower cost innovative approach being implemented.

We will update the CCG annually with regards to the progress that we are making to deliver the critical and significant programme of work, providing details of the capacity being created, the actual and forecast expenditure and the scheduled completion date.

Affordability

The total amount of the claim is £26.4 million.

This equates to £1.02 for an average wastewater customer.

Bills for our customers will be falling in AMP7 by significantly more than the amount of this claim (and our other cost adjustment claims).

Assurance

The cost estimates for the options that have been considered have been built using our well-established and regularly reviewed estimating cost curves, with scope lists developed by our Engineering and Technical Solutions team.

Robustness and efficiency of costs

We have used our Asset Lifecycle Management process to identify asset risks including: 'bottom-up' risks through engagement with operations, identifying issues such as increased compliance risk through the erosion in process capacity headroom, and; 'top down' risks, through analysis and scrutiny of Office for National Statistics (ONS), Experian and local authority data. Further details can be found in TA.12.WW05 - Wastewater Growth.

This analysis was then put through an Asset+ review – an internal challenge session involving operations, process scientists, planning and strategy, which enables us to prioritise risks presenting the greatest deterioration in service performance and consequence to our customers and statutory obligations. We identified risks which we consider require solutions to be scoped as part of our ongoing planning process and to inform our PR19 business plan. Those that are considered certain and urgent form part of our growth programme for delivery in AMP7.

The development at Whitfield was identified through this analysis and ongoing engagement with Dover District Council. Our Engineering and Technical Solutions team developed a solution report, which identified six potential options. These used our regularly reviewed engineering standards to ensure that the solutions are sized optimally, avoiding building excessive redundancy in to our designs and include innovative solutions as they become available. The solutions were then subject an internal challenge session to review and test the feasibility of the solutions, challenge the scope and consider local opportunities or risks. Following this, we sought further independent review using technical experts from our strategic supply partners. Using this approach for our wider growth programme has identified

improved options for a number of schemes but identified limited opportunities for Whitfield.

Having developed a robust view of the options available to resolve the need at Whitfield, we have utilised our Central Estimating Team (CET) to estimate of the cost for each of the optimised solutions. They maintain a suite of cost curves, based on the outturn costs of projects completed to date with efficiency adjustments made to align to our best estimate of upper quartile efficiency. We then used this information to select the lowest whole life cost solution. This estimating process aligns completely with our PR19 estimating process for complex projects.

We are also continuing to challenge available options to deliver best value to customers. This includes consideration of effluent reuse opportunities with Affinity Water, more localised flood management to address flooding risks in the area, and discussions with a third party owned and delivered treatment solution. At this stage we are not assuming that these discussions will result in adoption of a cheaper option, but if they do then our Performance Commitments will protect customers.

Board assurance

Our Board has reviewed all our Cost Adjustment Claims. The Board support the need for and have challenged the investment to ensure that we continue to meet our statutory obligations. We have carried out internal and external assurance of the options proposed in support of the Board challenge and assurance.

Detailed Technical Annex CAC03 Growth Whitfield

Introduction

This Detailed Technical Annex provides background to the solution development for the Whitfield Growth Cost Adjustment Claim (CAC).

Although it contains technical background and content, especially in the scope sections, it is generally written in a style to be understandable to a non-technical lay person.

Project Background / Need

The site to the west, north and east of the village of Whitfield in Kent has been allocated in Dover District Council's (DDC) master plan for strategic expansion of 5,750 properties by 2040. The properties will connect to the current Dover and Folkestone catchment upstream of Sandwich Road Whitfield Wastewater Pump Station (WPS), which serves the existing Whitfield catchment. A new interim storage tank will be provided adjacent to the Sandwich Road Whitfield WPS in AMP6 to protect properties from flooding as more connections are made up to 2025. In AMP7 the storage tank and existing WPS will be converted to a terminal WPS to transfer flows to treatment. By 2040 approximately 7,450 properties will be connected to this new WPS, with a proposed peak pump rate of 180l/s. The need to upgrade Folkestone and Dover WTW is directly related to the commissioning of this new pumping station, as there is no hydraulic capacity to accept the increased level of flow at the WTW.

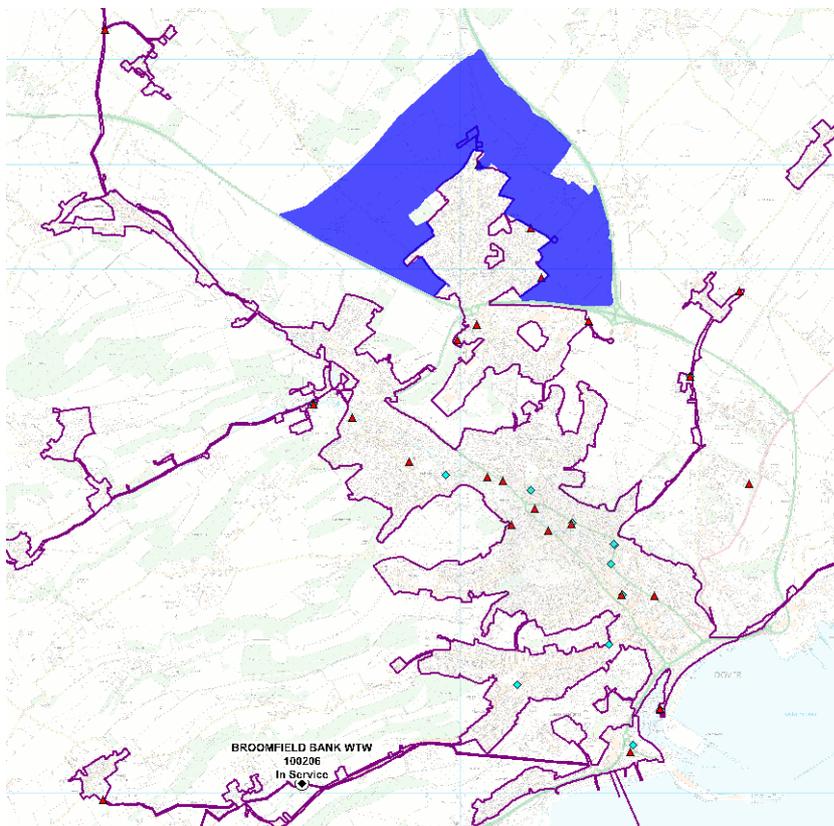


Figure 2: Whitfield Strategic Expansion (Blue), Dover and Folkestone Catchment (Purple)

The need for the expenditure is driven by concentrated greenfield housing growth and is part of the adopted core strategy and accepted master plan by DDC. Southern Water (SW) have a statutory duty to accommodate this growth, without a detriment to the environment or customers.

Development has already commenced, consisting of 74 houses that are now occupied (as of April 2017) and connected to the public sewerage network, with a further 126 houses due to be completed in 2018.

An interim storage scheme which will ultimately form the wet well of the new terminal WPS, is currently being progressed to facilitate the connection of the early stages of the development schedule and forms the initial phase of the Whitfield growth and resilience programme.

It is envisaged that the entire strategic expansion will take over 20 years to complete (i.e. up to 2040). SW have engaged with DDC to influence the development, however there remains some uncertainty over property build-out rate. The following schedule has been assumed when assessing the proposed strategy for Whitfield growth and resilience;

- 200 houses to be built by 2018 (74 units already built and occupied as of April 2017). Construction of the remaining 126 properties is currently underway.
- additional 960 houses to be built by 2022, mid-way through AMP7 (at a steady output of 240 per year, based on the housing delivery trajectory on the Master Plan¹¹)
- additional 4,590 houses to be built by 2040

We have designed our solutions based on the full 5,750 properties being constructed as per the agreed masterplan. This is estimated to occur before 2040 in our base scenario.

The trigger point for investment is point at which the interim storage scheme is transformed into the new terminal WPS. This needs to happen when the level of flooding protection falls below the 1 in 30-year protection level expected by customers. Using the above build rates this occurs in 2025. The WTW options for the discharge of the pumping station must therefore be constructed, commissioned and operable by this stage.

It is acknowledged that there will a phased delivery of housing in the area. We have utilised the masterplan forecast build schedule to maintain consistency with external forecasts. The 4,590 properties planned over the 18-year period (2022-2040) assumes a build out rate of circa 255 dwellings/yr, which is a slightly higher rate than would be achieved 2015-2022. We have developed scenarios that indicate what happens with a lower build rate and how customers would be protected in this eventuality. These are located within Appendix A.

Our solutions also include for the transfer of the existing Whitfield catchment to the new treatment solution. This is preferable for both technical reasons (our flow transfer point is the existing pumping station serving Whitfield) and from a long term growth facilitation perspective. Transferring the flow from the Whitfield catchment removes circa 1700 houses from the existing Dover and Folkestone catchment, allowing for projected catchment growth to 2035.

To ensure that we simultaneously meet our statutory obligation to accommodate this growth without harm to the environment whilst improving resilience, investment is required. Without this investment, the additional flow presented by the expansion of Whitfield would breach our statutory obligations and WTW environmental discharge permissions. It would also impact

¹¹ <https://www.dover.gov.uk/Planning/Planning-Policy-and-Regeneration/PDF/Whitfield-Masterplan.pdf>

on our environmental and customer obligations through increased spills to the environment, increased flood risk and reduced customer wellbeing.

A growth study was carried out in April 2017 which considered a number of initial options for the Whitfield expansion; including upsizing the existing sewers through Dover to the existing Wastewater Treatment Works (WTW) at Church Hougham (Dover and Folkestone WTW also known as Broomfield Bank WTW) or constructing a new Waste Water Treatment Works near to Whitfield, with a new environmental discharge.

Due to the scale and scope of works required to service the Whitfield expansion, and the engineering challenges faced a number of options have been assessed. This extensive option evaluation at this level of business planning demonstrates a commitment to explore opportunities to close the potential underfunding anticipated in Ofwat’s growth cost models. These options will be explored in the following section.

Options

Option 1 Dover and Folkestone WTW

Background

The existing Dover and Folkestone WTW (also referred to as Broomfield Bank), was constructed with a design horizon of 2021, and serves Dover, Folkestone and Whitfield. It is an entirely below ground treatment works due to planning conditions on the original development. The Channel Tunnel Rail Link (CTRL/HS1) is tunnelled on the western plot of SW land ownership.

Network upgrades were assessed in deriving the preferred transfer option to Dover and Folkestone WTW option. The existing sewerage system through much of historic centre of Dover would need major investment, causing significant disruption to residents and so was screened out in favour of the preferred direct pumped transfer from Sandwich Road WPS to Dover and Folkestone WTW via a more sympathetic route.

A hydraulic assessment was undertaken for the existing WTW and concluded there were significant hydraulic capacity limitations, with any increase in flows requiring a significant investment. Since Dover and Folkestone WTW is an entirely below ground works, there is little scope to provide additional hydraulic capacity alongside the existing process units and the storage volume required to balance future flows from the catchment does not present a viable long-term solution.

Catchment Growth Forecast

Including the Whitfield expansion, the Experian 7.1 population forecast predicts an increase in Population Equivalent (PE) of 18,929 in the Dover and Folkestone catchment by 2035.

Table 10: Dover and Folkestone Catchment PE forecast (2035)

	PE(2015)	PE(2030)	PE(2035)	Increase in population 2015 -2035 (PE)
Experian 7.1	119,749	134,495	138,678	18,929

When assessing the upgrade requirement at Dover and Folkestone WTW under this option, the preferred strategy relating to accommodating the growth forecast (2035), including the Whitfield strategic expansion (13,793 PE2035) considers the total growth in the catchment.

Scope & Cost

The following is the high-level scope required from both an Infrastructure (Network) and Non-Infrastructure (Treatment) perspective.

Infrastructure:

- 10km of new rising main (DN450)
- 1 No. New Wastewater Pumping Station (180l/s)
- 2 No. Railway crossings
- 1 No. Main river crossing

Capex Estimate: £14,306k

Non-Infrastructure :

- New below ground preliminary treatment building comprising:
 - Inlet chamber c/w H₂S suppression and storm separation
 - Storm screens c/w screenings handling plant and skips
 - Washwater booster station
 - Storm tank 691m³
 - Storm return pump station (17l/s)
 - Storm outfall connecting into the treated effluent outfall
 - Odour control to preliminary building
 - Replacement of thickened sludge transfer pumps
 - 350m³ additional thickened sludge storage
 - New centrifuge feed pump station
- To overcome the hydraulic capacity issues in the primary and secondary below ground treatment buildings:
 - Modify security chamber to accept flow from new preliminary treatment building
 - Replace inlet screens, sized for 1028 l/s capacity
 - Replace and raise outlet launders on the Fat Oil and Grease (FOG) tanks
 - Replace and raise outlet launders on all four lamellas in the lamella hall
 - Replace existing centrifuges for high capacity units
 - Reuse and strengthen the existing centrifuge support steelwork
 - Replace and strengthen the Biological Aerated Flooded Filter (BAFF) bead screens
- Provide a new Works MCC (220kW)
- New telemetry outstation

CapEx Estimate: £25,437k

Total CapEx Estimate: £39,743k

Scope exclusions:

The following items were acknowledged, but excluded from the notional scope:

- Ferric Storage:
 - Additional ferric consumption of 82 t/annum (at 13.1% concentrate solution). This equates to an additional 5m³ of storage being required. This was not sought, as the lowest WLC would be for more frequent chemical deliveries.

- Polymer Storage
 - Additional polymer consumption of 2t/annum is calculated. For similar reasons to the above, this was excluded based on more frequent chemical deliveries.
- Sludge Cake
 - Thickened sludge production has increased by 3522m³/yr at 25%. Cake transfer, and sludge cake storage have been excluded due to costs associated with modifying the primary treatment building. Instead it has been assumed that cake will be removed more frequently.
- Pre-thickened sludge storage
 - The existing pre-thickened sludge storage capacity is currently 10% of the requirement. The Whitfield growth component of this is comparatively small so the cost to provide 100% pre-thickened sludge storage capacity has been excluded.

Risk

The following high-level risks and complexities are listed below.

Infrastructure:

- Development site not confirmed, so route subject to change
- Railway crossing under a narrow railway bridge
- Main river crossing in the centre of Dover
- Railway crossing, across existing bridge along Tower Hamlets Road
- Significant disruption to the residents of Dover
- Working along a Type 2 Road (Frith Road and Barton Road)
- Ecological and archaeological surveys may be required for working across fields
- Roads in Dover are likely to be congested with existing services
- Risk to gaining permission for lane closure along Type 2 Roads
- Risk of delays due to permissions to cross railways and river

Non-Infrastructure

- The new preliminary treatment works below ground structure is adjacent to or over the Channel Tunnel Rail Link (HS1), posing a risk to critical national infrastructure
- The exclusions listed above fall into scope
- Environmental Impact Assessment is likely to be required
- The notional scope associated with hydraulic upgrades to the Primary and Secondary buildings are insufficient
- Although the process assessments indicate that there is biological process capacity at the works, there is a risk due to ongoing performance issues associated with the BAFF design that achieving full capacity is not reliably achieved across the full range of flows.

The greatest risk to this option is the likely planning requirement to house the preliminary treatment plant, within a building below ground, as per the original works design. Further to

this is the risk to critical national infrastructure (CTRL/HS1) which is tunnelled within this work area.

Southern Water lease the subsoil to 35m above the rail level of the CTRL in this area. HS1, Network Rail and GETLINK (formerly Euro Tunnel) have been engaged. Latest communications indicate the tunnel is at depth, however specialist consultants would be required to advise on monitoring regime (track, tunnel, vibration, noise etc.) and to advise on construction methodologies.

At the time of writing it has been assumed the construction area and the CTRL Ltd. leasehold / ownership interest areas do not occupy the same area, and that any nuisance (noise and vibration) will be managed in construction, and that the CTRL infrastructure will have geodetic and vibration monitoring throughout the construction process. The risk has been monetised in the cost estimate and captured on the risk register. The option evaluation weighs this factor in the option selection process.

Programme

The standard PR19 durations used for Non-Infrastructure projects, based on value have been reviewed for Options 1-5, as the 44-month duration was considered to be unrealistic for the complexity and value of work envisaged. The revised estimated total duration for this option was 54 months.

Option 2 – Transfer to another catchment

Background

The network upgrade and the expansion at Dover and Folkestone WTW presented a unique set of challenges which were considered to be inefficient and of low resilience. Several assessments on whether the Whitfield strategic expansion could be transferred to another catchment, or whether some of the existing Dover Folkestone catchment could be transferred to provide capacity were then progressed.

Transfer of Folkestone catchment to West Hythe WTW

Initially the option to divert flows from Folkestone to the west Hythe catchment was investigated to utilise headroom at the West Hythe WTW, and release capacity for connection at Dover and Folkestone WTW.

The terminal WPS for Folkestone is Folkestone Junction WPS, which currently pumps at around 430l/s, with a DWF of 78l/s and is located on the eastern edge of the town. These flows would need to be diverted over 8km to Range Road Hythe WPS. Primary treatment for this catchment is then carried out at this WPS before the flow is pumped to West Hythe WTW along a 4.7km 450mm diameter rising main. Due to the large increase in flow, from Folkestone Junction, this rising main would then also require upsizing at significant cost and disruption.

To reduce the scale of the solution, an option to divert a WPS closer to Hythe was investigated. Granville Parade Sandgate WPS is the only significant WPS closer to Hythe than Folkestone Junction, however, this is still located 5km from Range Road Hythe WPS. Granville Parade Sandgate WPS also only pumps around 96l/s (based on a historic report from 1996) with a DWF of 14l/s. Therefore, removing this WPS sub-catchment from the Folkestone catchment would not provide enough capacity for the Whitfield expansion, with the rising main from Range Road requiring upsizing.

The transfer of the entire Folkestone catchment would still require a rising main from Sandwich Road Whitfield WPS to the catchment area being transferred to leverage the headroom created.

Furthermore, there is another planned area of strategic expansion in the West Hythe catchment for the Otterpool Garden Village. This has the option to connect to West Hythe WTW, though this is currently not preferred. As this proposed site is for up to 12,000 houses, this could have a major impact on any potential capacity at this WTW and was dismissed from the catchment transfer sub-option evaluation.

Transfer to Eastry WTW

The nearest WTW to Whitfield is Eastry WTW, located approximately 9.5km to the north of Whitfield. A sewer to this location would be approximately 10km long through rural land, following the A256 from just north of Whitfield. The work would mainly be following boundaries of agricultural fields or small country roads without any major crossings required. However, this would therefore affect more land owners, but may provide a cost-effective solution for the new sewers to a WTW.

Eastry WTW serves a population of 2,283, and therefore a significant upgrade to the works or a new side stream WTW alongside the current arrangement would be required to take the additional flow from Whitfield. The works are located within agricultural land which provides scope for expansion.

A seven-fold increase in PE at that works and receiving water course was deemed untenable. We anticipate significant issues with potential septicity when pumping flows that distance, permitting requirements and the associated significant disruption to the small Eastry conurbation and numerous land estate holders.

For these reasons this option was screened out of the catchment transfer sub-option evaluation.

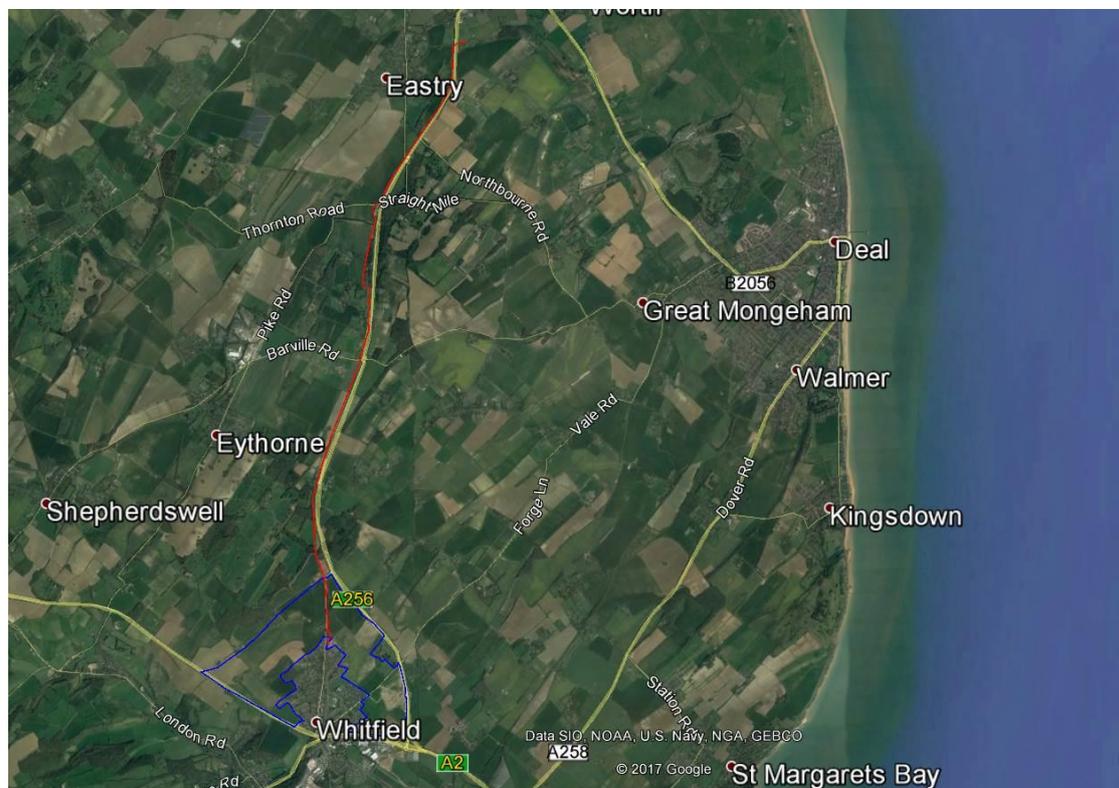


Figure 3: Proposed route from Whitfield WPS to Eastry WTW

Transfer to Weatherlees Hill

The nearest large WTW to Whitfield other than Dover and Folkestone WTW is Weatherlees Hill WTW, which serves a population of around 182,403. Located north of Sandwich, around 17km away from Whitfield there is scope for expansion to provide a third treatment stream (Weatherlees C) to treat the Whitfield flows.

This catchment is large and extends towards part of Ringwould, Deal c. 8km from Whitfield. The sewer to this catchment, and sewers on the extremity of the existing catchment would require significant infrastructure upgrades to cope with the flows. For this reason, a rising main direct to Weatherlees WTW was progressed at 19km long, following the A256. The majority of the rising main would be constructed within the fields adjacent to the road where possible. However, from Great Stonar, this would likely not be possible, and it would have to be in the verge or road. This route would require crossing at least 2 main rivers between Sandwich and Weatherlees Hill.

There is significant uncertainty associated with the permitting requirement, pumping capabilities at this distance (with associated septicity) and outfall capacity that this option was screened out of the sub-option transfer evaluation.

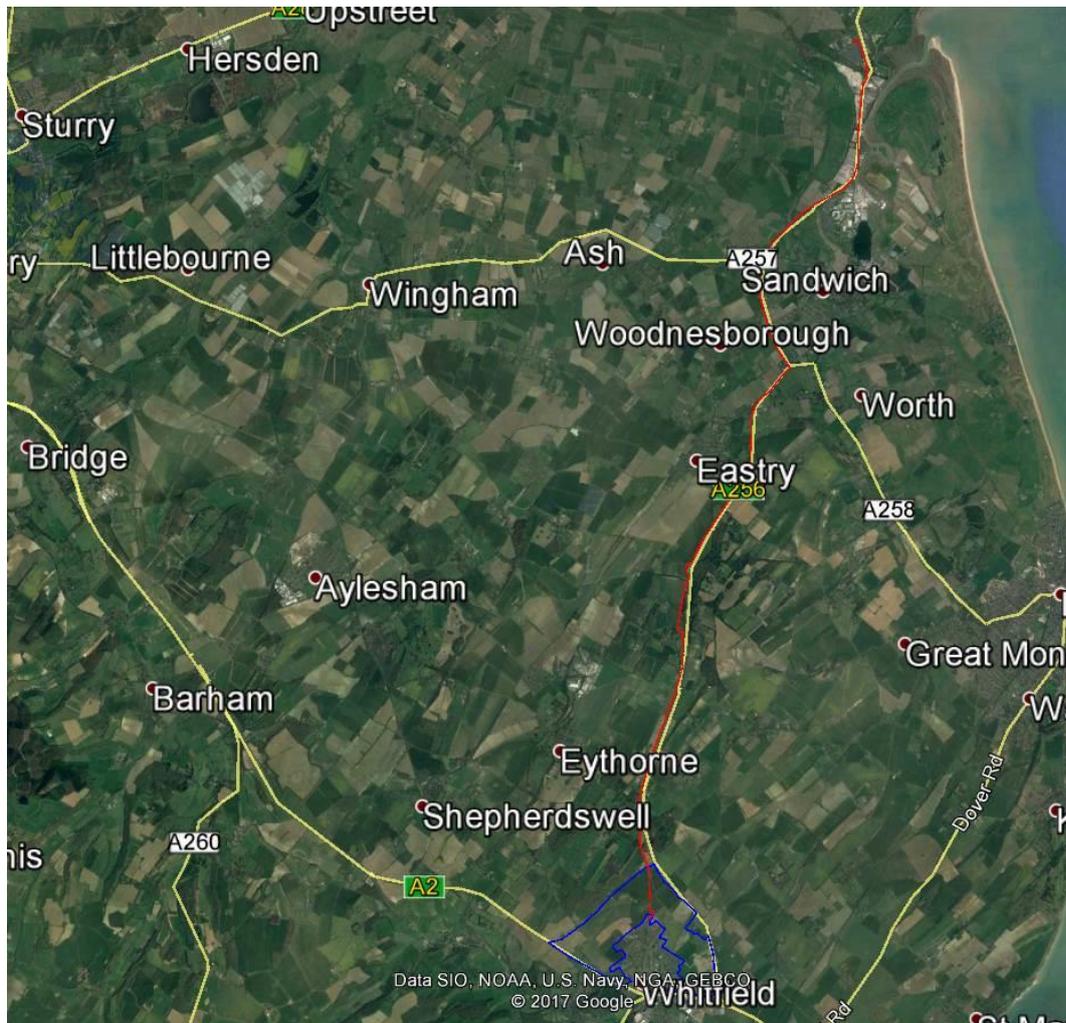


Figure 4: Proposed route to Weatherlees Hill WTW

Transfer to Dambridge Wingham WTW

Dambridge WTW serves a population of 16,906 and the location provides scope for expansion within the current SW land ownership area. The catchment is located approximately 4km to the north west of Whitfield, however, this catchment is spread over a large area with the WTW being 12.5km from Whitfield. As the catchment is quite small, the sewerage infrastructure was assessed as being unlikely to have sufficient capacity for the flows from Whitfield with significant infrastructure upgrades and disruption to residents over a large area. It was assessed that the connection would need to be directly to the WTW via a more sympathetic route to minimise disruption. A majority of this route follows the existing sewers in the Dambridge, Wingham catchment to the WTW along country roads and through fields.

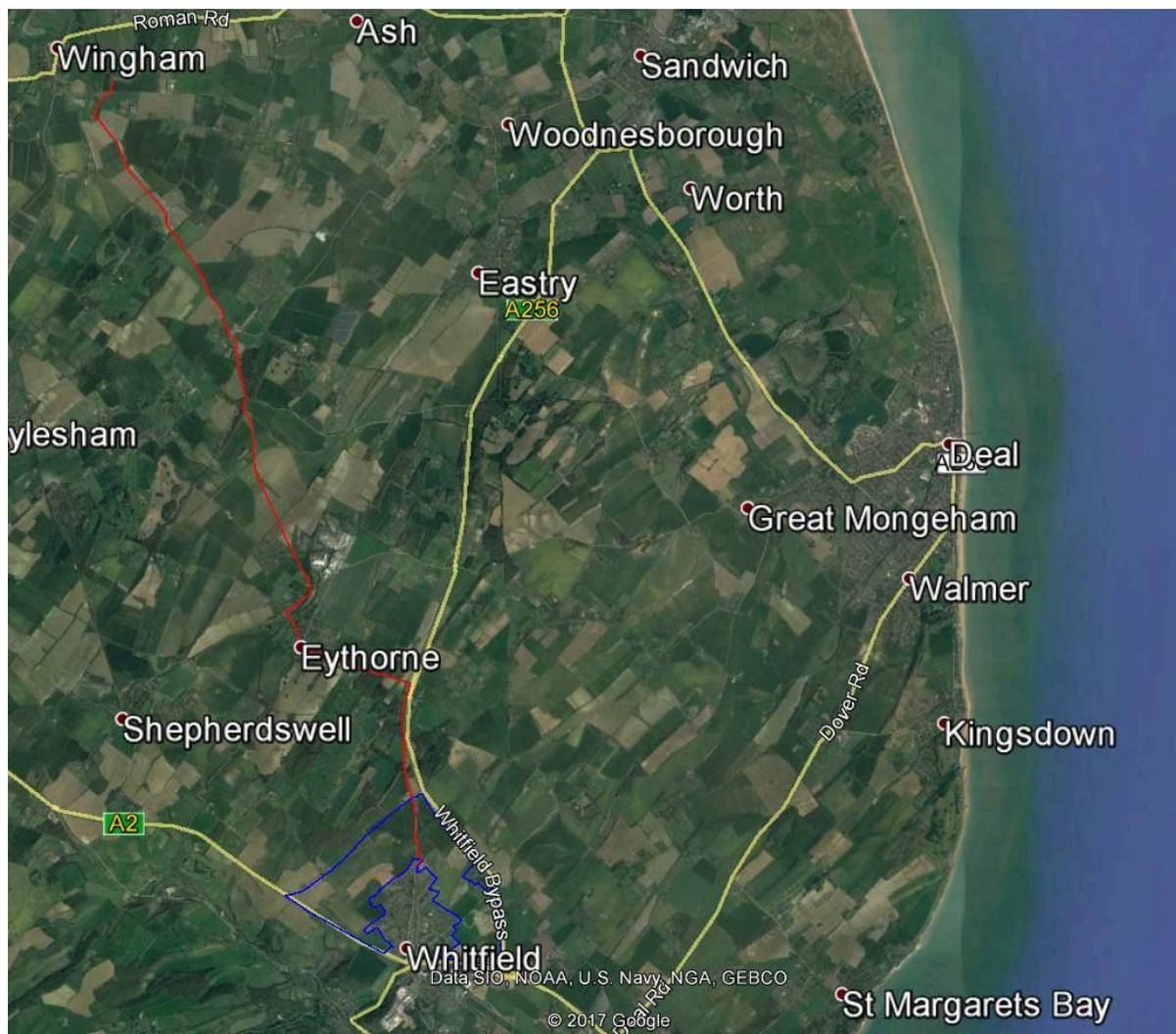


Figure 5: Proposed route from Whitfield to Dambridge, Wingham WTW

Table 11: Summary of catchment transfer options assessed

Transfer Sub Option	Length of sewer (km)	Urban/ Rural	Railway crossing	River crossing	Current total PE at WTW	Approx % increase of PE
Broomfield Bank	10.06	Urban	2	1	114,216	12
Eastry	10.14	Rural	0	0	2,283	783*
Weatherlees Hill (A & B)	18.75	Rural	0	2	182,403	10*
Dambridge Wingham	14.16	Rural	0	0	16,906	106*

*These percentage increases are based on the whole of Whitfield, not just the Whitfield expansion

Of the high-level sub-options considered above, the transfer to Dambridge WTW with subsequent expansion was progressed to a further level of detail and sub-option evaluation. This served as a comparison to expansion at Dover and Folkestone WTW, prior to evaluating new WTW options.

Option 2 – Dambridge WTW – Major Upgrade

Background

This option for the expansion of Dambridge WTW considers the following discharge permit conditions, based on a load-stand still presumption, common throughout the PR19 growth portfolio when addressing the permitting uncertainty. For this option Phosphorous was reduced beyond this to 0.25mg/l given the sensitivity of the receiving water course.

Table 12: Assumed permit conditions at Dambridge WTW for Option 2

Determinant	Current	Proposed
Dry Weather Flow (m ³ /d)	3150	6300
Flow to Full Treatment (FFT in l/s)	103	206
Total Suspended Solids (mg/l)	30	15
Biological Oxygen Demand (mg/l)	15	7.5
Ammonia (as N) mg/l	-	-
Total Iron (mg/l)	4	4
Total Phosphorous (mg/l)	2	0.25

Scope & Cost

Infrastructure:

- 14km DN450 rural rising main
- 1 No. Wastewater Pumping Station (180l/s)

Capex Estimate: £13,681k

Non-Infrastructure:

- 2 No. 539m³ Storm Tanks

- Inlet works comprising collection channel, flume, storm control / measurement and UWWTD sampling point
- 2 No inlet screens c/w screening handling and covered skips
- 1 No. Detritor c/w classifier and skips
- Extensive modification to existing inlet works to accept new transfer connection
- Upgrade existing wash water booster station
- 1 No. 10m³ Ferric storage for primary chemical dosing (in addition to the existing primary chemical ferric storage)
- 1 No. 10m³ ferric dosing system for secondary chemical dosing
- 1 No. 15m³ ferric dosing system for tertiary chemical dosing
- 3 No. Extended aeration lanes including internal recycle pump station
- 5 No. Aeration blowers 2030m³/hr
- Make redundant and safe
 - 2 no. syphon chambers
 - 8 no. filter beds
 - 2 no. humus tanks
 - 1 No. final effluent chamber
- 4 No. 17m dia. Final Settlement Tanks (FST)
- 1 No. Return/Surplus Activated Sludge (RAS/SAS) pump station at 158l/s capacity
- 1 No. Tertiary Treatment Plant (TTP) feed pump station at 220l/s capacity
- 2 No. Two-stage Tertiary cloth pile filters
- 1 No. Un-thickened sludge storage tank at 631m³ c/w Odour Treatment Unit (OTU)
- 1 No. Power upgrade
- 1No. Standby generator at 450kVA
- 1 No. Works Motor Control Centre (MCC) at 350kW c/w new telemetry outstation

Capex Estimate: £34,421k

Total Capex Estimate: £48,102k

Risk

The following high-level risks and complexities are listed below.

Infrastructure:

- Development site not confirmed, so route subject to change
- Ecological and archaeological surveys may be required for working across fields
- Septicity concerns over long rising main

Non-Infrastructure

- There is uncertainty over the permitting requirements and whether an increase in flows to the River Stour would be acceptable
- Drinking water hardness from Affinity Water indicates that alkalinity dosing will not be

required to adjust pH, following the three-point ferric dosing. There is a risk that this is not the case and further chemical dosing for pH correction is required

Programme

The standard PR19 durations used for Non-Infrastructure projects, based on value have been reviewed for Options 1-5, as the 44-month duration was considered to be unrealistic for the complexity and value of work envisaged. The revised estimated total duration for this option was 54 months.

Option 2A – Dambridge WTW – Side Stream

Background

Whilst undertaking the assessment at Dambridge WTW it was clear that a major works overhaul would be preferred technically to a side stream process but may not offer the least Whole Life Cost solution. The sub-option was assessed with a combined effluent stream to outfall in the River Stour.

Table 13: Assumed Permit Conditions at Dambridge WTW for Option 2A

Determinant	Current	Proposed
Dry Weather Flow (m ³ /d)	3150	6300
Flow to Full Treatment (FFT in l/s)	103	206
Total Suspended Solids (mg/l)	30	15
Biological Oxygen Demand (mg/l)	15	7.5
Ammonia (as N) mg/l	-	-
Total Iron (mg/l)	4	4
Total Phosphorous (mg/l)	2	0.25

It should be noted that the process design is based on a Membrane Bio Reactor (MBR) treating 50% of the Flow to Full Treatment (FFT) to a 0.1P and 5 BOD 95thile, to achieve the required effluent blend.

Scope & Cost

Infrastructure:

- 14km of DN450 rural rising main
- 1 No. Wastewater Pumping Station (180l/s)

Capex Estimate: £13,681k

Non-Infrastructure:

- New inlet works including collection channel, flume, storm/flow control and UWWTD sampling point
- 2 No. 6mm 2D Inlet screens c/w screening handling and covered skips
- 1 No. Detritor c/w classifier and skips
- Upgrade to existing wash water booster station
- Convert the existing Primary Settlement Tanks (PST) to storm tanks to provide min of

539m³ storm volume required, c/w provision of storm mixers

- 1 No. Storm return pump station (40l/s capacity)
- 2 No. 16m diameter Primary Settlement Tanks c/w with Auto De Sludge (ADS) unit
- 1 No. Flow split chamber 50:50 downstream of PST
- 1 No. 20m³ Ferric storage and dosing system to PSTs
- Reuse existing 10m³ primary ferric storage tank but convert the Point of Application (POA) to secondary treatment to MBR anoxic tank on Stream B
- 1 No. 15m³ Ferric dosing system to secondary settlement on Stream A
- Secondary treatment (Stream B)
 - 1 No. 270m³ anoxic selector c/w 2.7kW mixer
 - 3 No. Membrane Bio Reactor (MBR) plant to treat 50% flow to a 0.1P, 5 BOD standards
 - 3 No. Aeration lanes for MBR plant, 1800m³ c/w aeration blowers @ 2000m³/hr
 - 1 No. 200m³ permeate tank
- Tertiary treatment (Stream A)
 - 1 No. Deep Bed Sand Filter (DBSF) pump station at 110l/s capacity
 - 1 No. Deep Bed Sand Filter plant (40m² total area)
 - 1 No. clean and dirty backwash tanks – 50m³ each
- 1 No. Final effluent monitoring chamber
- 1 No Sludge storage tank at 631m³ capacity c/w OTU.
- 1 No. 500kVA transformer and power upgrade
- 1 No. Standby generator at 500kVA
- 1 No. Works MCC at 350kW with new telemetry outstation

Capex Estimate: £32,530k

Total Capex Estimate: £46,211k

Risk

The following high-level risks and complexities are listed below.

Infrastructure:

- Development site not confirmed, so route subject to change
- Ecological and archaeological surveys may be required for working across fields
- Septicity concerns over long rising main

Non-Infrastructure

- There is uncertainty over the permitting requirements and whether an increase in flows to the River Stour would be acceptable
- The blended option relies on 50% of the flow being treated to the current standard 95%ile without investment under this scheme to 2035.

- Drinking water hardness from Affinity Water indicates that alkalinity dosing will not be required to adjust pH, following the three-point ferric dosing. There is a risk that that is not the case and further chemical dosing for pH correction is required

Programme

The standard PR19 durations used for Non-Infrastructure projects, based on value have been reviewed for Options 1-5, as the 44-month duration was considered to be unrealistic for the complexity and value of work envisaged. The revised estimated total duration for this option was 54 months.

Option 3 – New WTW; Groundwater Discharge

Background

After establishing that the local existing treatment works options (ranging 10-19km from the development) required significant infrastructure and non-infrastructure investment to cater for the 2040 population projections from the Whitfield expansion, options were developed to assess the possibility of a new WTW local to the development site, with a discharge, within the catchment served.

Traditionally three options exist for discharge of settled storm and treated effluent; discharge to ground, discharge to sea or discharge to river.

With each of these discharge options there is significant uncertainty relating to the permit conditions, location of the WTW and the location of the discharge.

In December 2017, the Environment Agency (EA) were consulted to establish an early indication of constraints that may be a major factor in these development proposals. The initial feedback was that ‘we do not believe that is a good idea to discharge this volume of sewage effluent to the ground in these areas’. The EA did make clear that they would assess any application in its merits, however were concerned about potential detrimental impact on water quality.

At this early stage of the project it is not appropriate to undertake prior examination of the chalk aquifer, source protection zones, safeguard zones etc. Instead a review of stewardship areas relating to groundwater quality was assessed in order to locate the new WTW and groundwater discharge within the vicinity to the Whitfield development.

The proposed WTW location was notionally selected adjacent to the development area, in local pasture. It is outside the Groundwater Nitrate Pesticide Water Quality Priority Area (red, Figure 6) but sat just within the extent of both Faecal Indicator Organism issue area (yellow, Figure 6) and Ground and Surface Water Nitrate Vulnerable Zone [2017] (blue, Figure 7).

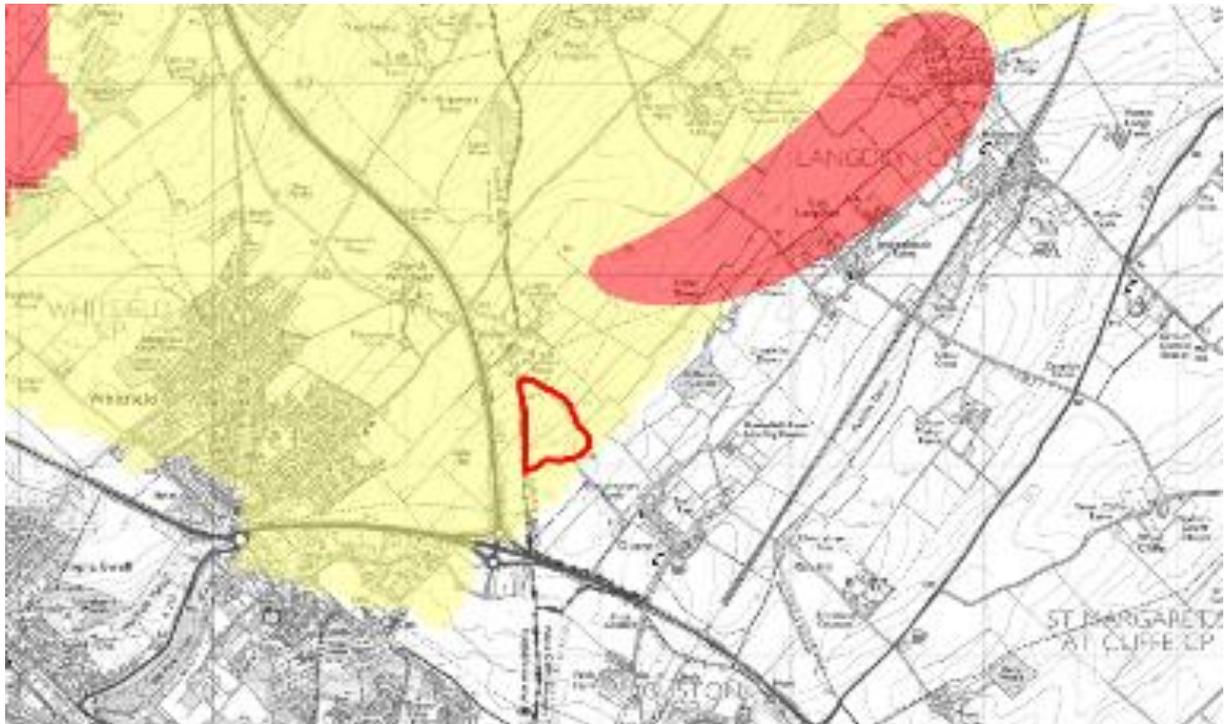


Figure 6: New WTW location overlain by Groundwater Nitrate and Pesticide Issue Priority Zones

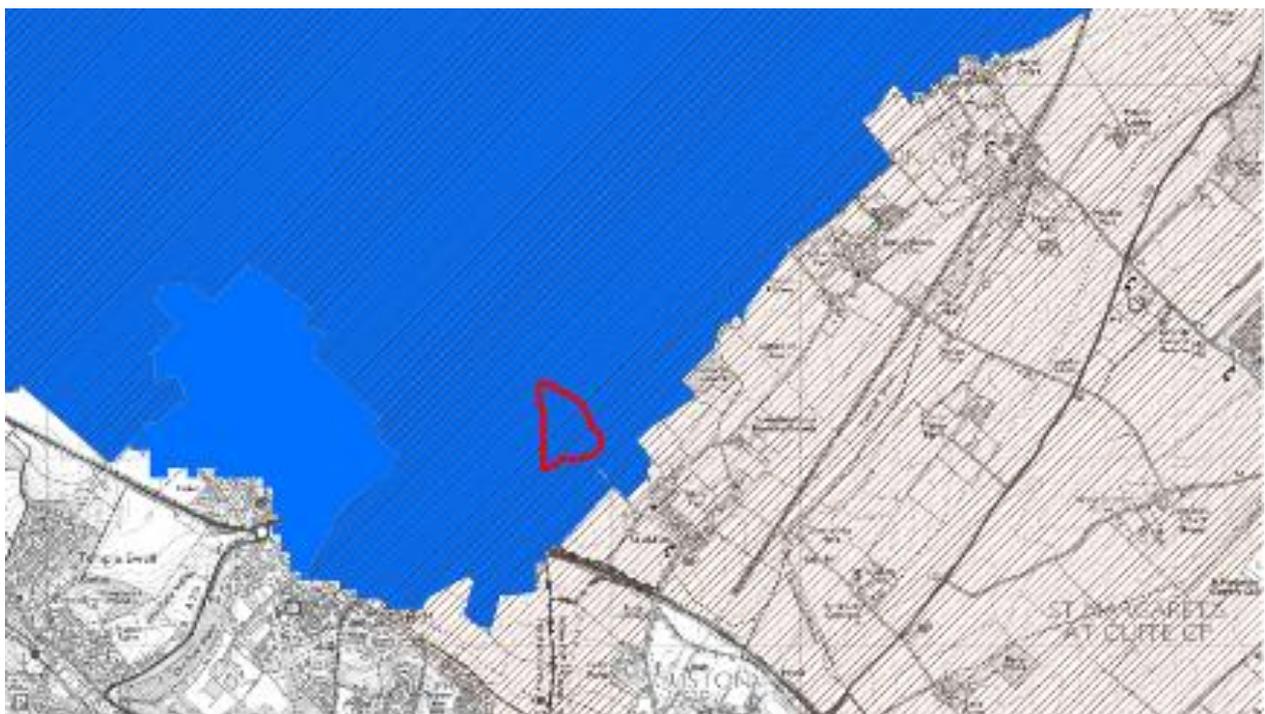


Figure 7: New WTW location overlain by Ground and Surface Water Nitrate Vulnerable Zones

The reason for this early siting within these stewardship areas was to assume a suitable, justifiable permit condition which promotes a high-quality treated effluent, suitable for water reuse.

At this level of definition, it would be possible to locate in an adjacent pastoral field which sits outside all priority areas, however it would still sit within a Zone III Source Protection Zone. As such we arrived on the following assumed permit condition:

Table 14: Assumed Permit Conditions at Whitfield New WTW for Option 3

Determinant	Proposed
Dry Weather Flow (m ³ /d)	3024
Flow to Full Treatment (FFT in l/s)	105
Total Suspended Solids (mg/l)	30
Biological Oxygen Demand (mg/l)	20
Total Nitrogen (mg/l)	10

It should be noted that the Dry Weather Flow (DWF) adopted, includes a 25% headroom factored in, which was felt appropriate to consider for a new strategic WTW, to enhance resilience to future growth.

Scope & Cost

Infrastructure:

- 3.1km DN450 rural rising main
 - 1 No. Major road crossing
- 1 No. Wastewater Pumping Station (180l/s)

Capex Estimate: £4,291k

Non-Infrastructure:

- Land purchase 270x170m (11.4 acres) min
- 1 No. Administration / welfare building (10x10m)
 - Power, water, transport link and communications to site
 - Including welfare, works laboratory and MCC Room
- 1 No. Inlet works comprising
 - 6mm 2D Screen with 180 l/s capacity, inlet channel and FFT/storm control
 - Screening handling c/w covered screening skips, grit detritor, classifier and skip
- 1 No. 540m³ storm tank c/w mixing and storm return pump station. Storm overflow to groundwater discharge
- 2 No. 11.2m dia. Primary Settlement Tanks (PSTs) c/w Auto De-Sludge pump station to sludge thickening plant
- 1 No. Picket Fence Thickener (PFT) at 82m³
- Thickened sludge transfer pumps to thickened sludge holding tank
- 1 No. 296m³ Thickened sludge holding tank
- 1 No Extended aeration plant comprising:
 - 1 No. Anoxic selector tank at 180m³ c/w 2kW mixer
 - 3 No. First stage anoxic zones (total volume 500m³)
 - 3 No. Aeration lanes (total volume 2,500m³)
 - 3 No. Second stage anoxic zones (total volume 500m³)
 - 3 No. reaeration zones (total volume 125m³)

- Fine Bubble Diffused Aeration (FBDA) and aeration blowers for 3433m³/h capacity
- 1 No. Methanol dosing plant sized for 20m³ storage and 10l/h dose rate
- 3 No. 14.5m dia. Final Settlement Tanks (FSTs) c/w Auto De-Sludge
- 1 No. Return Activated Sludge (RAS) pump station at 75l/s capacity
- 1 No. Surplus Activated Sludge (SAS) control to Works Return Pump Station (WRPS) at 10l/s
- 1 No. Works Return Pump Station (WRPS) sized at 20l/s
- 1 No. Final effluent monitoring chamber
- 1 No. Herringbone soakaway arrangement for land treatment / ground discharge
- 1 No. Washwater chamber with washwater booster station

Capex Estimate: £29,831k

Total Capex Estimate: £34,122k

Risk

The following high-level risks and complexities are listed below.

Infrastructure:

- Development site not confirmed, so route subject to change
- Ecological and archaeological surveys may be required for working across fields
- Crossing under major road (A256)

Non-Infrastructure

- There is uncertainty over the permitting requirements for the land discharge as no prior monitoring has been undertaken.
- There is a risk that land purchase and associated planning development is more complex

As there is uncertainty over the permitting requirements, we have sought wider guidance on the appropriate measures to be used. Our Strategic Solutions Partner suggests that a permit of 8.3mg/l Total Nitrogen (TN) and a requirement to disinfect prior to ground discharge may be imposed.

The basis of this view was that an 8.3mg/l TN permit has been issued to Southern Water and delivered under Quality programme in AMP6 at Shipton Bellinger WTW; the discharge at this site was also a groundwater discharge to a chalk aquifer. 8.3mg/l TN represents 75% of the drinking water safe nitrate limit. The requirement for disinfection is from the microbial concern raised by the EA in their initial response. This hasn't been established before, but it is a view on the potential direction of travel with the EA based on interpretation of some initial correspondence.

If this risk materialised it would require Real Time Control (RTC) to the extended aeration plant and Ultra Violet (UV) disinfection after secondary settlement. A sub-option which considers a Membrane Bio-Reactor could be considered in view of this but it's not clear which offers least Whole Life Cost.

At this stage, this risk has been excluded from our scope. It has been factored into the Optioneering matrix, within the uncertainty experienced across the entire presumed permit determinants.

Programme

The standard PR19 durations used for Non-Infrastructure projects, based on value have been reviewed for Options 1-5, as the 44-month duration was unrealistic for the complexity and value of work envisaged. The revised estimated total duration for this option was 57 months.

Option 4 – New WTW; Coastal Discharge

Background

It is widely acknowledged that discharging to a coastal marine environment facilitates a more relaxed standard of treatment, however the savings are often offset by expenditure associated with working in the marine environment.

This option was assessed as it was unclear whether the cost to treat to a lower standard, offsets the additional cost of a marine discharge. For the purposes of this assessment the following permit condition was assumed:

Table 15: Assumed permit conditions at Whitfield New WTW for Option 4

Determinant	Proposed
Dry Weather Flow (m ³ /d)	3024
Flow to Full Treatment (FFT in l/s)	105
Total Suspended Solids (mg/l)	60
Biological Oxygen Demand (mg/l)	40
Total Nitrogen (mg/l)	-
UWWTD % reduction applied?	YES

It should be noted that the DWF adopted, includes a 25% headroom factored in, which was felt appropriate to consider for a new strategic WTW, to enhance resilience to future growth.

In conjunction with developing this solution is an assessment of the marine environment's ability to accept further discharge in that region. The proposed discharge does not lie within Shellfish Waters; however the discharge has the potential to affect Bathing Water quality.

A high-level simulation was undertaken based on:

- Wind for six sectors
- Continuous treated discharge up to FFT
- Intermittent storm discharge (modelled as occurring 3 times per bathing season)

This initial assessment showed that an outfall of 2.1km in length would protect the coast such that a concentration of 25cfu/100ml (10% of the excellent standard) would be exceeded for less than 2% of the time at the coastline. Figure 7 illustrates the model plume dispersion.

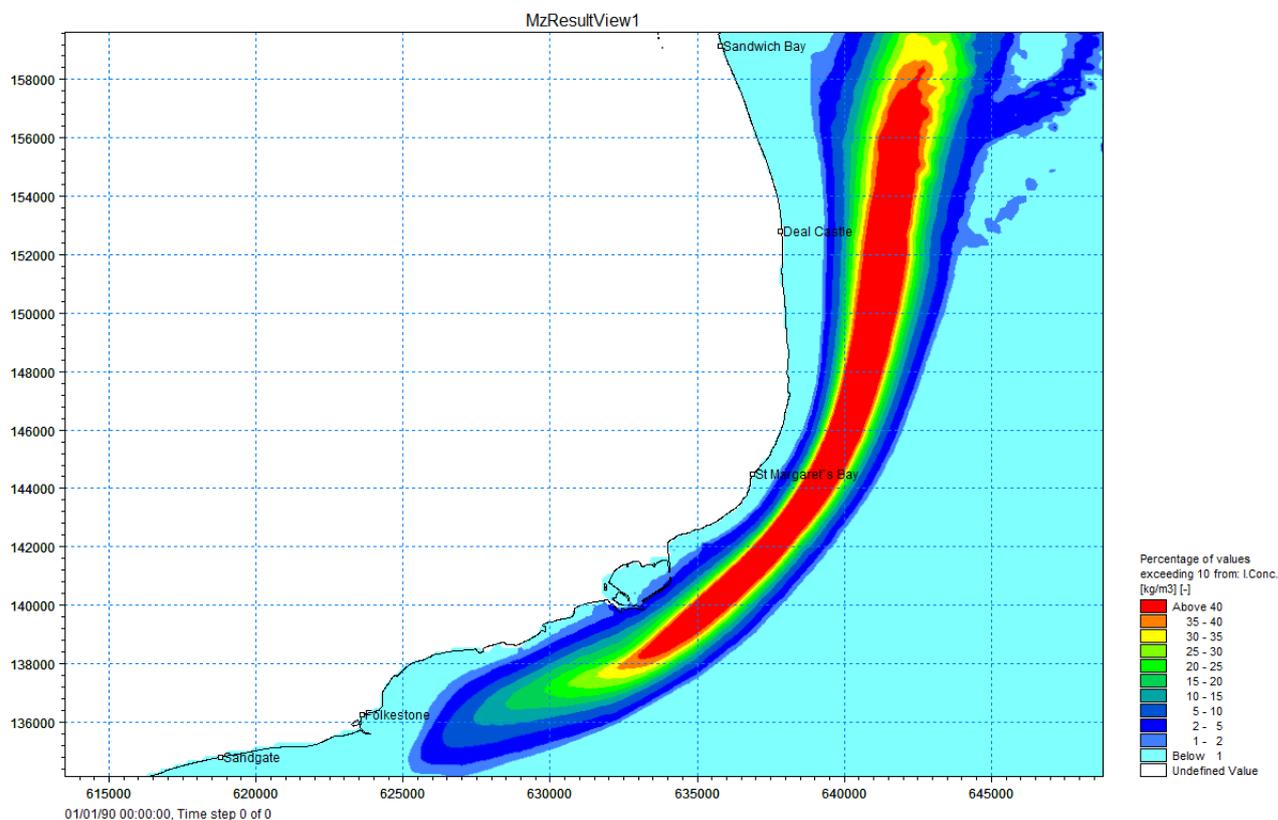


Figure 8: EC Exceedance Representation

However, due to the likelihood that storm discharges could occur more than 3 times per bathing season, an outfall length of 3km, like the existing outfall from Dover and Folkestone WTW was adopted for initial cost estimating purposes.

Scope & Cost

Infrastructure:

- 3.1km of new rising main (DN450)
- 1 No. Wastewater pumping stations (180l/s)

Capex Estimate: £4,291k

Non-Infrastructure:

- 1No. Wastewater pumping station (180l/s)
- 4.1km of new rising main (DN450)
- 2km of new gravity sewer (inc. tunnelling)
- 3km Long Sea Outfall
- Land Purchase 250x70 (min)

- 1 No. Administration / welfare building (10x10m)
 - Power, water and communications to site
 - Including welfare, works laboratory and MCC room
- 1 No. Inlet works comprising
 - 6mm 2D Screen with 180 l/s capacity, inlet channel and FFT/storm control
 - Screening handling c/w covered screening skips, grit detritor, classifier and skip
- 1 No. 540m³ storm tank c/w mixing and storm return pump station. Storm overflow to outfall
- 2 No. 11.2m dia. Primary Settlement Tanks c/w auto de sludge pump station to sludge thickening plant
- 1 No. Picket Fence Thickener at 82m³
- Thickened sludge transfer pumps to thickened sludge holding tank
- 1 No. 296m³ Thickened Sludge Holding Tank
- 1 No Extended aeration plant comprising:
 - 3 No. 14.5m dia Final Settlement Tanks c/w auto de sludge
 - Return Activated Sludge pump Station at 75l/s capacity
 - Surplus Activated Sludge control to Works Return Pump Station at 10l/s
 - 1 No. Works Return Pump Station sized at 20l/s
 - 1 No. Final Effluent monitoring chamber
 - 1 No. Washwater chamber with washwater booster station

Capex Estimate: £31,422k

Total Capex Estimate: £35,713k

Risk

The following high-level risks and complexities are listed below.

Infrastructure:

- Development site not confirmed, so route subject to change
- Ecological and archaeological surveys may be required for working across fields
- Crossing under major road (A256)
- Crossing of railway
- Tunnelling required through St. Margaret's at Cliffe
- Construction works on the foreshore / bay at adjacent to a popular restaurant
- Significant disruption to the residents of Dover
- Working along a Type 2 Road (Frith Road and Barton Road)
- Requires construction of a long sea outfall – marine working

Non-Infrastructure

- There is a risk that land purchase and associated planning development is more difficult

There is low risk that the discharge to sea would require a separate Short Sea Outfall (SSO) for intermittent discharges and a Long Sea Outfall (LSO) for continuous discharge. This risk has been evaluated to be low, and with an estimated total cost increase to £42,588k

Programme

The standard PR19 durations used for Non-Infrastructure projects, based on value have been reviewed for Options 1-5, as the 44-month duration was considered to be unrealistic for the complexity and value of work envisaged. The revised estimated total duration for this option was 57 months.

Option 5 – New WTW; Inland River Discharge

Background

The final option considered was new WTW with the discharge to an inland main river (River Dour).

The River Dour is a chalk stream, approximately 4km in length which discharges in to the Wellington Dock, which leads to the Granville Dock. Both docks have dock gates which open into a tidal basin at Dover harbour.

The River Dour is in hydraulic continuity with the groundwater; as the groundwater contributes to the flow in the river for part of the year and receives water from the river for part of the year. Therefore, any solution discharging into this surface water presents a risk to ground water quality as well as surface water quality.

With respect to the groundwater environment in the Whitfield area there are several abstractions operated by Southern Water and by Affinity Water with Source Protection Zones around them. Several of these abstractions are showing rising trends of pollution, predominately nitrate but some pesticides too. These deteriorating trends have resulted in the Source Protection Zones being determined as Safeguard Zones.

In December 2017, the Environment Agency were consulted to establish an early indication of constraints that may be a major factor in this development proposal. The same reservations that were communicated for Option 3 would apply to this option.

At this early stage of the project it is not appropriate to undertake prior examination of the chalk aquifer, source protection zones, safeguard zones etc. Instead a review of Source Protection Zones (SPZ) relating to groundwater quality was assessed to locate the new WTW and surface water discharge within the vicinity to the Whitfield development.

The surface water discharge in this option has been sited outside of the Source Protection Zone III into the River Dour. This is to reduce the risk of pollutants that affect groundwater quality within the safeguard / protection zones.

This option presents a similar level of uncertainty over permitting conditions, location of the WTW and the location of the outfall. For the purposes of this study the following permit was assumed:

Table 16: Assumed Permit Conditions at Whitfield New WTW for Option 5

Determinant	Proposed
Dry Weather Flow (m ³ /d)	3024
Flow to Full Treatment (FFT in l/s)	105
Total Suspended Solids (mg/l)	30
Biological Oxygen Demand (mg/l)	10
Total Nitrogen (mg/l)	10
Phosphorous (mg/l)	0.25

It should be noted that the DWF includes a 25% headroom factored in, which was felt appropriate to consider for a new strategic WTW, to enhance resilience to future growth.

Scope & Cost

Infrastructure:

- 2.5km of new rising main (DN450)
- 2.7km of gravity sewer
- 27 No. new Manholes
- 1 No. River Outfall

Capex Estimate: £6,237k

Non-Infrastructure:

- Land Purchase 270 x 90 (min)
- 1 No. Administration / welfare building (10x10m)
 - Power, water and communications to site
 - Including welfare, works laboratory and MCC room
- 1 No. Inlet works comprising
 - 6mm 2D Screen with 180 l/s capacity, inlet channel and FFT/storm control
 - Screening handling c/w covered screening skips, grit detritor, classifier and skip
- 1 No. 540m³ storm tank c/w mixing and storm return pump station.
- Storm overflow to outfall (River Dour)
- 2 No. 11.2m dia. Primary Settlement Tanks c/w auto de sludge pump station to sludge thickening plant
- 1 No. Picket Fence Thickener at 82m³
- Thickened sludge transfer pumps to thickened sludge holding tank
- 1 No. 296m³ Thickened Sludge Holding Tank
- 1 No Extended aeration plant comprising:
 - 1 No. Anoxic selector tank at 180m³ c/w 2kW mixer
 - 3 No. First stage anoxic zones (total volume 500m³)
 - 3 No. Aeration lanes (total volume 2,500m³)
 - 3 No. Second stage anoxic zones (total Volume 500m³)

- 3 No. reaeration zones (total volume 125m³)
- Fine Bubble Diffused Aeration and aeration blowers for 3433m³/h capacity.
- 1 No. Methanol dosing plant sized for 20m³ storage and 10l/h dose rate
- 1 No. Ferric storage and dosing plant sized for 30m³ capacity with 2 No. Ppmp sets for Primary and Tertiary dosing points of application
- 3 No. 14.5m dia Final Settlement Tanks c/w auto de sludge
- Return Activated Sludge pump station at 75l/s capacity
- Surplus Activated Sludge control to Works Return Pump Station at 10l/s
- 1 No. Works Return Pump Station sized at 20l/s
- 1 No. Final Effluent monitoring chamber
- 1 No. Washwater chamber with washwater booster station
- 1 No. outfall to River Dour.

Capex Estimate: £29,722k

Total Capex Estimate: £35,959k

Risk

The following high-level risks and complexities are listed below.

Infrastructure:

- Development site not confirmed, so route subject to change
- Ecological and archaeological surveys may be required for working across fields
- Crossing of railway
- Significant disruption to the residents of Dover
- Working along a major road (A256)

Non-Infrastructure

- There is a risk that land purchase and associated planning development is more difficult

The siting of the proposed WTW is located next the A2. Sections of this road corridor is safeguarded for future A2 Dualling so there is a risk that the WTW would need to be further offset from the safeguard zone. This is not likely to present any significant issues.

It should be noted that due to the uncertainty over the permitting requirements, differing views exist with our Strategic Solutions Partner, who suggesting the following:

Table 17: Assumed Permit Conditions at Whitfield New WTW for Option 5

Determinant	Proposed	Alternative Proposed
Dry Weather Flow (m ³ /d)	3024	3024
Flow to Full Treatment (FFT in l/s)	105	105
Total Suspended Solids (mg/l)	30	10
Biological Oxygen Demand (mg/l)	10	5
Total Nitrogen (mg/l)	10	1 (As Ammonia)
Phosphorous (mg/l)	0.25	1

If this risk materialised the second stage ferric dose could be removed along with the coagulation and flocculation zones on the tertiary treatment. The methanol requirement would be removed also. For a BOD of 5mg/l and Ammonia of 1mg/l the tertiary treatment would change to Deep Bed Sand Filters (c/w associated pumping stations).

At this stage, this risk has been excluded from our scope. It has been factored into the Optioneering matrix, within the uncertainty experienced across the entire presumed permit determinants.

Programme

The standard PR19 durations used for Non-Infrastructure projects, based on value have been reviewed for Options 1-5, as the 44-month duration was unrealistic for the complexity and value of work envisaged. The revised estimated total duration for this option was 57 months.

Option Selection

AMP7 Totex Estimates

The table below shows the AMP7 Infrastructure (network) and Non-Infrastructure (treatment) costs.

Table 18: Overall Totex Estimates (post efficiency)

Option	Description	Network Cost Estimate (£k)	Treatment Cost Estimate (£k)	Total Cost Estimate (£k)	20 year Whole Life Cost (£k)
OPTION 1:	FOLKSTONE AND DOVER WTW UPGRADE	14,306	25,437	39,743	29,863
OPTION 2:	DAMBRIDGE ASP	13,681	34,421	48,102	39,844
OPTION 2A:	DAMBRIDGE MBR	13,681	32,530	46,211	36,588
OPTION 3:	NEW WTW GW DISCHARGE	4,291	29,831	34,122	28,681
OPTION 4:	NEW WTW COASTAL DISCHARGE	4,291	31,422	35,713	29,385
OPTION 5:	NEW WTW SURFACE WATER DISCHARGE	6,237	29,722	35,959	30,229

Technical Option Evaluation Matrix

A qualitative assessment of the Strength Weaknesses Opportunities and Threats (SWOT) of each option was undertaken, as demonstrated in the main paper. In evaluating the Strength Weaknesses Opportunities and Threats (SWOT), we have developed a weighted scorecard applied to the key criteria.

The following were selected:

- Anticipated permit
- Process reliability
- Process resiliency
- Water re-use potential
- Maintainability and operability
- Modifications to mechanical and civil plant/structures
- Hydraulic resiliency/capacity
- Constructability
- Power requirements and usage
- Land requirements
- Third party / stakeholder liaison
- Carbon

- Innovation
- Programme
- Capex and Opex

This has been captured in an Option Evaluation matrix which is summarised in table 19.

Option Risk Register

In evaluating the threats associated with the SWOT and weighted evaluation matrix, a high-level Risk register was compiled.

Risk and complexity are already captured in the build-up of project costs, and so is included in the scheme estimate. The risk register is a tool used to capture and qualify some of the key project risks identified across the notional solutions, and potential mitigation, for consideration when deriving the preferred option.

Long-term resilience

Long term resilience is a key consideration for our option selection. Each of the options has an impact on long-term resilience which we consider within the options appraisal.

Customer and stakeholder impact

Each option has short and long-term impact on our customers and stakeholders. These have been considered within the options appraisal.

Preferred Solution

In view of the weighted scorecard used in the Option Evaluation Matrix and the noted risks and opportunities present in this technical annex the following assessment has been made.

Table 19: Preferred Solution Summary

Option	Description	AMP7 Totex (£k)	Discharge consent likelihood	Weighted Technical Ranking	Long-term Resilience	Customer impact	Overall Rank
OPT. 1:	FOLKSTONE AND DOVER WTW UPGRADE	£39,743	High	6 th (705)	Low	High	4
OPT. 2:	DAMBRIDGE ASP	£48,102	High	4 th (895)	Medium	Medium	6
OPT. 2A:	DAMBRIDGE MBR	£46,211	High	5 th (854)	Medium	Medium	5
OPT. 3:	NEW WTW GW DISCHARGE	£34,122	Low	1 st (1031)	High	Medium	2
OPT. 4:	NEW WTW COASTAL DISCHARGE	£35,713	High	3 rd (896)	High	Medium	1
OPT. 5:	NEW WTW SURFACE WATER DISCHARGE	£35,959	Low	2 nd (958)	High	Medium	3

New WTW Options

A unique confluence of dense expansion, environmental, engineering and construction constraints means that a dedicated WTW would offer the greatest resilience for the Whitfield development, whilst minimising environmental, and customer impact.

The option for a new greenfield WTW is not a light decision. To illustrate the highly unusual nature of the issues and its required solution, we have not constructed a greenfield WTW because of growth since privatisation.

Minimising customer and resident disruption is a key consideration when implementing a significant project such as this. The new WTW options have significantly lower customer impact during construction as the works is far more localised, and the outfalls generally cross agricultural land.

A new WTW / catchment to the north of Dover and Folkestone offers high levels of future resilience to growth in future. It also offers the ability for transferring elements of the existing catchment of Dover and Folkestone WTW to the Whitfield catchment / new WTW, to enable future growth to occur without significant upgrades at the restricted Dover and Folkestone WTW.

The transfer of the existing Whitfield catchment increases hydraulic and biological treatment capacity available at Dover and Folkestone WTW for the anticipated growth occurring in the catchment to 2035.

The AMP7 Totex costs for the new WTW options are the lowest of the 6 options developed.

WTW Discharge

The water consumption and subsequent return to sewer in this region is sourced from stressed groundwater aquifers with the discharge of the treated effluent to sea via the 3km Outfall off Dover Harbour from the Dover and Folkestone WTW. This equates to approximately 14,097,167 m³/year (3-year average 2015-2017 of total flow reported to the EA) of treated wastewater not returned to the source it was abstracted from, exacerbating water stress in this region.

The Secretary of State for the Environment, Food and Rural Affairs has designated all of Affinity Water's supply area as an area of serious water stress (Source: Affinity Water Final Water Resources Management Plan 2015-2020 <https://www.affinitywater.co.uk/docs/WSP-stat-notice.pdf>).

The potential opportunity to treat the Whitfield area (7,450 properties) to a higher standard and return to the water body (either surface water or groundwater which are in hydraulic continuity) is a real opportunity to help the Water Resource Management of the area, whilst offering the lowest cost solutions in dealing with the strategic expansion.

This is reflected in the weighted technical evaluation matrix where Option 3 (new WTW GW discharge) is ranked 1st and Option 5 (New WTW River Discharge) 2nd. The total scheme costs are estimated £34 and £36m respectively. The coastal discharge at £36m is within the range of these two options.

Through our recent discussions with Environment Agency, Option 4 Coastal Discharge has the highest chance of support given the concerns about Source Protection Zones and Nitrate and Pesticide Protection Zones. During our detailed optioneering process, we will continue to investigate the viability of the alternatives given the wider potential technical and environmental benefits. Given the similarity of the costs, all options will fit the criteria required of the Cost Adjustment Claim.

Transfer to Dambridge

Options 2 and 2a can be discounted based on cost alone. The two options are significantly more expensive than the new WTW options. The options do not score strongly on technical, resilience or customer impact and can therefore be discounted.

Folkestone and Dover WTW Upgrade

Despite having the lowest treatment totex, the combined network and treatments totex costs are higher than Options 3, 4 and 5.

Option 1 also has significant challenges in terms of long term resilience and customer and stakeholder impacts. The construction of an addition to Folkestone and Dover WTW is below ground and needs to be constructed as a distinct 'bolt on'. Any future upgrade post 2035 to allow for future growth will need to be further 'bolted on' to the works. This could prove extremely difficult dependent upon the specific growth driver as the potential for future modification of the works becomes increasingly constrained by relatively short-term additions.

The route of the rising main from Whitfield to Folkestone and Dover WTW passes through the centre of Dover, crosses multiple rail crossings and impacts significantly on highways operations. The disruption to Dover and our customers would be very high at a point of significant uncertainty for the town due to potential Brexit and customs implications.

For these reasons it is not the preferred option.

Preferred Option

Our preferred option is Option 4, at £36m combined totex. It carries a greater chance of permitting success, whilst offering strong levels of long-term resilience. The overall cost is very closely aligned with Options 3 & 5, with Option 1 slightly over at £40m. This option has the best whole life costs of the viable options.

In development of this growth and resilience project, our usual business process will re-evaluate all assumptions, solutions and costs, so our preferred option may evolve during the solution development process. This would particularly apply to Options 3 and 5, should it be possible to resolve the current issues around the discharge constraints for these options.

At this level of project feasibility, Option 4 – Coastal Discharge is the preferred option following evaluation of project costs, resilience, constraints, risks and opportunities.

Appendix A – Build Rate Scenarios

There are different views on the likely build rate associated with the Whitfield development. This is important as the need to deliver a solution is determined by the commissioning of the new pumping station that will serve the development.

There are also major external factors that may influence demand and development, not least of which Brexit, which could have a major impact on the local housing market, especially in a sensitive location such as Dover.

Our assessment is that 1800 properties is the point where the temporary storage solution needs to be transformed into the permanent WPS solution. This is the point where the storage solution fails to provide adequate protection to our customers from flooding in the catchment.

We have developed the following scenarios that allow us to predict the potential impact of different development rates within the Whitfield area.

Scenario 1 – Masterplan

This scenario allows for 200 properties by 2018, 240 properties per year up until 2022 and 255 properties per year until 2040.

Scenario 2 – Lower Range

This scenario allows for a lower build schedule. In the 2017 Dover District Council Local Plan Review it states ‘The future expansion of Whitfield (5,750 homes) is critical to the delivery of the Core Strategy housing target as this represents nearly half of that target but has to date delivered less than 50 additional homes because of issues with viability and infrastructure delivery. Since the delivery rate of new homes at Whitfield has significantly fallen behind schedule, it is important that the Council considers, as part of any Local Plan Review process, what actions could be taken to significantly improve the rate of housing delivery on this key strategic site.’

The criticality of the site within the Dover DC housing strategy is clear, however it would appear is not currently delivering at the rate desired by Dover DC.

This scenario allows for 200 properties by 2018 and then 125 properties per year from that point. The 125-unit scenario is sourced from the 2016/17 Dover DC Monitoring Report.

Scenario 3 – Upper Range

This scenario allows for an increase in the build rate to a higher level than the masterplan. This could be due to government or local authority pressure, an increase in the number of developers actively constructing or an improvement in the economic outlook for the area.

This scenario allows for 480 properties by 2020 and 300 properties per year from that point.

The following table details the build rate for the above scenarios key years in the future.

Table 20: Cumulative build rates for the various scenarios

Scenario	2018	2020	2022	2024	2026	2028	2030	2035	2040
Scenario 1	200	680	1160	1670	2180	2690	3200	4475	5750
Scenario 2	200	450	700	950	1200	1450	1700	1825	2950
Scenario 3	200	680	1280	1880	2480	3080	3680	5180	5750

The following graph details the points of 1 in 25-year flooding protection and 1 in 10-year protection associated with the above scenarios.

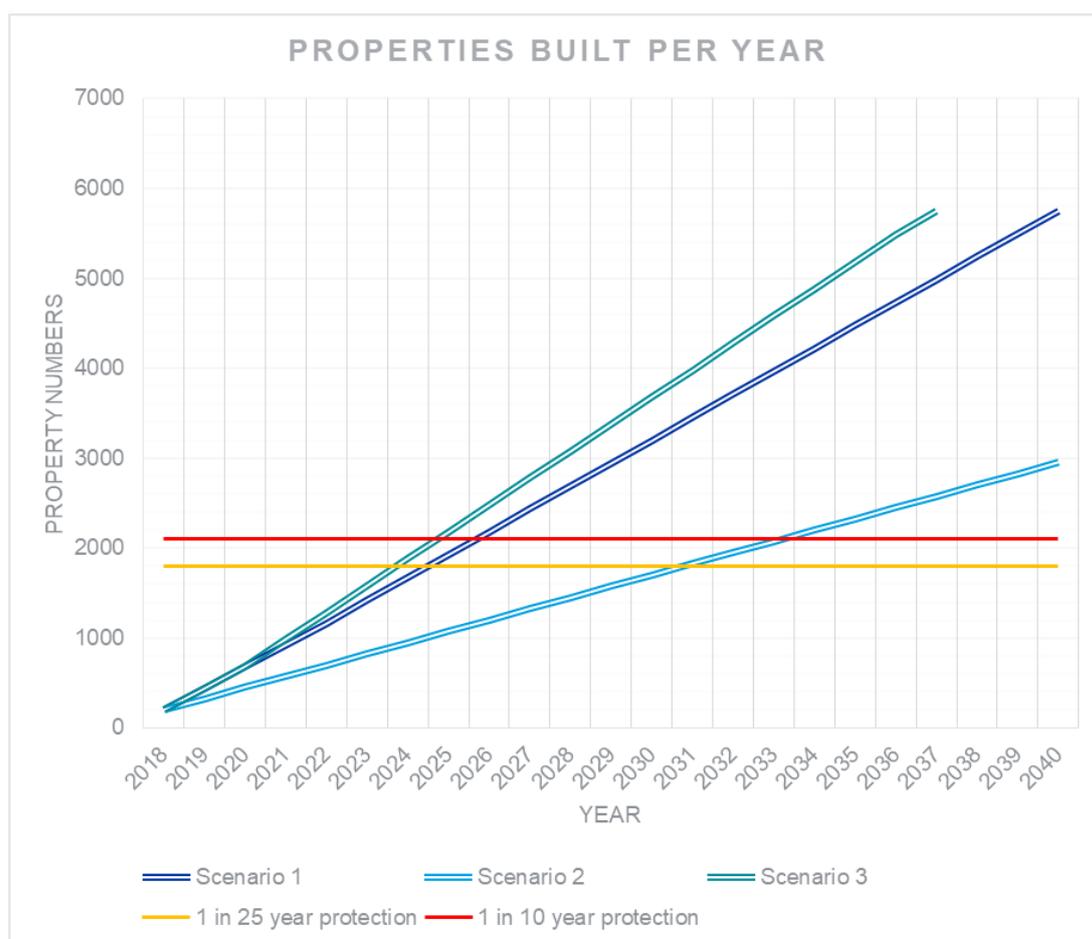


Figure 9: Scenario build rates vs flooding protection in the Whitfield catchment

Scenario 1

Scenario 1 is the option that we have used as the base option. This reaches a level of unacceptable risk in mid-2025, driving the need to translate the temporary storage solution into the new WPS. This means that the new WTW solution would need to be operational ahead of this point, around the end of AMP7. This provides enough time to develop the preferred solution and implement delivery in line with our early planning activities.

Scenario 2

Scenario 2 results in the point of unacceptable risk arriving significantly later. This profile predicts that point to be in late 2030. Given that we believe the options will range from 54 –

57 months to deliver, this would mean that there would be no need to deliver the project in AMP7. The project would only be required at the end of AMP8.

Although the Masterplan and states that the build target is 240 per year, we believe that the current local conditions and economic climate could mean a reduced build rate. Whilst this scenario is at the low end of the scale given the criticality of this development to the local housing requirements, we must consider options should the build rate not be as originally anticipated.

Scenario 3

Scenario 3 is the scenario that reaches the point of unacceptable risk first. This happens in late 2024, resulting in the need to have a new operation solution for the WTW ahead of this. Given that we believe the options will range from 54 – 57 months to deliver, this would make the delivery schedule extremely tight.

We believe that this scenario is the least likely of the three. Mitigation options would include the acceleration and overlap of the early works and design phases, consideration of an early start in the final year of AMP6 or temporary works to increase local effective storage volumes in the catchment.

Overall Mitigation

Given the potential duration of delivering a solution and the uncertainty around the build rate, we plan to progress on the basis that the masterplan build rate will be achieved. Our best view is that the build rate will be between Scenario 1 and 2 but given the large degree of uncertainty in the external environment, we propose to put controls in place to effectively plan ahead.

Control Point Assessments

We propose to place control point assessments at critical stages of the project development. These are:

- 1) At project initiation. We will thoroughly reassess the current position regarding build rates, the developer projections and the local authority expectations
- 2) At the point of solution identification. This is likely to be around 12 months after the start of the project. Again, we will follow the above process to establish the likely risk position and investment triggers
- 3) At the point of contract award. Before we commit to any delivery project, the above assessment will be undertaken

The goal of the control point assessment will be to assess at what date the confirmed building rate means that the temporary storage solution needs to be transformed into the new WPS. We will use this date to establish when we need to start the project to deliver the new solution.

Customer protection

Given the uncertainty around the development schedule, we have modified our Performance Commitment associated with this Cost Adjustment Claim. This will now state that lower in-AMP expenditure against a successful claim value will be returned to customers. This now

protects customers in the following scenarios:

- Savings being made against the solution cost. These could be through new or innovative solutions being identified or one of the lower cost options becoming viable
- Profiling of spend across AMP7/8 if the build rate is between Scenario 1 and Scenario 2
- Delay into AMP8 because of a very low build rate in line with Scenario 1

Should either of the last two scenarios be present, this may have the effect of simply pushing the claim into AMP8, if the same circumstances are present.

We believe that the combination of control point assessments and a modified performance commitment will give customers the protection required to manage the uncertainty associated with the claim due to external factors.