Appendix
YKY41_Growth at Sewage Treatment Works Enhancement Case

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YorkshireWater

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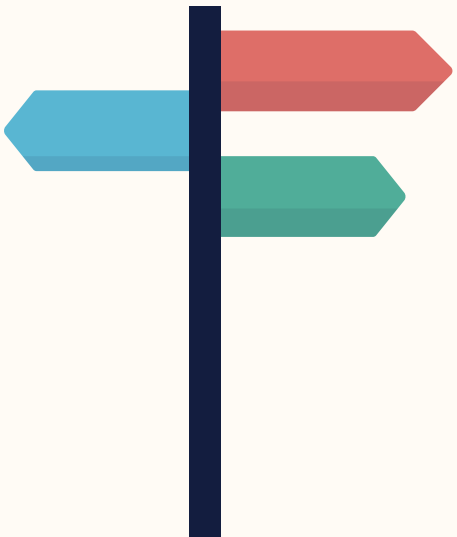
More detail on this subject can be found in **Chapter 8 Part 2: What our plan will deliver**



Contents

1. Growth at Sewage Treatment Works Enhancement Case

1.1 Driver: Wastewater Treatment Programme

1.1.1 Requested Investment

Table 1.1: Expenditure for the AMP8 Growth at Sewage Treatment Works Case

	£m	Table Line Ref.
Enhancement Expenditure Capex	35.526	CWW3.153
Enhancement Expenditure Opex	2.070	CWW3.154
Base Expenditure Capex		
DPC value		
Total	**37.596**	

1.1.2 Associated Reporting lines in Data Table

Table 1.2: CWW3 Reporting Lines

Line Number	Line Description
CWW3.153	Growth at sewage treatment works (excluding sludge treatment); enhancement capex
CWW3.154	Growth at sewage treatment works (excluding sludge treatment); enhancement opex
CWW3.155	Growth at sewage treatment works (excluding sludge treatment); enhancement totex

1.2 High Level Driver description

Wastewater treatment assets are designed and sized according to company standards (based upon water industry best practice) to achieve a minimum performance requirement in alignment with the Environmental Discharge Permit for each site. This Growth enhancement case covers three scenarios where catchment growth drives investment need:

- Growth in the catchment means that the site will become overloaded and will no longer be compliant with its permit conditions.
- Growth in the catchment means that the Dry Weather Flow limit in the permit is breached and a new permit is required. Due to the requirements of the permit and the growth in the catchment the site is then overloaded and cannot achieve compliance with the new permit conditions.
- There is growth in the catchment where there is no or limited existing treatment capacity therefore a new or significantly modified works is needed

The Environmental Discharge Permit sets out the permitted ‘Dry Weather Flow’ (DWF) volume from each Sewage Treatment Works (STW) site as well as: the acceptable residual contaminant concentrations within the treated final effluent on a site by site basis, dependent upon the characteristics of the receiving watercourses, and the Flow To Full Treatment (FFT) which is the maximum flow treated through STW’s (in the form of Pass Forward Flow) prior to the site discharging surplus flow to the storm route before entering the watercourse.

DWF is defined as the 20th percentile of total daily (flow) volume discharged by the site over the course of a calendar year, this is referred to as the 'Q80 flow'. For compliance purposes the 10th percentile of total daily (flow) volume, referred to as the 'Q90 flow', is used to assess compliance or non-compliance against the permitted limit.

Permitted DWF values are fixed for each site based upon the local residential populations, accounting for industrial (Trade) input flows and infiltration into the sewer network. Recent changes to the assessment of DWF compliance have resulted in a new assessment method. This new method means that if the Q90 exceeds the permitted DWF for any 3 years in 5 the site will be classed as non-compliant. Due to the time lags in upgrading a site to comply with an adjusted permit, if upgrades are required, this means water companies must forecast future flows to avoid a site being non-compliant with its DWF limit.

For all of the sites within this Enhancement Case (with the exception of Heronby) flows are forecast to exceed DWF. As a result an increased or new DWF permit is to be requested which will in turn lead to increased FFT and reduce other permit parameters. These permit changes mean that investment will be required to ensure that each site complies with the permit requirements.

1.3 Need

1.3.1 The Need for the Proposed Investment

The evidence for the Need for the investment is described for each site below. The approach taken varies between the sites depending on the scale of growth forecast within each catchment.

Summary

A summary of drivers for each of the proposed enhancements is provided below:

Table 1.3: Driver Summary

Site	AMP8 investment required	Trigger
Maltkiln new town	Yes	New town AMP8
Heronby new town	Yes – Feasibility Study only	New town AMP9
Howden new town	Yes	BOD load
Husthwaite	Yes	DWF
Cherry Burton	Yes	DWF
Silkstone	Yes	DWF
Wombwell	Yes	DWF

1.3.1.1 Maltkiln / Kirk Hammerton STW – New town trigger

Maltkiln is a planned new town in North Yorkshire located close to Kirk Hammerton STW. Up to 4000 new homes with supporting infrastructure are planned with 1500 homes planned to be complete by 2035. A feasibility study is in progress to consider options for treatment of wastewater flows from the new town. At this point in time the preferred option is to divert all flows from the new development to Kirk Hammerton STW where the existing works would be expanded to treat the current flows plus all flow from the new town.

Kirk Hammerton STW serves a population of 2045. The addition of 1500 homes would see a PE increase of around 3600 at 2035 and then by a further 6000 by 2050. It is assumed that a load

standstill approach would be applied and the existing discharge point to the River Nidd would be retained.

Kirk Hammerton STW does not have capacity for any increase in flow / load for treatment so a redevelopment of the existing works would be required.

A phased approach to the STW development is proposed with Phase 1 seeing the addition of a new inlet works with 6mm 2 D screens and grit removal, a radial flow primary settlement tank for all flows, sludge pumping, sludge storage and export facility and a 7.5 hectare integrated constructed wetland for all flows. Phase 2 would see the expansion of the inlet works and of the integrated constructed wetland (7.3 hectares) to allow for the increased flows and tighter discharge permit.

This solution would require the purchase or lease of around 8 hectares for Phase 1 and a further 8 hectares for Phase 2 of farmland that lies between the STW site and the discharge point on the River Nidd.

Table 1.4: The current and future permit limits for Kirk Hammerton (Maltkiln site) STW

	Current	Phase 1 (to 2035)	Phase 2 (to 2050)
DWF	482	878	1810
FFT	1158	2231	4598
BOD	100	55	27
TSS	150	82	40
Amm-N	21	12	6

1.3.1.2 Heronby – New town trigger

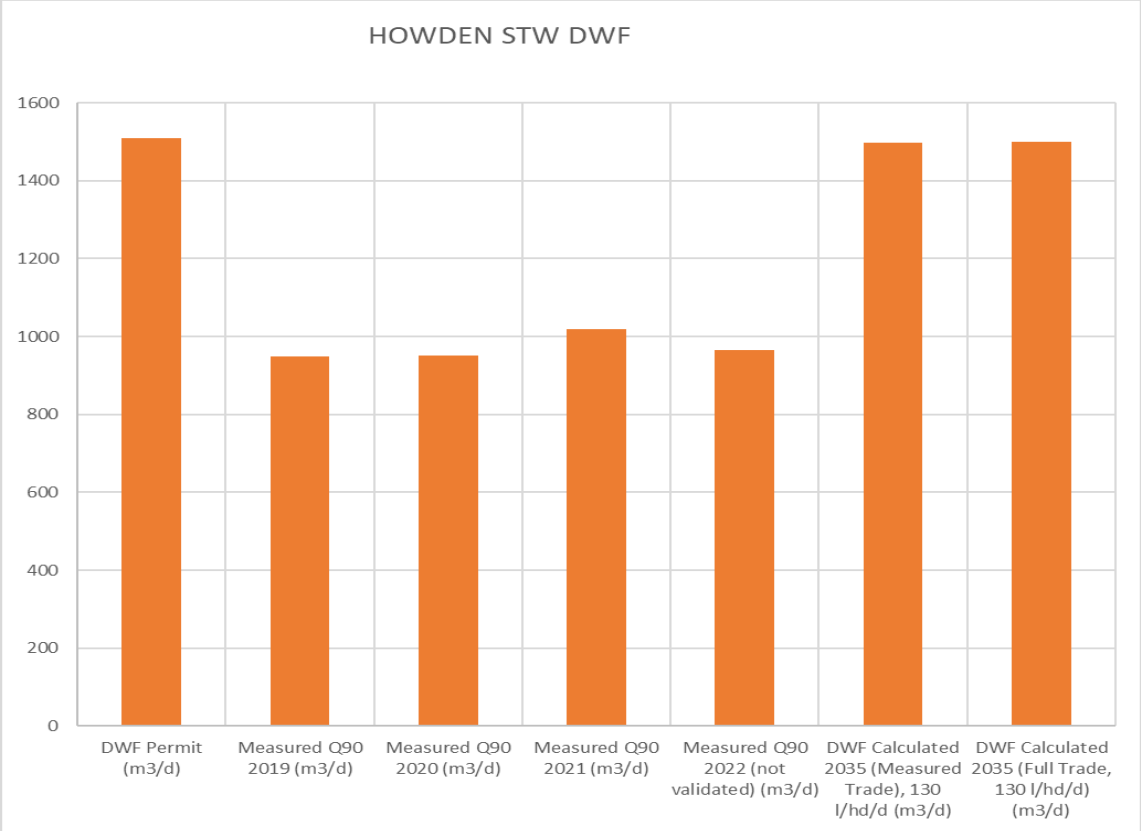
Selby council is considering the development of up to 3,000 dwellings and 5 hectares of employment land on land close to Stillingfleet. There is no capacity to accommodate the foul flows from this development at Escrick STW. A detailed feasibility study is required to determine the best way to accommodate flows from this development. No additional capacity is required in AMP8 but a plan needs to be in place to allow for treatment to be available in AMP9.

1.3.1.3 Howden STW – BOD load trigger

Howden STW has a DWF consent of 1509 m^3/d and a measured Q90 (2019-2022) of approximately 1000 m^3/d. Estimated measured DWF in 2035 increases to 1462 m^3/d due to 1325 new dwellings by 2035 increasing to 1865 by 2042/43 in the current local plan from the East Riding of Yorkshire Council. Estimated measured DWF increases above consent in 2036/2037 as more dwellings are built as predicted by the emerging local plan.

Howden STW has 6 trade dischargers and serves a population of 5,455, predicted to increase to 8,190 in 2035 and a population of 9,685 by 2043.

Figure 1.1: Howden STW DWF



Population growth and associated additional BOD load means that additional biological treatment capacity and therefore spend on a project to expand the site is required by 2028. Howden STW site performance since 2019 is summarised below:

Table 1.5: Howden STW Site Performance Since 2019

Parameter	95%ile (2019 to 2021)	Current Permit (95%ile)
BOD_5 (mg/l)	48.5	25
BOD_5 (% removed)	95.84	70
Ammonia-N (mg/l)	58.1	n/a
Total Suspended Solids (mg/l)	81	150

Howden is compliant with its Environmental Discharge Permit, with 95th percentile concentration of 81 mg/l Total Suspended Solids and BOD greater than 70% achieved (but not the 25 mg/l BOD 95th percentile, which does not result in a permit failure since compliance with either BOD criteria results in permit compliance). Howden STW comprises radial flow primary tanks, secondary plastic filters and radial flow humus tanks which were built in 2002. Many of the assets can be repurposed to help achieve the permit at the increased future flow and load scenario. Due to the almost doubling of the load by 2043, additional screening and secondary capacity akin to that already installed will be required to achieve compliance with the existing permit at the 2043 design horizon.

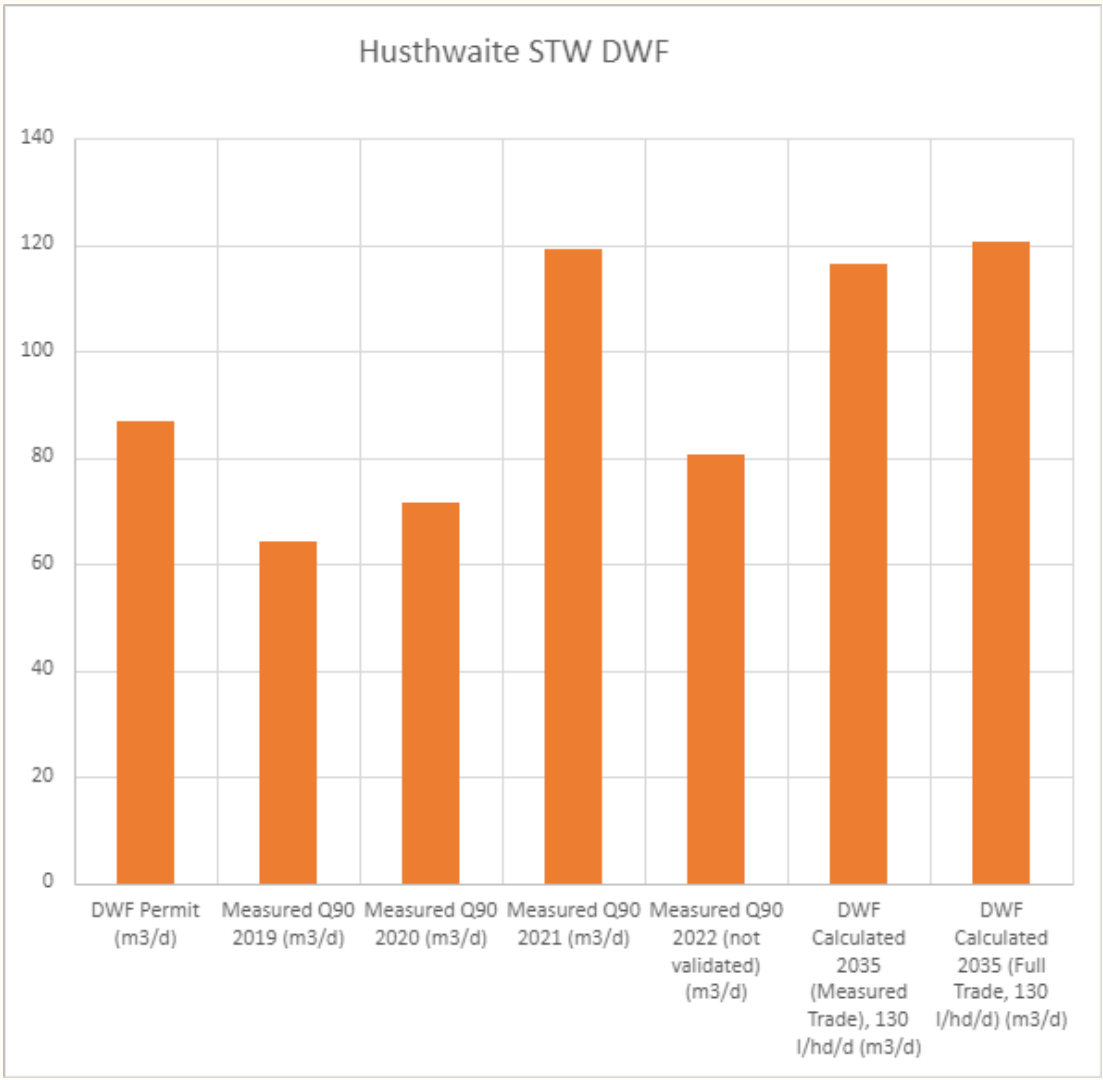
1.3.1.4 Husthwaite STW – DWF trigger

Husthwaite STW has a DWF consent of 87m³/d which is predicted to increase in line with growth to 117m^3/d by 2035. The site is currently on the limit of its DWF consent. The current FFT is

578m³/d, which is predicted to increase to 605m³/d, a greater ratio than x3 since the site operates as an 'all flows' site without a storm tank.

Husthwaite STW has no trade discharges and serves a small population of 354.

Figure 1.2: Husthwaite STW DWF



The Environmental Discharge Permit for Husthwaite is summarised below along with predicted future permit values on a load standstill basis. The site performance since 2019 is summarised to show the extent of compliance to date.

Table 1.6: Husthwaite STW Site Performance Since 2019

Parameter	95%ile (2019 to 2021)	Current Permit (95%ile)	Future Permit (95%ile)
BOD_5 (mg/l)	10.8	40	33
Ammonia-N (mg/l)	3.25	16	13
Total Suspended Solids (mg/l)	14.25	60	60

The site has met its Environmental Discharge Permit, for BOD_5, Ammonia (as N) and Total Suspended Solids respectively. The performance is better than would be expected under a load

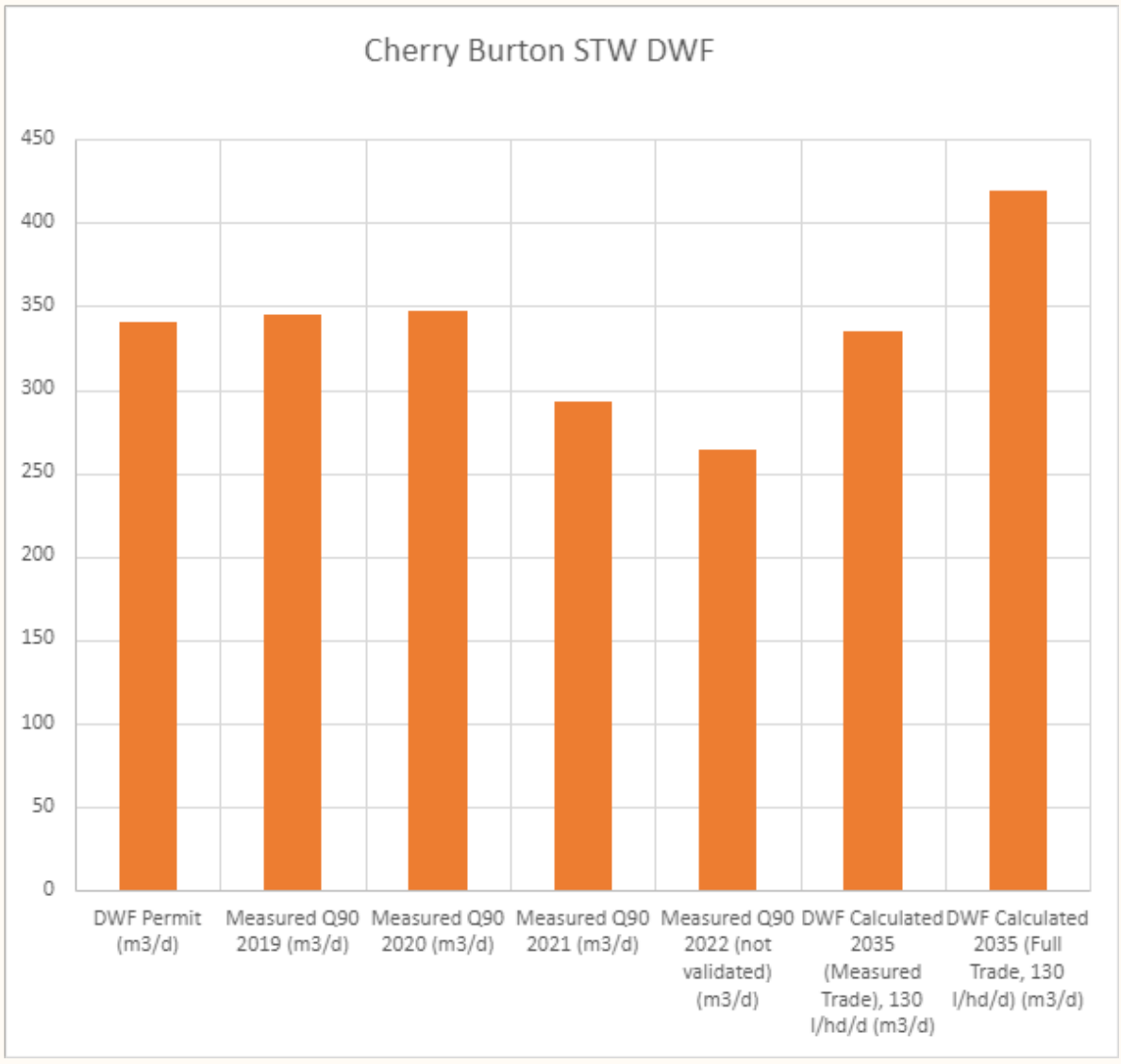
standstill basis, indicating that many of the assets can be repurposed to achieve the permit at the increased future flow scenario.

Treatment assets on site comprise Primary Settlement Tanks, Trickling Filters, Humus Tanks and Lagoons. At the calculated future FFT flow, the residence time within the Primary Settlement Tanks will be 1 hour 50 minutes (below the design guidance of 2 hours), however the secondary treatment capacity through the trickling filters is sufficient to ensure compliance with the BOD_5 and Ammonia (as N) requirements. The humus tanks, required to remove BOD_5, associated with the Total Suspended Solids are too small to meet the increased flows with a retention time of only 27 minutes against a requirement of 2 hours and would require replacement with a new humus settlement tank volume of 51 m^3 to maintain effective treatment at the future FFT.

1.3.1.5 Cherry Burton STW – DWF trigger

Cherry Burton STW has a DWF permit of 340 m^3/d and FFT of 1400 m^3/d, the ratio of FFT to DWF is greater than the three-fold multiplier. Growth in both residential population and tourist figures results in a predicted DWF of up to 420 m^3/d by 2035. The existing FFT value has been retained since this site is not an all flows works and the storm tanks are appropriately sized. The existing FFT was retained since it is in excess of 3xDWF.

Figure 1.3: Cherry Burton STW DWF



The current permit for Cherry Burton STW is summarised below with the predicted future permit and site performance since 2019:

Table 1.7: Cherry Burton STW Site Performance Since 2019

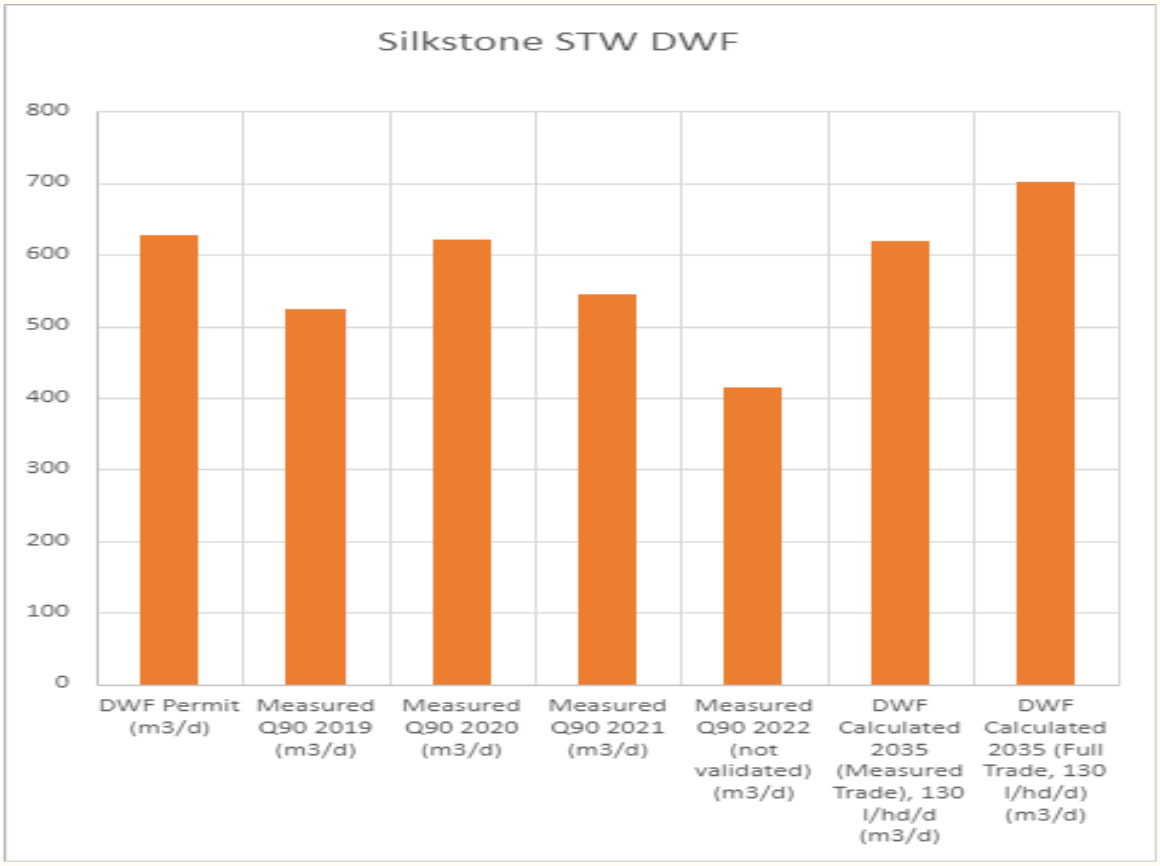
Parameter	95%ile (2019 to 2021)	Current Permit (95%ile)	Future Permit (95%ile)
BOD_5	11	30	27
Ammonia	5.02	4	3.7
Solids	19.5	40	40

Cherry Burton remains compliant with its ammonia consent on a Look Up Table basis and has recently had SAF assets installed to maintain compliance. Under the current load, without changing the FFT, the physical assets retain sufficient capacity to comply with the terms of the existing permit and in fact would comply with any tightening in permit following the 'load standstill' approach. However, with additional loads derived from the predicted future tourist populations the incoming ammonia loads will overload the existing tertiary ammonia removal process (two Submerged Aerated Filters). To provide sufficient capacity, one additional SAF is required with a total volume 56m^3.

1.3.1.6 Silkstone STW – DWF trigger

Silkstone STW has a DWF permit of 627 m^3/d, predicted to increase to 690 m^3/d. The current Flow to Full Treatment is 1555 m^3/d, predicted to increase to 2069 m^3/d using the FFT three-fold multiplication method. Silkstone has a single small trade effluent consent for 15m^3/d, which has been incorporated withing the calculations.

Figure 1.4: Silkstone STW DWF



Discharge permit values for Silkstone are summarised below with future Permit values and historic site performance (from spot regulatory samples) since 2019:

Table 1.8: Silkstone STW Site Performance Since 2019

Parameter	95%ile (2019 to 2021)	Current Permit (95%ile)	Future Permit (95%ile)
BOD_5 (mg/l)	16	35	34
Ammonia-N (mg/l)	4.45	10	9
Total Suspended Solids (mg/l)	36.5	60	60

Silkstone STW performs well against the current and possible future consent, with the current population loading. Total Suspended Solids concentrations, although compliant as a standalone parameter are high and could contribute to potential BOD_5 non-compliance. The existing performance indicates that the site could likely meet future consent requirements at increased population loadings without substantial interventions.

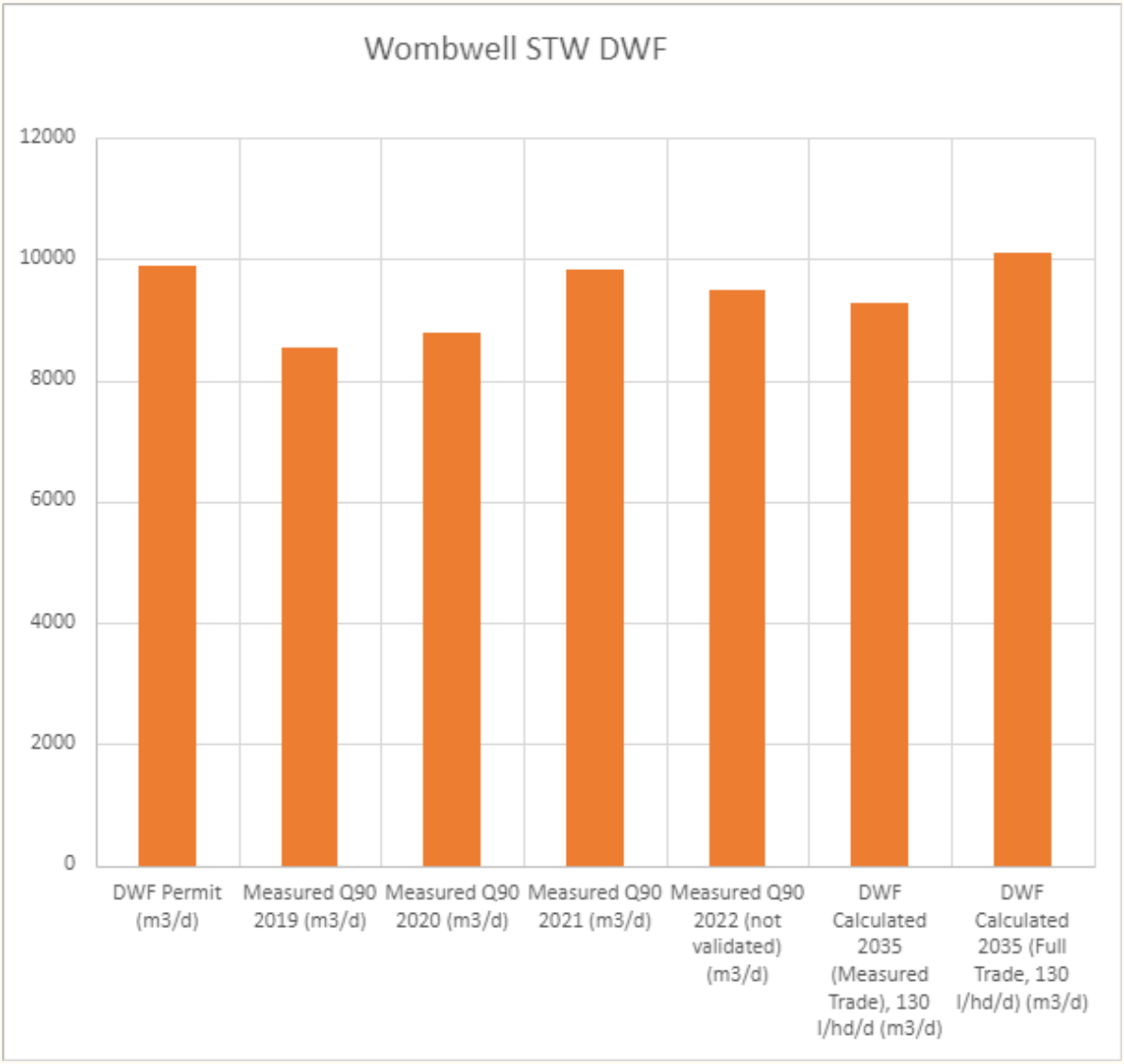
The site configuration at Silkstone comprises Primary Settlement and offline Storm Storage for flow in excess of FFT for which these assets are appropriately sized for the future flow. Secondary treatment comprises four mineral media Percolating Filters configured in 'Double Filtration' orientation through which flow passes over one pair of filters prior to settlement, the flow is then distributed over a second set of percolating filters prior to a second settlement stage.

In their current configuration, compared to YW design guidance, there is insufficient capacity within the percolating filters to meet the requirements of the future permit, however, if reconfigured into a conventional 'single pass' model with a new dedicated Humus settlement tank, and an internal treated effluent recirculation system to maintain wetting within the Percolating Filters, there is sufficient capacity to ensure compliant performance with a lower permit under load standstill performance basis.

1.3.1.7 Wombwell STW – DWF trigger

Wombwell STW has a current DWF permit to achieve a DWF of 9,900 m^3/d with a permitted FFT of 21,640 m^3/d. This is predicted to increase to a DWF of 10,696 m^3/d and a FFT of 32,089 m^3/d using the three-fold multiplication method. The full trade allowance of 1,202 m^3/d is allowed for, to allow for trade growth. With regard to population growth, population increase within the catchment is predicted to be 2,268, compared to an existing population of 39,000, an increase of 6%.

Figure 1.5: Wombwell STW DWF



The current and predicted discharge permit values are summarised with site performance (from spot regulatory samples) since 2019:

Table 1.9: Wombwell STW Site Performance Since 2019

Parameter	95%ile (2019 to 2021)	Current Permit (95%ile)	Future Permit (95%ile)
BOD	8	14	13
Ammonia	0.5	2.3	2.1
Solids	16	30	26

At current flows and loads, the site is meeting both the current permit requirements and the predicted load standstill predicted permits. Although Phosphorus data has been included within the table above, no allowance has been made for any change to the Phosphorus permit within this evaluation.

To maintain compliance at the predicted future flows, the inlet works, and storm tanks have sufficient capacity, however additional Primary Settlement capacity is required to accommodate the future FFT value. The existing Activated Sludge Plant providing secondary treatment is assessed to have sufficient capacity, however two additional Final Settlement Tanks are required to maintain compliance with the updated permit requirements at future FFT flows. Due to the increased flows a new interstage pumping station from the activated sludge plant to the settlement tanks is required.

1.3.2 The Scale and Timing of the Investment

An explanation of the scale and timing of the investment required to ensure that the forecast growth for each site can be accommodated, and an appropriate degree of treatment provided is set out on a site-by-site basis below.

Maltkiln development is in the North Yorkshire County Council planning process with forecast completion of the first 100 homes in 2026. Delivery of 150 houses per year is then forecast through to 2035. There is no headroom at Kirk Hammerton STW for additional flows so the expansion of the existing works to include the Integrated Constructed Wetland would need to be complete by the time the first homes are occupied.

Information provided by Selby District Council indicates that Heronby new town is not expected to have any housing complete in AMP8, but a feasibility study needs to be complete to allow for treatment capacity to available in early AMP9.

From information provided by East Riding of Yorkshire Council, the first of 50 houses to be delivered in the Howden catchment are planned for completion in 2024/25 with 105 houses per annum then completing up to 2035/36. As a result, it will be necessary to make additional capacity available at Howden STW in AMP8.

Husthwaite, Cherry Burton, Silkstone and Wombwell are all forecast to exceed the DWF permit by 2035 so it is planned to apply for revised DWF permits and provide additional treatment capacity in AMP8 so that the DWF permits are not exceeded.

The degree of expenditure reflects the size of each site and also the scale of change required. The population served at both Maltkiln and Howden is doubling so a major expansion of each site is required. Husthwaite, Cherry Burton and Silkstone require smaller changes to the sites as the population change and DWF permit changes are relatively small. Wombwell has a much larger population and treats a much greater flow, so the changes required at this site to accommodate the increased FFT require a higher degree of investment.

Table 1.10: Expenditure and consent limits by Site

Location / site	2025 DWF Consent (m^3/day)	2035 DWF Consent (m^3/day)	Change In PE (using 130 l/hd/day)	AMP8 total capex (£m)
Maltkiln new town (Kirk Hammerton)	482 (1)	878	3,046	£7.73
Heronby new town	N/A	N/A		£0.10
Howden new town	1509	BOD Trigger -design for extra 2,735 PE by 2035 and 4146 by 2043	4,146	£14.95
Husthwaite	87	117	231	£0.58
Cherry Burton	340	420	615	£1.57
Silkstone	627	690	485	£1.46
Wombwell	9900	10696	6123	£9.22
Inc in DWF				**£35.5**

Bespoke solutions were created for each of the sites using an assumed ‘load standstill’ method such as to create no detriment to the receiving watercourse. Any additional permit restrictions, whether reduced compared to the ‘load-standstill’ approach or addition of determinants (for example Phosphorus) are not accounted for within the proposed investment.

Timing of expenditure

These sites were chosen because they are predicted to exceed permits in AMP8 or early AMP9. Our capex profile has been estimated based on:

- Any growth within the STW catchment, whether through trade effluent, tourist loads or building of additional permanent residents (in the case of Howden and Silkstone STWs) are likely to require re-permitting. Reapplication for the permits is likely to be complete by Year 1 of AMP8 and the investment completed by the end of Yr3 of AMP8. However, the timing of the investment is subject to the rate of growth in the respective catchments and measured Q90 performance in subsequent years.
- For Maltklin / Kirk Hammerton initial plans had completion of the first houses in 2025/26. This has now been delayed but completion of the first units is expected in 2026/27. So early investment in AMP8 will be required.
- Heronby development is planned to deliver new housing in AMP9. For AMP8 a feasibility study is required to determine the best approach to delivering wastewater treatment for the 3000 new homes that are planned in the Selby area.

1.3.3 Interactions with Base Expenditure

There is no specific interaction with base expenditure planned on any of these sites. As is normal for delivery, we would look to integrate any routine base maintenance requirements into the schemes when they are commissioned to maximise delivery efficiency opportunities.

1.3.4 Activities Funded in Previous Price Reviews

None of these sites were given a specific funding allowance as part of the PR19 Final Determination.

1.3.5 Long-term Delivery Strategy Alignment

Growth investment in wastewater treatment works is shown in the core pathway in table LS4.5. The table shows a stable growth forecast of c£30m to £38m per AMP, which is aligned to AMP8. A similar level of DWF failures combined with new town development is predicted in the future. We would look to deliver nature-based solutions where possible in line with our sustainability strategy and low carbon approach.

For more information on the strategy itself, please refer to our LTDS, which is included with our PR24 documentation.

Read more about our LTDS at
Long Term Delivery Strategy

1.3.6 Customer Support

While there has not been customer engagement specific to the schemes within this enhancement case, due to the fact that it is driven by risks of non-compliance with our Environmental Discharge Permits, we know from our extensive research programme to support our PR24 business plan, that customers prioritise areas which would be impacted by the failure to invest in line with this requirement.

Firstly, from our DWMP customer research we know that our customers understand and acknowledge that an increase in population has a direct impact on our infrastructure and therefore investment requirements that we have, in order to maintain appropriate levels of service. As well as through our DWMP research, we have also seen similar views through other customer engagement studies, such as our consultation on storm overflows.

> *"I think the old sewage systems and the increase in population/floods etc will make it difficult to improve things without a huge input of finance."*
> Online Community Member, Your Water Online Community, Customers views on Storm Overflows Consultation, May 2022.

On top of this, we know that customers see the potential impact of failure to invest and ensure sewer treatment works can cope with increase in growth as of significant priority. For example, water quality across rivers, streams and the sea was a top 6 priority area indicated by household and non-household customers in our Valuing Water customer priorities research In addition, our acceptability & affordability qualitative research found that not meeting targets on pollutions was 'inexcusable' and that the areas they would most like Yorkshire water to focus on was reducing pollution and leakage.

More detailed information on the customer engagement related to river water quality and pollutions can be found in our performance commitment appendices and more information on our customer and stakeholder engagement can be found in Chapter 6 of our main business plan.

More detail on this subject can be found in
Chapter 6: Customer and Stakeholder Engagement

1.3.7 Factors Outside of Management Control

To reduce the impact of factors outside management control, each site has been selected based upon real data, over a three-year horizon. The DWF assessments were undertaken using conservative criteria, including a reduced per capita water consumption and assuming that network infiltration will not deteriorate. Population growth predictions were sourced from a specialist third party (Edge Analytics) demographic forecaster.

The realisation of predicted growth is outside of management control and may not arise as predicted in both timeline and magnitude due to economic conditions, political environment, immigration, rapid climate change or war and many other factors. Other factors impact on realised Q90 values such as trade flows tourist populations and actual infiltration flows which will deviate from forecasts. The selection criteria used to identify each site is robust such that a need for a permanent modification to the permit for each identified site is required.

These enhancement proposals, only cover increases to asset capacity to meet restrictions to permits on a 'load standstill approach'. This approach has been assumed and as such creates a risk that the EA may impose more stringent permit requirements which then requires additional asset investment.

1.4 Best Option for Customers

1.4.1 Options Considered

Yorkshire Water have reviewed flow data from all sites with MCerts flow measurement, using measured Q90 data and projections of population growth to forecast future Q90. If forecast future Q90 was within 5% of the permitted DWF or measured Q90 exceeded the permitted DWF in any of the years 2019-2021, then the sites were taken forward for further investigation. This initially identified eighteen sites which may require new DWF permits based upon population growth within each STW catchment.

This long list was then challenged using efficient per capita water consumption values, an assessment of likely infiltration rates, multiple trade scenarios and refined population growth characteristics provided by Edge Analytics.

Discharging additional flow at the same residual contaminant concentrations during dry weather would result in detriment to the receiving watercourse and as such a reduction in the permissible residual effluent concentrations has been allowed for pro-rata to the increase in DWF using a 'Load standstill' effect to have no detriment upon the watercourse. Further to this, an updated FFT was calculated based upon a multiplier of three times the DWF or the ratio between current consented FFT to DWF, whichever is the greater, such that there would be no deterioration in the operation of the storm route. No additional parameters (for example new Phosphorus consents if no current ones are applied) have been allowed for.

The combination of additional population in the catchment, an increase to DWF and potential increase to FFT and decreases to the permitted contaminant concentrations results in a substantial step change in requirements of the sewage treatment works performance. Each site has been assessed using the existing performance data and YWS design guidance to review existing performance and model the future performance. Any shortfalls in capacity have been addressed through this enhancements case.

1.4.1.1 DWF trigger - Husthwaite, Cherry Burton, Silkstone and Wombwell STWs

Due to the variety of assets incorporated at each site, the variety in site sizes and growth, each site has unique needs. Headroom calculations were undertaken for each of the sites and the results are discussed individually below.

The capacity of existing assets information (provided by YW on the Asset Inventory (AI2 database) was evaluated using Yorkshire Water Design Guidance Documents. This information was reviewed with measured site performance from the past three years against each existing permit parameter to determine whether the site is meeting the updated performance requirements. Where capacity shortfalls were identified against future revised permit requirements or existing performance did not meet the required standards, this was identified. The scope of works required in AMP8 was then identified. The hydraulic capacity of each site was not assessed. Where FFT is increased, there is a risk that there are hydraulic pinch points within the existing works that will need to be resolved to treat increased flows.

Since most solutions presented are in response to increases in DWF, the potential to reduce infiltration and resultant flow through network repair or replacement was initially considered; however this has not been examined further since infiltration at these sites is noted to be low,

meaning that attempts to reduce infiltration within the catchment would be unlikely to keep Q90 flows below the permitted DWF.

To maximise value, the options reviewed and evaluated primarily make use of and repurpose existing assets as far as reasonably possible, minimising the need for additional assets. Where interventions are in the form of additional tanks to increase capacity, these could be conventional solutions, however they are designed to complement the existing assets, minimising both the CAPEX and Carbon associated with construction of new assets. Figure 1.6 below shows extracts from the Wombwell STW Headroom Assessment that demonstrates the shortfall in capacity of the Primary Settlement and Final Settlement Tanks with an increased FFT flow.

Figure 1.6: Extracts from Wombwell STW Headroom Assessment

Primary Settlement Tanks	Unit	YW Design Guidance	Current @ FFT	Headroom vs DG (% +/-)	Future max @ FFT	Headroom vs DG (% +/-)
Upflow rate	m/h	1.5	1.16	23%	1.68	-12%
Retention time	hrs	2	2.12	6%	1.46	-37%
Upflow rate one tank o/s	m/h	1.75	2.31	-32%	3.36	-92%

Comments

- Additional PST required, proposed 1 No. PST of 22.5 m diameter (same as existing).

Final Settlement Tanks	Unit	Existing Capacity*	Current max @ FFT	Headroom vs DG (% +/-)	Future max @ FFT	Headroom vs DG (% +/-)
Total area	m2	1109.479	1878.97	-69%	2396.70	-116%
Total area one tank o/s	m2	795.32	2962.62	-273%	3998.07	-403%

Comments

- Assessment shows additional FSTs required, proposed 2 Nos FST of dia 22.5m (same as existing) considering site costraints. Though these units will not be sufficient and operating SSVI and RAS rate are unknown, this can be considered as risk.

- details of RAS/SAS pumps is not known.

For each site, the scope included in the PR24 cost is to address the shortfall at a particular process unit / treatment stage. It does not assume that all process stages require increased capacity. This means that the solutions are efficient.

1.4.1.2 New town trigger sites - Maltkiln and Howden

Where the level of growth is sufficient to require additional secondary capacity, then nature-based solutions such as Integrated Constructed Wetlands (ICW) (at Maltkiln) have been identified as potential alternative solutions. For Maltkiln, options for a new treatment works within the existing Kirk Hammerton STW boundary have been compared against costs for an ICW requiring additional land. For Howden conventional solutions have been scoped since all costs have been developed using the unit cost database which is derived from costs captured from historic YW projects.

For Maltkiln the “grey” solution option had a lower CAPEX (£6.1 million vs £7.5 million for the ICW option) but OPEX, Embodied Carbon, Operational Carbon and Net Present Value including monetised carbon are all considerably higher, so the ICW option has been selected. The ICW option is also expected to deliver significant biodiversity gain. Option 2 included Nereda, which is a filtration technology that would be used as part of new package plant.

Figure 1.7 below is a Cost and Carbon Summary of the shortlisted options. Due to the long build phase of the Maltkiln development each of the options has been considered in 2 phases with Phase 1 covering development up to 2035.

Figure 1.7: Cost and Carbon Summary for Kirk Hammerton STW expansion

KIRK HAMMERTON	OPTION 1 Wetland	OPTION 1b Wetland Phase 2	OPTION 2 Nereda	OPTION 2b Nereda Phase 2
Total Capex (£)	7,502,165	4,415,567	6,065,354	3,860,097
Opex (£/yr)	101,779	53,974 Additional to Opt1	165,520	137,467 Additional to Opt3
Embodied Carbon (tCO2e)	693.3	223.8	1,103.9	669.3
Operational Carbon (tCO2e/yr)	68.6	56.7	349.9	386.6
NPV (£) incl. Monetised Carbon	7,712,643	4,223,807	10,727,095	8,563,050

- **RPI= 334.6** (21/22)
- **Total Capex includes YW oncosts**
- NPV over 40yrs - annuitised Capex over the weighted average asset life as the project accounting life
- Assumed capital re-investment after asset life expiry
- Carbon monetised at £354.67/tCO2e

Total Capex (£) At current price base RPI 337.1 (July22)	7,558,218	4,448,558	6,110,672	3,888,938

1.4.2 Cost-Benefit Appraisal

As shown above, we considered different options depending on whether we were looking at extending existing sites. Our level of CBA also reflected the limited extent of options to meet the forecast capacity shortfall, where nature-based solutions were only feasible options for Maltkiln. The table shows that the NPV for the wetland options is lower than the Nereda options.

1.4.3 Best Value Analysis (Six Capitals)

As mentioned previously, we considered operational and embodied carbon as part of our options analysis. For more detail on our approach refer to section 6 in Introduction to Enhancement Cases.

Read more about this at
Introduction to Enhancement Cases

1.4.4 Impact Quantification

All the sites identified within the DWF trigger will require a permit review with the Environment Agency, which will most likely lead to restricted permits, under a ‘no detriment’ load-based approach. The sites identified are unlikely to be compliant with their updated permits unless the identified investment is completed. This has been assessed by reviewing current works performance and the treatment capacity of each treatment stage.

For the sites identified within new towns and growth, the predicted non-compliance cases are based upon planned developments. Maltkiln will be served by Kirk Hammerton STW which is already at capacity and there are 100 houses planned for 2026 with 150 per annum planned thereafter once the Maltkiln development proceeds. The long buildout plan requires land purchase to ensure land security for the construction. ICW units are modular and phasing with the build programme will create some redundant capacity whilst residences are constructed but without the investment, the site would be non-compliant with its permit.

The proposal for Heronby is a feasibility study to ensure that best value for customers money can be achieved if planned 3000 new residential developments are built in the Selby area. This study would include sewerage options, treatment options and phasing of works if possible.

At Howden, the increase of 2,735 residences does not push the DWF beyond its permit but does mean that the existing STW assets would receive excess organic load in the form of Biochemical Oxygen Demand, which would result in immediate performance deterioration. Although the growth is planned between 2023 and 2035, the nature of the assets is such that they need to be constructed in a single phase and therefore require upfront capital expenditure. The case also prevents deterioration in performance for DWF future proofing the site.

1.4.5 Cost and Benefit Uncertainties

All the solutions presented have been based upon unique site drivers in terms of changing DWF flows and the resultant estimated changes to the existing permit. Permit changes are subject to confirmation by the Environment Agency but have been based upon a 'no detriment' approach such that the amount of residual material within the discharge does not change. Should the Environment Agency apply more restrictive permit standards then there may be a need for a more comprehensive change to the treatment asset base on each of the sites, however this risk is low.

Bespoke outline solutions have been developed for each of the sites identified, such that they make use of engineering expertise, existing site data and YW Design Standards, to ensure that all the solutions are appropriately configured to meet the predicted permit requirements. If these proved to be unsuccessful, there may be a need for additional investment, however since the solutions are conventional and use existing assets, this risk is low.

There is a residual risk that the sites may not be able to physically pass the flows, however the relative increases in DWF and FFT are moderate, such that this risk is also considered low. For the expansion of Kirk Hammerton STW to accommodate flows from the Maltkiln development a phased approach has been taken. The planned ICW and supporting infrastructure would be built in 2 phases.

1.4.6 Third Party Funding

There is no third party funding for this enhancement case.

1.4.7 Customer Views

We have not carried out specific customer engagement related to solutions for this enhancement case given that it is a statutory requirement, but views on growth more generally can be found in the customer support section above.

1.4.8 Direct Procurement for Customers (DPC)

We do not propose to address this driver via a DPC approach. For more information on the process followed and the cases that were ultimately judged as suitable for DPC please see section 6.3 in Introduction to Enhancement Cases.

1.5 Cost Efficiency

1.6 Cost estimate for our preferred options

This section outlines how our overall approach to cost estimation and cost efficiency, as outlined in section 7.3 in Introduction to Enhancement Cases, has been applied to this enhancement case. Table 1.1 at the beginning of this document summarises the costs associated with this enhancement case. Our total cost is £37.60m.

We have followed a robust optioneering process supported by our Strategic Planning Partner, Stantec, and have developed a list of preferred options that includes nature-based solutions, grey infrastructure solutions, and feasibility studies to seek to deliver the best value to our customers.

For our grey infrastructure solutions, our costing estimates have been largely developed using our Unit Cost Database and our Decision-Making Framework (DMF) processes. Options were developed into site-specific scopes which went through out DAVE (Design and Value Engineering) process which provides an outline of the site needs. These needs were then costed using our Unit Cost Database. Further details on how we have applied these tools to develop cost estimates are provided in section 7.3.

Our approach to nature-based solutions at Malkin New Town required a bespoke costing system. This was due to higher uncertainty over costs and a lower level of data. For parts of the solution, we could utilise historic data from sites such as Clifton WwTW to inform our cost expectations. For other parts of the solution, such as local habitats, we had to undergo a custom costing exercise to identify expected cost.

Our approach to costing the feasibility studies we will be carrying out at Heronby New Town used historic costs. We have carried out many studies of the same nature and can assume that costs will be similar.

In summary we propose:

Table 1.11: Solution Costs

Solution type	Location / site	AMP8 total capex (£m)
Nature-based solution	Maltkiln new town	£7.73
Feasibility study	Heronby new town	£0.10
Grey solution	Howden new town	£14.95
	Husthwaite	£0.58
	Cherry Burton	£1.57
	Silkstone	£1.46
	Wombwell	£9.22
	Totals	**£35.5**

1.6.1 Efficiency of our cost estimate

Section 7.3 in Introduction to Enhancement Cases outlines our approach to cost efficiency in enhancement cases, and how our internal process and delivery decisions are designed with efficiency in mind. In putting together these costs we have been proactive on challenging ourselves to ensure that our costs are efficient.

To maximise the efficiency of our costs, our options were reviewed and evaluated to primarily utilise and repurpose existing assets as far as reasonably possible. This enabled us to limit the need for additional assets and where interventions had been required, they have been designed to complement existing assets. As a result, we have minimised the CAPEX and carbon cost associated with our programme.

On sites where nature-based solutions will be implemented we have carefully evaluated the associated costs and benefits of a nature-based against a grey infrastructure solution to choose the most efficient solution. At Maltkiln the grey infrastructure solution had lower CAPEX costs (£6.1m vs £7.5m before on-costs), but it had higher OPEX, embodied carbon, operational carbon, and NPV. Therefore, we will pursue the nature-based solution based on best value. We have costed in the cheaper grey solution using the Nereda technology to continue investigation how to deliver a nature-based solution at lower cost.

1.6.2 Need for enhancement model adjustment

We note that Ofwat has stated its intention to develop econometric models for WwTW growth at PR24. We do not have any specific reason to believe that an adjustment to these models would be required but without a view of these models ahead of submission, development of a case for an adjustment is not possible.

We do believe that growth costs can be lumpy and site specific so there is a risk that individual companies may be significantly over/under funded depending on what solutions are proposed and which drivers are selected. We ask that Ofwat carefully considers any reasons that companies may be outliers in costs in respect of the models rather than automatically attributing these to relative efficiency/inefficiency.

1.7 Third Party Assurance

Throughout the costing and optioneering process we have utilised third-parties to ensure that our process and costing are efficient. For this enhancement case, Turner and Townsend has

been engaged on the costs and have provided assurance that our enhancement costs are efficient.

Our internal Unit Cost Database also has its own regular assurance process.

For more information on Assurance please see section 7.4 in Introduction to Enhancement Cases.

1.8 Customer Protection

For information on the methodology we have used and the central assumptions we have applied for our Price Control Deliverables (PCDs) please see section 8.2 in Introduction to Enhancement Cases.

We reviewed our forecast enhancement totex and found this enhancement case does not meet the materiality threshold for PCDWW27. However, consistent with the guidance, we consider a price control deliverable is prudent to protect customers given there is no regulatory oversight for the proposed enhancement totex.

We also considered whether additional customer protection mechanisms were in existence or should be introduced to complement the PCD.

1.8.1 Price Control Deliverable (PCD)

We set out our PCD parameters and payment rate in the following tables.

Table 1.12: PCD Parameters

PCD Delivery Expectation	
Description	Investing in increased capacity at Sewage Treatment Works (STWs) to cater for population growth and the increased volumes of effluent the company must treat to achieve compliance with permit conditions. The load reaching the STWs is measured by population equivalent (PE); this is not a measure of population but a measure that quantifies the total Biological Oxygen Demand $(BOD)_5$ loadings to a STW (domestic population and trade). 1 PE is equivalent to 60g of BOD_5. The capacity of a works is also expressed as PE although this ideally includes an amount of headroom above the influent loads. The company will deliver an increase in capacity DWF Consents of 14,646 of PE across AMP8. Companies forecast their population served for each STW on a regular basis and invest in capacity upgrades to meet the needs of current and future customers.
Output measurement and reporting	Company will deliver the increase in population equivalent served by its STWs, reported to zero decimal places. The company will report annually through the APR.
Assurance	The company must commission an independent, third-party assurer, with a duty of care to Ofwat, to assure, to our satisfaction, that the conditions below have been met and the outputs of the scheme set out below have been delivered.
Conditions on scheme	None.

We propose a deliverable of the increase in population equivalent delivered across the AMP to reflect the uncertainty in the sizing of our upgrades to STWs. We considered specifying the number of sites, but customers would not be sufficiently protected if our population forecasts changed, and we only needed to develop a smaller scale of works for a given site.

Population equivalent is a common measurement for capacity at STWs, which can be forecast and audited robustly via modelling once works are complete.

We have set our delivery profile based on completing the works in time for forecast breaches of permits. For the potential new towns, we have assumed these works will not be complete until the final year of AMP8 to reflect typical application timeframes.

1.8.1.1 Forecast deliverables

Table 1.13: Forecast Deliverables

Deliverable	Unit	Forecast Deliverables- Increase in DWF Capacity (expressed as population Equivalent (PE) at STWs				
		2025/26	2026/27	2027/28	2028/29	2029/30
Maltkiln new town	Number (cumul)			3,046	3,046	3,046
Howden new town	Number (cumul)				4,146	4,146
Husthwaite	Number (cumul)			231	231	231
Cherry Burton	Number (cumul)			615	615	615
Silkstone	Number (cumul)			485	485	485
Wombwell	Number (cumul)				6,123	6,123
TOTAL				**4,377**	**14,646**	**14,646**

We consider the totex associated with our Heronby investigation is immaterial and does not align with the deliverable of population equivalent. We have excluded the amount from our PCD payment rate calculation to identify an average cost per unit where we are undertaking improvement works in AMP8.

1.8.1.2 Proposed PCD payment rate

Table 1.14 PCD Payment Rate

The payment rate per growth site is presented in the table below to reflect the variation in cost per PE, rather than using an average of £2,425/PE.

Location / site	Change In PE (using 130 l/hd/day)	AMP8 total capex (£)	Unit Payment (£/PE)	% Diff From Average £/PE
Maltkiln new town	3,046	£7,728,561	**£2,537.3**	+5%
Howden new town	4,146	£14,948,822	**£3,605**	+48%
Husthwaite	231	£585,418	**£2,534.3**	+5%
Cherry Burton	615	£1,570,536	**£2,553.7**	+5%
Silkstone	485	£1,468,061	**£3,026.9**	+24%
Wombwell	6123	£9,224,865	**£1,506.6**	-38%

We propose to apply the PCD payment per unit to the difference between the forecast and actual cumulative PE delivered where PE =0.130 litres/household/day DWF.

1.8.2 Annualised Outcome Delivery Incentives

This enhancement case does not have a material impact on any common performance commitments.

1.8.3 Annualised time delivery incentive

We do not propose a time incentive because this case does not meet the 1% materiality threshold to establish a PCD. In addition, we highlight that where increases in STW capacity are to meet the new town trigger, Yorkshire Water should delay its works where there are delays in planning and permitting for a given new town site.

1.8.4 Third Party Funding or Delivery Arrangements

This is not applicable for this case as no third party funding is proposed.