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dWRMP24 Option Details Reporting

CW24-01A: Combined Ouse Gravel sources - Fenstanton to St Ives (01A)

Cambridge Water

27 May 2022

5211472-ATK-RP-9-033

Notice

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This document has 16 pages including the cover.

Document history

Document title: CW24-01A: Combined Ouse Gravel sources - Fenstanton to St Ives (01A)

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Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Draft for client comment	CK/ALB	SF	EE	ALB	27.05.2022

Client signoff

Client	Cambridge Water
Project	dWRMP24 Option Details Reporting
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Contents

Notes

Methodology

This option detail report is expected to be used in conjunction with report 5211472-ATK-RP-7.7-015 *CAM WRMP24 Supply-Side Constrained Options Data Summary,* this provides the methodology used to produce the data outputs that are provided in this report.

Assumptions

The data provided in this report for the option is assumed to be high level, for strategic planning purposes only, and if this option is carried forward to feasible stage that the option will be reviewed, and appropriate design undertaken.

1.1. Option Information

Option name	**Combined Ouse gravel sources - Fenstanton to St Ives (01A)**		
Option ref	CW24-01A	**Previous ref**	CW2
Option type	Supply-side – Groundwater enhancement		
Concept	Recommissioning of the unused groundwater abstraction source (Ouse Gravels) at Fenstanton with connection to St Ives where the existing treatment and deployment will be used.		
Links to other options	Dependencies: None Exclusivities: CW24-01B Both options use the same source and infrastructure, CW24-01B has a higher DO, making these options exclusive.		

Screening decision	Peak option	Drought option	Resilience option
Constrained list	N/A	N/A	N/A

DO BENEFITS	Low	Best	Extreme
DYAA Ml/d	-	0.44 Ml/d	-
NYAA Ml/d	-	0.44 Ml/d	-
DYCP Ml/d	-	0.55 Ml/d	-
Reasoning behind DO (Ml/d) selection	DO is based on the available abstraction licence at Fenstanton BH.		

Background information	Abstraction at St Ives and Fenstanton boreholes ceased in around 1999 in response to the risks of microbial contamination which could not be treated economically at the time. The Fenstanton source is still licensed, though all operational plant has been removed. In WRMP19 this option included the upgrade of St Ives BHs and WTW. The St Ives BH and WTW have been progressed separately since WRMP19 and are undergoing recommissioning as part of AMP7.
Option description	This option is to recommission the unused groundwater abstraction source (Fenstanton, Ouse gravels). Fenstanton BH site ([redacted]) was decommissioned in 1999, it is assumed all operational plant has been removed, therefore new infrastructure is required comprising of: - 2 new 0.6m dia, 25m deep borehole shafts, inclusive of two 2.5kW pumps (5kW) - New borehole control building (20m^2) - A new 1.2km raw water pumped pipeline will be laid between Fenstanton BHs and St Ives WTW for transfer of raw water. - 1.2km of linear land compensation for the pipeline proposed. - 0-50kW Power supply In WRMP19 this option included the upgrade of St Ives BHs and WTW. The St Ives BH and WTW have been progressed separately since WRMP19 and are undergoing recommissioning as part of AMP7. This option assumes that the St Ives WTW will be operational and sized to receive the Fenstanton BH flows proposed for dWRMP24. It is also assumed no upgrades are required to deploy the additional water from St Ives.
Licensing and stakeholder feedback	Fenstanton BH site was operational until 1999 and CAM still holds the abstraction licence for these sources. It is expected that CAM will be able to recommence abstraction from the site. The EA has flagged potential concerns (Feb 2022) regarding the reactivation of the abstraction sources and the effect on the local shallow sand and gravel aquifer. This could potentially cause derogation to other sources from the aquifer

	and/or the linked bodies of open water that are connected to the sands and gravel, many of which are now heavily used for recreation/navigation purposes. The concerns raised by the EA with regard to the impact of this abstraction will be further investigated, and mitigation explored, if the option is progressed further.
Key assumptions	- Assumed the Fenstanton licence is still active and will remain the same after EA review. - It is assumed that Fenstanton BH site will not need any additional land to be purchased for the upgrades. - Assumed that combining the licences (St Ives and Fenstanton) to a single location is not possible due to yield restrictions. - The CAMS gravels source has not degraded since previous use (quality and quantity). - There is no viable infrastructure remaining on-site from previous use and it is assumed that new boreholes would be required. - All assets are sized for DYCP DO of 0.55Ml/d. - It is assumed that there is no hydraulic break between Fenstanton and St Ives. - The assumption is that St Ives WTW will be operational and can accept the increased raw water flows from Fenstanton for treatment and deployment. Therefore, no treatment or deployment is required to be costed separately for this option. - Land compensation is assumed to be needed for all lengths of pipeline included in the option. - It is assumed that a new power supply is required.
Risks and uncertainties	- The impact from recommencing abstraction (in terms of potential impact on other associated water sources) poses a risk to the DO as this has not been quantified; the EA have recommended that modelling is undertaken to support the use of this licence. - There is a risk that the delivery period expected from this option will not align with the (currently unconfirmed, May 2022) date that St Ives WTW will become operational.

1.2. Asset Pricing

The below data has been used to input into the costing methods for this option:

	Assets required for pricing	Method for pricing assets applied
Raw water source	- 2 new borehole shafts, assumed to be 0.6m dia, 25m deep - 2 new BH pumps 2.5kW each (5kW total) - New control building for borehole (20m^2) - 1.2km of 150mm raw water pipeline to connect Fenstanton and St Ives.	WRC TR61 method and tool applied.
Treatment	*N/A* *Assumed that the upgraded St Ives WTW will have the capacity to treat additional water from Fenstanton BHs.*	
Distribution	*N/A* *Assumed that the distribution network and required facility will be upgraded with the St Ives AMP7 works and no additional work will be required to deploy additional water from Fenstanton.*	
Land	Includes land compensation: - 1.2km for pipeline only.	Unable to represent in TR61, cost method applied as described in the costing report (5211472-ATK-RP-7.9-074)
Power	A new power connection (0-50kW)	Unable to represent in TR61, cost method applied as described in the costing report (5211472-ATK-RP-7.9-074)

1.3. Environmental Data

1.3.1. General

Included in WMP19	Yes – WRMP19 option included the St Ives BH and WTW upgrade. St Ives WTW and BH recommissioning is now being undertaken as part of AMP7 and excluded from this option.
CAPEX (£K)	See Appendix C2.
Re-use of existing asset?	Re-use and recommissioning of the Fenstanton BH site. All previous operational plant has been assumed to be removed and new infrastructure and boreholes are required. Not included in the option assets for assessment, but as part of the option DO delivery, St Ives WTW site is being used to treat the water and deploy it into the Cambridge network.
Environmental Mitigation and benefits	For further details refer to report CAM WRMP24 Supply-Side Constrained Options Data Summary (5211472-ATK-RP-7.7-015) Environment mitigation and benefits section. Assumed mitigation will be required for: * Best practice of construction * Biodiversity and ecosystems * Vehicle movements * Wider WFD no deterioration benefits/disbenefits * Use of local suppliers * Agriculture * CO2 emissions * Sustainable water management of resources To be assessed at design stage: * Archaeological Heritage * Noise * Air quality * Agriculture
WINEP - Relevant investigations	None listed on latest EA WINEP3 March 2020 Public version worksheet.

1.3.2. Abstractions

Type of abstraction (e.g., groundwater, river)	Groundwater abstraction				
New abstraction or change to existing abstraction?	Recommissioning of previous (currently unused) abstraction licence from the Fenstanton gravels.				
Name of watercourse/aquifer abstraction is from	Fenstanton Ouse Gravels				
Location of abstraction (x, y)	[redacted]				
Timing					
DYAA best	0.44Ml/d	**NYAA best**	0.44 Ml/d	**DYCP best**	0.55 Ml/d
If new					
Daily maximum	N/A	**Daily average**	N/A	**Any constraint?**	N/A

If change to existing	
Current max daily abstraction rate	No change to previously existing licence.
Current average daily abstraction rate	N/A
Change in max daily abstraction rate	N/A
Change in average daily abstraction rate	N/A
Any constraints?	N/A
Annual maximum	N/A
If groundwater	
Information on borehole depths and pumping tests	2 x BHs to be 0.6m dia and 25m deep (due to shallow gravels). No data available for pump tests.
Any known surface water interactions	This option is abstracting from the shallow Ouse Gravels which interact with the Great Ouse River.
Any seasonal variation in regime	N/A
HoF	HoF applied to the Great Ouse River, that is linked to the shallow Ouse Gravels, that this options abstraction is sourced from. However, this is deemed not applicable to this option as it is a fully licensed abstraction rate from a BH.

1.3.3. Discharges

Quantity	N/A – No discharges are included in this option.
Quality	N/A
Daily maximum	N/A
Annual maximum	N/A
Any seasonal variation in regime?	N/A
Timing	N/A

1.3.4. Construction

Delivery period - Duration of option construction (yrs)	5yrs
~ Working area of pipeline (m^2)	18,000m^2 working area based on 15m working width of pipeline.
~ Area of compounds (ha)	0.5ha (5000m^2) – assumed 2 compounds required for this option (*one proposed for BH temporary works store and one proposed for pipeline temporary works store*).
~ Area for option (ha)	2.3ha *This includes the working width of the pipeline plus the area of the compounds required.*
No. / type of vehicle / HGV movements	No available data.
Access routes	From the public highway, further confirmation will be required at design stage.
Carbon emissions (tonnes)	See Appendix C2.
Quantity of material (impact)	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.

Quantity of Concrete	See Appendix C2.
Waste to landfill (impact)	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Power impact status	See Appendix C2.

1.3.5. Pipelines/transfers

Pipe size (mm)		**Size (mm)**		**Length (m)**	
Pipe 1 raw water		150mm		1,200m	
DO (Ml/d)					
DYAA (Ml/d)	0.44 Ml/d	**NYAA (Ml/d)**	0.44 Ml/d	**DYCP (Ml/d)**	0.55 Ml/d
Max design pipeline capacity (Ml/d)		0.55Ml/d			
Quantity (Ml/yr)		160.6Ml/yr (for average 0.44Ml/d) / 200.75Ml/yr (for DYCP best)			
Quality					
Raw		Y	**Potable**	N	
Pipeline construction method		Pipeline will be constructed using open-cut methods unless specific conditions require otherwise. A specific construction methodology is expected to be developed once an option reaches later design stages.			
Type of crossings		**No. of crossings identified**			
Canal crossing		0			
Major Road (A/B)		0			
Major Road (M)		0			
Minor Road (uncl)		2			
Railway line crossing (private)		0			
Railway line crossing (public)		0			
Watercourse crossing		0			
Major River Crossings		0			

1.3.6. Operations

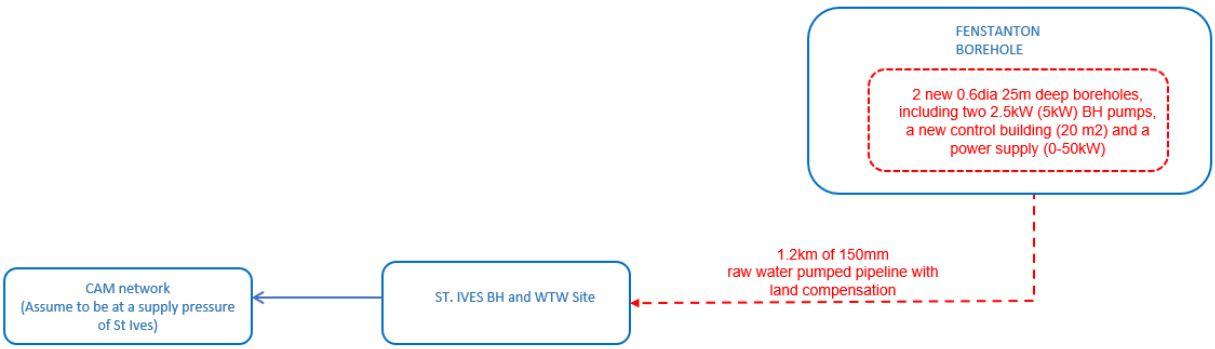
List of permanent above ground structures once operational	- Borehole site, inclusive of building		
Total new land take of completed option (m^2)	7,200m^2 for pipeline compensation only, it is assumed that the BH site at Fenstanton and treatment and deployment site at St Ives are not required to be included as they are already owned by CAM.		
Carbon emissions (tonnes)	See Appendix B2.		
Waste to landfill	Negligible – this requires detailed design to be undertaken at a later stage.		
Power (kWh/yr)	0.44Ml/d (utilised for 292 days as assets sized for peak) = 17,659kWh/year 0.55Ml/d = 22,074kWh/yr		
Chemical	**DYAA (tonnes per year)**	**NYAA (tonnes per year)**	**DYCP (tonnes per year)**
Polyaluminium Chloride	WTW assets are not included in this sub-option.		
Sodium Chloride			
Sodium Hydroxide			
Sulphur Dioxide (			
Phosphoric Acid			
Sodium Hypochlorite			

Poly - electrolytes	
Calcium Hydroxide	
Sodium Bisulphite	
Sulphuric Acid	
Ferric Sulphate	
Hydrochloric Acid	
Fluoride	
Vehicle movements (+/- 10%)	No available data.

1.3.7. Option Location Maps

1.3.8. Option schematic

Option: CW24-01A – Combined Ouse Gravel Sources – Fenstanton to St. Ives



Appendices

Appendix A. GIS

A.1. Shapefiles and register

GIS layers have been provided separately for the assets associated with this option. A GIS file register, reference 5211472-ATK-CA-9-037 of the files produced and shared with the environmental team is also available.

Appendix B. Engineering Data Methods

B.1. CAM dWRMP24 Operational Carbon Data Workbook

A separate spreadsheet, reference 5211472-ATK-CA-7.12-072 has been produced that includes the methodology undertaken to produce the operational carbon data.

Appendix C. Costing

C.1. CAM dWRMP24 Costing Report

The specific option cost assumptions applied are included in a costing assumption input section for this option in the costing report (reference 5211472-ATK-RP-7.9-074), produced to document the methodology undertaken to produce the options CAPEX, OPEX, NPV and AIC for the options progressed to the constrained list.

C.2. CAM dWRMP24 Option Cost Outputs

The option costs and relevant data sets that relate to the costing outputs (embedded carbon emissions, quantity of concrete and construction power) have been provided in a separate spreadsheet (reference 5211472-ATK-CA-7.9-076).

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dWRMP24 Option Details Reporting

CW24-01B: Combined Ouse Gravel sources - Fenstanton to St Ives (01B)

Cambridge Water

7th June 2022

5211472-ATK-RP-9-063-V2

Notice

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This document has 17 pages including the cover.

Document history

Document title: CW24-01B: Combined Ouse Gravel sources - Fenstanton to St Ives (01B)

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Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Draft for client comment	CK/ALB	SF	JT	ALB	30.05.2022
2.0	Updated draft for client comment WTW asset data input	RB	ML	HT	EE	07.06.2022

Client signoff

Client	Cambridge Water
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Notes

Methodology

This option detail report is expected to be used in conjunction with report 5211472-ATK-RP-7.7-015 *CAM WRMP24 Supply-Side Constrained Options Data Summary,* this provides the methodology used to produce the data outputs that are provided in this report.

Assumptions

The data provided in this report for the option is assumed to be high level, for strategic planning purposes only, and if this option is carried forward to feasible stage that the option will be reviewed, and appropriate design undertaken.

1.1. Option Information

Option name	**Combined Ouse gravel sources - Fenstanton to St Ives (01B)**		
Option ref	CW24-01B	**Previous ref**	CW2
Option type	Supply side – Groundwater enhancement		
Concept	Recommissioning of the unused groundwater abstraction source (gravels) at Fenstanton with connection to St Ives WTW which will require additional upgrade.		
Links to other options	Dependencies: None Exclusivities: CW24-01A Both options use the same source and infrastructure, making these options exclusive.		

Screening decision	Peak option	Drought option	Resilience option
Constrained list	N/A	N/A	N/A

DO BENEFITS	Low	Best	Extreme
DYAA Ml/d	-	2.0Ml/d	-
NYAA Ml/d	-	2.0Ml/d	-
DYCP Ml/d	-	4.0Ml/d	-
Reasoning behind DO Ml/d selection	There is an expectation that additional abstraction can be obtained from the Fenstanton Ouse Gravels due to the augmentation with the nearby Great Ouse River.		

Background	Abstraction at St Ives and Fenstanton boreholes ceased in around 1999 in response to the risks of microbial contamination which could not be treated economically at the time. The Fenstanton source is still licensed, though all operational plant has been removed. In WRMP19 this option previously included the upgrade of St Ives. The St Ives BH and WTW have been progressed separately since WRMP19 and are undergoing recommissioning as part of AMP7, therefore this option assumes that the St Ives WTW will be operational when connection is required.
Option description	This option is to recommission the unused groundwater abstraction source (Fenstanton, Ouse gravels). Fenstanton BH site ([redacted]) was decommissioned in 1999, it is assumed all operational plant has been removed, therefore new infrastructure is required comprising of: - 2 new 0.6m dia, 25m deep borehole shafts, inclusive of two 18.3kW pumps (37kW) - New borehole control building (20m^2 footprint area) - A new 1.2km raw water pumped pipeline will be laid between Fenstanton BHs and St Ives WTW for transfer of raw water. - 1.2km of linear land compensation for the pipeline proposed. - 0-50kW Power supply - 4Ml/d WTW upgrade required at St Ives WTW The new treatment stream at the WTW is composed of: - A new 4Ml/d treatment stream at the site of St. Ives WTW to treat water extracted from the recommissioned Fenstanton Borehole. - Pre-UV Boll Filters (4Ml/d); Dirty washwater holding tank (50m^3); UV Disinfection (4000m^3/d); Chlorine dosing rig and storage (4.0Ml/d) and Contact Tank (110m^3); Phosphoric Acid dosing rig and storage (4.0Ml/d). - A new Power source or upgrade (23kW); Land (352.5m^2) and Buildings (84.2m^2).

	Further information regarding the new treatment works can be found in Appendix D1.3.8.Appendix D In WRMP19 this option included the upgrade of St Ives BHs and WTW. The St Ives BH and WTW have been progressed separately since WRMP19 and are undergoing recommissioning as part of AMP7. This option assumes that the St Ives WTW will be operational, and an upgrade of the works is to be undertaken to allow for the additional 4Ml/d.
Licensing and stakeholder feedback	The EA has flagged potential concerns (Feb 2022) regarding the reactivation of the abstraction sources and the effect on the local shallow sand and gravel aquifer. This could potentially cause derogation to other sources from the aquifer and/or the linked bodies of open water that are connected to the sands and gravel, many of which are now heavily used for recreation/navigation purposes. Fenstanton BH site was operational until 1999 and CAM still holds the abstraction licence for these sources. It is expected that CAM will be able to recommence abstraction from the site. The concerns raised by EA with regard to the impact of this abstraction require further investigation and mitigation if the scheme is progressed further.
Key assumptions	- Assumed the Fenstanton licence is still active and will remain the same after EA review. - It is assumed that Fenstanton BH site will not need any additional land to be purchased for the upgrades. - Assumed that combining the licences (St Ives and Fenstanton) to a single location is not feasible due to yield restrictions. - The CAM gravels source has not degraded since previous use (quality and quantity). - There is no viable infrastructure remaining on-site from previous use and it is assumed that new boreholes would be required. - All assets are sized for DYCP DO of 4Ml/d, utilisation considerations will need to be assessed if a lower DO is progressed. - It is assumed that there is no hydraulic break between Fenstanton and St Ives. - Land compensation is assumed to be needed for all lengths of pipeline included in the option. It is assumed that a new power supply is required at the Fenstanton BH site and an upgrade to the power supply is required at St Ives. - It is assumed that St Ives WTW site will have land area capacity for the additional WTW upgrade requirements and no additional land purchase will be required. Treatment Assumptions: - At this stage, no new water quality information has been provided regarding the Fenstanton Borehole, and so in lieu of this, information provided during WRMP19 has been used to inform the water quality assessment at this stage. - As there is to be a substantial increase of desired output from St Ives WTW from 5.1Ml/d to 9.1Ml/d, a brand new, separate treatment stream will be developed to treat 4Ml/d of water from Fenstanton Borehole. Water from Fenstanton BH will not enter the existing St. Ives WTW treatment stream due to lack of information regarding the St. Ives assets/ design. - It is recommended that if this option is progressed, that water quality information be made available and reviewed to confirm the suitability of the proposed treatment.

	- WRMP19 alluded to a metaldehyde risk at St Ives and Fenstanton, however it is unclear if the Fenstanton borehole is equally affected. In light of the expected metaldehyde outdoor use ban, it is understood that Cambridge Water expect this risk to substantially decline prior to potential implementation of this scheme, and therefore no metaldehyde treatment has been provided for at this stage. - Abstraction from St Ives and Fenstanton ceased previously due to the risks of microbial contamination which could not be treated economically at the time. It is understood that the microbial risk included that of Cryptosporidium, for which the inclusion of UV in the treatment strategy is expected to manage this risk. - While no WQ data is available to confirm, there is also uncertainty to surface water influence on the source. In light of this it is recommended that consideration of the inclusion of a cartridge filtration step to manage potential turbidity spikes as a precautionary measure at this stage – however the use of boll filters will likely provide a more conservative approach to cost and land sizing, as well as waste, due to the washwater handling; therefore, at this stage, boll filters have been included for costing and sizing purposes only. The filtration stage should be confirmed by analysis of WQ data should the option be taken forward. - It's assumed this treatment capacity upgrade will be on the same site as the current St. Ives WTW and so it is assumed there will be shared welfare area, car park, etc.
Risks and uncertainties	- The impact from recommencing abstraction (in terms of potential impact on other associated water sources) poses a risk to the DO as this has not been quantified; the EA have recommended that modelling is undertaken to support the use of this licence. - There is a risk that the delivery period expected from this option will not align with the (currently unconfirmed, May 2022) date that St Ives WTW will become operational. - There is a risk that the expected 4Ml/d output will not be available from the Fenstanton Ouse Gravels – additional modelling and assessments are required to confirm availability.

1.2. Asset Pricing

The below data has been used to input into the costing methods for this option:

	Assets required for pricing	Method for pricing assets applied
Raw water source	- 2 new boreholes at Fenstanton, assumed to be 0.6m dia, 25m deep - 2 new BH pumps 18.9kW each (37kW total) and new headworks at Fenstanton. - New control building for borehole (20m$^{2)}$ - 1.2km of 325mm raw water pipeline to connect Fenstanton and St Ives.	WRC TR61 assets and tool applied.
Treatment	- Pre-UV Boll Filters (4Ml/d); Dirty washwater holding tank (50m^3); UV Disinfection (4000m^3/d); Chlorine dosing rig and storage (4.0Ml/d) and Contact Tank (110m^3); Phosphoric Acid dosing rig and storage (4.0Ml/d). - A new Power source or upgrade (23kW); Land (400m^2) and Buildings (100m^2). -	WRC TR61 assets and tool applied. Any assets unable to be represented will apply the cost method included in the costing report (5211472-ATK-RP-7.9-074)
Distribution	*N/A* *Assumed that the distribution network and required facility will be upgraded with the St Ives AMP7 works and no additional work will be required to deploy additional water from Fenstanton.*	
Land	Linear land compensation for: - 1.2km for pipelines only.	Unable to represent in TR61 therefore method applied from costing report (5211472-ATK-RP-7.9-074)
Power	- A new power connection (51-250kW)	Unable to represent in TR61, cost method applied from costing report (5211472-ATK-RP-7.9-074)

1.3. Environmental Data

1.3.1. General

Included in WMP19	Yes– WRMP19 scheme included the St Ives BH and WTW upgrade. This is now being undertaken as part of AMP7 and excluded from this scheme.
CAPEX (£K)	See Appendix C2.
Re-use of existing asset?	Re-use and recommission of the old St Ives and Fenstanton sites, that could not be economically utilised at the time. New infrastructure is required at both sites.
Environmental Mitigation and benefits	For further details refer to report CAM WRMP24 Supply-Side Constrained Options Data Summary (5211472-ATK-RP-7.7-015) Environment mitigation and benefits section. Assumed mitigation will be required for: * Best practice of construction * Biodiversity and ecosystems * Vehicle movements * Wider WFD no deterioration benefits/disbenefits * Use of local suppliers * Agriculture * CO2 emissions * Sustainable water management of resources To be assessed at design stage: * Archaeological Heritage * Noise * Air quality * Agriculture
WINEP - Relevant investigations	None listed on latest EA WINEP3 March 2020 Public version worksheet.

1.3.2. Abstractions

Type of abstraction (e.g., groundwater, river)		Groundwater			
New abstraction or change to existing abstraction?		Recommissioning of previous (currently unused) abstraction licence from the Fenstanton gravels.			
Name of watercourse/aquifer abstraction is from		This option will source its water by abstracting a higher rate than is currently licenced from the Fenstanton Ouse gravels, these gravels have a hydraulic link to the Ouse gravel works and Great River Ouse, therefore abstraction is expected to recharge through augmentation. .			
Location of abstraction (x, y)		[redacted]			
Timing					
DYAA best	2.0Ml/d	**NYAA best**	2.0 Ml/d	**DYCP best**	4.0 Ml/d
If new					
Daily maximum	4.0 Ml/d	**Daily average**	2.0 Ml/d	**Any constraint?**	River HoF
If change to existing					
Current max daily abstraction rate		0.55 Ml/d – representing the 1999 licence before the site ceased operations.			
Current average daily abstraction rate		0.44 Ml/d – representing the 1999 licence before the site ceased operations.			

Change in max daily abstraction rate	Increase of 3.45 Ml/d to 4Ml/d
Change in average daily abstraction rate	Increase of 1.66 Ml/d to 2Ml/d
Any constraints?	River Great Ouse HoF Environment Agency comments (as detailed above)
Annual maximum	1,460Ml/d
If groundwater	
Information on borehole depths and pumping tests	2 x BHs to be 0.6m dia at 25m deep (due to shallow gravels). No data available for pump tests.
Any known surface water interactions	This option is abstracting from the shallow Ouse Gravels which interact with the Great Ouse River.
Any seasonal variation in regime	None identified at this stage.
HoF	HoF applied to the Great Ouse River, that is linked to the shallow Ouse Gravels, that this options abstraction is sourced from.

1.3.3. Discharges

Quantity	N/A – No discharges are included in this option.
Quality	N/A
Daily maximum	N/A
Annual maximum	N/A
Any seasonal variation in regime?	N/A
Timing	N/A

1.3.4. Construction

Delivery period - Duration of scheme construction (yrs)	5yrs
~ Working area of pipeline (m^2)	18,000m^2 working area based on 15m working width of pipeline.
~ Area of compounds (ha)	0.5 (5000m^2) – assumed 2 compounds required for this option, one for both BH's temporary works store and one for pipeline temporary works store. It is assumed no compound will be required for the upgrades at St Ives WTW site.
~ Area for option (ha)	2.3ha *This includes the working width of the pipeline plus the area of the compounds required.*
No. / type of vehicle / HGV movements	No available data.
Access routes	From the public highway, further confirmation will be required at design stage.
Carbon emissions (tonnes)	See Appendix C2.
Quantity of material (impact)	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Quantity of Concrete	See Appendix C2.
Waste to landfill	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Power impact status	See Appendix C2.

1.3.5. Pipelines/transfers

Pipe size (mm)		Size (mm)		Length (m)	
Pipe 1 raw water		325mm		1,200m	
DO (Ml/d)					
DYAA (Ml/d)	2.0Ml/d	NYAA (Ml/d)	2.0Ml/d	DYCP (Ml/d)	4.0Ml/d
Max design pipeline capacity (Ml/d)		4.0 Ml/d			
Quantity (Ml/yr)		730 Ml/yr (for average 2.0Ml/d) 1,460 Ml/yr (for peak 4.0Ml/d)			
Quality					
Raw	Y	Potable	N		
Pipeline construction method		Pipeline will be constructed using open-cut methods unless specific conditions require otherwise. A specific construction methodology is expected to be developed once an option reaches later design stages.			
Type of crossings		No. of crossings identified			
Canal crossing		0			
Major Road (A/B)		0			
Major Road (M)		0			
Minor Road (uncl)		2			
Railway line crossing (private)		0			
Railway line crossing (public)		0			
Watercourse crossing		0			
Major River Crossings		0			

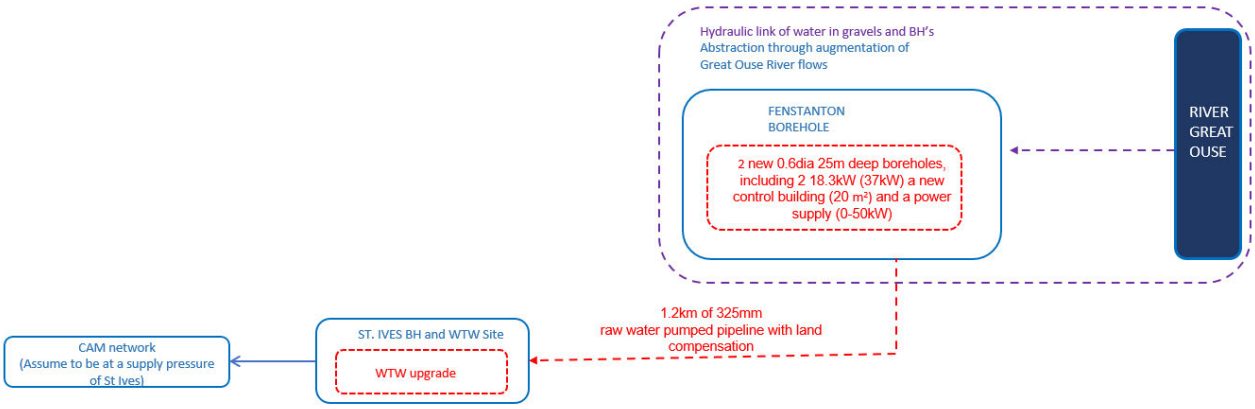
1.3.6. Operations

List of permanent above ground structures once operational	Borehole site, inclusive of building WTW upgrade at St Ives		
Total land take of completed option (m^2)	7,200m^2 for pipeline compensation only, it is assumed that the BH site at Fenstanton and treatment and deployment site at St Ives are not required to be included as they are already owned by CAM.		
Carbon emissions (tonnes)	See Appendix B2.		
Waste to landfill	Negligible – this requires detailed design to be undertaken at a later stage. Assuming that a sewer connection is required for the new treatment works at 1% of DO of average flows, which would be 20m^3/day.		
Power (kWh/yr)	Assuming a 4Ml/d usage a power rating of 21,900kW/yr is required.		
Chemical	DYAA (tonnes per year)	NYAA (tonnes per year)	DYCP (tonnes per year)
Phosphoric Acid	3.0	3.0	6.0
Sodium Hypochlorite	5.6	5.6	11.2
Vehicle movements (+/- 10%)	No available data.		

1.3.7. Location Maps

1.3.8. Option schematic

Option: CW24-01B – Combined Ouse Gravel Sources – Fenstanton to St. Ives



Appendices

Appendix A. GIS shapefiles

GIS layers have been provided separately for the assets associated with this option. A GIS file register, reference 5211472-ATK-CA-9-037 of the files produced and shared with the environmental team is also available.

Appendix B. Engineering Data Methods

B.1. CAM dWRMP24 Operational Carbon Data Workbook

A separate spreadsheet, reference 5211472-ATK-CA-7.12-072 has been produced that includes the methodology undertaken to produce the operational carbon data.

Appendix C. Costing

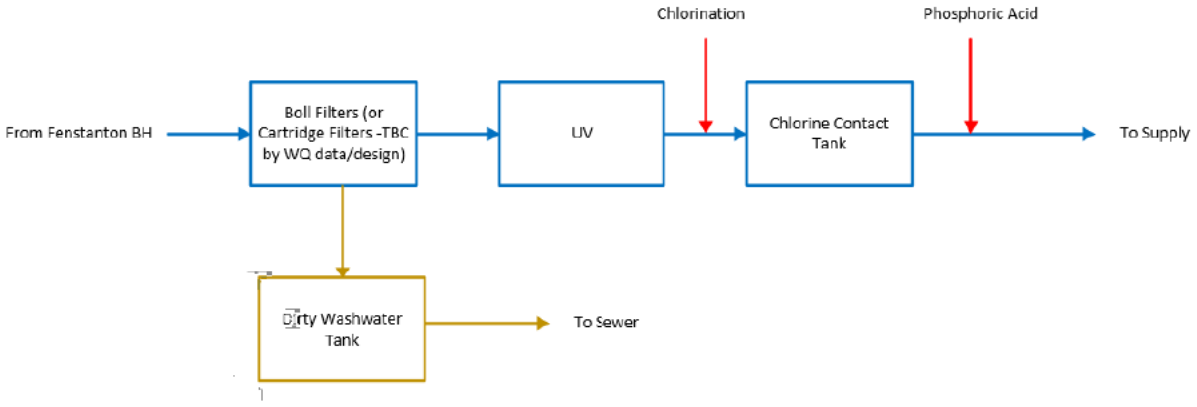
C.1. CAM dWRMP24 Costing Report

The specific option cost assumptions applied are included in a costing assumption input section for this option in the costing report (reference 5211472-ATK-RP-7.9-074), produced to document the methodology undertaken to produce the options CAPEX, OPEX, NPV and AIC for the options progressed to the constrained list.

C.2. CAM dWRMP24 Option Cost Outputs

The option costs and relevant data sets that relate to the costing outputs (embedded carbon emissions, quantity of concrete and construction power) have been provided in a separate spreadsheet (reference 5211472-ATK-CA-7.9-076).

Appendix D. Treatment Works Design Information



CAPEX Requirements

Asset	TR61 V13 Model no.	DYCP Driver	Unit
Boll Filter	-	4.0	Ml/d
Boll Filter Dirty Washwater Tank	-	50	m^3
UV Disinfection	66162	4000.0	m^3/day
Chlorine Dosing	71004	4.0	Ml/d
Phosphate Dosing	71006	4.0	Ml/d
Chlorine Contact Tank	71100	0.111	Thousand m^3
Land Area	-	400	m^2
Buildings (Treatment)	65557	100	m^2
Power Upgrades	-	23	kW

Operational Requirements- Chemical

Asset	DYAA Driver	NYAA Driver	DYCP Driver	Unit
Chlorine Dosing	16	16	31	kg/d
Phosphate Dosing	9	9	17	kg/d

Operational Requirements- Power

Asset	DYAA Driver	NYAA Driver	DYCP Driver	Unit
Chemical Dosing	48	48	48	kWh/d
UV	144	144	264	kWh/d
Instrumentation	120	120	120	kWh/d
Service Water	120	120	120	kWh/d
Total	432	432	552	kWh/d

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dWRMP24 Option Details Reporting

CW24-37A: Site-scale greywater re-use (Northstowe or similar growth)

Cambridge Water

30th May 2022

5211472-ATK-RP-9-036

Notice

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This document has 16 pages including the cover.

Document history

Document title: CW24-37A: Site-scale greywater re-use (Northstowe or similar growth)

Document reference: 5211472-ATK-RP-9-036

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Draft for client comment	CK/ALB	SF	JT	ALB	30.05.2022
2.0	Draft for client comment, updated ha size of reservoir	ALB	SF	JT	ALB	31.05.2022

Client signoff

Client	Cambridge Water
Project	dWRMP24 Option Details Reporting
Job number	5211472
Client signature/date	

Contents

Notes

Methodology

This option detail report is expected to be used in conjunction with report 5211472-ATK-RP-7.7-015 *CAM WRMP24 Supply-Side Constrained Options Data Summary,* this provides the methodology used to produce the data outputs that are provided in this report.

Assumptions

The data provided in this report for the option is assumed to be high level, for strategic planning purposes only, and if this option is carried forward to feasible stage that the option will be reviewed, and appropriate design undertaken.

1.1. Option Information

Option name	**Site-scale greywater re-use (Northstowe or similar growth)**		
Option ref	CW24-37A	**Previous ref**	None
Option type	Effluent reuse - greywater		
Concept	Site-scale greywater reuse scheme incorporated into large scale development (at full build out 10k properties)		
Links to other options	Dependencies: None Exclusivities: None This option could be constructed alongside option CW24-38 – both options consider the use of the same site however the sources of water differ.		

Screening decision	Peak option	Drought option	Resilience option
Constrained list	N/A	N/A	N/A

DO BENEFITS	Low	Best	Extreme
DYAA Ml/d	-	0.5Ml/d	-
NYAA Ml/d	-	0.5Ml/d	-
DYCP Ml/d	-	0.6Ml/d	-
Reasoning behind DO (Ml/d) selection	DO assumed available from advice given to CAM from AWS for similar options.		

Background	CAM are focusing on integrating with new large-scale developments to help facilitate a lower per capita consumption (PCC) for potable water, after initial demand management options have been implemented. This option is progressed at strategic level to allow CAM to apply the findings (costs/impacts) to other future development sites of similar growth size.
Option description	This option incorporates the requirements for site-scale greywater effluent re-use in a new large scale (10k) housing developments. The option is expected to be included in the development at design and planning stage. This assumes that the developer will include for greywater collection direct from each built property, that will connect to a centralised system that will be made available for this options assets. This option is being progressed at strategic level, and the findings (costs/impacts) applied to other future development sites of similar size. To progress the option for assessment and costing a proposed development site in Cambridge has been identified as an example site, this is located at Marshalls Airfield, Cambridge City Airport ([redacted]). For asset locational purposes a GIS polygon has been provided for the full assessment, as specific locations would require developer input and cannot be identified at this stage. It is proposed this option includes the required assets of: - 500m of 180mm raw water pipeline (used for connectivity) - A pre-treatment unit for 0.6Ml/d (to reduce the risks associated with the storage of greywater in the storage reservoir). - A 13.5ha service reservoir for 163.9Ml/yr storage capacity (this sizing allows for a constant supply to be assumed from the option throughout the year).

	- 1 control building (20m^2 footprint area) (assumed for the reservoir and pump controls) - 2 x 0.5kW pumps (1kW) (to export the flows from the reservoir to the WTW) - A new WTW for 0.6Ml/d (to treat the greywater to potable standards) - Land compensation costs for 2ha (included as an incentive for the developers for the land area required for the assets) - Power supply (51-250kW)
Licensing and stakeholder feedback	- There is no requirement for licensing for this option.
Key assumptions	- It is assumed that the development will include a collection system for greywater and a system to transfer the greywater to the option assets. - This option is subject to suitable sites and development areas. This needs discussion with several external stakeholders, particularly planners and developers. - This option is being progressed at a high level for the specified DO, it is assumed the costing / metric data will be applicable to other development site, further review of the data if additional sites are identified should be undertaken. - Assumption that 500m of raw water pipeline will be required is subject to change based on each development site. - It is assumed that no potable water pipeline is required in this option. - For costing purposes, it is assumed only 2ha of land are required for all assets - All assets are sized for the peak DO. - Land compensation is assumed to be needed for all lengths of pipeline included in the option. - It is assumed that a new power supply is required.
Risks and uncertainties	- Historically demand management options have resulted in minimal water savings. While they remain part of the solution, they are a small part. - The process of greywater collection and storage by the developer has not been finalised. - All proposed assets are required to be reviewed at design stage when further details are available from the proposed development site. - Risks and assumptions made in relation to the storage reservoir are included in a separate document (5211472-ATK-RP-7.7-080) – this relates to the option sizing, land requirement and assets included. - The quality of the collected water for treatment will require additional assessment.

1.2. Asset Pricing

The below data has been used to input into the costing methods for this option:

	Assets required for pricing	Method for pricing assets applied
Raw water source	- 500m of 180mm pipeline - 13.5ha / 163.8Ml/yr storage reservoir - Control building (20m^2 footprint area) - 2 x 1 kW (2kW) pumps	WRC TR61 assets and tool applied.
Treatment	- 0.6Ml/d pre-treatment - 0.6Ml/d new WTW	(These assets have not been included in the option costs at the time of report submission (27.05.2022) as the treatment asset requirements are being reviewed, this will be updated as more information becomes available).
Distribution	*N/A – not included as assumed to be connection on site*	
Land	Linear land compensation for: - 500m for pipelines only. Land purchase for: - 2ha for developer compensation.	Unable to represent in TR61, cost method applied as described in the costing report (5211472-ATK-RP-7.9-074)
Power	- A new power connection (51-250kW)	Unable to represent in TR61, cost method applied as described in the costing report (5211472-ATK-RP-7.9-074) (There is potential that the power connection requirement will increase, this is to be reassessed when the WTW asset requirements are defined, this could impact cost and power usage, which will be updated as more information becomes available).

Additional high level costing data for an open embankment reservoir was also undertaken and can be provided on request. This was undertaken as the initial option assessment required the comparison for the costing of both an open and closed reservoir. However, the open embankment reservoir was not progressed due to the identified risks related to the storage of greywater.

1.3. Environmental Data

1.3.1. General

Included in WMP19	N/A – New option for 2024
CAPEX (£K)	See Appendix C2.
Re-use of existing asset?	N/A – this option comprises of all new assets.
Environmental Mitigation and benefits	For further details refer to report CAM WRMP24 Supply-Side Constrained Options Data Summary (5211472-ATK-RP-7.7-015) Environment mitigation and benefits section. Assumed mitigation will be required for: * Best practice of construction * Biodiversity and ecosystems * Vehicle movements * Wider WFD no deterioration benefits/disbenefits * Use of local suppliers * Agriculture * CO2 emissions * Sustainable water management of resources To be assessed at design stage: * Archaeological Heritage * Noise * Air quality * Agriculture
WINEP - Relevant investigations	None listed on latest EA WINEP3 March 2020 Public version worksheet.

1.3.2. Abstractions

Type of abstraction (e.g. groundwater, river)	N/A – No abstractions are included in this option.				
New abstraction or change to existing abstraction?	N/A				
Name of watercourse/aquifer abstraction is from	N/A				
Location of abstraction (x, y)	N/A				
Timing					
DYAA best	N/A	**NYAA best**	N/A	**DYCP best**	N/A
If new					
Daily maximum	N/A	**Daily average**	N/A	**Any constraint?**	N/A
If change to existing					
Current max daily abstraction rate	N/A				
Current average daily abstraction rate	N/A				
Change in max daily abstraction rate	N/A				
Change in average daily abstraction rate	N/A				
Any constraints?	N/A				

Annual maximum	N/A
If groundwater	
Information on borehole depths and pumping tests	N/A
Any known surface water interactions	N/A
Any seasonal variation in regime	N/A
HoF	N/A

1.3.3. Discharges

Quantity	N/A – No discharges are included in this option.
Quality	N/A
Daily maximum	N/A
Annual maximum	N/A
Any seasonal variation in regime?	N/A
Timing	N/A

1.3.4. Construction

Delivery period - Duration of option construction (yrs)	10yrs
~ Working area of pipeline (m^2)	7,500m^2 working area based on 15m working width of pipeline.
~ Area of compounds (ha)	1.0 assumed 4 compounds required for this option, one for each asset type.
~ Area for option (ha)	8.5ha *This includes the working width of the pipeline plus the area of the compounds required.*
No. / type of vehicle / HGV movements	No available data.
Access routes	From the public highway, further confirmation will be required at design stage.
Carbon emissions (tonnes)	See Appendix C2.
Quantity of material (impact)	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Quantity of Concrete	See Appendix C2.
Waste to landfill	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Power impact status	See Appendix C2.

1.3.5. Pipelines/transfers

Pipe size (mm)		**Size (mm)**		**Length (m)**	
Pipe 1 raw water		180mm		500m	
DO (Ml/d)					
DYAA (Ml/d)	0.5Ml/d	**NYAA (Ml/d)**	0.5 Ml/d	**DYCP (Ml/d)**	0.6 Ml/d

Max design Pipeline capacity (Ml/d)	0.6 Ml/d		
Quantity (ML/yr)	182.5 Ml/yr (for average 0.5Ml/d) 219 Ml/yr (for peak 0.6Ml/d)		
Quality			
Raw	Y	Potable	Y
Pipeline construction method	Pipeline will be constructed using open-cut methods unless specific conditions require otherwise. A specific construction methodology is expected to be developed once an option reaches later design stages.		

Type of crossings	No. of crossings identified
Canal crossing	0
Major Road (A/B)	0
Major Road (M)	0
Minor Road (uncl)	0
Railway line crossing (private)	0
Railway line crossing (public)	0
Watercourse crossing	0
Major River Crossings	0

N.b. Due to the high-level assumptions applied to this option, and that the option will be implemented during the construction of a new development it is assumed no crossings will be required.

1.3.6. Operations

List of permanent above ground structures once operational	All new assets: - Pre-treatment plant - Control building - Storage reservoir - WTW - Pumping station
Total land take of completed option (m^2)	Originally proposed 2ha site – this will vary dependant on agreement with developer and asset sizing requirement. However the reservoir requirement for the 163.5Ml is that of an additional 13.5ha.
Carbon emissions (tonnes)	See Appendix B2.
Waste to landfill	Negligible – this requires detailed design to be undertaken at a later stage.
Power (kWh/yr)	For the pump usage only, 0.5Mld utilisation, as the asset is sized for the peak = 609kW/yr 0.6Ml/d (2kW/d) = 730kW/yr The power estimates will be updated when the usage of the pre-treatment and WTW has been selected and sized.

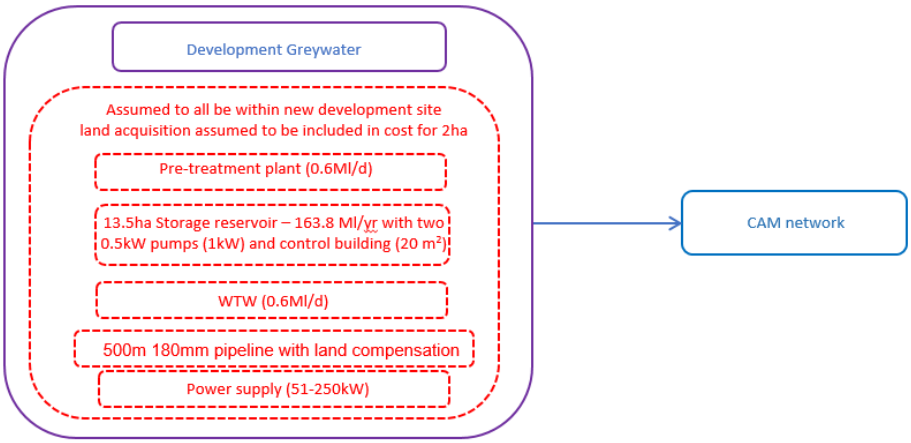
Chemical	DYAA (tonnes per year)	NYAA (tonnes per year)	DYCP (tonnes per year)
Polyaluminium Chloride	No WQ data available, this is required to be assessed at a future design stage when the appropriate WQ data is available.		
Sodium Chloride			
Sodium Hydroxide			
Sulphur Dioxide			
Phosphoric Acid			
Sodium Hypochlorite			
Poly - electrolytes			

Calcium Hydroxide	
Sodium Bisulphite	
Sulphuric Acid	
Ferric Sulphate	
Hydrochloric Acid	
Fluoride	
Vehicle movements (+/- 10%)	No available data.

1.3.7. Location Maps

1.3.8. Option Schematic

Option: CW24-37A – Site-scale greywater reuse (Northstowe or similar growth)



Appendices

Appendix A. GIS Shapefiles

GIS layers have been provided separately for the assets associated with this option. A GIS file register, reference 5211472-ATK-CA-9-037 of the files produced and shared with the environmental team is also available.

Appendix B. Engineering Data Methods

B.1. CAM dWRMP24 Operational Carbon Data Workbook

A separate spreadsheet, reference 5211472-ATK-CA-7.12-072 has been produced that includes the methodology undertaken to produce the operational carbon data.

Appendix C. Costing

C.1. CAM dWRMP24 Costing Report

The specific option cost assumptions applied are included in a costing assumption input section for this option in the costing report (reference 5211472-ATK-RP-7.9-074), produced to document the methodology undertaken to produce the options CAPEX, OPEX, NPV and AIC for the options progressed to the constrained list.

C.2. CAM dWRMP24 Option Cost Outputs

The option costs and relevant data sets that relate to the costing outputs (embedded carbon emissions, quantity of concrete and construction power) have been provided in a separate spreadsheet (reference 5211472-ATK-CA-7.9-076).

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dWRMP24 Option Details Reporting

CW24-38: Site-scale rainwater harvesting (Northstowe or similar growth)

Cambridge Water

31st May 2022

5211472-ATK-RP-7.11-071

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This document has 16 pages including the cover.

Document history

Document title: CW24-38: Site-scale rainwater harvesting (Northstowe or similar growth)

Document reference: 5211472-ATK-RP-7.11-071

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Draft for client comment	CK/ALB	SF	JT	ALB	30.05.2022
2.0	Draft for client comment with change to schematic to represent change of reservoir storage type.	ALB	SF	JT	ALB	30.05.2022
3.0	Draft for client comment, updated ha size of reservoir	ALB	SF	JT	ALB	31.05.2022

Client signoff

Client	Cambridge Water
Project	dWRMP24 Option Details Reporting
Job number	5211472
Client signature/date	

Contents

Notes

Methodology

This option detail report is expected to be used in conjunction with report 5211472-ATK-RP-7.7-015 *CAM WRMP24 Supply-Side Constrained Options Data Summary,* this provides the methodology used to produce the data outputs that are provided in this report.

Assumptions

The data provided in this report for the option is assumed to be high level, for strategic planning purposes only, and if this option is carried forward to feasible stage that the option will be reviewed, and appropriate design undertaken.

1.1. Option Information

Option name	**Site-scale rainwater harvesting (Northstowe or similar growth)**		
Option ref	CW24-38	**Previous ref**	None
Option Type	Rainwater harvesting		
Concept	Site-scale rainwater harvesting scheme incorporated into large scale development (at full build out 10k properties).		
Links to other options	Dependencies: None Exclusivities: None This option could be constructed alongside option CW24-37A – both options consider the use of the same site however the sources of water differ.		

Screening decision	Peak option	Drought option	Resilience option
Constrained list	N/A	N/A	N/A

DO BENEFITS	Low	Best	Extreme
DYAA Ml/d	-	0.9Ml/d	-
NYAA Ml/d	-	0.9Ml/d	-
DYCP Ml/d	-	0.9Ml/d	-
Reasoning behind DO (Ml/d) selection	DO assumed available from advice given to CAM from AWS from similar options.		

Background	CAM are focusing on integrating with new large-scale developments to help facilitate a lower per capita consumption (PCC) for potable water, after initial demand management options have been implemented. This option is progressed at strategic level to allow CAM to apply the findings (costs/impacts) to other future development sites of similar growth size.
Option description	This option incorporates the requirements for site-scale rainwater harvesting in a new large scale (10k) housing developments. The option is expected to be included in the development at design and planning stage. This assumes that the developer will include for rainwater harvesting direct from each built property, that will connect to a centralised system that will be made available for this option. This option is being progressed at strategic level, and the findings (costs/impacts) applied to other future development sites of similar size. To progress the option for assessment and costing a proposed development site in Cambridge has been identified as an example site, this is located at Marshalls Airfield, Cambridge City Airport ([redacted]). For asset locational purposes a GIS polygon has been provided for the full assessment, as specific locations would require developer input and cannot be identified at this stage. It is proposed this option includes the required assets of: - 500m of 180mm raw water pipeline (used for connectivity) - 0.9Ml/d pre-treatment (to reduce the risks associated with the storage of large volumes of untreated water in the storage reservoir). - A 17ha service reservoir for 245.7Ml/yr storage capacity (this sizing allows for a constant supply to be assumed from the option throughout the year). - 1 control building (20m^2 footprint area) (for the reservoir and pump controls) - 2 x 0.8kW pumps (2kW) (to export the flows from the reservoir to WTW)

	- A new WTW for 0.9Ml/d (to treat the rainwater to potable standards) - Land compensation costs for 2ha (included as an incentive for the developers for the land area required for the option assets) - Power supply (51-250kW)
Licensing and stakeholder feedback	- There is no requirement for licensing for this option.
Key assumptions	- It is assumed that the development will include a collection system for rainwater and a system to transfer the rainwater to the option assets. - This option is subject to suitable sites and development areas. This needs discussion with several external stakeholders, particularly planners and developers. - This option is being progressed at a high level for the specified DO, it is assumed the costing / metric data will be applicable to other development site, further review of the data if additional sites are identified should be undertaken. - The assumption that 500m of raw water pipeline will be required is subject to change based on the layout of each development site. - It is assumed that no potable water pipeline is required in this option. - For costing purposes, it is assumed only 2ha of land are required for all assets - All assets are sized for the peak DO. - Land compensation is assumed to be needed for all lengths of pipeline included in the option. - It is assumed that a new power supply is required.
Risks and uncertainties	- Historically these demand management options have resulted in minimal water savings. While they remain part of the solution, they are a small part. - All proposed assets are required to be reviewed at design stage when further details are available from the proposed development site. - Risks and assumptions made in relation to the storage reservoir are included in a separate document (5211472-ATK-RP-7.7-080) – this relates to the option sizing, land requirement and assets included. - There is an uncertainty in the rainfall events and the volume of water that could be collected. Additional assessment is required if this option is progressed to design stage. - The process of rainwater collection and storage by the developer has not been finalised. - The quality of the collected water for treatment will require additional assessment. - There is a risk of impact to water bodies in the area, further assessment is required if this option progresses.

1.2. Asset Pricing

The below data has been used to input into the costing methods for this option:

	Assets required for pricing	Method for pricing assets applied
Raw water source	- 500m of 180mm pipeline - 17ha / 245.7Ml storage reservoir - Control building (20m^2 footprint area) - 2 x 0.8kW (2kW) pumps	WRC TR61 method and tool applied.
Treatment	- 0.9Ml/d Pre-treatment - 0.9Ml/d New WTW	(These asset have not been included in the option costs at the time of report submission (27.05.2022) as the treatment asset requirements are being reviewed, this will be updated as more information becomes available).
Distribution	*N/A – not included as assumed to be connection on site*	
Land	Linear land compensation for: - 500m for pipelines only. Land purchase for: - 2ha for developer compensation.	Unable to represent in TR61, cost method applied as described in the costing report (5211472-ATK-RP-7.9-074)
Power	- A new power connection (51-250kW)	Unable to represent in TR61, cost method applied as described in the costing report (5211472-ATK-RP-7.9-074) (There is potential that the power connection requirement will increase, this is to be reassessed when the WTW asset requirements are defined, this will impact cost and power usage, which will be updated as more information becomes available).

Additional high level costing data for an open embankment reservoir was also undertake and can be provided on request. This was undertaken as the initial option assessment required the comparison for the costing of both an open and closed reservoir. However, although the open embankment reservoir would potentially provide amenity/environmental benefit, this was not progressed due to a need to represent a higher costed asset. Additionally, it is recommended to store the rainwater in a closed storage reservoir as it reduces the WQ contamination and therefore the final WTW requirement needs

1.3. Environmental data

1.3.1. General

Proforma WMP19	N/A – New option for WRMP24
CAPEX (£K)	See Appendix C2.
Re-use of existing asset?	N/A – New assets
Environmental Mitigation and benefits	For further details refer to report CAM WRMP24 Supply-Side Constrained Options Data Summary (5211472-ATK-RP-7.7-015) Environment mitigation and benefits section. Assumed mitigation will be required for: * Best practice of construction * Biodiversity and ecosystems * Vehicle movements * Wider WFD no deterioration benefits/disbenefits * Use of local suppliers * Agriculture * CO2 emissions * Sustainable water management of resources To be assessed at design stage: * Archaeological Heritage * Noise * Air quality * Agriculture
WINEP - Relevant investigations	N/A

1.3.2. Abstractions

Type of abstraction (e.g. groundwater, river)		N/A – No abstractions are included in this option.			
New abstraction or change to existing abstraction?		N/A			
Name of watercourse/aquifer abstraction is from		N/A			
Location of abstraction (x, y)		N/A			
Timing					
DYAA best	N/A	**NYAA best**	N/A	**DYCP best**	N/A
If new					
Daily maximum	N/A	**Daily average**	N/A	**Any constraint?**	N/A
If change to existing					
Current max daily abstraction rate		N/A			
Current average daily abstraction rate		N/A			
Change in max daily abstraction rate		N/A			
Change in average daily abstraction rate		N/A			

Any constraints?	N/A
Annual maximum	N/A
If groundwater	
Information on borehole depths and pumping tests	N/A
Any known surface water interactions	N/A
Any seasonal variation in regime	N/A
HoF	N/A

1.3.3. Discharges

Quantity	N/A – No discharges included in this option.
Quality	N/A
Daily maximum	N/A
Annual maximum	N/A
Any seasonal variation in regime?	N/A
Timing	N/A

1.3.4. Construction

Delivery Period - Duration of scheme construction (yrs)	10yrs
~ Working area of pipeline (m^2)	7,500m^2 working area based on 15m working width of pipeline.
~ Area of compounds (ha)	1.0 assumed 4 compounds required for this option, one for each asset type.
~ Area for scheme (ha)	8.5ha *This includes the working width of the pipeline plus the area of the compounds required.*
No. / type of vehicle / HGV movements	No available data.
Access routes	From the public highway, further confirmation will be required at design stage.
Carbon emissions (tonnes)	See Appendix C2.
Quantity of material (impact)	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Quantity of Concrete	See Appendix C2.
Waste to landfill	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Power impact status	See Appendix C2.

1.3.5. Pipeline/Transfers

Pipe size (mm)		Size (mm)		Length (m)	
Pipe 1 raw water		180mm		500m	
DO (Ml/d)					
DYAA (Ml/d)	0.9Ml/d	NYAA (Ml/d)	0.9Ml/d	DYCP (Ml/d)	0.9Ml/d
Max design Pipeline capacity (Ml/d)		0.9Ml/d			
Quantity (ML/yr)		328.5Ml/yr			
Quality					
Raw	Y		Potable	Y	
Pipeline construction method		Pipeline will be constructed using open-cut methods unless specific conditions require otherwise. A specific construction methodology is expected to be developed once an option reaches later design stages.			

Type of crossings	No. of crossings identified
Canal crossing	0
Major Road (A/B)	0
Major Road (M)	0
Minor Road (uncl)	0
Railway line crossing (private)	0
Railway line crossing (public)	0
Watercourse crossing	0
Major River Crossings	0

N.b. Due to the high-level assumptions applied to this option, and that the option will be implemented during the construction of a new development it is assumed no crossings will be required.

1.3.6. Operations

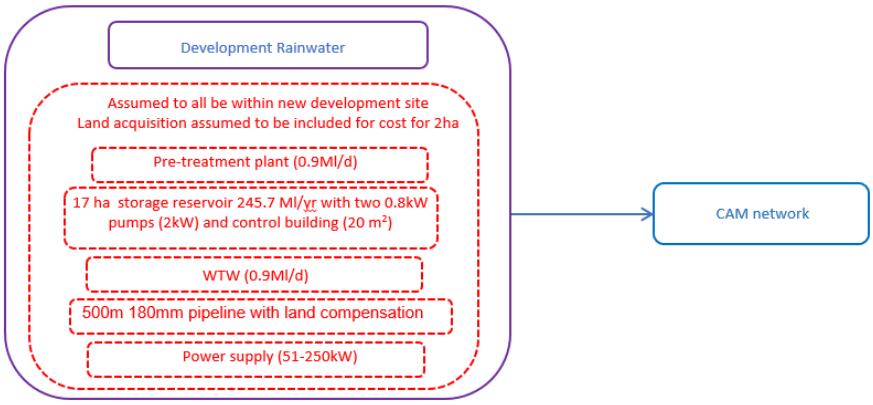
List of permanent above ground structures once operational	All new assets: - Pre-treatment plant - Control building - Storage reservoir - WTW - Pumping station		
Total land take of completed option (m^2)	Proposed 2ha site – this will vary dependant on agreement with developer and asset sizing requirement. An additional 17ha will be required for the storage reservoir.		
Carbon emissions (tonnes)	See Appendix B2.		
Waste to landfill	Negligible – this requires detailed design to be undertaken.		
Power (kWh/yr)	For the pump usage only, 0.9Ml/d (2kW) = 730kW/yr The power will be updated when the usage of the pre-treatment and WTW has been selected and sized.		
Chemical	DYAA (tonnes per year)	NYAA (tonnes per year)	DYCP (tonnes per year)
Polyaluminium Chloride	No WQ data available, this is required to be assessed at a further design stage when the appropriate WQ data is available.		
Sodium Chloride			
Sodium Hydroxide			
Sulphur Dioxide			

Phosphoric Acid	
Sodium Hypochlorite	
Poly - electrolytes	
Calcium Hydroxide	
Sodium Bisulphite	
Sulphuric Acid	
Ferric Sulphate	
Hydrochloric Acid	
Fluoride	
Vehicle movements (+/- 10%)	No available data.

1.3.7. Location Maps

1.3.8. Option Schematic

Option: CW24-38 – Site-scale rainwater harvesting (Northstowe or similar growth)



Appendices

Appendix A. GIS Shapefiles

GIS layers have been provided separately for the assets associated with this option. A GIS file register, reference 5211472-ATK-CA-9-037 of the files produced and shared with the environmental team is also available.

Appendix B. Engineering Data Methods

B.1. CAM dWRMP24 Operational Carbon Data Workbook

A separate spreadsheet, reference 5211472-ATK-CA-7.12-072 has been produced that includes the methodology undertaken to produce the operational carbon data.

Appendix C. Costing

C.1. CAM dWRMP24 Costing Report

The specific option cost assumptions applied are included in a costing assumption input section for this option in the costing report (reference 5211472-ATK-RP-7.9-074), produced to document the methodology undertaken to produce the options CAPEX, OPEX, NPV and AIC for the options progressed to the constrained list.

C.2. CAM dWRMP24 Option Cost Outputs

The option costs and relevant data sets that relate to the costing outputs (embedded carbon emissions, quantity of concrete and construction power) have been provided in a separate spreadsheet (reference 5211472-ATK-CA-7.9-076).

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dWRMP24 Option Details Reporting

CW24-57: River Cam abstraction and treatment works.

Cambridge Water

20th June 2022

5211472-ATK-RP-9-064

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This document has 19 pages including the cover.

Document history

Document title: CW24-57: River Cam abstraction and treatment works.

Document reference: 5211472-ATK-RP-9-064

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Draft for client comment	CK/ALB	SF	JT	ALB	30.05.2022
2.0	Updated draft for client comment	CK/ALB	EE	JT	JT	07/06/2022
3.0	Updated draft with WTW input	RB	ML	HT	ALB	20/06/2022

Client signoff

Client	Cambridge Water
Project	dWRMP24 Option Details Reporting
Job number	5211472
Client signature/date	

Contents

Notes

Methodology

This option detail report is expected to be used in conjunction with report 5211472-ATK-RP-7.7-015 *CAM WRMP24 Supply-Side Constrained Options Data Summary,* this provides the methodology used to produce the data outputs that are provided in this report.

Assumptions

The data provided in this report for the option is assumed to be high level, for strategic planning purposes only, and if this option is carried forward to feasible stage that the option will be reviewed, and appropriate design undertaken.

1.1. Option Information

Option name	**River Cam abstraction and treatment works**		
Option ref	CW24-57	**Previous ref**	None
Option type	Supply-side – New surface water abstraction		
Concept	Surface water abstraction from the River Cam utilising the available HoF to provide additional raw water that will be stored in an embankment reservoir. This raw water will then be treated in a new WTW and transferred to Cherry Hinton for deployment at an output of 7Ml/d. This stretch of the River Cam is supplemented by effluent discharge from Milton WWTW, an Anglian Water (AWS) site.		
Links to other options	Dependencies: None (AWS option) Exclusivities: CW24-71 Both options consider the use of the discharge from Milton WWTW and the HoF for the River Cam therefore they are exclusive.		

Screening decision	Peak option	Drought option	Resilience option
Constrained list	N/A	N/A	N/A

DO BENEFITS	Low	Best	Extreme
DYAA Ml/d	-	7 Ml/d	-
NYAA Ml/d	-	7 Ml/d	-
DYCP Ml/d	-	7 Ml/d	-
Reasoning behind DO (Ml/d) selection	DO is based on the available abstraction of the River Cam HoF – allowing 22.2Ml/d to be abstracted during 120 days of the year, producing a rate of availability of 2,664Ml/yr. This has allowed for the sizing of a reservoir that the output from has been divided down to allow for a constant supply flow throughout the year of 7Ml/d.		

Background information	The River Cam flows through Cambridge in a northerly direction to join the River Great Ouse. The AWS site Milton WWTW, which is at the northern edge of Cambridge, discharges its final effluent into the River Cam. The extra water available from the WWTW discharge into the River Cam is to be utilised to address the supply deficit in the area.
Option description	This option is to construct a new bankside pumped abstraction point on the River Cam ~2km downstream of Milton WWTW, this is to provide a buffer for the blending of final effluent and river water before abstraction. Due to the unavailability of WWTW discharge data at this stage of option development, it has been assumed that up to the River Cam's HoF will be available for abstraction (22.2Ml/d for 120 days a year, corresponding to a DO of 7Ml/d). Once abstracted the water will be stored in a large embankment reservoir. From this reservoir the water will be pumped to a new WTW for treatment and deployed via an additional pumped pipeline into the Cambridge network, proposed at Chery Hinton. The following assets have been proposed for this option. 1. Two 31.6kW river bankside intake pumps (63kW), with the necessary arrangements, inclusive of features such as gravel traps and eel screens etc. 2. New embankment open reservoir (2664Ml) 3. Two 9.9kW reservoir abstraction pumps (20kW) 4. Control building for reservoir (20m^2 footprint area) 5. 50m of 650mm pumped pipeline 6. New 7Ml/d WTW with the following treatment: Coagulant Dosing storage and rig (7Ml/d), Dissolved Air Flotation (7Ml/d), Rapid Gravity Filtration (7Ml/d), Ozone Contact Basin, generator and dosing rig (7Ml/d), Biological Activated Filtration (7Ml/d), Membrane Filtration (7Ml/d), UV-AOP (7Ml/d), Granular Activated Carbon Filtration (3.5Ml/d), Chlorine Contact Tank (7Ml/d), Chlorine dosing rig and storage (7Ml/d), Dirty Washwater holding tank (150m3), Phosphoric acid dosing rig and storage (7Ml/d), Hydrogen

	Peroxide Dosing rig (7Ml/d), Sulphuric Acid dosing rig (7Ml/d), Caustic Soda Dosing Rig (7Ml/d). 7. Control building for WTW (20m^2 footprint area) 8. Two 50.1kW (100kW) pumps to transfer water to Cambridge network (Cherry Hinton) 9. 10km of 400mm pipeline from new WTW to Cherry Hinton 10. Three new power supplies, two 0-50kW and one 251-500kW 11. Land purchase for the river abstraction (1ha), embankment reservoir (45ha) and WTW (0.5ha). 12. Land compensation for the pipeline lengths
Licensing and stakeholder feedback	Based on the Cam and Ely Ouse ALS1, AP6 is the first assessment point downstream of the effluent discharge location. Table 2 of ALS states the availability of 22.2Ml/d for 120 days with the HoF Restriction of 250.5Ml/d. Based on these numbers it is assumed that there is availability within River Cam for abstraction. Stakeholder engagement with AWS and EA will be required for the abstraction licence for this option.
Key assumptions	- EA will allow the abstraction from River Cam and the effects on the EA assets will be acceptable. - Treated water could be deployed into the network via existing Cherry Hinton SR. - It is assumed the CAM network at Cherry Hinton can accept the additional flows and does not require upgrade. - The river abstraction and reservoir are sized for 22.2Ml/d, as the water is available for 120 days - It is assumed that the DO of 7Ml/d will be available, all assets from the embankment reservoir are sized for this. - It is assumed that 56ha will be required for land purchase, this is subject to change during design stage. It is assumed no infrastructure is available on site, including power supply. - Land compensation is assumed to be needed for all lengths of pipeline included in the option. - Land purchase is assumed to be required for the river abstraction, embankment reservoir and WTW. - Further specific consideration will be required regarding the intake and discharge points to manage risks (e.g. to prevent the ingress of eels or transfer of invasive non-native species (INNS)). Treatment Assumptions: - This scheme involves planned indirect reuse of final effluent from Milton WwTW, with the use of raw water storage in a new embankment reservoir. It is assumed the new reservoir will provide sufficient retention time as to be described as an environmental buffer, prior to treatment and distribution to supply. - As no water quality information is available for review, including the quality/ discharge permit and volume of flows from the Milton WwTW final effluent, it has been assumed that the ~2km distance of river mixing between final effluent discharge point and abstraction location is not sufficient to completely mitigate effluent reuse risks.

[1] https://www.gov.uk/government/publications/cam-and-ely-ouse-abstraction-licensing-strategy/cam-and-ely-ouse-abstraction-licensing-strategy

	- The selected treatment follows a developed and proven carbon-based advanced treatment method, suitable for pathogen removal and chemical control in effluent reuse schemes for water recycling. - Water in the bankside storage will be retained long enough for some settlement of suspended solids, as well as some solubilisation of metals and potential algal blooms. - Future water quality information will be required in future stages to determine the suitability of the proposed treatment. - 1% of the DO (70m^3/day) will be used to remove sludge from site via sewer connection. It is likely this volume will lower once water quality information becomes available.
Risks and uncertainties	- All proposed assets are required to be reviewed at design stage when further details are available. - Constraints from the EA on abstraction of water from the River Cam may reduce the final DO available for this option. - The quality of the water to be treatment will require additional assessment as the option progresses. - Risks and assumptions made in relation to the embankment reservoir are included in a separate document (5211472-ATK-RP-9-081) – this relates to the option sizing, land requirement and assets included.

1.2. Asset Pricing

The below data has been used to input into the costing methods for this option:

	Assets required for pricing	Method for pricing assets applied
Raw water source	- Two 31.6kW river bankside intake pumps (63kW), with the necessary arrangements, inclusive of features such as gravel traps and eel screens etc. - New embankment open reservoir (2664Ml) - Two 9.9kW pumps (20kW) - Control building for reservoir (20m^2 footprint area) - 50m of 650mm pumped raw water pipeline	WRC TR61 method and tool applied to the pumps, control building and pipeline. Unable to represent the embankment reservoir and additional features (eel screens and gravel traps) in TR61, cost method applied as described in the costing report (5211472-ATK-RP-7.9-074)
Treatment	- Coagulant Dosing storage and rig (7Ml/d), Dissolved Air Flotation (7Ml/d), Rapid Gravity Filtration (7Ml/d), Ozone Contact Basin, generator and dosing rig (7Ml/d), Biological Activated Filtration (7Ml/d), Membrane Filtration (7Ml/d), UV-AOP (7Ml/d), Granular Activated Carbon Filtration (3.5Ml/d), Chlorine Contact Tank (7Ml/d), Chlorine dosing rig and storage (7Ml/d), Dirty Washwater holding tank (150m3), Phosphoric acid dosing rig and storage (7Ml/d), Hydrogen Peroxide Dosing rig (7Ml/d), Sulphuric Acid dosing rig (7Ml/d), Caustic Soda Dosing Rig (7Ml/d). - Control building for WTW (20m^2 footprint area) - More detail regarding treatment can be found in Section 1.3.9 and Section 1.3.10	
Distribution	- Two 50.1kW (100kW) pumps to transfer water to Cambridge network (Cherry Hinton) - 10km of 400mm potable water pipeline from new WTW to Cherry Hinton	WRC TR61 assets and tool applied.
Land	Linear land compensation for: - 10,050m for pipelines only (60,300m^2) Land purchase for: - 1ha for river intake - 45ha for embankment reservoir. - 0.5ha for WTW	Unable to represent in TR61, cost method applied as described in the costing report (5211472-ATK-RP-7.9-074)

Power	Three new power supplies, two 0-50kW and one 251-500kW	Unable to represent in TR61, cost method applied as described in the costing report (5211472-ATK-RP-7.9-074)

1.3. Environmental Data

1.3.1. General

Included in WMP19	No – New option for dWRMP24.
CAPEX (£K)	See Appendix C2.
Re-use of existing asset?	All proposed assets are new infrastructure, it is assumed that deployment into the Cambridge Water network will take place at Cherry Hinton and that the network has the capability to accept the additional DO.
Environmental Mitigation and benefits	For further details refer to report CAM WRMP24 Supply-Side Constrained Options Data Summary (5211472-ATK-RP-7.7-015) Environment mitigation and benefits section. Assumed mitigation will be required for: * Best practice of construction * Biodiversity and ecosystems * Vehicle movements * Wider WFD no deterioration benefits/disbenefits * Use of local suppliers * Agriculture * CO2 emissions * Sustainable water management of resources To be assessed at design stage: * Archaeological Heritage * Noise * Air quality * Agriculture
WINEP - Relevant investigations	None listed on latest EA WINEP3 March 2020 Public version worksheet.

1.3.2. Abstractions

Type of abstraction (e.g., groundwater, river)	Surface water abstraction				
New abstraction or change to existing abstraction?	New abstraction				
Name of watercourse/aquifer abstraction is from	River Cam				
Location of abstraction (x, y)	[redacted]				
Timing					
DYAA best	7Ml/d	**NYAA best**	7Ml/d	**DYCP best**	7Ml/d
If new					
Daily maximum	7Ml/d	**Daily average**	7Ml/d	**Any constraint?**	River Cam HoF
If change to existing					

Current max daily abstraction rate	N/A – new abstraction
Current average daily abstraction rate	N/A
Change in max daily abstraction rate	N/A
Change in average daily abstraction rate	N/A
Any constraints?	N/A
Annual maximum	N/A
If groundwater	
Information on borehole depths and pumping tests	N/A
Any known surface water interactions	N/A
Any seasonal variation in regime	HoF in place on River Cam allowing 22.2Ml/d to be abstracted from the river over 120 days of the year – to be compensated by a reservoir.
HoF	HoF in place on River Cam allowing 22.2Ml/d to be abstracted from the river over 120 days of the year.

1.3.3. Discharges

Quantity	N/A – No discharges are included in this option.
Quality	N/A
Daily maximum	N/A
Annual maximum	N/A
Any seasonal variation in regime?	N/A
Timing	N/A

1.3.4. Construction

Delivery period - Duration of option construction (yrs)	15yrs
~ Working area of pipeline (m^2)	150,750[2] (15.08ha) working area based on 15m working width of pipeline.
~ Area of compounds (ha)	1ha (10,000m^2) – assumed 4 compounds required for this option (*one for each major asset type*).
~ Area for option (ha)	16.08ha *This includes the working width of the pipeline plus the area of the compounds required.*
No. / type of vehicle / HGV movements	No available data.
Access routes	From the public highway, further confirmation will be required at design stage.
Carbon emissions (tonnes)	See Appendix C2.
Quantity of material (impact)	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Quantity of Concrete	See Appendix C2.
Waste to landfill (impact)	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.

Power impact status	See Appendix C2.

1.3.5. Pipelines/transfers

Pipe size (mm)		**Size (mm)**		**Length (m)**	
Pipe 1 raw water		650mm		50m	
Pipe 2 potable water		400mm		10,000m	
DO (Ml/d)					
DYAA (Ml/d)	7Ml/d	**NYAA (Ml/d)**	7Ml/d	**DYCP (Ml/d)**	7Ml/d
Max design pipeline capacity (Ml/d)		7Ml/d			
Quantity (Ml/yr)		2,555Ml/d			
Quality					
Raw		Y	**Potable**	Y	
Pipeline construction method		Pipeline will be constructed using open-cut methods unless specific conditions require otherwise. A specific construction methodology is expected to be developed once an option reaches later design stages.			
Type of crossings		**No. of crossings identified**			
Canal crossing		0			
Major Road (A/B)		1			
Major Road (M)		0			
Minor Road (uncl)		7			
Railway line crossing (private)		0			
Railway line crossing (public)		0			
Watercourse crossing		1			
Major River Crossings		0			

1.3.6. Operations

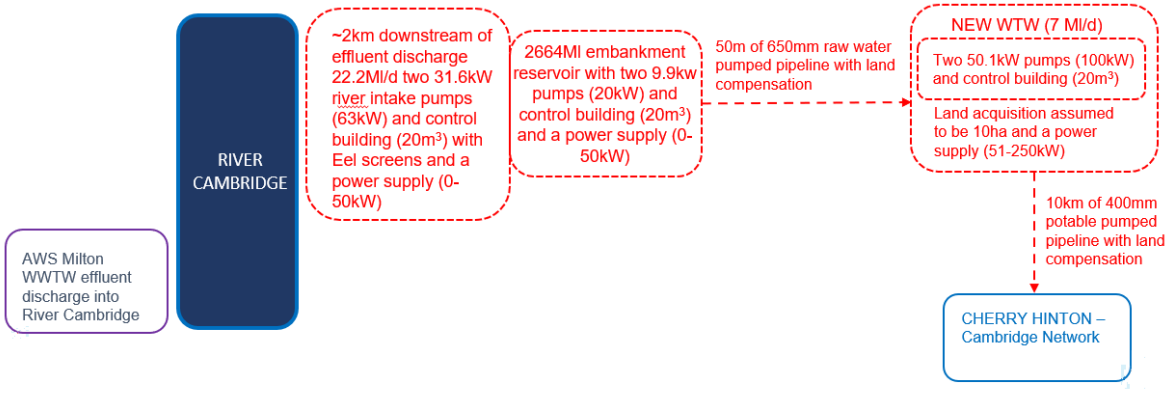
List of permanent above ground structures once operational	River intake abstraction and control building 45ha embankment reservoir WTW and control building		
Total new land take of completed option (m^2)	60,300m^2 for pipeline compensation only. 45ha for the embankment reservoir Proposed 0.5 ha for the WTW 1ha for the river abstraction		
Carbon emissions (tonnes)	See Appendix B2.		
Waste to landfill	Negligible – this requires detailed design to be undertaken at a later stage.		
Power (kWh/yr)	63kW required for river intake pumps 20kW required for reservoir pumps 100kW potable water pump from WTW to Cherry Hinton 444kW power unit for new WTW, 5288kWh/d Total = 627kW/d = 228,855kW/yr		
Chemical	**DYAA (tonnes per year)**	**NYAA (tonnes per year)**	**DYCP (tonnes per year)**
Polyaluminium Chloride			
Sodium Chloride			
Sodium Hydroxide	110	110	110

Sulphur Dioxide			
Phosphoric Acid	11	11	11
Sodium Hypochlorite	30	30	30
Poly - electrolytes			
Calcium Hydroxide			
Sodium Bisulphite			
Sulphuric Acid	27	27	27
Ferric Sulphate	220	220	220
Hydrochloric Acid			
Fluoride			
Liquid Oxygen	77	77	77
Hydrogen Peroxide	44	44	44
Vehicle movements (+/- 10%)	No available data.		

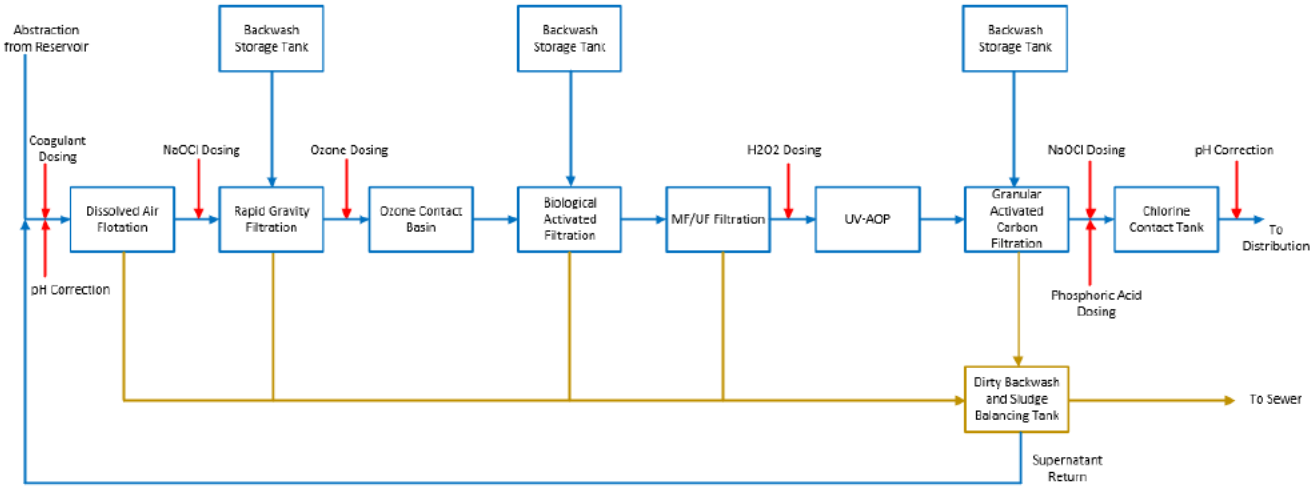
1.3.7. Option Location Maps

1.3.8. Option schematic

Option: CW24-57



1.3.9. Water Treatment Works Block Flow Diagram



1.3.10. Water Treatment Works CAPEX and OPEX Summary

Asset	TR61 V13 Model no.	Driver	Unit
Dissolved Air Flotation	-	7.0	Ml/d
Rapid Gravity Filters	70400	7.0	Ml/d
Ozone Contact Basin and Dosing Rig	71005	7.0	Ml/d
Biological Activated Carbon Filters (use GAC as substitute for costing)	70300	7.0	Ml/d
Membrane Filtration	70200	7.0	Ml/d
UV for AOP	-	7.0	Ml/d
Granular Activated Carbon	70300	3.5	Ml/d
Chlorine Contact Tank	71100	0.2	Thousand m^3
Dirty Washwater Holding Tank	-	0.15	Thousand m^3
Coagulant Dosing Rig	71001	7.0	Ml/d
Phosphoric Acid Dosing Rig	71006	7.0	Ml/d
Hydrogen Peroxide Dosing Rig	70900	7.0	Ml/d
Chlorine Dosing Rig	71004	7.0	Ml/d
Sulphuric Acid Dosing Rig	70900	7.0	Ml/d
Caustic Soda Dosing Rig	70900	7.0	Ml/d
Land Area	-	5000	m^2
Buildings Control	-	200	m^2
Buildings (Treatment)	65557	1300	m^2
Power Upgrades	-	500	kW

Asset	DYAA Driver	NYAA Driver	DYCP Driver	Unit
Chlorine Dosing	81	81	81	kg/d
Phosphate Dosing	30	30	30	kg/d
Ferric Sulphate	600	600	600	kg/d
Liquid Oxygen/ LOX for Ozone Dosing	210	210	210	kg/d
Hydrogen Peroxide Dosing	120	120	120	Kg/d

Asset	DYAA Driver	NYAA Driver	DYCP Driver	Unit
Sulphuric Acid	73	73	73	Kg/d
Sodium Hydroxide	300	300	300	Kg/d

Asset	DYAA Driver	NYAA Driver	DYCP Driver	Unit
Chemical Dosing	168	168	168	kWh/d
Process Unit Required Power	4952	4952	4952	kWh/d
Instrumentation	48	48	48	kWh/d
Service Water	120	120	120	kWh/d
Total	5288	5288	5288	kWh/d

Appendices

Appendix A. GIS

A.1. Shapefiles and register

GIS layers have been provided separately for the assets associated with this option. A GIS file register, reference 5211472-ATK-CA-9-037 of the files produced and shared with the environmental team is also available.

Appendix B. Engineering Data Methods

B.1. CAM dWRMP24 Operational Carbon Data Workbook

A separate spreadsheet, reference 5211472-ATK-CA-7.12-072 has been produced that includes the methodology undertaken to produce the operational carbon data.

Appendix C. Costing

C.1. CAM dWRMP24 Costing Report

The specific option cost assumptions applied are included in a costing assumption input section for this option in the costing report (reference 5211472-ATK-RP-7.9-074), produced to document the methodology undertaken to produce the options CAPEX, OPEX, NPV and AIC for the options progressed to the constrained list.

C.2. CAM dWRMP24 Option Cost Outputs

The option costs and relevant data sets that relate to the costing outputs (embedded carbon emissions, quantity of concrete and construction power) have been provided in a separate spreadsheet (reference 5211472-ATK-CA-7.9-076).

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dWRMP24 Option Details Reporting

CW24-71: AWS Milton WWTW effluent discharge re-use

Cambridge Water

20th June 2022

5211472-ATK-RP-9-07165

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Document history

Document title: CW24-71: AWS Milton WWTW effluent discharge re-use

Document reference: 5211472-ATK-RP-9-071

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Draft for client comment	CK/ALB	SF	JT	ALB	30.05.2022
2.0	WTW update	RB	ML	HT	ALB	20.06.2022

Client signoff

Client	Cambridge Water
Project	dWRMP24 Option Details Reporting
Job number	5211472
Client signature/date	

Contents

Notes

Methodology

This option detail report is expected to be used in conjunction with report 5211472-ATK-RP-7.7-015 *CAM WRMP24 Supply-Side Constrained Options Data Summary,* this provides the methodology used to produce the data outputs that are provided in this report.

Assumptions

The data provided in this report for the option is assumed to be high level, for strategic planning purposes only, and if this option is carried forward to feasible stage that the option will be reviewed, and appropriate design undertaken.

1.1. Option Information

Option name	**AWS Milton WWTW effluent discharge re-use**		
Option ref	CW24-71	**Previous ref**	None
Option Type	Supply side – Effluent re-use		
Concept	Effluent discharged from Milton WWTW, an Anglian Water (AWS) site, will be directly treated in a new WTW and transferred to Cherry Hinton for deployment into the CAM network.		
Links to other options	Dependencies: None Exclusivities: CW24-57 Both options consider the use of the discharge from Milton WWTW and the HoF for the River Cam, therefore they are exclusive.		

Screening decision	Peak option	Drought option	Resilience option
Constrained list	N/A	N/A	N/A

DO BENEFITS	Low	Best	Extreme
DYAA Ml/d	-	7Ml/d	-
NYAA Ml/d	-	7Ml/d	-
DYCP Ml/d	-	7Ml/d	-
Reasoning behind DO (Ml/d) selection	DO is based on the available abstraction of the River Cam HoF – allowing 22.2Ml/d to be abstracted during 120 days of the year, producing a rate of availability of 2,664Ml/yr. This has been assumed as no discharge data has been made available for Milton WWTW, but as the WWTW discharges into the river it is assumed to be acceptable to size the assets on an output similar to that of the HoF, of 2,664Ml/yr (corresponding to a steady supply flow of 7Ml/d).		

Background	AWS's Milton WWTW is located north of Cambridge at the junction of A14 and A1309. Currently final effluent from the WWTW gets discharged into the River Cam.
Option description	This option is to capture the final effluent from Milton WWTW which currently gets discharged into the River Cam. The effluent will be transferred to a new WTW where it will be treated to potable standard and then the water will be deployed to the Cambridge Water network via new pipeline and pumping station. The following assets have been proposed for this option: 1. Two 5.7kW (11kW) final effluent transfer pumps to New WTW 2. Control building (20m^2 footprint area) 3. 800m of 400mm raw water pumped pipeline 4. Raw water environmental buffer open top reservoir (49Ml) 5. New 7Ml/d WTW with the following treatment: Coagulant Dosing storage and rig (7Ml/d), Dissolved Air Flotation (7Ml/d), Rapid Gravity Filtration (7Ml/d), Ozone Contact Basin, generator and dosing rig (7Ml/d), Biological Activated Filtration (7Ml/d), Membrane Filtration (7Ml/d), UV-AOP (7Ml/d), Granular Activated Carbon Filtration (3.5Ml/d), Chlorine Contact Tank (7Ml/d), Chlorine dosing rig and storage (7Ml/d), Dirty Washwater holding tank (150m3), Phosphoric acid dosing rig and

	storage (7Ml/d), Hydrogen Peroxide Dosing rig (7Ml/d), Sulphuric Acid dosing rig (7Ml/d), Caustic Soda Dosing Rig (7Ml/d). 6. Control building (50m^2) footprint area 7. Two 48.5kW (97kW) pumps to transfer water to Cambridge network (Cherry Hinton) 8. 8.3km 400mm diameter pumped pipeline from new WTW to Cherry Hinton 9. Two new power supplies, one for 0-50kW and one for 251-500kW Land acquisition assumed to be 2.5ha for new WTW and raw water storage and 0.5ha for final effluent pump at WWTW. 10. Land compensation for pipelines (9.1km)
Licensing and stakeholder feedback	Based on the Cam and Ely Ouse ALS1, AP6 is the first assessment point downstream of the effluent discharge location. Table 2 of ALS states the availability of 22.2Ml/d for 120 days with the HoF Restriction of 250.5Ml/d. Based on these numbers it is assumed that there is availability within River Cam for abstraction. Stakeholder engagement with AWS and EA will be required for the confirmed available DO from the WWTW.
Key assumptions	- EA will allow the use of the WWTW final effluent discharge, and the effects on the EA assets will be acceptable. - Treated water could be deployed into the network via the existing Cherry Hinton SR. It is assumed the CAM network at Cherry Hinton can accept the additional flows and does not require upgrade. - It is assumed that the DO of 7Ml/d will be available, all assets are sized for this. - It is assumed no infrastructure is available on site, including power supply. - It is assumed that the final effluent can be captured and transferred for treatment. - Land compensation is assumed to be needed for all lengths of pipeline included in the option. - Land purchase is assumed for 2.5 ha for the WTW and raw water storage. Treatment Assumptions: - This scheme involves planned indirect reuse of final effluent from Milton WwTW, with the use of raw water storage to provide 7 days of environmental buffer storage. It is assumed the new buffer storage will provide sufficient retention time as to be described as an environmental buffer, prior to treatment and distribution to supply. The use of an environmental buffer is key in water reuse schemes. - The selected treatment follows a developed and proven carbon-based advanced treatment method, suitable for pathogen removal and chemical control in effluent reuse schemes for water recycling. - Water in the buffer storage will be retained long enough for some settlement of suspended solids, as well as some solubilisation of metals and potential algal blooms. - Future water quality information will be required in future stages to determine the suitability of the proposed treatment.

[1] https://www.gov.uk/government/publications/cam-and-ely-ouse-abstraction-licensing-strategy/cam-and-ely-ouse-abstraction-licensing-strategy

	- 1% of the DO (70m^3/day) will be used to remove sludge from site via sewer connection. It is likely this volume will lower once water quality information becomes available.
Risks and uncertainties	- All proposed assets are required to be reviewed at design stage when further details are available. - Constraints from the EA may reduce the final DO available for this option. - The quality of the water for treatment will require additional assessment. - There is a risk of public perception and acceptability with regard to re-use of final effluent wastewater.

1.2. Asset Pricing

The below data has been used to input into the costing methods for this option:

	Assets required for pricing	Method for pricing assets applied
Raw water source	- Two 5.7kW (11kW) final effluent transfer pumps to New WTW - Control building (20m^2 footprint area) - 800m of 400mm raw water pumped pipeline	WRC TR61 method and tool applied.
Treatment	- 7 Day environmental Buffer Storage (49Ml), Coagulant Dosing storage and rig (7Ml/d), Dissolved Air Flotation (7Ml/d), Rapid Gravity Filtration (7Ml/d), Ozone Contact Basin, generator and dosing rig (7Ml/d), Biological Activated Filtration (7Ml/d), Membrane Filtration (7Ml/d), UV-AOP (7Ml/d), Granular Activated Carbon Filtration (3.5Ml/d), Chlorine Contact Tank (7Ml/d), Chlorine dosing rig and storage (7Ml/d), Dirty Washwater holding tank (150m3), Phosphoric acid dosing rig and storage (7Ml/d), Hydrogen Peroxide Dosing rig (7Ml/d), Sulphuric Acid dosing rig (7Ml/d), Caustic Soda Dosing Rig (7Ml/d). - Control building for WTW (20m^2 footprint area) More detail regarding treatment can be found in Section 1.3.9 and Section 1.3.10	
Distribution	- Two 48.5kW (97kW) pumps to transfer water to Cambridge network (Cherry Hinton) - 8.3km 400mm diameter pumped pipeline from new WTW to Cherry Hinton	WRC TR61 method and tool applied.
Land	Linear land compensation for: - 9.1km for pipelines only. Land purchase for: - 2.5ha for new WTW - 0.5ha for new raw water pump at WWTW	Unable to represent in TR61, cost method applied as described in the costing report (5211472-ATK-RP-7.9-074).
Power	- New power connection (0-50kW and 251-500kW)	Unable to represent in TR61, cost method applied as described in the costing report (5211472-ATK-RP-7.9-074)

1.3. Environmental data

1.3.1. General

Proforma WMP19	N/A – New option for WRMP24
CAPEX (£K)	See Appendix C2.
Re-use of existing asset?	N/A – New assets
Environmental Mitigation and benefits	For further details refer to report CAM WRMP24 Supply-Side Constrained Options Data Summary (5211472-ATK-RP-7.7-015) Environment mitigation and benefits section. Assumed mitigation will be required for: * Best practice of construction * Biodiversity and ecosystems * Vehicle movements * Wider WFD no deterioration benefits/disbenefits * Use of local suppliers * Agriculture * CO2 emissions * Sustainable water management of resources To be assessed at design stage: * Archaeological Heritage * Noise * Air quality * Agriculture
WINEP - Relevant investigations	N/A

1.3.2. Abstractions

Type of abstraction (e.g. groundwater, river)		N/A – Final WWTW effluent re-use			
New abstraction or change to existing abstraction?		N/A			
Name of watercourse/aquifer abstraction is from		N/A			
Location of abstraction (x, y)		N/A			
Timing					
DYAA best	N/A	**NYAA best**	N/A	**DYCP best**	N/A
If new					
Daily maximum	N/A	**Daily average**	N/A	**Any constraint?**	N/A
If change to existing					
Current max daily abstraction rate		N/A			
Current average daily abstraction rate		N/A			
Change in max daily abstraction rate		N/A			
Change in average daily abstraction rate		N/A			
Any constraints?		N/A			
Annual maximum		N/A			

If groundwater	
Information on borehole depths and pumping tests	N/A
Any known surface water interactions	N/A
Any seasonal variation in regime	N/A
HoF	N/A

1.3.3. Discharges

Quantity	N/A – No discharges are included in this option.
Quality	N/A
Daily maximum	N/A
Annual maximum	N/A
Any seasonal variation in regime?	N/A
Timing	N/A

1.3.4. Construction

Delivery Period - Duration of scheme construction (yrs)	10yrs
~ Working area of pipeline (m^2)	136,500m^2 (13.65ha) working area based on 15m working width of pipeline.
~ Area of compounds (ha)	0.5 assumed 2 compounds required for this option, one for the raw water pump and one for the WTW.
~ Area for scheme (ha)	14.15ha *This includes the working width of the pipeline plus the area of the compounds required.*
No. / type of vehicle / HGV movements	No available data.
Access routes	From the public highway, further confirmation will be required at design stage.
Carbon emissions (tonnes)	See Appendix C2.
Quantity of material (impact)	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Quantity of Concrete	See Appendix C2.
Waste to landfill	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Power impact status	See Appendix C2.

1.3.5. Pipeline/Transfers

Pipe size (mm)		Size (mm)		Length (m)	
Pipe 1 raw water		400mm		800m	
Pipe 2 potable water		400mm		8,300m	
DO (Ml/d)					
DYAA (Ml/d)	7Ml/d	NYAA (Ml/d)	7Ml/d	DYCP (Ml/d)	7Ml/d
Max design Pipeline capacity (Ml/d)		7Ml/d			
Quantity (ML/yr)		2,555Ml/yr			
Quality					
Raw	Y		Potable	Y	
Pipeline construction method		Pipeline will be constructed using open-cut methods unless specific conditions require otherwise. A specific construction methodology is expected to be developed once an option reaches later design stages.			

Type of crossings	No. of crossings identified
Canal crossing	0
Major Road (A/B)	2
Major Road (M)	0
Minor Road (uncl)	4
Railway line crossing (private)	0
Railway line crossing (public)	0
Watercourse crossing	1
Major River Crossings	1

1.3.6. Operations

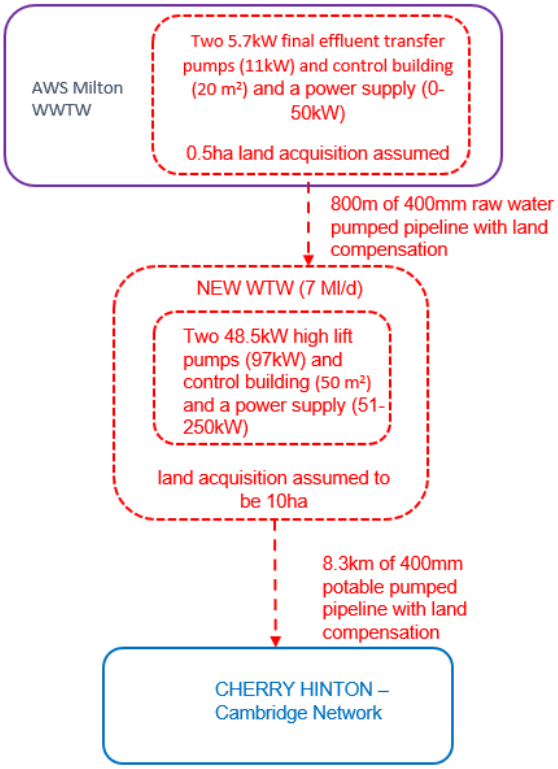
List of permanent above ground structures once operational	Raw water pump at WWTW and control building Water treatment works, control building and potable water deployment pump.		
Total land take of completed option (m^2)	0.5ha for final effluent raw water pump at WWTW Proposed 2.5ha WTW site		
Carbon emissions (tonnes)	See Appendix B2.		
Waste to landfill	Negligible – this requires detailed design to be undertaken.		
Power (kWh/yr)	For the pump usage only, 11kw/d raw water pump 97kW/d potable water pump 444kW power unit for new WTW, 5288kWh/d 552kW/d = 201,480kW/yr		
Chemical	DYAA (tonnes per year)	NYAA (tonnes per year)	DYCP (tonnes per year)
Polyaluminium Chloride			
Sodium Chloride			
Sodium Hydroxide	110	110	110
Sulphur Dioxide			
Phosphoric Acid	11	11	11
Sodium Hypochlorite	30	30	30

Poly - electrolytes			
Calcium Hydroxide			
Sodium Bisulphite			
Sulphuric Acid	27	27	27
Ferric Sulphate	220	220	220
Hydrochloric Acid			
Fluoride			
Liquid Oxygen	77	77	77
Hydrogen Peroxide	44	44	44
Vehicle movements (+/- 10%)	No available data.		

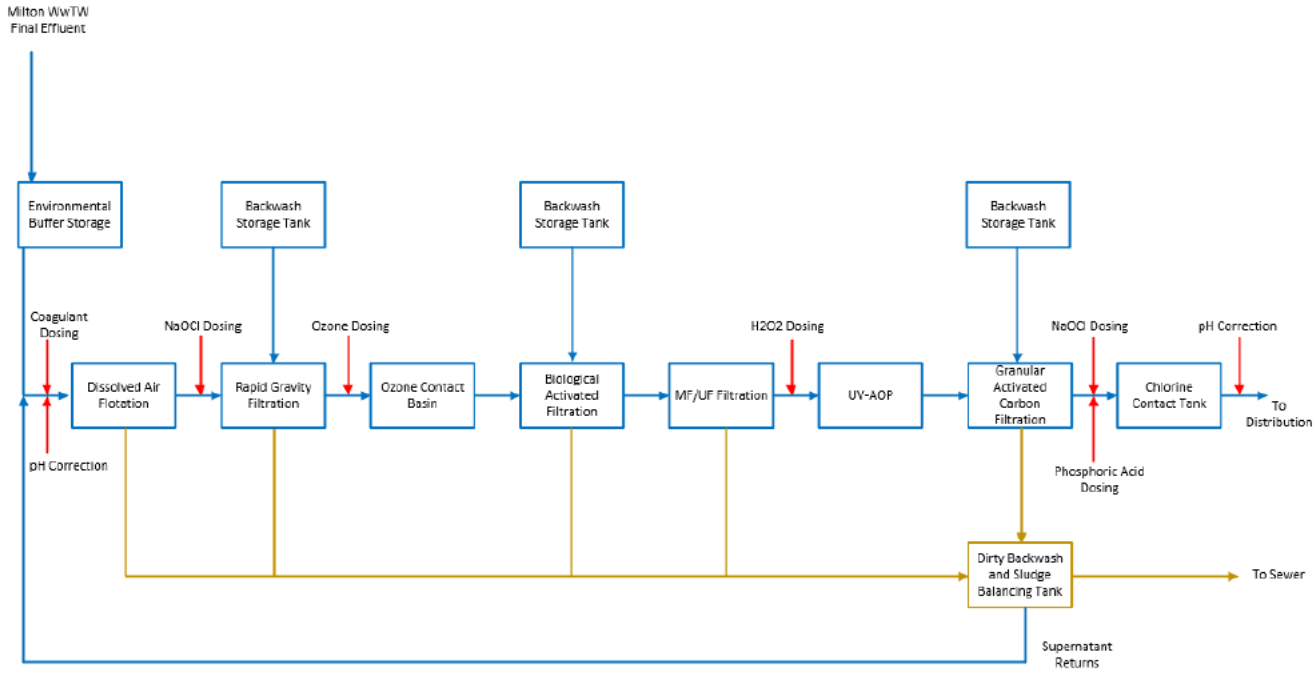
1.3.7. Location Maps

1.3.8. Option Schematic

Option: CW24-71



1.3.9. Water Treatment Works Block Flow Diagram



1.3.10. Water Treatment Works CAPEX and OPEX Summary

Asset	TR61 V13 Model no.	Driver	Unit
Environmental Buffer Storage		49.0	Ml
Dissolved Air Flotation	-	7.0	Ml/d
Rapid Gravity Filters	70400	7.0	Ml/d
Ozone Contact Basin and Dosing Rig	71005	7.0	Ml/d
Biological Activated Carbon Filters (use GAC as substitute for costing)	70300	7.0	Ml/d
Membrane Filtration	70200	7.0	Ml/d
UV for AOP	-	7.0	Ml/d
Granular Activated Carbon	70300	3.5	Ml/d
Chlorine Contact Tank	71100	0.2	Thousand m^3
Dirty Washwater Holding Tank	-	0.15	Thousand m^3
Coagulant Dosing Rig	71001	7.0	Ml/d
Phosphoric Acid Dosing Rig	71006	7.0	Ml/d
Hydrogen Peroxide Dosing Rig	70900	7.0	Ml/d
Chlorine Dosing Rig	71004	7.0	Ml/d
Sulphuric Acid Dosing Rig	70900	7.0	Ml/d
Caustic Soda Dosing Rig	70900	7.0	Ml/d
Land Area	-	25000	m^2
Buildings Control	-	200	m^2
Buildings (Treatment)	65557	1300	m^2
Power Upgrades	-	500	kW

Asset	DYAA Driver	NYAA Driver	DYCP Driver	Unit
Chlorine Dosing	81	81	81	kg/d
Phosphate Dosing	30	30	30	kg/d

Asset	DYAA Driver	NYAA Driver	DYCP Driver	Unit
Ferric Sulphate	600	600	600	kg/d
Liquid Oxygen/ LOX for Ozone Dosing	210	210	210	kg/d
Hydrogen Peroxide Dosing	120	120	120	Kg/d
Sulphuric Acid	73	73	73	Kg/d
Sodium Hydroxide	300	300	300	Kg/d

Asset	DYAA Driver	NYAA Driver	DYCP Driver	Unit
Chemical Dosing	168	168	168	kWh/d
Process Unit Required Power	4952	4952	4952	kWh/d
Instrumentation	48	48	48	kWh/d
Service Water	120	120	120	kWh/d
Total	5288	5288	5288	kWh/d

Appendices

Appendix A. GIS Shapefiles

GIS layers have been provided separately for the assets associated with this option. A GIS file register, reference 5211472-ATK-CA-9-037 of the files produced and shared with the environmental team is also available.

Appendix B. Engineering Data Methods

B.1. CAM dWRMP24 Operational Carbon Data Workbook

A separate spreadsheet, reference 5211472-ATK-CA-7.12-072 has been produced that includes the methodology undertaken to produce the operational carbon data.

Appendix C. Costing

C.1. CAM dWRMP24 Costing Report

The specific option cost assumptions applied are included in a costing assumption input section for this option in the costing report (reference 5211472-ATK-RP-7.9-074), produced to document the methodology undertaken to produce the options CAPEX, OPEX, NPV and AIC for the options progressed to the constrained list.

C.2. CAM dWRMP24 Option Cost Outputs

The option costs and relevant data sets that relate to the costing outputs (embedded carbon emissions, quantity of concrete and construction power) have been provided in a separate spreadsheet (reference 5211472-ATK-CA-7.9-076).

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dWRMP24 Option Details Reporting

CW24-73A: Fens Reservoir internal potable water transfer (Chatteris)

Cambridge Water

27 May 2022

5211472-ATK-RP-9-040

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This document has 16 pages including the cover.

Document history

Document title: CW24-73A: Fens Reservoir internal potable water transfer (Chatteris)

Document reference: 5211472-ATK-RP-9-040

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	For client comment	CK/ALB	SF	EE	ALB	27.05.2022

Client signoff

Client	Cambridge Water
Project	dWRMP24 Option Details Reporting
Job number	5211472
Client signature/date	

Contents

Notes

Methodology

This option detail report is expected to be used in conjunction with report 5211472-ATK-RP-7.7-015 *CAM WRMP24 Supply-Side Constrained Options Data Summary,* this provides the methodology used to produce the data outputs that are provided in this report.

Assumptions

The data provided in this report for the option is assumed to be high level, for strategic planning purposes only, and if this option is carried forward to feasible stage that the option will be reviewed, and appropriate design undertaken.

1.1. Option Information

Option name	**Fens Reservoir internal potable water transfer (Chatteris)**		
Option ref	CW24-73A	**Previous ref**	None
Scheme type	Supply-side - Internal potable water transfer		
Concept	The overall concept of the scheme is to build a major new surface water reservoir in South Fenland, to be shared between CAM and Anglian Water (AWS), with associated abstraction and WTW. This option only assesses a high lift pump and pumped pipeline transfer of potable water to Madingley reservoir, with an offtake to Bluntisham reservoir, with additional storage included at these two locations. There are 4 sub-options to this option. Each sub-option relates to a different proposed location of the Fens reservoir (A - Chatteris, B - Ely, C - Southery and D - Burnt Fen), therefore the pumped pipeline locations differ but the overall option assumptions are the same.		
Links to other options	Dependencies: None Exclusivities: CW24-73B, 73C, 73D Each sub-option relates to the different proposed Fens Reservoir locations, therefore, the source of water will be the same, making these options exclusive dependant on the selected location.		

Screening decision	Peak option	Drought option	Resilience option
Constrained list	N/A	N/A	N/A

DO BENEFITS	Low	Best	Extreme
DYAA Ml/d	-	49.5 Ml/d	-
NYAA Ml/d	-	49.5 Ml/d	-
DYCP Ml/d	-	49.5 Ml/d	-
Reasoning behind DO Ml/d selection	Initial iterative WRE simulator modelling in the RAPID programme has predicted a 99Ml/d availability proposed from the new Fens reservoir, 50% of this figure is expected to be made available to Cambridge Water.		

Background	The construction of a major new surface water reservoir with WTW in South Fenland is progressing at strategic level, this is to be shared between CAM and AWS. The location of the reservoir is to be chosen from four potential alternatives (A - Chatteris, B - Ely, C - Southery and D - Burnt Fen). The sub-options only assess the connectivity from the different locations for the potable water to the Cambridge network, they do not include the reservoir or WTW and their associated asset requirements.
Option description	The overall concept for sub-option A, is to construct the new raw water reservoir with a new abstraction point at Forty Foot Drain, north of Chatteris (at ([redacted]) although the locations provided are indicative for this stage of the project), along with a WTW. The treated water from this new WTW will then be transferred via a new pumping station and pumped pipeline to Madingley DSR, with offtake to Bluntinsham DSR, inclusive of additional storage at both locations. As option CW24-73A only includes the treated water transfer elements, only the following infrastructure assets have been included in the option: - High lift 980kW pump for 55Ml/d with a 106m lift. - Control building (footprint area of 200m^2) - 18km of 900mm between high lift pump and Bluntisham offtake - 18km of 800mm between Bluntisham offtake and Madingley.

	- 5Ml/d storage reservoir to be provided at Bluntisham - 21Ml/d storage reservoir to be provided at Madingley - Land compensation for the pipelines - Land purchase for the two storage reservoirs - Power supply (251-1000kW) Note: The storage reservoir sizes are based on upsizing the current storage at the two locations to allow for 55Ml/d to be stored.
Licensing and stakeholder feedback	- The availability of raw water that will feed this option is to be checked and agreed with EA and other relevant authorities as part of the Fens reservoir option progression. Therefore further stakeholder engagement with EA and AWS will be required with regard to licensing.
Key assumptions	- It is assumed a DO of 49.5Ml/d will be available, all assets have been sized from this. - Assumed that the distribution network will not require additional work to deploy additional water from Madingley and Bluntisham and has capacity to utilise the additional flows. - Assumed there is a current storage capacity of 29Ml/d at the existing Bluntisham DSR and Madingley DSR locations. - Land compensation is assumed for all lengths of pipeline included in the option. - It is assumed that a new power supply is required at the Fens Reservoir location for the high lift pump. - It is assumed there is insufficient space for the two storage reservoirs on the DSR sites and land purchase will be required adjacent to the sites. - It is assumed the water received to the pump from the WTW located at the reservoir will have the same WQ as the CAM network and that therefore no “polishing” is required.
Risks and uncertainties	- Risk to water quality due to the mixing of water from different sources and treatment works. - Risk to the final DO available for the option from the Fens Reservoir as this may be subject to licence agreements. This option assumes the full DO is available. - Pumps and pipes are sized from the expected DO output. - It is assumed that a large control building will be required due to the size of the high lift pump. - Pipe lengths are assumed from a review of GIS for the most appropriate pipeline location, there is a risk of subject to change after environmental and design option stages and discussions with landowners.

1.2. Asset Pricing

The below data has been used to input into the costing methods for this option:

	Assets required for pricing	Method for pricing assets applied
Raw water source	*N/A* - *Reservoir assumed to be constructed as part of multi-company option, not to be costed here.*	
Treatment	*N/A* - *It is assumed for this option that no treatment needs are required, and potable water will be available.*	
Distribution	- One high lift 980kW pump for ~55Ml/d for 106m lift. - Control building (footprint area of 200m^2) - 18km of 900mm between high lift pump and Bluntisham offtake - 18km of 800mm between Bluntisham offtake and Madingley. - 5Ml/d Bluntisham DSR storage reservoir - 10Ml/d volume Madingley DSR storage reservoir *Assumed that the distribution network will not require additional work to deploy additional water from Madingley and Bluntisham.*	WRC TR61 method and tool applied.
Land	Linear land compensation for: - 36km of linear land compensation (for pipelines) Land purchase for: - One 5Ml/d storage reservoir at Bluntisham DSR - One 21Ml/d storage reservoir at Madingley DSR.	Unable to represent in TR61, cost method applied from costing report (5211472-ATK-RP-7.9-074)
Power	New power connection (251-1000kW)	Unable to represent in TR61, cost method applied from costing report (5211472-ATK-RP-7.9-074)

1.3. Environmental Data

1.3.1. General

Included in WMP19	No, this is a new option for WRMP24.
CAPEX (£K)	See Appendix C2.
Re-use of existing asset?	Bluntisham DSR will have 5Ml/d additional service reservoir storage added that will require deployment into the CAM network. Madingley DSR will have 21Ml/d additional service reservoir storage added that will require deployment into the CAM network.
Environmental Mitigation and benefits	For further details refer to report CAM WRMP24 Supply-Side Constrained Options Data Summary (5211472-ATK-RP-7.7-015) Environment mitigation and benefits section. Assumed mitigation will be required for: * Best practice of construction * Vehicle movements * Use of local suppliers * Agriculture * CO2 emissions * Sustainable water management of resources * Biodiversity and ecosystems * Protected sites and species To be assessed at design stage: * Archaeological Heritage * Noise * Air quality * Agriculture
WINEP - Relevant investigations	None listed on latest EA WINEP3 March 2020 Public version worksheet.

1.3.2. Abstractions

Type of abstraction (e.g. groundwater, river)	N/A - No abstractions are included in this option as it is a potable water source from a new reservoir.				
New abstraction or change to existing abstraction?	N/A				
Name of watercourse/aquifer abstraction is from	N/A				
Location of abstraction (x, y)	N/A				
Timing					
DYAA best	N/A	**NYAA best**	N/A	**DYCP best**	N/A
If new					
Daily maximum	N/A	**Daily average**	N/A	**Any constraint?**	N/A
If change to existing					
Current max daily abstraction rate	N/A				

Current average daily abstraction rate	N/A
Change in max daily abstraction rate	N/A
Change in average daily abstraction rate	N/A
Any constraints?	N/A
Annual maximum	N/A
If groundwater	
Information on borehole depths and pumping tests	N/A
Any known surface water interactions	N/A
Any seasonal variation in regime	N/A
HoF	N/A

1.3.3. Discharges

Quantity	N/A - No discharges are included in this option.
Quality	N/A
Daily maximum	N/A
Annual maximum	N/A
Any seasonal variation in regime?	N/A
Timing	N/A

1.3.4. Construction

Delivery period - Duration of option construction (yrs)	10yrs
~ Working area of pipeline (m^2)	540,000m^2 working area based on 15m working width of pipeline.
Area of compounds (ha)	0.75ha (7,500m^2) – assumed 3 compounds required for this option (*one proposed for the high lift pump and then one at each DSR for the service reservoir construction*).
~ Area for option (ha)	54.75ha *This includes the working width of the pipeline plus the area of the compounds required.*
No. / type of vehicle / HGV movements	No available data.
Access route	From the public highway, further confirmation will be required at design stage.
Carbon emissions (tonnes)	See Appendix C2.
Quantity of material (impact)	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Quantity of Concrete	See Appendix C2.
Waste to landfill	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Power impact status	See Appendix C2.

1.3.5. Pipeline/Transfers

Pipe size (mm)		Size (mm)		Length (m)	
Pipe 1 (Reservoir to Bluntisham)		800mm		18,000m	
Pipe 2 (Bluntisham to Madingley)		900mm		18,000m	
DO (Ml/d)					
DYAA (Ml/d)	49.5Ml/d	NYAA (Ml/d)	49.5Ml/d	DYCP (Ml/d)	49.5Ml/d
Max design pipeline capacity (Ml/d)		49.5Ml/d			
Quantity (Ml/yr)		18,067.5lM/yr			
Quality					
Raw	N		Potable	Y	
Pipeline construction method		Pipeline will be constructed using open-cut methods unless specific conditions require otherwise. A specific construction methodology is expected to be developed once an option reaches later design stages.			
Type of crossings		No. of crossings identified			
Canal crossing		2			
Major Road (A/B)		5			
Major Road (M)		0			
Minor Road (uncl)		19			
Railway line crossing (private)		0			
Railway line crossing (public)		0			
Watercourse crossing		3			
Major River Crossings		1			

1.3.6. Operations

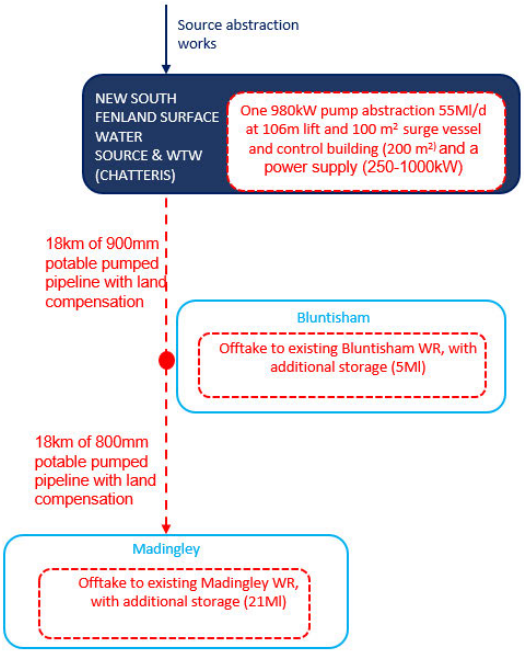
List of permanent above ground structures once operational	New high lift pump and building at new reservoir location in Chatteris		
Total land take of completed scheme (m^2)	216,000 m^2 for pipeline compensation only, it is assumed that the high lift pump compound will be included in the new reservoir site land purchase.		
Carbon emissions (tonnes)	See Appendix B2.		
Waste to landfill	Negligible – this requires detailed design to be undertaken.		
Power (kWh/yr)	1x 980kW pump – 357,700kWh/yr		
Chemical	DYAA (tonnes per year)	NYAA (tonnes per year)	DYCP (tonnes per year)
Polyaluminium Chloride	N/A – option is of potable water assumed to be of the same CAM water standard.		
Sodium Chloride			
Sodium Hydroxide			
Sulphur Dioxide			
Phosphoric Acid			
Sodium Hypochlorite			
Poly - electrolytes			
Calcium Hydroxide			
Sodium Bisulphite			

Sulphuric Acid	
Ferric Sulphate	
Hydrochloric Acid	
Fluoride	
Vehicle movements (+/- 10%)	No available data.

1.3.7. Location Maps

1.3.8. Option schematic

Option: CW24-73A - Internal potable water transfer – Fens Reservoir potable transfer (Chatteris)



Appendices

Appendix A. GIS Shapefiles

GIS layers have been provided separately for the assets associated with this option. A GIS file register, reference 5211472-ATK-CA-9-037 of the files produced and shared with the environmental team is also available.

Appendix B. Engineering Data Methods

B.1. CAM dWRMP24 Operational Carbon Data Workbook

A separate spreadsheet, reference 5211472-ATK-CA-7.12-072 has been produced that includes the methodology undertaken to produce the operational carbon data.

Appendix C. Costing

C.1. CAM dWRMP24 Costing Report

The specific option cost assumptions applied are included in a costing assumption input section for this option in the costing report (reference 5211472-ATK-RP-7.9-074), produced to document the methodology undertaken to produce the options CAPEX, OPEX, NPV and AIC for the options progressed to the constrained list.

C.2. CAM dWRMP24 Option Cost Outputs

The option costs and relevant data sets that relate to the costing outputs (embedded carbon emissions, quantity of concrete and construction power) have been provided in a separate spreadsheet (reference 5211472-ATK-CA-7.9-076).

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dWRMP24 Option Details Reporting

CW24-75D Opt 2: Third party potable water transfer: AWS grid main crossing West to East through CAM area of supply (26Ml/d) with AWS main cost included and blending WTW plant.

Cambridge Water

13th September 2023

5211472-ATK-RP-9-119_V1.0

Notice

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Atkins Limited assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 17 pages including the cover.

Document history

Document title: CW24-75D Opt 2: Third party potable water transfer: AWS grid main crossing West to East through CAM area of supply (26Ml/d) with AWS main cost included and blending WTW plant.

Document reference: 5211472-ATK-RP-9-119_V1.0

Revision	Purpose description	Originated	Checked	Reviewed	Authorise	Date
1.0	Draft for client comment	RB	PE	JT	MS	13.09.2023

Client signoff

Client	Cambridge Water
Project	dWRMP24 Option Details Reporting
Job number	5211472
Client signature/date	

Contents

Notes

Methodology

This option detail report is expected to be used in conjunction with report 5211472-ATK-RP-7.7-015 *CAM WRMP24 Supply-Side Constrained Options Data Summary,* this provides the methodology used to produce the data outputs that are provided in this report.

Assumptions

The data provided in this report for the option is assumed to be high level, for strategic planning purposes only, and if this option is carried forward to a feasible stage then the option will be reviewed, and appropriate design undertaken.

1.1. Option Information

Option name	**Third party potable water transfer: AWS grid main crossing West to East through CAM area of supply (26Ml/d) with AWS main cost included and blending WTW plant.**		
Option ref	CW24-75D Opt 2	**Previous ref**	None
Scheme Type	External import of potable water bulk supply/transfer		
Concept	Cross-connection from AWS new strategic pipeline to Cambridge network north of Longstanton with a supply of 26Ml/d, inclusive of AWS main cost and a blending plant.		
Links to other options	Dependencies: None Exclusivities: CW24-75A, CW24-75B and CW24-75Ci. Each sub-option represents the same water source just at different DO sizes; therefore, these options are exclusive.		

Screening decision	Peak option	Drought option	Resilience option
Constrained list	N/A	N/A	N/A

DO BENEFITS	Low	Best	Extreme
DYAA Ml/d	-	26 Ml/d	-
NYAA Ml/d	-	26 Ml/d	-
DYCP Ml/d	-	26 Ml/d	-
Reasoning behind DO (Ml/d) selection	AWS advised a provision of available surplus DO from the new proposed strategic main – 3 sub options have been progressed at this stage while AWS undertakes detailed modelling which will advise CAM on the final DO output available and which sub-option to progress to design stage.		

Background	AWS are understood to be considering construction of a new strategic pipeline running from their existing Grafham WTW to a new strategic reservoir at Rede, that is being constructed adjacent to an existing distribution reservoir at Rede. This main is expected to run through the north of Cambridge and will therefore intersect existing CAM supply mains.
Option description	A cross-connection will be constructed where the new AWS strategic main from Grafham to Rede (west to east) intersects the existing CAM supply mains; this will notionally be located approximately 2km north of Longstanton ([redacted]). The infrastructure required for this option includes: - 750m of 700mm diameter cross-connection pipework has been included in this option for variable allowance and costing purposes due to the uncertainty of the final AWS strategic main location. - 8000m of 1000mm diameter cross-connection pipework to the AWS strategic main. - The pipework will be equipped with a flowmeter and pressure reducing valve (PRV) - Land compensation for the pipelines Work is ongoing to assess indicative requirements and will be priced separately. Further work, including review of customer research outputs, will determine whether this additional treatment element will be included at a later stage of the option's development. A review of water quality of the receiving network, and of the bulk import of potable water has indicated that additional treatment, in the form of breakpoint chlorination, is required on the imported potable water from

	AWS, prior to mixing with the existing CAM network to make the two treated waters compatible. To read the full water quality assessment, please refer to document 5211472-ATK-RP-7.14.2-112. The infrastructure required for breakpoint chlorination includes: - Chlorine contact tank (516 m^3) - Sodium Hypochlorite dosing rig and storage (26 Ml/d) - Land requirement (600 m^2)
Licensing and stakeholder feedback	- There will be no licensing required for this import as the source belongs to AWS and only potable water is being received. - It is assumed that a suitable quantity of treated water will be available for import from AWS. - Ongoing close engagement with AWS to develop the collaborative option is required. - AWS are progressing modelling and will advise CAM on the available surplus and therefore which sub-option (CW24-75A/B/C/D) to progress to design stage. It is noted that CW24-75D Option 2 has been identified as a preferred option at Draft WRMP stage.
Key assumptions	- Assumes ongoing close engagement with AWS to develop the collaborative option and final sub-option for progression. - Pumping will not be required as part of this option, as it is assumed the hydraulic head already developed in the AWS main to reach Rede should be sufficient. - AWS have confirmed they are undertaking modelling to ensure availability of water for this option, it is assumed the water is available for this option. - AWS have confirmed they are undertaking the costing and environmental assessment of the new strategic main therefore it is assumed assessment of the main is not required as part of this option, only a contribution toward the cost from CAM is to be included in the option cost outputs. - Due to the uncertainty around the final AWS new strategic main location, an additional length of 750m has been allowed for and included in this option. - It is assumed the existing CAM network has the capability to deploy the additional water from this option at the connection point. - Land compensation is assumed for all lengths of pipeline included in the option. - Assumes that additional land acquisition is required and possible, to host the site of breakpoint chlorination prior to blending. - Due to low power requirements, it is assumed a new power supply is not required for the breakpoint chlorination plant. This will power chemical dosing rigs, instruments and any required site security. - It is assumed further trials will be undertaken to determine the full extent of treatment required, including corrosivity trials. - Risk assessment for the mixing of two separate sources and the impact on customer acceptability will likely be required. - Chlorine contact tank is sized for 28.5 mins hydraulic retention time (20 mins required, plus additional time due to an assumed 70% hydraulic efficiency). - Chlorine dose required for breakpoint chlorination is 1.57 mg/l, with an additional 0.5 mg/l (total 2.07 mg/l) to allow for an increased chlorine residual, with allowance for further decay in the network. It is assumed the chlorination dose applied for

	breakpoint chlorination will be refined at a later design stage through breakpoint trials. - Corrosion and breakpoint chlorination trials should also be undertaken to determine corrosivity towards existing assets and determine if there are any risks associated with disinfection by product formation or the need for booster chlorination.
Risks and uncertainties	- A key risk is the dependence on AWS being able to provide the available water now and in the future. - There is a risk of degradation of water quality over time if AWS do not maintain the assets (strategic main) providing the water to the CAM network. - Pipes are sized based on the expected DO output. - Pipe lengths are assumed from a review of GIS for the most appropriate pipeline location. There is a risk that these are subject to change after environmental and design stages and discussions with landowners. - Further impact of the stability of the blended water will be assessed, as additional chemical dosing may be required. A review of the aggressivity of the blended water within the network should be undertaken, to determine how the blended sources will impact the equilibrium of pipework/ water interactions, as well as a review of any risk of calcium precipitating out of the blended water, causing a build-up in pipes and discolouration. - Initial water quality analysis indicates that both sources are moderately hard and potentially scale forming according to corrosion indices. However, a corrosion index (Larson ratio) suggests the Grafham water could be more corrosive to ferrous pipes. - Substituting surface water for a groundwater source carries a risk of customer contacts due to the aesthetic change (taste & odour) associated with the higher organics concentration in surface waters.

1.2. Asset Pricing

The below data has been used to input into the costing methods for this option:

	Assets required for pricing	**Method for pricing assets applied**
Raw water source	N/A *Potable water is being provided by AWS.*	
Treatment	- Chlorine contact tank (516 m^3) - Sodium Hypochlorite dosing rig and storage (26 Ml/d) - Chemical Dosing and storage kiosk building (75 m^2)	WRC TR61 method and tool applied.
Distribution	- 750m 650mm pipeline (costed at 700mm) - 8000m 1000mm AWS pipeline contribution - Flowmeter - Pressure reducing valve (PRV)	WRC TR61 method and tool applied. Unable to represent in TR61, cost method applied from costing report (5211472-ATK-RP-7.9-074)

Land	Linear land compensation for: - 12,750m^2 of pipeline - Land requirement for treatment site (600 m^2)	Unable to represent in TR61, cost method applied from costing report (5211472-ATK-RP-7.9-074)
Power	- Assumed connection to local power connection.	

1.3. Environmental Data

1.3.1. General

Included in WMP19	No – New option for dWRMP24.
CAPEX (£K)	See Appendix C2.
Re-use of existing asset?	No reuse of existing assets included in option only connection of new pipeline to CAM network.
Environmental Mitigation and benefits	For further details refer to report CAM WRMP24 Supply-Side Constrained Options Data Summary (5211472-ATK-RP-7.7-015) Environment mitigation and benefits section. Assumed mitigation will be required for: * Best practice of construction * Vehicle movements * Use of local suppliers * Agriculture * CO2 emissions * Sustainable water management of resources * Biodiversity and ecosystems * Protected sites and species To be assessed at design stage: * Archaeological Heritage * Noise * Air quality * Agriculture
WINEP - Relevant investigations	None listed on latest EA WINEP3 March 2020 Public version worksheet.

1.3.2. Abstractions

Type of abstraction (e.g. groundwater, river)	N/A – No abstractions are included in this option as it is a potable water source from third party trade (AWS import)				
New abstraction or change to existing abstraction?	N/A				
Name of watercourse/aquifer abstraction is from	N/A				
Location of abstraction (x, y)	N/A				
Timing					
DYAA best	N/A	**NYAA best**	N/A	**DYCP best**	N/A
If new					
Daily maximum	N/A	**Daily average**	N/A	**Any constraint?**	N/A
If change to existing					
Current max daily abstraction rate	N/A				
Current average daily abstraction rate	N/A				
Change in max daily abstraction rate	N/A				

Change in average daily abstraction rate	N/A
Any constraints?	N/A
Annual maximum	N/A
If groundwater	
Information on borehole depths and pumping tests	N/A
Any known surface water interactions	N/A
Any seasonal variation in regime	N/A
HoF	N/A

1.3.3. Discharges

Quantity	N/A - No discharges are included in this option.
Quality	N/A
Daily maximum	N/A
Annual maximum	N/A
Any seasonal variation in regime	N/A
Timing	N/A

1.3.4. Construction

Delivery period - Duration of option construction (yrs)	5yrs
~ Working pipeline construction width (m)	11,250 m^2 working area based on 15m working width of pipeline.
~ Area of compounds (ha)	0.25ha (2,500 m^2) - assumed 1 compound required for this option (one proposed compound for installation of the breakpoint chlorination site and pipeline).
~ Area for option (ha)	1.375ha (13,750 m^2) *This includes the working width of the pipeline plus the area of the compounds required.*
No. / type of vehicle / HGV movements	No available data.
Access routes	From the public highway, further confirmation will be required at design stage.
Carbon emissions (tonnes)	See Appendix C2.
Quantity of material (impact)	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Quantity of Concrete	See Appendix C2
Waste to landfill	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Power impact status	See Appendix C2.

1.3.5. Pipelines/transfers

Pipe size (mm)	**Size (mm)**	**Length (m)**
Pipe 1 potable	650mm	750m

Pipe 2 potable (AWS main)	1000mm		8,000m		
DO (Ml/d)					
DYAA (Ml/d)	26.0Ml/d	**NYAA (Ml/d)**	26.0 Ml/d	**DYCP (Ml/d)**	26.0 Ml/d
Max design pipeline capacity (Ml/d)	26.0 Ml/d				
Quantity (Ml/yr)	9,490 Ml/yr				
Quality					
Raw	N	**Potable**	Y		
Pipeline construction method	Pipeline will be installed using open-cut methods unless specific conditions require otherwise. A specific construction methodology is expected to be developed once an option reaches later design stages.				

No. / type of crossings	**No. of crossings identified**
Canal crossing	0
Major Road (A/B)	0
Major Road (M)	0
Minor Road (uncl)	0
Railway line crossing (private)	0
Railway line crossing (public)	0
Watercourse crossing	0
Major River Crossings	0

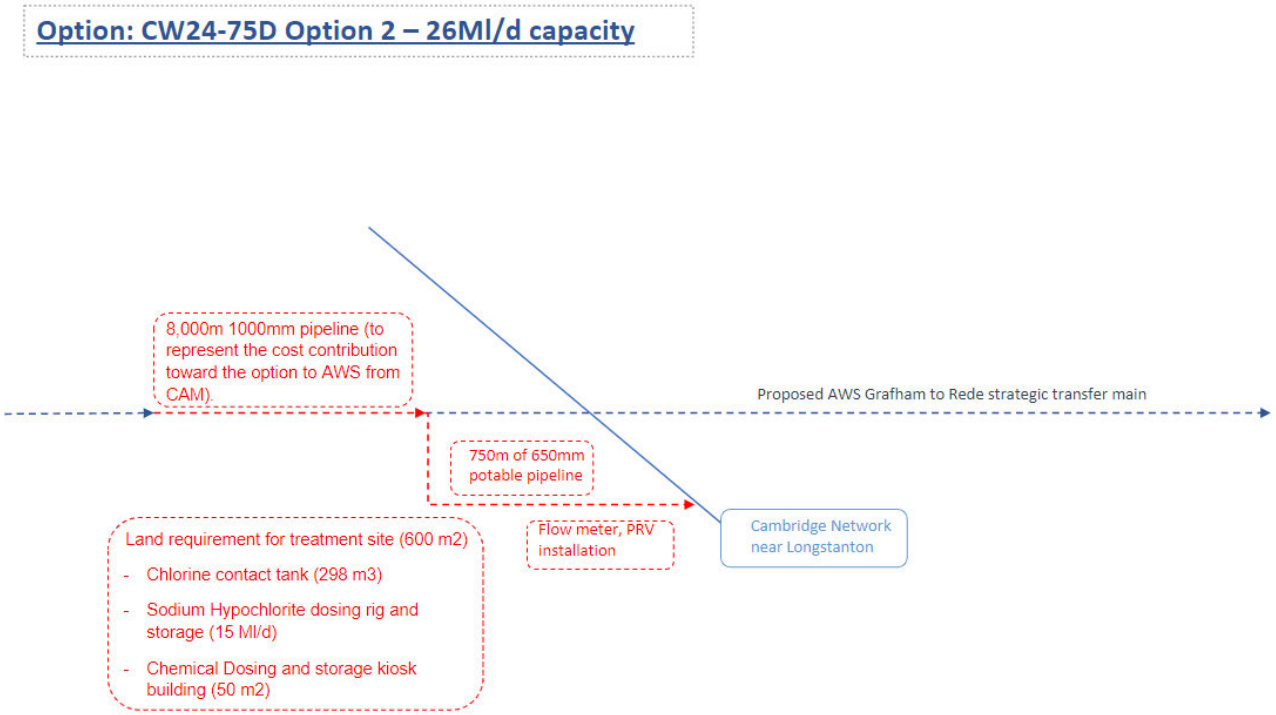
1.3.6. Operation

List of permanent above ground structures once operational	Control building		
Total land take of completed scheme (m_2)	600m² represents the blending plant compound. *Pipeline easement to be determined at a later stage.*		
Carbon emissions (tonnes)	See Appendix B2.		
Waste to landfill	Due to chemical waste, this requires detailed design to be undertaken.		
Power (kWh/yr)	26,280 kWh/yr		
Chemical	**DYAA (tonnes per year)**	**NYAA (tonnes per year)**	**DYCP (tonnes per year)**
Polyaluminium Chloride			
Sodium Chloride			
Sodium Hydroxide			
Sulphur Dioxide			
Phosphoric Acid			
Sodium Hypochlorite	130.67	130.67	130.67
Poly - electrolytes			
Calcium Hydroxide			
Sodium Bisulphite			
Sulphuric Acid			
Ferric Sulphate			
Hydrochloric Acid			
Fluoride			
Vehicle movements (+/- 10%)	No available data.		

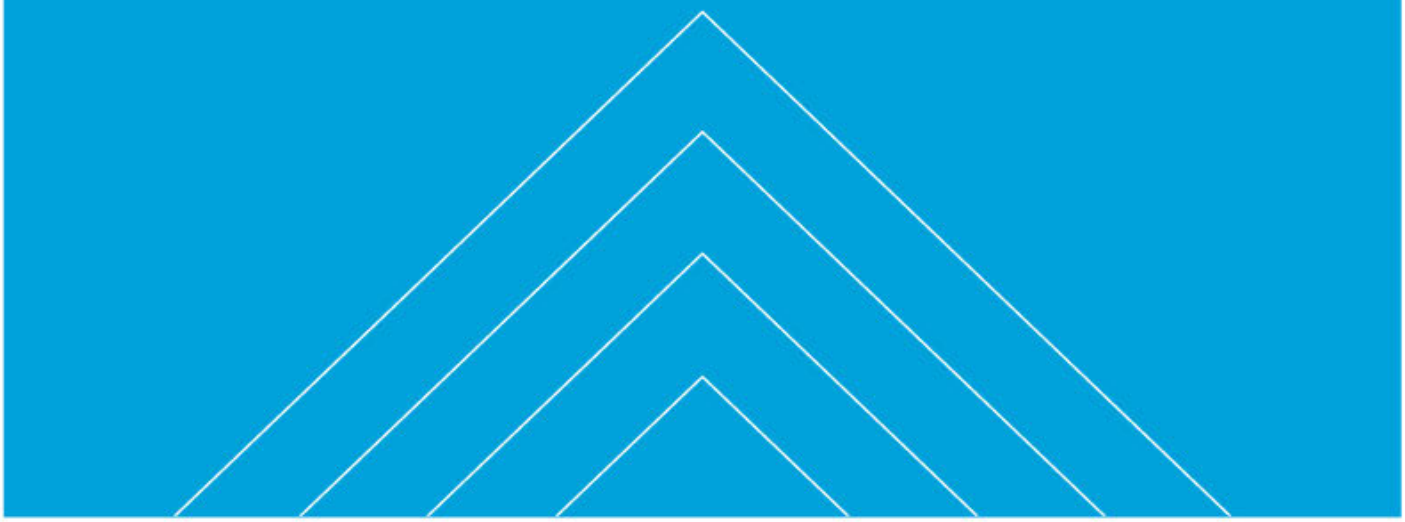
1.3.7. Option location GIS Map

Note: the AWS main pipeline is not included in the GIS layers as this asset has only been represented for costing purposes, it is understood that AWS are undertaking the environmental impacts review of the asset.

1.3.8. Option schematic



Appendices



Appendix A. GIS shapefiles

GIS layers have been provided separately for the assets associated with this option. A GIS file register, reference 5211472-ATK-CA-9-037 of the files produced and shared with the environmental team is also available.

Appendix B. Engineering Data Methods

B.1. CAM dWRMP24 Operational Carbon data workbook

A separate spreadsheet, reference 5211472-ATK-CA-7.12-072 has been produced that includes the methodology undertaken to produce the operational carbon data.

Appendix C. Costing

C.1. CAM dWRMP24 Costing Report

The specific option cost assumptions applied are included in a costing assumption input section for this option in the costing report (reference 5211472-ATK-RP-7.9-074), produced to document the methodology undertaken to produce the options CAPEX, OPEX, NPV and AIC for the options progressed to the constrained list.

C.2. CAM dWRMP24 Option Cost Outputs

The option costs and relevant data sets that relate to the costing outputs (embedded carbon emissions, quantity of concrete and construction power) have been provided in a separate spreadsheet (reference 5211472-ATK-CA-7.9-076).

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dWRMP24 Option Details Reporting

CW24-75D Opt 3: Third party potable water transfer: AWS grid main crossing West to East through CAM area of supply (26Ml/d) with AWS main cost included and blending WTW plant.

Cambridge Water

13th September 2023

5211472-ATK-RP-9-120_V1.0

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Document history

Document title: CW24-75D Opt 3: Third party potable water transfer: AWS grid main crossing West to East through CAM area of supply (26Ml/d) with AWS main cost included and blending WTW plant.

Document reference: 5211472-ATK-RP-9-120_V1.0

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Draft for client comment	RB	PE	JT	MS	13.09.2023

Client signoff

Client	Cambridge Water
Project	dWRMP24 Option Details Reporting
Job number	5211472
Client signature/date	

Contents

Notes

Methodology

This option detail report is expected to be used in conjunction with report 5211472-ATK-RP-7.7-015 *CAM WRMP24 Supply-Side Constrained Options Data Summary,* this provides the methodology used to produce the data outputs that are provided in this report.

Assumptions

The data provided in this report for the option is assumed to be high level, for strategic planning purposes only, and if this option is carried forward to feasible stage then the option will be reviewed, and appropriate design undertaken.

1.1. Option Information

Option name	**Third party potable water transfer: AWS grid main crossing West to East through CAM area of supply (26Ml/d) with AWS main cost included and blending WTW plant.**		
Option ref	CW24-75D Opt 3	**Previous ref**	None
Scheme Type	External import of potable water bulk supply/transfer		
Concept	Cross-connection from AWS new strategic pipeline to Cambridge network north of Longstanton with a supply of 26Ml/d, inclusive of AWS main cost and a blending plant.		
Links to other options	Dependencies: None Exclusivities: CW24-75A, CW24-75B and CW24-75C. Each sub-option represents the same water source just at different DO sizes; therefore, these options are exclusive.		

Screening decision	Peak option	Drought option	Resilience option
Constrained list	N/A	N/A	N/A

DO BENEFITS	Low	Best	Extreme
DYAA Ml/d	-	26 Ml/d	-
NYAA Ml/d	-	26 Ml/d	-
DYCP Ml/d	-	26 Ml/d	-
Reasoning behind DO (Ml/d) selection	AWS advised a provision of available surplus DO from the new proposed strategic main – 3 sub options have been progressed at this stage while AWS undertakes detailed modelling which will advise CAM on the final DO output available and which sub-option to progress to design stage.		

Background	AWS are understood to be considering construction of a new strategic pipeline running from their existing Grafham WTW to a new strategic reservoir at Rede, that is being constructed adjacent to an existing distribution reservoir at Rede. This main is expected to run through the north of Cambridge and will therefore intersect existing CAM supply mains.
Option description	A cross-connection will be constructed where the new AWS strategic main from Grafham to Rede (west to east) intersects the existing CAM supply mains; this will notionally be located approximately 2km north of Longstanton ([redacted]). The infrastructure required for this option includes: - 750m of 650mm diameter cross-connection pipework has been included in this option for variable allowance and costing purposes due to the uncertainty of the final AWS strategic main location. - 8000m of 1000mm diameter cross-connection pipework to the AWS strategic main. - The pipework will be equipped with a flowmeter and pressure reducing valve (PRV) - Land compensation for the pipelines Work is ongoing to assess indicative requirements and will be priced separately. Further work, including review of customer research outputs, will determine whether this additional treatment element will be included at a later stage of the option's development. A review of water quality of the receiving network, and of the bulk import of potable water has indicated that additional treatment, in the form of breakpoint chlorination, is required on the imported potable water from

	AWS, prior to mixing with the existing CAM network to make the two treated waters compatible. This option also uses intense treatment with the use of Reverse Osmosis (RO) and remineralisation to treat the imported water to a similar water quality as the existing ground water sources to minimise all water quality risks. To read the full water quality assessment, please refer to document 5211472-ATK-RP-7.14.2-112. The infrastructure required for the RO and remineralisation plant includes: - Land requirement for treatment site (4,000 m^2) - Sulphur Dioxide dosing rig and storage (26 Ml/d) - RO plant (26 Ml/d) - RO Feed pumps (422 kW) - Chlorine contact tank (413 m^3) - Sodium Hypochlorite dosing rig and storage (20.8 Ml/d) - Hydrated Lime dosing rig and storage (20.8 Ml/d) - Carbon Dioxide dosing rig and storage (20.8 Ml/d) - Remineralisation tank (1,240 m^3) - Chemical Dosing and storage kiosk building (100 m^2) - New Power Supply (250-1000 kW)
Licensing and stakeholder feedback	- There will be no licensing required for this import as the source belongs to AWS and only potable water is being received. - It is assumed that a suitable quantity of treated water will be available for import from AWS. - Ongoing close engagement with AWS to develop the collaborative option is required. - AWS are progressing modelling and will advise CAM on the available surplus and therefore which sub-option (CW24-75A/B/C/D) to progress to design stage. It is noted that CW24-75D Option 3 has been selected as a feasible option at Draft WRMP stage.
Key assumptions	- Assumes ongoing close engagement with AWS to develop the collaborative option and final sub-option for progression. - Pumping will not be required as part of this option, as it is assumed the hydraulic head already developed in the AWS main to reach Rede should be sufficient. - AWS have confirmed they are undertaking modelling to ensure availability of water for this option, it is assumed the water is available for this option. - AWS have confirmed they are undertaking the costing and environmental assessment of the new strategic main therefore it is assumed assessment of the main is not required as part of this option, only a contribution toward the cost from CAM is to be included in the option cost outputs. - Due to the uncertainty around the final AWS new strategic main location an additional length of 750m has been allowed for and included in this option. - It is assumed the existing CAM network has the capability to deploy the additional water from this option at the connection point. - Land compensation is assumed for all lengths of pipeline included in the option. - Assumes that additional land acquisition is required and possible, to host the site of breakpoint chlorination prior to blending. - Due to high power requirements, it is assumed a new power supply is required for the RO plant. This will power RO feed pumps, chemical dosing rigs, instruments and any required site security.

	- It is assumed further trials will be undertaken to determine the full extent of treatment required, including corrosivity trials. - Risk assessment for the mixing of two separate sources and the impact on customer acceptability will likely be required. - Corrosion and breakpoint chlorination trials should also be undertaken to determine corrosivity towards existing assets and determine if there are any risks associated with disinfection by product formation or the need for booster chlorination. - It is assumed that the reject from the RO plant is 20% of flows, and assumed a connection to sewer is possible. Further review of RO reject stream volumetric flows and connection to sewer to be determined at a future design stage.
Risks and uncertainties	- A key risk is the dependence on AWS being able to provide the available water now and in the future. - There is a risk of degradation of water quality over time if AWS do not maintain the assets (strategic main) providing the water to the CAM network. - Pipes are sized based on the expected DO output. - Pipe lengths are assumed from a review of GIS for the most appropriate pipeline location. There is a risk that these are subject to change after environmental and design stages and discussions with landowners. - Further impact of the stability of the blended water will be assessed, as additional chemical dosing may be required. A review of the aggressivity of the blended water within the network should be undertaken, to determine how the blended sources will impact the equilibrium of pipework/ water interactions, as well as a review of any risk of calcium precipitating out of the blended water, causing a build-up in pipes and discolouration. - Initial water quality analysis indicates that both sources are moderately hard and potentially scale forming according to corrosion indices. However, a corrosion index (Larson ratio) suggests the Grafham water could be more corrosive to ferrous pipes. - Substituting surface water for a groundwater source carries a risk of customer contacts due to the aesthetic change (taste & odour) associated with the higher organics concentration in surface waters.

1.2. Asset Pricing

The below data has been used to input into the costing methods for this option:

	Assets required for pricing	**Method for pricing assets applied**
Raw water source	N/A *Potable water is being provided by AWS.*	
Treatment	- Sulphur Dioxide dosing rig and storage (26 Ml/d) - RO plant (26 Ml/d) - RO Feed pumps (422 kW) - Chlorine contact tank (413 m^3) - Sodium Hypochlorite dosing rig and storage (20.8 Ml/d) - Hydrated Lime dosing rig and storage (20.8 Ml/d)	WRC TR61 method and tool applied.

	- Carbon Dioxide dosing rig and storage (20.8 Ml/d) - Remineralisation tank (1,240 m^3) - Chemical Dosing and storage kiosk building (100 m^2) - New Power Supply (250-1000 kW)	
Distribution	- 750m 650mm pipeline (costed at 700mm) - 8000m 1000mm AWS pipeline contribution - Flowmeter - Pressure reducing valve (PRV)	WRC TR61 method and tool applied. Unable to represent in TR61, cost method applied from costing report (5211472-ATK-RP-7.9-074)
Land	Linear land compensation for: - 12,750m^2 of pipeline - Land requirement for treatment site (4000 m^2)	Unable to represent in TR61, cost method applied from costing report (5211472-ATK-RP-7.9-074)
Power	- New power supply connection (250-1000kW).	

1.3. Environmental Data

1.3.1. General

Included in WMP19	No – New option for dWRMP24.
CAPEX (£K)	See Appendix C2.
Re-use of existing asset?	No reuse of existing assets included in option only connection of new pipeline to CAM network.
Environmental Mitigation and benefits	For further details refer to report CAM WRMP24 Supply-Side Constrained Options Data Summary (5211472-ATK-RP-7.7-015) Environment mitigation and benefits section. Assumed mitigation will be required for: * Best practice of construction * Vehicle movements * Use of local suppliers * Agriculture * CO2 emissions * Sustainable water management of resources * Biodiversity and ecosystems * Protected sites and species To be assessed at design stage: * Archaeological Heritage * Noise * Air quality * Agriculture
WINEP - Relevant investigations	None listed on latest EA WINEP3 March 2020 Public version worksheet.

1.3.2. Abstractions

Type of abstraction (e.g. groundwater, river)	N/A – No abstractions are included in this option as it is a potable water source from third party trade (AWS import)				
New abstraction or change to existing abstraction?	N/A				
Name of watercourse/aquifer abstraction is from	N/A				
Location of abstraction (x, y)	N/A				
Timing					
DYAA best	N/A	**NYAA best**	N/A	**DYCP best**	N/A
If new					
Daily maximum	N/A	**Daily average**	N/A	**Any constraint?**	N/A
If change to existing					
Current max daily abstraction rate	N/A				
Current average daily abstraction rate	N/A				
Change in max daily abstraction rate	N/A				

Change in average daily abstraction rate	N/A
Any constraints?	N/A
Annual maximum	N/A
If groundwater	
Information on borehole depths and pumping tests	N/A
Any known surface water interactions	N/A
Any seasonal variation in regime	N/A
HoF	N/A

1.3.3. Discharges

Quantity	N/A - No discharges are included in this option.
Quality	N/A
Daily maximum	N/A
Annual maximum	N/A
Any seasonal variation in regime	N/A
Timing	N/A

1.3.4. Construction

Delivery period - Duration of option construction (yrs)	5yrs
~ Working pipeline construction width (m)	11,250 m^2 working area based on 15m working width of pipeline.
~ Area of compounds (ha)	0.8ha (8,000 m^2) - assumed 1 compounds required for this option (one proposed compound for installation of the treatment site and pipeline).
~ Area for option (ha)	1.925ha (19,250 m^2) *This includes the working width of the pipeline plus the area of the compounds required.*
No. / type of vehicle / HGV movements	No available data.
Access routes	From the public highway, further confirmation will be required at design stage.
Carbon emissions (tonnes)	See Appendix C2.
Quantity of material (impact)	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Quantity of Concrete	See Appendix C2
Waste to landfill	At this stage assumed to be Minor Negative – the option requires new infrastructure, with limited opportunities to reuse or recycle waste materials.
Power impact status	See Appendix C2.

1.3.5. Pipelines/transfers

Pipe size (mm)	Size (mm)	Length (m)
Pipe 1 potable	650mm	750m

Pipe 2 potable (AWS main)		1000mm		8,000m	
DO (Ml/d)					
DYAA (Ml/d)	26.0Ml/d	**NYAA (Ml/d)**	26.0 Ml/d	**DYCP (Ml/d)**	26.0 Ml/d
Max design pipeline capacity (Ml/d)		26.0 Ml/d			
Quantity (Ml/yr)		9,490 Ml/yr			
Quality					
Raw		N	**Potable**	Y	
Pipeline construction method		Pipeline will be installed using open-cut methods unless specific conditions require otherwise. A specific construction methodology is expected to be developed once an option reaches later design stages.			
No. / type of crossings		**No. of crossings identified**			
Canal crossing		0			
Major Road (A/B)		0			
Major Road (M)		0			
Minor Road (uncl)		0			
Railway line crossing (private)		0			
Railway line crossing (public)		0			
Watercourse crossing		0			
Major River Crossings		0			

1.3.6. Operation

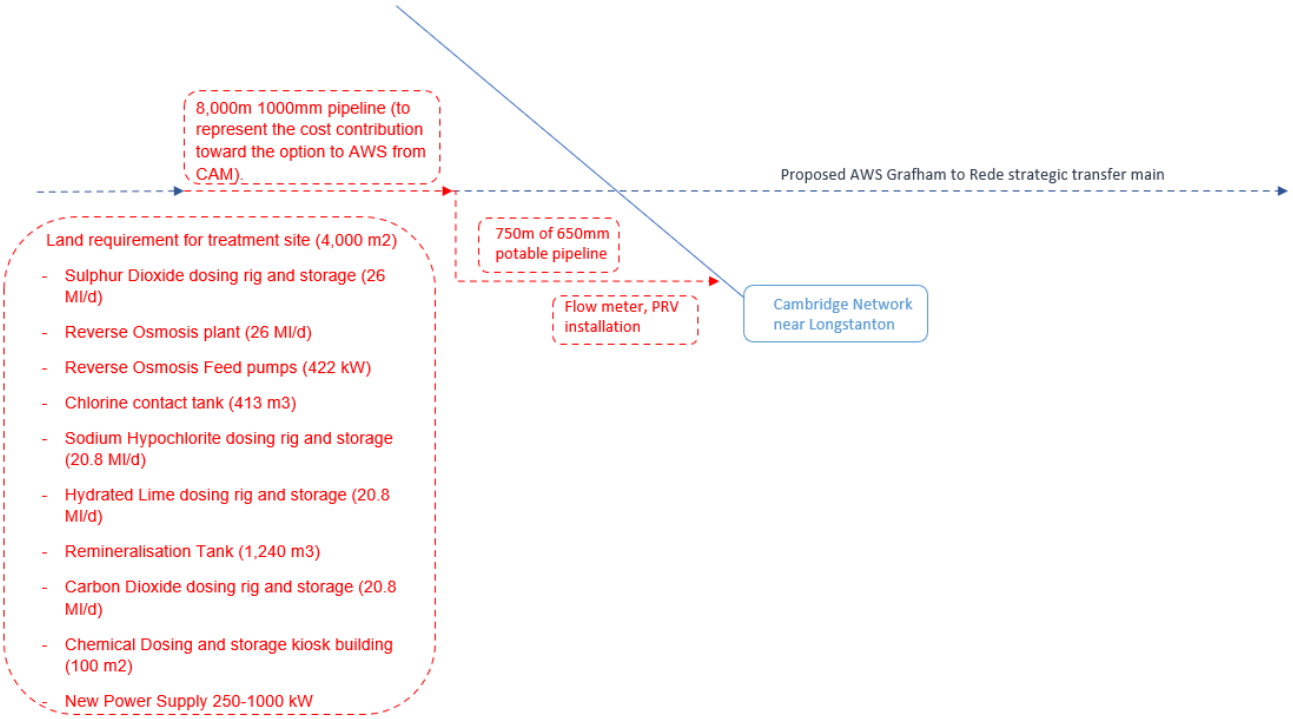
List of permanent above ground structures once operational	Control building, RO Unit building		
Total land take of completed scheme (m_2)	4,000m^2 represents the blending plant compound. *Pipeline easement to be determined at a later stage.*		
Carbon emissions (tonnes)	See Appendix B2.		
Waste to landfill	Due to chemical waste, this requires detailed design to be undertaken.		
Power (kWh/yr)	3,746,881 kWh/yr		
Chemical	**DYAA (tonnes per year)**	**NYAA (tonnes per year)**	**DYCP (tonnes per year)**
Polyaluminium Chloride			
Sodium Chloride			
Sodium Hydroxide			
Sulphur Dioxide	1.28	1.28	1.28
Phosphoric Acid			
Sodium Hypochlorite	60.74	60.74	60.74
Poly - electrolytes			
Calcium Hydroxide	1404.96	1404.96	1404.96
Sodium Bisulphite			
Sulphuric Acid			
Ferric Sulphate			
Hydrochloric Acid			
Fluoride			
Carbon Dioxide	801.18	801.18	801.18
Vehicle movements (+/- 10%)	No available data.		

1.3.7. Option location GIS Map

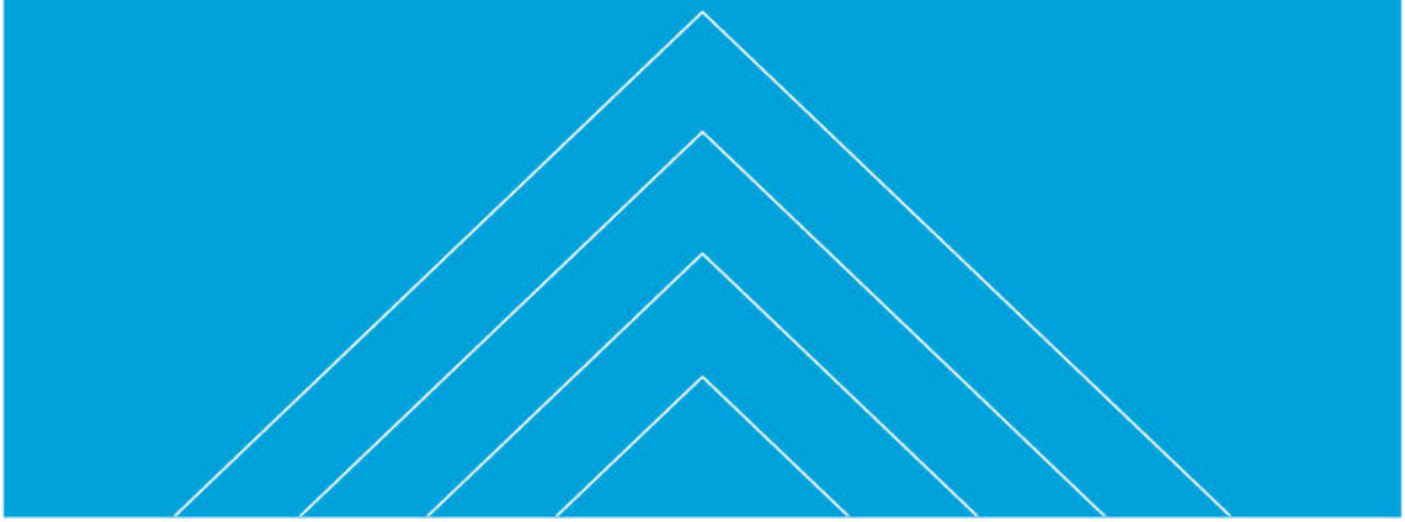
Note: the AWS main pipeline is not included in the GIS layers as this asset has only been represented for costing purposes, it is understood that AWS are undertaking the environmental impacts review of the asset.

1.3.8. Option schematic

Option: CW24-75D Option 3 – 26Ml/d capacity



Appendices



Appendix A. GIS shapefiles

GIS layers have been provided separately for the assets associated with this option. A GIS file register, reference 5211472-ATK-CA-9-037 of the files produced and shared with the environmental team is also available.

Appendix B. Engineering Data Methods

B.1. CAM dWRMP24 Operational Carbon data workbook

A separate spreadsheet, reference 5211472-ATK-CA-7.12-072 has been produced that includes the methodology undertaken to produce the operational carbon data.

Appendix C. Costing

C.1. CAM dWRMP24 Costing Report

The specific option cost assumptions applied are included in a costing assumption input section for this option in the costing report (reference 5211472-ATK-RP-7.9-074), produced to document the methodology undertaken to produce the options CAPEX, OPEX, NPV and AIC for the options progressed to the constrained list.

C.2. CAM dWRMP24 Option Cost Outputs

The option costs and relevant data sets that relate to the costing outputs (embedded carbon emissions, quantity of concrete and construction power) have been provided in a separate spreadsheet (reference 5211472-ATK-CA-7.9-076).

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